Spring Lake Management Plan

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II. Introduction

Spring Lake and the surrounding lake habitat are part of Texas State University-San Marcos. The university is a public, student-centered, doctoral-granting institution dedicated to excellence in serving the educational needs of the diverse population of Texas and the world beyond. We value engaged teaching and learning, and research, scholarship, and creative activity, among other pursuits. Therefore, Spring Lake and the surrounding habitat will be managed in accordance with the university's mission.

A. *Significance of Spring Lake*

The San Marcos Springs, which bubble up from the Edwards Aquifer to fill Spring Lake, are the second largest spring system in Texas. They have never stopped flowing in recorded history and have more environmental stability and flow of any spring system in the southwestern United States. Archaeological research indicates that the area surrounding Spring Lake has been inhabited for over 12,000 years serving populations of Paleo-Indians through the earliest European settlers.

Spring Lake constitutes the headwaters of the San Marcos River that extends 68.2 miles to its confluence with the Guadalupe River, and continues another 196 miles to the Gulf of Mexico. The San Marcos River supplies drinking water for many communities in the watersheds of the San Marcos River and Guadalupe River, including San Marcos (49,000 residents) and Victoria(60,000 residents).

Spring Lake also provides critical habitat to several threatened or endangered species protected by the federal Endangered Species Act of 1973. This law prohibits any actions that jeopardize the continued existence of these listed species or causes destruction or adverse modification of the critical habitat of these species. Substantial civil and criminal penalties including fines and imprisonment may be levied against persons who knowingly violate provisions of this act.

Protection and careful management of Spring Lake is key to minimizing any negative impacts to the unique hydrological, cultural, economic and biological resources found there.

B. *Purpose for the Spring Lake Management Plan*

The major objectives for the development of the Spring Lake Management Plan are:

1. To manage the lake in such a way as to support and enhance the University's efforts in teaching, research/scholarship, and service;
2. To assure that the University fulfills its commitment to be a good steward of Spring Lake by carefully managing and maintaining the healthy ecosystems that exist in the lake;
3. To formalize the process by which decisions are made regarding access to and use of Spring Lake;
4. To emphasize the use of scientific data to support management decisions that are made; and
5. To provide guidelines regarding access and use of Spring Lake to individuals and organizations wanting to engage in teaching, research or service activities in the lake.

III. Spring Lake Management

A. *Management Goal and Objectives*

Texas State's goal is to provide effective stewardship of the existing springs and lake habitat in accordance with the university's mission. Responsibility for stewardship of Spring Lake and the fulfillment of this goal has been assigned to the Provost and Vice President for Academic Affairs. The Provost has delegated the responsibility for management of Spring Lake to the Executive Director of the River Systems Institute.

The main objectives of the River Systems Institute in the management of Spring Lake are to protect its healthy ecosystems, to provide research and educational opportunities in and around Spring Lake, and to provide access to Spring Lake for service activities. Crucial to undertaking these objectives is the establishment of several overriding indicators that reflect healthy ecosystems within Spring Lake. During the first year of implementation of this management plan, a blue-ribbon commission of faculty and researchers will establish acceptable ranges for key data that will be collected on the ecosystems in Spring Lake, as well as a monitoring protocol for assessing these data. It is these key indicators that will be monitored by RSI to determine the health of the lake.

Further, the River Systems Institute will work to:

- Research, develop, and establish baseline data on the existing conditions of the lake and the ecological health of the system.
- Continually perform or review ongoing monitoring that will indicate the overall conditions and health of the system in order to identify changes or negative impacts that may occur over time.
- Administer programs that comply with the Endangered Species Act and the Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan.
- Manage the lake in such a way that will either enhance or minimally impact critical habitat for the aquatic and riparian resources.
- Ensure that any impact to the lake from human use through educational or research programs is scientifically justified and will not result in long term impacts or degrade the overall integrity of the lake ecosystem.
- Encourage use of Spring Lake for educational, research and service activities which support the University's mission.

B. *Spring Lake Management*

Figure 1 reflects the organization structure for management of the lake.

