HABITAT CONSERVATION PLAN
BIOLOGICAL MONITORING PROGRAM
San Marcos Springs/River Ecosystem

ANNUAL REPORT

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EXECUTIVE SUMMARY

The Edwards Aquifer Habitat Conservation Plan (HCP) Biological Monitoring program activities conducted in 2018 continued to track biota and habitat conditions of the San Marcos Springs/River ecosystem. Sampling efforts specifically targeting HCP species in the San Marcos system were conducted for the Fountain Darter *Etheostoma fonticola*, Texas wild-rice *Zizania texana*, and the San Marcos salamander *Eurycea nana*. Additional community level monitoring data was also collected on aquatic vegetation, fish, and benthic macroinvertebrates. The results from this 2018 report provide valuable data to further assess temporospatial shifts among aquatic floral and faunal communities of the upper San Marcos system.

Stream discharge in 2018 decreased and was generally consistent with the historic average, though mean monthly discharge from July to September were below historic observations. Moreover, the upper San Marcos River was hydrologically stable compared to previous years. The difference between minimum and maximum daily mean discharge was relatively small, averaging 117 cfs and 315 cfs, respectively. As a result, typical trends in water temperature were observed, decreasing in stability with increasing distance downstream of Spring Lake.

The HCP full system mapping of submerged aquatic vegetation occurred in March 2018 from Spring Lake dam to just below Stoke's Park / Thompson's Island. These full system mapping events occur every five years. In 2013, approximately 50,000 m^2 of aquatic vegetation was recorded while in 2018 aquatic vegetation totaled over 38,000 m^2. Repeated changes in flow regime (drought in 2013 to 2014 and high flows 2015 to 2017) coupled with active restoration of the native aquatic plants resulted in notable changes to the aquatic vegetation community of the San Marcos River between 2013 and 2018. Aquatic vegetation coverages within the long-term biological goal reaches were variable along the river continuum with overall coverages in 2018 similar to 2017. Trends in overall aquatic vegetation coverage in the study reaches continue to be cyclical, with curtailment often associated with elevated flows and recreational disturbance. Texas wild-rice coverage surpassed 10,000 m^2 in the spring for the first time ever and remained above 9,000 m^2 following the summer recreational period. With large stands present, Texas wild-rice continues to be the most dominant native species in the upper San Marcos aquatic vegetation community.

Drop-net results revealed that normalized Fountain Darter population estimates were substantially lower than seasonal averages for the third consecutive year. Declines in Fountain Darter occurrences were also apparent during the spring sampling based on Random Station dip-netting but increased over the course of the year. Despite this declining trend in drop-net related population size and occurrence within the long-term biological goal reaches, recent recruits 15 mm or less were observed at all sites sampled, confirming that adults are successfully spawning and juveniles are surviving. It was previously hypothesized that increased flows may have impeded key vegetation utilized by Fountain Darters, which may also be exacerbated by recreational disturbance. Moreover, the expansion and dominance of Texas wild-rice stands in the upper reaches, which are purposely avoided during Fountain Darter drop-net sampling, is also likely a contributing factor. Although the decrease in total system discharge during 2018 did not immediately discourage the trend, it is anticipated that this return to more normal flow

conditions, will over time allow expansion of higher quality Fountain Darter habitat facilitating population resurgence.

A total of 7,705 fishes represented by 33 species were recorded during 2018 fish community surveys, which is an increase in abundance following the decline observed in 2017. The community in 2018 generally resembled assemblages from 2015 and 2016. Similar to the Fountain Darter, elevated flows observed in 2017 may have also led to a decrease in the overall numbers in the fish community or impeded detection of pelagic species. Nonetheless, the increase in community abundance in 2018 exemplifies the resiliency of upper San Marcos fishes. San Marcos Salamander densities were equal to or higher than the long-term average at the Hotel Site and Riverbed locations in Spring Lake. The spring densities observed at both of these sites were the second highest observed since 2000. Conversely, observed densities at Spring Lake Dam were below the long-term averages for both sample events which is not surprising considering the natural and human-induced modifications to habitat that presently occurs at this location.

The benthic macroinvertebrate rapid bioassessment identified both Spring Lake Dam and I-35 as exceptional quality habitat. Conversely, Spring Lake and City Park habitat quality ranged from intermediate to limited. The lower B-IBI scores observed at these sites are likely attributed to natural differences in macroinvertebrate assemblages among lentic and lotic environments. The reference streams used for the indices developed represent lotic systems, which may explain the low score of Spring Lake. Similar to aquatic vegetation, intermediate to limited habitat quality observed in City Park may also be attributed to recreational disturbance within this river reach.

Overall, 2018 observations of habitat and species condition remain excellent in Spring Lake, while conditions in the river continue to be variable. For Texas wild-rice, increasing overall coverage continues to demonstrate the success of HCP restoration and mitigation efforts. Despite low Fountain Darter normalized population estimates from drop-netting, the bounce back in dip-net and fish community abundance observed during 2018 is encouraging. Moreover, the recovery of the fish community illustrates the benefits of time-series data to evaluate the status of biotic communities. Long-term monitoring of the upper San Marcos River will continue to provide useful information on the status of aquatic communities and the mechanisms that influence demographic trends that will help continue appropriate and practical management practices that aid in conserving this unique ecosystem.

INTRODUCTION

Section 6.3.1 of the Edwards Aquifer Habitat Conservation Plan (HCP) laid out the path forward for continuation of biological monitoring. Originally, the biological monitoring program's (formerly known as the Edwards Aquifer Authority [EAA] Variable Flow Study) main objective was to evaluate the effects of variable flow on the biological resources (particularly threatened/endangered species) within the Comal and San Marcos spring systems. This fundamental objective is still imperative to the success of the HCP, as is continued monitoring of system conditions over time and filling in important data gaps where appropriate and practical. However, the utility of the HCP biological monitoring program has surpassed this original goal and objective. The biological monitoring data collected through this original program (BIO-WEST 2001a–2014a, b) now also serves as (1) the cornerstone for several underlying sections in the HCP including long-term biological goals and management objectives (HCP Section 4.1); (2) determination of potential impacts to and incidental take assessment relative to the HCP and Environmental Impact Statement alternatives (HCP Section 4.2); and (3) establishment of core adaptive management activities for triggered monitoring and adaptive management response actions (HCP Sections 6.4.3 [Comal] and 6.4.4 [San Marcos]).

As the HCP proceeds, successful execution of the biological monitoring program is mandatory to adequately assess these topics relative to HCP Phase II decisions and guide management decisions aimed at protection of the species during low-flow conditions. Additionally, the HCP biological monitoring program data, in conjunction with other available information, is essential to assess the effectiveness and efficiency of certain HCP mitigation/restoration activities conducted in both the Comal and San Marcos springs systems and calculate the HCP habitat baseline and net disturbance determination and annual incidental "take" estimate. Over the years, the EAA Variable Flow Study (now HCP biological monitoring program) has undergone numerous reviews and critiques. Adjustments have been made as appropriate. Most recently the National Academy of Science conducted a thorough review (NRC 2015), which led to the formation of an HCP Biological Working Group (BWG) and specific modifications being implemented to the plan in 2017.

It is important to understand that many different sampling components are included in the HCP biological monitoring program and several sampling location strategies are employed. The sampling locations selected are designed to cover the entire extent of endangered species habitats in both systems, but they also allow for holistic ecological interpretation while maximizing resources. The current design employs five basic sampling location strategies for the San Marcos system as follows, with associated sampling components.

The five sampling location strategies are as follows:

1. System-wide sampling
   - Texas wild-rice *Zizania texana* full-system mapping—annually
   - Full-system aquatic vegetation mapping—once every 5 years (conducted in 2013, 2018 and next scheduled for 2023)

2. Select Longitudinal Locations
   - Temperature monitoring—thermistors
   - Water quality sampling—during low-flow sampling
   - Fixed-station photography

3. Reach Sampling (three reaches)
   - Aquatic vegetation mapping
   - Fountain Darter *Etheostoma fonticola* drop netting
   - Fountain Darter random-station dip netting

4. Springs Sampling
   - San Marcos salamander *Eurycea nana* sampling

5. River Section/Segment Sampling
   - Fountain Darter timed dip netting surveys
   - Fish community sampling
   - Macroinvertebrate community sampling

The following section provides a brief description of the methods utilized for 2018 activities, followed by a presentation of observations and results. A more detailed description of the gear types used, methodologies employed, and specific GPS coordinates can be found in the Standard Operating Procedures Manual for the HCP biological monitoring program for the San Marcos Springs/River ecosystem (EAA 2017).

METHODS

Study Location

The upper San Marcos River, which is part of the Edwards Aquifer system, extends from its origin as a series of spring upwellings in Spring Lake to the confluence with the Blanco River in Hays County. The upper portion of the river is characterized by near-constant water temperatures and relatively constant flow. This portion of the river also includes several endemic organisms that are federally listed as threatened or endangered, including: Texas wild-rice, San Marcos salamander, San Marcos Gambusia Gambusia *georgei*, Comal Springs riffle beetle *Heterelmis comalensis*, Texas blind salamander *Eurycea rathbuni*, and Fountain Darter. This section of the river is located within an urban area and is subjected to a substantial amount of recreational use. Sites were chosen in this section of the river to better understand the interactions between the biota, the surrounding environment, and recreational users of this unique ecosystem (Figure 1).

During 2018, two comprehensive sampling events (spring and fall) and scheduled annual activities were conducted in the San Marcos River system. The 2018 sampling schedule included the following components:

Aquatic Vegetation
Texas wild-rice full-system survey
Full-system HCP benchmark aquatic vegetation survey
Sample reach GPS mapping

Water Quality and Fixed Station Photos
Thermistor placement and retrieval
Fixed-station photography
Point water quality measurements

San Marcos Salamander Observations
Snorkel/SCUBA surveys

Texas Wild-Rice Physical Observations
Physical measurements

Fountain Darter Sampling
Drop-nets, dip-nets

Fish Community Sampling
SCUBA surveys
Seining

Macroinvertebrate Community Sampling
Benthic Macroinvertebrate Rapid Bioassessment

As discussed in previous annual reports, two types of low-flow sampling were incorporated into the HCP biological monitoring program in 2013. Respective sampling triggers and data collection activities are outlined in Appendix A. The first was the historically conducted Critical Period low-flow sampling, which is for the most part a repetition of sampling components and activities performed for a comprehensive sampling event. The second type of sampling that was incorporated in 2013 is species-specific triggered sampling, which was designed specifically to inform HCP adaptive management decisions.

San Marcos Springflow

San Marcos River discharge data were acquired from the US Geological Survey (USGS) Water Resources Division. Some of these data are provisional (as indicated in the disclaimer on the USGS website) and, as such, may be subject to revision at a later date. According to the disclaimer, "recent data provided by the USGS in Texas—including stream discharge, water levels, precipitation, and components from water-quality monitors—are preliminary and have not received final approval" (USGS 2018). The discharge data for the San Marcos River were taken from USGS gage 08170500 at the University Drive Bridge. This site represents the cumulative discharge of the springs that form the San Marcos River system, and also includes local runoff coming from the Sink Creek drainage.

Low-flow Sampling

Low-flow Critical Period events can prompt an intensive data collection effort that includes triggers and associated activities as outlined in Appendix A. Only one low flow event was conducted at 120 cfs for Texas Wild-rice vulnerable stands in August 2018.

HCP Species-specific Triggered Sampling

Appendix A provides a detailed list of sampling requirements for HCP species-specific triggered sampling in the San Marcos system. No HCP species-specific triggered sampling was conducted in 2018.

San Marcos Water Quality and Fixed Station Photography

Standard parameters, including water temperature, conductivity, pH, dissolved oxygen, water depth at sampling point, and observations of local conditions, were recorded at all drop-net sampling sites and fish community sampling locations using a multiprobe water quality sonde. In addition, fixed-station photography continues to provide visual documentation of changes in the system. It is important to note that a separate comprehensive water and stormwater monitoring program is being conducted as part of the HCP with study locations, methods, sampling schedule, and results being presented as a stand-alone report (SWCA 2018, Draft).

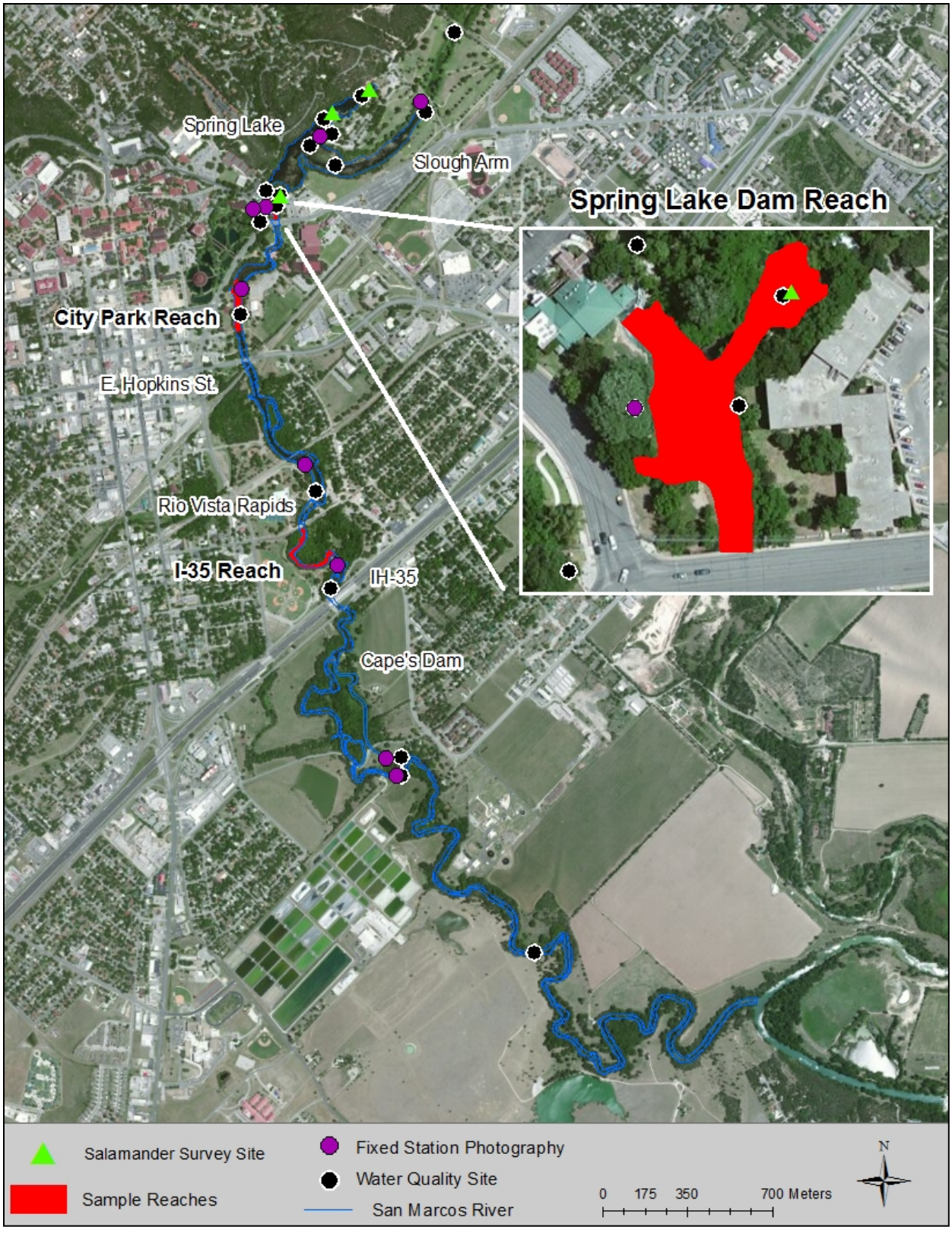


Figure 1. Upper San Marcos River sample reaches, San Marcos salamander count sites, water quality sampling sites, and fixed-station photography sites.

Water Temperature Thermistors

One important component for maintenance of long-term baseline data is temperature loggers (thermistors), which are placed throughout the river. Thermistors (HOBO Tidbit v2 Temp Loggers) set to record water temperature every 10 minutes were placed at select water quality stations along the San Marcos River, and they continue to be downloaded at regular intervals to provide continuous monitoring of water temperatures in these areas. To provide a more manageable dataset, 10-minute readings are summarized as 4-hour averages. Thermistors were also placed in two deeper locations within Spring Lake using SCUBA. Thermistor locations will not be described in detail here to minimize the potential for tampering.

Water Quality Grab Samples

During Critical Period sampling events, surface-water grab samples are scheduled to be collected in Spring Lake and along the San Marcos River to evaluate conventional water chemistry parameters (Figure 1). There were no Critical Period sampling events, and thus no water quality grab sampling events in 2018.

Fixed Station Photography

In addition to the water quality data collection effort, a long-term record of habitat conditions has been maintained with fixed-station photography. Fixed-station photographs allow qualitative temporal habitat evaluations. The record includes upstream, cross-stream, and downstream photographs; these were taken in proximity to several water quality sites as noted in Figure 1.

Aquatic Vegetation Mapping

Aquatic vegetation mapping was conducted using a Trimble Geoexplorer 6000 GPS and a Trimble Tempest external antenna capable of submeter accuracy. The antenna and GPS unit were attached, with the antenna on the bow, to a sit-in kayak with a plexiglass window in the bottom. The aquatic vegetation was identified and mapped by gathering coordinates (creating polygons) while maneuvering the kayak around the perimeter of each vegetation type at the water's surface. All vegetation species in mixed stands were assigned a percentage of cover, which was multiplied by the total area of the stand to calculate the surface area of that species. For maps (Appendix B), only the dominant vegetation type is presented for each polygon. Vegetation stands that measured between 0.5 and 1.0 meter (m) in diameter were mapped by recording a single point. Vegetation stands less than 0.5 m in diameter were not mapped.

Full system benchmark mapping was conducted in 2018 to gauge long-term changes in the plant community and evaluate fountain darter habitat and determine benefits / impacts of restoration efforts for the long-term biological goals of the HCP. In 2013, a system wide HCP baseline vegetation mapping event took place to record the makeup of the aquatic vegetation community in the San Marcos River before the initiation of HCP restoration activities.

Texas Wild-Rice Physical Observations

At the beginning of the initial sampling activities for this project in 2000, Texas wild-rice stands throughout the San Marcos River were assessed and documented as being in "vulnerable" areas if they possessed one or more of the following characteristics: (1) occurred in shallow water (<0.5 feet), (2) revealed extreme root exposure because of substrate scouring, or (3) generally

appeared to be in poor condition. Monitoring activities associated with vulnerable stands were designed following discussions with Dr. Robert Doyle, currently with Baylor University, and Ms. Paula Power, formerly with the USFWS San Marcos Aquatic Resource Center. The areal coverage of Texas wild-rice stands in vulnerable locations was determined in 2018 by GPS mapping (described above) in most instances, with some smaller stands measured using maximum length and maximum width. The length measurement was taken at the water surface parallel to streamflow and included the distance between the bases of the roots to the tip of the longest leaf. The width was measured at the widest point perpendicular to the stream current (this usually did not include roots). The length and width measurements were used to calculate the area of each stand according to a method used by the Texas Parks and Wildlife Department (J. Poole, TPWD, pers. comm.) in which percent cover was estimated for a rectangle formed from the maximum length and maximum width measurements.

The conditions of vulnerable Texas wild-rice stands were assessed by combing quantitative and qualitative observational measurements. These included the following categories: the percent of the stand that was emergent (and the percent of that seeding), the percent covered with vegetation mats or algae buildup, any evidence of foliage predation, and a categorical estimation of root exposure. Flow measurements were taken at the upstream edge of each Texas wild-rice stand and depth was measured at the shallowest point in the stand.

Fountain Darter Sampling

Drop-net Sampling

A drop-net is a sampling device originally designed by the USFWS to sample Fountain Darters and other benthic fish species specific to the Comal and San Marcos springs/river ecosystems. The net encloses a known area (2 square meters [m^2]) and allows thorough sampling by preventing escape of fish occupying that area. A large dip net (1 m^2) is used within the drop net and is swept along the length of the river substrate 15 times to ensure complete enumeration of all fish trapped within the net. A stratified random design was used with random points generated within the dominant vegetation types in each reach (Figure 1) using GIS software.

Within each Drop-net sample, mean column velocity, velocity at 15 centimeters (cm) above the bottom, water temperature, conductivity, pH, and DO were recorded. In addition, vegetation type, height, and areal coverage, along with dominant substrate type, were recorded within each Drop-net sample and for the adjacent area within 3 m of the net. Fountain Darters were identified, enumerated, measured for total length, and returned to the river at the point of collection. The same data were collected for all other fish species, except for very abundant species, in which case only the first 25 individuals were measured. Fish not readily identifiable in the field were preserved for identification in the laboratory. All live giant ramshorn snails *Marisa cornuarietis*, were counted, measured, and destroyed, while a categorical abundance was recorded (i.e., none, slight, moderate, or heavy) for the exotic Asian snails *Melanoides tuberculatus,* and *Tarebia granifera* and the Asian clam *Corbicula* sp. Total counts of crayfish *Procambarus* sp. and grass shrimp *Palaemonetes* sp. were also recorded for each dip-net sweep.

Drop-net data collected over the entire study period (2001-2018) were used to calculate mean density of Fountain Darters within each major vegetation type, and thus investigate patterns in

habitat utilization. Mean densities of Fountain Darters in each vegetation type were then multiplied by the areal coverage of that type (taken from aquatic vegetation mapping) to generate estimates of Fountain Darter abundance. By summing values for all vegetation types in all reaches, an estimate of Fountain Darter abundance within the study reaches during each sampling event (spring/fall) was calculated. Since trends are more important in this data than actual values, data were then normalized by dividing all estimates by the maximum value. Resulting normalized population estimates provide a means of estimating changes to Fountain Darter populations based on available habitat.

Dip-net Sampling

In addition to drop-net sampling for Fountain Darters, a dip net of approximately 40 cm x 40 cm (1.6-millimeter [mm] mesh) was used to conduct two separate types of Fountain Darter sampling (timed surveys, and random-station presence/absence surveys).

Dip-net Timed Surveys

A dip net was used to sample all habitat types within each river section (see Figure 2 and 3 for general sampling locations). Collection was generally performed by personnel moving upstream through a section. Habitats thought to contain Fountain Darters, such as along or in clumps of aquatic vegetation, were targeted and received the most effort. Areas deeper than 1.4 m were not sampled. Fountain Darters collected by this method were identified, measured, recorded as number per dip-net sweep, and returned to the river at the point of collection. To balance the effort expended across sampling events, a predetermined time constraint was used for each section (Hotel: 0.5 hour, City Park: 1.0 hour, I-35: 1.0 hour, Todd Island: 1.0 hour). The areas of Fountain Darter collection were marked on a base map of the section, and these same areas were revisited in subsequent surveys. Spending a comparable length of time sampling the entirety of each reach allowed comparisons to be made between the data gathered during each sampling event. Dip-net data were used to identify periods of Fountain Darter reproductive activity because this method is effective for collecting small Fountain Darters (<15 mm).

Random-station Dip Netting

Random-station presence/absence dip netting was initiated on the San Marcos River during spring 2006. It was designed to be a quick, efficient, and repetitive means of monitoring the Fountain Darter population. Also, because the footprint of impact is smaller than drop netting, it can be conducted during extremely low-flow periods with fewer disturbances to critical habitat.

During each event, 50 random locations were selected within vegetated areas across the three study reaches (Figure 1) using a random-point generator in ArcGIS and the most recent vegetation map of that reach. Sample stations in each study reach were distributed based on total area, diversity of vegetation, and previous Fountain Darter abundance estimates of each sample reach. Fifteen stations were chosen in the Spring Lake Dam Reach, 20 stations were chosen in the City Park Reach, and 15 stations were chosen in the I-35 Reach. At each random station, four dips were conducted for a total 200 dips per sample period. After each dip, presence or absence of Fountain Darters was recorded. To avoid recapture, Fountain Darters were placed into a plastic tub filled with river water or moved a sufficient distance away from the dip netter. At each station, the dominant surficial substrate (clay, silt, sand, gravel, cobble, boulder, bedrock) was recorded, along with the dominant type of aquatic vegetation (e.g., *Sagittaria*, bryophytes,

open). Also, because bryophytes and algae are key Fountain Darter habitat components and can grow within or attach to other vegetation types, presence/absence of bryophytes and algae at each station was also noted. After four dips were completed and data recorded, all organisms were released near the station of capture.

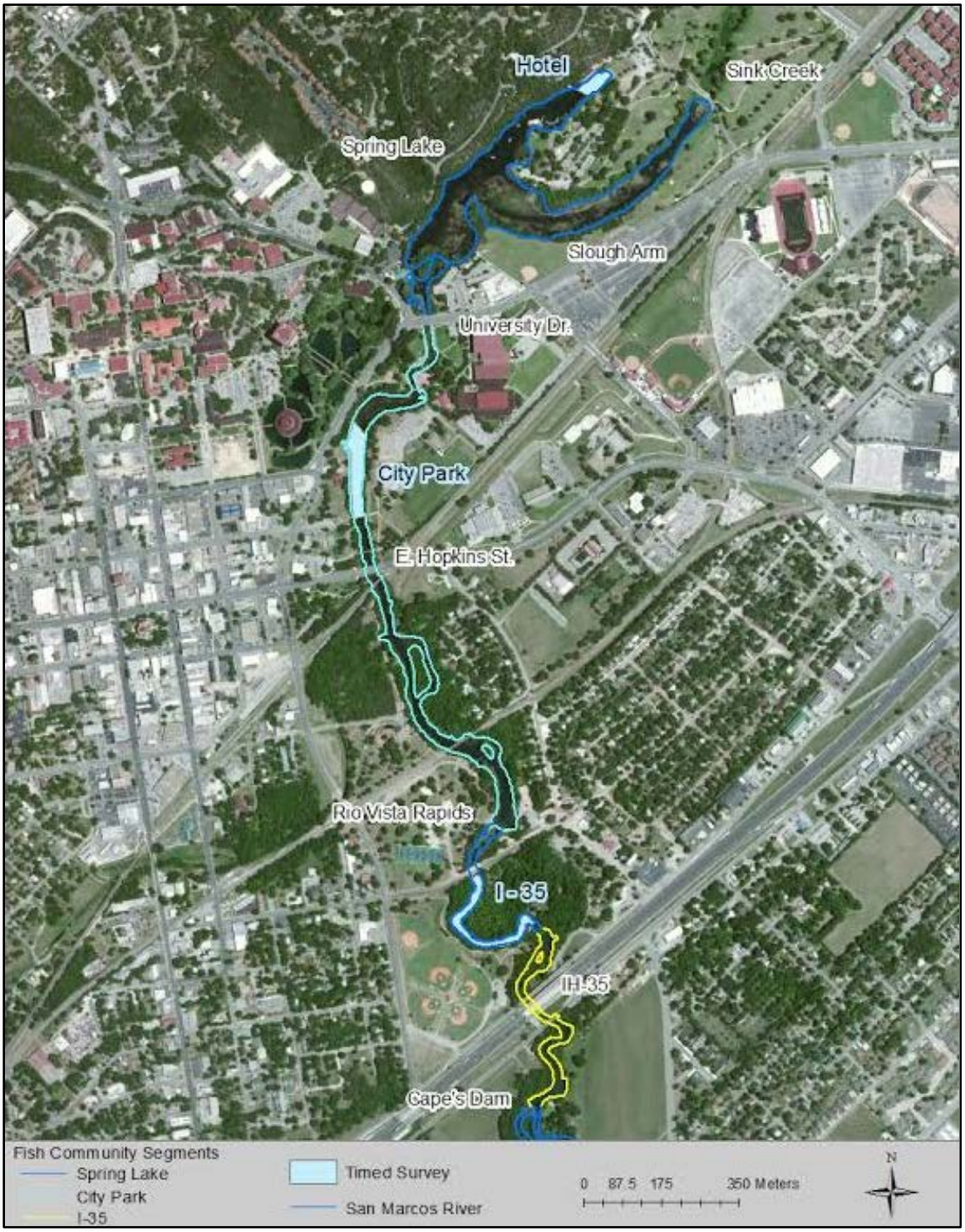


Figure 2. Fish community sampling segments and dip-net timed survey sections (blue) for the upper San Marcos River.

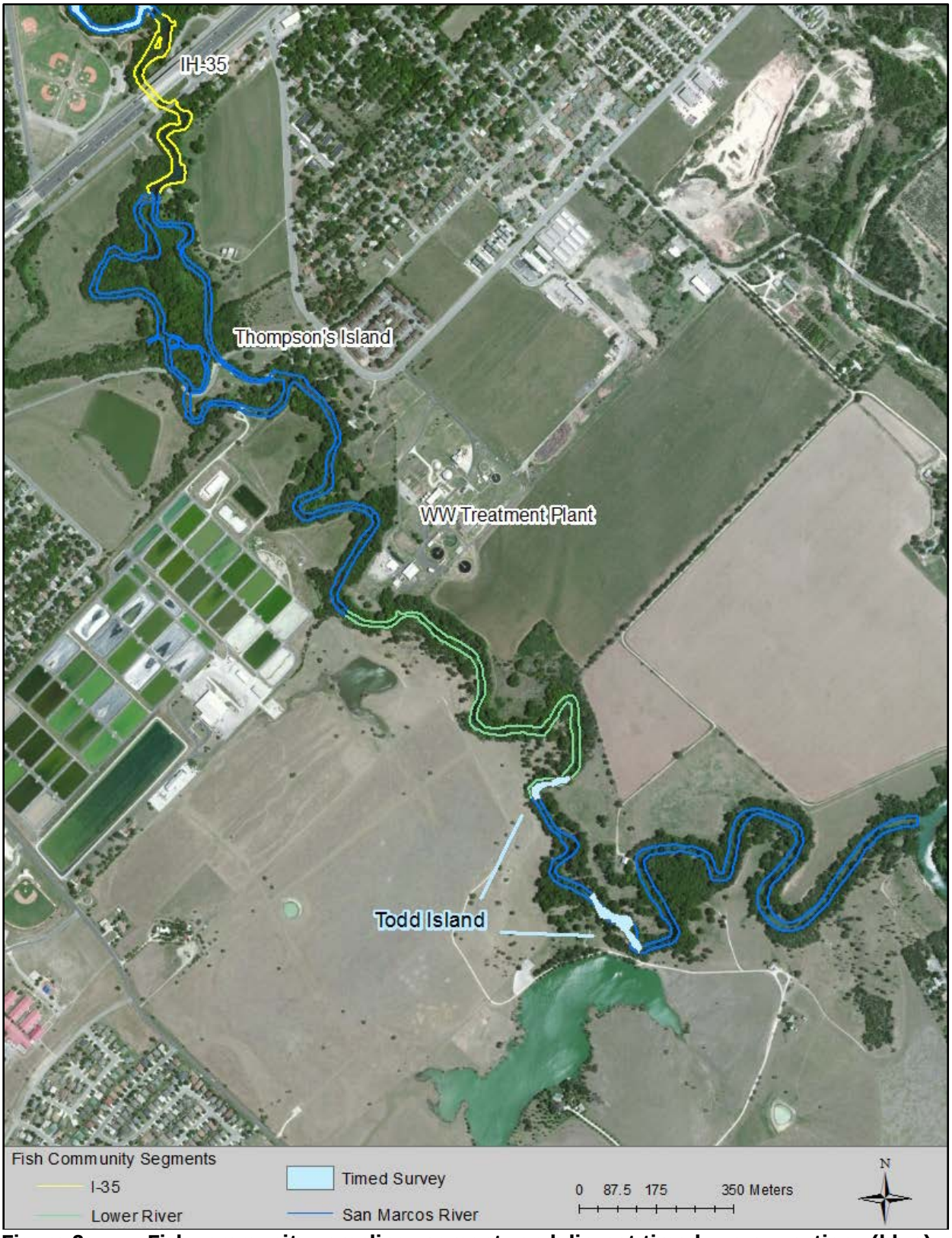


Figure 3. Fish community sampling segments and dip-net timed survey sections (blue) for the lower San Marcos River.

Fish Community Sampling

A multifaceted sampling methodology to efficiently monitor fish community composition and abundance was employed by using seines in shallower areas as well as conducting visual underwater SCUBA surveys in deeper habitats. This methodology was developed by Dr. Timothy H. Bonner and his students at Texas State University during previous fish community work on the San Marcos River (Behen 2013). Dr. Bonner and crew performed all HCP fish community sampling in the San Marcos system in 2018.

For fish community monitoring, the San Marcos system was split into the following four segments: (1) Spring Lake, (2) City Park, (3) I-35, and (4) Lower River (Figures 2 and 3). Within the deeper parts of each segment, at least three visual transect surveys were conducted by SCUBA and/or Hookah divers during each sampling event. At each transect, four divers swam across the river perpendicular to the flow at approximately mid-column depth. Divers identified and enumerated all fish observed. After the divers completed this initial transect, four 5-meter-long PVC pipe segments (micro-transect pipes) were placed on the stream bottom, spaced evenly along the original transect and oriented parallel to the river's current. Divers swam to the bottom and surveyed each of the micro-transect pipes. Divers started at the downstream end and swam up the pipe searching through the vegetation (if present) and substrate within approximately 1 meter of the pipe to dislodge small benthic-oriented fishes such as darters. Again, all fish observed were identified and counted. Percent coverage of various substrate and vegetation types were also recorded. After fish surveys were complete, depth and velocity data were collected in the middle of each micro-transect pipe using a Marsh McBirney Model 2000 portable flowmeter and adjustable wading rod. At each micro-transect pipe, velocity measurements were taken 15 cm from the bottom, mid-column, and the surface. Standard water quality parameters were also recorded once at each transect using a handheld water quality sonde.

In addition to visual surveys, seining was used to sample the fish community in shallow areas. At least three seining transects were conducted within each segment (except Spring Lake, which was too deep for seining) during each sampling event. At each transect, multiple seine hauls were pulled until the entire wadeable area at that transect had been covered. For example, seines were pulled along the bank on one side of the river and then the biologists moved closer to midchannel, taking caution not to sample the same area. They continued to move toward the opposite bank with subsequent seine hauls until the other bank was reached or water became too deep to seine effectively. Randomly selecting seining transects within the wadeable portion of each reach and using the protocol above ensured that habitats were sampled in similar proportions to their availability. After each seine haul, fish were identified, measured to the nearest mm of total length, and enumerated. To prevent recapture on subsequent seine hauls, captured fish were placed in a bucket containing river water. After completion of the transect, all fish were released from holding buckets. Habitat data at each seine haul location included, percent coverage of substrate, vegetation, water depth and velocity measured at 15 cm, mid-column, and the surface.

Data from underwater observations were combined with seine hauls to examine overall fish community composition during each event. Densities are calculated by dividing the abundance of each species captured by area sampled (m^2). Individual densities are averaged across each site

per season to determine average densities of each species. Data are also collected in a way that allow calculation of catch-per-unit-effort (CPUE) by gear type and taxa.

San Marcos Salamander Visual Observations

Visual salamander surveys were conducted in 2018 at three sites within Spring Lake and the San Marcos River for each routine sampling effort. Visual observations were made in areas previously described as habitat for San Marcos salamanders (Nelson 1993) (Figure 1). Two of the sites are located within Spring Lake: the Hotel Site is adjacent to the old hotel and was identified as Site 2 in Nelson (1993), and the Riverbed Site was located across from the former Aquarena Springs boat dock and was identified as Site 14 in Nelson (1993). The third survey area, called the Spring Lake Dam Site, is located in the main river channel immediately downstream of Spring Lake Dam in the eastern spillway. This was identified as Site 21 in Nelson (1993). The Spring Lake Dam Site is subdivided into three smaller areas to allow greater coverage of suitable salamander habitat; calculated salamander densities from these three subdivisions were averaged.

SCUBA gear was used to sample habitats in Spring Lake, while a mask and snorkel were used in the site below Spring Lake Dam. For each sample, an area of macrophyte-free rock was outlined using flagging tape, and three timed surveys (5 minutes each) were conducted by overturning rocks >5 cm wide and counting the number of San Marcos salamanders observed underneath. Following each timed search, the total number of rocks surveyed were recorded to estimate the number of San Marcos salamanders per rock in the area searched. The three surveys were averaged to yield the number of San Marcos salamanders per rock. Densities of suitably sized rocks at each sampling site were determined using quadrats (0.25 m^2). Three random samples were taken in each area by blindly throwing the quadrat into the sampling area and counting the number of appropriately sized rocks. The three samples were then averaged to yield a density estimate of the suitable rocks in the sampling area. The area of each site was determined by physically measuring each sampling area with a tape measure.

Benthic Macroinvertebrate Rapid Bioassessment Protocol

Rapid Bioassessment Protocols (RBPs) are tools for evaluating biotic integrity and overall habitat health, based on the community of organisms present (Barbour et al. 1999). Macroinvertebrates are the most frequently used biological units for RBPs because they are ubiquitous, diverse, and there is an acceptable working knowledge of their taxonomy and life histories (Poff et al. 2006, Merritt et al. 2008).

BIO-WEST performed sampling and processing of freshwater benthic macroinvertebrates, following Texas RBP standards (TCEQ 2014). Macroinvertebrates were sampled with a D-frame kick net (500 µm mesh) by disturbing riffle habitat consisting primarily of cobble-gravel substrate, when available, for 5 minutes while moving in a zig-zag fashion up-stream. When suitable cobble-gravel substrate was not available, the riffle sample was supplemented with a snag sample. Snag sampling entailed collecting submerged wood “snags” 0.5 – 2.5 cm in diameter and placing them in a sieve bucket. Snag materials were washed thoroughly in the bucket to remove attached organisms. Invertebrates from riffle and snag samples were then combined in a sorting tray and randomly distributed. Subsamples for riffle or riffle + snag were taken by scooping out random portions of material and placing them into a separate sorting tray.

All macroinvertebrates were picked from the tray before another subsample was taken. This process was continued until a minimum of 140 individuals were picked to represent a sample. If the entire sample did not contain 140 individuals, the process was repeated again until this minimum count was reached. Macroinvertebrates were collected in this fashion from Spring Lake, Spring Lake Dam, City Park and I-35 reaches (Figure 1).

Picked samples were preserved in 70% isopropyl, returned to the laboratory, and identified to the TCEQ taxonomic effort levels (TCEQ 2014), usually genus, though members of the family Chironomidae (non-biting midges) and class Oligochaeta (worms) were retained at those taxonomic levels. The 12 ecological measures or metrics of the Texas RBP benthic index of biotic integrity (B-IBI) were calculated for each sample. Each metric represents a functional aspect of the macroinvertebrate community, related to ecosystem health and sample values are scored 1 – 4 based on benchmarks set by reference condition streams for the state of Texas. The aggregate of all 12 metric scores for a sample represent the B-IBI score for the reach that sample was taken from. B-IBI point-scores for each sample are compared to benchmark ranges and are described as having aquatic-life-uses as “Exceptional”, “High”, “Intermediate”, or “Limited.” In this way, point-scores were calculated and the aquatic-life-use for each sample reach was evaluated.

OBSERVATIONS

The project team conducted 2018 comprehensive sampling during three different periods: spring full event (April 14 – April 25), summer Fountain Darter dip netting and Texas wild-rice annual mapping (August 2018), and fall full event (October 1 – October 31). In addition to comprehensive sampling, full system benchmark aquatic vegetation mapping was conducted in March and April 2018.

San Marcos Springflow

Total system mean monthly discharge in the San Marcos River during 2018 closely followed the historic average in the system for the majority of the year after a period of three years with above average discharge (Figure 4). A minimum average daily flow of 117 cubic feet per second (cfs) occurred on August 30 and 31 with the maximum average daily flow of 315 cfs occurring on March 28 (Table 1).

Central Texas experienced rainfall totals in 2018 that were consistently below long-term averages compared to what was experienced from 2015-2017 and this is evident in the daily discharge measurements from the San Marcos River (Figure 5). Spring and fall discharge levels were stable with no flood events observed in 2018.

