



# NAS Report 1 Implementation Plan

	Recommended for Implementation	Program Component	Recommendation	Reference (pg.#:line#)	Description	Category (Science/Policy)	Required for Compliance	Supports Achieving Biological Objectives or Goals	Fatal Flaw of Program	Immediate Implementation	Phased or Delayed Implementation	Operationally Feasible	Politically Feasible	Fiscally Feasible	Implementation Strategy	Additional Comments
15	Done - in progress and continual; silt should be addressed through Applied Research	Ecological Model	Include more field studies in the Applied Research program to assess silt impacts and critical life history and habitat assessment of the CSRB.	87:36	Field studies to answer the following questions: <input type="checkbox"/> What is the basis for the assumption that silt deposition represents an important environmental effector of CSRB population densities? <input type="checkbox"/> How does siltation quantitatively affect the known habitats of CSRB, and are there habitats that may act as Refugia during times of heavy deposition? <input type="checkbox"/> Are there quantitative relationships between silt-free gravel and cobble area with beetle population densities? <input type="checkbox"/> How many generations occur throughout the year for the CSRB and how does variable flow and sedimentation affect food availability and the beetle's population biology? <input type="checkbox"/> Are there invasive predators or competitors in these systems that might apply biotic control on the population numbers? <input type="checkbox"/> What other factors are likely to affect the population biology and ecology of CSRB? <input type="checkbox"/> How reliable is the cotton lure sampling method for quantitatively estimating densities of both adult and immature life stages of the CSRB?	Science	No	No	No	Yes	Yes	Yes	Yes	Yes - Applied Research budget	In 2015 and 2016, the Applied Research Program is focusing on the Comal Springs riffle beetle, including field and tolerance studies.	However, the CSRB is no longer a module in the Eco Model, therefore the data collected will only be utilized if the CSRB is added to the model at some point in the future. Need to address the concerns related to siltation through Applied Research program
16	Done	Ecological Model	Develop a conceptual model that shows how water quality and quantity, other biota and restoration and mitigation activities are expected to interact with the indicator species.	89:22	A conceptual model is a series of models of increasing resolution, that show how water quality and quantity, other biota, and restoration and mitigation activities are expected to interact with the indicator species, as well as with all covered species.	Science	No	No	No	No	No	Yes	Yes	Yes	N/A	Already Done - 2010 EARIP Influence Diagrams: facilitated by Jean Cochrane
17	Done - in progress	Ecological Model	Ensure proper interpretation of the ongoing effort to build an individual-based model for fountain darter.	91:10	The ongoing effort to build an individual-based model for fountain darter will require extensive data for model formulation, calibration, and validation.	Science	No	No	No	No	No	Yes	Yes	Yes	N/A	The Eco Modeling team already plans to conduct verification testing.
18	Yes	Ecological Model	Develop a much deeper understanding of the CSRB.	91:33	If the CSRB is to be an adequate indicator of some of the other Covered Species, it is critical to have a much deeper understanding of the spatial distribution, range of potential habitats, and natural history of the CSRB.	Science	No	No	No	Yes	Yes	Yes	Yes	Yes - Applied Research budget	In 2015 and 2016, the Applied Research Program is focusing on the Comal Springs riffle beetle.	The workshop participants generally supported more CSRB research. However, there was discussion about if the CSRB should be used as an indicator species, as it is assumed the CSRB simply retreats into subterranean habitat.