Spring Lake Management Organization Structure

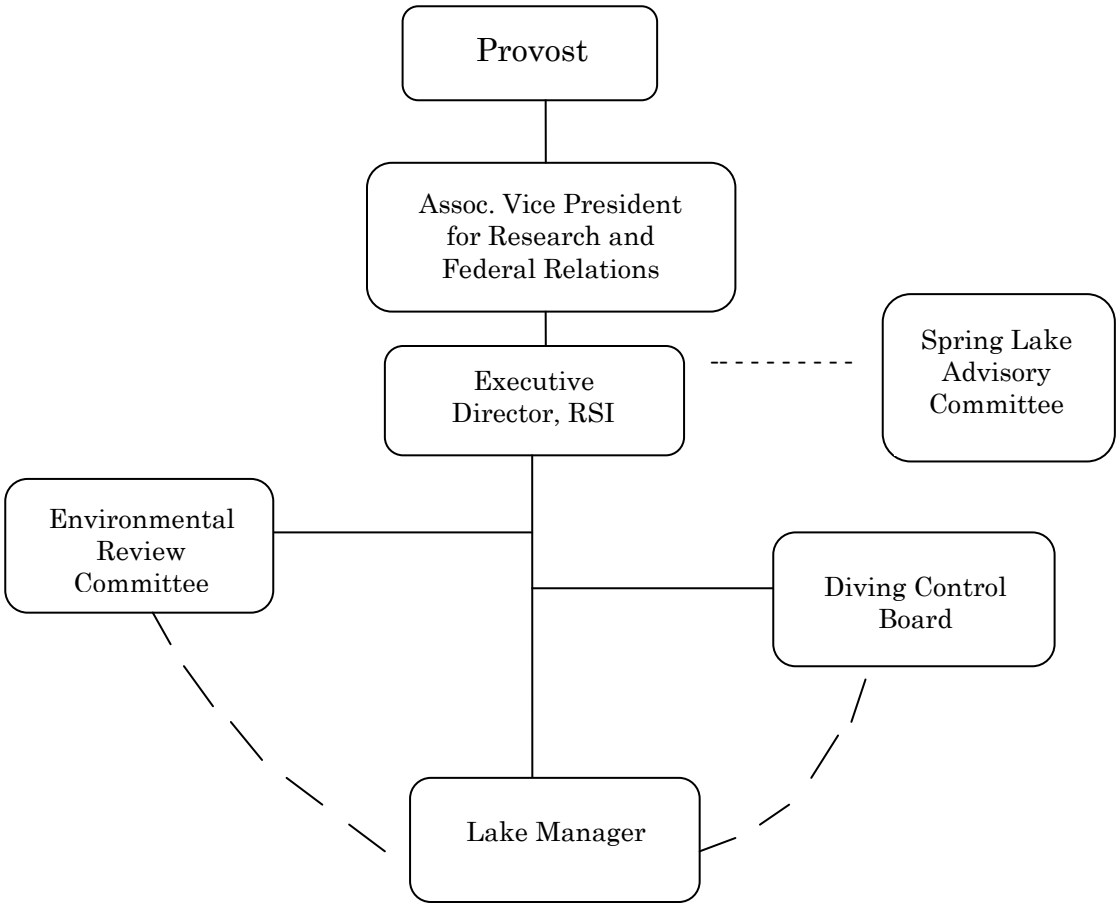

Figure 1

The Executive Director of the River Systems Institute has oversight responsibility for Spring Lake. He has assigned responsibility for management of all daily activities in the lake to the Lake Manager.

The Spring Lake Advisory Committee will advise the Executive Director on any activity occurring in and around Spring Lake, and will be a conduit to interested stakeholders regarding activities occurring in and around Spring Lake. The Executive Director will routinely consult with the Advisory Committee regarding use of Spring Lake and the impacts upon this resource. Reports will be provided to the Committee reflecting requested activities impacting the lake and disposition of these requests. All annual reports on the health of the ecosystems in Spring Lake will be shared with the Committee. All proposed modifications to Spring Lake policies and procedures will be vetted through the Spring Lake Advisory Committee.

The Executive Director, in consultation with the Associate Vice President for Research & Federal Programs, will appoint members to the Spring Lake Advisory Committee. These members will be the chair of the Biology Department, the chair of the Anthropology Department, the chair of the Geography Department, the Associate Vice President for Facilities, the Director of Campus Recreation, the Director of the Edwards Aquifer Research and Data Center, the Associate VPFSS for Planning, a representative of the City of San Marcos, a representative of US Fish and Wildlife, and a representative of the San Marcos River Foundation.

The Environmental Review Committee will assist the Executive Director in deciding which requests for access and use of Spring Lake are granted.
The Executive Director, in consultation with the Associate Vice President for Research & Federal Programs, will appoint members to the Environmental Review Committee. These members will be the Chief Science Officer of RSI, the City Watershed Protection Manager, two University faculty members with expertise in aquatic ecosystems and one faculty member with knowledge of the cultural resources located at the Spring Lake site.

The Diving Control Board will assist and advise the Executive Director on all scuba diving activities occurring in the lake to assure that such activities are procedurally safe and environmentally sensitive.
The Executive Director, in consultation with the Associate Vice President for Research & Federal programs, will appoint members to the Diving Control Board. These members will be the Director of Aquarena Center, the Chief Science Officer of RSI, the Diving Safety Officer, a representative of the Center for Archeological Studies, a faculty member from Health and Human Performance and a faculty member with expertise in aquatic ecosystems.

The Lake Manager will monitor, index, and catalog the activities and scientific studies conducted by all entities working on, in, or around Spring Lake. An index of these activities and studies will be maintained as an appendix to the Lake Management Plan. The River Systems Institute will maintain an archive of scientific studies conducted on, in, or around Spring Lake.

The Lake Manager, in collaboration with the Environmental Review Committee, will annually review the Spring Lake Management Plan and on-going activities in Spring Lake, and recommend to the Executive Director changes or actions needed to ensure the ongoing health of the system and the continued success of the listed species. The Lake Manager is responsible for annually updating the Spring Lake Management Plan to incorporate approved changes.