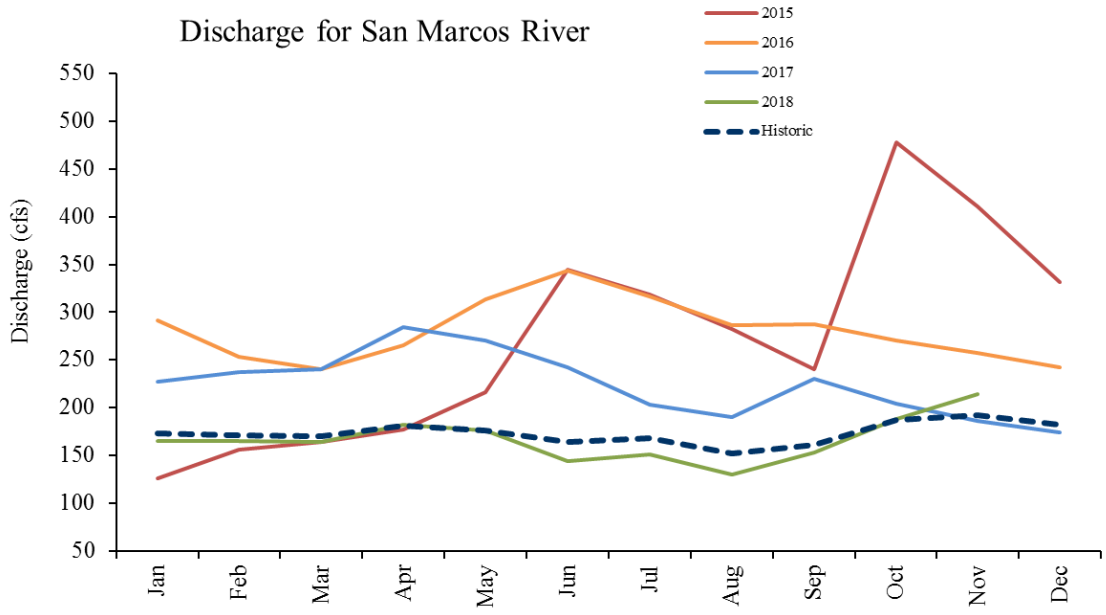


Figure 4. **Mean monthly discharge (cubic feet per second) in the San Marcos River during recent years and averaged over the 1956–2018 period of record (Historic).**

Table 1. Minimum and maximum daily average discharge in cubic feet per second (cfs) in the San Marcos River since the beginning of the study in 2000.

YEAR	MINIMUM DISCHARGE (cfs)	MAXIMUM DISCHARGE (cfs)
2000	108	397
2001	167	1,019
2002	157	668
2003	156	332
2004	146	1,280
2005	136	361
2006	90	145
2007	101	971
2008	97	217
2009	83	206
2010	163	273
2011	88	173
2012	100	241
2013	99	2,600
2014	104	176
2015	116	5,400
2016	227	737
2017	172	489
2018	117	315

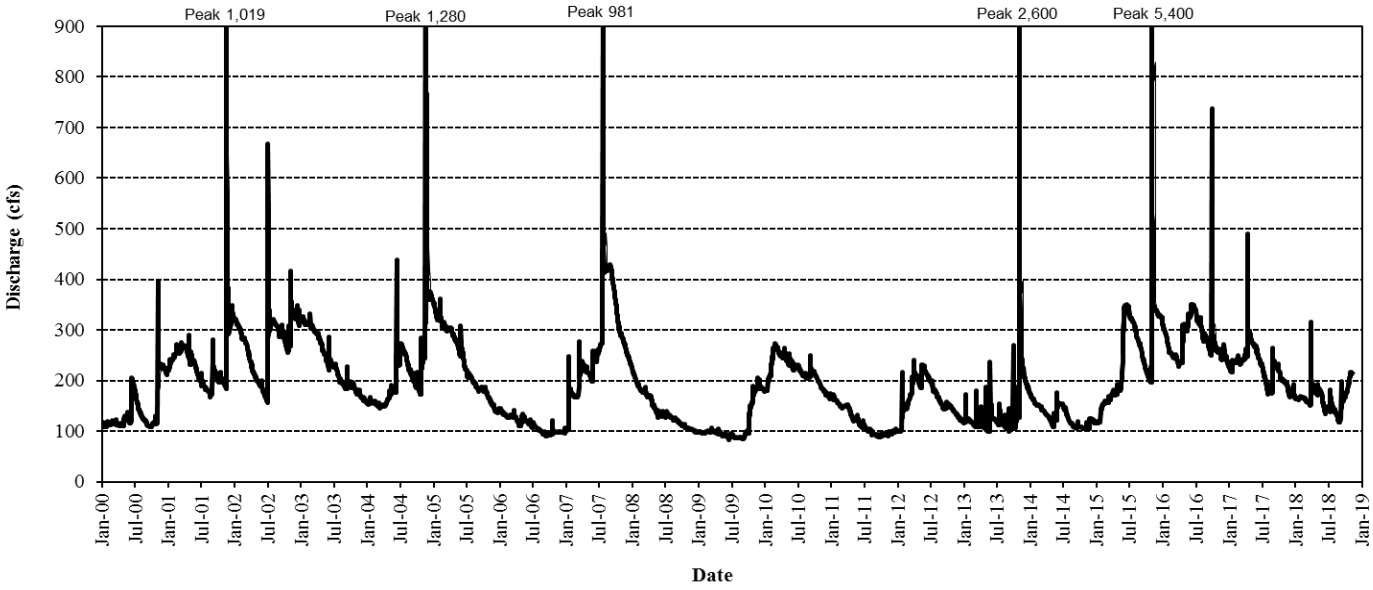


Figure 5. Daily average discharge (cubic feet per second) for the San Marcos River since the beginning of monitoring in 2000.

Water Quality Results

Water Temperature Thermistors

Water temperature data for the City Park and I-35 reaches are presented in Figure 6, and additional graphs for all reaches can be found in Appendix C.1. As expected, thermistors closest to spring inputs (farthest upstream) display relatively constant water temperatures, with periodic spikes of low temperatures signaling rainfall events. Also, quite evident is the difference that higher system discharge makes with the more consistent temperatures at the City Park and I-35 sites recorded during the higher discharge years of 2015 through 2017 versus the fluctuating water temperatures at these sites during the previous drought (Figure 6).

Further downstream, ambient conditions exert a greater influence on water temperature due to increased exposure time and runoff from rain events. Figures 6 and 7 display this relationship; higher temperature fluctuations occur at the downstream thermistor (Animal Shelter) compared to thermistors that are closer to spring inputs (I-35, City Park). The Sessoms creek thermistor was the only thermistor that collected readings exceeding the TCEQ water quality standard of 26.7 ºC for the San Marcos River in 2018 (Appendix C.1). This occurred in late June and again in late July 2018 during a period of above average air temperatures for the region. This has happened in the past and is likely due to Sessoms creeks shallow depths and increased influence by ambient temperatures and runoff.

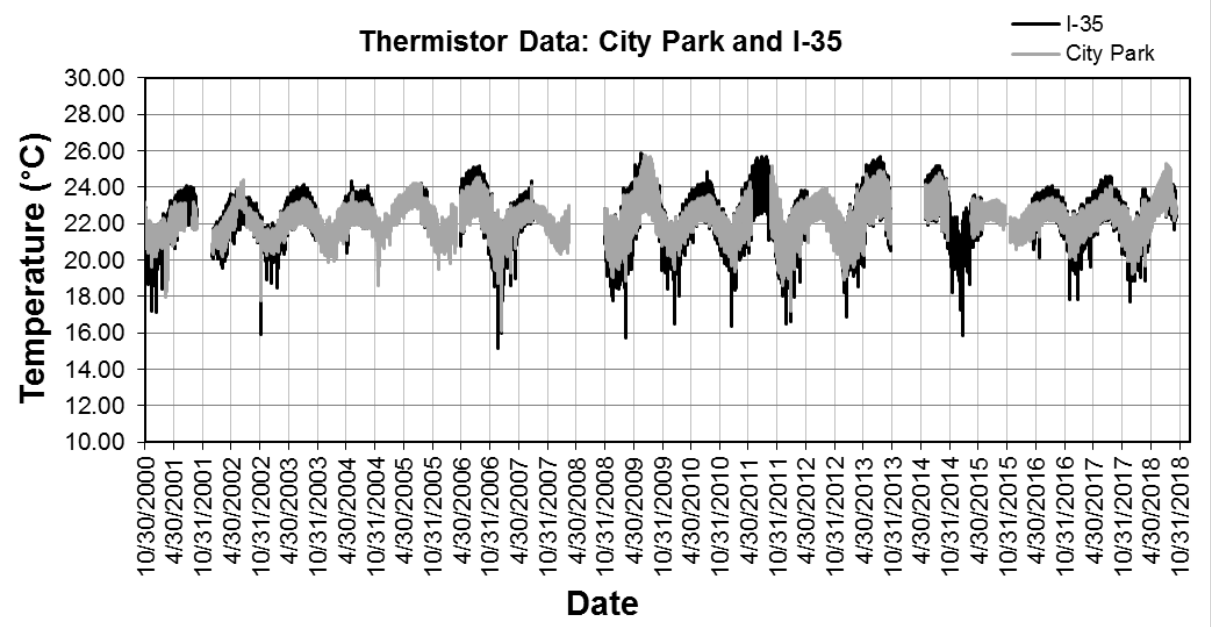


Figure 6. Thermistor data from the City Park and I-35 reaches.

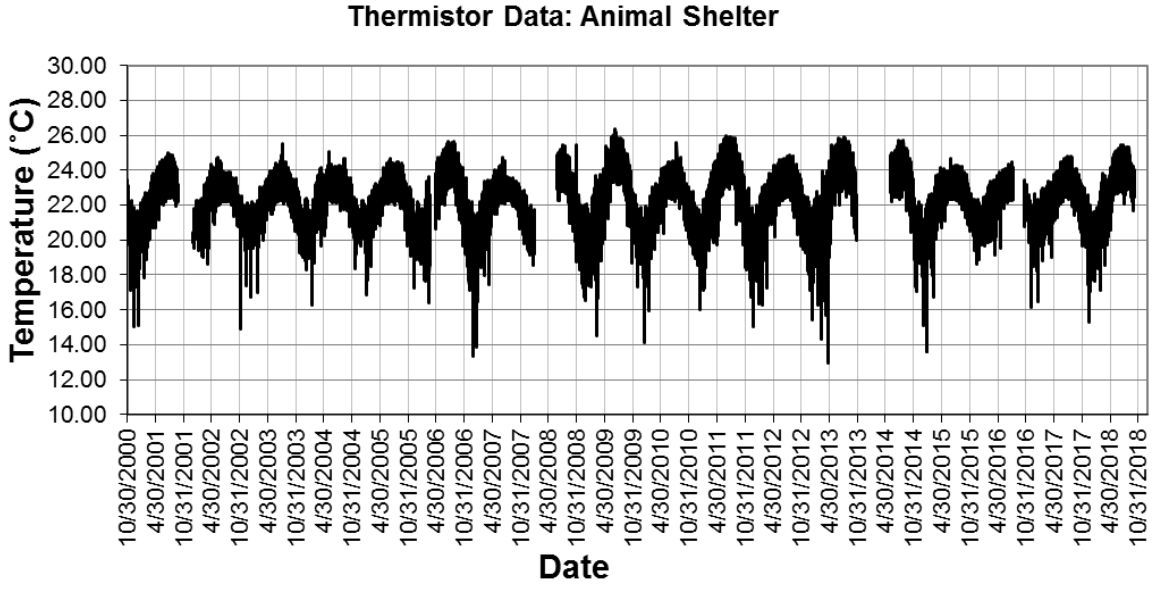


Figure 7. Thermistor data from the Animal Shelter Reach.

Water Quality Grab Samples

No Critical Period water quality grab samples were collected in the San Marcos River in 2018. A more in-depth look at water quality can be found in the 2018 EAA HCP Expanded Water Quality Report (SWCA 2018, Draft).

Aquatic Vegetation Mapping

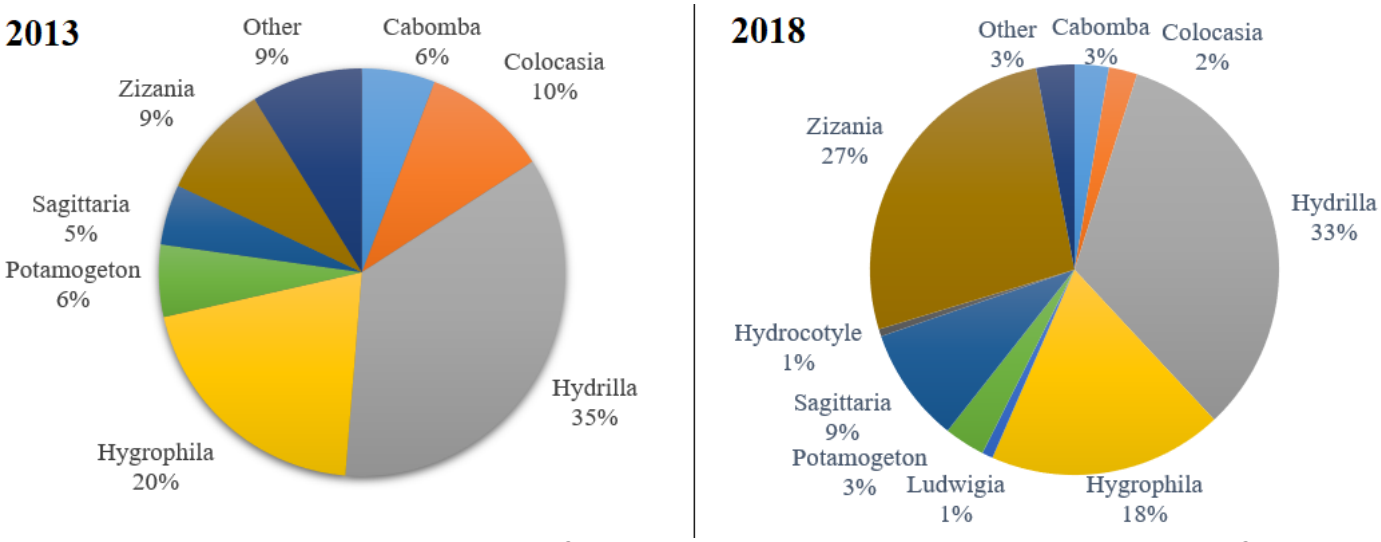
Aquatic vegetation maps for all study reaches and for both sampling periods are presented in Appendix B. The maps are organized by individual reach with successive mapping events ordered chronologically. While less dominant species may not be represented on the maps, the San Marcos vegetation community is a natural mosaic with intermixed stands containing multiple aquatic plant species, thus their coverage is estimated and included into the total vegetation calculations.

HCP Benchmark Full System Mapping

The HCP benchmark full system mapping occurred in March 2018. Aquatic vegetation from Spring Lake dam (29° 53’ 24.99” N: 97° 56’ 01.35” W) to just below Stoke’s Park/ Thompson’s Islands (29° 52’ 08.56” N: 97° 55’ 43.46” W) was mapped. Full system mapping is completed every five years for the duration of the HCP. In 2013, approximately 50,000 m^2 of aquatic vegetation was mapped in this stretch of river. In 2018, aquatic vegetation totaled just over 38,000 m^2. Natural stressors can greatly impact aquatic vegetation. In 2013 to 2014, San Marcos flows were at some of the lowest recorded in decades. In 2015 and into 2017, the San Marcos River was subjected to some of the highest flows seen in decades with sustained flows well above historical average for nearly two years. Sustained high flow events typically favor more flow tolerant plant species, including Texas wild-rice while discouraging less flow tolerant plants such as *Hygrophila*. Repeated changes in flow regime coupled with active restoration of the

native aquatic plants resulted in notable changes to the aquatic vegetation community of the San Marcos River between 2013 and 2018.

The comparison between 2013 baseline mapping data and the 2018 benchmark mapping data (Figure 8) along the same length of river, Spring Lake Dam to Stoke's Park, show an increasing trend in the percent dominance of native aquatic vegetation. Texas wild-rice has seen remarkable increase within this time frame and a few other native species (*Hydrocotyle* and *Ludwigia)* have seen small increases as well. The non-native species *Colocasia esculenta*, once a dominant invasive, has been greatly reduced from this stretch as a direct result of restoration efforts. Other non-native species show moderate reductions. The increase in Texas wild- rice can be attributed to HCP restoration efforts as well as prolonged favorable growing conditions since 2015. Appendix B contains a full map set of the 2018 benchmark mapping event.



2013 Total Aquatic Vegetation: **53,363** (m^2)

Cabomba	3,114
Colocasia	5,370
Hydrilla	18,927
Hygrophila	10,778
Ludwigia	139
Potamogeton	3,053
Sagittaria	2,556
Nuphar	123
Hydrocotyle	173
Zizania	4,892
Other species	4,238

2018 Total Aquatic Vegetation: **38,374** (m^2)

Cabomba	1,039
Colocasia	863
Hydrilla	12,685
Hygrophila	7,112
Ludwigia	330
Potamogeton	1,233
Sagittaria	3,485
Nuphar	125
Hydrocotyle	220
Zizania	10,224
Other species	1,058

Figure 8. Comparison of the aquatic vegetation community between Spring Lake dam and Stoke's Park in 2013 (left) and 2018 (right).

Spring Lake Dam Reach

The Spring Lake Dam reach is the most upstream reach of the San Marcos River. Covered area of aquatic vegetation in the Spring Lake Dam reach has been highly variable in past years due to heavy recreation pressure and flooding events. Recent attempts to curb recreation in this reach have been successful but recreation pressure has increased moderately in 2018 with observable impacts. The aquatic plant community is dominated by Texas wild-rice which expanded from

predominately existing stands as well as established new plants introduced as part of the restoration program. Texas wild-rice accounts for a significant portion of vegetation in this reach (60 % or more) with smaller amounts of *Potamogeton*, *Hydrocotyle* and *Hygrophila* among others making up the rest of the community.

For 2018, the total vegetation cover decreased between spring and fall sampling as is typical in this reach. Total vegetative coverage was above long-term averages for both seasons (Figure 9). The breakdown of the cover for each species found in the reach during the spring and fall sampling periods can be found in Table 2.

Texas Wild-rice dominates the Spring Lake Dam Study Reach.

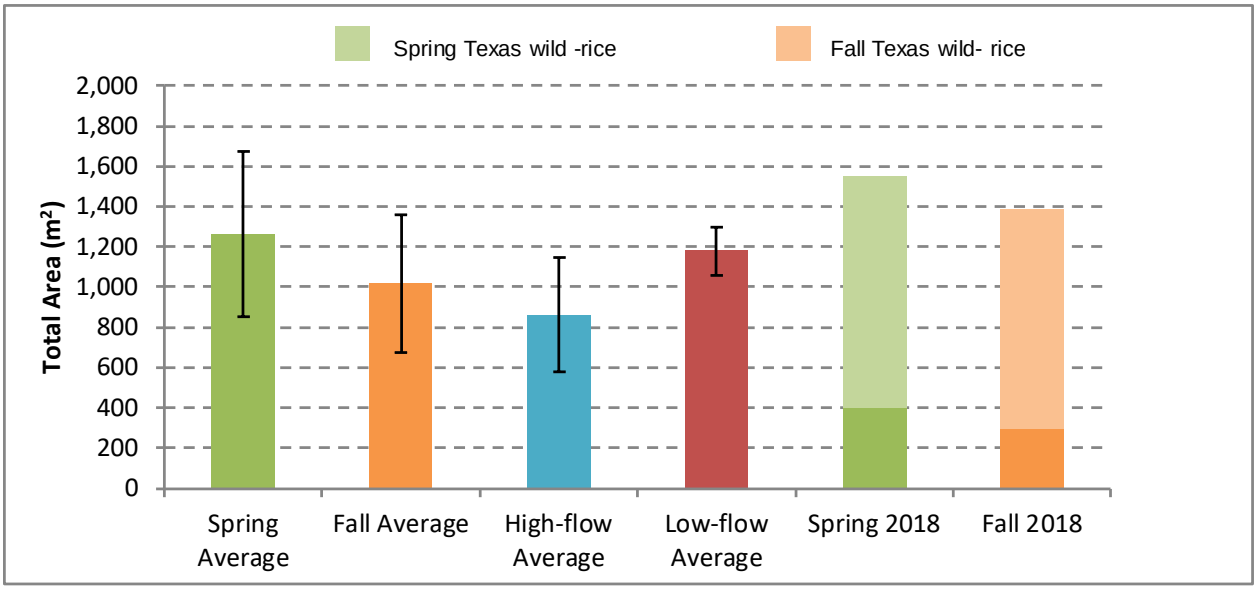


Figure 9. **Total surface area (m^2) of aquatic vegetation in the Spring Lake Dam reach. Long-term study averages are provided with bars representing one standard deviation from the mean.**

Table 2. **Cover of each species observed in the Spring Lake Dam reach during spring and fall sampling.**

Species	Spring Cover (m^2)	Fall cover (m^2)
Cabomba	0.3	1.5
Ceratophyllum	0	6.8
Ceratopteris	1.5	0
Heteranthera	0	0.1
Hydrocotyle	135.9	52.8
Hygrophila	23.6	39.6
Ludwigia	19.6	22.4
Nasturtium	0.7	0
Potamogeton	200.5	148.0
Sagittaria	13.6	22.3
Vallisneria	3.5	3.3
Texas wild-rice	1,152.2	1088.5
Total	**1,552.7**	**1386.4**

City Park Reach

The City Park reach is characterized by high recreation. Tubing and swimming are both very popular here. This results in wide swings in vegetation cover season by season and year by year. Both spring and fall 2018 values, 3,017 m^2 and 2,394 m^2 respectively, remained significantly below the long-term seasonal average for the study reach (Figure 10). Loss of Texas wild-rice in this reach contributed significantly to total loss of vegetation coverage from spring to fall, although vegetation totals excluding Texas wild-rice remained similar. The amount of Texas

wild-rice has increased significantly over the past two years in this reach. Damage to Texas wild-rice stands seems to be short-lived as the plants show regrowth each winter. Other vegetation types also rebound during the same time frame. In both spring and fall, Texas wild-rice made up a majority (> 50%) of the aquatic vegetation in this reach. The breakdown of the cover for each species found in the reach during the spring and fall sampling periods can be found in Table 3**.**

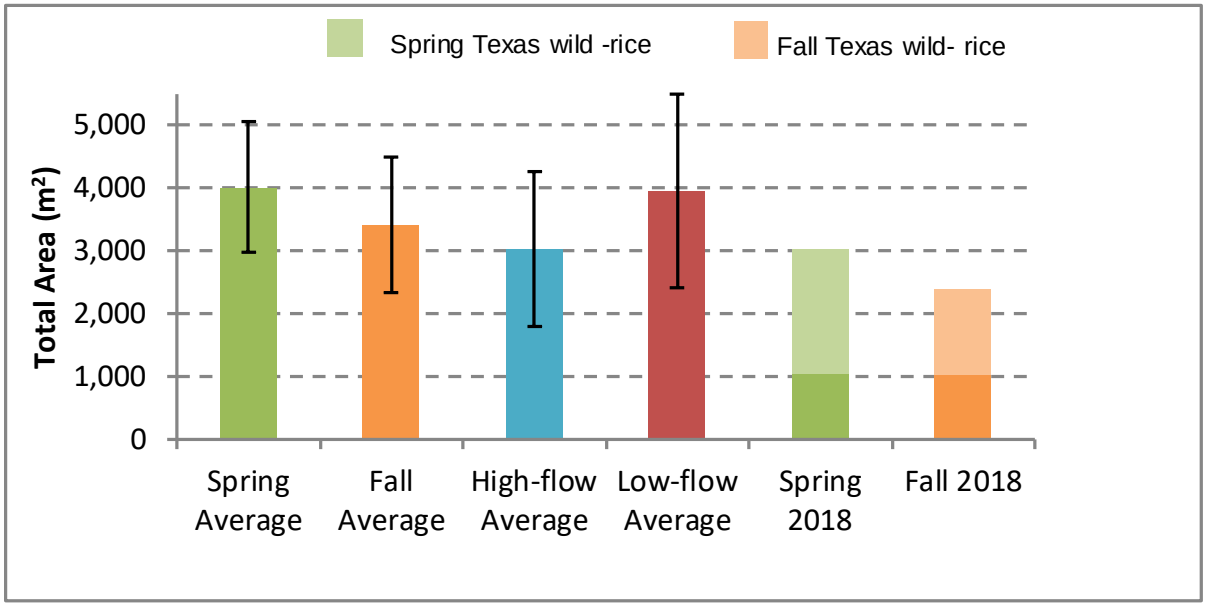


Figure 10. Total surface area (m²) of aquatic vegetation at the City Park reach. Long- term study averages are provided with bars representing one standard deviation from the mean.

Table 3. Cover of each species observed in the City Park reach during spring and fall sampling.

Species	Spring Cover (m²)	Fall cover (m²)
Bacopa	0.4	2.4
Cabomba	1.9	50.1
Ceratophyllum	0	174.2
Ceratopteris	2.8	1.0
Eicchornia	0	1.5
Heteranthera	1.8	2.6
Hydrilla	390.3	101.7
Hygrophila	254.2	288.1
Ludwigia	58.3	79.2
M. heterophyllum	0	16.2
Nasturtium	0	6.1
Pontedaria	0.3	0
Potamogeton	176.5	203.3
Sagittaria	162.4	106.8
Vallisneria	3.0	0
Texas wild-rice	1,969	1,362
Total	**3,023.7**	**2,395.4**

I-35 Reach

The I-35 study reach has changed considerably over the past five years. Recreation has become more popular in this area challenging vegetation sustainability and expansion. In 2018, the total vegetation coverage remained similar from spring to fall (Table 4, Figure 11). Spring and fall total vegetation coverage were also higher than the seasonal averages calculated since reach expansion in 2014. In 2018, *Hygrophila* and Texas wild-rice dominated the community in both seasons, while the cover of *Hydrilla* and *Sagittaria* dropped significantly. The overall dominance of native species versus non-native species in this reach has improved. A breakdown of the cover for each species found in the reach during the spring and fall sampling periods can be found in Table 4. River bed scouring, both natural and human induced, continues to challenge vegetation expansion in this reach.

Table 4. Cover of each species observed in the I-35 reach during spring and fall sampling.

Species	Spring Cover (m^2)	Fall cover (m^2)
Cabomba	86.4	73.0
Ceratophyllum	0	55.2
Heteranthera	4.7	7.4
Hydrilla	58.3	10.4
Hydrocotyle	1.1	3.8
Hygrophila	505	799.7
Ludwigia	271.1	146.3
Nuphar	39.8	29.7
Sagittaria	495.2	291.8
Texas wild-rice	548.9	622.8
Total	**2,010.6**	**2,040.1**

Native and non-native mixed stand of aquatic vegetation reduced due to river bed scour.

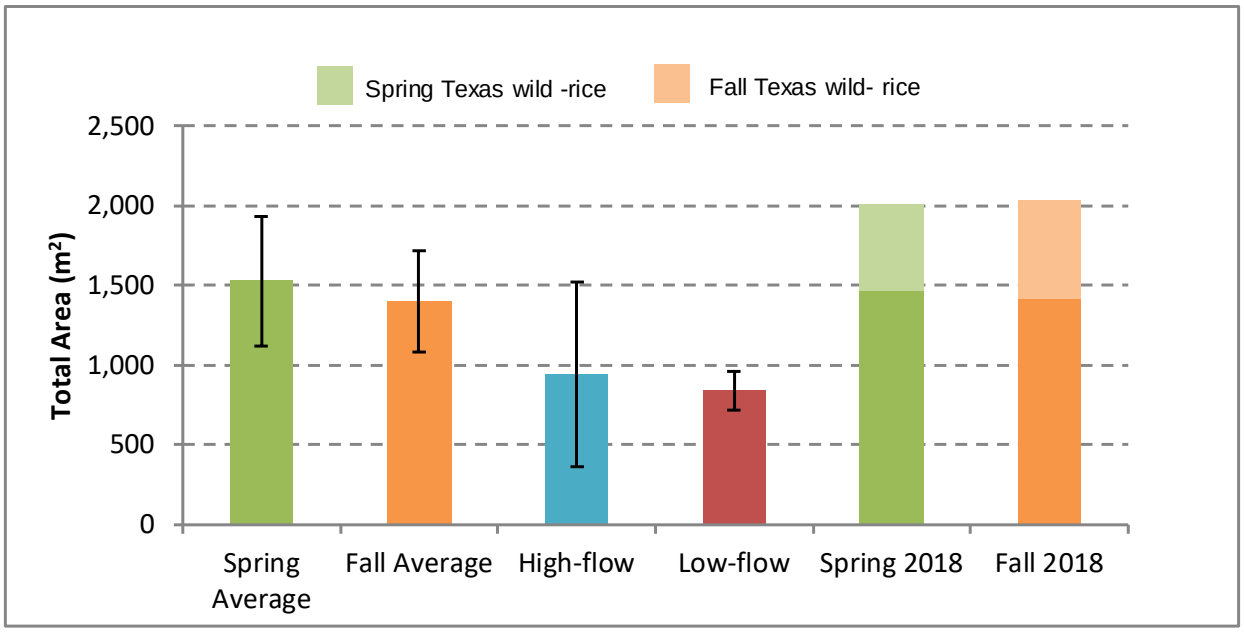


Figure 11. Total surface area (m^2) of aquatic vegetation at the I-35 Reach. Long-term study averages for this reach were adjusted to 2014 through present to account for reach expansion. Bars represent one standard deviation from the mean.

Texas Wild-rice Annual Mapping

In 2018, two full system mapping events took place. The first full system mapping event for Texas wild- rice corresponded with the aquatic vegetation benchmark mapping event scheduled every fifth year (done in 2013, 2018 and next scheduled for 2023). Mapping occurred through March and into April 2018. This map set is compiled with the aquatic vegetation map set in Appendix B**.** The annual summer mapping event occurred as regularly scheduled in August. This map set, broken out by river segment, can also be found in Appendix B.

Results of the 2018 full system mapping event showed an aerial coverage of 10,230 m^2 of Texas wild-rice. This is the highest coverage of Texas wild-rice mapped to date. Cover decreased slightly to 9,429.5 m^2 (Figure 12) by August 2018.

Figure 13 displays BIO-WEST designated river segments to further compare localized changes in Texas wild-rice per segment between August 2017 and August 2018 mapping events. The 2018 benchmark mapping event is included for comparison as well. Almost all segments exhibited an increase in Texas wild-rice cover between August 2017 and August 2018 except two which only included minor losses in Texas wild-rice (Table 5). Comparatively the benchmark mapping event documented increases in Texas wild-rice from August 2017, reaching the highest coverage yet. However, subsequent losses in Texas wild- rice from the benchmark to August 2018 occurred in just about every segment. This provides an excellent example of the dramatic changes that can occur in Texas wild-rice cover in between annual mapping events.

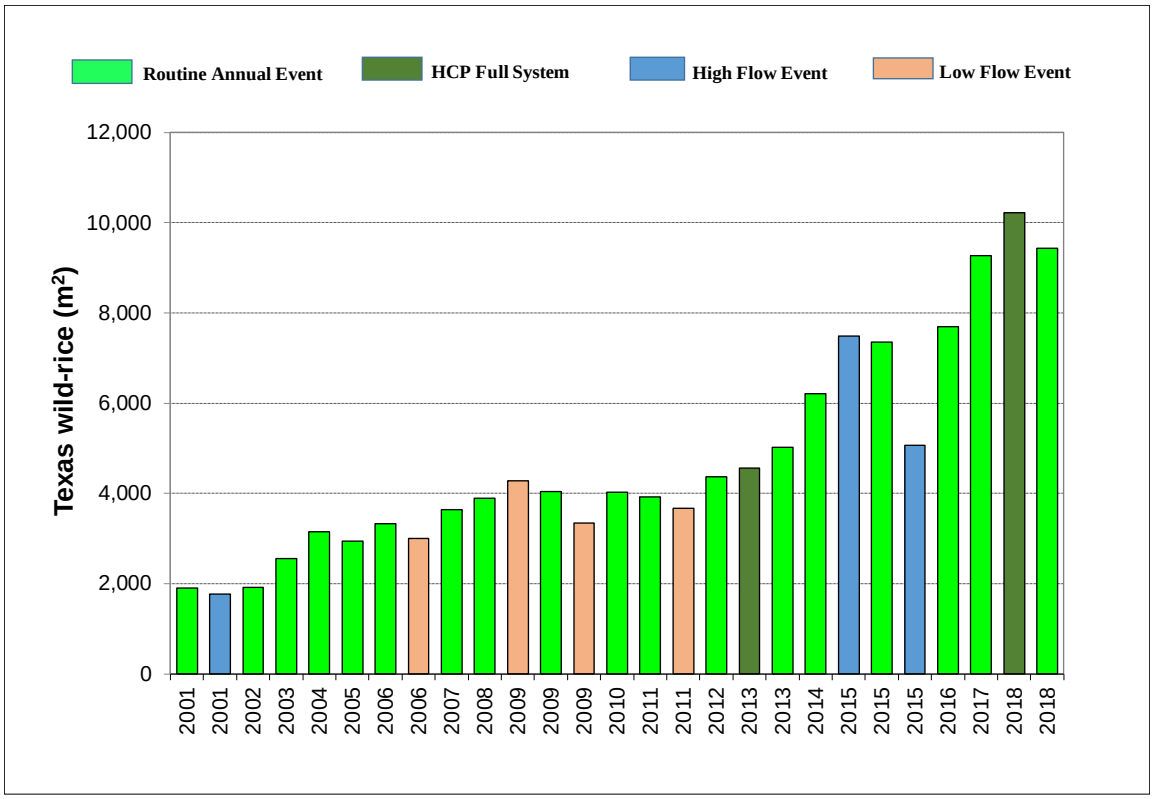


Figure 12. Coverage of Texas wild-rice across selected years.

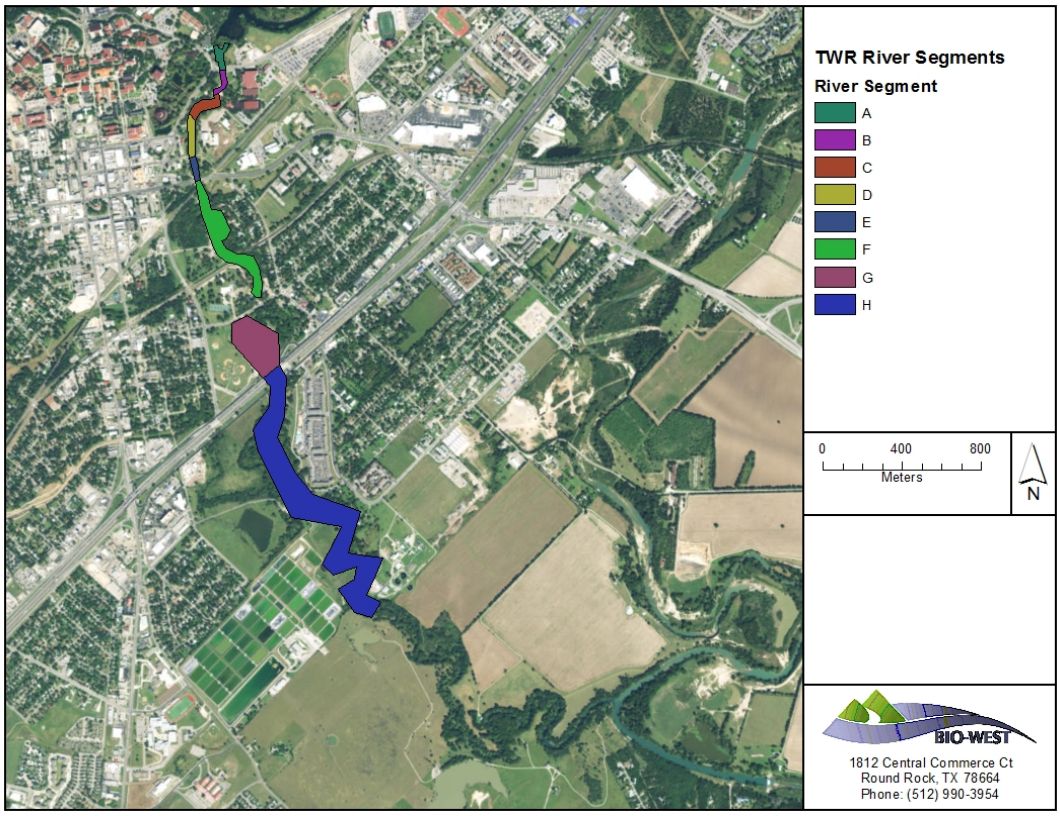


Figure 13. BIO-WEST designated Texas wild-rice river segments.

Table 5. Change in cover of Texas wild-rice in river segments (Figure 13) between August 2017 and August 2018 mapping. Benchmark included for comparison.

RIVER SEGMENT	AUG 2017 COVER (m^2)	BENCHMARK 2018 COVER (m^2)	AUG 2018 COVER (m^2)	STATUS 2017–2018	DIFFERENCE 2017–2018	CHANGE 2017–2018
A Spring Lake Dam Reach	1,096	1,231	1,169	↑	73	6%
B Sewell Park	1,181	1,196	1,182	↑	1	0%
C Sewell Park to City Park Reach	2,815	2,889	2,589	↓	226	8%
D City Park Reach	1,652	2,490	1,689	↑	37	2%
E City Park Reach to Hopkins Street Bridge	502	493	488	↓	14	3%
F Hopkins Street Bridge to Rio Vista Dam	1,519	1,617	1,531	↑	12	1%
G I-35 Reach	400	557	522	↑	122	23%
H I-35 to below WWTP	52	83	86	↑	34	39%

For the benchmark mapping event 687 polygons and 223 points of Texas wild-rice were mapped compared to 571 polygons and 161 points mapped in August 2017. Distribution of Texas wild-rice remained similar to that of previous recent years with the downstream extent limited to just below Thompson's Island. Texas wild-rice continues to expand in Spring Lake and new occurrences were noted in the side channel below Cheatham Street and in the diversion channel at Thompson's Island.

Of the 687 mapped polygons, 395 were found to be in water deeper than three feet, and 292 stands were found to be in water less than three feet in depth (Table 6**)**. Over 50% of Texas wild-rice stands were found to be associated with another aquatic plant species. Two non-native aquatic plant species, *Hydrilla* and *Hygrophila* remain the most commonly associated aquatic plant species with Texas wild-rice (Table 7) although the association with native aquatic plant species has increased over the last few years. There were 56 Texas wild-rice stands in bloom and bloom percent ranged from 10 to 90%.

Table 6. Distribution of Texas wild-rice based on water depth from Benchmark mapping event (n=687).

DEPTH (FEET)	NUMBER OF TEXAS WILD-RICE STANDS	FREQUENCY (%)
0–0.9	16	2
1–1.9	117	17
2–2.9	159	23
3+	395	58

Table 7. Associated species found with Texas wild-rice from Benchmark mapping event (n=377).

SPECIES	NUMBER OF TEXAS WILD-RICE STANDS	FREQUENCY (%)
Hydrilla verticillata	196	52
Hygrophila polysperma	99	26
Potamogeton illinoensis	37	10
Sagittaria platyphylla	27	7
Ludwigia repens	10	3
Hydrocotyle verticillata	7	2
Nasturtium officinale	1	<1

A total of 673 Texas wild-rice polygons were mapped along with 232 Texas wild-rice points during the annual mapping event in August 2018. Of the 571 Texas wild-rice stands mapped, 323 of them were found to be in water deeper than three feet and 350 stands were found to be in water less than three feet in depth (Table 8). Nearly 50% of Texas wild-rice stands were found to be associated with another aquatic plant species (Table 9). Frequency associations were similar to results from the benchmark mapping and recent years. The observed number of blooming stands was 38 and bloom percent ranged from 10 to 90%.

Table 8. Distribution of Texas wild-rice based on water depth from Annual Summer 2018 event (n=673).

DEPTH (FEET)	NUMBER OF TEXAS WILD-RICE STANDS	FREQUENCY (%)
0–0.9	42	6
1–1.9	145	21
2–2.9	163	24
3+	323	48

Table 9. Associated species found with Texas wild-rice from Annual Summer 2018 event (n=260).

SPECIES	NUMBER OF TEXAS WILD-RICE STANDS	FREQUENCY (%)
Hydrilla verticillata	92	35
Hygrophila polysperma	83	32
Potamogeton illinoensis	34	13
Sagittaria platyphylla	30	11
Hydrocotyle verticillata	10	4
Ludwigia repens	10	4
Heteranthera dubia	1	<1

Texas Wild-rice Physical Observations

Observations for vulnerable Texas wild-rice stands were conducted during both spring (April 26) and fall (October 26) routine biomonitoring events and one low-flow event (August 29) in 2018. Rectangular study plots, established around chosen vulnerable stands in previous years were used to locate and identify vulnerable Texas wild-rice stands for 2018 sampling. Individual stands are mapped in GIS to provide length, width and cover estimates. The average daily

discharge for the San Marcos River at the time of spring sampling (April 26) was 175 cfs, which is slightly lower than the historical mean daily discharge for April of 181 cfs. The mean daily discharge during the single low flow sampling event (August 29) was 120 cfs, well below the historical mean for August of 174 cfs. The mean daily discharge of the fall sampling event (October 26) was 206 cfs which is above the historical daily mean of 187 cfs.

