

HCP § 6.3.1 – 2015 BIOLOGICAL MONITORING WORK PLAN

Introduction/Overview: Since 2000, the Edwards Aquifer Authority (EAA) has conducted an extensive biological monitoring program in the Comal and San Marcos spring systems. This program was referred to as the Variable Flow Study¹ (VFS). The elements of this study have now been incorporated into the Edwards Aquifer Habitat Conservation Plan (EAHCP) as the Biological Monitoring Program (BioMP). EAHCP § 6.3.1.

The EAA developed the VFS in collaboration with a Technical Advisory Group consisting of resource specialists/scientists from multiple entities and with input from other natural resource professionals from the Texas Parks and Wildlife Department (TPWD), United States Fish and Wildlife Service's (FWS) Austin Ecological Services and National Fish Hatchery and Technical Center, and scientists from the Edwards Aquifer Research and Data Center, and Texas State University (*see* BIO-WEST, "Variable Flow Study: Seven Years of Monitoring and Applied Research," 2007). The VFS consisted of a comprehensive sampling program conducted in the spring, summer, fall, and winter.² *Id.* The VFS also included a Critical Period component for both the Comal and San Marcos systems based on established trigger levels (including high and low flows) for each. *Id.* The Critical Period component essentially mirrors efforts made during Comprehensive Sampling Plan except at a greater frequency triggered by low flows. *Id.*

During the development of the EAHCP, additional components were added to the VFS in 2013, creating the BioMP. The additional components were developed through discussions between scientists involved with the EARIP process including Thom Hardy, Ed Oborny and scientists from Texas State University, Baylor University, TPWD, San Antonio Water System, and the FWS.

The BioMP includes: (1) Comprehensive Sampling, (2) any triggered Critical Period monitoring, (3) any high flow triggered monitoring (4) and any EAHCP-specific sampling required by Section 6.4.

Long-term Objective: The EAHCP establishes that the purpose of the BioMP is "to monitor changes to habitat availability and population abundance of the Covered Species that may result from Covered Activities" (EAHCP § 6.3.1). Although not expressly stated in the EAHCP, another purpose that will be served by the BioMP is to collect data that can be used

¹ EAA, "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," 2000.

² In 2003, the winter sampling was eliminated from the Comprehensive Plan. In 2005, the Comprehensive Sampling Program was amended. The spring and fall events remained the same. During the summer, the Comprehensive Sampling Program included only Texas wild-rice annual mapping, dip net sampling for fountain darter, and parasite evaluations.

in the applied environmental research studies (EAHCP § 6.3.4) and provide data and information for the ecological model development described in EAHCP § 6.3.3.

Assumptions: It is assumed that the 2014 biological monitoring has been completed. In addition, it is assumed that the contractor will coordinate all monitoring activities with the implementation of any Conservation Measures.

HCP Science Committee: The BioMP methodologies and scope of work was reviewed and slightly modified by the Science Committee.

Target for 2015: Following renewal of the contract, the contractor will implement the BioMP for the San Marcos and Comal spring systems.

Elements of the 2015 Biological Monitoring Program: The BioMP consists of a Comprehensive Sampling Program that will be conducted in the fall and spring of 2015. During the summer, the only elements of the Comprehensive Sampling program that will be conducted are Texas wild-rice mapping, dip netting for fountain darters, and parasite evaluations. The 2015 Comprehensive Sampling Program will consist of the following elements:

- **Aquatic Vegetation Mapping, Including Texas Wild-Rice:** Aquatic vegetation mapping, including Texas wild-rice, will be conducted each spring and fall in four representative reaches in the Comal Springs system (Upper Spring reach, Landa Lake reach, Old Channel reach, and New Channel reach) and in three representative reaches in the San Marcos Springs system (Spring Lake Dam reach, City Park reach, and IH-35 reach). Vegetation stands less than 0.5 meters in diameter will not be mapped. The location of the reaches is shown in Attachments 1 and 2. This includes both the physical mapping in the field and map preparation using GIS.

Full system aquatic vegetation mapping occurred in 2013 and will not occur again until 2018; therefore, it is not included in this Work Plan. Full system mapping included the San Marcos River from Spring Lake to the confluence with the Blanco River and the Comal River from Upper Spring Run reach to the confluence with the Guadalupe River.

