# NARRATIVE & BUDGET

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## HCP Measure 6.3.1 – BIOLOGICAL MONITORING

**Long-term Objective:** The major long-term objective of biological monitoring is to monitor changes to habitat availability and population abundance of the Covered Species that may result from Covered Activities. A concurrent objective is to continue data collection aimed at filling important gaps in the ecological knowledge of the Comal and San Marcos springs and river ecosystems. The collection of data aimed at filling data gaps through biological monitoring will be coordinated with the applied environmental research (HCP Measure 6.3.4) to be conducted at the USFWS National Fish Hatchery and Technology Center (NFH&TC) and conducted in a manner to inform the ecological model development described in HCP Measure 6.3.3.

**Introduction/Overview:** The Comprehensive and Critical Period Monitoring Program to Evaluate the Effects of Variable Flow on Biological Resources in the Comal and San Marcos Springs Aquatic Ecosystems (Variable Flow Study) was initiated in Fall 2000. The development of the Variable Flow Study was a collaborative effort starting as a prospective study within the Edwards Aquifer Optimization Program (EAOP) in the late 1990's. During the late 1990's, a Technical Advisory Group (TAG) for the EAOP was formed consisting of resource specialists / scientists from multiple entities (see BIO-WEST 2007). The TAG developed the framework for the Variable Flow Study and a workshop was held in May 2000 to discuss a proposed sampling protocol for both springs' systems. The workshop was attended by resource professionals from the Edwards Aquifer Authority, TPWD, USFWS Austin Ecological Services (ES), USFWS NFHTC, and scientists from the Edwards Aquifer Research and Data Center (EARDC), and Texas State University (TSU). Discussions were conducted at the workshop, and subsequently, comments were incorporated into a final sampling program which was further reviewed and accepted by the USFWS and TPWD during late summer 2000.

As discussed in HCP section 6.3.1, the Variable Flow Study will provide the core for biological monitoring associated with the HCP. As proven over the past decade and evident by the extensive use of this data for the preparation of the HCP, the Variable Flow Study has provided an excellent framework for tracking the Covered Species and associated habitat responses of both the Comal and San Marcos systems over time. However, to increase the robustness of the program and answer additional questions posed during HCP development, several additional components to the Variable Flow study will be added as described below. As specified in the HCP, the scope of the Variable Flow Study currently can be modified on a yearly basis as provided in the Funding and Management Agreement (FMA) with agreement by the USFWS. Additionally, it is proposed that upon development of the EARIP Adaptive Management Plan (AMP) science panel, a full review of all HCP measures and AMP activities (including biological monitoring) be undertaken by that entity.

**Target for 2013:** Continue the Variable Flow Study program along with implementing new study components as described below.

**Protocol:** The Variable Flow Study program consists of the on-going Comprehensive monitoring that is currently being conducted. A detailed description of activities is presented in BIO-WEST (2007) and summarized as follows:

- VARIABLE FLOW STUDY
  - Aquatic Vegetation mapping – GPS mapping – Conducted Spring and Fall.
    - Representative study reaches - 4 reaches at Comal Springs and 3 reaches at San Marcos Springs.
  - Texas wild-rice mapping – GPS mapping – Conducted annually (Summer)
    - Full System mapping at San Marcos
  - Fish sampling – Drop Netting – Conducted Spring and Fall.
    - Same reaches as aquatic vegetation mapping (note: the Spring Lake Dam reach at San Marcos is added for Drop Net sampling as a new activity)
    - All darters collected are visually examined for evidence of gill parasites
  - Fountain Darter specific sampling – Dip Netting and SCUBA surveys – Conducted Spring and Fall.
    - Dip netting involves timed surveys as well as Presence/Absence surveys in specified reaches throughout the spatial extent of both systems.
    - SCUBA surveys include area surveys in fixed locations in Landa Lake and Spring Lake.
  - Comal springs riffle beetle sampling - Cotton lure sampling – Conducted Spring and Fall.
    - Spring Run 3, Western Shoreline, and Spring Island area – Comal Springs
  - Comal Springs Riffle Beetle, Peck's cave amphipod and Comal Springs dryopid beetle sampling – Drift Net – Conducted Spring and Fall.
    - Spring runs and Western Shoreline – Comal Springs
  - Salamander sampling – Snorkeling and SCUBA surveys – Conducted Spring and Fall
    - San Marcos Salamander – 3 locations (1 below Spring Lake Dam [snorkel] and 2 within Spring Lake [SCUBA])
    - Comal Salamander – 3 locations (Spring runs 1 and 3, and Spring Island area)
  - Comal Springs Discharge measurements – Conducted Spring and Fall.
    - Conducted at Spring runs 1, 2, and 3, upper spring run reach, and Old Channel below Elizabeth Street.
  - Water quality – standard parameters and fixed-station temperature loggers
    - Standard parameters conducted spring and fall throughout each system.
    - Temperature data via continuous data loggers.
  - Fixed station photography – Conducted Spring and Fall.
    - Both Comal and San Marcos systems