As in the previous year physical observations were made for vulnerable Texas wild-rice stands within three general study areas, the Spring Lake Dam / Sewell Park location, Veramendi Park and the I-35 location. These locations are heavily trafficked with river recreation and are also located near river access points where river recreationists enter, exit or linger for the duration of the day. Therefore, during peak recreation season Texas wild-rice patches at these locations are subjected to harsher disturbances compared to Texas wild-rice located in any other part of the river. The coverage of each vulnerable stand in the San Marcos River is presented in Table 10 and discussed below. Maps of vulnerable stands during each monitoring event as well as graphs indicating selected physical conditions of Texas wild-rice in these three locations are found in Appendix B and C.

Spring Lake Dam/Sewell Park Reach

The stands in this reach have continued to maintain a high degree of cover due to the decrease in recreational pressure since river access has been limited. However, the 2018 monitoring exhibited increasing evidence of recreational damage in this stretch (Figure 14). The total coverage of vulnerable stands exhibited an initial increase from fall 2017 to spring 2018 with stand # 7 and stand # 2 expanding enough to merge together. However, over the course of 2018 total cover decreased falling below all coverages for the previous year. Stand # 1 located above Aquarena Drive Bridge accounts for the largest amount of cover for vulnerable stands in this sample reach. Expansion and loss of coverage in this single stand can dramatically change the total coverage. Although this stand expanded over the first several sampling periods in 2018, it saw a decrease of 70 m^2 in cover between the Low-flow sampling event and the fall 2018 comprehensive sampling event. Stand # 7 has also seen major fragmentation and loss in 2018. This stand, located in a shallow area, saw increased fragmentation from foot traffic and trampling during the summer, especially in July and August when river flows approached 120 cfs. During the Low-flow sampling event stand # 6 was observed as a terrestrial patch of Texas wild-rice (Figure 15). During the fall sampling period, some regrowth of stand # 8 had appeared.

Table 10. Cover of individual vulnerable Texas wild-rice stands from fall 2017 to fall 2018.

Reach Stand Number	Fall 2017	Spring 2018	Low-flow	Fall 2018
Sewell Park 1	113.5	148.1	154.1	84.7
Sewell Park 2	8.5	9.6	3.6	7.6
Sewell Park 3	Gone	Gone	Gone	Gone
Sewell Park 4/5	20.3	37.0	30.1	44.0
Sewell Park 6	3.5	2.9	4.1	0.9
Sewell Park 7	91.1	80.4	62.2	75.9
Sewell Park 8	Gone	Gone	Gone	0.7
Sum of Cover	**236.9**	**278.0**	**254.1**	**213.8**
Veramendi 1	18.0	22.0	11.7	12.5
Veramendi 2	31.4	21.4	10.8	17.5
Veramendi 3	35.1	58.1	9.5	41.4
Sum of Cover	**84.5**	**101.5**	**32.0**	**71.4**
I-35-1	Gone	Gone	Gone	Gone
I-35-2	Gone	Gone	Gone	Gone
I-35-3	3.2	2.8	1.6	2.1
I-35-4	35.6	65.7	44.9	99.6
I-35-5	Gone	Gone	Gone	Gone
I-35-6	Gone	Gone	Gone	Gone
I-35-7	57.5	23.5	35.3	36.5
I-35-8	8.3	4.0	4.6	19.4
I-35-9	0.1	0.9	Gone	Gone
I-35-10	4.4	2.4	Gone	Gone
Sum of Cover	**109.1**	**99.3**	**86.4**	**157.6**

During spring sampling, velocity at individual stands ranged from 0.38 ft/sec. to 0.94 ft/sec and depths at all stands were deeper than 0.5 ft. Little root exposure from scouring was noted in this section, with only excessive scouring at stand # 4/5. Three stands, # 1, #3 and # 4, were noted in bloom. Floating vegetation on average was about 20%. For the Low-flow sampling event, velocities ranged from 0.10 ft/sec to 2.3 ft/sec. Root exposure was higher across the board with excessive exposure noted on stand # 2 and # 4/5. The occurrence of stands located in water less than 0.5 ft of depth was higher. As much as 30% of stand # 4/5 was located in water less than 0.5 ft depth and 100% of stand # 6 occurring out of the water. During the fall sampling event velocity ranged from 0.04 ft/ sec to 2.19 ft/sec with all stands returning to water depths deeper than 0.5 ft. Root exposure was still noted as medium in stands # 2 and # 4/5. Stand # 7 had excessive amounts of exposed roots and significant river bed scour around the upper portion of the stand.

Figure 14. Wading paths through Texas wild-rice were evident above Aquarena Springs Drive bridge.

Figure 15. Vulnerable stand # 6 emergent and dry during Low-flow sampling.

Veramendi Park

Total cover of vulnerable Texas wild-rice stands in Veramendi Park was highest in the spring sampling period and lowest in the Low-flow sampling event. The Texas wild-rice here is adjacent to a highly popular river access point. Although stands see minimal disturbances when flows are high, recreational pressure causes increased damage at low flows. All three stands saw declines in cover over the course of 2018 and an increase in fragmentation.

During the spring sample period, velocities ranged from 0.82 ft/ sec. to 1.3 ft/sec. All stands were noted occurring in water depths deeper than 0.5 ft. Stand # 1 was noted as having a high degree of root exposure. During the Low-flow sampling event, velocities ranged from 0.75 ft/ sec. to 1.03 ft/ sec with all stands still occurring in water deeper than 0.5 ft. Root exposure was noted as medium to excessive and signs of recreational damage were obvious with fragmentation being noted in each stand as well as thin growth. During the fall sampling event, velocities ranged from 0.88 ft/sec. to 1.23 ft/ sec. No stands were noted occurring in water less than 0.5 ft in depth but root exposure was high to excessive with large areas of streambed eroding from around the stands and a high degree of loss in other vegetation types (Figure 16)

Figure 16. Condition of vulnerable Texas wild-rice stands at Veramendi Park during fall 2018 showing high degree of bare substrate due to loss of vegetation in the area.

I-35 Reach

The overall loss of cover of vulnerable Texas wild-rice in this location continued through the beginning of 2018 and was evident during the Low-flow sampling in August. However, expansion of a few stands led to an increase in coverage by the fall sampling period. Stands # 9 and # 10 which had been decreasing steadily over the last few sampling periods were noted as completely gone by the Low-flow event (Figure 17). Stand # 4 rebounded from steady loss by fall increasing the total coverage to approximately 100 m^2 (Table 10).

Velocities for the spring sampling event ranged from 0. 14 ft/ sec to 2.05 ft/ sec. with no stands observed in water 0.5 ft deep or less. Root exposure was minimal except in stand # 10 which showed excessive exposure with roots barely attached to the substrate. Very few stands were in flower. During Low-flow sampling, velocities ranged from 0.11 to 1. 61 ft/sec with a few stands located in shallow water, 0.5 ft or less. Root exposure was minimal. Stands # 9 and # 10 were completely gone and stand # 4 was highly fragmented. During fall sampling velocities ranged from 0.17 to 1.07 ft/ sec. Root exposure was noted as medium. Expansion in cover was noted in stand # 4 and stand # 8 although expansion in the other stands remained minimal. Stand # 4 was likely expanded due to planting of Texas wild-rice in adjacent areas.

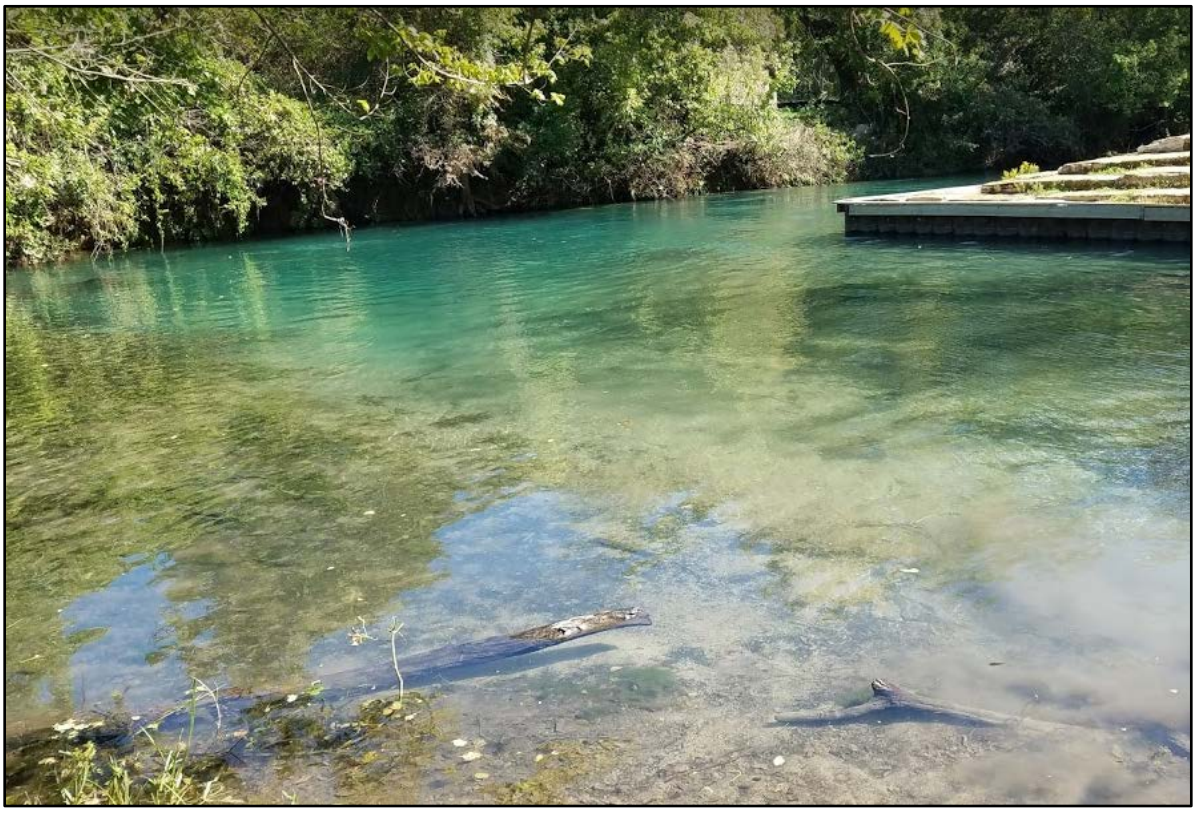


Figure 17. Former location of Texas wild-rice stand # 9 and stand #10 in the I-35 Study Reach during the fall 2018 observation.

Fountain Darter Sampling Results

Drop-net Sampling

In 2018, drop netting was conducted on the San Marcos River during the spring (April) and fall (October) routine sampling efforts. Drop-net raw data for 2018 are included in Appendix D. The number of drop-net sites and vegetation types sampled in each sample reach per event is presented in Table 11. Using drop nets, biologists captured 248 Fountain Darters in the San Marcos River in 2018, with 104 captured during spring and 149 in fall. This is an increase from the number of Fountain Darters observed in 2017 (n=210). Effort has varied only slightly between events with the number of Fountain Darters captured per sampling event ranging from 24 to 616 (mean=144) in 52 separate sampling events since the beginning of the comprehensive monitoring study in 2000.

Table 11. Drop-net sites and vegetation types sampled in each reach in the San Marcos River in 2018.

VEGETATION TYPE	SPRING (April 23–24)			FALL (October 17–19)			TOTALS
	Spring Lake Dam	City Park	I-35	Spring Lake Dam	City Park	I-35	
Potamogeton	2			2			4
Hydrilla		2	2		2		6
Hygrophila	2	2	2	2	2	2	12
Potamogeton/ Hygrophila		2			2		4
Hydrocotyle	2			2			4
Sagittaria	2	2	2	2	2	2	12
Cabomba			2			2	4
Ludwigia						2	2
Open	2	2	2	2	2	2	12
TOTALS	10	10	10	10	10	10	60

Submerged aquatic vegetation is a critical component of Fountain Darter habitat in the San Marcos River, as demonstrated by the observed density of Fountain Darters in open habitats (near zero) vs. vegetated habitats (1.9–7.7/m^2, Table 12). However, Fountain Darter density varies considerably both within and between various vegetation types. Long-term data reveals the highest densities of Fountain Darters of native vegetation types (*Cabomba* 7.7 /m^2) sampled, while *Hydrilla* (6.4 /m^2) showed the highest densities of Fountain Darters in nonnative vegetation types sampled in the San Marcos River. While these densities are similar, these aquatic plants are different in both structure and physical habitat requirements. *Cabomba* has a more complex leaf structure, and is typically found in low-velocity backwaters while *Hydrilla* is typically found in areas with more velocity. The macroinvertebrate assessment of the HCP biological monitoring program has also shown that *Cabomba* harbors the most Fountain Darter prey items (amphipods, true flies, mayflies, caddisflies) at both the City Park and I-35 reaches (this plant is not found at the Spring Lake Dam Reach); therefore, it is not surprising to find higher densities of Fountain Darters in this native species. Additionally, *Hydrocotyle* (5.2/m^2) is another native that has been observed to contain a higher density of Fountain Darters. This plant has a simple leaf structure but grows in very dense mats close to the substrate.

Table 12. Fountain Darter mean densities and one standard deviation from the mean per aquatic vegetation per meter squared (m^2) for all drop net samples collected in the San Marcos Springs / River system from 2000 through 2018.

Sample Type	Mean Density (m^2)	Standard Deviation
Open	0.0	0.3
Ludwigia	1.9	0.8
Potamogeton	2.1	14.1
Sagittaria	2.3	3.3
Potamogeton / Hygrophila	4.6	4.3
Hygrophila	4.9	5.3
Hydrocotyle	5.2	7.2
Hydrilla	6.4	11.4
Cabomba	7.7	6.3

Fountain Darter densities are generally lower in the San Marcos system than in the Comal system, in which certain vegetation types, such as bryophytes, exhibit higher mean densities (26.9 Fountain Darters/m^2) and an overall greater number of Fountain Darters (BIO-WEST 2019). Bryophytes provide dense cover at the substrate level and also harbor very large numbers of invertebrates on which Fountain Darters commonly feed. Spring Lake is the only reach in the San Marcos system that yields a relatively high abundance of bryophytes. Although Spring Lake is not sampled by drop netting, dip-net data confirms a high abundance of Fountain Darters in this vegetation type within the lake.

The length-frequency distributions for Fountain Darters collected by drop nets in the San Marcos system during spring and fall sampling events over the entire sampling period and specific to 2018 are presented in Figure 18. Laboratory studies have shown that Fountain Darters of 16 mm total length are approximately 63 days old (Brandt et al. 1993). Therefore, the presence of Fountain Darters at or below this size threshold suggests recent reproduction. Studies on Fountain Darter reproduction found that reproductive effort peaks in late winter/early spring and declines throughout the summer before beginning to increase in the fall (BIO-WEST 2014c). Both collection events in 2018 follow the long-term trend with spring collections from all reaches showing a larger proportion of small Fountain Darters and a peak in reproduction in early spring (Figure 18). In contrast, fall samples are usually dominated by larger individuals due to less recent reproductive activity. The overall similarities in patterns in 2018 confirms a consistent life-stage distribution relative to previous years.

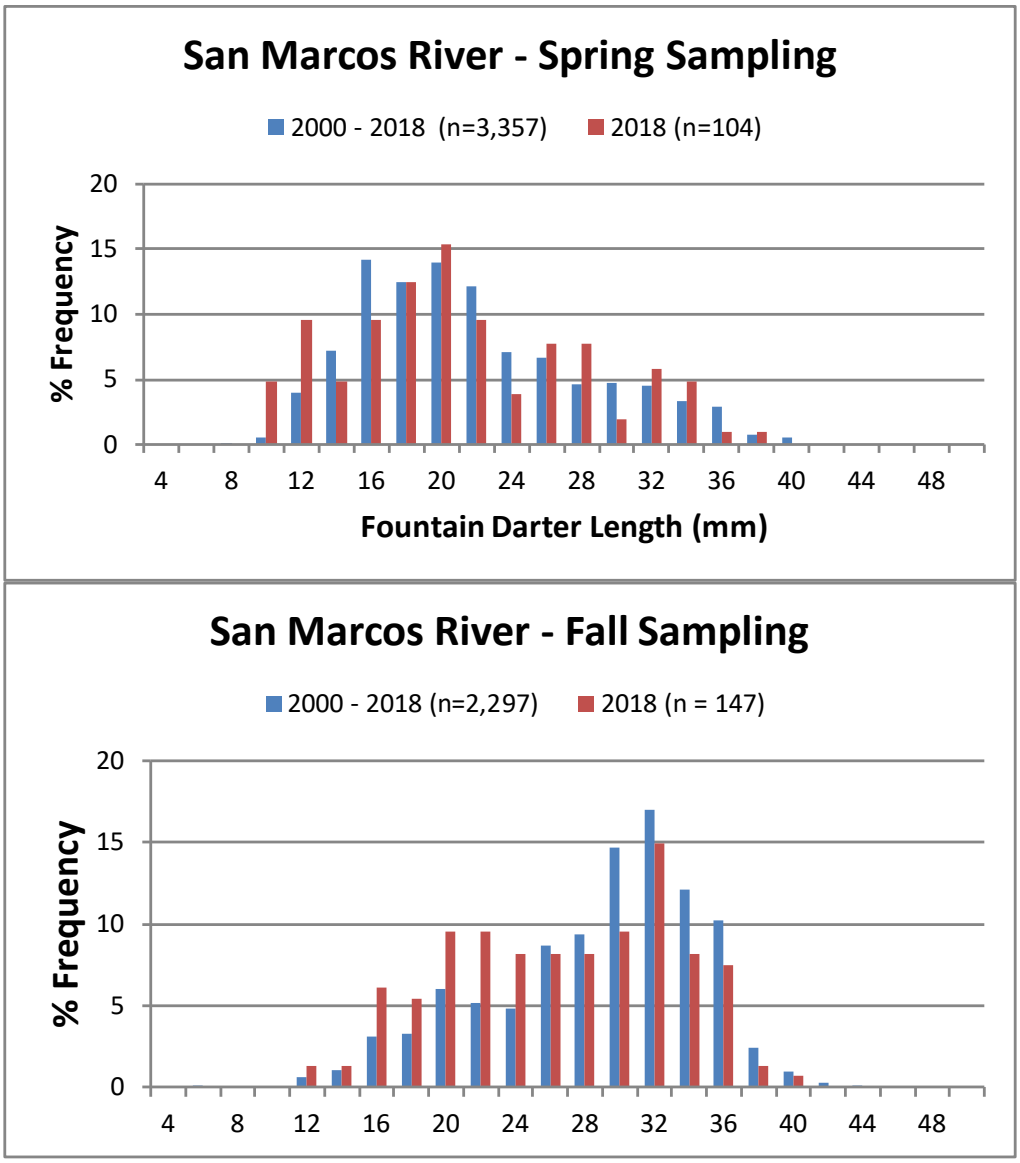


Figure 18. Length frequency distribution of Fountain Darters collected from the San Marcos system during all routine spring (top) and fall (bottom) drop-net events (2000–2018), and during 2018 only.

Fountain Darter normalized population estimates in all reaches (Figure 19) were based on vegetation composition and abundance, and the long-term average density of Fountain Darters found in sampled vegetation typed from 2000-2018. For the third consecutive year, both the spring and fall 2018 population estimates were lower than the long-term average and outside of one standard deviation from the mean. It was hypothesized in last year's annual report that the higher flow conditions experienced the past several years had been a deterrent to establishment and expansion of native aquatic vegetation (e.g. *Cabomba*) that provides quality Fountain Darter habitat. The return to average or slightly below average flows in 2018 did not immediately reverse this trend. An additional contributing factor might be the large increase in Texas wild-rice coverage in all sample reaches, which has more than doubled since fall 2014. This increase

is coupled with not sampling Texas wild-rice with the drop net and thus, not being able to generate densities in that habitat type.

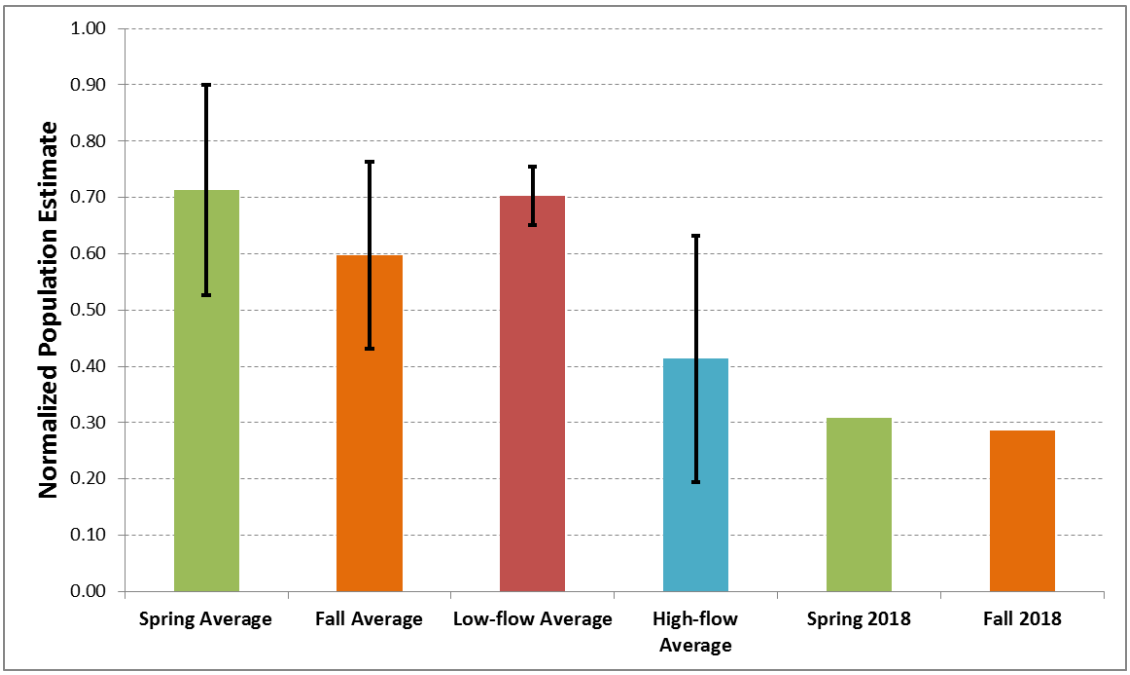


Figure 19. Normalized population estimate for all events 2000–2018. Long-term study averages are provided with error bars representing one standard deviation from the mean.

In addition to Fountain Darters, 53,591 fishes representing 27 other taxa have been collected by drop netting since 2000 (Table 13). Commonly captured exotic or introduced species collected in the San Marcos system include the Rock Bass *Ambloplites rupestris*, Rio Grande Cichlid *Herichthys cyanoguttatus*, Redbreast Sunfish *Lepomis auritus*, and the Sailfin Molly *Poecilia latipinna*. Although these species are not native to the system, most have been established for decades and negative impacts to the Fountain Darter have not been observed. The most common native fishes other than Fountain Darters collected include Mosquito Fish *Gambusia* spp., Redspotted Sunfish *Lepomis miniatus* and Yellow bullhead *Ameiurus natalis*.

Table 13. All fish collected in drop nets from 2000 to 2018.

Family	Scientific Name	Common Name	Status	Number Collected	
				2018	2000-2018
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar	N		1
Cyprinidae	*Campostoma anomalum*	Central Stoneroller	N	1	4
	Cyprinella venusta	Blacktail Shiner	N		6
	Dionda nigrotaeniata	Guadalupe Roundnose minnow	N	6	130
	Notropis amabilis	Texas Shiner	N		90
	Notropis chalybaeus	Ironcolor Shiner	N		131
	Notropis sp.	Unknown Shiner	N		5
Catostomidae	*Moxostoma congestum*	Gray Redhorse	N		2
Characidae	*Astyanax mexicanus*	Mexican Tetra	I	4	76
Ictaluridae	*Ameiurus melas*	Black Bullhead	N		4
	Ameiurus natalis	Yellow Bullhead	N	6	168
	Noturus gyrinus	Tadpole Madtom	N		4
Loricariidae	*Hypostomus plecostomus*	Suckermouth Catfish	I	1	65
Poeciliidae	*Gambusia* sp.	Mosquitofish	N	1,928	49,332
	Poecilia latipinna	Sailfin Molly	I	13	176
Centrarchidae	*Ambloplites rupestris*	Rock Bass	I		858
	Lepomis auritus	Redbreast Sunfish	I	18	118
	Lepomis cyanellus	Green Sunfish	N		13
	Lepomis gulosus	Warmouth	N	6	72
	Lepomis macrochirus	Bluegill	N	4	98
	Lepomis megalotis	Longear Sunfish	N		19
	Lepomis microlophus	Redear Sunfish	N		4
	Lepomis miniatus	Redspotted Sunfish	N	164	1,830
	Lepomis sp.	Sunfish	N/I	11	336
	Micropterus salmoides	Largemouth Bass	N	2	102
Percidae	*Etheostoma fonticola*	Fountain Darter	N	253	7,697
	Percina apristis	Guadalupe Darter	N		27
	Percina carbonaria	Texas Logperch	N		1
Cichlidae	*Herichthys cyanoguttatus*	Rio Grande Chichlid	I	21	244
	Oreochromis aureus	Blue Tilapia	I		16
[b]**Total**				2,438	61,629

a N=Native, I=Introduced.
b Includes Fountain Darters and unidentified fishes.

Dip-net Sampling

Dip-net Timed Surveys

Timed dip-net collections were conducted three times in the San Marcos River during 2018: April (spring), July (summer), and October (fall). Although only half the sampling time is spent in the Hotel Section (Spring Lake) compared with other sections, the overall number of Fountain Darters collected by dip netting there is typically greater than found in the other three sections. This was again true for all three surveys in 2018. Filamentous algae and bryophytes present in this area continue to provide the highest-quality habitat found in the San Marcos system via dense cover at the substrate level and also harboring very large numbers of invertebrates on which Fountain Darters commonly feed.

Almost all samples collected from the Hotel Section during the study period contained individuals in the smallest size class (5–15 mm). The presence of this size class suggests some reproduction is occurring in Spring Lake during all seasons. Spring Lake has an influx of spring fissures and upwellings, and heterogeneous vegetation. These habitat characteristics are thought to provide quality habitat for darters in the system and may explain the year-round reproduction. Fountain Darters within this size class are more sporadically observed in the other sections within the San Marcos River and are often found only in spring collections. This may suggest lower recruitment in these downstream sections highlighting the importance of habitats in Spring Lake to the overall stability of the Fountain Darter population.

Fountain Darter abundances collected in 2018 timed dip-net samples in Spring Lake were consistent to what has been observed in the past with 59 Fountain Darters collected in spring, 60 in summer, and 48 in the fall (the average of 2000–2018 for the Hotel site is 62). Within the City Park section, abundances observed in 2018 during timed dip-net surveys were higher than all 2017 surveys with 29, 39, 33 Fountain Darters collected in the spring, summer and fall, respectively. This is much closer to the average number collected from 2000-2018 of 36 darters per sample for the City Park section. In the I-35 reach, abundances observed were equal to or above average (n=37) for all samples. Forty-three Fountain Darters were collected in the spring, 37 in the summer and 44 in the fall.

Observed abundance of Fountain Darters is generally lower and more variable in the lower portion of the river near Todd Island (2009-2018 Average=5). In fact, no Fountain Darters were collected in the lower section in 2018. Habitat (sparse patches of submerged *Hygrophila* and filamentous algae) within this reach fluctuates drastically based on flow conditions and land use in the area. High flows result in excessive scouring, whereas low flows often result in portions of the sampling area being trampled by cattle entering the river for water. Occurrence of Fountain Darter in this lower section is essentially dependent on availability of submerged aquatic vegetation, which fluctuates based on the above-mentioned factors. When such habitat is present within the sampled areas, Fountain Darters are typically present, though never abundant. Additionally, competitive interactions with the Orangethroat Darter *Etheostoma spectabile*, a congener of the Fountain Darter, which also occurs in this segment of the San Marcos River, may influence Fountain Darter populations in this area.

Random-station Dip-net Surveys

Random-station presence/absence dip netting was conducted on the San Marcos River during the spring (April), summer (July), and fall (October) sampling events in 2018. Fountain Darters were present at 34% of sites in spring (Figure 20) which is equal to the lowest percentage ever observed in Fall 2017. This number increased to 42% during the July summer event, and increased again to 48% during the fall event. Figure 20 shows the variation observed in this metric since 2006. The average percent of sites occupied by Fountain Darters during comprehensive sampling is 54%, and the blue lines show the 5th and 95th percentiles of the comprehensive sampling data. To date, only four samples have occurred outside of this range from the 2006 to 2018 time-period. The percent of occupied sites was 36% in fall 2009 after total flows increased following a period of sustained low flows in 2008–2009, and was highest in summer 2014 (78%), during a period of sustained lower-than-average flows. The fall 2017 sample and all 2018 samples were taken after a long period of above-average flows in 2015, 2016 and most of 2017 that has not been seen since presence/absence dip netting began in 2006

(Figure 5). The upward trend in 2018 may represent a response to improved aquatic vegetation conditions during more average mean monthly discharge conditions.

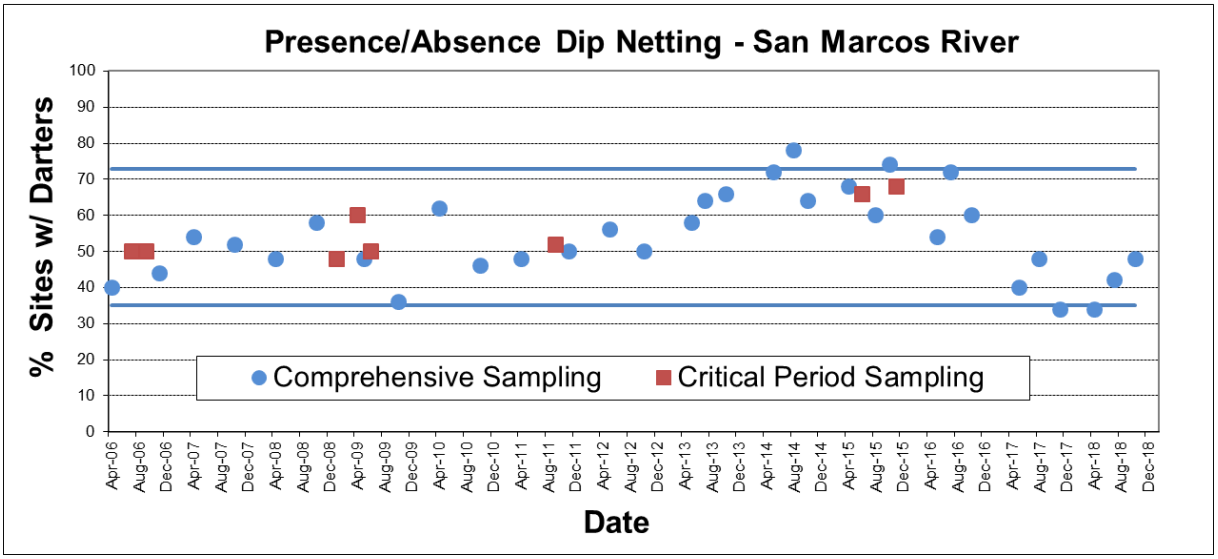


Figure 20. Percentage of sites (n=50) in which Fountain Darters were present. Solid blue lines mark 5th and 95th percentiles of comprehensive sampling data.

Fish Community Sampling

Thirty-three species of fishes and 7,705 individuals were identified and enumerated among four locations in the San Marcos River during spring and fall 2018 (Table 14). The Mexican Tetra *Astyanax mexicanus* (23%) and Largespring Gambusia *Gambusia geiseri* (23%) were the most abundant species, representing approximately 46% of all individuals in 2018. Other abundant species included the Guadalupe Roundnose Minnow *Dionda nigrotaeniata* (18%), Fountain Darter (6%) and Redbreast Sunfish *Lepomis auratus* (4%). Uncommon species in 2018 collections included Central Stoneroller *Campostoma anomalum* (1 individual), Gray Redhorse *Moxostoma congestum* (1 individual), and Black Bullhead *Ameiurus melas* (1 individual). The Black Bullhead was the first individual of this species collected in fish community sampling.

An increase in abundance was seen in 2018 following the decline observed in 2017. The community in 2018 generally resembled assemblages from 2015 and 2016. Similar to the Fountain Darter, elevated flows observed in 2017 may have also led to a decrease in the overall numbers in the fish community. For example, the Guadalupe Roundnose Minnow experienced substantial declines in 2017, but improved to about 50% of the 2015 and 2016 abundance estimates. Elevated flows may have led to the short-term decline of similar species (e.g., pelagic), or they simply sought flow refuges, such as undercut banks, decreasing detectability. Nonetheless, the increase in community abundance exemplifies the resiliency of upper San Marcos fishes.

Fish community sampling from 2013 to 2018 in the San Marcos River has resulted in collection of 27,843 fishes representing 36 different species. In contrast, the San Marcos River drop-net database (2000–2018) contains 61,629 fishes representing 28 species. Higher species richness within the fish community dataset is likely a result of both sampling technique and location.

Seining and visual observation are more effective at enumerating large or highly mobile species such as Centrarchids, Cyprinids, or Characids. Additionally, fish community sampling is conducted much lower in the system than drop netting, which does not extend below I-35. As a result, riverine fishes characteristic of downstream areas are more abundant within fish community data than drop-net data. Species identified in fish community sampling that are not present within the drop-net database include Common Carp *Cyprinus carpio*, Burrhead Chub *Macrhybopsis marconis*, Mimic Shiner *Notropis volucellus*, Bullhead Minnow *Pimephales vigilax*, Channel Catfish *Ictalurus punctatus*, Amazon Molly *Poecilia latipinna*, and Orangethroat Darter *Etheostoma spectabile*. Only one species, Tadpole Madtom *Noturus gyrinus* is present in the drop-net dataset but not in the fish community dataset.

Table 14. Number (#) and percent relative abundance (%) of fish species captured in fish community sampling during 2015–2018 compared to drop-net data from 2000–2018. N=native and I=Introduced.

FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS	DROP NET (2000–2018)		FISH COMMUNITY (2015–2018)					
				Total #	Total %	2015 #	2016 #	2017#	2018#	Total #	Total %
Lepisosteidae	*Lepisosteus oculatus*	Spotted Gar	N	1	0.00	9	3	1	0	13	0.05
Cyprinidae	*Campostoma anomalum*	Central Stoneroller	N	4	0.01	0	2	0	1	3	0.01
	Cyprinella venusta	Blacktail Shiner	N	6	0.01	286	116	123	210	735	2.81
	Dionda nigrotaeniata	Guadalupe Roundnose Minnow	N	130	0.21	2,394	2,690	336	1,407	6,827	26.14
	Macrhybopsis marconis	Burrhead Chub	N	0	0.00	1	0	0	0	1	0.00
	Notropis amabilis	Texas Shiner	N	90	0.15	23	14	42	162	241	0.92
	Notropis chalybaeus	Ironcolor Shiner	N	131	0.21	10	54	4	52	120	0.46
	Notropis volucellus	Mimic Shiner	N	0	0.00	0	0	0	4	4	0.02
	Notropis sp.	Unknown shiner	N	5	0.01	0	0	0	0	0	0.00
	Pimephales vigilax	Bullhead Minnow	N	0	0.00	5	0	3	17	25	0.10
Catostomidae	*Moxostoma congestum*	Gray Redhorse	N	2	0.00	40	2	6	1	49	0.19
Characidae	*Astyanax mexicanus*	Mexican Tetra	I	76	0.12	2,757	1,177	380	1,785	6,099	23.35
Ictaluridae	*Ameiurus melas*	Black Bullhead	N	4	0.01	0	0	0	1	1	0.00
	Ameiurus natalis	Yellow Bullhead	N	168	0.27	13	2	0	2	17	0.07
	Ictalurus punctatus	Channel Catfish	N	0	0	6	3	0	1	10	0..04
	Noturus gyrinus	Tadpole Madtom	N	4	0.01	0	0	0	0	0	0.00
Loricariidae	*Hypostomus plecostomus*	Armadillo Del Rio	I	65	0.11	179	68	111	97	455	1.74
Poeciliidae	*Gambusia affinis*	Western Mosquitofish	N	-	-	13	13	3	52	81	0.31
	Gambusia geiseri	Largespring Gambusia	N	-	-	640	943	381	1,766	3,730	14.28
	Gambusia sp.	Mosquitofish	N	49,332	80.05	349	369	27	402	1,147	4.39
	Poecilia latipinna	Sailfin Molly	I	176	0.29	26	39	1	29	95	0.36
	Poecilia formosa	Amazon Molly	I	0	0.00	0	3	0	1	4	0.02
Centrarchidae	*Ambloplites rupestris*	Rock Bass	I	858	1.39	4	12	7	16	39	0.15
	Lepomis auritus	Redbreast Sunfish	I	118	0.19	450	264	174	331	1,219	4.68

	Lepomis cyanellus	Green Sunfish	N	13	0.02	0	4	2	1	7	0.03
	Lepomis gulosus	Warmouth	N	72	0.12	4	9	0	2	15	0.06
	Lepomis macrochirus	Bluegill	N	98	0.16	263	81	67	156	567	2.17
	Lepomis megalotis	Longear Sunfish	N	19	0.03	56	38	4	6	104	0.40
	Lepomis microlophus	Redear Sunfish	N	4	0.01	338	39	19	38	434	1.66
	Lepomis miniatus	Redspotted Sunfish	N	1,830	2.97	40	44	13	48	145	0.56
	Lepomis sp.	Sunfish	N/I	336	0.55	287	248	143	412	1,090	4.17
	Micropterus salmoides	Largemouth Bass	N	102	0.17	290	144	103	194	731	2.80
	Micropterus sp.	Unknown Bass		0	0.00				6	6	0.02
Percidae	*Etheostoma fonticola*	Fountain Darter	N	7,697	12.49	481	541	145	366	1,533	5.87
	Etheostoma spectabile	Orangethroat Darter	N	0	0	62	15	16	23	116	0.44
	Percina apristis	Guadalupe Darter	N	27	0.04	75	57	54	54	240	0.92
	Percina carbonaria	Texas Logperch	N	1	0.00	50	5	7	16	78	0.30
	Percina sp.	Unkown Percina	N	0	0	1	3	0	0	4	0.02
Cichlidae	*Herichthys cyanoguttatus*	Rio Grande Cichlid	I	244	0.40	51	17	18	39	125	0.48
	Oreochromis aureus	Blue Tilapia	I	16	0.03	4	0	0	7	11	0.04
Totals				61,629		9,207	7,019	2,190	7,705	26,121	

Nine non-native species are present within the long-term fish community dataset. Of these, Blue Tilapia *Oreochromis aurea* and two taxa of exotic Loricariid Catfishes (*Hypostomus* and *Pterygoplichthys*) are considered the most invasive. An ongoing HCP-sponsored nonnative removal program is focusing on removing these species from the system. Relative abundance and catch-per-unit-effort (CPUE) for both of these species has been variable over the past five years, and no distinct trends in abundance are apparent. Continued monitoring will be important to assess the long-term effectiveness of non-native removal programs.

San Marcos Salamander Visual Observations

In 2018, sampling events for the San Marcos Salamander were conducted during both the routine sampling events (spring and fall). Biologists observed 287 San Marcos salamanders for the spring sampling and 246 salamander observations in the fall sampling for a total of 533 salamander observations. San Marcos salamander densities observed during the spring and fall sampling events in 2018 were equal to or higher than the long-term averages at both the Hotel Site (Site 2) (Figure 21) and Riverbed (Site 14) (Figure 23). In fact, both spring surveys for the Hotel and Riverbed sites were the second highest observed for those sites since this sampling began in 2000. Conversely, at the Spring Lake Dam Site (Site 21), salamander observations were below the long-term average but within one standard deviation for both spring and fall events (Figure 22), which is not surprising considering the natural and human-induced modifications to habitat that presently occurs at this location.

