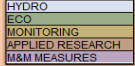
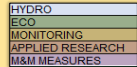


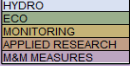
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Category	Synopsis	#	Recommendation	Workshop Input	Implementation Recommended	Compliance-oriented	Fiscally-feasible	Feasible	Implementation Strategy	Comments
Research Priorities Moving Forward 	Some specific applied research foci are especially important given the HCP's management objectives.	1	The 2017 project to establish better relationships between the fountain darter and the different species and coverages of submerged aquatic vegetation (including Ludwigia) in both systems is critically important.	General agreement; Population studies should try to include all species, not just the Comal Springs riffle beetle, for use as a baseline (using an empirical model)	Done and may potentially be examined further through future Applied Research.	No	Yes, with the caveat that budget only extends until 2019.	Yes		1. Research to be conducted in 2018 and 2019 was established by the 2017 Research Work Group. Generally, this list is more comprehensive than what has been provided by NAS; 2. 2018 and 2019 are the last two years of Applied Research.
		2	Research to better understand the life history of listed species and identifying effective sampling techniques rightfully deserves high priority.		Yes	No	Yes, with the caveat that budget only extends until 2019.	Yes	To be conducted through the Refugia research program.	
Application and Limitations to Application for Existing Applied Research Results	Applied research study results can and should be used to inform management efforts; in some cases, caution is warranted in applying these results, however.	3	The Comal Springs riffle beetle temp and oxygen study's use of surrogates is of questionable relevance for the Comal Springs riffle beetle.	General agreement, and the following specific comments: The Spring Communities should: maintain focus on planting and using native plant species in both systems; promote native plant species for restoration but not to the detriment of surrounding species.	No action required	No	Yes, with the caveat that budget only extends until 2019.	Yes	HCP staff agrees with this comment.	
		4	The Comal Springs riffle beetle temp and oxygen study's use of lab environments may not provide a relevant test of Comal Springs riffle beetle behavior in its natural environment.		No action required	No	Yes, with the caveat that budget only extends until 2019.	Yes	HCP staff agrees with this comment.	
		5	Areas where Hygrophila is of concern should be targeted for Ludwigia establishment where restoration efforts are being carried out.		In process	No	Yes, with the caveat that budget only extends until 2019.	Yes	This recommendation is available to NB and SM/TXSTATE for consideration as they implement the submerged aquatic vegetation schedule/regime established through AMP; City of New Braunfels already doing this.	
		6	The competitive advantage of Ludwigia against Hygrophila should be communicated to the submerged aquatic vegetation modeling team and incorporated into their efforts.		Done	No	Yes, with the caveat that budget only extends until 2019.	Yes	The submerged aquatic vegetation research was conducted by members of the modeling team.	
		7	Additional consideration of the interactions between Hydrilla and Ludwigia is needed before conclusions are made or further application of this research occurs.		In process	No	Yes, with the caveat that budget only extends until 2019.	Yes	HCP staff agrees with this comment.	
		8	Ludwigia should be seriously considered for use in the San Marcos system.		In process	No	Yes, with the caveat that budget only extends until 2019.	Yes	This recommendation will be made available to SM/TXSTATE for consideration as they implement the submerged aquatic vegetation schedule/regime established through AMP	
		9	miniDOT oxygen sensors in Landa Lake and Upper Spring Run should be continued as part of a routine integrated water quality and biological monitoring program.		Yes	No	Yes, with the caveat that budget only extends until 2019.	Yes	EAHCP added a sonde to Landa Lake; CONB plans to add through 2018 Work Plans (not yet approved).	
		10	The Committee recommends that aeration not be used routinely as a mitigation measure.		TBD through Landa Lake DO Mgmt. Plan under development.	No	Yes, with the caveat that budget only extends until 2019.	Yes	NB is currently conducting research to establish a DO Mgmt. Plan for Landa Lake; may pursue AMP next year.	