The Variable Flow Study also consists of additional flow-triggered Critical Period Sampling to be conducted when flows reach predefined trigger levels (both high and low) (BIO-WEST 2007). This sampling consists of a repeat of all the study components described above in addition to water quality sampling for conventional parameters (nutrients, alkalinity, and total suspended solids) at 15 sites in the Comal system and 18 sites in the San Marcos system; additional Texas wild-rice physical habitat mapping; and predation/gut content studies associated with extreme low-flow events.

Additional components for inclusion in Variable Flow Study program for 2013 include:

- Full system – aquatic vegetation mapping – GPS. The full system vegetation mapping is being added to ensure the representative study reaches remain representative of the system as a whole as the HCP moves forward.
  - San Marcos (Spring Lake to confluence with the Blanco River) and Comal (Upper spring run reach to confluence with the Guadalupe River). This includes both the physical mapping in the field and map preparation using GIS.
  - Conducted in Spring 2013, then every 5 years.
- Expand fish sampling (Dropnet) in San Marcos to include the Spring Lake Dam reach. This measure is being added to maximize the efficiency of the aquatic vegetation data currently being collected and add robustness to the fountain darter data set for the San Marcos River.
  - Using the standard dropnetting techniques established for the Variable Flow Study, conduct dropnet sampling in duplicate within 3 main aquatic vegetation types in the Spring Lake Dam study reach.
  - Conducted Spring and Fall, and during any Critical Period Sampling.
- Additional flow partitioning within Landa Lake during each Variable Flow Study Comprehensive and Critical Period sampling effort. This measure is being added to provide a better understanding of the spring flow influence within Landa Lake as upwelling flow within Landa Lake is imperative to Comal Springs riffle beetle survival during low-flow events.
  - Using an Acoustic Doppler profiler or similar device, measure the flow patterns and current velocities from Spring Island through the upper portion of Landa Lake concurrently with Variable Flow Study discharge measurements at Comal Springs.
  - Conducted Spring and Fall.
- Macroinvertebrate food source monitoring within Variable Flow Study representative reaches. This measure is being added to better understand the food source base for fountain darters in each system and how that food base responds to varying flow conditions. It may turn out that fountain darter food sources are depleted long before aquatic vegetation dies off (meaning current HCP flow requirements may be presently under protective), or that food sources remain long after aquatic vegetation decay which may mean current requirements are over protective. Regardless, this component is currently a

major unknown that has the potential to affect long-term biological goals for the fountain darter.

- Conduct macroinvertebrate sampling using a modified surber sampler, modified stovepipe sampler or similar device within each of the 7 study reaches (4 at Comal and 3 at San Marcos) to characterize food sources available for fountain darters.
- Samples will be collected in triplicate from 3 vegetation types (based on majority present or adjusted based on fountain darter habitat quality) within each of the 7 study reaches for a total of 63 samples per event. Activity includes macroinvertebrate sample processing.
- Additionally, the macroinvertebrate sampling will assist in gathering baseline data on the two non-listed macroinvertebrate species, the Edwards Aquifer diving beetle, and Texas troglobitic water slater that are covered in the HCP.
- Conducted during Spring and Fall Variable Flow Study monitoring.