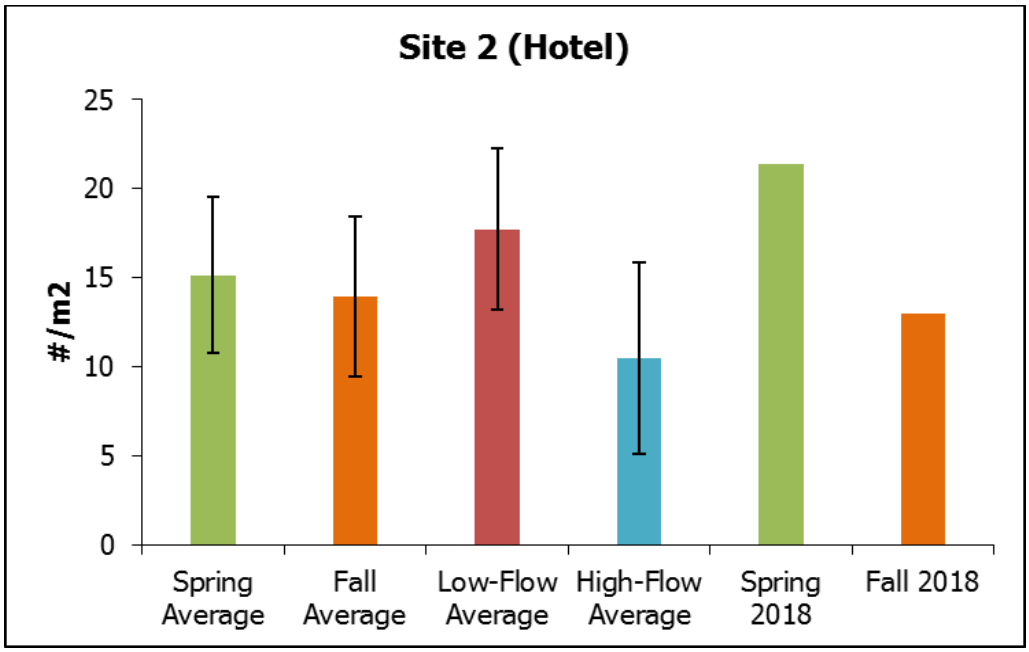


Figure 21. **San Marcos salamander observations at Site 2 (Hotel Site) in 2018. Long-term monitoring averages are provided with error bars representing one standard deviation of the mean.**

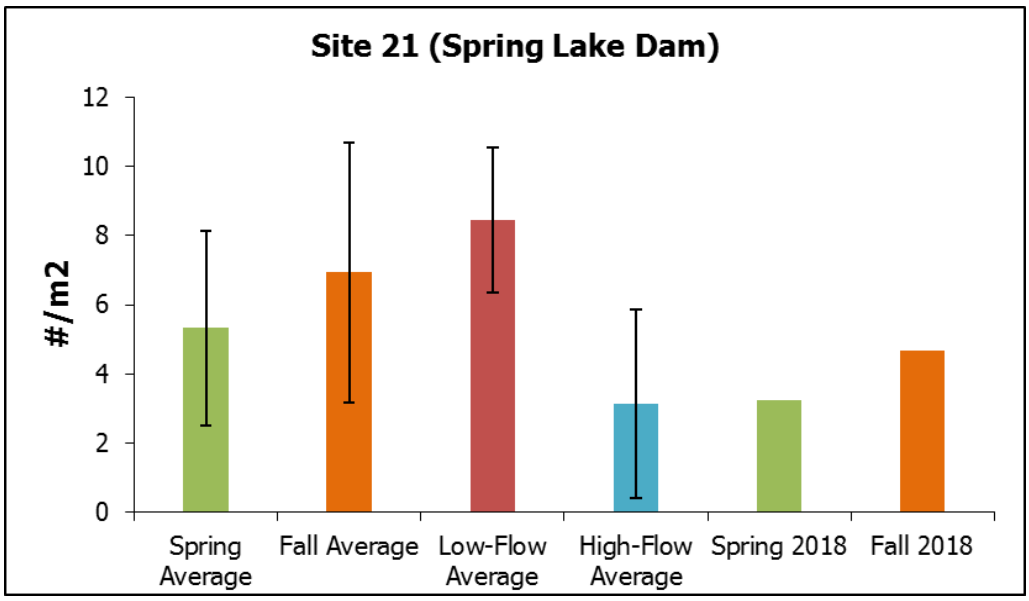


Figure 22. **San Marcos salamander observations at Site 21 (Spring Lake Dam Site) in 2018. Long-term monitoring averages are provided with error bars representing one standard deviation of the mean.**

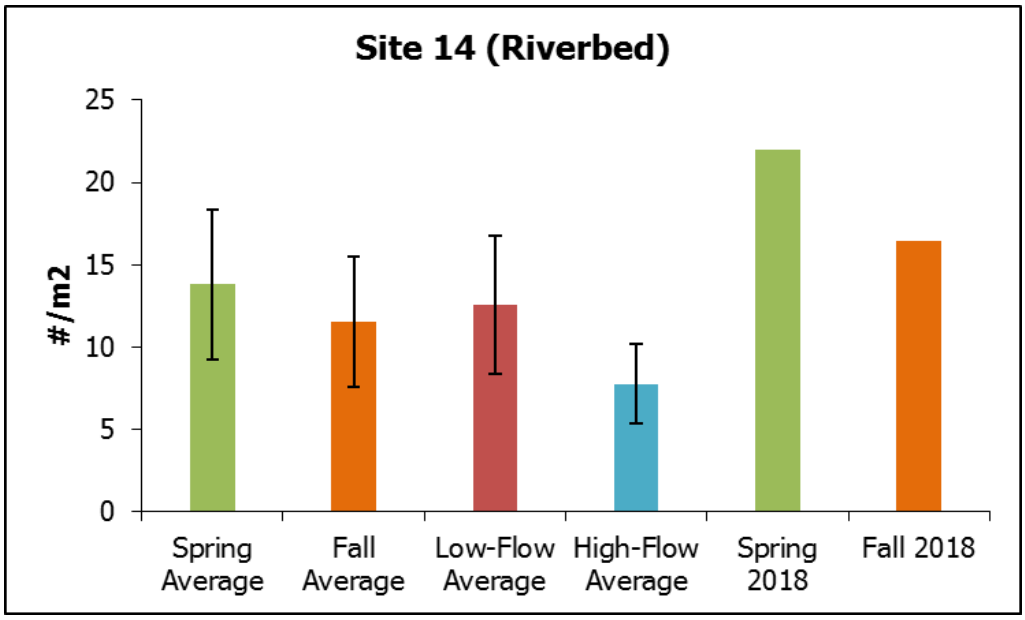


Figure 23. San Marcos salamander observations at Site 14 (Riverbed Site) in 2018. Long-term monitoring averages are provided with error bars representing one standard deviation of the mean.

Benthic Macroinvertebrate Rapid Bioassessment

Benthic macroinvertebrate rapid Bioassessment data was collected during both the spring and fall sampling events in 2018 (raw data presented in Appendix C). A total of 1,063 and 1,066 individual macroinvertebrates, representing 45 and 50 unique taxa were sampled in spring and fall, respectively. Altogether, 58 unique taxa were represented among all samples from 2018. Values for each metric are reported, while metric scores for calculating the B-IBI can be found in Table 15. Figures for each metric can be found in Appendix C. All samples in 2018 consisted of kick samples with suitable cobble-gravel habitat with no snag sampling supplements.

Table 15. Metric value scoring ranges for calculating the Texas RBP B-IBI (TCEQ 2014).

METRIC	SCORING CRITERIA			
	4	3	2	1
Taxa richness	>21	15–21	8–14	<8
EPT taxa abundance	>9	7–9	4–6	<4
Biotic index (HBI)	<3.77	3.77–4.52	4.56–5.27	>5.27
% Chironomidae	0.79–4.10	4.11–9.48	9.49–16.19	<0.79 or >16.19
% Dominant taxon	<22.15	22.15–31.01	31.02–39.88	>39.88
% Dominant FFG	<36.50	36.50–45.30	45.31–54.12	>54.12
% Predators	4.73–15.20	15.21–25.67	25.68–36.14	<4.73 or >36.14
Ratio of intolerant: tolerant taxa	>4.79	3.21–4.79	1.63–3.20	<1.63
% of total Trichoptera as Hydropsychidae	<25.50	25.51–50.50	50.51–75.50	>75.50 or no Trichoptera
# of non–insect taxa	>5	4–5	2–3	<2
% Collector–gatherers	8.00–19.23	19.24–30.46	30.47–41.68	<8.00 or >41.68
% of total number as Elmidae	0.88–10.04	10.05–20.08	20.09–30.12	<0.88 or >30.12

The overall results of this metric analysis contribute to the B-IBI scores and assessment of the aquatic-life-use (Figure 24). Spring Lake and City Park were described from these assessments

as being “Limited” or “Intermediate” in supporting a balanced, integrated, adaptive community of organisms. Spring Lake Dam and I-35 showed “Exceptional” support for aquatic life in both seasons.

In summary, areas of more lentic -type habitat (e.g. Spring Lake), scored lower as these communities are naturally different compared to swift flowing “least-disturbed reference streams.” Downstream and tailwater areas with more lotic conditions generally scored higher, as habitat is more similar to reference streams. It should also be noted that most reference streams do not exhibit the stenothermal conditions present within the upper San Marcos River, and this may result in differing community composition. Additional monitoring will allow development of a reference dataset, specific to this unique ecosystem. Comparison to other spring systems not as strongly influenced by anthropogenic activities could be useful for developing a more specific assessment tool for these systems.

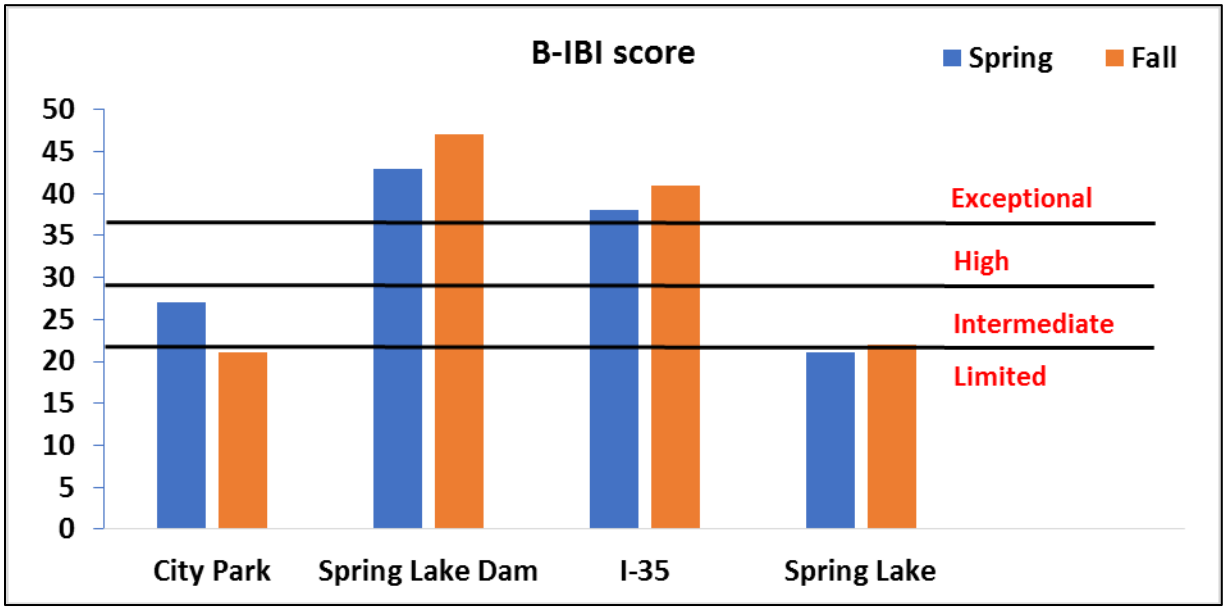


Figure 24. Benthic macroinvertebrate Index of Biotic Integrity (B-IBI) scores and aquatic-life-use point-score ranges for San Marcos River sample sites. “Exceptional” indicates highest quality habitats.

CONCLUSION

The results from this 2018 report provide valuable data to further assess temporospatial shifts among aquatic floral and faunal communities of the upper San Marcos system; specifically showing conditional differences in biotic assemblages following consecutive years of elevated flows. Stream discharge monthly averages in 2018 diminished to similar historic levels and were more stable relative to recent years. As a result, typical trends in water temperature were observed throughout the study period.

Repeated changes in flow regime (drought in 2013 to 2014 and high flows 2015 to 2017) coupled with active restoration of the native aquatic plants resulted in notable changes to the aquatic vegetation community of the San Marcos River between 2013 and 2018. Aquatic vegetation coverages within the long-term biological goal reaches were variable along the river continuum with overall coverages in 2018 similar to 2017. Trends in overall aquatic vegetation coverage in the study reaches continue to be cyclical, with curtailment often associated with elevated flows and recreational disturbance. Texas wild-rice coverage surpassed 10,000 m^2 in the spring for the first time ever and remained above 9,000 m^2 following the summer recreational period. The increase in Texas wild-rice coverage throughout the upper San Marcos River is encouraging for the long-term persistence of this endangered species and the vegetation community as a whole.

Fish community and Fountain Darter dip net results exhibited an increase in abundance since 2017, while normalized Fountain Darter population estimates via drop net sampling remained low for the third consecutive year. Although downward trends in Fountain Darter drop net population size and occurrence were observed, recent recruits 15 mm or less were present at all sites sampled. This documents that adults are still successfully spawning and juveniles are surviving. It was previously hypothesized that increased flows may have impeded key vegetation utilized by Fountain Darters, which may also be exacerbated by recreational disturbance. Future examination on the relationships between hydrology/aquatic vegetation coverage and Fountain Darter population size should help elucidate mechanisms that cause population declines and resurgences.

In 2018, the San Marcos Salamander densities observed in Spring Lake were equal to or higher than historic averages. In the spring specifically, densities were the second highest since 2000, supporting that Spring Lake remains a healthy ecosystem. The low B-IBI scores observed during Spring Lake macroinvertebrate sampling contradicts this notion, however as discussed, that metric is not as appropriate for lacustrine systems compared to riverine sites, such as Spring Lake Dam and I-35. Additional data in the years to come will be helpful for establishing metric values that are more appropriate for Spring Lake.

Overall, 2018 observations of habitat and species condition remain excellent in Spring Lake, while variable conditions continue in the river. Long-term monitoring of the upper San Marcos River will continue to provide useful information on the status of aquatic communities and the mechanisms that influence demographic trends that will help continue appropriate and practical management practices that aid in conserving this unique ecosystem.

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APPENDIX A: CRITICAL PERIOD MONITORING SCHEDULES

SAN MARCOS RIVER/SPRINGS
Critical Period Low-Flow Sampling – Schedule and Parameters

FLOW TRIGGER (+ or - 5 cfs)	**PARAMETERS**
120 cfs	Wild Rice vulnerable stands - Every 5 cfs decline (maximum weekly)
100 cfs	Full Sampling Event
100 cfs - 85 cfs	Habitat Evaluations - Every 5 cfs decline (maximum weekly)
85 cfs	Full Sampling Event
85 cfs - 60 cfs	Habitat Evaluations - Every 5 cfs decline (maximum weekly)
60 cfs	Full Sampling Event
60 cfs - 25 cfs	Habitat Evaluations - Every 5 cfs decline (maximum weekly)
25 cfs	Full Sampling Event
25 cfs - 0 cfs	Habitat Evaluations - Every 5 cfs decline (maximum weekly)
10 - 0 cfs	Full Sampling Event
RECOVERY	
25 cfs - 85 cfs	Full Sampling Event (dependant on flow stabilization)
85 cfs - 125 cfs	Full Sampling Event (dependant on flow stabilization)

PARAMETER DESCRIPTION

Wild Rice Monitoring	Physical changes vulnerable stands
Full Sampling Event	Aquatic Vegetation Mapping - including Texas Wild-Rice Fountain Darter Sampling Drop Net, Dip net (Presence/Absence), and Visual Parasite evaluations Fish Community Sampling Salamander Sampling - Visual Fish sampling - Exotics / Predation (85 cfs and below) Water Quality - Suite I and Suite II
Habitat Evaluations	Photographs

SAN MARCOS RIVER/SPRINGS
Species-Specific Triggered Sampling

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 fifteen (15) sites in Spring Lake Dam reach; twenty (20) sites in City Park reach, and fifteen (15) 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 sampling/visual parasite evaluations at 50 sites in high quality habitat to include fifteen (15) sites in Spring Lake Dam reach; twenty (20) sites in City Park reach, and fifteen (15) 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

APPENDIX B: AQUATIC VEGETATION MAPS

APPENDIX B-1: AQUATIC VEGETATION MAPS

Full System – San Marcos

San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Spring 2018

Surveyed: Feb. 26 - April 05, 2018

2018 *Zizania texana* Cover
for Full System = 10,228.3 m²

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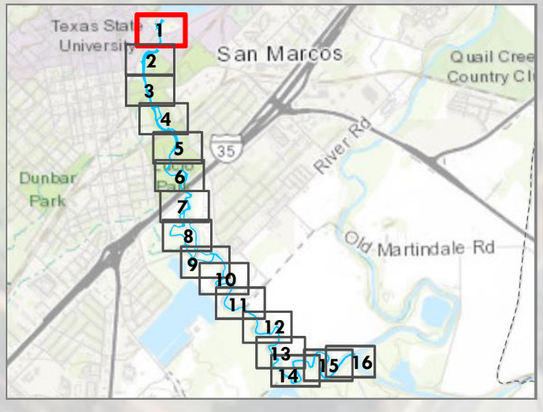

FULL SYSTEM MAP

- San Marcos River
- Study Reach
- Zizania texana
- Bryophyte
- Algae
- Bacopa
- Cabomba
- Canna
- Ceratopteris
- Colocasia
- Eicchornia
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- Hydrilla
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- Nasturtium
- Nuphar
- Pontederia
- Potamogeton
- Sagittaria
- Vallisneria
- Zizaniopsis

N

0 50 100 200 ft
0 10 20 40 m

1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

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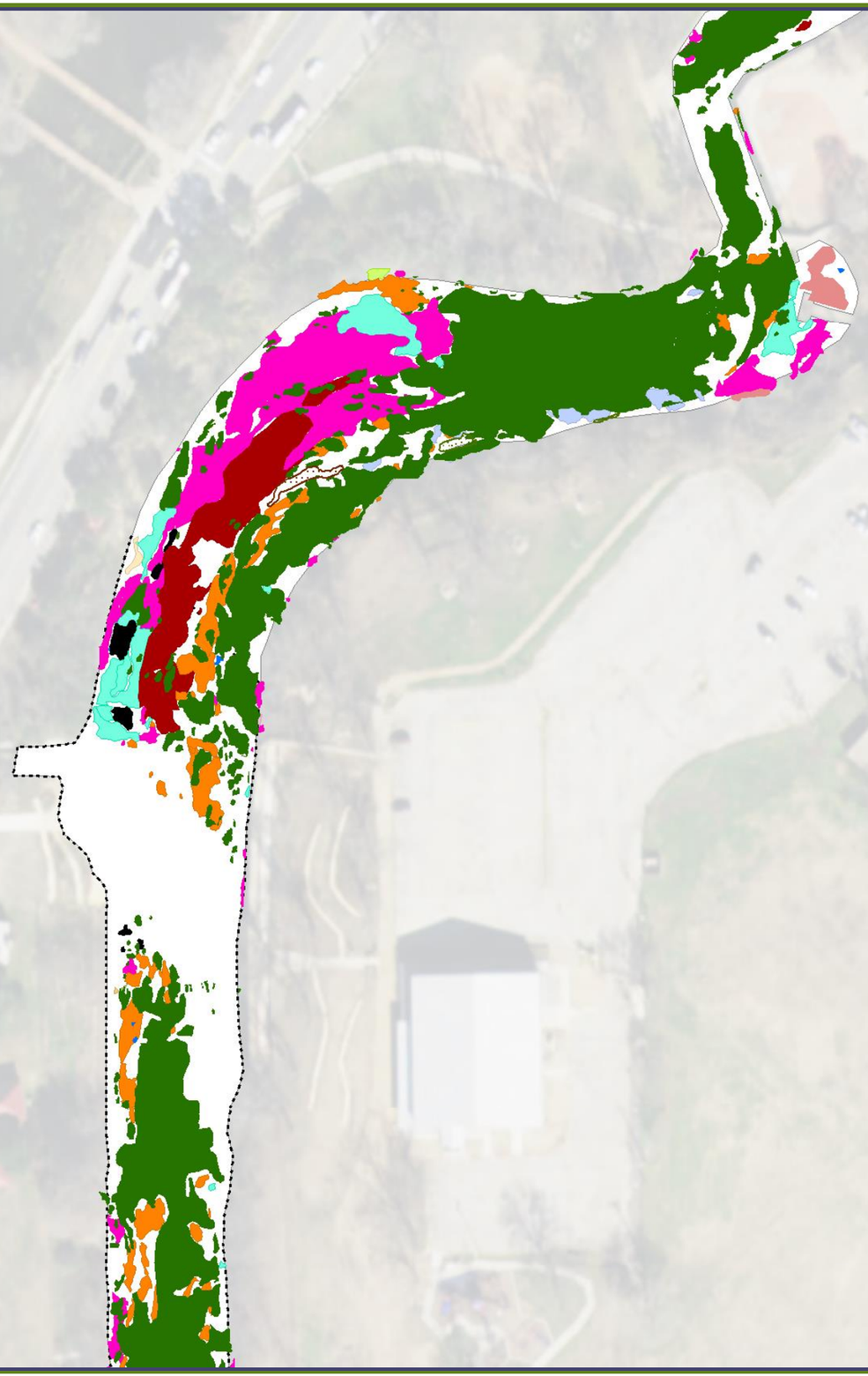

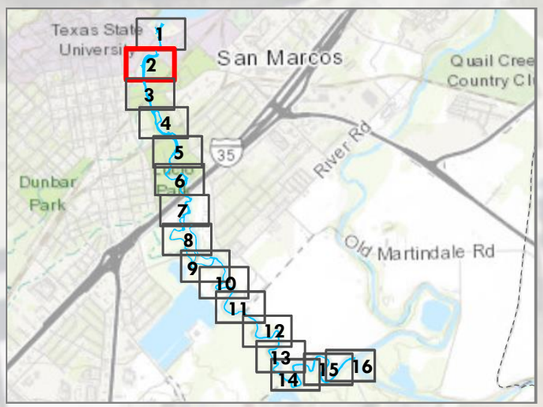

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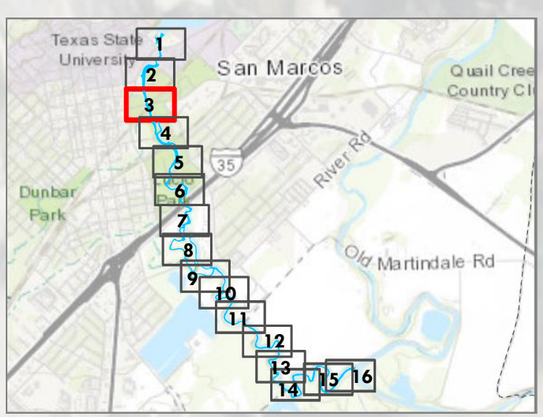

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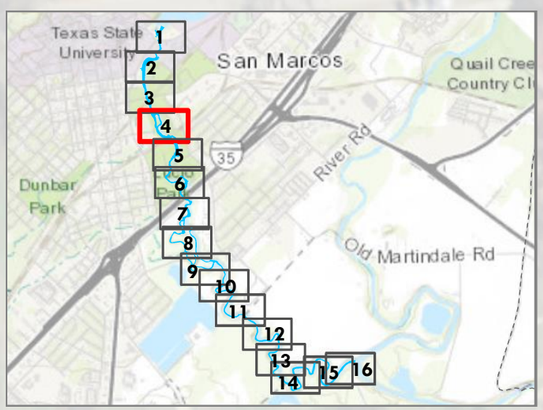

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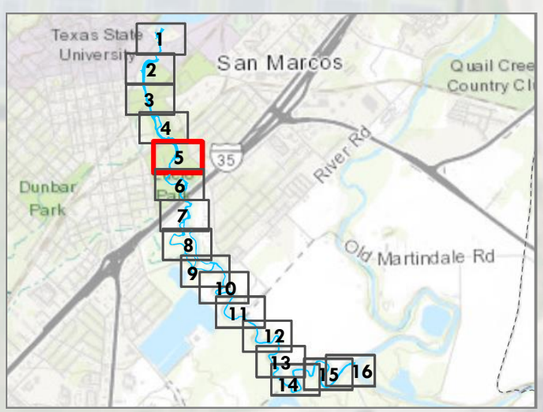

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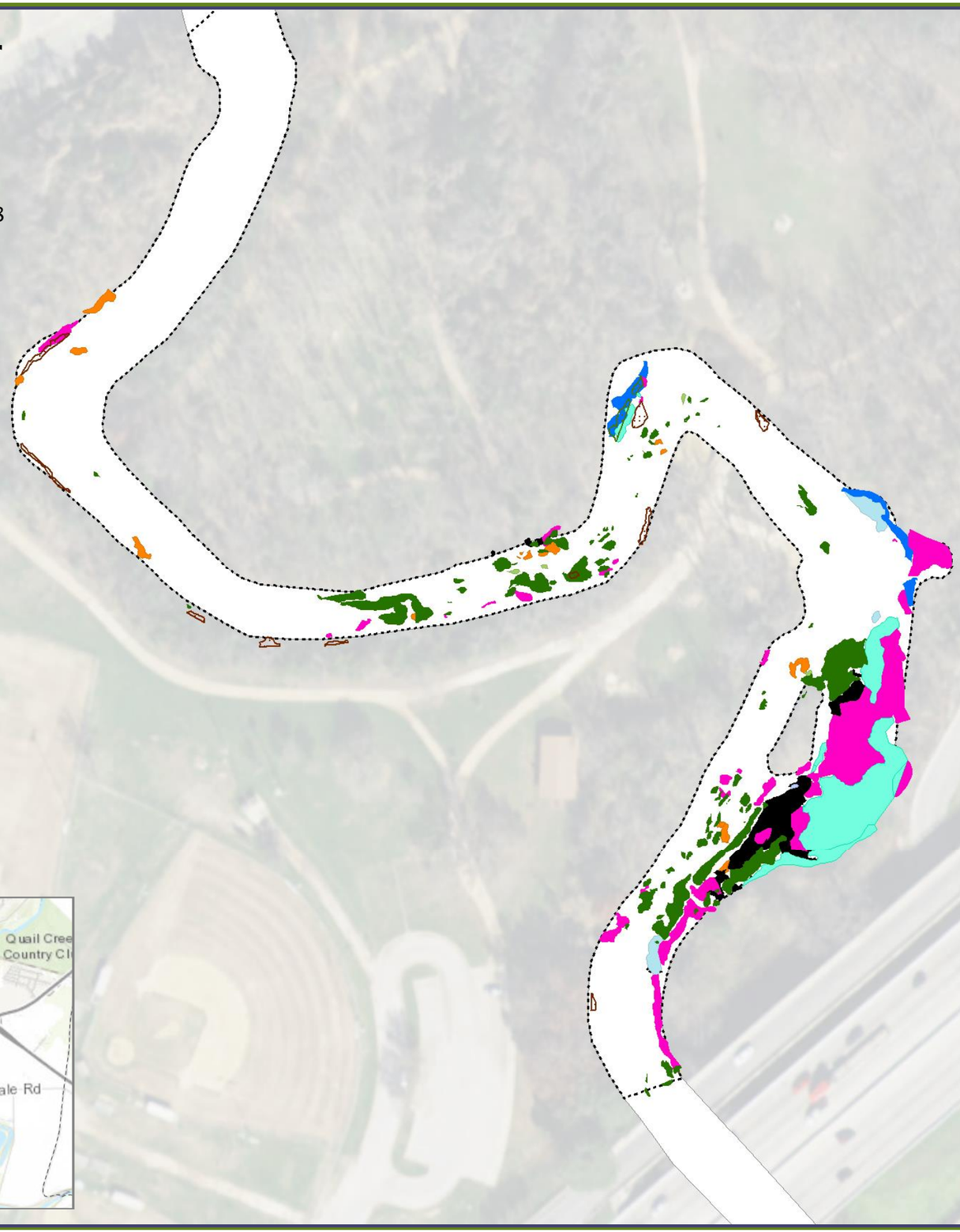

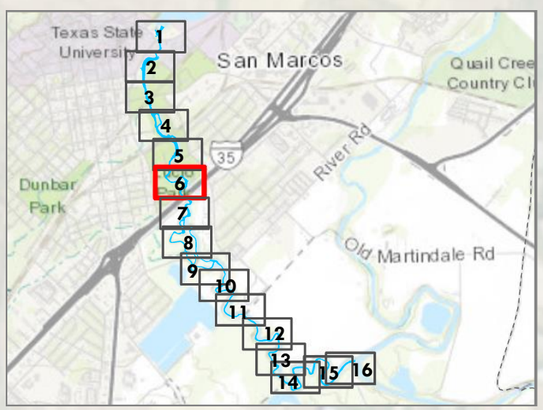

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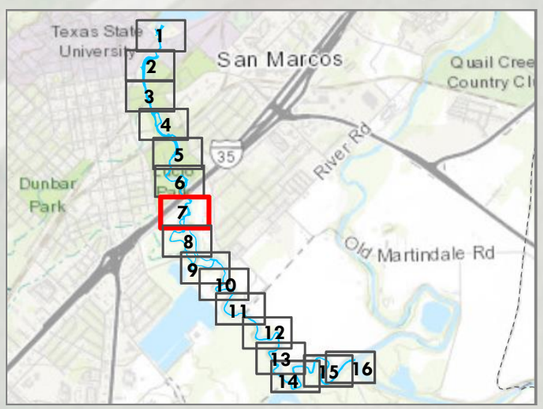

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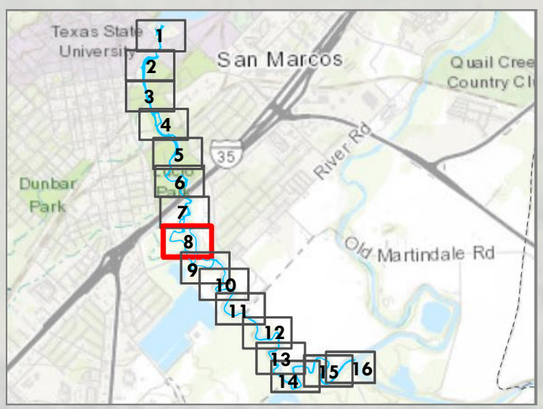

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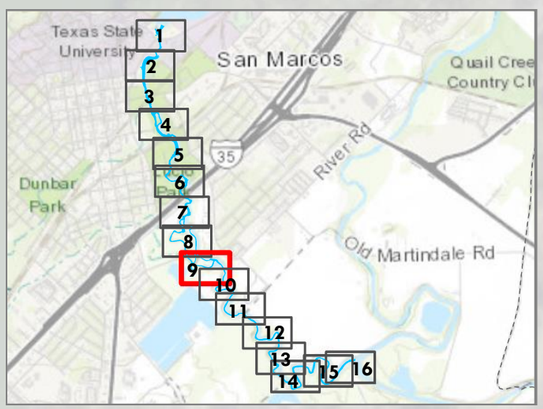
- Zizaniopsis



N

0 50 100 200 ft
0 10 20 40 m
1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Spring 2018

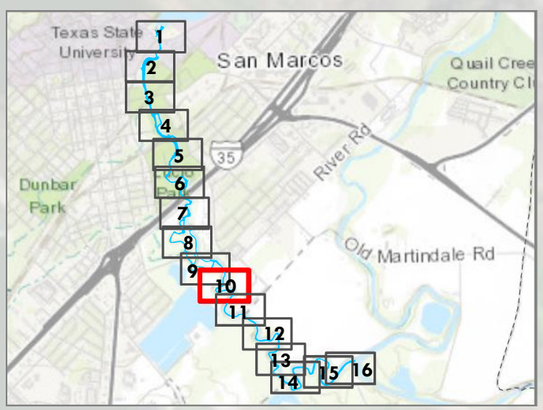
Surveyed: Feb. 26 - April 05, 2018

2018 *Zizania texana* Cover
for Full System = 10,228.3 m²

BIO-WEST
www.bio-west.com
512.990.3954

FULL SYSTEM MAP

- San Marcos River
- Study Reach
- Zizania texana
- Bryophyte
- Algae
- Bacopa
- Cabomba
- Canna
- Ceratopteris
- Colocasia
- Eicchornia
- Heteranthera
- Hydrilla
- Hydrocotyle
- Hygrophila
- Limnophila
- Ludwigia
- Myriophyllum aquaticum
- Myriophyllum heterophyllum
- Nasturtium
- Nuphar
- Pontederia
- Potamogeton
- Sagittaria
- Vallisneria
- Zizaniopsis



N

0 50 100 200 ft
0 10 20 40 m

1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Spring 2018

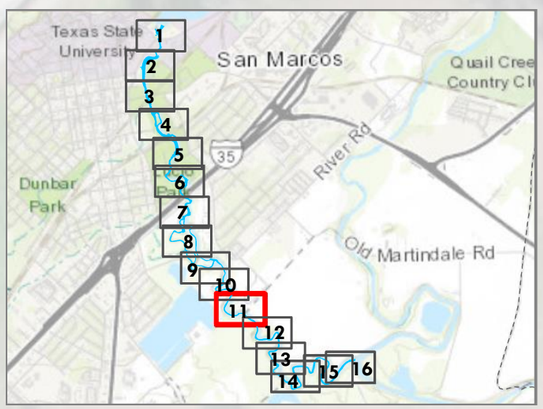
Surveyed: Feb. 26 - April 05, 2018

2018 *Zizania texana* Cover
for Full System = 10,228.3 m²

BIO-WEST
www.bio-west.com
512.990.3954

FULL SYSTEM MAP

- San Marcos River
- Study Reach
- Zizania texana
- Bryophyte
- Algae
- Bacopa
- Cabomba
- Canna
- Ceratopteris
- Colocasia
- Eicchornia
- Heteranthera
- Hydrilla
- Hydrocotyle
- Hygrophila
- Limnophila
- Ludwigia
- Myriophyllum aquaticum
- Myriophyllum heterophyllum
- Nasturtium
- Nuphar
- Pontederia
- Potamogeton
- Sagittaria
- Vallisneria
- Zizaniopsis



N

0 50 100 200 ft
0 10 20 40 m
1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Spring 2018

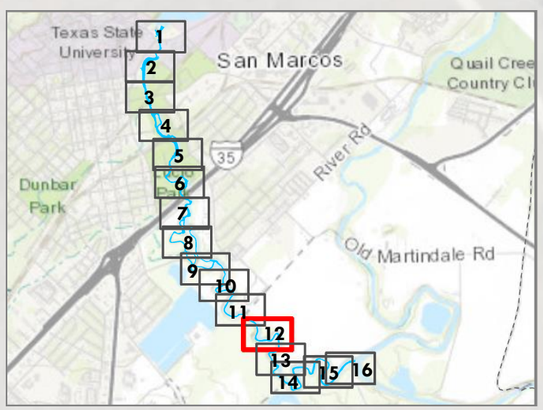
Surveyed: Feb. 26 - April 05, 2018

2018 *Zizania texana* Cover
for Full System = 10,228.3 m²

BIO-WEST
www.bio-west.com
512.990.3954

FULL SYSTEM MAP

- San Marcos River
- Study Reach
- Zizania texana
- Bryophyte
- Algae
- Bacopa
- Cabomba
- Canna
- Ceratopteris
- Colocasia
- Eicchornia
- Heteranthera
- Hydrilla
- Hydrocotyle
- Hygrophila
- Limnophila
- Ludwigia
- Myriophyllum aquaticum
- Myriophyllum heterophyllum
- Nasturtium
- Nuphar
- Pontederia
- Potamogeton
- Sagittaria
- Vallisneria
- Zizaniopsis



N

0 50 100 200 ft
0 10 20 40 m
1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Spring 2018

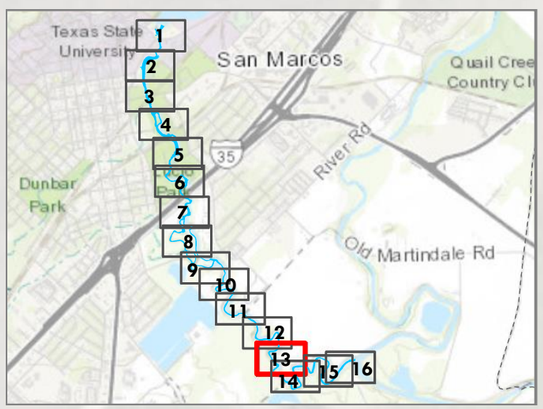
Surveyed: Feb. 26 - April 05, 2018

2018 *Zizania texana* Cover
for Full System = 10,228.3 m²

BIO-WEST
www.bio-west.com
512.990.3954

FULL SYSTEM MAP

- San Marcos River
- Study Reach
- Zizania texana
- Bryophyte
- Algae
- Bacopa
- Cabomba
- Canna
- Ceratopteris
- Colocasia
- Eicchornia
- Heteranthera
- Hydrilla
- Hydrocotyle
- Hygrophila
- Limnophila
- Ludwigia
- Myriophyllum aquaticum
- Myriophyllum heterophyllum
- Nasturtium
- Nuphar
- Pontederia
- Potamogeton
- Sagittaria
- Vallisneria
- Zizaniopsis



N

0 50 100 200 ft
0 10 20 40 m
1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Spring 2018

Surveyed: Feb. 26 - April 05, 2018

2018 *Zizania texana* Cover
for Full System = 10,228.3 m²

BIO-WEST
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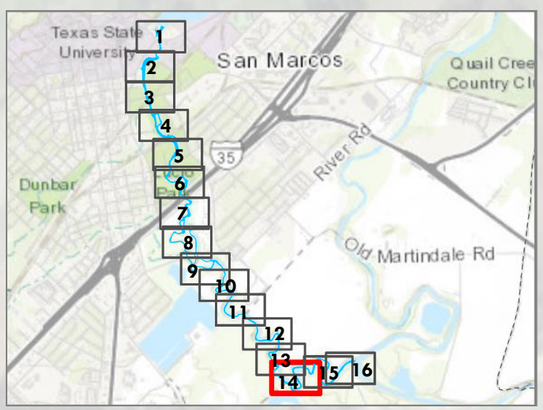
FULL SYSTEM MAP

- San Marcos River
- Study Reach
- Zizania texana
- Bryophyte
- Algae
- Bacopa
- Cabomba
- Canna
- Ceratopteris
- Colocasia
- Eicchornia
- Heteranthera
- Hydrilla
- Hydrocotyle
- Hygrophila
- Limnophila
- Ludwigia
- Myriophyllum aquaticum
- Myriophyllum heterophyllum
- Nasturtium
- Nuphar
- Pontederia
- Potamogeton
- Sagittaria
- Vallisneria
- Zizaniopsis



N

0 50 100 200 ft
0 10 20 40 m
1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Spring 2018

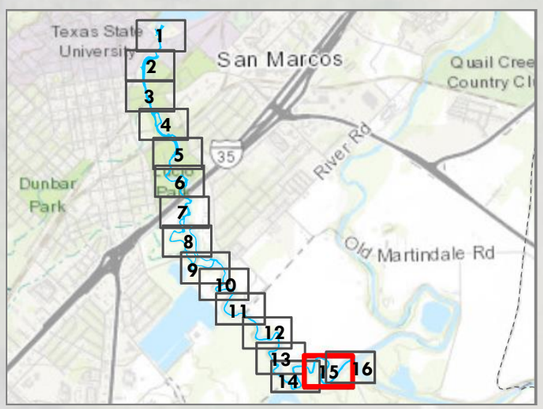
Surveyed: Feb. 26 - April 05, 2018

2018 *Zizania texana* Cover
for Full System = 10,228.3 m²

BIO-WEST
www.bio-west.com
512.990.3954

FULL SYSTEM MAP

- San Marcos River
- Study Reach
- Zizania texana
- Bryophyte
- Algae
- Bacopa
- Cabomba
- Canna
- Ceratopteris
- Colocasia
- Eicchornia
- Heteranthera
- Hydrilla
- Hydrocotyle
- Hygrophila
- Limnophila
- Ludwigia
- Myriophyllum aquaticum
- Myriophyllum heterophyllum
- Nasturtium
- Nuphar
- Pontederia
- Potamogeton
- Sagittaria
- Vallisneria
- Zizaniopsis