- **Annual Texas Wild-Rice Mapping.** Texas wild-rice mapping will be conducted each summer in the San Marcos River from the Spring Lake Dam to the river's confluence with the Blanco River. In addition, surveys will be conducted in the upper stretch of the San Marcos River to identify, map, and record any stands of Texas wild-rice that appear to be in vulnerable areas. Texas wild-rice stands will be considered to be vulnerable if they: 1) occur in shallow water; or 2) possess

extreme root exposure due to scouring of substrate; or 3) appear to be in poor condition. Measurements will be taken at each stand of Texas wild-rice that is considered to be located in a vulnerable area. Measurements will include the maximum length and width of each stand. Water depth and flow measurements will be taken at each stand.

- **Fountain Darter Sampling:** Dip and drop netting and visual aquatic surveys with SCUBA will be conducted in the spring and fall. Additional dip net sampling will be conducted in the summer.

Drop Net Sampling:

- Drop nets will be placed in specific aquatic vegetation types that have been selected through stratified random methods. Aquatic vegetation will be mapped in the following reaches prior to drop net activities.

Reach	Number of Sites	Vegetation
San Marcos River		
• City Park Reach	8	hygrophila, hydrilla, vegetation complexes
• IH-35 reach	8	hygrophila, hydrilla, cabomba
• Spring Lake Dam Reach	8	hygrophila, hydrilla, vegetation complexes
Comal River		
• Upper Spring Run Reach	6	hygrophila, sagittaria, bryophytes
• Landa Lake Reach	10	hygrophila, ludwigia, vallisneria, cabomba, bryophytes
• Old Channel Reach	6	algae, ludwigia, hygrophila

Fountain darters will be identified, enumerated, measured, and returned to the river at the point of collection. All darters collected in the drop net monitoring will be examined visually for evidence of gill parasites.³ Other fish will be identified and released or preserved and identified in a laboratory. All live ramshorn snails will be counted, measured, and destroyed. Exotic Asian snails (*Melanooides tuberculata* and *Thiara granifera*) and Asian clam (*Corbicula sp.*) will be identified and general abundance recorded. At each location the vegetation type, height, areal coverage, substrate type, mean column velocity, velocity at 15 cm above

³ In addition, the City of New Braunfels will monitor for gill parasites as part of the requirements in EAHCP § 5.2.6. The monitoring program will evaluate cercarial concentrations in multiple areas along the Comal River on a semiannual basis and more frequently when springflow drops below 150 cfs. See EAHCP § 6.3.6.

the bottom, water temperature, conductivity, and dissolved oxygen levels will be recorded.

- Dip Net Sampling: Dip netting involves timed surveys as well as presence/absence surveys in specified reaches throughout the spatial extent of both systems. All darters collected in the dip net monitoring will be examined visually for evidence of gill parasites.
- With respect to the timed sampling, a standard time is set for sampling each reach that will be maintained throughout the study.

San Marcos River	Survey Time	Comal river	Survey Time
Hotel reach	0.5 hours	Upper Spring Run reach	0.5 hours
City park reach	1 hour	Spring Island area	0.5 hours
IH-35 reach	1 hour	Landa Lake reach	1 hour
Todd Island reach	1 hour	New Channel reach	1 hour
		Old Channel reach	1 hour
		Garden Street reach	1 hour

- Fountain darters will be identified, enumerated, measured, and returned to the river at the point of collection.
 - Dip net presence/absence surveys will be conducted at 50 sample sites within four representative reaches at Comal Springs (Upper Spring reach, Landa Lake reach, Old Channel reach, and New Channel reach) and three representative reaches in San Marcos Springs (Spring Lake Dam reach, City Park reach, and IH-35 reach). Four “dips” will be conducted at each sample site.
 - Visual aquatic surveys will be conducted using SCUBA in fixed locations in Landa Lake and Spring Lake to identify fountain darters at depth deeper than conventional sampling methods allow.
- **Comal Springs Invertebrate Sampling (Comal Springs riffle beetle, Peck’s Cave amphipod and Comal Springs dryopid beetle):** Sampling for Comal Springs invertebrates will be conducted in the spring and fall.
 - Drift nets will be placed on the spring orifices of the major Comal Springs, samples will be collected, transferred to an off-site laboratory, and the contexts characterized taxonomically.

