

### HCP Measure 6.3.3 – ECOLOGICAL MODELING

**Long-term Objective:** The long-term objectives of this measure are to develop a predictive ecological model for the individual Covered Species, to estimate potential adverse ecological effects from Covered Activities, and to quantify the magnitude of such effects if they occur. Additionally, the predictive tool will assist the Applicants in developing alternative approaches or possible mitigation strategies, if necessary.

**Introduction/Overview:** The other HCP measures are designed to continue tracking the ecological systems over time (biological and water quality monitoring), improve habitat and Covered Species conditions (restoration and non-native controls, etc.), and increase the understanding of the ecological interactions (applied research at the experimental channel, gill parasite research, Old Channel restoration and protection, etc.) relative to the Covered Species. These are all necessary and informative activities. However, until a repeat of the drought of record occurs or extended periods of drought (as modeled for the proposed HCP alternative) are encountered, none of these activities can predict what impacts are likely to occur, and ultimately, whether the proposed Action is protective. As such, there is a critical need to develop a predictive tool to evaluate potential scenarios using the best available data to date and the data collected via the AMP.

The development of mechanistic ecological models is a fast-developing field that has seen many successes and failures in the past decade. As repeatedly documented in the literature, the results coming out of any model are only as good as the data going in. As such, data collection and coordination amongst each HCP measure need to be designed to the degree practicable to provide inputs to the ecological models. This will be particularly important for the following HCP Measures: biological monitoring, applied research, Old Channel restoration and protection, gill parasite research, expanded water quality monitoring, non-native species control and monitoring on both systems, Texas wild-rice restoration and monitoring, and native aquatic vegetation restoration and monitoring on both systems.

**Target for 2013:** Develop the framework for a mechanistic ecological model for the fountain darter specific to Comal Springs through the initial development of a conceptual model and proof of concept model runs as described below.

**Protocol:** The development of a mechanistic ecological model for every individual component of a complex, karst driven aquifer is likely unattainable. However, the proposed effort focuses on the ecological aspects of the Covered Species and springs environment using a three-phased approach.

Phase 1 will be the preparation of a detailed conceptual model for the fountain darter at Comal Springs. The influence diagrams produced for the HCP will serve as a starting point for this exercise, followed by the development of a more detailed conceptual model. At this point, a group of scientists familiar with the fountain darter and the Comal system will be convened for a

series of meetings/workshops focused on describing and defining the ecological linkages that could be addressed within a mechanistic ecological model. Additionally, this group of scientists will also be determining the level and type of mechanistic modeling that may be necessary to accomplish defining and describing these ecological linkages in a manner supportive of the AMP. These discussions will occur concurrently with conceptual model development and are anticipated to be concluded by early spring 2013. The available data will be examined in detail and discussions will focus on how the ongoing HCP measures could be designed to further answer questions for data input into the ecological model. From the results of the series of meetings/workshops, the conceptual model and modeling approach will be determined and serve as the framework for mechanistic model development. Following agreement on a modeling approach, the contractor will perform monthly conference calls with the HCP applicants and program manager, as well as face-to-face meetings on a quarterly schedule.

Phase 2 will involve the development of the model framework and grid within the established model boundary. For the proof of concept exercise in 2013 the model boundary will include Comal Springs and the associated watershed areas directly affecting surface water runoff into Comal Springs. Groundwater flow dynamics will not be recreated for simulation, but rather MODFLOW or an updated EAA groundwater model will be linked to the ecological model to provide the groundwater discharge input. Additionally, a basic rainfall, runoff model will be incorporated to allow for the introduction of potential surface water contaminants into the springs environment at a larger spatial scale. The focus will be to incorporate those larger scale inputs into a local depiction of Comal Springs on a much finer scale. It is anticipated that cell size over the watershed would be approximately 40 m by 40 m, whereas the spring environments would be modeled on a 5 m by 5 m grid with specific areas including 1 m by 1m grids.

Phase 3 will be to build several of the key model linkages established during phase 1 into the model and run the model on a proof of concept level. At the conclusion of 2013, the proof of concept model runs will be presented to the HCP implementing committee and any established scientific body established during the AMP. It will be understood that not all of the model components (in fact, many of the key aquatic vegetation, gill parasite, Old Channel restoration and protection, etc. interactions) simply won't be known at the conclusion of 2013. Full model development for the fountain darter at Comal Springs will be completed in 2014. However, at the 2013 meeting, a decision will be made whether a proof of concept level approach should be extended in 2014 for development of a Comal Springs riffle beetle model. Expanding the fountain darter model to San Marcos Springs and adding a Texas wild-rice proof of concept model development would occur in 2015.

### **Modeling Protocol Process**

A two-day workshop will be held with consultants that offer a particular model (such as EDYS) or a modeling approach (regression, neural networks, IBMs, etc.), modeling experts that understand ecological modeling, but are not promoting a model or approach, and local scientists such as Dr. Thom Hardy and Ed Oborny. All parties will be sent Section 6.3.3 (Ecological Modeling) from the HCP in advance of the meeting and be instructed that the goals of an ecological model are to address the requirements listed in that section. On the first day of the workshop, the consultants will make their presentations and answer questions by the modeling experts and local scientists. The second day the modeling experts will convene, debrief about the presentations from the previous day and prepare a report for the Implementing Committee that summarizes the model presentation and provides a group recommendation on the appropriate model or approach. The Implementing Committee will consider the report and make a determination as to if and to what extent the Ecological Modeling work plan and budget should be revised for 2013.

#### **Allocated funds for 2013: \$175,000**

Estimated 2013 Budget broken down per activity:

- Phase 1 - Development of conceptual model and meetings/workshops.
  - Total Cost:\$22,500
- Phase 2 – Establishment of model boundary and framework.
  - Total Cost: \$115,000
- Phase 3 – Inclusion of basic linkages and proof of concept model runs.
  - Total Cost: \$37,500

Allocated Amount	\$175,000
Money Advanced in 2012 as part of Zero Year Program	\$25,000
Money Available in 2013 <sup>1</sup>	\$150,000

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<sup>1</sup> The \$25,000 advanced by EAA in 2012 will be reimbursed to EAA out of the \$175,000 Allocated Amount leaving \$150,000 for work in 2013.