N

0 50 100 200 ft
0 10 20 40 m

1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Spring 2018

Surveyed: Feb. 26 - April 05, 2018

2018 *Zizania texana* Cover
for Full System = 10,228.3 m²

BIO-WEST
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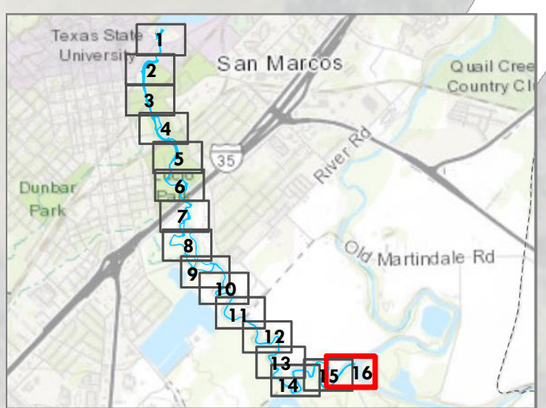
512.990.3954

FULL SYSTEM MAP

- San Marcos River
- Study Reach
- Zizania texana
- Bryophyte
- Algae
- Bacopa
- Cabomba
- Canna
- Ceratopteris
- Colocasia
- Eicchornia
- Heteranthera
- Hydrilla
- Hydrocotyle
- Hygrophila
- Limnophila
- Ludwigia
- Myriophyllum aquaticum
- Myriophyllum heterophyllum
- Nasturtium
- Nuphar
- Pontederia
- Potamogeton
- Sagittaria
- Vallisneria
- Zizaniopsis



N

0 50 100 200 ft
0 10 20 40 m
1 inch = 100 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

APPENDIX B-2: AQUATIC VEGETATION MAPS

Texas Wild Rice Summer
Full System – San Marcos

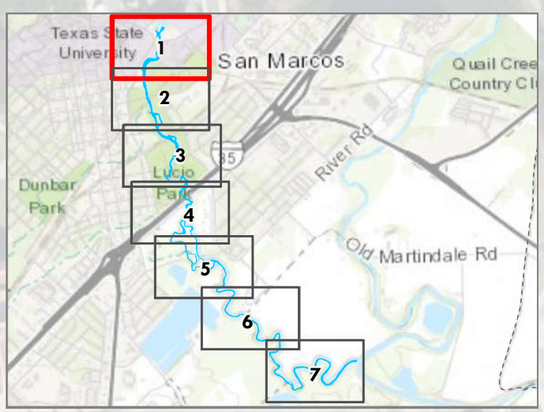
San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, Summer 2018

Surveyed: July 16 - Aug. 10, 2018

BIO-WEST
www.bio-west.com
512.990.3954



TEXAS WILD RICE FULL SYSTEM MAP

Page 1 of 7

Zizania texana

Study Reach

San Marcos River

Summer 2018 *Zizania texana* Cover in Full System = 9,429.5 m²

N

0 100 200 400 ft

0 25 50 100 m

1 inch = 200 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

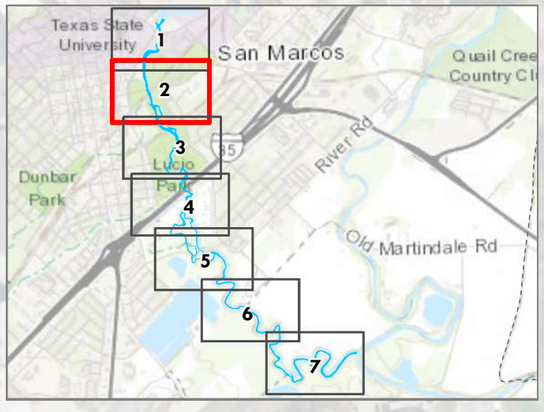
San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, Summer 2018

Surveyed: July 16 - Aug. 10, 2018

BIO-WEST
www.bio-west.com
512.990.3954



TEXAS WILD RICE FULL SYSTEM MAP

Zizania texana

Study Reach

San Marcos River

Summer 2018 *Zizania texana* Cover in Full System = 9,429.5 m²

N

0 100 200 400 ft
0 25 50 100 m

1 inch = 200 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

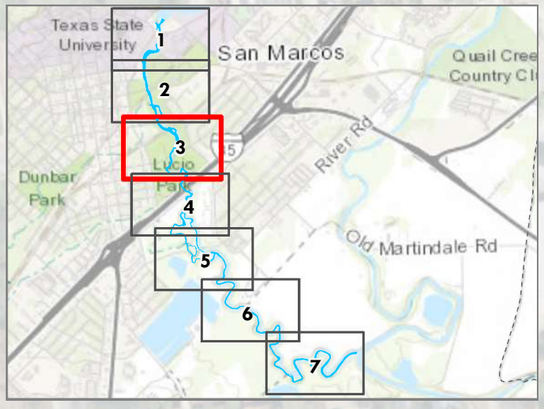
San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, Summer 2018

Surveyed: July 16 - Aug. 10, 2018

BIO-WEST
www.bio-west.com
512.990.3954



TEXAS WILD RICE FULL SYSTEM MAP

Page 3 of 7

Zizania texana

Study Reach

San Marcos River

Summer 2018 *Zizania texana* Cover in Full System = 9,429.5 m²

N

0 100 200 400 ft

0 25 50 100 m

1 inch = 200 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

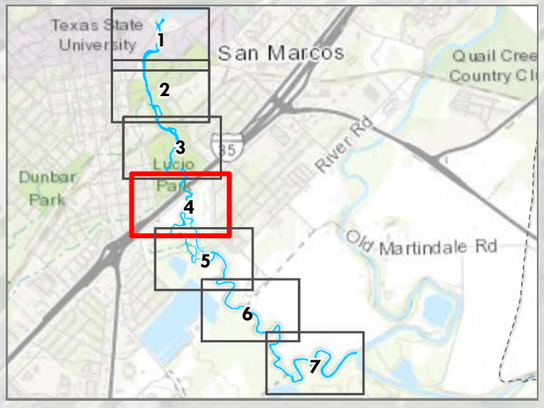
San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, Summer 2018

Surveyed: July 16 - Aug. 10, 2018

BIO-WEST
www.bio-west.com
512.990.3954



TEXAS WILD RICE FULL SYSTEM MAP

Zizania texana

Study Reach

San Marcos River

Summer 2018 *Zizania texana*
Cover in Full System = 9,429.5 m²

N

0 100 200 400 ft
0 25 50 100 m

1 inch = 200 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

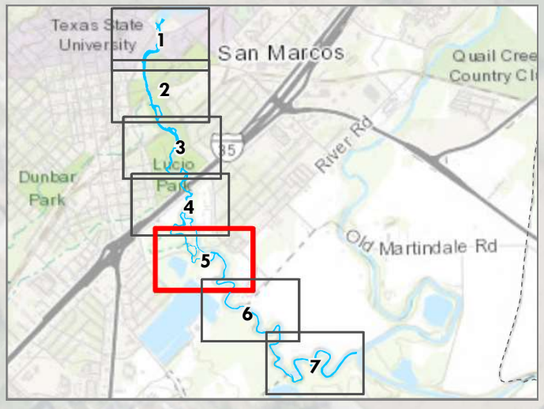
San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, Summer 2018

Surveyed: July 16 - Aug. 10, 2018

BIO-WEST
www.bio-west.com
512.990.3954



TEXAS WILD RICE FULL SYSTEM MAP

Page 5 of 7

Zizania texana

Study Reach

San Marcos River

Summer 2018 *Zizania texana*
Cover in Full System = 9,429.5 m²

N

0 100 200 400 ft
0 25 50 100 m
1 inch = 200 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

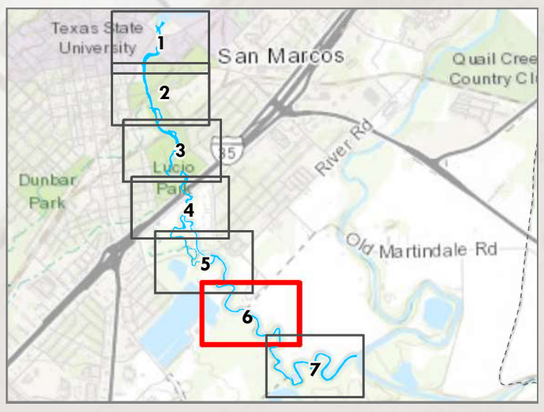
San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, Summer 2018

Surveyed: July 16 - Aug. 10, 2018

BIO-WEST
www.bio-west.com
512.990.3954



TEXAS WILD RICE FULL SYSTEM MAP

Page 6 of 7

Zizania texana

Study Reach

San Marcos River

Summer 2018 *Zizania texana*
Cover in Full System = 9,429.5 m²

N

0 100 200 400 ft
0 25 50 100 m
1 inch = 200 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

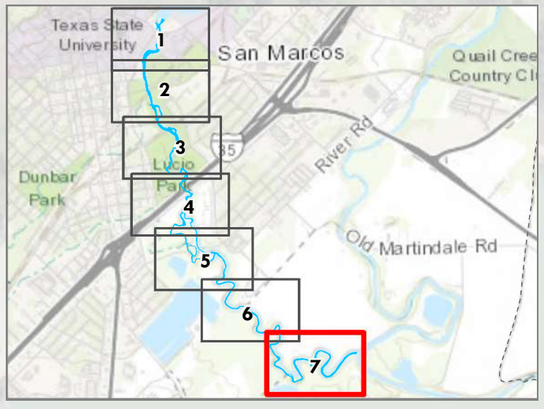
San Marcos River

San Marcos, Texas

Aquatic Vegetation Study
Texas Wild Rice, Summer 2018

Surveyed: July 16 - Aug. 10, 2018

BIO-WEST
www.bio-west.com
512.990.3954



TEXAS WILD RICE FULL SYSTEM MAP

Page 7 of 7

- Zizania texana
- Study Reach
- San Marcos River

Summer 2018 *Zizania texana*
Cover in Full System = 9,429.5 m²

N

0 100 200 400 ft
0 25 50 100 m

1 inch = 200 feet

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/18/2018.

APPENDIX B-3: AQUATIC VEGETATION MAPS

Study Reaches – San Marcos

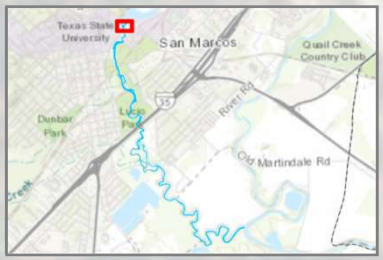
San Marcos River

San Marcos, Texas

Spring Lake Dam
Aquatic Vegetation
Study Reach

Spring 2018
Surveyed: March 16, 2018

BIO-WEST
www.bio-west.com
512.990.3954



Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/10/2018.

Spring Lake Dam

Study Reach	
Zizania texana	1152.2 m²
Cabomba	0.3 m²
Ceratopteris	1.5 m²
Hydrocotyle	135.9 m²
Hygrophila	23.6 m²
Ludwigia	19.6 m²
Nasturtium	0.7 m²
Potamogeton	200.5 m²
Sagittaria	13.6 m²
Vallisneria	3.5 m²
Zizaniopsis	1.3 m²

N

0 25 50 100 ft
0 5 10 20 m

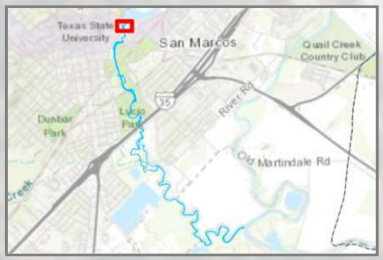
San Marcos River

San Marcos, Texas

Spring Lake Dam
Aquatic Vegetation
Study Reach

Fall 2018
Surveyed: October 03, 2018

BIO-WEST
www.bio-west.com
512.990.3954



Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/10/2018.

Spring Lake Dam

Study Reach	
Zizania texana	1,089.5 m²
Cabomba	1.5 m²
Ceratophyllum	6.8 m²
Heteranthera	0.1 m²
Hydrocotyle	52.8 m²
Hygrophila	39.6 m²
Ludwigia	22.4 m²
Potamogeton	148.0 m²
Sagittaria	22.3 m²
Vallisneria	3.3 m²

N

0 25 50 100 ft
0 5 10 20 m

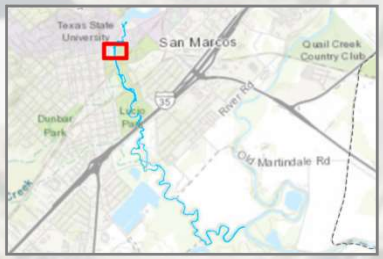
San Marcos River

San Marcos, Texas

CITY PARK
Aquatic Vegetation
Study Reach

Spring 2018
Surveyed: April 18, 2018

BIO-WEST
www.bio-west.com
512.990.3954



Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/10/2018.

City Park

Study Reach	
Zizania texana	1,969.0 m²
Bacopa	0.42 m²
Cabomba	1.9 m²
Ceratopteris	2.8 m²
Heteranthera	1.8 m²
Hydrilla	390.3 m²
Hydrocotyle	0.63 m²
Hygrophila	254.2 m²
Ludwigia	58.3 m²
Nasturtium	2.1 m²
Pontederia	0.34 m²
Potamogeton	176.5 m²
Sagittaria	162.4 m²
Vallisneria	3.0 m²

N

0 25 50 100 ft
0 5 10 20 m

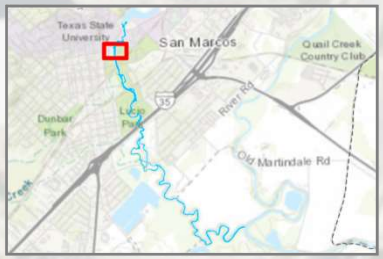
San Marcos River

San Marcos, Texas

CITY PARK
Aquatic Vegetation
Study Reach

Fall 2018
Surveyed: October 01, 2018

BIO-WEST
www.bio-west.com
512.990.3954



Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/10/2018.

City Park

Study Reach	
Zizania texana	1,362.0 m²
Bacopa	2.4 m²
Cabomba	50.1 m²
Ceratophyllum	174.2 m²
Ceratopteris	1.0 m²
Eicchornia	1.5 m²
Heteranthera	2.6 m²
Hydrilla	101.7 m²
Hygrophila	288.1 m²
Ludwigia	79.2 m²
M. heterophyllum	16.2 m²
Nasturtium	6.1 m²
Potamogeton	203.3 m²
Sagittaria	106.8 m²

N

0 25 50 100 ft
0 5 10 20 m

San Marcos River

San Marcos, Texas

I-35
Aquatic Vegetation
Study Reach

Spring 2018
Surveyed: April 20, 2018

BIO-WEST
www.bio-west.com
512.990.3954

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/10/2018.

I-35

Study Reach	
Zizania texana	548.9 m²
Cabomba	86.4 m²
Heteranthera	4.7 m²
Hydrilla	58.3 m²
Hydrocotyle	1.1 m²
Hygrophila	505.0 m²
Ludwigia	271.1 m²
Nuphar	39.8 m²
Sagittaria	495.2 m²

N

0 50 100 200 ft
0 10 20 40 m

San Marcos River

San Marcos, Texas

I-35
Aquatic Vegetation
Study Reach

Fall 2018
Surveyed: October 05, 2018

BIO-WEST
www.bio-west.com
512.990.3954

Projected in NAD 1983 UTM Zone 14N. Imagery basemap courtesy of ESRI. Created on 12/10/2018.

I-35

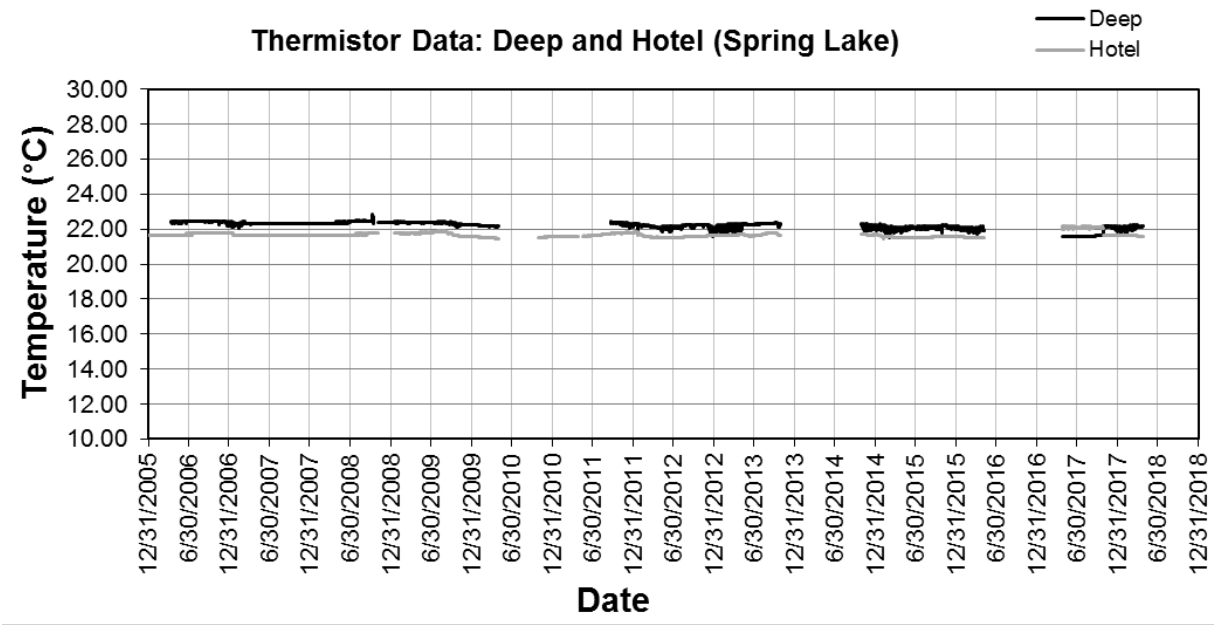
Study Reach	
Zizania texana	622.8 m²
Cabomba	73.0 m²
Ceratophyllum	55.2 m²
Heteranthera	7.4 m²
Hydrilla	10.4 m²
Hydrocotyle	3.8 m²
Hygrophila	799.7 m²
Ludwigia	146.3 m²
Nuphar	29.7 m²
Sagittaria	291.8 m²

N

0 50 100 200 ft
0 10 20 40 m

APPENDIX C: DATA AND GRAPHS

Thermistor Graphs


Thermistor Data: Deep and Hotel (Spring Lake)
Deep
Hotel
Temperature (°C)
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
12/31/2005
6/30/2006
12/31/2006
6/30/2007
12/31/2007
6/30/2008
12/31/2008
6/30/2009
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6/30/2010
12/31/2010
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12/31/2015
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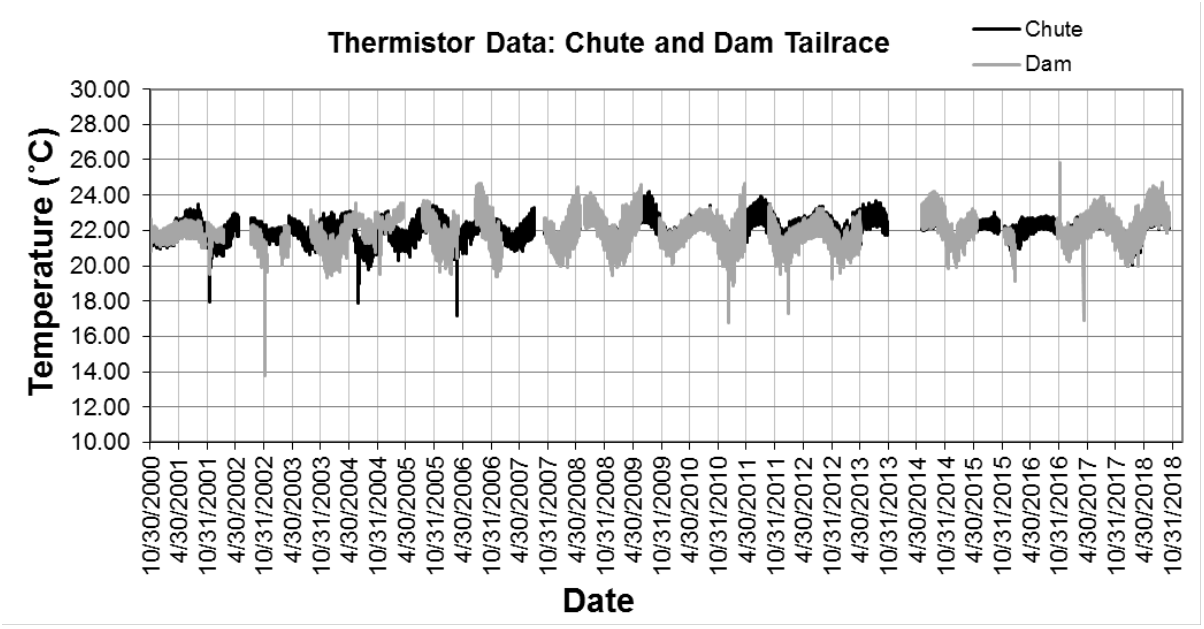
12/31/2016
6/30/2017
12/31/2017
6/30/2018
12/31/2018
Date


Thermistor Data: Chute and Dam Tailrace
Chute
Dam
Temperature (°C)
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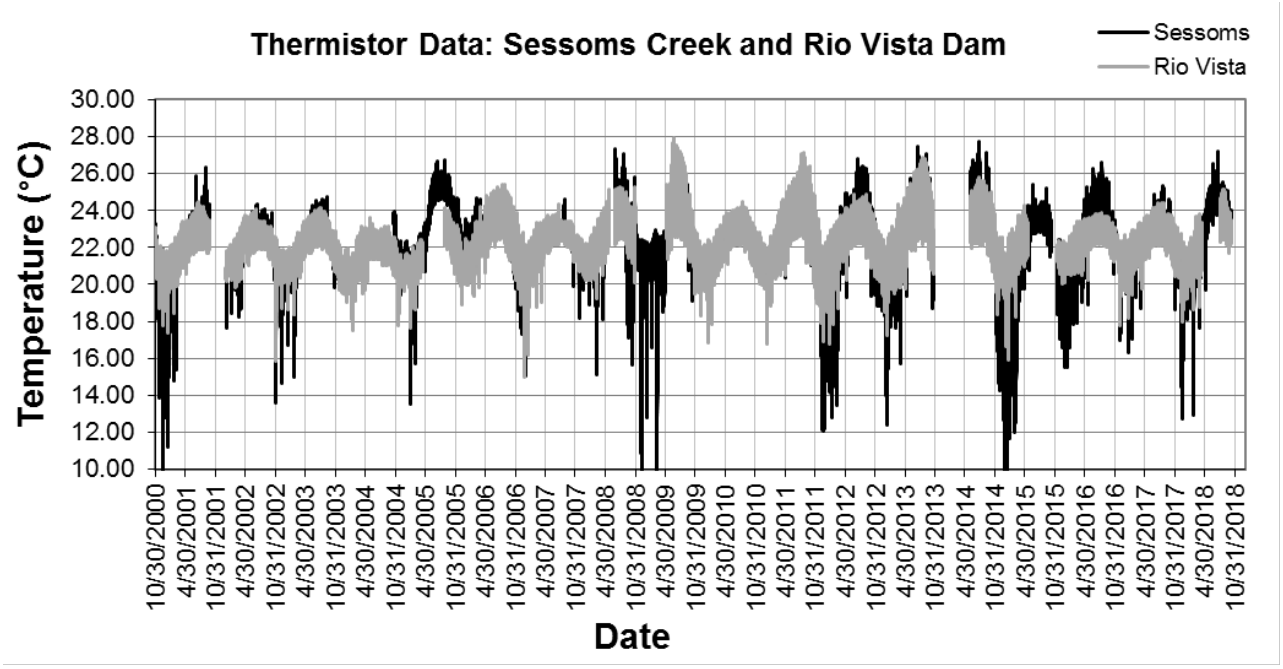
Date


Thermistor Data: Sessoms Creek and Rio Vista Dam
Sessoms
Rio Vista
Temperature (°C)
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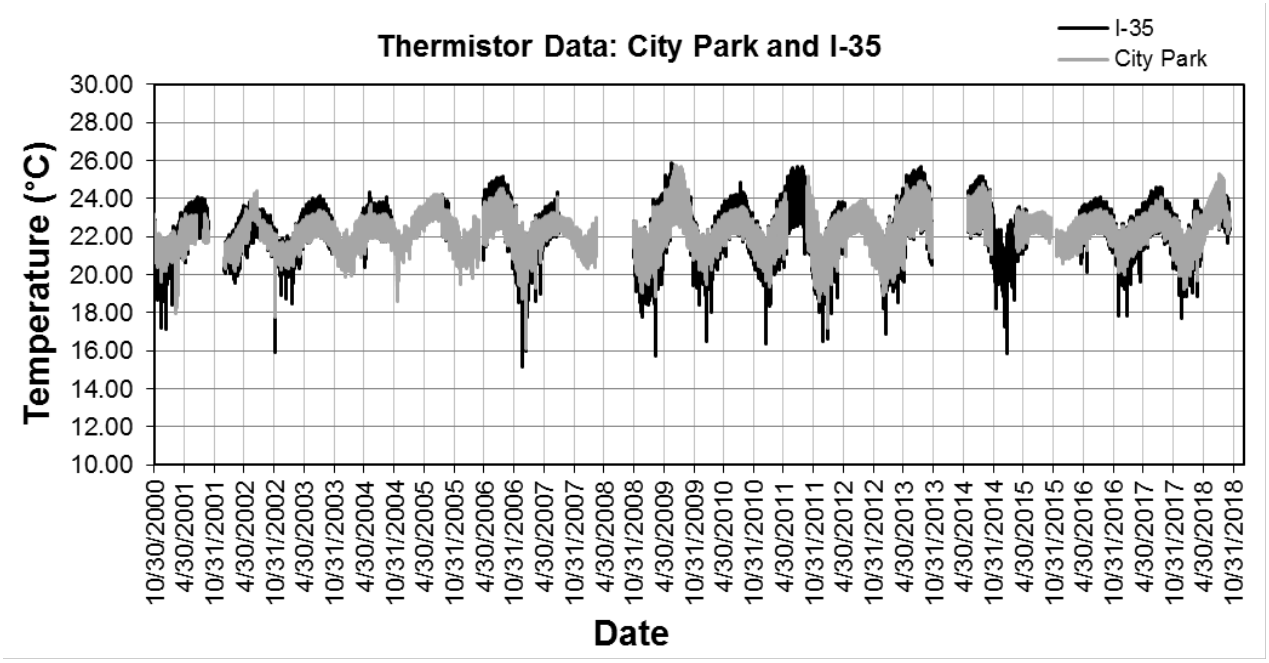
Date


Thermistor Data: City Park and I-35
I-35
City Park
Temperature (°C)
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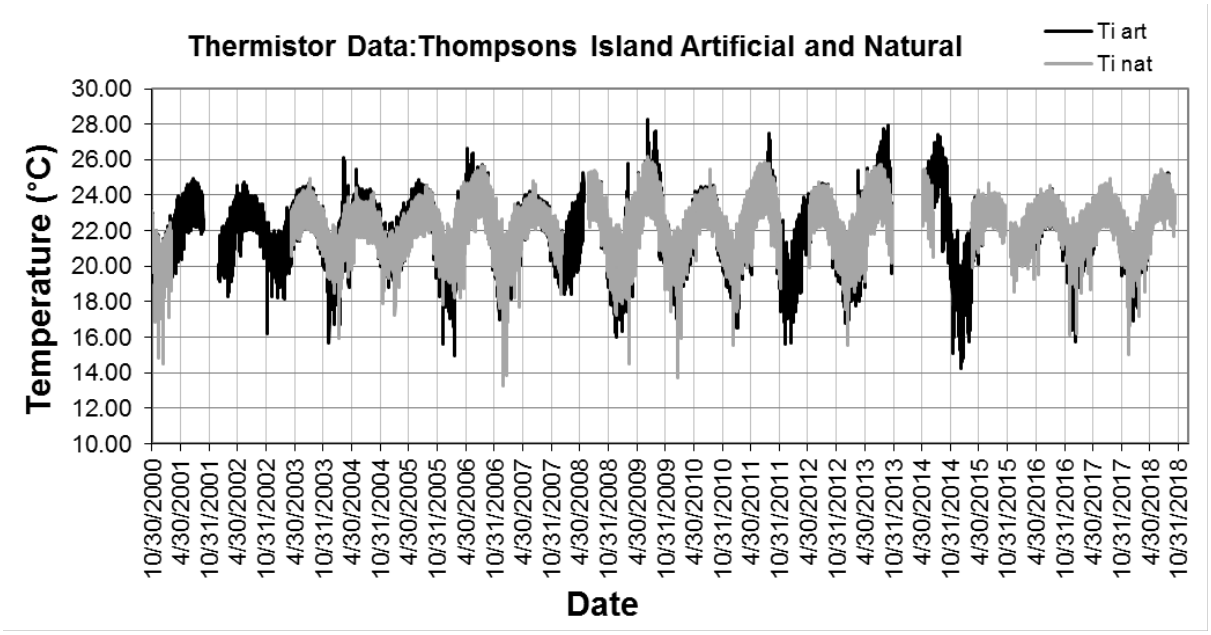
Thermistor Data:Thompsons Island Artificial and Natural
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Temperature (°C)
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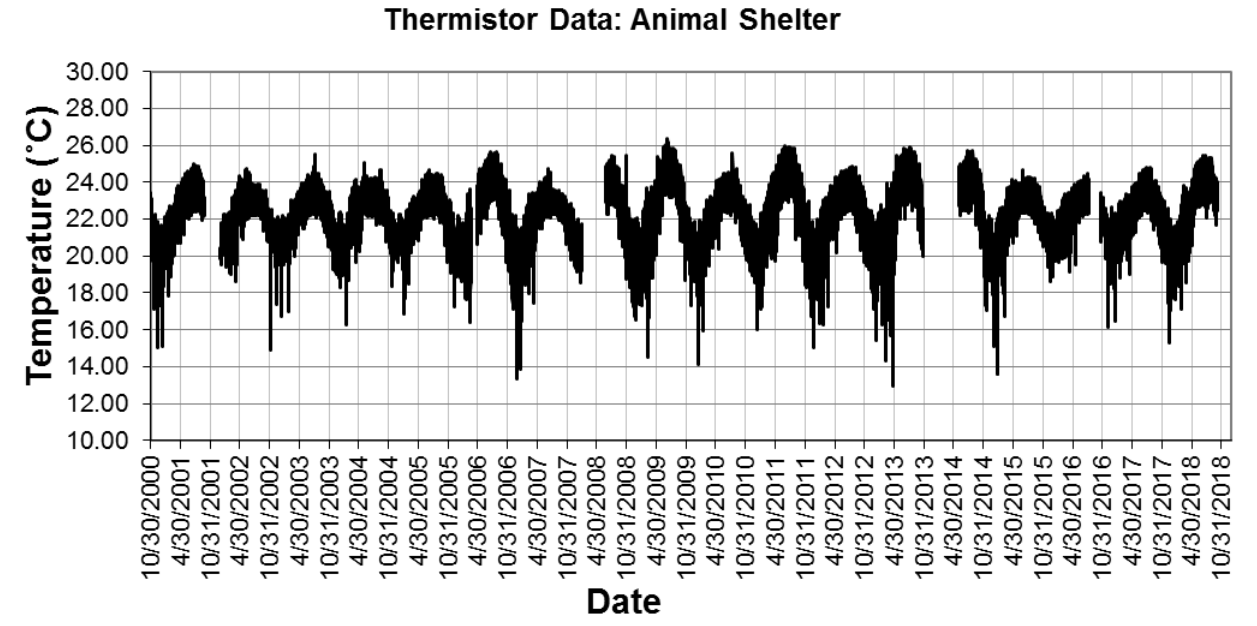
Thermistor Data: Animal Shelter
Temperature (°C)
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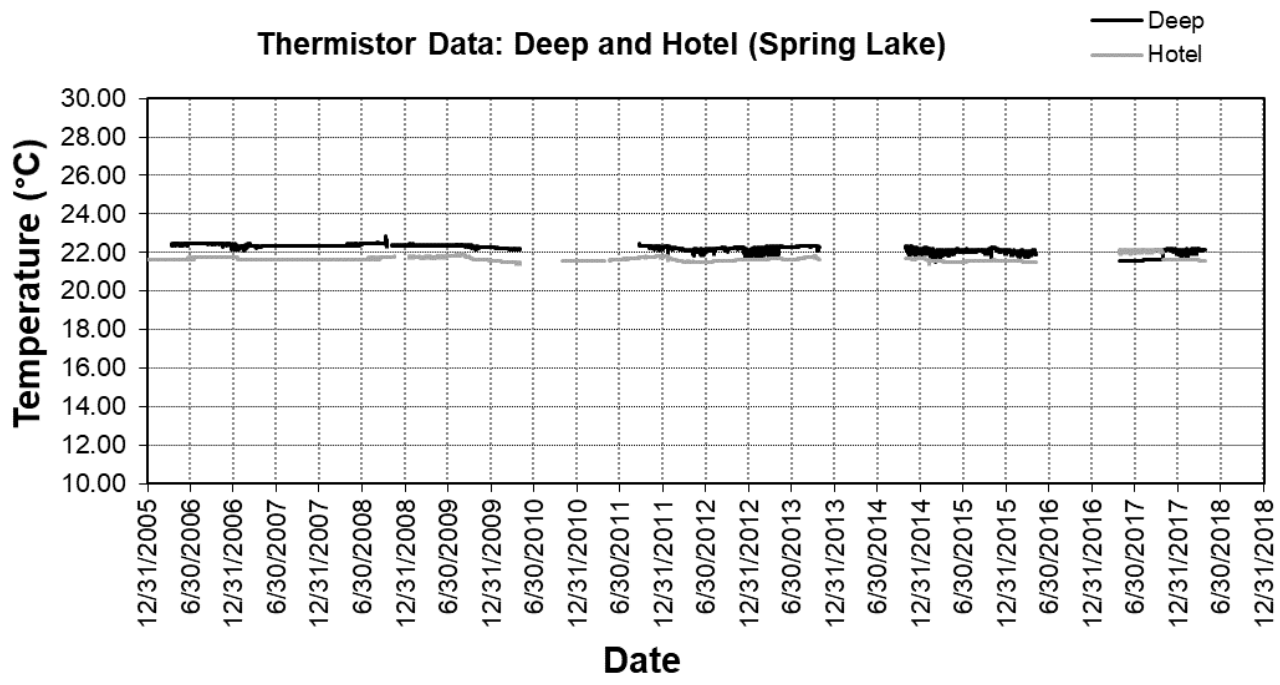
Thermistor Data: Deep and Hotel (Spring Lake)
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Hotel
Temperature (°C)
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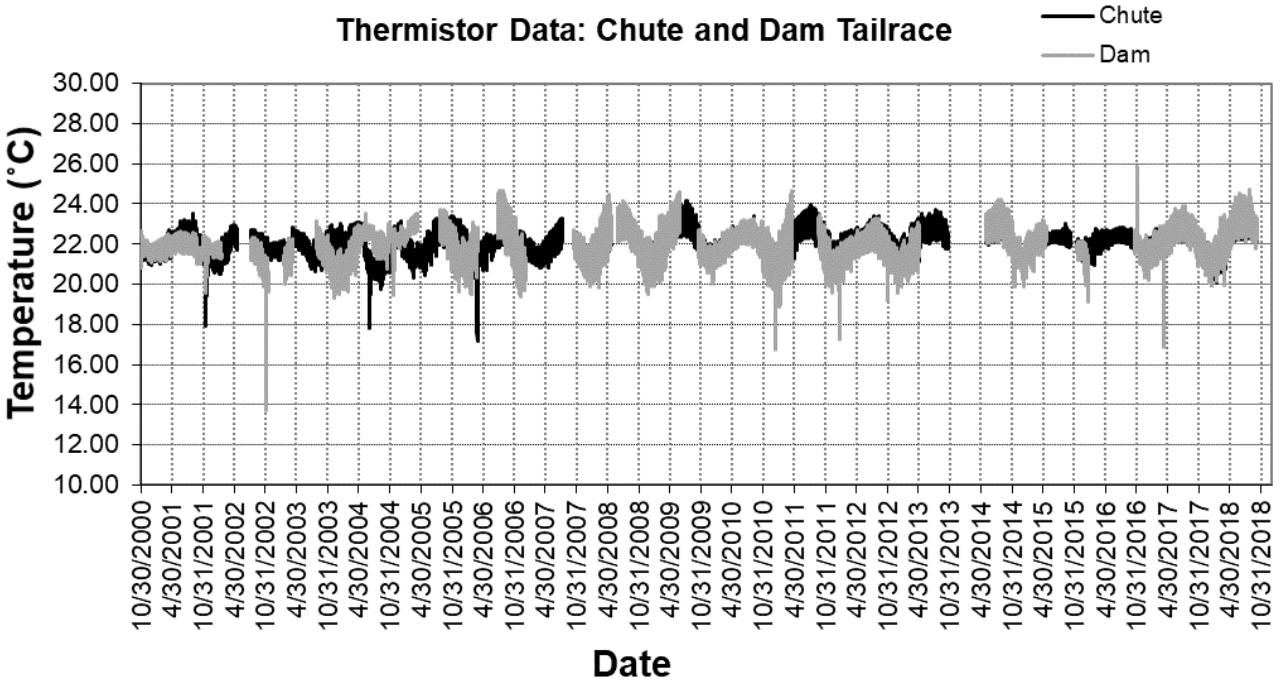
Thermistor Data: Chute and Dam Tailrace
Chute
Dam
Temperature (°C)
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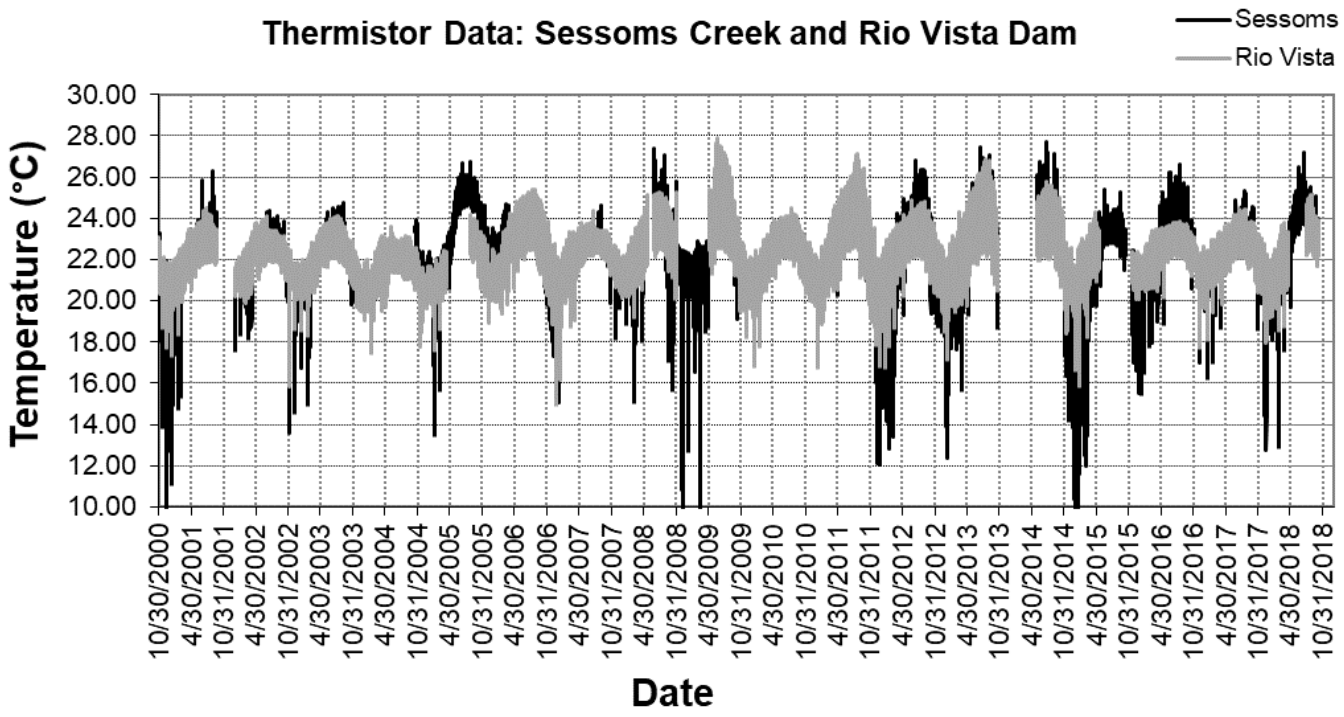
Thermistor Data: Sessoms Creek and Rio Vista Dam
Sessoms
Rio Vista
Temperature (°C)
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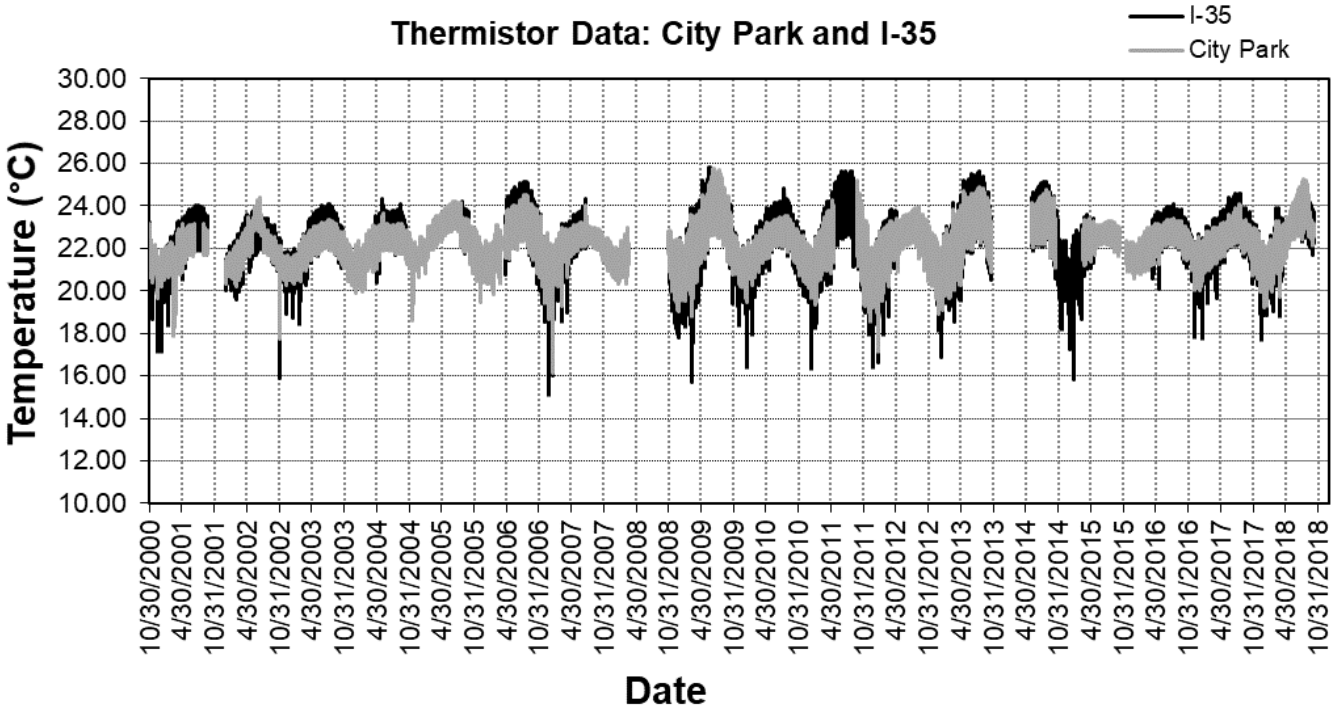
Thermistor Data: City Park and I-35
I-35
City Park
Temperature (°C)
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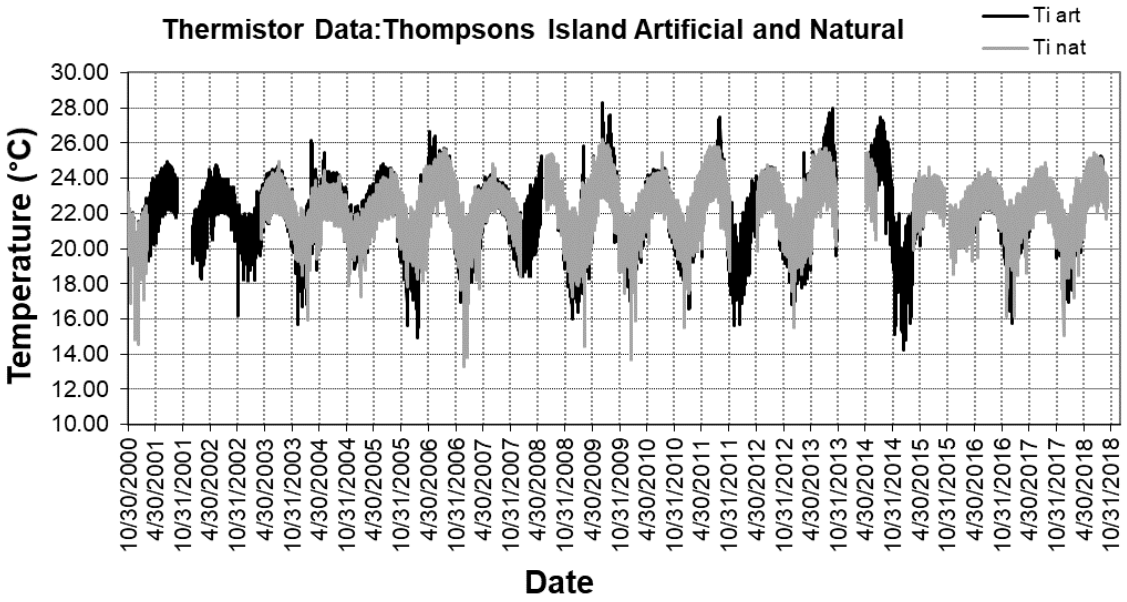
Thermistor Data:Thompsons Island Artificial and Natural
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Temperature (°C)
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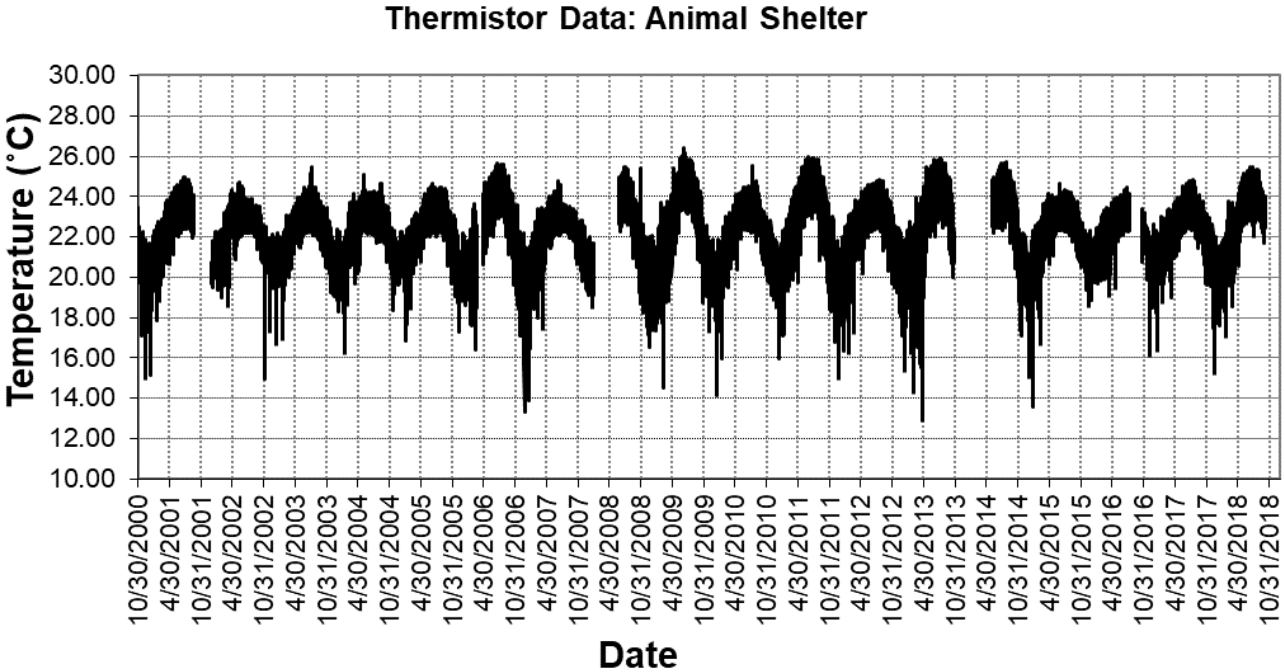
Thermistor Data: Animal Shelter
Temperature (°C)
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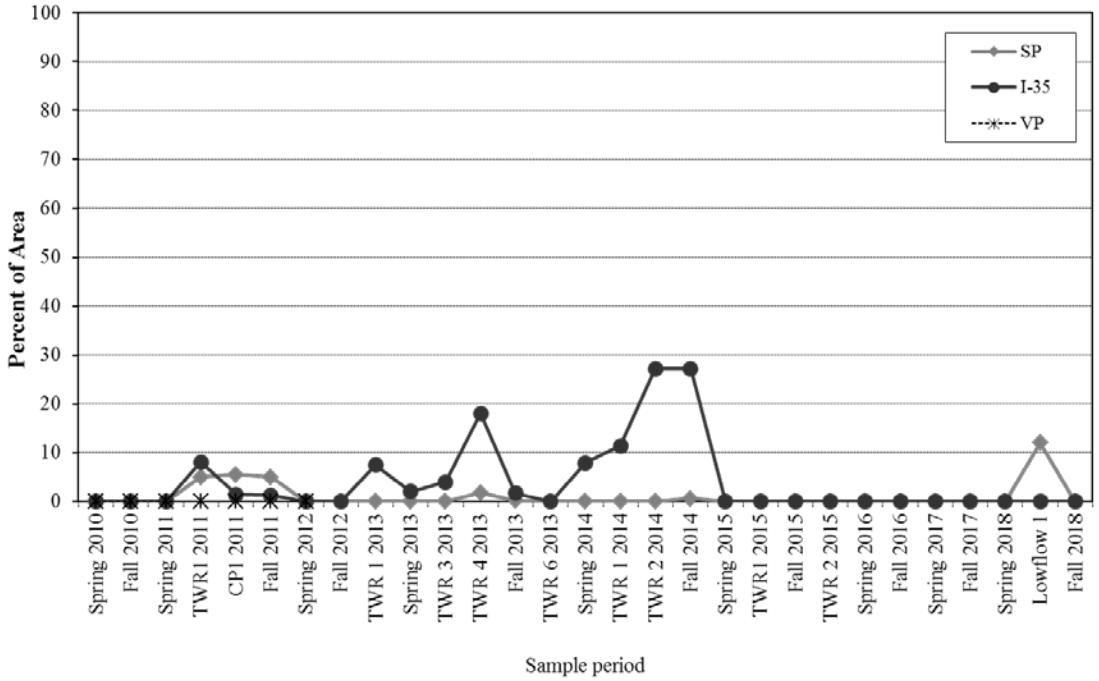
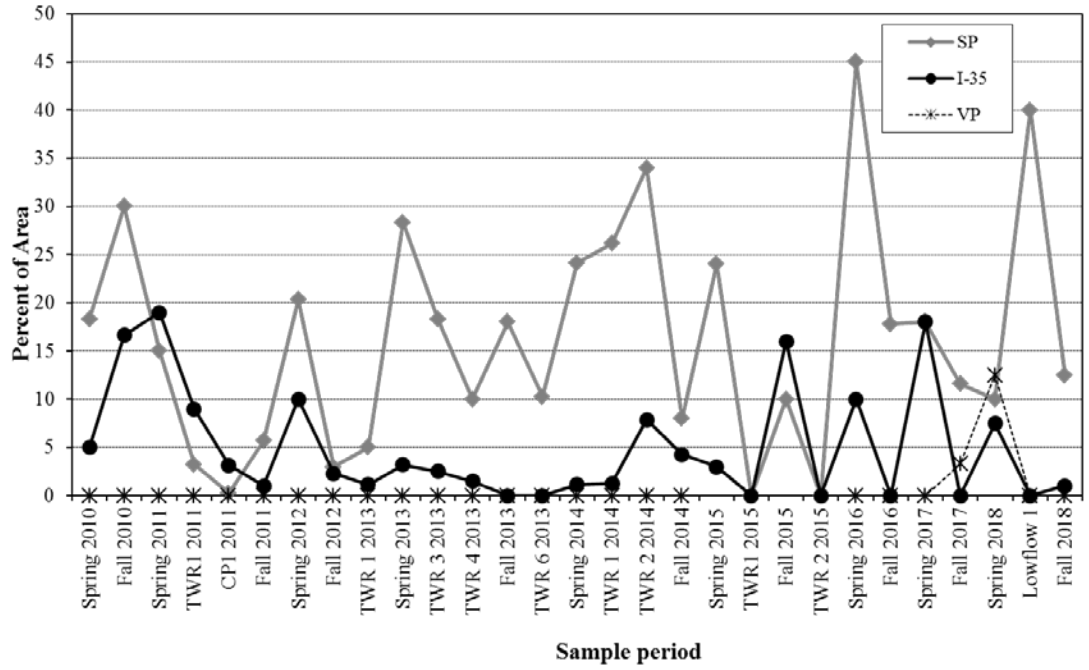
Date