- Fish Sampling – multiple gear types for native fishes – Spring and Fall. This component is being added to provide a more holistic fishery evaluation of the overall aquatic ecosystem. The information may assist in describing cause and effect relationships with fountain darter abundances over time.
  - Using seines and SCUBA perform fisheries surveys in both the Comal and San Marcos as follows.
- Two locations within Spring Lake associated with San Marcos Salamander surveys (Big riverbed and hotel area) will be sampled for fish via SCUBA transect surveys in conjunction with the Variable Flow study sampling. Five locations spatially located between Spring Lake dam and the confluence of the Blanco River will be sampled by seining to evaluate and track native fish populations in the San Marcos River over time.
- Similarly, one location in Landa Lake associated with fountain darter belt transect surveys will be expanded to include a transect survey for all fish via SCUBA. Additionally, 3 locations (Upper Spring Run, New Channel, and Old Channel) will be sampled via seines to evaluate and track native fish populations in the Comal River over time.
  - For seine samples, fish will be collected in each identifiable mesohabitat within a sample reach length of 40 times the mean wetted width (or one full meander wavelength). Physical measurements will be made in association with each seine haul and will include current velocity, depth, substrate composition, and instream cover (large woody debris, boulders, undercut banks, macrophytes, velocity shelters, etc.). Notes on climatic conditions and mesohabitat typing will also be recorded. Released fish will be identified, measured, and examined for disease and other anomalies. Voucher specimens will be preserved in 10% formalin. In all cases, fish sampling will continue as long as additional species are being collected. Seining (minimum 10 effective seine hauls) will be conducted in various habitats using a variety of seines sizes and seining techniques (e.g., riffles kicks). It should be noted that a seine haul where zero fish are collected is considered an effective seine haul if the haul was not impeded

(i.e. snagged), allowing fish to escape. Examples of commonly used seines include a 9.1 m x 1.8 m x 7.6 cm (30' x 6' x 1/4") mesh seine for sampling pools and open runs and a 4.6 m x 1.8 m x 5.7 cm (15' x 6' x 3/16") mesh seine for sampling riffles, runs, and small pools. Seines will be constructed of delta weave mesh with double lead weights on the bottom line. Seine size used, seine haul length, site information, and personnel will be recorded. Fishes collected from each seine haul will be processed independently.

- Underwater observation transects will occur from downstream to upstream with 5 meter transects arranged parallel to the shoreline. Underwater observers will work each 5 m transect from the downstream position moving upstream (i.e., moving into the flow). Fishes within each transect will be identified and counted.
- Spring and fall sampling in coordination with Variable Flow study sampling.
- All non-native fishes collected during seine hauls will be removed from the system per scientific permit requirements.

**Allocated funds for 2013:** $400,000 combined for Comal and San Marcos systems

Estimated 2013 Budget broken down per activity:

- Existing Variable Flow Study Comprehensive Sampling:
  - Total Cost: $250,000
- Existing Variable Flow Study Critical Period Sampling: $0 - As these events are flow-triggered and unpredictable relative to occurrence, funding for the Critical Period sampling component will be provided under EAA endangered species contingency funding.
- Full system aquatic vegetation mapping
  - Total Cost: $35,000
- Expanded fish sampling (Dropnet) in San Marcos to the Spring Lake Dam reach
  - Total Cost: $7,500
- Additional flow partitioning within Landa Lake during sampling efforts.
  - Total Cost: $9,500
- Macroinvertebrate food source monitoring within representative reaches.
  - Total Cost: $57,500
- Fish Sampling – multiple gear types for native fishes assessment
  - Total Cost: $40,500 in 2013 with the potential for additional funding in other 4 years as full aquatic vegetation mapping won't be conducted

**Bio-Monitoring Budget Justification**

Comprehensive bio-monitoring efforts began with a collaborative effort that included input from the Edwards Aquifer Authority, Texas Parks & Wildlife Department (TPWD), USFWS, and scientists from the Edwards Aquifer Research and Data Center and Texas State University. , All subsequent monitoring plan modifications were made in conjunction with Bio-West, USFWS and the TPWD. The original bio-monitoring plan included a comprehensive and critical period portion. The comprehensive portion was four regularly-scheduled seasonal monitoring events to capture average flow variation of low, high and two transitional periods. The critical period portion was a menu of specific activities for each ecosystem that was triggered by designated low-flow conditions.