19	Done	Ecological Model	In developing the fountain darter model, pay attention to movement, density dependence and other topics.	85	The Ecological model should address the following: <input type="checkbox"/> How movement is represented <input type="checkbox"/> Clear documentation and justification for how flow, temperature, and vegetation are included in the growth, mortality, reproduction, and movement relationships <input type="checkbox"/> How density-dependence is included <input type="checkbox"/> Using the model to generate predictions of the population responses to various combinations of years with scour events and droughts <input type="checkbox"/> Calibration and validation, which are needed to ensure sufficient model credibility <input type="checkbox"/> Careful tracking of uncertainty <input type="checkbox"/> Expectations are high because much discussion has pushed things to the ecological modeling and the term "predictive" has been used. Clarification of what the darter modeling can do and cannot do would be wise.	Science	No	No	No	Yes	No	Yes	Yes	Yes	Ask Eco Modeling team to address and consider all the points identified by NAS. Ensure they are or were considered by the Eco Modeling team.	These studies were conducted through the Applied Research Program and results were incorporated into the Ecological Model
20	Yes	Ecological Model	Clarify the goal of the submerged aquatic vegetation (SAV) model.	90:36	The goal of the SAV modeling, which is in its early stages, should be clarified. Whether the goal is to simulate SAV biomass dynamics or to simulate habitat for the fountain darter model will affect how many models are needed and how each model is formulated.	Science	No	No	No	Yes	No	Yes	Yes	Yes	Require the Eco Modeling team to provide a clear and concise goal of the SAV model.	
21	Done - applied verification in the field is continual	Ecological Model	Test the robustness of the current habitat suitability analysis for Texas wild-rice.	91:1	Given the absence of a planned ecological model for Texas wild rice, the current habitat suitability analysis should be treated as an hypothesis and tested for robustness throughout the San Marcos River.	Science	No	Yes - there is as Biological Goal for the coverage of TWR in the San Marcos River.	No	Yes	No	Yes - could be applied research project	Yes	Yes - funds could be allocated in the Applied Research Program	N/A	*TWR has been extremely successful to date; therefore additional TWR work is not needed at this point. *The Meadows Center has been collecting this information as Applied Research imbedded in their TWR restoration work. Habitat suitability has taken the form of applied verification in the field.
22	Done	Ecological Model	Use the habitat suitability analyses for the fountain darter as "back-up" to individual-based modeling.	91:22	The habitat suitability analyses done for fountain darter could act as a "back-up" to the individual-based modeling and provide additional quasi-independent results to support a weight of evidence approach for the fountain darter.	Science	No	No	No	No	No	Yes	Yes	No - no current funding is identified for this additional work	N/A	*Conducting this exercise would not answer questions for Phase II, the model does that. *Implementing this recommendation would be taking steps backwards.
23	Done	Ecological Model	Revisit the estimation fountain darter suitability curves.	77:35	With the availability of the monitoring data and other information, a more formal estimation of the habitat suitability curves is warranted.	Science	No	No	No	No	No	Yes	Yes	No - there are no funds allocated for this exercise.	N/A - step backwards	*These curves are the first step in creating the Ecological Model. If to be used for the development of the Ecological Model, we are past that point. *If the Fountain Darter module fails or does not calibrate, then suitability curves should be revisited.
24	No	Ecological Model	Add nutrient limitation to the submerged aquatic vegetation (SAV) model formulation.	82:40	Nutrient limitation is not included presently in the model, but should be added if it is determined to be an important water quality factor affecting photosynthesis.	Science	No	No	No	No	No	No - current not enough data to include	Yes	No - no funding to conduct the extensive research that would be needed.	N/A	*Nutrients are not a limiting factor, except to algae (presence/absence). Algae is not in the Eco Model. *The SAV model is tied to Fountain Darter habitat, so therefore this is not necessary.
25	Done - in progress	Biological Monitoring	Measure the distribution of the CSRB.	108:32	Measuring CSRB distribution should be a high priority, using a randomized or stratified randomized approach throughout Landa Lake, Spring Island and other areas of potential habitat.	Science	No	No	No	No	No	Yes	Yes	Yes	If this study is conducted to build on the work done by ZARA in 2014, it should be prioritized by the Science Committee as part of the regular Applied Research program.	This study was conducted in 2014 by ZARA environmental as part of the Applied Research program. The study established a distribution during a low flow year, but did not establish a population estimate with confidence. This study could be expanded by conducting again during a normal flow year or attempting to establish a population estimate. It could be done through the 2016 Applied Research program.