- Additional riffle beetle sampling will be conducted in Spring Run 3, western shoreline of Landa Lake, and Spring Island area. At each spring site, 10 springs in potential habitat will be sampled using a cotton lure. Detailed photodocumentation of the wetted perimeter and available habitat will be conducted. Lures will be in place for approximately four weeks, then removed. Beetles will be identified, counted, and returned to their spring of origin. Water depths, current velocity, dissolved oxygen, and temperature also will be measured at each location.
- **Salamander Visual Observations:** Salamander sampling will be conducted in the spring and fall. Salamanders observed within the Comal system will be noted along with time, location, habitat type, and water depth. Salamanders observed in the San Marcos system will be noted along with the substrate composition. The sampling will occur in the following locations:
 - Observation for the San Marcos Salamander will occur at three locations (one below Spring Lake Dam [snorkel] and two within Spring Lake [SCUBA])
 - Observation for the Comal Salamander will occur at three locations (Spring Runs 1 and 3, and Spring Island area).
 - In both systems, the salamanders will be observed and no collection will occur.
- **Comal Springs Discharge Measurements:** To supplement USGS discharge sampling Comal Springs discharge measurements will be conducted spring and fall. The measurements will be conducted at Spring Runs 1, 2, and 3, Upper Spring Run reach, and the Old Channel below Elizabeth Street. The measurements will be used to establish the contributions of each major spring run to total discharge in the river and to establish the relative proportion of water flowing in the Old and New Channels.
- **Water Quality Sampling:** – standard parameters and fixed-station temperature loggers
 - Water quality sampling for standard parameters (temperature, conductivity, pH, and dissolved oxygen) will be conducted in the spring and fall at eighteen stations longitudinally distributed in the San Marcos system and twelve stations longitudinally distributed in the Comal system. The sampling sites are shown in *See Attachments 1 and 2*. All of the standard parameters will be measured at the surface, mid-depth and near bottom, if there is stratification. Additional sampling for nitrates, total nitrogen, ammonium, soluble reactive phosphorous, total phosphorus, alkalinity, and total suspended solids will be conducted as warranted.

- The EAA will conduct additional water quality sampling as required by EAHCP § 6.2.⁴
 - Temperature data will be recorded via eleven thermistors longitudinally distributed in the San Marcos system and thirteen thermistors longitudinally distributed twenty continuous data loggers in each system, and will be downloaded at least once every six months.
- **Fixed Station Photography:** Fixed station photography will be conducted in the spring and fall at each established water quality/thermistor site in both the Comal and San Marcos systems. The photographs will typically involve an upstream, across, and downstream photograph of the reach and capture key changes in the habitat in the reach. Any identified changes will be recorded.
 - **Flow Partitioning within Landa Lake:** Additional flow partitioning will be monitored within Landa Lake during each Comprehensive Sampling event.⁵ The measurements will be made during the spring and fall. This element will provide a better understanding of the spring flow influence within Landa Lake as upwelling flow within Landa Lake plays a role in understanding Comal Springs riffle beetle survival during low-flow events.
 - An Acoustic Doppler profiler or similar device will be used to measure the flow patterns and current velocities from Spring Island through the upper portion of Landa Lake will be measured concurrently with BiOMP discharge measurements at Comal Springs.
 - **Macroinvertebrate Food Source Monitoring:** Macroinvertebrate food source monitoring will be conducted during the spring and fall to better understand the food source base for fountain darters in each system and how that food base responds to varying flow conditions.
 - The sampling will occur within the City Park, IH-35 and Spring Lake Dam reaches on the San Marcos River, and the Upper Spring Run, Landa Lake, New Channel, and Old Channel reaches on the Comal River
 - Samples will be collected in triplicate from 3 vegetation types (based on majority of species present or adjusted based on fountain darter habitat quality) within each of the seven study reaches for a total of 63 samples per event. Macroinvertebrate samples will be preserved and transferred to a lab for processing.