Texas Wild Rice Observation Data

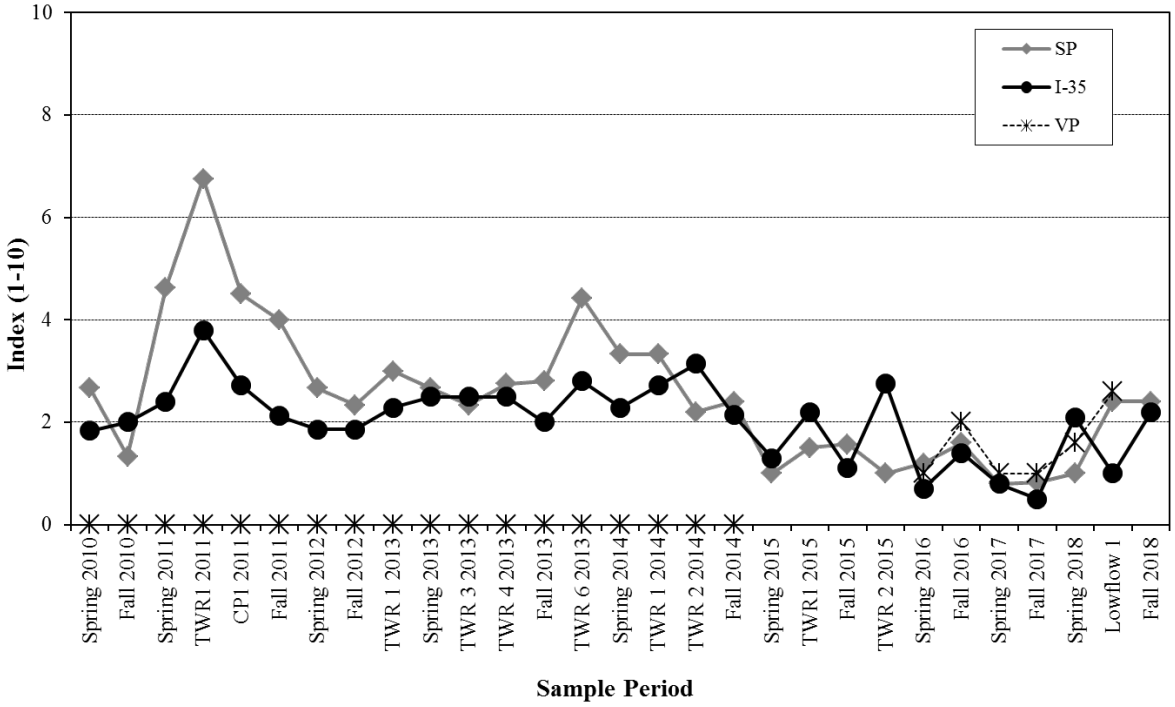
Percent of TWR Stands < 0.5 Feet



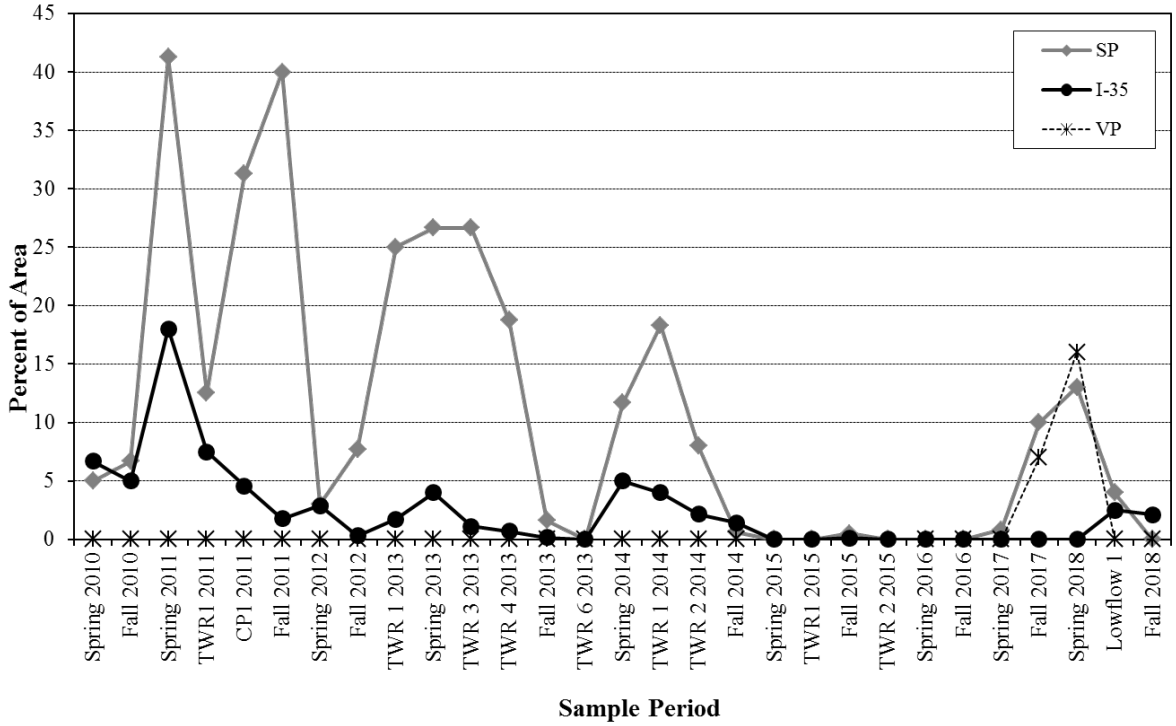
Percent Flowering & Seeding TWR



Index of Root Exposure for TWR Stands



Percent of TWR Covered by Vegetation Mats



Macroinvertebrate Raw Data

Spring

Date	Site	Class	Order	Family	FinalID	No.	Tolerance Value	Functional Feeding Guild 1	Functional Feeding Guild 2
4/25/2018	City Park	Arachnida	Trombidiformes		Acari	1	6	Predator	
4/25/2018	City Park	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae	4			
4/25/2018	City Park	Clitellata	Rhynchobdellida	Glossiphoniidae	Helobdella stagnalis	1			
4/25/2018	City Park	Gastropoda	Neotaenioglossa	Pleuroceridae	Elimia	21	2.5	Scraper	
4/25/2018	City Park	Gastropoda	Neotaenioglossa	Thiaridae	Terabia	3		Scraper	
4/25/2018	City Park	Insecta	Coleoptera	Psephinidae	Psephenus	1	4	Scraper	
4/25/2018	City Park	Insecta	Diptera	Chironomidae	Eukiefferiella	1			
4/25/2018	City Park	Insecta	Diptera	Chironomidae	Rheotanytarsus	1			
4/25/2018	City Park	Insecta	Ephemeroptera	Baetidae	Baetis	6	4	Gather/Collector	Scraper
4/25/2018	City Park	Insecta	Ephemeroptera	Baetidae	Fallceon	24	4	Gather/Collector	Scraper
4/25/2018	City Park	Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	14	5	Gather/Collector	
4/25/2018	City Park	Insecta	Hemiptera	Naucoridae	Cryphocricos	1		Predator	
4/25/2018	City Park	Insecta	Hemiptera	Naucoridae	Limnocoris	6	5	Predator	
4/25/2018	City Park	Insecta	Trichoptera	Glossosomatidae	Protoptila	14	1	Scraper	
4/25/2018	City Park	Insecta	Trichoptera	Heliocopyschidae	Helicopsyche	5	2	Scraper	
4/25/2018	City Park	Insecta	Trichoptera	Leptoceridae	Nectopsyche	16	3	Shredder	Gather/Collector
4/25/2018	City Park	Malacostraca	Amphipoda	Talitridae	Hyalella	108	8	Gather/Collector	Shredder
4/25/2018	City Park	Turbellaria	Tricladida		Planariidae	3			
4/25/2018	Headwaters	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae	7			
4/25/2018	Headwaters	Clitellata	Rhynchobdellida	Glossiphoniidae	Helobdella triserialis	1			
4/25/2018	Headwaters	Gastropoda	Basommatophora	Physidae	Physa	1	9	Scraper	
4/25/2018	Headwaters	Gastropoda	Neotaenioglossa	Pleuroceridae	Elimia	8	2.5	Scraper	
4/25/2018	Headwaters	Insecta	Coleoptera	Elmidae	Hexacylloepus ferrugineus	1	2	Scraper	
4/25/2018	Headwaters	Insecta	Coleoptera	Elmidae	Macrelmis	2	4	Scraper	
4/25/2018	Headwaters	Insecta	Coleoptera	Elmidae	Microcylloepus pusillus	7			
4/25/2018	Headwaters	Insecta	Coleoptera	Psephinidae	Psephenus	3	4	Scraper	

4/25/2018	Headwaters	Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius complex	2			
4/25/2018	Headwaters	Insecta	Diptera	Chironomidae	Pseudochironomus	3	5	Gather/Collector	
4/25/2018	Headwaters	Insecta	Diptera	Chironomidae	Rheocricotopus	1			
4/25/2018	Headwaters	Insecta	Diptera	Chironomidae	Rheotanytarsus	5			
4/25/2018	Headwaters	Insecta	Diptera	Chironomidae	Thienemanniella	1			
4/25/2018	Headwaters	Insecta	Diptera	Simuliidae	Simulium	3	4	Filterer/Collector	
4/25/2018	Headwaters	Insecta	Ephemeroptera	Baetidae	Baetis	1	4	Gather/Collector	Scraper
4/25/2018	Headwaters	Insecta	Ephemeroptera	Baetidae	Baetodes	17	4	Scraper	
4/25/2018	Headwaters	Insecta	Ephemeroptera	Baetidae	Fallceon	56	4	Gather/Collector	Scraper
4/25/2018	Headwaters	Insecta	Ephemeroptera	Leptohyphidae	Allenhyphes	8			
4/25/2018	Headwaters	Insecta	Ephemeroptera	Leptohyphidae	Leptohyphes	35	2	Gather/Collector	
4/25/2018	Headwaters	Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	3	5	Gather/Collector	
4/25/2018	Headwaters	Insecta	Hemiptera	Naucoridae	Ambrysus	35	5	Predator	
4/25/2018	Headwaters	Insecta	Lepidoptera	Pyralidae	Petrophila	2	5	Scraper	
4/25/2018	Headwaters	Insecta	Odonata	Coenagrionidae	Argia	2	6	Predator	
4/25/2018	Headwaters	Insecta	Odonata	Libellulidae	Brechmorhoga	7	6	Predator	
4/25/2018	Headwaters	Insecta	Trichoptera	Heliocopyschidae	Helicopsyche	8	2	Scraper	
4/25/2018	Headwaters	Insecta	Trichoptera	Hydrobiosidae	Atopsyche	2	0	Predator	
4/25/2018	Headwaters	Insecta	Trichoptera	Philopotamidae	Chimarra	18	2	Filterer/Collector	
4/25/2018	Headwaters	Malacostraca	Amphipoda	Talitridae	Hyalella	37	8	Gather/Collector	Shredder
4/25/2018	Headwaters	Turbellaria	Tricladida		Planariidae	23			
4/25/2018	I-35	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae	12			
4/25/2018	I-35	Gastropoda	Neotaenioglossa	Hydrobiidae	Hydrobiidae	2	7	Scraper	
4/25/2018	I-35	Gastropoda	Neotaenioglossa	Pleuroceridae	Elimia	24	2.5	Scraper	
4/25/2018	I-35	Gastropoda	Neotaenioglossa	Thiaridae	Terabia	17		Scraper	
4/25/2018	I-35	Insecta	Coleoptera	Elmidae	Hexacylloepus ferrugineus	1	2	Scraper	
4/25/2018	I-35	Insecta	Coleoptera	Elmidae	Macrelmis	2	4	Scraper	
4/25/2018	I-35	Insecta	Coleoptera	Psephinidae	Psephenus	2	4	Scraper	
4/25/2018	I-35	Insecta	Ephemeroptera	Baetidae	Fallceon	1	4	Gather/Collector	Scraper

4/25/2018	I-35	Insecta	Ephemeroptera	Isonychiidae	Isonychia	1			
4/25/2018	I-35	Insecta	Ephemeroptera	Leptohyphidae	Allenhyphes	1			
4/25/2018	I-35	Insecta	Ephemeroptera	Leptohyphidae	Leptohyphes	6	2	Gather/Collector	
4/25/2018	I-35	Insecta	Ephemeroptera	Leptophlebiidae	Thraulodes	17	2	Gather/Collector	
4/25/2018	I-35	Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	2	5	Gather/Collector	
4/25/2018	I-35	Insecta	Hemiptera	Naucoridae	Ambrysus	2	5	Predator	
4/25/2018	I-35	Insecta	Hemiptera	Naucoridae	Limnocoris	16	5	Predator	
4/25/2018	I-35	Insecta	Odonata	Coenagrionidae	Argia	2	6	Predator	
4/25/2018	I-35	Insecta	Trichoptera	Glossosomatidae	Protoptila	10	1	Scraper	
4/25/2018	I-35	Insecta	Trichoptera	Heliocopyschidae	Helicopsyche	58	2	Scraper	
4/25/2018	I-35	Insecta	Trichoptera	Leptoceridae	Nectopsyche	4	3	Shredder	Gather/Collector
4/25/2018	I-35	Insecta	Trichoptera	Leptoceridae	Oecetis	2			
4/25/2018	I-35	Malacostraca	Amphipoda	Talitridae	Hyalella	46	8	Gather/Collector	Shredder
4/25/2018	I-35	Turbellaria	Tricladida		Planariidae	8			
4/25/2018	Spring Lake	Arachnida	Trombidiformes		Acari	2	6	Predator	
4/25/2018	Spring Lake	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae	6			
4/25/2018	Spring Lake	Gastropoda	Basommatophora	Ancylidae	Ferrissia	3			
4/25/2018	Spring Lake	Gastropoda	Basommatophora	Physidae	Physa	1	9	Scraper	
4/25/2018	Spring Lake	Gastropoda	Neotaenioglossa	Hydrobiidae	Hydrobiidae	1	7	Scraper	
4/25/2018	Spring Lake	Gastropoda	Neotaenioglossa	Pleuroceridae	Elimia	9	2.5	Scraper	
4/25/2018	Spring Lake	Insecta	Coleoptera	Psephinidae	Psephenus	1	4	Scraper	
4/25/2018	Spring Lake	Insecta	Diptera	Chironomidae	Pseudochironomus	2	5	Gather/Collector	
4/25/2018	Spring Lake	Insecta	Ephemeroptera	Baetidae	Procloeon	1			
4/25/2018	Spring Lake	Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	37	5	Gather/Collector	
4/25/2018	Spring Lake	Insecta	Hemiptera	Naucoridae	Ambrysus	1	5	Predator	
4/25/2018	Spring Lake	Insecta	Odonata	Coenagrionidae	Enallagma	1	6	Predator	
4/25/2018	Spring Lake	Insecta	Trichoptera	Heliocopyschidae	Helicopsyche	4	2	Scraper	
4/25/2018	Spring Lake	Malacostraca	Amphipoda	Talitridae	Hyalella	224	8	Gather/Collector	Shredder
4/25/2018	Spring Lake	Malacostraca	Decapoda	Palaemonidae	Palaemonetes	5	4	Gather/Collector	

Fall

Date	Site	Class	Order	Family	FinalID	No.	Tolerance Value	Functional Feeding Guild 1	Functional Feeding Guild 2
10/19/2018	City Park	Arachnida	Trombidiformes		Acari	1	6	Predator	
10/19/2018	City Park	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae	3			
10/19/2018	City Park	Clitellata	Rhynchobdellida	Glossiphoniidae	Helobdella stagnalis	5			
10/19/2018	City Park	Clitellata	Tubificida	Naididae	Naidinae	23			
10/19/2018	City Park	Gastropoda	Neotaenioglossa	Pleuroceridae	Elimia	12	2.5	Scraper	
10/19/2018	City Park	Gastropoda	Neotaenioglossa	Thiaridae	Terabia	3		Scraper	
10/19/2018	City Park	Insecta	Coleoptera	Elmidae	Hexacylloepus ferrugineus	1	2	Scraper	
10/19/2018	City Park	Insecta	Diptera	Chironomidae	Cryptochironomus	1			
10/19/2018	City Park	Insecta	Diptera	Chironomidae	Tanytarsus	1			
10/19/2018	City Park	Insecta	Ephemeroptera	Baetidae	Baetis	1	4	Gather/Collector	Scraper
10/19/2018	City Park	Insecta	Ephemeroptera	Baetidae	Fallceon	3	4	Gather/Collector	Scraper
10/19/2018	City Park	Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	92	5	Gather/Collector	
10/19/2018	City Park	Insecta	Hemiptera	Naucoridae	Limnocoris	3	5	Predator	
10/19/2018	City Park	Insecta	Odonata	Coenagrionidae	Argia	1	6	Predator	
10/19/2018	City Park	Insecta	Odonata	Gomphidae	Aphylla	1		Predator	
10/19/2018	City Park	Insecta	Trichoptera	Leptoceridae	Nectopsyche	26	3	Shredder	Gather/Collector
10/19/2018	City Park	Insecta	Trichoptera	Polycentropodidae	Polycentropus	1	3	Filterer/Collector	Predator
10/19/2018	City Park	Malacostraca	Amphipoda	Talitridae	Hyalella	156	8	Gather/Collector	Shredder
10/19/2018	City Park	Malacostraca	Decapoda	Palaemonidae	Palaemonetes	1	4	Gather/Collector	
10/19/2018	City Park	Turbellaria	Tricladida		Planariidae	8			
10/19/2018	Headwaters	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae	6			

10/19/2018	Headwaters	Gastropoda	Basommatophora	Ancylidae	Ferrissia	1			
10/19/2018	Headwaters	Gastropoda	Neotaenioglossa	Hydrobiidae	Hydrobiidae	2	7	Scraper	
10/19/2018	Headwaters	Gastropoda	Neotaenioglossa	Pleuroceridae	Elimia	23	2.5	Scraper	
10/19/2018	Headwaters	Gastropoda	Neotaenioglossa	Thiaridae	Melanoides tuberculata	1		Scraper	
10/19/2018	Headwaters	Gastropoda	Neotaenioglossa	Thiaridae	Terabia	2		Scraper	
10/19/2018	Headwaters	Insecta	Coleoptera	Elmidae	Hexacylloepus ferrugineus	1	2	Scraper	
10/19/2018	Headwaters	Insecta	Coleoptera	Elmidae	Macrelmis	2	4	Scraper	
10/19/2018	Headwaters	Insecta	Coleoptera	Elmidae	Phanocerus clavicornis	1			
10/19/2018	Headwaters	Insecta	Coleoptera	Psephinidae	Psephenus	7	4	Scraper	
10/19/2018	Headwaters	Insecta	Diptera	Chironomidae	Eukiefferiella	1			
10/19/2018	Headwaters	Insecta	Diptera	Chironomidae	Rheocricotopus	2			
10/19/2018	Headwaters	Insecta	Diptera	Chironomidae	Thienemanniella	3			
10/19/2018	Headwaters	Insecta	Ephemeroptera	Baetidae	Baetodes	5	4	Scraper	
10/19/2018	Headwaters	Insecta	Ephemeroptera	Baetidae	Fallceon	11	4	Gather/Collector	Scraper
10/19/2018	Headwaters	Insecta	Ephemeroptera	Leptohyphidae	Allenhyphes	3			
10/19/2018	Headwaters	Insecta	Ephemeroptera	Leptohyphidae	Leptohyphes	17	2	Gather/Collector	
10/19/2018	Headwaters	Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	7	5	Gather/Collector	
10/19/2018	Headwaters	Insecta	Hemiptera	Naucoridae	Ambrysus	12	5	Predator	
10/19/2018	Headwaters	Insecta	Lepidoptera	Pyralidae	Petrophila	1	5	Scraper	
10/19/2018	Headwaters	Insecta	Odonata	Libellulidae	Brechmorhoga	2	6	Predator	
10/19/2018	Headwaters	Insecta	Trichoptera	Heliocopyschidae	Helicopsyche	4	2	Scraper	
10/19/2018	Headwaters	Insecta	Trichoptera	Philopotamidae	Chimarra	28	2	Filterer/Collector	
10/19/2018	Headwaters	Malacostraca	Amphipoda	Talitridae	Hyalella	7	8	Gather/Collector	Shredder

10/19/2018	Headwaters	Turbellaria	Tricladida		Planariidae	27			
10/19/2018	I-35	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae	4			
10/19/2018	I-35	Clitellata	Tubificida	Naididae	Naidinae	2			
10/19/2018	I-35	Gastropoda	Neotaenioglossa	Hydrobiidae	Hydrobiidae	3	7	Scraper	
10/19/2018	I-35	Gastropoda	Neotaenioglossa	Pleuroceridae	Elimia	29	2.5	Scraper	
10/19/2018	I-35	Gastropoda	Neotaenioglossa	Thiaridae	Terabia	42		Scraper	
10/19/2018	I-35	Insecta	Coleoptera	Elmidae	Hexacylloepus ferrugineus	4	2	Scraper	
10/19/2018	I-35	Insecta	Coleoptera	Elmidae	Microcylloepus pusillus	1			
10/19/2018	I-35	Insecta	Coleoptera	Elmidae	Stenelmis	1	7	Gather/Collector	Scraper
10/19/2018	I-35	Insecta	Coleoptera	Psephinidae	Psephenus	1	4	Scraper	
10/19/2018	I-35	Insecta	Diptera	Chironomidae	Rheotanytarsus	1			
10/19/2018	I-35	Insecta	Ephemeroptera	Baetidae	Baetis	1	4	Gather/Collector	Scraper
10/19/2018	I-35	Insecta	Ephemeroptera	Baetidae	Fallceon	6	4	Gather/Collector	Scraper
10/19/2018	I-35	Insecta	Ephemeroptera	Isonychiidae	Isonychia	1			
10/19/2018	I-35	Insecta	Ephemeroptera	Leptohyphidae	Leptohyphes	1	2	Gather/Collector	
10/19/2018	I-35	Insecta	Ephemeroptera	Leptophlebiidae	Thraulodes	20	2	Gather/Collector	
10/19/2018	I-35	Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	11	5	Gather/Collector	
10/19/2018	I-35	Insecta	Hemiptera	Naucoridae	Ambrysus	6	5	Predator	
10/19/2018	I-35	Insecta	Hemiptera	Naucoridae	Limnocoris	4	5	Predator	
10/19/2018	I-35	Insecta	Odonata	Coenagrionidae	Argia	2	6	Predator	
10/19/2018	I-35	Insecta	Odonata	Libellulidae	Libellulidae	1		Predator	
10/19/2018	I-35	Insecta	Trichoptera	Glossosomatidae	Protoptila	9	1	Scraper	
10/19/2018	I-35	Insecta	Trichoptera	Heliocopyschidae	Helicopsyche	22	2	Scraper	
10/19/2018	I-35	Insecta	Trichoptera	Leptoceridae	Nectopsyche	8	3	Shredder	Gather/Collector
10/19/2018	I-35	Insecta	Trichoptera	Philopotamidae	Chimarra	1	2	Filterer/Collector	

10/19/2018	I-35	Malacostraca	Amphipoda	Talitridae	Hyalella	4	8	Gather/Collector	Shredder
10/19/2018	I-35	Turbellaria	Tricladida		Planariidae	12			
10/19/2018	Spring Lake		Decopoda	Cambaridae	Cambaridae	6	5	Gather/Collector	
10/19/2018	Spring Lake	Clitellata	Lumbriculida	Lumbriculidae	Lumbriculidae	2			
10/19/2018	Spring Lake	Gastropoda	Neotaenioglossa	Pleuroceridae	Elimia	2	2.5	Scraper	
10/19/2018	Spring Lake	Insecta	Coleoptera	Elmidae	Microcylloepus pusillus	1			
10/19/2018	Spring Lake	Insecta	Diptera	Chironomidae	Cricotopus/Orthocladius complex	1			
10/19/2018	Spring Lake	Insecta	Diptera	Chironomidae	Dicrotendipes	2			
10/19/2018	Spring Lake	Insecta	Diptera	Stratiomyidae	Odontomyia	2	7	Gather/Collector	
10/19/2018	Spring Lake	Insecta	Ephemeroptera	Tricorythidae	Tricorythodes	7	5	Gather/Collector	
10/19/2018	Spring Lake	Insecta	Hemiptera	Naucoridae	Ambrysus	3	5	Predator	
10/19/2018	Spring Lake	Insecta	Odonata	Coenagrionidae	Enallagma	2	6	Predator	
10/19/2018	Spring Lake	Insecta	Odonata	Coenagrionidae	Ischnura	1	9	Predator	
10/19/2018	Spring Lake	Insecta	Trichoptera	Heliocopyschidae	Helicopsyche	1	2	Scraper	
10/19/2018	Spring Lake	Malacostraca	Amphipoda	Talitridae	Hyalella	318	8	Gather/Collector	Shredder
10/19/2018	Spring Lake	Malacostraca	Decapoda	Palaemonidae	Palaemonetes	2	4	Gather/Collector	

APPENDIX D: DROP NET RAW DATA

SiteCode 2226 Date 4/23/2018 Reach Spring Lake Dam Site_No H1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2226	1	Lepomis miniatus	30	1
2226	1	Palaemonetes sp.		3
2226	1	Gambusia sp.	14	1
2226	1	Gambusia sp.	14	1
2226	1	Gambusia sp.	19	1
2226	1	Gambusia sp.	18	1
2226	1	Gambusia sp.	20	1
2226	1	Gambusia sp.	15	1
2226	1	Gambusia sp.	18	1
2226	1	Gambusia sp.	17	1
2226	2	Lepomis miniatus	80	1
2226	2	Gambusia sp.	23	1
2226	2	Gambusia sp.	25	1
2226	2	Gambusia sp.	15	1
2226	2	Gambusia sp.	15	1
2226	2	Gambusia sp.	15	1
2226	2	Gambusia sp.	26	1
2226	2	Procambarus sp.		2
2226	3	Lepomis miniatus	65	1
2226	3	Palaemonetes sp.		1
2226	3	Gambusia sp.	20	1
2226	4	Procambarus sp.		1
2226	5	Gambusia sp.	20	1
2226	5	Gambusia sp.	20	1
2226	5	Gambusia sp.	15	1
2226	5	Gambusia sp.	10	1
2226	6	Gambusia sp.	15	1
2226	7	Procambarus sp.		1
2226	8	Etheostoma fonticola	22	1
2226	9	Procambarus sp.		1

2226	10	Gambusia sp.	23	1
2226	11	No fish collected		
2226	12	Procambarus sp.		1
2226	12	Etheostoma fonticola	22	1
2226	13	Gambusia sp.	11	1
2226	14	No fish collected		
2226	15	No fish collected		

SiteCode 2227 Date 4/23/2018 Reach Spring Lake Dam Site_No H2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2227	1	Gambusia sp.	16	1
2227	1	Gambusia sp.	15	1
2227	1	Gambusia sp.	15	1
2227	1	Gambusia sp.	15	1
2227	1	Gambusia sp.	20	1
2227	1	Gambusia sp.	28	1
2227	1	Gambusia sp.	15	1
2227	1	Gambusia sp.	14	1
2227	1	Gambusia sp.	15	1
2227	1	Gambusia sp.	15	1
2227	1	Gambusia sp.	15	1
2227	1	Gambusia sp.	18	1
2227	1	Gambusia sp.	13	1
2227	1	Gambusia sp.	11	1
2227	1	Gambusia sp.	14	1
2227	1	Gambusia sp.	14	1
2227	1	Gambusia sp.	15	1
2227	1	Lepomis sp.	16	1
2227	1	Palaemonetes sp.		7
2227	2	Etheostoma fonticola	22	1
2227	2	Gambusia sp.	12	1
2227	2	Gambusia sp.	15	1
2227	2	Palaemonetes sp.		1
2227	3	No fish collected		
2227	4	Lepomis sp.	16	1
2227	4	Etheostoma fonticola	16	1
2227	5	Gambusia sp.	17	1
2227	5	Gambusia sp.	15	1
2227	5	Gambusia sp.	20	1
2227	5	Gambusia sp.	20	1