26	Done - in progress, part of current program	Biological Monitoring	Continue monitoring index reaches.	114:33	Monitoring of index reaches needs to continue in order to assess trends and build on existing databases.	Science	Yes	No	No	No	No	Yes	Yes	Yes - currently covered in existing budget.	N/A	This is already part of the Bio Monitoring work plan and program. Recommend to establish a Biological Monitoring Work Group to do a holistic review of the biological monitoring program and its integration with the water quality monitoring program.
27	Yes	Biological Monitoring	Develop quantitative sampling methods for the CSRB.	116:1	New quantitative sampling methods are needed for the CSRB to complement and improve upon the cotton lure approach. The comprehensive survey of CSRB distribution proposed as part of the Applied Research Program should be given high priority.	Science	No	No	No	Yes	No	Yes	Yes	Yes - conduct research as part of the 2016 or 2017 Applied Research program	Add this research to the 2016 and/or 2017 Applied Research work plan; this project should be prioritized by the Science Committee as part of the regular Applied Research program	*The Science Committee has been discussing this topic at recent meetings. This recommendation should complement their discussions. *Workshop participants generally supported establishment of new methods. *This research would specifically look at methods other than use of the "cotton lure"; but also could be designed to include an "Optimization Study" for the cotton lure. *This research could also be used to determine the composition of the biofilm; or if already established by other researchers, could determine the utilization of the biofilm by the CSRB.

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28	Yes	Biological and Water Quality Monitoring	Increase coordination and integration of the biological monitoring and water quality monitoring programs.	115:9	The bio monitoring and water quality monitoring programs are only loosely integrated. Increased coordination and integration of the bio monitoring and water quality monitoring activities is needed.	Science	No	No	No	Yes	No	Yes	Yes	Yes - the cost to fund the staff position is available in the Refugia budget.	Create a Water Quality monitoring work group and a Biological monitoring work group to develop a strategy to implement this recommendation.	It is recommended that a Director of Refugia and Covered Species Programs be added to the HCP staff to assist with this workgroup facilitation, analysis and resulting implementation.
29	Yes per the NAS RRRWG - who also recommended a final determination from a Water Quality monitoring Work Group	Water Quality Monitoring	Enhance nutrient sampling.	115:24	Enhance sampling for nutrients is recommended. It is expected that nutrients and other urban background contaminants may be more important than many of the specific toxins that are currently included in the sampling program. The planned elimination of many of these parameters after one or two initial rounds of sampling if significant detections are not observed is supported by the NAS.	Science	No	No	No	TBD	No	Yes	Yes	Potentially - for this component to be added to the water quality program, another of equal fiscal impact would need to be removed.	Create a Water Quality monitoring work group to develop a strategy to implement this recommendation.	*As several years of data have been collected under the HCP Water Quality program and much has been learned, it is time to take a step back and revisit the Water Quality monitoring program from a holistic approach. It is recommended that a work group be formed to consider all NAS Water Quality monitoring recommendations and look for needed modifications based on data collected. *Additionally it is recommended that a Director of Refugia and Covered Species Programs be added to the HCP staff to assist with this workgroup facilitation, analysis and resulting implementation.
30	Yes, per the NAS RRRWG - who also recommended a final determination from a Water Quality monitoring Work Group.	Water Quality Monitoring	Conduct additional residential herbicide, residential chemicals, and personal care product testing.	113:9	Household chemicals, personal care products and residential herbicides should be evaluated for their potential to be introduced into the springs and river systems.	Science	No	No	No	TBD	TBD	Yes	TBD	Potentially - for this component to be added to the Water Quality monitoring program, another of equal fiscal impact would need to be removed.	Create a Water Quality monitoring work group to develop a strategy to implement this recommendation.	*As several years of data have been collected under the HCP water quality monitoring program and much has been learned, it is time to take a step back and revisit the water quality monitoring program from a holistic approach. It is recommended that a work group be formed to consider all NAS water quality monitoring recommendations and look for needed modifications based on data collected. *Additionally it is recommended that a Director of Refugia and Covered Species Programs be added to the HCP staff to assist with this workgroup facilitation, analysis and resulting implementation.