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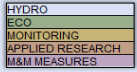
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		21	The EAA should continue to look for ways to remove conditions that restrict the pool of potential Applied Research applicants.	RFPs, creating multi-year contracts, reducing specifications regarding invoicing, payments, reporting, and deliverables; • EAA should develop a method to access and fund MS and PhD students to conduct research in the springs, thereby training new scientists familiar with the springs and creating more data from their research; • Request a reduction of overhead/indirect costs to make it more affordable to work with universities; • There should be a way to try to integrate new data with existing data.	Done - continual	No	Yes	Yes	See comments.	Efforts have been made to greatly increase the distribution of RFPs to the scientific community; efforts are being made to extend the application window (see #20); the program is entering Y2 of its first ever two-year project (BIO-WEST, Inc., 2016).
		22	The EAA should use the data management system being implemented to allow greater data discovery and access by the outside scientific community and the public.		Yes	No	No	Yes	Currently there are no plans or resources to make the database accessible online. However, EAA is committed to providing all data when requested.	
		23	The cause for the large mortalities of Comal Springs riffle beetle at the FAB still need to be definitively identified and resolved through additional study.		Done	No	No	No		There have been no issues since additional precautions and upgrades were implemented by TXSTATE; a report was provided by Juan Guerra detailing measures taken (unpublished).
		24	The EAA should be prepared to invest in additional research projects in life history of listed species and sampling techniques that span multiple years, if necessary.		Done	No	Yes	Yes	This research is already funded through the refugia program.	Comal Springs riffle beetle life history study (BIO-WEST, Inc., 2016) began first two years in Applied Research and will continue through Refugia; other life history studies will be undertaken through Refugia as well.
		25	Monitoring effectiveness of M&M measures should not be part of the Applied Research Program, but should instead be incorporated within long-term monitoring programs.		Yes; however, certain exceptions may be warranted for specific projects	No	Yes	Yes		While this may be true for long term monitoring, the Applied Research program may be useful for snapshot monitoring questions and issues (e.g., sediment study).
		26	Resources for ongoing data management activities will need to be allocated throughout the lifetime of the HCP.		No	No	No, but prudent as long as within existing resources and looking for additional funding opportunities	Yes	Currently there is no resources for ongoing database upgrades or maintenance; however, database management activities will continue.	The original database itself was an unfunded initiative agreed to by EAA; staff time can be committed, but building new modules or interfaces does not have funding at this time. Data is available to the public on request.
		27	Modeling efforts should become more integral to consideration of future Applied Research projects; referring to providing data and informing operating, refining, and expanding models.		TBD	No	Yes; with the caveat that the Applied Research budget only extends until 2019	Yes	A public process will be followed for the implementation of both the hydro and eco models, through which any additional research needs may be identified (but are not anticipated).	Modeling has been supported via past Applied Research projects; may be looked at in the event the eco model is updated in the future. There is a placeholder in the 2018-2019 research program in case this would be needed, but is not anticipated.
Methodological Issues Associated with Water Quality Monitoring 	Additional methodological considerations should be taken into account in the WQ monitoring program.	28	If the EAA is to use Clean Rivers Program water quality (WQ) data, it should co-located in sampling space and time.	• Evaluate Clean Rivers Program (CRP) data on a predetermined time series analysis to identify trends that adversely affect the systems; • There is value to the NAS recommendation regarding PAHs in sediment as an impact on life-cycle of beetles and salamanders; • In regards to PAH and other nutrient concentrations in sediment, it is more important to determine source than to identify effect; Consider	No	No	No	No	1. Any changes to the monitoring programs will be considered in 2018/2019. The WQ and Bionitoring contracts are up at the end of 2018 and will be rebid and renegotiated for implementation in 2019, creating a natural time to incorporate changes; 2. Additionally, the two monitoring programs were just modified as a result of NAS Report #1. These changes were effective for 2017 and 2018. It would be premature to modify these programs again, before realizing the new and additional data that will be	HCP is coordinating with CRP to obtain its data. Spring systems ambient conditions are extremely constant, clean, and have rapid turnover. Finally, the HCP has no ability to influence the CRP sampling regime.
		29	All nutrient analyses be performed on the same water sample(s).	Yes	No	TBD	TBD	Feasibility and fiscal responsibility will be evaluated once changes are considered in 2018 and 2019.		

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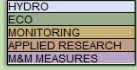
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		37	The performance monitoring of M&M measures should be integrated into the existing water quality and biological monitoring programs.		Yes	No	No	Yes		Have added riparian; considering others in the future.