IV. Policy Guidelines

A. *Coordination and Management of Spring Lake*

1. The Lake Manager is responsible for the daily use and maintenance of Spring Lake. These responsibilities include:

- Monitoring of all activity on Spring Lake
- Maintenance of records of all activity occurring on the lake

- Monitoring of key indicators(developed in conjunction with the Environmental Review Committee), on the health of the lake
- In consultation with the Environmental Review Committee, annually informing the Executive Director of RSI of activities occurring on the lake and the impact of these activities on the health of the lake
- Ensuring that proper protocols are being followed for access to and conduct of activities in the lake
- Compiling, submitting and maintaining records on all reports required by regulatory agencies regarding the lake

2. The Environmental Review Committee will assess requests to use the lake and will assist the Lake Manager in assessing the health of ecosystems in the lake.

3. The Diving Control Board will assess requests to dive in the lake and will assist the Lake Manager in monitoring diving activities in the lake.

B. *Research Activities in Spring Lake*

1. Proposals for research projects in Spring Lake must be submitted to the Environmental Review Committee, through the Lake Manager, for review and approval.

2. Proposals for research projects must be submitted in writing and include:

- Name and contact information of the responsible party conducting the research,
- Purpose and expected outcomes of the activities, including a description of how the project contributes to science,
- Description of activities, including, if appropriate, measures to be taken to minimize any impact on endangered species or their habitat, or any cultural resources found in the lake,
- Methodology, including literature review,
- Type of equipment used, how much, where it will be placed, and for how long it will remain in lake (see *Equipment in Lake* section E)
- Expected impact, and
- Timeline of Project

3. A copy of the final report and any publications on a research project should be provided to the Lake Manager

4. The Lake Manager will compile an annual summary of the research conducted in the lake, including statements on the impact of these activities on the health of the lake, and update Appendix F.

C. *Education Activities in Spring Lake*

1. Proposals for educational activities in Spring Lake must be submitted to the Environmental Review Committee, through the Lake Manager, for review and approval.

2. Proposals for educational activities must be submitted in writing and include:

- Name and contact information of the responsible party conducting the activity,
- Purpose and expected outcomes of the activities,
- Description of activities, including, if appropriate, measures to be taken to minimize any impact on endangered species or their habitat, or any cultural resources found at the lake,
- Description of equipment, (See Equipment in Lake section E)
- Number of participants,
- Expected impact, and
- Duration

3. Once an activity is completed, a summary report of the educational activity will be provided to the Lake Manager.

4. Annually the Lake Manager will compile a summary of the educational activities conducted in the lake, including statements on the impact of these activities on the health of the lake, and update Appendix F.

D. *Special Events in Spring Lake*

1. Proposals for special events in Spring Lake must be submitted to the Environmental Review Committee, through the Lake Manager, for review and approval.

2. Proposals for special events must be submitted in writing and include:

- Name and contact information of the responsible party conducting the event,
- Purpose and expected outcomes of the event,
- Description of activities, including, if appropriate, measures to be taken to minimize any impact on endangered species or their habitat, or any cultural resources found at the lake,
- Description of equipment,(See Equipment in Lake section E)
- Number of expected participants,
- Expected impact, and
- Duration

3. Once the special event is completed, a summary report of the event will be provided to the Lake Manager.

4. Annually the Lake Manager will compile a summary of the special events conducted in the lake, including statements on the impact of these events on the health of the lake, and update Appendix F.

E. *Equipment in Spring Lake*

1. All equipment placed in Spring Lake for research, educational purposes, or special events must be approved by the Lake Manager. The Manager will consult with the Environmental Coordinating Committee to ensure the proposed equipment has scientific value and any negative impacts to the lake are minimal.

2. All equipment must be properly washed/disinfected on-site using the process approved by the Lake Manager before being placed in the lake.

3. All equipment that is left in the lake must have responsible party contact information attached to equipment and on file with the Lake Manager.

4. Equipment must be removed by the responsible party promptly at the end of the project period. Equipment not promptly removed by the responsible party will be removed by the Lake Manager and all associated costs billed to the responsible party.

5. The Lake Manager will maintain a record of equipment installed in the lake.

F. *Access to Spring Lake*

1. Access to Spring Lake is strictly controlled and regulated in accordance to federal, state and local laws. City ordinance and state law designate the public waters of Spring Lake as restricted to activities authorized by the University.

2. All access to Spring Lake must be approved by the Lake Manager, in consultation with the Environmental Review Committee.

3. All activities involving access to the lake, including glass bottom boat operations, will abide by the rules and intentions of the Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan.

4. Boat (canoe, kayak) use for educational activities, excluding glass bottom boats:

- All boats must be properly washed/disinfected before being placed in lake and once they are removed (see *Equipment in Lake* above).
- Participants must receive an orientation prior to boating including: instruction on safety, basic boat handling, and on-site rules and regulations. The orientation will cover information specific to Spring Lake's sensitivity and endangered species.
- All boating events must be designed to keep participants away from glass bottom boat operations.