2227	5	Gambusia sp.	20	1
2227	6	Palaemonetes sp.		1
2227	6	Gambusia sp.	20	1
2227	6	Gambusia sp.		1
2227	6	Gambusia sp.		1
2227	6	Gambusia sp.		1
2227	7	Gambusia sp.		2
2227	8	Gambusia sp.		2
2227	9	Gambusia sp.		1
2227	10	Lepomis miniatus	140	1
2227	11	No fish collected		
2227	12	No fish collected		
2227	13	Gambusia sp.		2
2227	14	No fish collected		
2227	15	No fish collected		

SiteCode 2228 Date 4/23/2018 Reach Spring Lake Dam Site_No O1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2228	1	No fish collected		
2228	2	No fish collected		
2228	3	No fish collected		
2228	4	No fish collected		
2228	5	No fish collected		
2228	6	No fish collected		
2228	7	No fish collected		
2228	8	No fish collected		
2228	9	No fish collected		
2228	10	No fish collected		

SiteCode 2229 Date 4/23/2018 Reach Spring Lake Dam Site_No O2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2229	1	No fish collected		
2229	2	No fish collected		
2229	3	No fish collected		
2229	4	No fish collected		
2229	5	No fish collected		
2229	6	No fish collected		
2229	7	No fish collected		
2229	8	No fish collected		
2229	9	No fish collected		
2229	10	No fish collected		

SiteCode 2230 Date 4/23/2018 Reach Spring Lake Dam Site_No P1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2230	1	Gambusia sp.	34	1
2230	1	Gambusia sp.	32	1
2230	1	Procambarus sp.		1
2230	2	No fish collected		
2230	3	Procambarus sp.		1
2230	4	Lepomis miniatus	70	1
2230	4	Procambarus sp.		1
2230	5	No fish collected		
2230	6	No fish collected		
2230	7	No fish collected		
2230	8	No fish collected		
2230	9	No fish collected		
2230	10	No fish collected		
2230	11	No fish collected		
2230	12	No fish collected		
2230	13	No fish collected		
2230	14	No fish collected		
2230	15	No fish collected		

SiteCode 2231 Date 4/23/2018 Reach Spring Lake Dam Site_No P2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2231	1	Etheostoma fonticola	18	1
2231	2	No fish collected		
2231	3	No fish collected		
2231	4	No fish collected		
2231	5	No fish collected		
2231	6	No fish collected		
2231	7	No fish collected		
2231	8	No fish collected		
2231	9	Etheostoma fonticola	13	1
2231	10	No fish collected		
2231	11	No fish collected		
2231	12	No fish collected		
2231	13	No fish collected		
2231	14	No fish collected		
2231	15	No fish collected		

SiteCode 2232 Date 4/23/2018 Reach Spring Lake Dam Site_No S1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2232	1	Herichthys cyanoguttatus	59	1
2232	1	Herichthys cyanoguttatus	28	1
2232	1	Etheostoma fonticola	34	1
2232	1	Palaemonetes sp.		9
2232	1	Procambarus sp.		1
2232	2	Procambarus sp.		2
2232	2	Lepomis gulosus	83	1
2232	2	Lepomis miniatus	61	1
2232	2	Palaemonetes sp.		3
2232	2	Procambarus sp.		1
2232	3	No fish collected		
2232	4	Procambarus sp.		1
2232	5	Lepomis miniatus	45	1
2232	5	Herichthys cyanoguttatus	48	1
2232	5	Procambarus sp.		1
2232	5	Palaemonetes sp.		1
2232	6	Lepomis miniatus	40	1
2232	6	Procambarus sp.		3
2232	6	Palaemonetes sp.		1
2232	7	No fish collected		
2232	8	No fish collected		
2232	9	No fish collected		
2232	10	Procambarus sp.		1
2232	11	Procambarus sp.		2
2232	11	Herichthys cyanoguttatus	64	1
2232	12	Etheostoma fonticola	35	1
2232	13	Procambarus sp.		1
2232	14	Palaemonetes sp.		1
2232	15	Procambarus sp.		1

SiteCode 2233 Date 4/23/2018 Reach Spring Lake Dam Site_No S2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2233	1	Procambarus sp.		2
2233	1	Herichthys cyanoguttatus	50	1
2233	1	Palaemonetes sp.		11
2233	2	Procambarus sp.		3
2233	2	Lepomis gulosus	68	1
2233	2	Lepomis miniatus	47	1
2233	3	Procambarus sp.		2
2233	3	Herichthys cyanoguttatus	60	1
2233	3	Herichthys cyanoguttatus	60	1
2233	3	Gambusia sp.	42	1
2233	4	No fish collected		
2233	5	Procambarus sp.		2
2233	6	Procambarus sp.		1
2233	7	Procambarus sp.		3
2233	8	Procambarus sp.		1
2233	9	Procambarus sp.		3
2233	10	No fish collected		
2233	11	No fish collected		
2233	12	No fish collected		
2233	13	No fish collected		
2233	14	Lepomis miniatus	22	1
2233	15	No fish collected		

SiteCode 2234 Date 4/23/2018 Reach Spring Lake Dam Site_No Hydro1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2234	1	Gambusia sp.	12	1
2234	1	Procambarus sp.		1
2234	1	Palaemonetes sp.		1
2234	2	Etheostoma fonticola	22	1
2234	3	Palaemonetes sp.		2
2234	3	Procambarus sp.		1
2234	3	Gambusia sp.	10	1
2234	3	Lepomis sp.	15	1
2234	4	Palaemonetes sp.		1
2234	5	No fish collected		
2234	6	No fish collected		
2234	7	No fish collected		
2234	8	No fish collected		
2234	9	Etheostoma fonticola	26	1
2234	9	Etheostoma fonticola	16	1
2234	10	Gambusia sp.	13	1
2234	11	Procambarus sp.		1
2234	12	Etheostoma fonticola	30	1
2234	13	No fish collected		
2234	14	Procambarus sp.		1
2234	15	No fish collected		

SiteCode 2235 Date 4/23/2018 Reach Spring Lake Dam Site_No Hydro2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2235	1	Etheostoma fonticola	35	1
2235	2	No fish collected		
2235	3	No fish collected		
2235	4	Etheostoma fonticola	34	1
2235	5	No fish collected		
2235	6	No fish collected		
2235	7	Procambarus sp.		1
2235	8	Procambarus sp.		1
2235	9	No fish collected		
2235	10	Procambarus sp.		1
2235	11	No fish collected		
2235	12	No fish collected		
2235	13	No fish collected		
2235	14	No fish collected		
2235	15	Procambarus sp.		1

SiteCode 2236 Date 4/23/2018 Reach City Park Site_No O1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2236	1	No fish collected		
2236	2	No fish collected		
2236	3	No fish collected		
2236	4	No fish collected		
2236	5	No fish collected		
2236	6	No fish collected		
2236	7	No fish collected		
2236	8	No fish collected		
2236	9	No fish collected		
2236	10	No fish collected		

SiteCode 2237 Date 4/23/2018 Reach City Park Site_No O2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2237	1	No fish collected		
2237	2	No fish collected		
2237	3	No fish collected		
2237	4	No fish collected		
2237	5	No fish collected		
2237	6	No fish collected		
2237	7	No fish collected		
2237	8	No fish collected		
2237	9	No fish collected		
2237	10	No fish collected		

SiteCode 2238 Date 4/23/2018 Reach City Park Site_No H1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2238	1	Procambarus sp.		8
2238	1	Gambusia sp.	15	1
2238	1	Gambusia sp.	16	1
2238	1	Gambusia sp.	14	1
2238	1	Gambusia sp.	12	1
2238	1	Gambusia sp.	14	1
2238	1	Gambusia sp.	15	1
2238	1	Gambusia sp.	25	1
2238	1	Gambusia sp.	14	1
2238	1	Gambusia sp.	18	1
2238	1	Gambusia sp.	15	1
2238	1	Gambusia sp.	12	1
2238	1	Etheostoma fonticola	19	1
2238	1	Gambusia sp.	13	1
2238	1	Gambusia sp.	11	1
2238	1	Gambusia sp.	15	1
2238	1	Gambusia sp.		17
2238	2	Procambarus sp.		3
2238	2	Gambusia sp.		33
2238	3	Etheostoma fonticola	22	1
2238	3	Gambusia sp.		1
2238	4	Procambarus sp.		3
2238	4	Gambusia sp.		1
2238	5	Etheostoma fonticola	34	1
2238	5	Etheostoma fonticola	17	1
2238	5	Gambusia sp.		2
2238	5	Procambarus sp.		1
2238	6	Lepomis miniatus	140	1
2238	6	Procambarus sp.		2
2238	7	Etheostoma fonticola	24	1

2238	7	Procambarus sp.		3
2238	7	Gambusia sp.		1
2238	8	Gambusia sp.		1
2238	8	Etheostoma fonticola	17	1
2238	8	Procambarus sp.		1
2238	9	Etheostoma fonticola	25	1
2238	9	Procambarus sp.		2
2238	10	Procambarus sp.		2
2238	11	Etheostoma fonticola	15	1
2238	11	Etheostoma fonticola	21	1
2238	11	Procambarus sp.		5
2238	12	Procambarus sp.		1
2238	13	No fish collected		
2238	14	Procambarus sp.		1
2238	15	Procambarus sp.		1
2238	1	Gambusia sp.	19	1
2238	1	Gambusia sp.	18	1
2238	1	Gambusia sp.	14	1
2238	1	Gambusia sp.	10	1
2238	1	Gambusia sp.	16	1
2238	1	Gambusia sp.	20	1
2238	1	Gambusia sp.	19	1
2238	1	Gambusia sp.	14	1
2238	1	Gambusia sp.	13	1
2238	1	Gambusia sp.	11	1
2238	1	Gambusia sp.	15	1

SiteCode 2239 Date 4/23/2018 Reach City Park Site_No H2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2239	1	Gambusia sp.	25	1
2239	1	Gambusia sp.	26	1
2239	1	Gambusia sp.	16	1
2239	1	Gambusia sp.	29	1
2239	1	Gambusia sp.	13	1
2239	1	Gambusia sp.	32	1
2239	1	Gambusia sp.	30	1
2239	1	Gambusia sp.	25	1
2239	1	Gambusia sp.	16	1
2239	1	Gambusia sp.	10	1
2239	1	Gambusia sp.	12	1
2239	1	Gambusia sp.	15	1
2239	1	Gambusia sp.	12	1
2239	1	Gambusia sp.	19	1
2239	1	Gambusia sp.	21	1
2239	1	Gambusia sp.	15	1
2239	1	Gambusia sp.	20	1
2239	1	Gambusia sp.	12	1
2239	1	Gambusia sp.	15	1
2239	1	Gambusia sp.	23	1
2239	1	Gambusia sp.	15	1
2239	1	Gambusia sp.	16	1
2239	1	Gambusia sp.	18	1
2239	1	Gambusia sp.	15	1
2239	1	Gambusia sp.	30	1
2239	1	Gambusia sp.		31
2239	1	Etheostoma fonticola	19	1
2239	1	Procambarus sp.		1
2239	2	Lepomis miniatus	62	
2239	2	Lepomis miniatus	20	

2239	2	Gambusia sp.		3
2239	3	No fish collected		
2239	4	Etheostoma fonticola	32	1
2239	4	Etheostoma fonticola	23	1
2239	4	Gambusia sp.		8
2239	4	Procambarus sp.		1
2239	5	Etheostoma fonticola	20	1
2239	5	Gambusia sp.		7
2239	6	Lepomis macrochirus	59	1
2239	6	Gambusia sp.		2
2239	7	Gambusia sp.		5
2239	8	No fish collected		
2239	9	Gambusia sp.		1
2239	10	Procambarus sp.		2
2239	10	Gambusia sp.		1
2239	11	Gambusia sp.		2
2239	12	No fish collected		
2239	13	Procambarus sp.		2
2239	14	Procambarus sp.		2
2239	15	No fish collected		

SiteCode 2240 Date 4/23/2018 Reach City Park Site_No HD1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2240	1	Ambloplites rupestris	110	1
2240	1	Gambusia sp.	14	1
2240	1	Gambusia sp.	25	1
2240	1	Gambusia sp.	13	1
2240	1	Gambusia sp.	10	1
2240	1	Gambusia sp.	15	1
2240	1	Gambusia sp.	12	1
2240	1	Gambusia sp.	39	1
2240	1	Gambusia sp.	41	1
2240	1	Gambusia sp.	21	1
2240	1	Gambusia sp.	14	1
2240	1	Gambusia sp.	21	1
2240	1	Gambusia sp.	25	1
2240	1	Gambusia sp.	35	1
2240	1	Gambusia sp.	46	1
2240	1	Gambusia sp.	17	1
2240	1	Gambusia sp.	14	1
2240	1	Gambusia sp.	15	1
2240	1	Gambusia sp.	14	1
2240	1	Gambusia sp.	20	1
2240	1	Gambusia sp.	24	1
2240	1	Gambusia sp.	22	1
2240	1	Gambusia sp.	12	1
2240	1	Gambusia sp.	14	1
2240	1	Gambusia sp.	15	1
2240	1	Gambusia sp.	24	1
2240	1	Gambusia sp.	25	1
2240	1	Gambusia sp.		26
2240	1	Etheostoma fonticola	14	1
2240	2	Gambusia sp.		25

2240	3	Gambusia sp.		20
2240	4	Gambusia sp.		7
2240	5	Gambusia sp.		5
2240	6	Gambusia sp.		4
2240	7	Etheostoma fonticola	30	1
2240	7	Gambusia sp.		3
2240	8	Gambusia sp.		4
2240	9	Gambusia sp.		2
2240	10	Gambusia sp.		1
2240	11	No fish collected		
2240	12	No fish collected		
2240	13	No fish collected		
2240	14	Gambusia sp.		1
2240	15	No fish collected		

SiteCode 2241 Date 4/23/2018 Reach City Park Site_No HD2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2241	1	Gambusia sp.	47	1
2241	1	Gambusia sp.	17	1
2241	1	Gambusia sp.	23	1
2241	1	Gambusia sp.	16	1
2241	1	Gambusia sp.	40	1
2241	1	Gambusia sp.	27	1
2241	1	Gambusia sp.	21	1
2241	1	Gambusia sp.	26	1
2241	1	Gambusia sp.	19	1
2241	1	Gambusia sp.	20	1
2241	1	Gambusia sp.	25	1
2241	1	Gambusia sp.	21	1
2241	1	Gambusia sp.	21	1
2241	1	Gambusia sp.	17	1
2241	1	Gambusia sp.	17	1
2241	1	Gambusia sp.	17	1
2241	1	Gambusia sp.	20	1
2241	1	Gambusia sp.	15	1
2241	1	Gambusia sp.	15	1
2241	1	Gambusia sp.	20	1
2241	1	Gambusia sp.	17	1
2241	1	Gambusia sp.	22	1
2241	1	Gambusia sp.	21	1
2241	1	Gambusia sp.	21	1
2241	1	Gambusia sp.	13	1
2241	1	Gambusia sp.		24
2241	1	Ameiurus natalis	21	1
2241	2	Lepomis miniatus	160	1
2241	2	Herichthys cyanoguttatus	81	1
2241	2	Ameiurus natalis	18	1

2241	2	Gambusia sp.		12
2241	3	Gambusia sp.		21
2241	4	Procambarus sp.		2
2241	4	Gambusia sp.		4
2241	5	Gambusia sp.		25
2241	6	Etheostoma fonticola	34	1
2241	6	Gambusia sp.		7
2241	7	Gambusia sp.		9
2241	8	Gambusia sp.		3
2241	9	Gambusia sp.		3
2241	10	No fish collected		
2241	11	Gambusia sp.		1
2241	12	Ambloplites rupestris	196	1
2241	13	Gambusia sp.		4
2241	14	No fish collected		
2241	15	No fish collected		

SiteCode 2242 Date 4/23/2018 Reach City Park Site_No PH1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2242	1	Procambarus sp.		3
2242	1	Lepomis miniatus	102	1
2242	1	Etheostoma fonticola	19	1
2242	2	Etheostoma fonticola	22	1
2242	3	Procambarus sp.		1
2242	4	Etheostoma fonticola	30	1
2242	4	Procambarus sp.		1
2242	5	Procambarus sp.		2
2242	6	No fish collected		
2242	7	No fish collected		
2242	8	No fish collected		
2242	9	Etheostoma fonticola	14	1
2242	9	Etheostoma fonticola	24	1
2242	10	Etheostoma fonticola	14	1
2242	11	No fish collected		
2242	12	Dionda nigrotaeniata	23	1
2242	13	Ambloplites rupestris	21	1
2242	14	No fish collected		
2242	15	No fish collected		

SiteCode 2243 Date 4/23/2018 Reach City Park Site_No PH2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2243	1	No fish collected		
2243	2	Micropterus salmoides	136	1
2243	3	No fish collected		
2243	4	No fish collected		
2243	5	Procambarus sp.		1
2243	6	No fish collected		
2243	7	Etheostoma fonticola	19	1
2243	8	Etheostoma fonticola	28	1
2243	8	Etheostoma fonticola	21	1
2243	8	Etheostoma fonticola	14	1
2243	8	Etheostoma fonticola	13	1
2243	9	No fish collected		
2243	10	No fish collected		
2243	11	No fish collected		
2243	12	Procambarus sp.		1
2243	13	No fish collected		
2243	14	No fish collected		
2243	15	No fish collected		

SiteCode 2244 Date 4/23/2018 Reach City Park Site_No S1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2244	1	No fish collected		
2244	2	Ambloplites rupestris	35	1
2244	3	No fish collected		
2244	4	No fish collected		
2244	5	No fish collected		
2244	6	No fish collected		
2244	7	No fish collected		
2244	8	No fish collected		
2244	9	No fish collected		
2244	10	No fish collected		
2244	11	No fish collected		
2244	12	No fish collected		
2244	13	Etheostoma fonticola	29	1
2244	14	No fish collected		
2244	15	No fish collected		

SiteCode 2245 Date 4/23/2018 Reach City Park Site_No S2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2245	1	Etheostoma fonticola	26	1
2245	2	No fish collected		
2245	3	Etheostoma fonticola	30	1
2245	3	Gambusia sp.	20	1
2245	4	Poecilia latipinna		2
2245	4	Etheostoma fonticola	27	1
2245	5	Procambarus sp.		2
2245	6	No fish collected		
2245	7	Etheostoma fonticola	30	1
2245	8	Ambloplites rupestris	14	1
2245	9	No fish collected		
2245	10	No fish collected		
2245	11	Etheostoma fonticola	27	1
2245	12	No fish collected		
2245	13	No fish collected		
2245	14	No fish collected		
2245	15	No fish collected		

SiteCode 2246 Date 4/24/2018 Reach I-35 Site_No H1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2246	1	Procambarus sp.		13
2246	1	Etheostoma fonticola	21	1
2246	1	Lepomis miniatus	45	1
2246	1	Lepomis macrochirus	25	1
2246	1	Etheostoma fonticola	39	1
2246	1	Dionda nigrotaeniata	17	1
2246	1	Lepomis miniatus	20	1
2246	1	Gambusia sp.	11	1
2246	1	Etheostoma fonticola	20	1
2246	2	Lepomis miniatus	18	1
2246	2	Procambarus sp.		2
2246	2	Gambusia sp.	13	1
2246	3	Etheostoma fonticola	24	1
2246	3	Procambarus sp.		4
2246	4	Procambarus sp.		2
2246	4	Palaemonetes sp.		1
2246	5	Gambusia sp.	15	1
2246	5	Procambarus sp.		3
2246	6	Gambusia sp.	11	1
2246	6	Gambusia sp.	11	1
2246	6	Procambarus sp.		2
2246	7	Etheostoma fonticola	22	1
2246	7	Procambarus sp.		2
2246	8	No fish collected		
2246	9	Procambarus sp.		1
2246	10	No fish collected		
2246	11	No fish collected		
2246	12	No fish collected		
2246	13	No fish collected		
2246	14	Ambloplites rupestris	98	1

2246	15	No fish collected	

SiteCode 2247 Date 4/24/2018 Reach I-35 Site_No H2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2247	1	Procambarus sp.		21
2247	1	Etheostoma fonticola	33	1
2247	1	Etheostoma fonticola	27	1
2247	1	Etheostoma fonticola	30	1
2247	1	Etheostoma fonticola	33	1
2247	1	Etheostoma fonticola	16	1
2247	1	Gambusia sp.	29	1
2247	1	Gambusia sp.	18	1
2247	1	Gambusia sp.	11	1
2247	1	Gambusia sp.	18	1
2247	1	Gambusia sp.	23	1
2247	1	Gambusia sp.	22	1
2247	1	Gambusia sp.	19	1
2247	1	Gambusia sp.	22	1
2247	1	Gambusia sp.	15	1
2247	1	Gambusia sp.	17	1
2247	1	Gambusia sp.	12	1
2247	1	Gambusia sp.	14	1
2247	1	Gambusia sp.	21	1
2247	1	Gambusia sp.	13	1
2247	1	Gambusia sp.	20	1
2247	1	Gambusia sp.	16	1
2247	1	Gambusia sp.	16	1
2247	1	Gambusia sp.	9	1
2247	1	Gambusia sp.	10	1
2247	2	Procambarus sp.		6
2247	2	Gambusia sp.	25	1
2247	2	Gambusia sp.	22	1
2247	2	Gambusia sp.	21	1
2247	2	Gambusia sp.	20	1

2247	2	Gambusia sp.	25	1
2247	2	Gambusia sp.	15	1
2247	3	Ambloplites rupestris	23	1
2247	3	Procambarus sp.		2
2247	4	Gambusia sp.		3
2247	4	Etheostoma fonticola	19	1
2247	4	Procambarus sp.		3
2247	5	Procambarus sp.		2
2247	6	Procambarus sp.		3
2247	6	Etheostoma fonticola	35	1
2247	7	Gambusia sp.		1
2247	7	Procambarus sp.		7
2247	8	No fish collected		
2247	9	Procambarus sp.		1
2247	10	Etheostoma fonticola	23	1
2247	10	Procambarus sp.		1
2247	11	Procambarus sp.		2
2247	10	No fish collected		
2247	13	No fish collected		
2247	14	Ambloplites rupestris	75	1
2247	15	No fish collected		

SiteCode 2248 Date 4/24/2018 Reach I-35 Site_No S1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2248	1	Ambloplites rupestris	80	1
2248	1	Ambloplites rupestris	26	1
2248	1	Procambarus sp.		19
2248	1	Ameiurus natalis	30	1
2248	1	Gambusia sp.	27	1
2248	1	Gambusia sp.	30	1
2248	1	Gambusia sp.	11	1
2248	1	Gambusia sp.	20	1
2248	1	Gambusia sp.	18	1
2248	1	Gambusia sp.	12	1
2248	1	Gambusia sp.	16	1
2248	1	Gambusia sp.	16	1
2248	1	Gambusia sp.	19	1
2248	1	Gambusia sp.	15	1
2248	1	Gambusia sp.	13	1
2248	2	Astyanax mexicanus	48	1
2248	2	Procambarus sp.		24
2248	3	Procambarus sp.		9
2248	4	Procambarus sp.		9
2248	4	Gambusia sp.	26	1
2248	5	Procambarus sp.		5
2248	6	Procambarus sp.		5
2248	6	Gambusia sp.	21	1
2248	7	Procambarus sp.		5
2248	8	Gambusia sp.	34	1
2248	8	Procambarus sp.		2
2248	9	Procambarus sp.		3
2248	10	Procambarus sp.		4
2248	11	Gambusia sp.	21	1
2248	12	Gambusia sp.	13	1

2248	13	Procambarus sp.		1
2248	14	Procambarus sp.		3
2248	14	Gambusia sp.	12	1
2248	15	Procambarus sp.		1

SiteCode 2249 Date 4/24/2018 Reach I-35 Site_No S2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2249	1	Procambarus sp.		6
2249	1	Gambusia sp.	21	1
2249	1	Gambusia sp.	25	1
2249	1	Etheostoma fonticola	12	1
2249	2	Procambarus sp.		1
2249	2	Ambloplites rupestris	72	1
2249	3	Lepomis miniatus	77	1
2249	4	Procambarus sp.		3
2249	4	Gambusia sp.	22	1
2249	4	Gambusia sp.	18	1
2249	5	Procambarus sp.		2
2249	6	Gambusia sp.	21	1
2249	6	Procambarus sp.		2
2249	6	Etheostoma fonticola	18	1
2249	7	Procambarus sp.		1
2249	8	Procambarus sp.		3
2249	9	Procambarus sp.		1
2249	10	Procambarus sp.		2
2249	11	Astyanax mexicanus	90	1
2249	12	Gambusia sp.	21	1
2249	13	Procambarus sp.		2
2249	14	Gambusia sp.	16	1
2249	15	No fish collected		

SiteCode 2250 Date 4/24/2018 Reach I-35 Site_No HD1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2250	1	Procambarus sp.		4
2250	2	Procambarus sp.		1
2250	3	Procambarus sp.		3
2250	4	No fish collected		
2250	5	No fish collected		
2250	6	No fish collected		
2250	7	No fish collected		
2250	8	No fish collected		
2250	9	No fish collected		
2250	10	Procambarus sp.		1
2250	11	No fish collected		
2250	12	Procambarus sp.		2
2250	13	Procambarus sp.		1
2250	14	No fish collected		
2250	15	No fish collected		

SiteCode 2251 Date 4/24/2018 Reach I-35 Site_No HD2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2251	1	No fish collected		
2251	2	Procambarus sp.		3
2251	3	No fish collected		
2251	4	Etheostoma fonticola	22	1
2251	5	Hypostomus plecostomus	19	1
2251	6	Procambarus sp.		1
2251	7	No fish collected		
2251	8	No fish collected		
2251	9	No fish collected		
2251	10	Procambarus sp.		1
2251	11	No fish collected		
2251	12	No fish collected		
2251	13	No fish collected		
2251	14	No fish collected		
2251	15	No fish collected		

SiteCode 2252 Date 4/24/2018 Reach I-35 Site_No O1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2252	1	No fish collected		
2252	2	No fish collected		
2252	3	No fish collected		
2252	4	No fish collected		
2252	5	No fish collected		
2252	6	No fish collected		
2252	7	No fish collected		
2252	8	No fish collected		
2252	9	No fish collected		
2252	10	No fish collected		

SiteCode 2253 Date 4/24/2018 Reach I-35 Site_No O2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2253	1	No fish collected		
2253	2	No fish collected		
2253	3	No fish collected		
2253	4	No fish collected		
2253	5	No fish collected		
2253	6	No fish collected		
2253	7	No fish collected		
2253	8	No fish collected		
2253	9	No fish collected		
2253	10	No fish collected		
2253	11	No fish collected		
2253	12	No fish collected		
2253	13	No fish collected		
2253	14	No fish collected		
2253	15	No fish collected		

SiteCode 2254 Date 4/24/2018 Reach I-35 Site_No C1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2254	1	Etheostoma fonticola	24	1
2254	1	Etheostoma fonticola	28	1
2254	1	Etheostoma fonticola	27	1
2254	1	Etheostoma fonticola	23	1
2254	1	Etheostoma fonticola	28	1
2254	1	Etheostoma fonticola	17	1
2254	1	Etheostoma fonticola	14	1
2254	1	Gambusia sp.	21	1
2254	1	Procambarus sp.		8
2254	2	Procambarus sp.		15
2254	2	Etheostoma fonticola	21	1
2254	2	Etheostoma fonticola	20	1
2254	2	Etheostoma fonticola	11	1
2254	2	Lepomis miniatus	61	1
2254	3	Etheostoma fonticola	22	1
2254	3	Procambarus sp.		1
2254	4	Etheostoma fonticola	37	1
2254	4	Procambarus sp.		5
2254	5	Gambusia sp.	41	1
2254	5	Procambarus sp.		1
2254	6	Etheostoma fonticola	35	1
2254	6	Procambarus sp.		2
2254	7	No fish collected		
2254	8	Procambarus sp.		1
2254	9	Lepomis miniatus	52	1
2254	10	Procambarus sp.		3
2254	11	Lepomis miniatus	70	1
2254	12	No fish collected		
2254	13	Procambarus sp.		1
2254	14	No fish collected		

2254	15	No fish collected		
2254	9	Etheostoma fonticola	14	1

SiteCode 2255 Date 4/24/2018 Reach I-35 Site_No C2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2255	1	Micropterus salmoides	35	1
2255	1	Etheostoma fonticola	23	1
2255	1	Etheostoma fonticola	24	1
2255	1	Etheostoma fonticola	18	1
2255	1	Etheostoma fonticola	12	1
2255	1	Etheostoma fonticola	21	1
2255	1	Gambusia sp.	14	1
2255	1	Gambusia sp.	11	1
2255	2	Etheostoma fonticola	20	1
2255	2	Etheostoma fonticola	22	1
2255	2	Etheostoma fonticola	14	1
2255	2	Etheostoma fonticola	25	1
2255	2	Etheostoma fonticola	23	1
2255	2	Etheostoma fonticola	22	1
2255	2	Etheostoma fonticola	17	1
2255	2	Etheostoma fonticola	12	1
2255	2	Etheostoma fonticola	16	1
2255	2	Lepomis sp.	14	1
2255	3	Etheostoma fonticola	35	1
2255	3	Etheostoma fonticola	18	1
2255	3	Etheostoma fonticola	17	1
2255	3	Etheostoma fonticola	19	1
2255	3	Etheostoma fonticola	19	1
2255	3	Procambarus sp.		2
2255	3	Gambusia sp.	11	1
2255	3	Gambusia sp.	12	1
2255	3	Gambusia sp.	10	1
2255	4	Etheostoma fonticola	27	1
2255	4	Etheostoma fonticola	14	1
2255	4	Etheostoma fonticola	20	1

2255	4	Procambarus sp.		11
2255	4	Gambusia sp.	12	1
2255	5	Procambarus sp.		1
2255	6	Etheostoma fonticola	11	1
2255	6	Procambarus sp.		2
2255	7	Gambusia sp.	11	1
2255	8	Etheostoma fonticola	18	1
2255	8	Etheostoma fonticola	19	1
2255	9	No fish collected		
2255	10	Etheostoma fonticola	31	1
2255	11	Procambarus sp.		2
2255	12	No fish collected		
2255	13	Procambarus sp.		2
2255	14	Procambarus sp.		2
2255	14	Etheostoma fonticola	29	1
2255	15	Procambarus sp.		3

SiteCode 2287 Date 10/17/2018 Reach City Park Site_No HD1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2287	1	Ambloplites rupestris	147	1
2287	1	Gambusia sp.	32	1
2287	1	Gambusia sp.	30	1
2287	1	Gambusia sp.	30	1
2287	1	Gambusia sp.	20	1
2287	1	Gambusia sp.	21	1
2287	1	Gambusia sp.	30	1
2287	1	Gambusia sp.	23	1
2287	1	Gambusia sp.	17	1
2287	1	Gambusia sp.	16	1
2287	1	Gambusia sp.	15	1
2287	1	Gambusia sp.	12	1
2287	1	Gambusia sp.	12	1
2287	1	Gambusia sp.	11	1
2287	1	Gambusia sp.	11	1
2287	2	Gambusia sp.	35	1
2287	2	Gambusia sp.	25	1
2287	2	Gambusia sp.	20	1
2287	2	Gambusia sp.	22	1
2287	2	Gambusia sp.	17	1
2287	2	Gambusia sp.	33	1
2287	2	Gambusia sp.	21	1
2287	2	Gambusia sp.	22	1
2287	2	Gambusia sp.	12	1
2287	2	Gambusia sp.	16	1
2287	2	Gambusia sp.	12	1
2287	3	Gambusia sp.		4
2287	3	Procambarus sp.		1
2287	4	Gambusia sp.		5
2287	5	No fish collected		

2287	6	Gambusia sp.	8
2287	7	Gambusia sp.	12
2287	8	Gambusia sp.	2
2287	9	Gambusia sp.	5
2287	10	No fish collected	
2287	11	Gambusia sp.	5
2287	12	No fish collected	
2287	13	No fish collected	
2287	14	No fish collected	
2287	15	No fish collected	

SiteCode 2288 Date 10/17/2018 Reach City Park Site_No HD2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2288	1	Lepomis miniatus	65	1
2288	1	Gambusia sp.	10	1
2288	1	Gambusia sp.	24	1
2288	1	Gambusia sp.	18	1
2288	1	Gambusia sp.	16	1
2288	1	Gambusia sp.	16	1
2288	1	Gambusia sp.	11	1
2288	1	Gambusia sp.	17	1
2288	1	Gambusia sp.	15	1
2288	1	Gambusia sp.	12	1
2288	1	Gambusia sp.	15	1
2288	2	Gambusia sp.	14	1
2288	3	Ambloplites rupestris	64	1
2288	4	Gambusia sp.	18	1
2288	4	Gambusia sp.	12	1
2288	4	Gambusia sp.	15	1
2288	4	Gambusia sp.	12	1
2288	4	Gambusia sp.	19	1
2288	5	Gambusia sp.	20	1
2288	6	Procambarus sp.		1
2288	7	Gambusia sp.	23	1
2288	7	Gambusia sp.	20	1
2288	8	Gambusia sp.	16	1
2288	8	Gambusia sp.	12	1
2288	7	Etheostoma fonticola	35	1
2288	9	Gambusia sp.		18
2288	10	Etheostoma fonticola	33	1
2288	11	Etheostoma fonticola	30	1
2288	12	Gambusia sp.		1
2288	13	Gambusia sp.		1

2288	14	No fish collected	
2288	15	No fish collected	

SiteCode 2289 Date 10/17/2018 Reach City Park Site_No O1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2289	1	No fish collected		
2289	2	No fish collected		
2289	3	No fish collected		
2289	4	No fish collected		
2289	5	No fish collected		
2289	6	Gambusia sp.	18	1
2289	6	Gambusia sp.	15	1
2289	7	No fish collected		
2289	8	No fish collected		
2289	9	No fish collected		
2289	10	Gambusia sp.	15	1
2289	11	No fish collected		
2289	12	No fish collected		
2289	13	No fish collected		
2289	14	No fish collected		
2289	15	No fish collected		

SiteCode 2290 Date 10/17/2018 Reach City Park Site_No O2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2290	7	No fish collected		
2290	8	No fish collected		
2290	9	No fish collected		
2290	10	No fish collected		
2290	1	No fish collected		
2290	2	No fish collected		
2290	3	No fish collected		
2290	4	No fish collected		
2290	5	No fish collected		
2290	6	No fish collected		

SiteCode 2291 Date 10/17/2018 Reach City Park Site_No PH1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2291	1	Lepomis miniatus	26	1
2291	1	Lepomis miniatus	28	1
2291	1	Lepomis miniatus	95	1
2291	1	Lepomis miniatus	97	1
2291	1	Gambusia sp.	22	1
2291	1	Gambusia sp.	23	1
2291	1	Gambusia sp.	19	1
2291	1	Gambusia sp.	21	1
2291	1	Gambusia sp.	16	1
2291	1	Gambusia sp.	15	1
2291	1	Gambusia sp.	15	1
2291	1	Etheostoma fonticola	16	1
2291	2	Lepomis miniatus	100	1
2291	2	Gambusia sp.	18	1
2291	2	Gambusia sp.	19	1
2291	2	Gambusia sp.	17	1
2291	2	Gambusia sp.	24	1
2291	2	Gambusia sp.	14	1
2291	2	Gambusia sp.	11	1
2291	2	Gambusia sp.	14	1
2291	2	Procambarus sp.		1
2291	3	Gambusia sp.	25	1
2291	3	Gambusia sp.	13	1
2291	3	Gambusia sp.	14	1
2291	3	Gambusia sp.	15	1
2291	3	Palaemonetes sp.		1
2291	4	Gambusia sp.	15	1
2291	5	Etheostoma fonticola	31	1
2291	6	Gambusia sp.	22	1
2291	6	Gambusia sp.	23	1

2291	6	Gambusia sp.	18	1
2291	6	Gambusia sp.	15	1
2291	6	Gambusia sp.	17	1
2291	7	Etheostoma fonticola	17	1
2291	7	Etheostoma fonticola	30	1
2291	7	Gambusia sp.	10	1
2291	8	Lepomis miniatus	125	1
2291	8	Gambusia sp.		1
2291	9	Gambusia sp.		2
2291	10	Procambarus sp.		1
2291	10	Gambusia sp.		1
2291	11	Gambusia sp.		1
2291	12	Gambusia sp.		1
2291	13	Gambusia sp.		5
2291	14	No fish collected		
2291	15	Gambusia sp.		4
2291	15	Procambarus sp.		1
2291	3	Etheostoma fonticola	18	1
2291	3	Etheostoma fonticola	36	1
2291	8	Gambusia sp.		8

SiteCode 2292 Date 10/17/2018 Reach City Park Site_No PH2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2292	1	Gambusia sp.	15	1
2292	1	Gambusia sp.	18	1
2292	1	Gambusia sp.	10	1
2292	1	Gambusia sp.	12	1
2292	1	Gambusia sp.	14	1
2292	1	Gambusia sp.	15	1
2292	1	Gambusia sp.	10	1
2292	1	Gambusia sp.	20	1
2292	1	Gambusia sp.	16	1
2292	1	Gambusia sp.	15	1
2292	1	Gambusia sp.	15	1
2292	1	Gambusia sp.	12	1
2292	1	Gambusia sp.	14	1
2292	1	Gambusia sp.	11	1
2292	1	Gambusia sp.	11	1
2292	1	Gambusia sp.	22	1
2292	1	Gambusia sp.	13	1
2292	1	Gambusia sp.	12	1
2292	1	Gambusia sp.	20	1
2292	1	Gambusia sp.	23	1
2292	1	Gambusia sp.	20	1
2292	1	Gambusia sp.	22	1
2292	1	Gambusia sp.	10	1
2292	1	Etheostoma fonticola	14	1
2292	2	Gambusia sp.	16	1
2292	2	Gambusia sp.	16	1
2292	2	Gambusia sp.	15	1
2292	2	Gambusia sp.		7
2292	2	Palaemonetes sp.		2
2292	3	Gambusia sp.		8

2292	3	Procambarus sp.		1
2292	4	Gambusia sp.		11
2292	5	Gambusia sp.		2
2292	6	Gambusia sp.		5
2292	6	Procambarus sp.		1
2292	7	Etheostoma fonticola	22	1
2292	7	Procambarus sp.		1
2292	7	Gambusia sp.		2
2292	8	Lepomis miniatus		82
2292	8	Gambusia sp.		1
2292	8	Procambarus sp.		2
2292	9	Gambusia sp.		3
2292	10	Gambusia sp.		4
2292	11	Gambusia sp.		4
2292	12	No fish collected		
2292	13	Gambusia sp.		3
2292	14	Gambusia sp.		1
2292	14	Procambarus sp.		1
2292	15	Gambusia sp.		1

SiteCode 2293 Date 10/17/2018 Reach City Park Site_No S1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2293	1	Etheostoma fonticola	35	1
2293	1	Etheostoma fonticola	17	1
2293	1	Etheostoma fonticola	20	1
2293	1	Etheostoma fonticola	22	1
2293	1	Etheostoma fonticola	20	1
2293	1	Gambusia sp.	18	1
2293	1	Gambusia sp.	19	1
2293	1	Gambusia sp.	20	1
2293	1	Gambusia sp.	17	1
2293	1	Gambusia sp.	12	1
2293	1	Gambusia sp.	10	1
2293	1	Gambusia sp.	10	1
2293	1	Gambusia sp.	12	1
2293	1	Gambusia sp.	12	1
2293	1	Gambusia sp.	11	1
2293	1	Gambusia sp.	17	1
2293	1	Gambusia sp.	16	1
2293	1	Gambusia sp.	7	1
2293	1	Gambusia sp.	9	1
2293	1	Gambusia sp.	15	1
2293	2	Lepomis miniatus	94	1
2293	2	Etheostoma fonticola	36	1
2293	2	Etheostoma fonticola	32	1
2293	2	Etheostoma fonticola	31	1
2293	2	Etheostoma fonticola	20	1
2293	3	Gambusia sp.	20	1
2293	3	Gambusia sp.	21	1
2293	4	Gambusia sp.	24	1
2293	4	Gambusia sp.	16	1
2293	5	Gambusia sp.	22	1

2293	5	Procambarus sp.		1
2293	6	Procambarus sp.		2
2293	7	Gambusia sp.	11	1
2293	7	Procambarus sp.		2
2293	8	Gambusia sp.	30	1
2293	9	Gambusia sp.	20	1
2293	9	Gambusia sp.	16	1
2293	10	Etheostoma fonticola	20	1
2293	10	Procambarus sp.		1
2293	11	Gambusia sp.	32	1
2293	11	Gambusia sp.	20	1
2293	12	Gambusia sp.		3
2293	13	Gambusia sp.		3
2293	14	No fish collected		
2293	15	No fish collected		