Submerged Aquatic Vegetation & Related Conservation Measures 	Additional monitoring, effectiveness assessment, and integration should be considered in these Measures.	38	M&M effectiveness monitoring should be done periodically with a comprehensive synthesis of the monitoring data every five years or so.	* The goal of the non-native vegetation removal and native vegetation restoration is not to strictly increase fountain darter numbers, but rather normalize the eco system and increase health of the system; o Not dismissing NAS comment, but a broader view of the ecosystem is necessary; - Focus specifically on sediment sources prevention rather than removal; o Current reevaluation through AMP process was noted and encouraged; + To be able to remove enough sediment in the systems is futile. Reducing watershed sources is a better use of funds; o Importance in communicating outside organization efforts that complement the HCP efforts (MS4 and SAWS ASR); - In regards to the non-native vs. native restoration concern staff should remind NAS that the ITP requires less than or equal to 10% of habitat disturbance in any given year; + Landa Lake aeration is ineffective, especially during low dissolved oxygen (DO) as seen in past years; o DO management plan is currently in effect; o Mini Dot oxygen loggers are a good plan; o Should add additional temperature loggers.	Done	No	Yes	Yes	The EAHCP conducts annual monitoring, with full mapping every 5 years.	This is our plan.
		39	We recommend continuing to compute ratios from data such as those reported in BIO-WEST and Watershed Systems Group (2016), further refining the data to be as species specific as possible.		Yes	No	Yes	Yes	Through CONB and COSM/TXST Work Plans and Annual Report.	Contractors will implement.
		40	In light of October 2015 flooding damage, upstream erosion and stormwater runoff control measures may be needed to protect planting and sediment control efforts downstream.		Yes	No	Yes	Yes	This question will be investigated through the AMP process in 2017.	
		41	There is not enough new habitat from native plantings to maintain populations of fountain darter to balance non-native plant removal.		No	Yes	?	Yes		USFWS has approved the new submerged aquatic vegetation regime and resulting Biological Goals and habitat availability.
		42	Habitat availability for the fountain darter should be verified by considering the carrying capacity of the various submerged aquatic vegetation species (both native and non-native) for fountain darter.		Done	No	No	Yes		Was part of the submerged aquatic vegetation AMP process.
		43	It is important to track the difference between the area of non-native plants removed and the sustained native coverage (reported as m ²).		Yes; in progress continually	No	Yes	Yes	Biological monitoring and submerged aquatic vegetation mapping.	
		44	It is important to track the number of plants planted, resulting sustained area, coverage of vegetation from baseline maps in 2013, and lessons learned regarding new species or techniques.		Yes; in progress continually	No	Yes	Yes	Biological monitoring and submerged aquatic vegetation mapping. Comprehensive mapping to be done in 2018. Also through CONB/COSM/TXST Work Plans.	
		45	Non-native vegetation should be considered as fountain darter habitat when it comes to maintaining and increasing habitat availability for the fountain darter.		Yes and no	No	Yes	Yes	So long as non-native submerged aquatic vegetation exists, it is and will continue to be counted as fountain darter habitat. However, additional non-natives will not be planted to increase available darter habitat.	See also #41; USFWS agrees.
		46	Bank pins and turbidity loggers could be used to evaluate sediment deposition where background knowledge is not currently available. Water depth and sediment accumulation should be monitored in areas being considered for sediment removal as well as post-removal as well.		No - sediment removal is no longer going to be conducted	No	No	Yes	Sediment prevention is being considered and appropriate steps will be taken to ensure a before and after comparison can be conducted.	HCP plans to conduct a before and after study through its 2018-2019 Applied Research program.

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		57	The Committee recommends that at a minimum of annually, determine specific injection at each ASR well to assess if there are any long-term changes in ASR well performance.		No	No	No	No		
		58	The Committee recommends to design and implement water quality monitoring for arsenic and related constituents in monitoring wells during recharge and storage events.		No	No	No	No		
		59	The Committee recommends to design and implement water quality monitoring in ASR wells during recovery events.		No	No	No	No		
		60	The Committee recommends that compliance of the parties participating in the spring flow protection measures be audited due to the high expense of the spring flow protection measures and their importance to the HCP's success.		Yes	No	TBD	TBD	TBD; recommended for consideration by the Stakeholder and Implementing Committees	The recommendation appears to be recommending both an operational and a financial audit. Permittees and Partners are committed to transparency in the HCP process. Internal audits have been regularly conducted.