⁴ For the details of the water quality monitoring program see, EAHCP, “Work Plan: Water Quality Monitoring Program Strategy for Comal Springs and San Marcos Springs for 2014,” April 15, 2013.

⁵ The Edwards Aquifer Authority plans to conduct flow partition monitoring using an Acoustic Doppler profiler. This task in the Work Plan will be evaluated once the EAA program is developed, to ensure that the two programs are coordinated to operate cost-effectively and to avoid duplication of effort.

- Sample methods will take into account habitat disturbance and will minimize disturbance to maximum extent possible.
- **Edwards Aquifer Diving Beetle and Texas Troglotic Water Slater** The macroinvertebrate sampling will also gather baseline data on the two non-listed macroinvertebrate species, the Edwards Aquifer diving beetle, and Texas troglotic water slater that are covered in the EAHCP.
- **Fish Community Sampling For Native Fish:** In coordination with BioMP sampling, fish community sampling for native fish will be conducted in the spring and fall to provide a 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 fisheries surveys in both the Comal and San Marcos systems will be conducted 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. 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, three 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.
 - Underwater observation transects will occur from downstream to upstream with 5 meter transects arranged parallel to the shoreline. Underwater observers will work each 5 meter transect from the downstream position moving upstream (*i.e.*, moving into the flow). Fish within each transect will be identified, measured, examined for disease, and returned to the river.
 - In addition to collected data on fish, each seine haul will include data on the velocity, depth, substrate composition, in stream coverage, climatic conditions, and mesohabitat typing of the site at the time of the observation.
 - All non-native fish collected during seine hauls will be removed from the system per scientific permit requirements.
 - Records will be kept as to the non-native species encountered and relative quantity.

- Reporting

EAA will require its contractor to submit monthly progress reports to EAA describing the contractor's activities conducted during the previous month. The contractor will be required to submit an annual report no later than December 31, 2015, that provides all of the sampling activities conducted for the year period and an evaluation of the results of those activities, and a cumulative evaluation of the data collected since 2000 for the BioMP and its predecessor VFS program. In evaluating the data, the contractor will be required to evaluate the effects of any ongoing Conservation measures on the results of the monitoring program. Sufficient tables, graphs, and exhibits will be provided in the text to clearly indicate what data was collected, the location, and the analytical data. As an appendix to the written report, copies of completed field logbooks and copies of the raw data sheets for all water chemistry and biological sampling will be included.

Elements of the Critical Period and EAHCP Components of the BioMP

In the low flow Critical Period monitoring component of the BioMP, the frequency of the Comprehensive Sampling changes when certain flow triggers are reached. In the San Marcos system, the Texas wild-rice physical observations from the Comprehensive Sampling component are triggered when flows at the springs reach 120 cfs. All Comprehensive Sampling elements are implemented when flows reach 100, 85, 60, 25, and 10-0 cfs. Beginning at 100 cfs, habitat evaluations consisting of observing the habitat in the system and documenting those observations photographically will occur each time the flows decrease 5 cfs, but will not occur more frequently than once a week.

In the Comal system, the full Comprehensive Sampling component will be implemented at 200, 150, 100, 50, and 10-0 cfs. In addition, starting at 100 cfs habitat evaluations consisting of observing the habitat in the system and documenting those observations photographically will occur each time the flows decrease 10 cfs, but will not occur more frequently than once a week. The Comal Springs riffle beetle sampling element will be implemented when flows decline to 120 cfs and continued in 10 cfs increments during any continued decline.

In addition, during the Critical Period component, a gill net evaluation will be conducted in Spring Lake and Landa Lake for preliminary examination of exotic fish concentrations and for stomach content analyses with respect to predation of list species. The number of each species (native and non-native) collected in the gill net will be recorded. Finally, the full Comprehensive Sampling elements will be conducted twice as the Comal and San Marcos systems rebound from low-flows.

The elements of the EAHCP component of the BioMP will be conducted when flows reach predefined trigger levels defined by the EAHCP in Section 6.4. This sampling, which is in addition to the Comprehensive and Critical Period components, consists of an increased frequency of sampling for aquatic vegetation and Texas wild-rice mapping and fountain darter, Comal Springs riffle beetle, salamander, and water quality sampling. The increased mapping and sampling are summarized in Attachments 3 and 4.