5. Glass Bottom Boats:

- Boats that have been exposed to other aquatic environments will be washed/disinfected in accordance with the approved protocol (see Equipment in Lake above).

- To ensure safety and operational efficiency, all boat traffic will be coordinated with all on-going monitoring, research, maintenance, and educational programs.

G. *Scuba Activities in Spring Lake*

The Diving Control Board will assist and advise the Executive Director on all scuba activities occurring in Spring Lake. It is responsible for:

- Developing and maintaining a Diving Manual for Spring Lake. This manual sets forth the criteria to be met before an individual is authorized to dive in Spring Lake. It contains procedures and protocols to be observed by all diving operations in the Lake that:
  - Protect and preserve the natural and cultural resources found in the Lake
  - Ensure that diving activities support the educational and research programs at Texas State
  - Establish standards for training, certification and equipment maintenance such that all diving operations are environmentally sensitive and procedurally safe
  - Protect divers from occupational injury and illness.
- Establishing and/or approving diver training programs for Spring Lake.
- Reviewing and approving requests for diving operations in Spring Lake.
- Advising the Lake Manager and the Diving Safety Officer on monitoring diving activities in Spring Lake.

1. Requests for individuals to dive in Spring Lake must be submitted to the Diving Control Board, through the Lake Manager, for review and approval. These requests must be submitted in writing and include:

- Name and contact information for each individual who will be diving
- Diving experience and certifications of each diver
- Whether divers have been authorized to dive in Spring Lake
- Description of diving activities in which each individual will engage, including specific areas of Spring Lake that activities will occur, including, if appropriate, measures to be taken to minimize any impact on endangered species or their habitat, or cultural resources found at the lake
- Description of any equipment that will be brought into lake for diving activities
- Timeline for diving activities

2. All diving activities will be confined to the designated training area in Spring Lake, unless specifically approved by the Lake Manager.

3. The Diving Safety Officer, using guidelines set out in the Diving Safety Manual for Spring Lake, will determine which individuals are qualified to dive in Spring Lake. Individuals determined

not qualified to dive in Spring Lake by the Diving Safety Officer may appeal this decision to the Diving Control Board.

4. The Diving Safety Officer will monitor all diving activities in Spring Lake, assuring all guidelines contained in the Diving Safety Manual for Spring Lake are observed.

5. The Lake Manager, with assistance from the Diving Safety Officer, will compile an annual summary of diving activities conducted in Spring Lake and provide to the Diving Control Board for its review.

H. *Conduct on Spring Lake*

All University regulations dealing with conduct of individuals on University property will be enforced at Spring Lake. The unique resources found at this site require that conduct of individuals accessing and using Spring Lake not harm or disturb these resources. Protocols for enforcement of University regulations regarding individual conduct at Spring Lake will be developed by the Executive Director in consultation with the Spring Lake Advisory Committee.

V. Key Processes

A. *Indexing, cataloging and monitoring activities and studies conducted in the Lake*

The Lake Manager will maintain records of all activities and studies requested for Spring Lake and will annually update the Spring Lake Projects/Monitoring chart in Appendix F with information on all approved activities. Upon updating Appendix F, the Lake Manager will prepare a brief report to the Executive Director of RSI, with copies to the Environmental Review Committee, of all activities occurring in Spring Lake during the past year, impacts these activities had on the health of the lake, and any concerns or issues arising from these activities.

B. *Site Maintenance: Aquatic Vegetation*

Spring Lake will be maintained in an aesthetically pleasing manner. Boat paths and spring openings will be maintained such that guests are easily able to view the springs from glass bottom boats.
Boat lanes will be maintained by means of a harvester boat operated by qualified Lake Maintenance staff. The harvester will run as seasons dictate.
Spring openings will be gardened by Lake Maintenance staff and by certified “Diving for Science” volunteers under staff supervision. These gardening activities will be dictated by seasonal requirements and include removal of invasive plant species and reintroduction of approved native plants. Underwater gardening activities will be monitored by the Lake Manager, in consultation with the Diving Safety Officer.

C. *Site Maintenance: Wetlands Area and Boardwalk*

The wetlands area and wetlands boardwalk will be maintained aesthetically to provide park guests with the opportunity to observe the fauna and flora resident in this unique ecosystem. Lake Maintenance staff will be responsible for the maintenance and repair of the boardwalk, the removal of non-native plants throughout the wetlands area and the planting of native plants in this area. Aquarena Center staff, under the supervision of the Lake Manager, will be responsible for the annual review and update of interpretive information provided on the boardwalk.

D. *Site Maintenance: Golf Course and Grounds*

The golf course and grounds will be maintained in an aesthetically pleasing, yet environmentally sensitive manner. It is the responsibility of the Golf Course Manager to maintain the course and grounds in accordance with the Integrative Pest Management Plan (IPM). This plan will describe the activities and materials to be used to control pests (i.e. insects, weeds, and other living organisms requiring control) on the golf course in a way that minimally impacts the environment. The IPM will be developed and updated by the Golf Course Manager, in consultation with the Lake Manager and the Environmental Review Committee.
The Golf Course Manager will consult with the Lake Manager on any unique situation that may arise outside of routine maintenance that could impact Spring Lake.
Each year the Golf Course Manager will report to the Lake Manager detailed information on maintenance activities and materials used during the year.