Modeling for Phase 2 Decisions	MODFLOW should be used to help develop strategic decisions associated with adaptive management and revisions to minimization and mitigation measures.	61	Developing a more refined framework that incorporates modeling into the decision criteria for triggers rather than relying on triggers based on measured groundwater elevations at specific wells should be considered in planning for Phase 2 of the HCP.	- Regardless of how the phase II decision is made with respect to MODFLOW output, clarity and transparency should be at a maximum; • A regional scale decision support system incorporating MODFLOW predictive output would be useful; • Reevaluate the benefits of other springflow protection measures (i.e. RWCP, VISPO) (from Monitoring/Mitigation group); • In addition to using model output to predict cessation of spring flows, the empirical record should be examined to determine if there are measurable early warning signs.		No	Yes	Not in Phase I; however, may be considered in Phase II.	Conduct the Phase II Strategic AMP, recognizing that EAA has model uses beyond the HCP.	Triggers are based on benefit to springflow and additional socioeconomic factors outside of the EAHCP purview. Many of the groundwater level-based triggers are derived from the EAA Act and can only be changed through legislative action.
		62	A decision support system (DSS) should be developed to be used in Phase 2 of the HCP in order to apply the model to short-term decisions (e.g., a one-month time frame) related to determining springflow protection triggers.			No	Yes	Not in Phase I; however, may be considered in Phase II.		1. At the workshop, a DSS utilizing model predictions was discussed with many favorable comments. This may be a valid future tool; 2. However, triggers and mgmt. strategies are annual, not monthly.
		63	A DSS would clearly direct these decisions on the basis of different model outcomes. A good DSS is developed and applied with the understanding that model predictions, although uncertain, represent the best available science on which to base management decisions.	Only to the extent it is part of the Phase II process		No	Yes	Not in Phase I; however, may be considered in Phase II.		1. At the workshop, a DSS utilizing model predictions was discussed with many favorable comments. This may be a valid future tool.
		64	MODFLOW should be used to evaluate scenarios that help understand what processes are important in the system. Examples would include applying the model for testing concepts, parameters, and system conditions, not just producing predictions, which can be highly uncertain.			No	HCP has no budgeted allocated for this exercise; however, this may be appropriate for the EAA program.	Yes		1. Exploratory modeling is not part of the EAHCP; however, EAA has done this to some extent through model development and will document in Groundwater Model Report. 2. At the conclusion of Phase II, EAA will use the model to continue to assess mgmt. strategies and explore mgmt. options-also, much of this is implicitly captured by modeling a range of hydrologic conditions over the 50+ year calibration timeframe.



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Ecological Model Scenario Testing 	There are several different scenarios and/or issues that should be investigated using the ecological model.	101	To explore how submerged aquatic vegetation habitat affects fountain darter, the timing of the existing maps could be switched within simulations to determine whether simulated fountain darter population dynamics are sensitive to sub-regional scale and interannual variability in the observed submerged aquatic vegetation (habitat) record.	• Low flow and spring flow protection measures should be simulated; • Catastrophic simulation would be a useful exercise for refugia planning (e.g., to model reintroduction and population growth); • Eco model should look at a range of flows, not just extremes; • It would be useful to use a wider lens to apply eco model to a variety of different questions (not just darter populations); • The eco model can be used to simulate conditions to approximate different climate change scenarios, and should be used for this purpose—planning for climate change should begin sooner, rather than later, to begin building new data to support the renewal of the ITP; • Eco model should be used to verify darter density per submerged aquatic vegetation metrics; • High flows, such as flooding, should be simulated; • Streambed morphology should be examined with a view to identifying whether velocity shelters would be appropriate to situate in the river channel to provide additional protection to Covered Species, such as the darter; • Eco model should be used to identify what environmental factors are most critical for influencing darter populations (e.g. under low flows, are certain parameters most critical to manage for?); • Eco model should include impacts of runoff on water quality; • The general orientation towards the model should be one of maximizing its usefulness to answer a variety of ecological questions relevant for management, not just a strict, narrow “compliance focus”	Not in Phase I; however, selected projects may be undertaken in Phase II through a prioritization process, but only to the extent resources allow.	No	No	Yes	Possible during Phase II. At the conclusion of Phase I (around 2021) all possible runs will be compiled and a public process used to prioritize.	1. The Ecological Model was designed specifically for the Phase II process to ensure that the fountain darter would recover after a repeat of the DOR mitigated by the bottom up package. 2. Currently, the Ecological Model contract has expired and there are no remaining dedicated resources to do further development on the Ecological Model or run additional scenarios. 3. Exploratory modeling is not part of the EAHCP; However, is possible that modeling could be conducted after Phase II and used to evaluate aspects of Conservation Measures. 4. Any one scenario requires significant time and investment in resources; does not simply entail twirling a dial on the model and hitting “run.” 5. Some specific questions might be addressed sooner if resources are available; the Science Committee will be used to vet these.