The comprehensive monitoring activities were easy to include in a yearly budget and were a part of the regular budget from the outset (2000). However, the critical period sampling monitoring was more difficult. The thresholds, monitoring activities, and cost estimates were provided for specific events and an annual budget was presented for contract purposes based on a hypothetical estimate of specific events. Therefore, an Endangered Species Mitigation Fund was created from all fines received for compliance settlements and payment for critical period monitoring came from the fund. Also, high-flow triggers were added to critical period in recognition of habitat disturbance caused by flood scouring. Since 2005 the EAA spent $400,000 for critical period monitoring as follows:

| YEAR | AMOUNT |
|---|---|
| 2005 | 0.00 |
| 2006 | $36,518.60 |
| 2007 | 0.00 |
| 2008 | 0.00 |
| 2009 | 206,701.24 |
| 2010 | 50,000.00 |
| 2011 | 107,428.33 |
| | |
| Total | $400,648.17 |

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The 2012 EAA regular budget contains $240,000 for comprehensive bio-monitoring and $50,000 for critical period bio-monitoring. The 2013 bio-monitoring work plan includes $250,000 for existing comprehensive monitoring efforts in the two ecosystems and $150,000 for new monitoring efforts in the two ecosystems. As Table 7.1 identifies $200,000 of bio-monitoring activities for each ecosystem, the EAA anticipated moving all of the bio-monitoring activities to the HCP budget, except the critical period bio-monitoring that will still be paid from the Endangered Species Mitigation Fund.

In addition, the EAA funds numerous other activities at its own expense that directly support the HCP:

- In 2012, the EAA approved a contract with southwest Research Inc. to begin development a new groundwater model to more accurately predict aquifer and spring discharge scenarios. The contract is for $1, 090,852 and the EAA estimates it will expend at least $250,000 in 2013
- The USGS has been collecting various hydrologic data for the EAA for decades. Because of the increased importance of timely accurate springflow data, the USGS regularly visits the monitoring station in Comal and San Marcos springs to confirm the proper reporting of flow data and recalibrate if necessary. This activity occurs on two-week intervals during severe drought and dropping springflow conditions.
- The USGS installed new flow gages on the old and new channels at Comal springs to better discern the flow regimes for each segment.
- In the last ten years, the EAA has conducted numerous dye traces in both ecosystems to better learn the hydrologic plumbing.
- Finally, four special focused studies were funded to answer specific questions that were raised during bio-monitoring activities:

BIO-WEST, Inc. 2002b. Comal Springs Riffle Beetle Habitat and Population Evaluation. Final Report. Edwards Aquifer Authority. 24 p.

BIO-WEST, Inc. 2002c. Comal Springs riffle beetle laboratory evaluation study: evaluation under variable flow conditions. Final Report. Edwards Aquifer Authority. 27 p.

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BIO-WEST, Inc. 2002d. Fountain darter laboratory study: reproductive response to parasites and temperature fluctuations. Final Report. Edwards Aquifer Authority. 12 p.

BIO-WEST, Inc. 2004b. Aquatic vegetation laboratory study: Phase 1: Observations of water quality changes and plant growth under various flows. Phase 2: Effects of carbon dioxide level on aquatic plants found in the Comal and San Marcos Springs/River Ecosystems. Final Report. Edwards Aquifer Authority. 25 p.

In summary, bio-monitoring was established as a support mechanism for endangered species mitigation and the data collected since 2000 has been invaluable in developing the HCP. The existing and expanded bio-monitoring activities will play a pivotal role in adaptive management during the next seven years. The EAA recognizes and supports consistency and equity in HCP funding eligibility among the Implementing Committee members and does not wish to have special treatment.

Accordingly, the EAA prefers to include all bio-monitoring activities in the HCP budget and remove bio-monitoring expenses from the regular EAA budget, excepting critical period.

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