E. *Conflict Resolution*

If an individual or organization is not satisfied with any decision on a request to have access to or use of Spring Lake, he may appeal the decision to the Executive Director of RSI.
Conflicts between the Environmental Review Committee and the Lake Manager will be resolved by the Executive Director of RSI.

VI. Strategic Plan for Spring Lake

Program goals and objectives for Spring Lake will be a component of the strategic plan for the River Systems Institute and will be developed through the University's strategic planning process. The Spring Lake Advisory Committee and the Environmental Review Committee will be consulted in the development of program goals and objectives for Spring Lake.

VII. Current Activities on Spring Lake

A number of activities reoccur in Spring Lake each year in support of the University's teaching, research and service mission.

Teaching: HHP uses Spring Lake for the open water requirements of its scuba diving classes; generally 400-500 students make 1-2 dives in the Spring Lake Dive Training Area each year as part of these requirements. Over 3250 students take a glassbottom boat tour each year as part of a University seminar class or other organized class. Biology, Geography and Anthropology occasionally conduct portions of research courses or independent study courses in Spring Lake; such courses typically involve a small number of students each year. Appendix F contains detailed information on classes held in Spring Lake during the past year.

Research: Several academic departments are annually involved in research studies in Spring Lake. These studies range from collection and sampling of biological species in the lake to hydrological studies of the lake to archaeological investigations. Generally 8-12 research studies are conducted in the lake each year. In addition, several departments, as well as a number of federal and state agencies monitor equipment collecting on-going data about the lake and its ecosystems. Typically 8-10 of these monitoring activities occur each month. Appendix F contains details on the research and monitoring activities occurring in Spring Lake during the last year.

Public Service: Several categories of public service activities occur in Spring Lake each year: (1) environmental education; (2) scuba; (3) stewardship; and (4) special events. Environmental education tours conducted on glassbottom boats or glassbottom kayaks involve over 100,000 individuals each year. Generally 1-5 boats are on the lake six-eight hours a day; depending on the season (i.e. attendance is greatest during summer months and least during winter months). In addition to the glassbottom boat tour, school groups, involving 25,000 students annually, participate in other activities in and around the lake, ranging from wetlands boardwalk tour to water sampling or bug collection. Scuba activities in Spring Lake include (a) training/authorization of divers to participate in supervised diving activities throughout the lake; (b) academic classes; (c) open-water checkout for noncredit classes; (d) habitat maintenance activities; and (e) research/data collection activities. Training/authorization dives involve 300-350 individuals each year undergoing 36-48 hours of training on how to dive in Spring Lake, understanding not only safety issues of scuba diving, but also understanding the unique species and cultural resources found in the lake and how to assure that these resources are not harmed or disturbed during diving activities. Open water checkout dives for both academic scuba classes and noncredit scuba classes involve 1-2 dives each year by 2500 individuals. Both training dives and checkout dives are confined to the Spring Lake Dive Training Area. Habitat maintenance activities and research/data collection activities involve RSI staff and faculty, students and volunteers who have been trained and authorized to dive throughout Spring Lake. Generally these activities occur weekly and involve 40-50 individuals each year. Stewardship activities focus on the removal of exotic plants throughout the lake and replacement with native plants. Some of these activities occur underwater as part of the habitat maintenance /underwater gardening activities conducted by staff and trained volunteers. Most stewardship activities occur along the shoreline of the lake and in the wetlands area, and are conducted by volunteers supervised by RSI staff; over 2900 volunteers provide 7000-8000 hours in stewardship activities each year. Several special event activities occur in Spring Lake each year. The two largest events are the Texas Water Safari, which involves around 200 individuals launching canoes at the headwaters of the lake to begin a 260 mile race to the Texas coast; and the Texas State Triathlon which has the 500 meter swim component of the race for its 300 participants in Spring Lake. Both of these events occur only once each year. Appendix F contains details on the public service activities occurring in Spring Lake during the past year.

VIII. Contact Information

The following individuals have responsibilities for policies and procedures contained in this management plan:

- Executive Director
  River Systems Institute
  Andrew Sansom
  Texas Rivers Center
  Sansom@TXSTATE.EDU
  512/245-9200
- Lake Manager
  River Systems Institute
  Ron Coley
  Aquarena Center
  RC13@TXSTATE.EDU
  512/245-7539
- Chief Science Officer
  River Systems Institute
  Thom Hardy
  Texas Rivers Center
  Thom.Hardy@TXSTATE.EDU
  512/245-6729
- Diving Safety Officer
  River Systems Institute
  Frederick Hanselmann
  Texas Rivers Center
  FH16@TXSTATE.EDU
  512/245-2724
- Golf Course Manager
  Campus Recreation
  Ryan Zimmerman
  Golf Course Pro Shop
  RZ10@TXSTATE.EDU
  512/245-2392