31	TBD- per the NAS RRRWG - who also recommended a final determination from a Biological monitoring Work Group	Biological Monitoring	Provide a clear mechanism to scale results to the entire spring and reach system.	115:1	The sampling programs do not provide a clear mechanism to scale results to the entire spring and reach system. It may be necessary to provide system-wide estimates of population densities.	Science	No	No	No	No	No	Yes	Yes	No - the Bio Monitoring Budget is already maxed out. For this sampling to be added, another component would need to be dropped. This addition would more than likely be a big ticket item with annual cost over the term of the ITP.	Create a Biological monitoring work group to develop a strategy to implement this recommendation.	*The NAS RRRWG discussed that the purpose of expanding the index reaches to representative reaches (system wide representation) has not been determined. If this is considered, a rationale as to why a system wide representation is needed for ITP compliance should be developed. *The Biological Goals and Objectives are tied to the previously identified reaches, not the entire river system. * NAS themselves comments that this is necessary only if desired.
32	No- per the NAS RRRWG - who also recommended a final determination from a Biological monitoring Work Group	Biological Monitoring	Increase the frequency of sampling in Comal Springs system.	106:7	Because of the apparent sensitivity and variable response of SAV to flow conditions, particularly in the Comal River, it would be best to either sample the total river more frequently than every five years or increase and/or randomize the sampling locations if a more accurate representation of SAV throughout the river is desired. The above sampling methods do not include data needed for the SAV modeling efforts, i.e., plant biomass. For dominant species and species specifically used in the modeling process, biomass data should be collected annually (and may need to be collected multiple times during the growing season to estimate specific growth rates) to validate the percent cover data and to provide accurate data for the SAV model.	Science	No	No	No	No	No	Yes	Yes	No - the Bio Monitoring Budget is already maxed out. For this sampling to be added, another component would need to be dropped. This addition would more than likely be a big ticket item with annual cost over the term of the ITP.	N/A	*Originally, the Variable Flow sampling was conducted 4 times a year. It has since been reduced to twice a year as it was determined there was no additional advantage to sampling a higher frequency. *The NAS RRRWG discussed the consistency in data sets and lack of variability in most parameters, leading to the questioning of why implementation of this recommendation would be needed.
33	No	Biological Monitoring	Conduct special studies on the fountain darter.	106:47	These special studies could be performed for a limited time to confirm or even improve the interpretation of the standard year-to-year monitoring. One set of studies could be designed to address the representativeness of the index reaches, and to benchmark the degree of uncertainty when index information is extrapolated to the regional or system level.	Science	No	No	No	No	No	Yes	Yes	No - the Bio Monitoring Budget is already maxed out. For this sampling to be added, another component would need to be dropped.	If this recommendation was implemented, it should be prioritized by the Science Committee as part of the regular Applied Research program.	*The purpose of expanding the index reaches to representative reaches (system wide representation) has not been determined. If this is considered, a rationale as to why a system wide representation is needed for ITP compliance should be developed. *The Biological Goals and Objectives are tied to the previously identified reaches, not the entire river system. * NAS themselves comments that this is necessary only if desired.
34	No	Biological Monitoring	Expand macro invertebrate surveys.	110:5	Macro invertebrate surveys should be expanded to habitats that are not currently being evaluated to provide information on the overall health of the aquatic ecosystem, similar to what is done for surface waters throughout the United States as part of national bio assessment programs	Science	No	No	No	No	No	Yes	Yes	No - the Bio Monitoring Budget is already maxed out. For this sampling to be added, another component would need to be dropped.	Create a Biological monitoring work group to develop a strategy to implement this recommendation.	*The participants in the NAS Report #1 workshop supported this recommendation, but did not identify how it contributed to compliance or the Biological Goals. *Macroinvertebrate sampling is typically performed to monitor the health of an aquatic system; the health of the Comal and San Marcos system is being monitored by other components of the monitoring programs. *Macroinvertebrate sampling in the HCP was to originally performed to populate the Ecological model. That effort is now close to complete, and new data would not be generated in time to be used by the modeling team.