It is likely that some of the sampling dates of the three components of the BioMP will coincide with each other during low flow periods. Efforts will be made to coordinate sampling events when they are closely-related temporally so as to prevent duplicative sampling events.

Incidental Take Permit: Permit Conditions, Habitat Baseline, and Take Estimation.

Section 11.H of the Incidental Take Permit (ITP) sets out the terms and conditions and incidental take protection provided for each covered species over the 15-year term of the permit. The ITP requires the permittees to document compliance with the ITP. To quantify the amount of take per species, the USFWS allows the use of habitat as a surrogate for population number. The BioMP contractor will provide the sampling necessary to establish a baseline of suitable and occupied habitat at the end of each year to be used in documenting compliance with the ITP. The baseline will be used in the subsequent year as the beginning baseline and may be used in the current year to establish a delta if other methods are insufficient.

Budget for Implementing 2014 BioMP:

<i>Table 7.1</i>	<i>\$400,000</i>
<i>2015 Work Plan</i>	<i>\$417,029</i>

The EAHCP budgeted amount for the BioMP (Comprehensive Sampling component and EAHCP Chapter 6 drought triggered monitoring) is \$417,029 for the Comal and San Marcos systems. The cost of any Critical Period component of the BioMP as established by the former EAA Variable Flow Study will continued to be paid by the EAA.