IX. Appendices

A. *Historical Perspective of Spring Lake*

Archaeological research indicates that the area around San Marcos Springs (i.e. Spring Lake) has been inhabited for over 12,000 years. Early Spanish missionaries traveling the El Camino Real de los Tejas described the springs as "leaping, sparkling waters".
In 1849, General Edward Burleson, Vice President of the Republic of Texas established a homestead at the site and created Spring Lake by building a dam on the San Marcos River to supply power to his grist mill.
In 1926, A. B. Rogers purchased the Burleson tract and transformed the site into "one of the greatest playgrounds of Texas and the Southwest". Rogers wanted visitors to enjoy and appreciate the natural beauty of the San Marcos River. In 1929 Rogers opened Spring Lake Park Hotel; in 1946 Rogers began construction of a tourist resort featuring glass bottom boats, a submarine theatre, and an underwater show with aquamaids, swimming clowns and a swimming pig. In 1950, Aquarena Springs Resort and Theme Park had its grand opening. By 1970 Aquarena was the leading paid tourist attraction in the State, and only exceeded in the annual number of visitors by the Alamo and the State Capitol.
In 1986, John Baugh bought Aquarena from the Rogers family and continued to operate the theme park and hotel; however the more modern theme parks in San Antonio and Houston severely cut into the number of visitors to Aquarena.
In 1994, the University bought the 90 acre park from Baugh. Since then the University has steadily moved to incorporate this unique resource into enhancing the University's mission. The focus has turned from theme park attractions to education and research activities regarding the natural and cultural resources found at the site. The old hotel has been renovated to house the River Systems Institute which provides research and educational activities on the study and protection of Texas rivers. The glass bottom boats have become a key element in educating the public on the appreciation and protection of our natural and cultural resources.
Today the Spring Lake site has over 100,000 visitors participate annually in environmental education tours; faculty and students from several academic departments conducting research activities; and numerous volunteers participating in stewardship efforts to protect the unique resources found at the site.

B. *Baseline Data on Spring Lake (2009-2010)*

1. Overview

Spring Lake is an approximately 18-acre horseshoe-shaped water body with two main regions: the Spring Arm and the Slough Run. Sink Creek, the Lake's only significant surface water tributary, discharges into the Slough Arm of the Lake. Most of the hydrological inputs to the Lake occur from spring openings in the Spring Arm, where artesian spring water from the Edwards Aquifer emerges from approximately 200 openings.