35	Done	Applied Research	Conduct a follow-up fountain darter movement study.	119:39	A follow-up study on movement should be considered, perhaps using tags that provide near-continuous information on the locations and temperatures experienced by the individually tagged fish.	Science	No	No	No	No	No	Yes - within technical capabilities.	Yes	No - the additional cost of pit tagging FD's and tracking would be cost prohibitive.	N/A	A Fountain Darter movement study was conducted in 2014. NAS did not have the benefit of seeing these results prior to putting forth this recommendation.
36	Done	Applied Research	Increase transparency in prioritizing and funding research projects.	130:6	The Applied Research Program would benefit from a more transparent process for prioritizing and funding projects that includes stakeholder involvement, for example through the Science Committee and peer review.	Policy	No	No	No	Yes	No	Yes	Yes	Yes	N/A	*In 2014 and 2015, EAHCP staff modified the Applied Research prioritization process to be more transparent, solicit additional proposals from new proposers, solicit more input from the Science Committee on the technical merits of proposals, solicit key elements from the Science Committee to be included in the RFP's, and generally increase the role of the Science Committee in the process.
37	In progress	Applied Research	Increase competition and collaboration with outside scientific experts.	130:9	The Applied Research Program would benefit from a greater competition and collaboration with outside scientific experts through open and widely disseminated solicitation for research.	Policy	No	No	No	Yes	No	Yes	Yes	Yes	N/A	*For 2016 Applied Research solicitations, EAHCP staff referenced literature cited reports and bibliographies of researchers that performed similar research or are familiar with the EAHCP Covered Species. EAHCP staff will reach out to these identified researchers and ensure they are aware of the EAHCP research projects. * Additionally, for 2016 research solicitations, EAHCP staff will utilize numerous posting boards.
38	Yes	Applied Research	Remove Literature Review tasks	118:18	Literature reviews are usually not part of an applied research project, but rather are done during preparation of the proposal to demonstrate that the proposal authors have a strong knowledge of the background information necessary to develop suitable hypotheses and propose appropriate methods for testing them.	Science	No	No	No	No	No	Yes	Yes	Yes - this recommendation could actually result in saved \$.	Request literature reviews with the proposal, rather than as a deliverable of contract.	*Thus far Literature Review has been conducted by all selected contractors and represents a very minor expense. Proposers should do their background work (literature review) prior to submitting, but what is the harm in requesting to see their lit review if selected. *As most of the Applied Research in the HCP has been conducted or determined to not be needed, and new projects and topics are recommended for research by NAS and the Science Committee, a Applied Research work group should be formed to review completed research and establish a new research plan moving forward. *In Table 7.1, applied research funding ends in 2019; with identified additional research needs and continuing unknowns, the Implementing Committee might should consider extending applied research funding through the duration of the ITP. This additional funding would need to be reallocated from another HCP activity to applied research. *Additionally, it is recommended that a scientific Ph. D be added to the HCP staff to assist with workgroup facilitation, analysis and resulting implementation. Additionally, this staff person could assist in review of the research proposals, selecting contractors, and facilitating the research prioritization process and QA/QC of research conductance.
39	Yes - as allowed for by the FMA	Applied Research	Offer longer-term projects.	130:13	The program should offer some longer-term (two- to five-year ) projects in order to maximize interest and collaboration from the region's leading researchers.	Policy	No	No	No	No	No	Currently No - Annual planning cycle in the FMA and annual prioritization process is prohibitive.	Yes	Currently No - funding is on an Annual cycle	The FMA and budgeting cycle should be explored to identify opportunities to create multiple year research projects. Recommended as a critical component by the Work Group	*The Science Committee has echoed the same recommendation for longer and on-going studies. However, that remains a challenge within the current planning and budgeting framework. *The NAS RRRWG supported this as an important step in increasing the number of potential bidders to projects. All opportunities to implement this recommendation should be explored.