SiteCode 2294 Date 10/17/2018 Reach City Park Site_No S2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2294	1	Gambusia sp.	14	1
2294	1	Gambusia sp.	10	1
2294	1	Gambusia sp.	12	1
2294	1	Gambusia sp.	13	1
2294	1	Gambusia sp.	11	1
2294	1	Gambusia sp.	17	1
2294	1	Gambusia sp.	10	1
2294	1	Gambusia sp.	12	1
2294	1	Gambusia sp.	16	1
2294	1	Gambusia sp.	15	1
2294	1	Gambusia sp.	10	1
2294	1	Gambusia sp.	10	1
2294	1	Gambusia sp.	12	1
2294	1	Gambusia sp.	10	1
2294	1	Gambusia sp.	14	1
2294	1	Gambusia sp.	13	1
2294	1	Gambusia sp.	9	1
2294	1	Gambusia sp.	10	1
2294	1	Gambusia sp.	12	1
2294	1	Gambusia sp.	13	1
2294	1	Gambusia sp.	8	1
2294	1	Gambusia sp.	12	1
2294	1	Gambusia sp.	13	1
2294	2	Gambusia sp.	19	1
2294	2	Gambusia sp.	16	1
2294	2	Gambusia sp.		22
2294	2	Etheostoma fonticola	32	1
2294	2	Etheostoma fonticola	13	1
2294	3	Gambusia sp.		18
2294	4	Lepomis miniatus	60	1

2294	4	Gambusia sp.		8
2294	4	Procambarus sp.		1
2294	5	Gambusia sp.		1
2294	6	Gambusia sp.		6
2294	7	Gambusia sp.		9
2294	8	Lepomis miniatus	72	1
2294	8	Lepomis miniatus	42	1
2294	9	Gambusia sp.		5
2294	10	Gambusia sp.		2
2294	11	No fish collected		
2294	12	No fish collected		
2294	13	Gambusia sp.		3
2294	14	No fish collected		
2294	15	Gambusia sp.		1

SiteCode 2295 Date 10/17/2018 Reach City Park Site_No H1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2295	1	Procambarus sp.		1
2295	1	Gambusia sp.	11	1
2295	1	Gambusia sp.	12	1
2295	1	Gambusia sp.	19	1
2295	1	Gambusia sp.	22	1
2295	1	Gambusia sp.	13	1
2295	1	Gambusia sp.	17	1
2295	1	Gambusia sp.	16	1
2295	1	Gambusia sp.	12	1
2295	1	Gambusia sp.	10	1
2295	1	Gambusia sp.	10	1
2295	1	Gambusia sp.	12	1
2295	1	Gambusia sp.	9	1
2295	1	Gambusia sp.	19	1
2295	1	Gambusia sp.	20	1
2295	1	Gambusia sp.	10	1
2295	1	Gambusia sp.	12	1
2295	1	Gambusia sp.	12	1
2295	1	Gambusia sp.	20	1
2295	1	Gambusia sp.	17	1
2295	1	Gambusia sp.	10	1
2295	1	Gambusia sp.	18	1
2295	1	Gambusia sp.	12	1
2295	1	Gambusia sp.	13	1
2295	1	Gambusia sp.	15	1
2295	1	Gambusia sp.	14	1
2295	1	Gambusia sp.	10	1
2295	1	Gambusia sp.		23
2295	1	Gambusia sp.		10
2295	1	Etheostoma fonticola	20	1

2295	1	Etheostoma fonticola	37	1
2295	1	Etheostoma fonticola	34	1
2295	2	Lepomis miniatus	68	1
2295	2	Ambloplites rupestris	65	1
2295	2	Etheostoma fonticola	36	1
2295	2	Etheostoma fonticola	15	1
2295	2	Etheostoma fonticola	23	1
2295	2	Gambusia sp.		74
2295	3	Etheostoma fonticola	11	1
2295	3	Gambusia sp.		22
2295	4	Etheostoma fonticola	33	1
2295	4	Etheostoma fonticola	34	1
2295	4	Etheostoma fonticola	19	1
2295	4	Etheostoma fonticola	18	1
2295	4	Etheostoma fonticola	17	1
2295	4	Etheostoma fonticola	18	1
2295	4	Etheostoma fonticola	27	1
2295	4	Gambusia sp.		26
2295	5	Lepomis miniatus	61	1
2295	5	Procambarus sp.		2
2295	5	Gambusia sp.		1
2295	6	Etheostoma fonticola	25	1
2295	6	Gambusia sp.		1
2295	7	Gambusia sp.		1
2295	8	No fish collected		
2295	9	Procambarus sp.		1
2295	9	Etheostoma fonticola	31	1
2295	10	Gambusia sp.		2
2295	11	Lepomis miniatus	84	1
2295	11	Etheostoma fonticola	22	1
2295	12	Gambusia sp.		1
2295	12	Procambarus sp.		1
2295	13	Ambloplites rupestris	65	1
2295	13	Gambusia sp.		1
2295	14	No fish collected		

2295	15	Gambusia sp.	2

SiteCode 2296 Date 10/17/2018 Reach City Park Site_No H2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2296	3	Gambusia sp.	20	1
2296	4	Gambusia sp.	22	1
2296	4	Gambusia sp.	18	1
2296	4	Gambusia sp.	18	1
2296	4	Gambusia sp.	31	1
2296	4	Gambusia sp.	26	1
2296	4	Lepomis miniatus	48	1
2296	5	Gambusia sp.	26	1
2296	5	Gambusia sp.	13	1
2296	6	Gambusia sp.	33	1
2296	6	Gambusia sp.	12	1
2296	6	Gambusia sp.	23	1
2296	6	Gambusia sp.	25	1
2296	6	Gambusia sp.		2
2296	7	Lepomis miniatus	50	1
2296	7	Etheostoma fonticola	31	1
2296	7	Gambusia sp.		2
2296	8	Lepomis miniatus	65	1
2296	8	Gambusia sp.		3
2296	9	No fish collected		
2296	10	Gambusia sp.		4
2296	11	No fish collected		
2296	12	Lepomis miniatus	50	1
2296	12	Gambusia sp.		3
2296	13	No fish collected		
2296	14	Gambusia sp.		1
2296	15	Gambusia sp.		1
2296	1	Lepomis miniatus	115	1
2296	1	Gambusia sp.	26	1
2296	2	Lepomis miniatus	64	1

2296	3	Gambusia sp.	20	1
2296	3	Gambusia sp.	20	1
2296	3	Gambusia sp.	25	1
2296	3	Gambusia sp.	20	1
2296	3	Gambusia sp.	15	1
2296	3	Gambusia sp.	8	1
2296	3	Gambusia sp.	22	1
2296	3	Gambusia sp.	25	1
2296	3	Gambusia sp.	13	1
2296	3	Gambusia sp.	15	1
2296	3	Gambusia sp.	11	1
2296	3	Gambusia sp.	25	1
2296	3	Gambusia sp.	16	1
2296	3	Gambusia sp.	24	1

SiteCode 2297 Date 10/17/2018 Reach I-35 Site_No C1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2297	1	Ambloplites rupestris	54	1
2297	1	Gambusia sp.	18	1
2297	1	Gambusia sp.	20	1
2297	1	Gambusia sp.	19	1
2297	1	Gambusia sp.	13	1
2297	1	Gambusia sp.	12	1
2297	1	Gambusia sp.	13	1
2297	1	Gambusia sp.	13	1
2297	1	Gambusia sp.	19	1
2297	1	Lepomis miniatus	30	1
2297	1	Lepomis miniatus	23	1
2297	1	Campostoma anomalum	53	1
2297	1	Procambarus sp.		31
2297	1	Etheostoma fonticola	22	1
2297	2	Gambusia sp.	10	1
2297	2	Gambusia sp.	12	1
2297	2	Gambusia sp.	15	1
2297	2	Gambusia sp.	30	1
2297	2	Gambusia sp.	14	1
2297	2	Gambusia sp.	19	1
2297	2	Etheostoma fonticola	30	1
2297	2	Etheostoma fonticola	24	1
2297	2	Procambarus sp.		9
2297	2	Palaemonetes sp.		1
2297	3	Gambusia sp.	16	1
2297	3	Gambusia sp.	16	1
2297	3	Gambusia sp.	22	1
2297	3	Gambusia sp.	16	1
2297	3	Lepomis miniatus	85	1
2297	3	Herichthys cyanoguttatus	30	1

2297	3	Etheostoma fonticola	26	1
2297	3	Etheostoma fonticola	19	1
2297	3	Procambarus sp.		9
2297	4	Lepomis macrochirus	66	1
2297	4	Etheostoma fonticola	27	1
2297	4	Etheostoma fonticola	31	1
2297	4	Etheostoma fonticola	20	1
2297	4	Gambusia sp.	15	1
2297	4	Procambarus sp.	13	1
2297	5	Ambloplites rupestris	32	1
2297	5	Etheostoma fonticola	32	1
2297	5	Gambusia sp.	16	1
2297	5	Gambusia sp.	12	1
2297	5	Palaemonetes sp.		1
2297	6	Gambusia sp.	14	1
2297	6	Etheostoma fonticola	32	1
2297	6	Etheostoma fonticola	28	1
2297	6	Procambarus sp.		7
2297	7	Etheostoma fonticola	26	1
2297	7	Etheostoma fonticola	31	1
2297	7	Procambarus sp.		8
2297	8	Procambarus sp.		2
2297	9	Procambarus sp.		6
2297	10	Procambarus sp.		2
2297	11	No fish collected		
2297	12	Procambarus sp.		1
2297	13	Lepomis miniatus	62	1
2297	13	Etheostoma fonticola	31	1
2297	13	Procambarus sp.		1
2297	14	Procambarus sp.		1
2297	15	Gambusia sp.	17	1
2297	15	Procambarus sp.		1

SiteCode 2298 Date 10/17/2018 Reach I-35 Site_No C2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2298	1	Lepomis miniatus	46	1
2298	1	Lepomis miniatus	56	1
2298	1	Lepomis miniatus	46	1
2298	1	Etheostoma fonticola	33	1
2298	1	Etheostoma fonticola	38	1
2298	1	Gambusia sp.	32	1
2298	1	Gambusia sp.	17	1
2298	1	Gambusia sp.	20	1
2298	1	Gambusia sp.	16	1
2298	1	Gambusia sp.	15	1
2298	1	Gambusia sp.	16	1
2298	1	Gambusia sp.	30	1
2298	1	Gambusia sp.	32	1
2298	1	Gambusia sp.	17	1
2298	1	Gambusia sp.	12	1
2298	1	Gambusia sp.	17	1
2298	1	Lepomis sp.	15	1
2298	1	Gambusia sp.	19	1
2298	1	Gambusia sp.	14	1
2298	1	Gambusia sp.	15	1
2298	1	Gambusia sp.	9	1
2298	1	Gambusia sp.	12	1
2298	1	Procambarus sp.		5
2298	2	Gambusia sp.	30	1
2298	2	Gambusia sp.	31	1
2298	2	Gambusia sp.	32	1
2298	2	Gambusia sp.	24	1
2298	2	Gambusia sp.	21	1
2298	2	Gambusia sp.	23	1
2298	2	Lepomis sp.	16	1

2298	2	Lepomis sp.	15	1
2298	2	Lepomis miniatus	16	1
2298	2	Lepomis macrochirus	27	1
2298	2	Etheostoma fonticola	17	1
2298	2	Gambusia sp.	14	1
2298	3	Gambusia sp.	30	1
2298	3	Gambusia sp.	20	1
2298	3	Gambusia sp.	20	1
2298	3	Gambusia sp.	20	1
2298	3	Etheostoma fonticola	33	1
2298	3	Lepomis miniatus	70	1
2298	3	Procambarus sp.		2
2298	4	Gambusia sp.		2
2298	4	Procambarus sp.		1
2298	5	Etheostoma fonticola	24	1
2298	5	Lepomis miniatus	67	1
2298	6	Etheostoma fonticola	31	1
2298	7	Gambusia sp.		3
2298	8	No fish collected		
2298	9	No fish collected		
2298	10	No fish collected		
2298	11	No fish collected		
2298	12	Procambarus sp.		1
2298	13	No fish collected		
2298	14	No fish collected		
2298	15	No fish collected		

SiteCode	2299	Date	10/17/2018	Reach	I-35	Site_No	O1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2299	1	No fish collected		
2299	2	No fish collected		
2299	3	No fish collected		
2299	4	No fish collected		
2299	5	No fish collected		
2299	6	No fish collected		
2299	7	No fish collected		
2299	8	No fish collected		
2299	9	No fish collected		
2299	10	No fish collected		

SiteCode 2300 Date 10/17/2018 Reach I-35 Site_No O2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2300	1	No fish collected		
2300	2	No fish collected		
2300	3	No fish collected		
2300	4	No fish collected		
2300	5	No fish collected		
2300	6	No fish collected		
2300	7	No fish collected		
2300	8	No fish collected		
2300	9	No fish collected		
2300	10	No fish collected		

SiteCode 2301 Date 10/17/2018 Reach I-35 Site_No H1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2301	1	Etheostoma fonticola	32	1
2301	1	Gambusia sp.	22	1
2301	1	Gambusia sp.	23	1
2301	1	Gambusia sp.	16	1
2301	1	Gambusia sp.	20	1
2301	1	Gambusia sp.	21	1
2301	1	Gambusia sp.	22	1
2301	1	Gambusia sp.	27	1
2301	1	Gambusia sp.	40	1
2301	1	Gambusia sp.	17	1
2301	1	Gambusia sp.	10	1
2301	1	Herichthys cyanoguttatus	50	1
2301	1	Gambusia sp.	24	1
2301	1	Procambarus sp.		18
2301	2	Gambusia sp.	21	1
2301	2	Gambusia sp.	15	1
2301	2	Gambusia sp.	18	1
2301	2	Gambusia sp.	20	1
2301	2	Gambusia sp.	19	1
2301	3	Gambusia sp.	12	1
2301	3	Gambusia sp.	20	1
2301	3	Gambusia sp.	22	1
2301	3	Gambusia sp.	16	1
2301	3	Gambusia sp.	34	1
2301	3	Gambusia sp.	18	1
2301	3	Gambusia sp.	21	1
2301	3	Gambusia sp.	16	1
2301	3	Ambloplites rupestris	71	1
2301	3	Etheostoma fonticola	34	1
2301	3	Etheostoma fonticola	30	1

2301	3	Procambarus sp.		12
2301	4	Procambarus sp.		5
2301	4	Gambusia sp.		2
2301	5	Procambarus sp.		6
2301	6	Procambarus sp.		2
2301	7	Procambarus sp.		1
2301	7	Gambusia sp.		1
2301	8	No fish collected		
2301	9	No fish collected		
2301	10	Etheostoma fonticola	31	1
2301	11	Etheostoma fonticola	34	1
2301	12	No fish collected		
2301	13	No fish collected		
2301	14	No fish collected		
2301	15	No fish collected		

SiteCode 2302 Date 10/17/2018 Reach I-35 Site_No H2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2302	1	Procambarus sp.		4
2302	1	Lepomis miniatus	55	1
2302	1	Gambusia sp.	22	1
2302	1	Gambusia sp.	17	1
2302	1	Gambusia sp.	18	1
2302	1	Gambusia sp.	16	1
2302	1	Gambusia sp.	13	1
2302	1	Gambusia sp.	12	1
2302	1	Gambusia sp.	12	1
2302	1	Gambusia sp.	22	1
2302	1	Gambusia sp.	16	1
2302	1	Etheostoma fonticola	35	1
2302	2	Gambusia sp.	40	1
2302	2	Gambusia sp.	18	1
2302	2	Gambusia sp.	16	1
2302	2	Gambusia sp.	22	1
2302	2	Gambusia sp.	20	1
2302	2	Ameiurus natalis	49	1
2302	3	Gambusia sp.	8	1
2302	4	Etheostoma fonticola	21	1
2302	4	Gambusia sp.	18	1
2302	4	Gambusia sp.	25	1
2302	4	Procambarus sp.		7
2302	5	Lepomis miniatus	48	1
2302	5	Procambarus sp.		3
2302	6	Gambusia sp.	14	1
2302	6	Procambarus sp.		2
2302	7	Procambarus sp.		1
2302	8	Lepomis miniatus	39	1
2302	8	Etheostoma fonticola	35	1

2302	8	Procambarus sp.		1
2302	9	Lepomis sp.	18	1
2302	9	Gambusia sp.	12	1
2302	9	Etheostoma fonticola	34	1
2302	10	Procambarus sp.		2
2302	11	Lepomis miniatus	65	1
2302	11	Procambarus sp.		1
2302	12	No fish collected		
2302	13	Procambarus sp.		1
2302	14	Gambusia sp.	20	1
2302	14	Procambarus sp.		2
2302	15	Procambarus sp.		1

SiteCode 2303 Date 10/17/2018 Reach I-35 Site_No L1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2303	1	No fish collected		
2303	2	Procambarus sp.		1
2303	3	Procambarus sp.		1
2303	4	Procambarus sp.		1
2303	5	No fish collected		
2303	6	No fish collected		
2303	7	No fish collected		
2303	8	Etheostoma fonticola	25	1
2303	9	No fish collected		
2303	10	No fish collected		
2303	11	Procambarus sp.		1
2303	12	No fish collected		
2303	13	No fish collected		
2303	14	No fish collected		
2303	15	No fish collected		

SiteCode 2304 Date 10/17/2018 Reach I-35 Site_No L2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2304	2	Gambusia sp.	15	1
2304	2	Gambusia sp.	15	1
2304	3	Gambusia sp.	10	1
2304	3	Gambusia sp.	15	1
2304	3	Gambusia sp.	11	1
2304	3	Gambusia sp.	11	1
2304	3	Procambarus sp.		3
2304	4	Procambarus sp.		1
2304	4	Gambusia sp.		2
2304	5	Etheostoma fonticola	28	1
2304	5	Gambusia sp.		4
2304	5	Procambarus sp.		3
2304	6	Procambarus sp.		1
2304	7	Procambarus sp.		1
2304	8	Gambusia sp.		1
2304	8	Procambarus sp.		1
2304	9	Etheostoma fonticola	30	1
2304	10	Procambarus sp.		1
2304	11	No fish collected		
2304	12	No fish collected		
2304	13	No fish collected		
2304	14	No fish collected		
2304	15	Gambusia sp.		2
2304	1	Gambusia sp.	19	1
2304	1	Gambusia sp.	19	1
2304	1	Gambusia sp.	14	1
2304	1	Gambusia sp.	15	1
2304	1	Gambusia sp.	20	1
2304	1	Gambusia sp.	17	1
2304	1	Gambusia sp.	16	1

2304	1	Gambusia sp.	13	1
2304	1	Gambusia sp.	12	1
2304	1	Gambusia sp.	14	1
2304	1	Gambusia sp.	11	1
2304	1	Gambusia sp.	10	1
2304	1	Gambusia sp.	11	1
2304	1	Procambarus sp.		2
2304	2	Procambarus sp.		6
2304	2	Etheostoma fonticola	34	1
2304	2	Gambusia sp.	26	1
2304	2	Gambusia sp.	12	1
2304	2	Gambusia sp.	16	1
2304	2	Gambusia sp.	15	1
2304	2	Gambusia sp.	10	1
2304	2	Gambusia sp.	14	1
2304	2	Gambusia sp.	16	1

SiteCode 2305 Date 10/17/2018 Reach I-35 Site_No S1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2305	1	Etheostoma fonticola	31	1
2305	1	Procambarus sp.		1
2305	2	No fish collected		
2305	3	No fish collected		
2305	4	No fish collected		
2305	5	No fish collected		
2305	6	No fish collected		
2305	7	No fish collected		
2305	8	No fish collected		
2305	9	No fish collected		
2305	10	Lepomis miniatus	87	1
2305	11	No fish collected		
2305	12	No fish collected		
2305	13	No fish collected		
2305	14	Lepomis miniatus		
2305	15	No fish collected		

SiteCode 2306 Date 10/17/2018 Reach I-35 Site_No S2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2306	1	Gambusia sp.	15	1
2306	1	Gambusia sp.	13	1
2306	1	Gambusia sp.	18	1
2306	1	Gambusia sp.	12	1
2306	1	Gambusia sp.	10	1
2306	1	Gambusia sp.	8	1
2306	1	Gambusia sp.	12	1
2306	1	Gambusia sp.	11	1
2306	1	Procambarus sp.		2
2306	2	Etheostoma fonticola	30	1
2306	2	Etheostoma fonticola	16	1
2306	2	Etheostoma fonticola	27	1
2306	2	Etheostoma fonticola	22	1
2306	2	Gambusia sp.	16	1
2306	2	Gambusia sp.	13	1
2306	2	Gambusia sp.	18	1
2306	2	Gambusia sp.	13	1
2306	2	Gambusia sp.	19	1
2306	2	Gambusia sp.	12	1
2306	2	Gambusia sp.	10	1
2306	3	Gambusia sp.	19	1
2306	3	Gambusia sp.	17	1
2306	3	Gambusia sp.	10	1
2306	3	Procambarus sp.		1
2306	4	Gambusia sp.	11	1
2306	4	Gambusia sp.	10	1
2306	4	Procambarus sp.		1
2306	5	Gambusia sp.	15	1
2306	5	Gambusia sp.	10	1
2306	6	No fish collected		

2306	7	Etheostoma fonticola	27	1
2306	7	Gambusia sp.	12	1
2306	7	Procambarus sp.		1
2306	8	Gambusia sp.	10	1
2306	9	Gambusia sp.	18	1
2306	9	Gambusia sp.		1
2306	10	No fish collected		
2306	11	No fish collected		
2306	12	No fish collected		
2306	13	Procambarus sp.		1
2306	14	No fish collected		
2306	15	Procambarus sp.		2

SiteCode 2307 Date 10/19/2018 Reach Spring Lake Dam Site_No P1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2307	1	Astyanax mexicanus	53	1
2307	2	Dionda nigrotaeniata	55	1
2307	2	Dionda nigrotaeniata	54	1
2307	2	Dionda nigrotaeniata	54	1
2307	2	Herichthys cyanoguttatus	56	1
2307	3	Lepomis miniatus	75	1
2307	4	No fish collected		
2307	5	Gambusia sp.	28	1
2307	6	Procambarus sp.		1
2307	7	Dionda nigrotaeniata	55	1
2307	7	Gambusia sp.	30	1
2307	8	No fish collected		
2307	9	No fish collected		
2307	10	No fish collected		
2307	11	No fish collected		
2307	12	No fish collected		
2307	13	No fish collected		
2307	14	No fish collected		
2307	15	No fish collected		

SiteCode 2308 Date 10/19/2018 Reach Spring Lake Dam Site_No P2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2308	1	Procambarus sp.		1
2308	2	No fish collected		
2308	3	No fish collected		
2308	4	No fish collected		
2308	5	No fish collected		
2308	6	No fish collected		
2308	7	No fish collected		
2308	8	No fish collected		
2308	9	No fish collected		
2308	10	No fish collected		

SiteCode 2309 Date 10/19/2018 Reach Spring Lake Dam Site_No O1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2309	1	No fish collected		
2309	2	No fish collected		
2309	3	No fish collected		
2309	4	Etheostoma fonticola	25	1
2309	5	No fish collected		
2309	6	No fish collected		
2309	7	No fish collected		
2309	8	No fish collected		
2309	9	No fish collected		
2309	10	No fish collected		
2309	11	No fish collected		
2309	12	No fish collected		
2309	13	No fish collected		
2309	14	No fish collected		
2309	15	No fish collected		

SiteCode 2310 Date 10/19/2018 Reach Spring Lake Dam Site_No O2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2310	1	No fish collected		
2310	2	No fish collected		
2310	3	No fish collected		
2310	4	No fish collected		
2310	5	No fish collected		
2310	6	No fish collected		
2310	7	No fish collected		
2310	8	No fish collected		
2310	9	No fish collected		
2310	10	No fish collected		

SiteCode 2311 Date 10/19/2018 Reach Spring Lake Dam Site_No S1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2311	1	Gambusia sp.	14	1
2311	1	Gambusia sp.	10	1
2311	1	Gambusia sp.	10	1
2311	1	Gambusia sp.	12	1
2311	1	Gambusia sp.	11	1
2311	1	Gambusia sp.	14	1
2311	1	Gambusia sp.	10	1
2311	1	Gambusia sp.	10	1
2311	1	Gambusia sp.	17	1
2311	1	Gambusia sp.	15	1
2311	1	Gambusia sp.	14	1
2311	1	Gambusia sp.	9	1
2311	1	Gambusia sp.	12	1
2311	1	Gambusia sp.	13	1
2311	1	Gambusia sp.	18	1
2311	1	Gambusia sp.	12	1
2311	1	Gambusia sp.	13	1
2311	1	Gambusia sp.	15	1
2311	1	Etheostoma fonticola	25	1
2311	1	Etheostoma fonticola	19	1
2311	1	Etheostoma fonticola	25	1
2311	1	Etheostoma fonticola	16	1
2311	1	Etheostoma fonticola	21	1
2311	1	Etheostoma fonticola	23	1
2311	1	Etheostoma fonticola	18	1
2311	1	Etheostoma fonticola	15	1
2311	1	Palaemonetes sp.		16
2311	1	Procambarus sp.		2
2311	2	Etheostoma fonticola	33	1
2311	2	Etheostoma fonticola	30	1

2311	2	Etheostoma fonticola	16	1
2311	2	Etheostoma fonticola	25	1
2311	2	Etheostoma fonticola	23	1
2311	2	Lepomis sp.	18	1
2311	2	Procambarus sp.		2
2311	2	Palaemonetes sp.		13
2311	2	Gambusia sp.		98
2311	3	Etheostoma fonticola	23	1
2311	3	Gambusia sp.		34
2311	3	Palaemonetes sp.		6
2311	4	Etheostoma fonticola	23	1
2311	4	Gambusia sp.		23
2311	4	Palaemonetes sp.		8
2311	5	Lepomis miniatus	45	1
2311	5	Etheostoma fonticola	21	1
2311	5	Etheostoma fonticola	15	1
2311	5	Gambusia sp.		15
2311	5	Palaemonetes sp.		5
2311	6	Etheostoma fonticola	30	1
2311	6	Gambusia sp.		8
2311	6	Palaemonetes sp.		2
2311	7	Etheostoma fonticola	15	1
2311	7	Etheostoma fonticola	23	1
2311	7	Etheostoma fonticola	33	1
2311	7	Etheostoma fonticola	20	1
2311	7	Etheostoma fonticola	28	1
2311	7	Gambusia sp.		2
2311	7	Palaemonetes sp.		2
2311	8	Etheostoma fonticola	19	1
2311	8	Etheostoma fonticola	23	1
2311	8	Etheostoma fonticola	22	1
2311	8	Etheostoma fonticola	30	1
2311	8	Gambusia sp.		8
2311	9	Etheostoma fonticola	22	1
2311	9	Etheostoma fonticola	28	1

2311	9	Etheostoma fonticola	25	1
2311	9	Etheostoma fonticola	28	1
2311	9	Etheostoma fonticola	30	1
2311	9	Etheostoma fonticola	30	1
2311	9	Etheostoma fonticola	19	1
2311	9	Gambusia sp.		8
2311	9	Palaemonetes sp.		2
2311	10	Palaemonetes sp.		1
2311	11	Gambusia sp.		7
2311	11	Etheostoma fonticola	32	1
2311	11	Etheostoma fonticola	36	1
2311	11	Etheostoma fonticola	20	1
2311	11	Etheostoma fonticola	32	1
2311	11	Etheostoma fonticola	21	1
2311	11	Etheostoma fonticola	17	1
2311	11	Palaemonetes sp.		2
2311	12	Gambusia sp.		2
2311	12	Palaemonetes sp.		1
2311	13	Etheostoma fonticola	23	1
2311	13	Gambusia sp.		2
2311	14	Etheostoma fonticola	12	1
2311	14	Gambusia sp.		2
2311	15	Gambusia sp.		2
2311	15	Palaemonetes sp.		1
2311	1	Herichthys cyanoguttatus	34	1
2311	1	Gambusia sp.	15	1
2311	1	Gambusia sp.	12	1
2311	1	Gambusia sp.	13	1
2311	1	Gambusia sp.	13	1
2311	1	Gambusia sp.	15	1
2311	1	Gambusia sp.	12	1
2311	1	Gambusia sp.	11	1

SiteCode 2312 Date 10/19/2018 Reach Spring Lake Dam Site_No S2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2312	1	Lepomis miniatus	80	1
2312	1	Lepomis miniatus	59	1
2312	1	Lepomis miniatus	58	1
2312	1	Lepomis miniatus	44	1
2312	1	Lepomis miniatus	48	1
2312	1	Lepomis miniatus	44	1
2312	1	Lepomis miniatus	28	1
2312	1	Herichthys cyanoguttatus	46	1
2312	1	Herichthys cyanoguttatus	56	1
2312	1	Herichthys cyanoguttatus	56	1
2312	1	Ameiurus natalis	65	1
2312	1	Ameiurus natalis	58	1
2312	1	Gambusia sp.	24	1
2312	1	Gambusia sp.	22	1
2312	1	Gambusia sp.	39	1
2312	1	Gambusia sp.	24	1
2312	1	Gambusia sp.	16	1
2312	1	Gambusia sp.	26	1
2312	1	Gambusia sp.	20	1
2312	1	Gambusia sp.	22	1
2312	1	Gambusia sp.	16	1
2312	1	Gambusia sp.	20	1
2312	1	Gambusia sp.	19	1
2312	1	Gambusia sp.	14	1
2312	1	Etheostoma fonticola	22	1
2312	1	Etheostoma fonticola	20	1
2312	2	Procambarus sp.		15
2312	2	Palaemonetes sp.		3
2312	2	Herichthys cyanoguttatus	43	1
2312	2	Herichthys cyanoguttatus	50	1

2312	2	Herichthys cyanoguttatus	41	1
2312	2	Herichthys cyanoguttatus	48	1
2312	2	Gambusia sp.	32	1
2312	2	Gambusia sp.	28	1
2312	2	Gambusia sp.	35	1
2312	2	Gambusia sp.	21	1
2312	2	Gambusia sp.	19	1
2312	2	Gambusia sp.	18	1
2312	2	Gambusia sp.	24	1
2312	2	Gambusia sp.	23	1
2312	2	Gambusia sp.	25	1
2312	2	Gambusia sp.	18	1
2312	2	Gambusia sp.	19	1
2312	2	Gambusia sp.	26	1
2312	2	Gambusia sp.	28	1
2312	2	Gambusia sp.		1
2312	2	Gambusia sp.		1
2312	2	Gambusia sp.		1
2312	2	Lepomis miniatus	42	1
2312	2	Lepomis miniatus	60	1
2312	2	Lepomis miniatus	38	1
2312	3	Gambusia sp.		11
2312	3	Lepomis sp.	20	1
2312	4	Lepomis gulosus	78	1
2312	4	Lepomis miniatus	42	1
2312	4	Gambusia sp.		38
2312	5	Lepomis miniatus	60	1
2312	5	Herichthys cyanoguttatus	40	1
2312	5	Procambarus sp.		4
2312	6	Lepomis miniatus	30	1
2312	6	Procambarus sp.		3
2312	6	Gambusia sp.		13
2312	7	Procambarus sp.		1
2312	7	Gambusia sp.		3
2312	8	Gambusia sp.		4

2312	9	Procambarus sp.		2
2312	10	No fish collected		
2312	11	Lepomis sp.	20	1
2312	12	No fish collected		
2312	13	Herichthys cyanoguttatus	32	1
2312	14	Gambusia sp.		2
2312	15	Gambusia sp.		1

SiteCode 2313 Date 10/19/2018 Reach Spring Lake Dam Site_No H1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2313	1	Gambusia sp.	13	1
2313	1	Gambusia sp.	22	1
2313	1	Gambusia sp.	25	1
2313	1	Gambusia sp.	19	1
2313	1	Gambusia sp.	13	1
2313	1	Gambusia sp.	22	1
2313	1	Gambusia sp.	16	1
2313	1	Gambusia sp.	21	1
2313	1	Gambusia sp.	20	1
2313	1	Gambusia sp.	12	1
2313	1	Gambusia sp.	12	1
2313	1	Gambusia sp.	10	1
2313	1	Gambusia sp.	12	1
2313	1	Poecilia latipinna	40	1
2313	1	Poecilia latipinna	27	1
2313	1	Poecilia latipinna	20	1
2313	1	Poecilia latipinna	32	1
2313	1	Procambarus sp.		2
2313	2	Etheostoma fonticola	36	1
2313	2	Gambusia sp.	22	1
2313	2	Gambusia sp.	15	1
2313	2	Gambusia sp.	12	1
2313	2	Gambusia sp.	18	1
2313	2	Gambusia sp.	27	1
2313	2	Gambusia sp.	21	1
2313	2	Gambusia sp.	22	1
2313	2	Gambusia sp.	15	1
2313	2	Gambusia sp.	20	1
2313	2	Gambusia sp.	22	1
2313	2	Gambusia sp.	16	1

2313	2	Gambusia sp.	12	1
2313	2	Gambusia sp.	13	1
2313	2	Gambusia sp.		6
2313	2	Poecilia latipinna	30	1
2313	2	Poecilia latipinna	25	1
2313	2	Procambarus sp.		1
2313	3	Poecilia latipinna	23	1
2313	3	Poecilia latipinna	24	1
2313	3	Poecilia latipinna	20	1
2313	3	Etheostoma fonticola	16	1
2313	3	Gambusia sp.		12
2313	3	Procambarus sp.		8
2313	4	Procambarus sp.		6
2313	4	Gambusia sp.		7
2313	4	Etheostoma fonticola	31	1
2313	5	Gambusia sp.		4
2313	5	Procambarus sp.		2
2313	6	Gambusia sp.		2
2313	7	Astyanax mexicanus	35	1
2313	7	Procambarus sp.		2
2313	7	Etheostoma fonticola	31	1
2313	7	Poecilia latipinna	34	1
2313	7	Gambusia sp.		2
2313	8	Poecilia latipinna	25	1
2313	9	Procambarus sp.		2
2313	10	No fish collected		
2313	11	Etheostoma fonticola	30	1
2313	12	Gambusia sp.		1
2313	12	Procambarus sp.		1
2313	13	Gambusia sp.		1
2313	14	Gambusia sp.		4
2313	14	Procambarus sp.		1
2313	15	Procambarus sp.		1

SiteCode 2314 Date 10/19/2018 Reach Spring Lake Dam Site_No H2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2314	1	Lepomis miniatus	65	1
2314	1	Lepomis miniatus	96	1
2314	1	Lepomis miniatus	28	1
2314	1	Gambusia sp.	10	1
2314	1	Gambusia sp.	12	1
2314	1	Gambusia sp.	15	1
2314	1	Gambusia sp.	13	1
2314	1	Gambusia sp.	12	1
2314	1	Gambusia sp.	10	1
2314	1	Gambusia sp.	16	1
2314	1	Gambusia sp.	11	1
2314	1	Gambusia sp.	15	1
2314	1	Gambusia sp.	10	1
2314	1	Gambusia sp.	10	1
2314	1	Gambusia sp.	10	1
2314	1	Gambusia sp.	15	1
2314	1	Gambusia sp.	12	1
2314	1	Gambusia sp.	13	1
2314	1	Gambusia sp.	10	1
2314	1	Gambusia sp.	15	1
2314	1	Gambusia sp.	15	1
2314	1	Gambusia sp.	14	1
2314	1	Gambusia sp.	10	1
2314	1	Gambusia sp.	8	1
2314	1	Gambusia sp.	8	1
2314	1	Gambusia sp.	12	1
2314	1	Gambusia sp.	9	1
2314	1	Gambusia sp.	12	1
2314	1	Gambusia sp.	10	1
2314	1	Gambusia sp.	11	1

2314	1	Gambusia sp.		19
2314	1	Etheostoma fonticola	26	1
2314	1	Etheostoma fonticola	35	1
2314	1	Etheostoma fonticola	23	1
2314	1	Etheostoma fonticola	32	1
2314	1	Etheostoma fonticola	28	1
2314	1	Palaemonetes sp.		1
2314	2	Lepomis miniatus	48	1
2314	2	Lepomis miniatus	50	1
2314	2	Lepomis miniatus	60	1
2314	2	Lepomis miniatus	41	1
2314	2	Gambusia sp.		24
2314	3	Etheostoma fonticola	36	1
2314	3	Etheostoma fonticola	35	1
2314	3	Lepomis miniatus	56	1
2314	3	Gambusia sp.		16
2314	4	Lepomis gulosus	46	1
2314	4	Lepomis miniatus	35	1
2314	4	Lepomis miniatus	71	1
2314	4	Gambusia sp.		9
2314	5	Gambusia sp.		8
2314	6	No fish collected		
2314	7	Lepomis gulosus	74	1
2314	7	Gambusia sp.		4
2314	8	Lepomis gulosus	80	1
2314	8	Lepomis miniatus	58	1
2314	8	Gambusia sp.		7
2314	9	Etheostoma fonticola	30	1
2314	9	Gambusia sp.		4
2314	10	Gambusia sp.		3
2314	11	Gambusia sp.		10
2314	12	Etheostoma fonticola	40	1
2314	12	Gambusia sp.		7
2314	13	Gambusia sp.		18
2314	14	Gambusia sp.		4

2314	15	Palaemonetes sp.	1
2314	15	Gambusia sp.	4

SiteCode 2315 Date 10/19/2018 Reach Spring Lake Dam Site_No Hydro1

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2315	1	No fish collected		
2315	2	Procambarus sp.		1
2315	3	No fish collected		
2315	4	Gambusia sp.	20	1
2315	5	Gambusia sp.	12	1
2315	5	Gambusia sp.	15	1
2315	5	Gambusia sp.	12	1
2315	5	Gambusia sp.	10	1
2315	5	Procambarus sp.		1
2315	6	Etheostoma fonticola	27	1
2315	6	Gambusia sp.	20	1
2315	7	Gambusia sp.	15	1
2315	6	Gambusia sp.	21	1
2315	6	Gambusia sp.	16	1
2315	6	Gambusia sp.	14	1
2315	8	Gambusia sp.	16	1
2315	9	Gambusia sp.	13	1
2315	10	No fish collected		
2315	11	Gambusia sp.	13	1
2315	12	No fish collected		
2315	13	No fish collected		
2315	14	No fish collected		
2315	15	Etheostoma fonticola	23	1
2315	16	Procambarus sp.		1

SiteCode 2316 Date 10/19/2018 Reach Spring Lake Dam Site_No Hydro2

Fish Data

Site Code	Dip Net	Species	Length (mm)	Count
2316	1	Gambusia sp.	20	1
2316	1	Gambusia sp.	25	1
2316	1	Gambusia sp.	20	1
2316	1	Gambusia sp.	18	1
2316	1	Etheostoma fonticola	32	1
2316	1	Etheostoma fonticola	21	1
2316	2	Gambusia sp.	17	1
2316	2	Gambusia sp.	19	1
2316	2	Gambusia sp.	20	1
2316	2	Gambusia sp.	21	1
2316	2	Gambusia sp.	22	1
2316	2	Etheostoma fonticola	27	1
2316	2	Etheostoma fonticola	32	1
2316	2	Etheostoma fonticola	26	1
2316	2	Palaemonetes sp.		4
2316	2	Procambarus sp.		1
2316	3	Gambusia sp.	22	1
2316	3	Gambusia sp.	21	1
2316	3	Etheostoma fonticola	30	1
2316	3	Etheostoma fonticola	26	1
2316	4	Lepomis miniatus	14	1
2316	4	Gambusia sp.	16	1
2316	4	Gambusia sp.	20	1
2316	4	Gambusia sp.	31	1
2316	4	Gambusia sp.	19	1
2316	4	Etheostoma fonticola	22	1
2316	4	Palaemonetes sp.		1
2316	5	Gambusia sp.	25	1
2316	5	Gambusia sp.	21	1
2316	5	Gambusia sp.	16	1

2316	6	Palaemonetes sp.		1
2316	7	No fish collected		
2316	8	Gambusia sp.	30	1
2316	8	Gambusia sp.	19	1
2316	8	Gambusia sp.	21	1
2316	9	Gambusia sp.	11	1
2316	10	Gambusia sp.	26	1
2316	10	Gambusia sp.	25	1
2316	11	No fish collected		
2316	12	Gambusia sp.	26	1
2316	13	No fish collected		
2316	14	No fish collected		
2316	15	No fish collected		