Figure 1: Aerial Photograph of Spring Lake

2. Spring Lake Watershed

Area 172.3 Acres

Elevation Lowest – 574 ft. above sea level Highest – 754 ft. above sea level

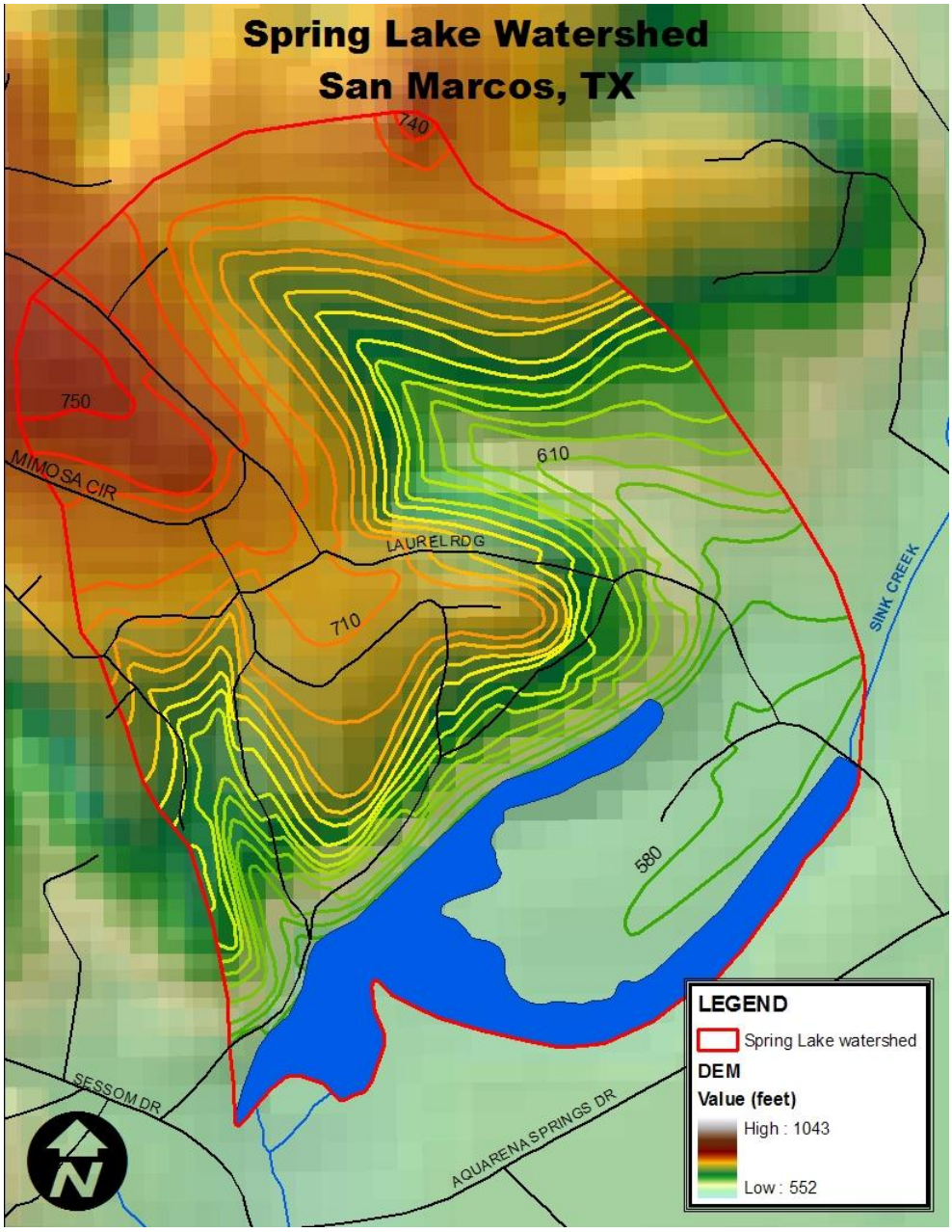

Figure 2: Spring Lake Watershed Elevation

Table 1: Landownership in Spring Lake Watershed

LAND OWNERSHIP	ACRES	% WATERSHED
Private Residence	65	37.8%
University	52.8	30.6%
City of San Marcos	41	23.8%
Texas Treatment Center	< 1	< 1%

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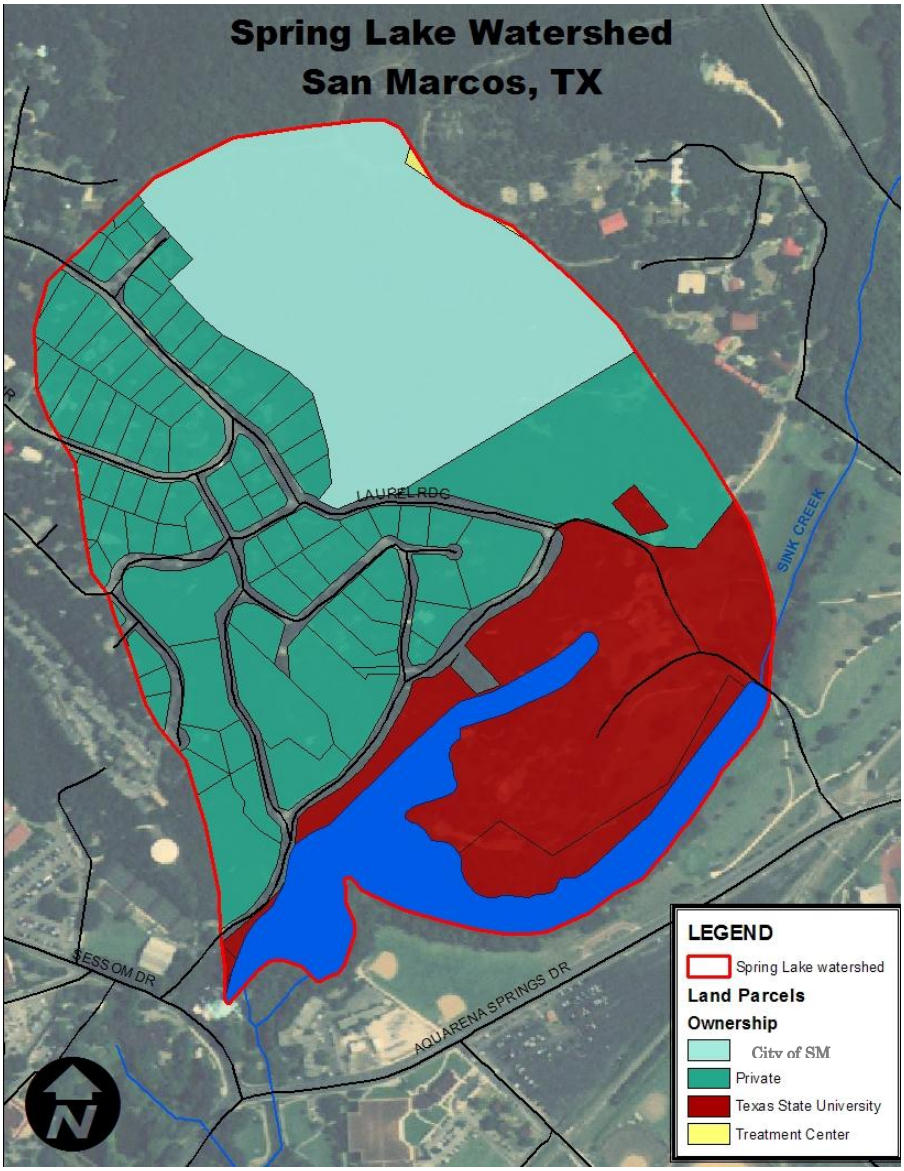