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40	Done - in progress and continual	Applied Research	Increase transparency of research results.	130:17	Results from the Applied Research Program, Particularly from outside researchers, should be provided in a form that ensures transparency and accessibility to other researchers and to the EAA.	Science / Policy	No	No	No	No	Yes	Yes	Yes	TBD - depends on method utilized for formatting, storage and access/dissemination.		*It is recommended that a scientific Ph. D be added to the HCP staff to assist with the creation and implementation of a data management plan, if determined it is needed to achieve compliance. *This recommendation seems to lead one to believe that there is a lack of transparency in the research process or that data generated through the EAHCP is not made available to other entities. However, all reports, results and data are posted on the EAHCP website and provided to any requestor. *The NAS RRRWG discussed that the purpose of data generated within the EAHCP is for the purpose of building the Eco Model or providing information to the Implementing Committee to make decisions. The purpose is not to ensure the data is in a usable format for another program/entity to utilize. If it is not in a usable format for a requesting program/entity to use, it should be the responsibility of the requestor to format for their purposes.
41-58	TBD	Applied Research	Pursue additional Applied Research topics as provided.	125-129	Numerous projects for varying species are recommended and listed individually below:											Applies to Applied Research Recommendations 41-58 *As most of the Applied Research in the HCP has been conducted or determined to not be needed, and new projects and topics are recommended for research by NAS and the Science Committee, a Applied Research work group should be formed to review completed research and establish a new research plan moving forward. *In Table 7.1, applied research funding ends in 2019; with identified additional research needs and continuing unknowns, the Implementing Committee might should consider extending applied research funding through the duration of the ITP. This additional funding would need to be reallocated from another HCP activity to applied research. *Additionally, it is recommended that a scientific Ph. D be added to the HCP staff to assist with workgroup facilitation, analysis and resulting implementation. Additionally, this staff person could assist in review of the research proposals, selecting contractors, and facilitating the research prioritization process and QA/QC of research conductance.
41	TBD	Applied Research	Fountain Darter: Conduct additional studies on movement, preferably allowing for Lagrangian tracks to be estimated.	125	Various types of mark-recapture and tracking technologies should be investigated and tested to determine movement ranges and patterns under a range of environmental (e.g. springflow) conditions. Sampling should involve different sizes of fountain darter during each of the key seasons. Understanding the movement patterns of individuals will provide information on the movement exchanges among habitat areas, range size, and provide data for model calibration and validation.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
42	TBD	Applied Research	Fountain Darter: Confront the persistent lack of a relationship found between flow and fountain darter metrics...it is critical to refine the relationship at low to moderate flows and also at high flows (scour events).	125	Changing flows can have effects on growth, mortality, and reproduction that can affect multiple life stages and accumulate over time, resulting in important effects at the population level...relationships need to be delineated based on empirical evidence and, in some cases, quantified...these measures could be further supported by studies that use lab and field measurements to ensure responses are recorded over a range of flows.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
43	TBD	Applied Research	Fountain Darter: Obtain measurements related to individual fountain darter health that go beyond the densities and lengths of individuals measured in the current bio monitoring.	125	Densities have high variability and are difficult to extrapolate spatially, and lengths alone are a relatively insensitive indicator of fish responses to conditions...many bio indicators proposed that reflect the health of individual fish.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
44	TBD	Applied Research	Submerged Aquatic Vegetation: Supply data on SAV growth, dispersal, and recolonization for those SAV species that are the best habitat for the fountain darter.	126	New studies that elucidate the interactions between SAV and the fountain darter would be particularly helpful.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
45	TBD	Applied Research	Submerged Aquatic Vegetation: Determine if the fountain darters are using SAV for protection, to find food, and/or as a nursery area for young.	126		Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
46	TBD	Applied Research	Submerged Aquatic Vegetation: Determine why the fountain darters prefer bryophytes and filamentous algae, which are not vascular plants.	126		Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