Attachment 1

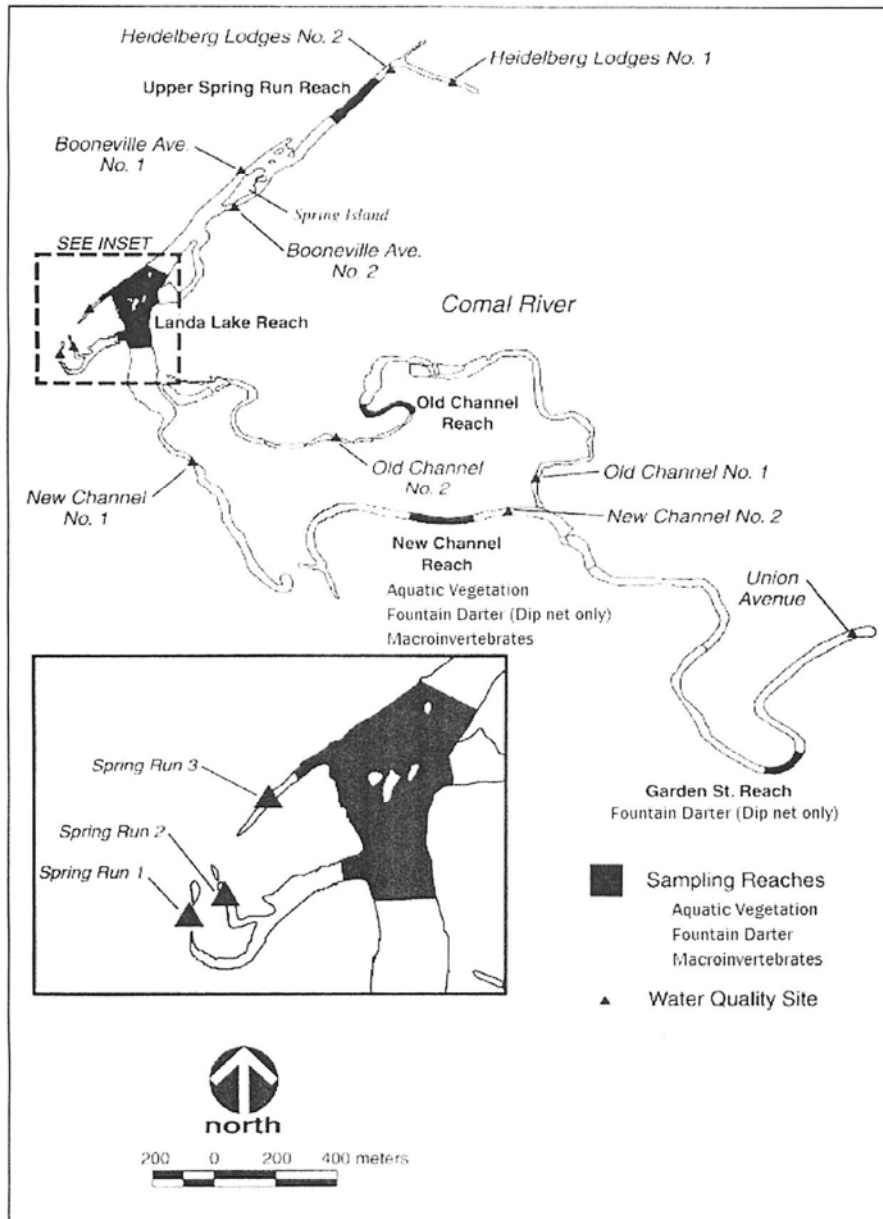
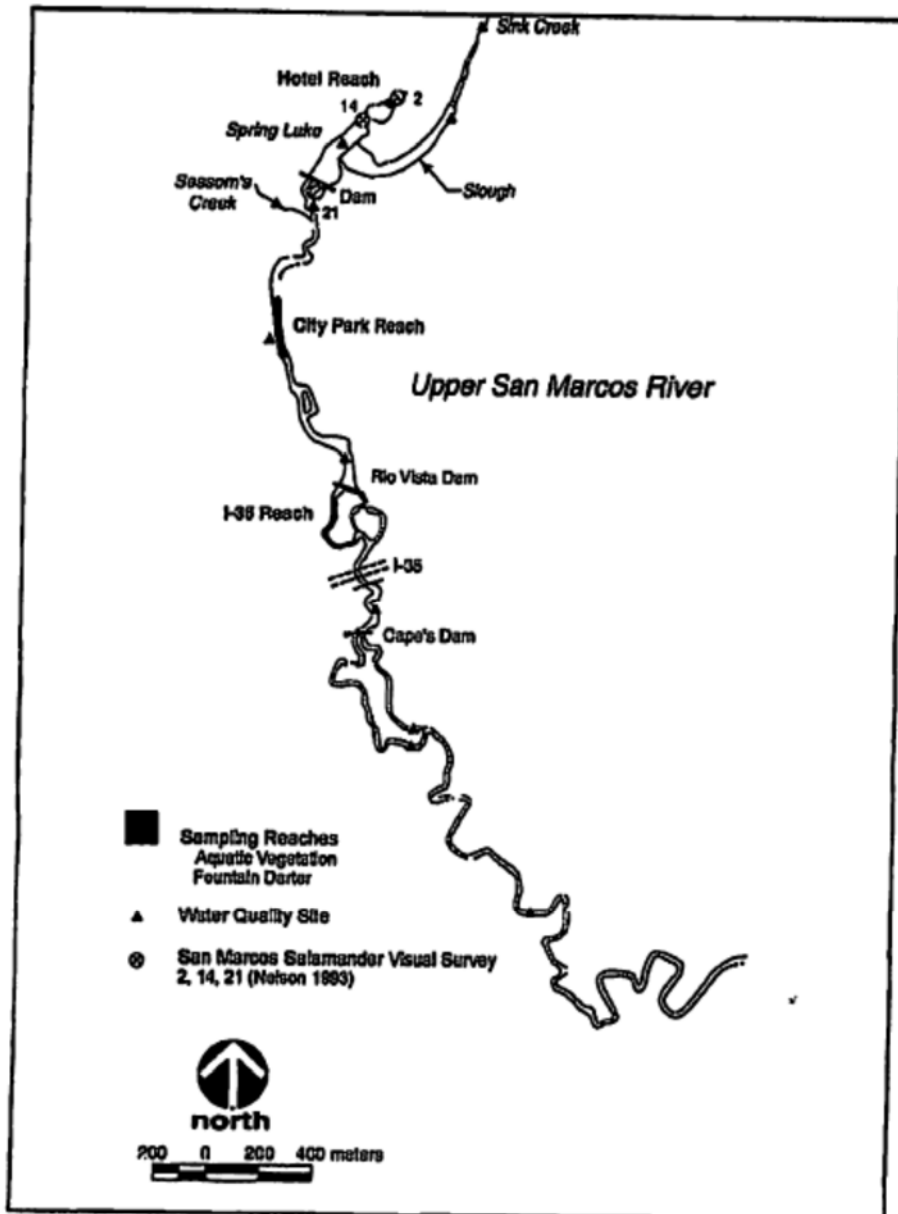


Figure 1. Comal River water quality and biological sampling stations.