		102	A scenario could be run to force fountain darter population reductions (simply remove individuals on a day in certain areas) and determine the time period that the population remains below a threshold and the subsequent rate of recovery of the population to a healthier value.		No	No	Yes	Possible during Phase II. At the conclusion of Phase I (around 2021) all possible runs will be compiled and a public process used to prioritize.		
		103	Running the model under low flows and for flow protection measures to evaluate the impact on predicted submerged aquatic vegetation is a critical question for the fountain darter model.		No	No	Yes	Possible during Phase II. At the conclusion of Phase I (around 2021) all possible runs will be compiled and a public process used to prioritize.		
		104	Pushing the model to catastrophic scenarios – for example where submerged aquatic vegetation is only present in refugia – might reveal some insights regarding recovery following such an event.		No	No	Yes	Possible during Phase II. At the conclusion of Phase I (around 2021) all possible runs will be compiled and a public process used to prioritize.		
		105	Examining simulated maps of submerged aquatic vegetation representative of “good” and “bad” years in various virtual time series should be done in a dynamic submerged aquatic vegetation model.		No	No	Yes	Possible during Phase II. At the conclusion of Phase I (around 2021) all possible runs will be compiled and a public process used to prioritize.		
		106	A possible useful application of the model would be to better understand the degree of long-term maintenance that might be required to eradicate non-native species.		No	No	Yes	Possible during Phase II. At the conclusion of Phase I (around 2021) all possible runs will be compiled and a public process used to prioritize.		
		107	The EAA should explore the diagnostic abilities of this mechanistic model to better understand the environmental forcings that influence vegetation, and to identify future applied research questions that might best serve management goals.		No	No	Yes	Possible during Phase II. At the conclusion of Phase I (around 2021) all possible runs will be compiled and a public process used to prioritize.		
		108	An additional scenario could be designed to examine whether there are measurable thresholds of submerged aquatic vegetation acreage in a given reach that result in dramatic increases or declines in fountain darter abundance.		No	No	Yes	Possible during Phase II. At the conclusion of Phase I (around 2021) all possible runs will be compiled and a public process used to prioritize.		

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		145	The representation of flow effects in the model seems too limited in potential effects due to reliance on having site-specific empirical evidence for the effects.			No	No	No	None at this time.	
		146	Thresholds in process representations should be used cautiously because they can erroneously create nonlinear population responses and unrealistic sensitivities to changes in habitat & flow.			No	No	No	None at this time.	
		147	The representation of density-dependence and how its effects on individuals manifest at the population level needs further evaluation.			No	No	No	None at this time.	
		148	Calibration and validation of the fountain darter model to date shows the model can reproduce the historical abundances, but additional confidence is needed to most effectively use the model for management purposes.			No	No	No	None at this time.	
		149	<i>As a top priority the EAA should develop an ecosystem-based conceptual model, or a series of conceptual 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.</i>			No	No	No	None at this time.	
		150	<i>The habitat suitability analyses done for the fountain darter should be used 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.</i>			No	No	No	None at this time.	
		151	<i>A much deeper understanding of the Comal Springs riffle beetle's natural history should be obtained in order to be able to include the Comal Springs riffle beetle in a mechanistic model.</i>			No	No	No	None at this time.	