47	TBD	Applied Research	Texas wild-rice: Focus studies on the restoration of this plant.	126	In particular in areas that are considered suitable habitat yet are devoid of this plant.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
48	TBD	Applied Research	Texas wild-rice: Focus studies on the restoration of this plant.		Planting Texas wild rice in suitable areas and monitoring for success.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
49	TBD	Applied Research	Texas wild-rice: Focus studies on the restoration of this plant.		Determining whether low flow conditions are more detrimental to TWR than recreation.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
50	TBD	Applied Research	Texas wild-rice: Focus studies on the restoration of this plant.		Determining the effects of restricting recreation from areas where Texas wild rice is growing under various flow rates.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
51	TBD	Applied Research	Comal Springs riffle beetle: Understand the life history, life cycle and spatial distribution for better modeling of this species.		...including information on true densities of both immature and adult life stages throughout the year.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	

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52	TBD	Applied Research	Comal Springs riffle beetle: Understand the life stages of the CSRB.		Growth rates of the life stages.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
53	TBD	Applied Research	Comal Springs riffle beetle: Understand the life stages of the CSRB.		How many generations occur each year and are they synchronous?	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
54	TBD	Applied Research	Comal Springs riffle beetle: Understand the life stages of the CSRB.		How fast the life cycle proceeds or how the life cycle and other life history attributes like fecundity might be affected by changing flow or sediment conditions?	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
55	TBD	Applied Research	Comal Springs riffle beetle: Determine the representativeness of Cotton Lure sampling		Identify how representative the currently sampling method (i.e. cotton lures) is to quantitative densities of both adult and immature stages of the CSRB.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
56	TBD	Applied Research	Comal Springs riffle beetle: Understand the life stages of the CSRB.		Identify life history information important to better understanding how the populations, or portions of them, respond to changing habitat conditions related to flow or sedimentation.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
57	TBD	Applied Research	Comal Springs riffle beetle: Determine its status as an indicator species.		Better assessment of how well the CSRB acts as an indicator species for the other listed species will be critical for more comprehensive management of all threatened or endangered species that are not currently being monitored.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
58	TBD	Applied Research	Determine the effects from phosphorus sources, cycling, and availability on the productivity of the ecosystems.		In addition to the physical impacts of low flow, there could be very important indirect effects of low flow on the overall productivity and food web dynamics of the spring/river ecosystems due to nutrients.	Science	No	No	No	TBD	TBD	Yes	Yes	TBD - there is funding through 2019, but that would not cover all projects recommended.	Utilize the Applied Research work group to establish a research plan for the remainder of Phase I and possibly Phase II.	
59	No	Applied Research	Develop a general conceptual model for the Comal and San Marcos springs ecosystem.	130:1	Project partners should be tasked with the development of a general conceptual model for the Comal and San Marcos System.	Science	No	No	No	No	No	Yes	Yes	Yes	N/A	*Already Done for Species - 2010 EARIP Influence Diagrams: facilitated by Jean Cochrane. *Models for each system could be extrapolated from these influence diagrams or created if needed. But first, the need and goal should be identified as it relates to compliance with the ITP.
60	Done	Overarching Issues	Future scenario planning: Think how possible worst case scenarios would impact both modeling and HCP implementation (provided 5 scenarios; pgs. 137-139).	136:21	The five scenarios are the following: 1. Increased exempt pumping, 2. Drought conditions exceed Drought of Record, 3. Mismatch between conservation triggers and hydrologic changes, 4. Climate change, 5. Bragg litigation, and 6. Whooping Crane ESA issues	Policy	No	No	No	No	No	Yes	No	Yes	N/A	During the EARIP planning process, these topics were discussed, deliberated on, and decisions were already made regarding these topics.
61	Done	Overarching Issues	Conduct performance-based monitoring of the minimization/mitigation measures.	135: 5	The minimization and mitigation measures should be monitored for their performance.	Policy	Yes - demonstrate the completion of mitigation and resulting achievement of the Biological Objectives and Goals.	Yes	No	Yes	No	Yes	Yes	Yes - no impact	EAHCP staff has already begun to develop a tracking matrix of all M&M measures, how to measure success/completion and their status (% completion as measured against the Biological Goals)	This matrix should be completed late-summer 2015.