Attachment 2



Attachment 3
 UPPER SAN MARCOS RIVER/SPRINGS
 EAHCP MONITORING - LOW FLOW SCHEDULE (Added 2/2013)

Flow Rate (+ or - 10 cfs)	Species	Frequency	Parameter
≤80 cfs or ≥ 50 cfs continuing until flow rate restores to ≥100 cfs	fountain darter	every other month	Aquatic vegetation mapping at Spring Lake Dam reach, City Park reach, and IH-35 reach.
≤80 cfs or ≥ 50 cfs continuing until flow rate restores to ≥100 cfs	fountain darter	every other month	Conduct dip net sampling/visual parasite evaluations at 50 sites in high quality habitat to include twenty (20) sites in Spring Lake; ten (10) sites in Spring Lake Dam reach; ten (10) sites in City Park reach, and ten (10) sites in IH-35 reach.
≤50 cfs	fountain darter	monthly	Aquatic vegetation mapping at Spring Lake Dam reach, City Park reach, and IH-35 reach.
≤50 cfs	fountain darter	weekly	Conduct Dip net presence/absence sampling/visual parasite evaluations at 50 sites in high quality habitat to include twenty (20) sites in Spring Lake; ten (10) sites in Spring Lake Dam reach; ten (10) sites in City Park reach, and ten (10) sites in IH-35 reach.
≤80 cfs or ≥ 50 cfs	San Marcos salamander	every other week	Salamander surveys (SCUBA and snorkel) will be conducted at the Hotel Area, Riverbed area, and eastern spillway of Spring Lake Dam.
<50 cfs	San Marcos salamander	weekly	Salamander surveys (SCUBA and snorkel) will be conducted at the Hotel Area, Riverbed area, and eastern spillway of Spring Lake Dam.
100 cfs	Texas wild- Rice	once	Mapping of Texas wild-rice coverage for the entire San Marcos River will be conducted.

≤100 cfs or ≥60 cfs	Texas wild-rice	every other week	Physical parameters of Texas wild-rice will be monitored in designated “vulnerable” areas.
<80 cfs	Texas wild-rice	monthly	Mapping of Texas wild-rice coverage for the entire San Marcos River will be conducted.
<80 cfs	Texas wild-rice	weekly	Physical visual observations of Texas wild-rice will occur.

Attachment 4
COMAL RIVER/SPRINGS
EAHCP MONITORING FLOW SCHEDULE (Revised 1/2013)

Flow Rate (+ or - 5 cfs)	Species	Frequency	Parameter
≤150 or ≥80 cfs	fountain darter	every other month	Aquatic vegetation mapping to include Upper Spring Run reach, Landa Lake, Old Channel reach, and New Channel reach.
≤150 or ≥80 cfs	fountain darter	every other month	Conduct Dip net sampling/visual parasite evaluations at five (5) sites in the Upper Spring Reach; twenty (20) sites in Landa Lake; twenty (20) sites in the Old Channel reach and; at five (5) sites in the New Channel reach.
≤60 cfs	fountain darter	weekly	Conduct Dip net sampling/visual parasite evaluations at five (5) sites in the Upper Spring Reach; twenty (20) sites in Landa Lake; twenty (20) sites in the Old Channel reach and; at five (5) sites in the New Channel reach.
≤60 cfs	fountain darter	monthly	Aquatic vegetation mapping at Upper Spring Run reach, Landa Lake, Old Channel reach, and New Channel reach
≤120 cfs	riffle beetle	every 2 weeks	Monitoring via cotton lures at Spring Run 3, western shore of Landa Lake, and Spring Island upwelling
≤120 cfs or ≥80 cfs	salamander	every other week	Salamander snorkel surveys will be conducted at three sites (Spring Runs 1 and 3 and the Spring Island area)
≤80 cfs	salamander	weekly	Salamander snorkel surveys will be conducted at three sites (Spring Runs 1 and 3 and the Spring Island area)