62	TBD	Overarching Issues	A comprehensive information management plan.	134:15	A comprehensive information management plan would ensure both internal and external access to relevant data over both the short and long-term, facilitate data analyses and syntheses across multiple data types and sources, buffer against the potential turnover of key personnel, and increase t.	Science / Policy	No	No	No	TBD	TBD	Yes	Yes	TBD - depends on method utilized for dissemination; no budget is currently identified for this exercise.	*Develop a data management plan. *Utilize a data manager (consultant or staff) or staff scientific Ph. D to establish a required data format for contractors to adhere to, reformat and organize existing data.	*It is recommended that a scientific Ph. D be added to the HCP staff to assist with the creation and implementation of a data management plan, if determined it is needed to achieve compliance. *The purpose of data generated within the EAHCP is for the purpose of building the Eco Model or providing information to the Implementing Committee to make decisions. The purpose is not to ensure the data is in a usable format for another program/entity to utilize. If it is not in a usable format for a requesting program/entity to use, it should be the responsibility of the requestor to reformat for their purposes.
63	TBD	Overarching Issues	Conduct rigorous statistical data analysis.	135:15	The recommendation for a more formal and rigorous statistical analyses of laboratory and field data such as summary statistics, variance of means etc..	Science / Policy	No	TBD	No	TBD	TBD	Yes	Yes	TBD - depends on method utilized for analysis. Currently, there is no budget for this exercise.	*At the June 2015 SC meeting, the SC will deliberate what/if any additional information can be gained to further compliance with the ITP from additional data analysis. *Utilize a data manager (consultant or staff) or staff scientific Ph. D to facilitate a Science Committee discussion to explore what, if any, questions should be answered by additional data analysis.	*Before implementation of this recommendation, the Science Committee should be utilized to identify questions that should be answered through the additional data analysis. These questions should be directly tied to achieving compliance or furthering accomplishment of the Biological Goals. *Utilize a data manager (consultant or staff) or staff scientific Ph. D to facilitate a Science Committee discussion to explore what, if any, questions should be answered by additional data analysis.
64	No	Overarching Issues	Increase project integration.	132 -133	1. Develop an overall conceptual model of the Edwards system. 2. Develop a unified data management system. 3. Convene an annual Science Meeting to discuss all relevant topics.	Science/Policy	No	No	No	No	No	Yes	Yes	Yes	*Two of the specific recommendations identified (conceptual model and data integration) have been addressed in other sections of this implementation plan. *The third recommendation to hold a Annual Science meeting may be covered by the proposed Bio Monitoring, Water Quality and Applied Research work groups.	*A EAHCP Conceptual Model was created by EAHCP staff and shared with Implementing Committee in 2014. *The Annual Science meeting covering the Edwards Aquifer appears to be a good idea. But not sure it is the EAHCP that should host, rather the EAHCP should be a participant.

Column Definitions

<b>Required for Compliance:</b>	Is implementation of this recommendation required to maintain compliance with the ITP or HCP
<b>Supports Achieving Biological Objectives or Goals</b>	Will implementation of a recommendation contribute to achieving the Biological Objectives or Goals.
<b>Fatal Flaw of Program</b>	1. Does a recommendation correct a wrong direction, decision or approach that prevents the permitted from achieving the Biological Objectives or Biological Goals in the HCP. 2. Does a recommendation correct a wrong direction, decision or approach that would cause the Permittees to exceed the Take levels identified in the ITP.
<b>Immediate Implementation</b>	Within the next year
<b>Delayed Implementation</b>	2-5 year implementation schedule
<b>Operationally Feasible</b>	Can the technical and physical elements of a recommendation be implemented based on the current level of knowledge, understanding and resources.
<b>Politically Feasible</b>	Has there been an expression historically by the Permittees as to the political nature or controversial nature of the recommendation

Hydrological Model
Ecological Model
Bio and WQ Monitoring
Applied Research