Figure 3: Spring Lake Watershed Land Ownership

3. Spring Lake Bathymetry

Range of Depth	.1-28 feet
Average Depth Main Lake	10 feet
Average Depth Including Slough	4 feet

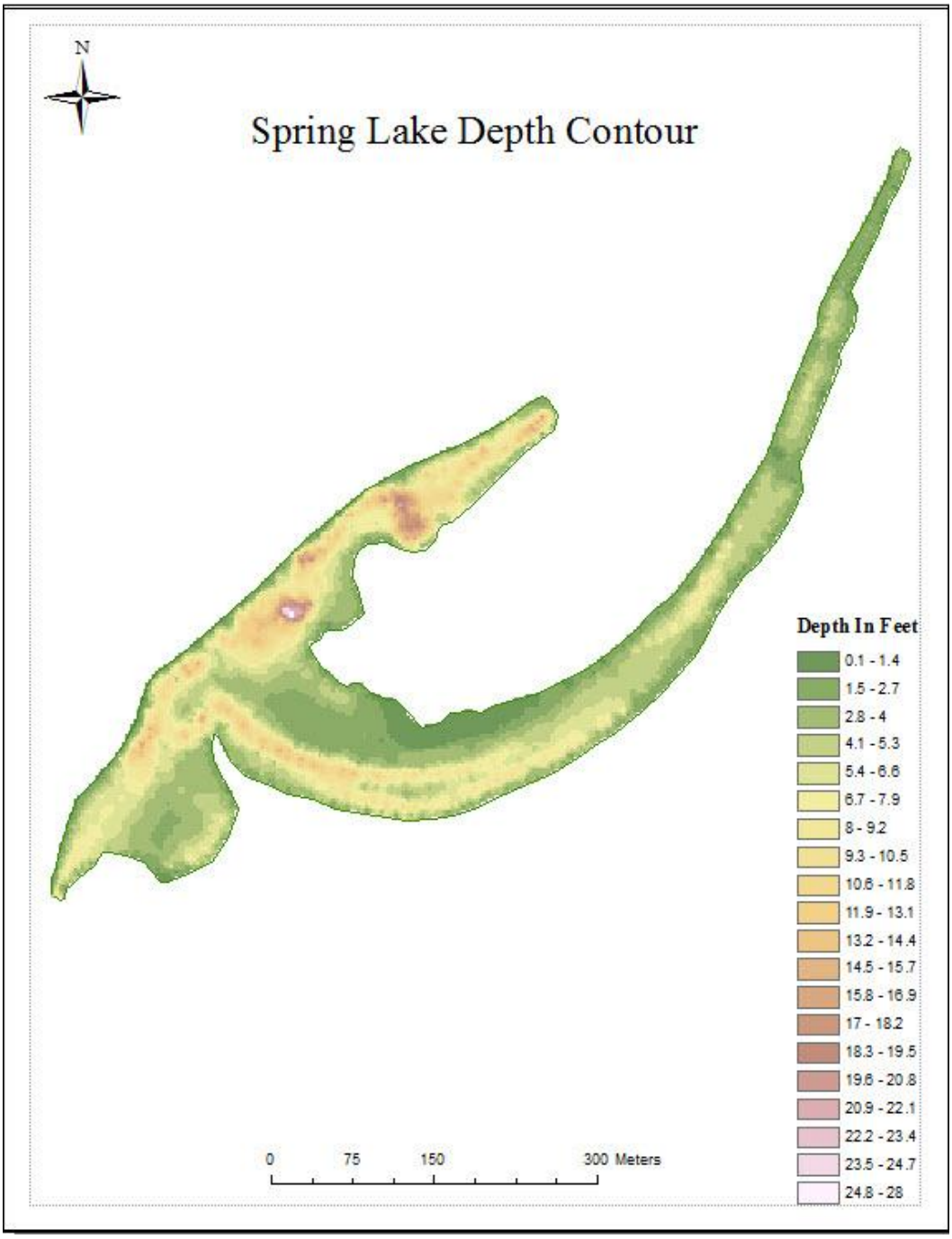

Figure 4: Spring Lake Depth Contours

4. Spring Lake Water Quality

Parameters	Texas Surface Water Standards (TCEQ)	Hotel Springs	Deep Hole Spring
D.O. mg/L	> 5.0	5.92	6.45
pH	6.5-9.0	6.92	7.37
Nutrients: K mg/L		1.92	1.89
Ni mg/L	NO3 ~2.0	1.40	1.51
Phosphates mg/L			
bacteria cfu/100m²	E. coli <394		
turbidity NTU		0.28	1.17
chlorophyll			
Temp ° C		21.58	18.93
conductivity µ mohs/cm	250-950	693	681

5. Spring Lake Water Quantity

Record Low Spring Flow	46 cfs (August, 1958)
Record High Spring Flow	451 cfs (March, 1992)
Average Spring Flow	160 cfs

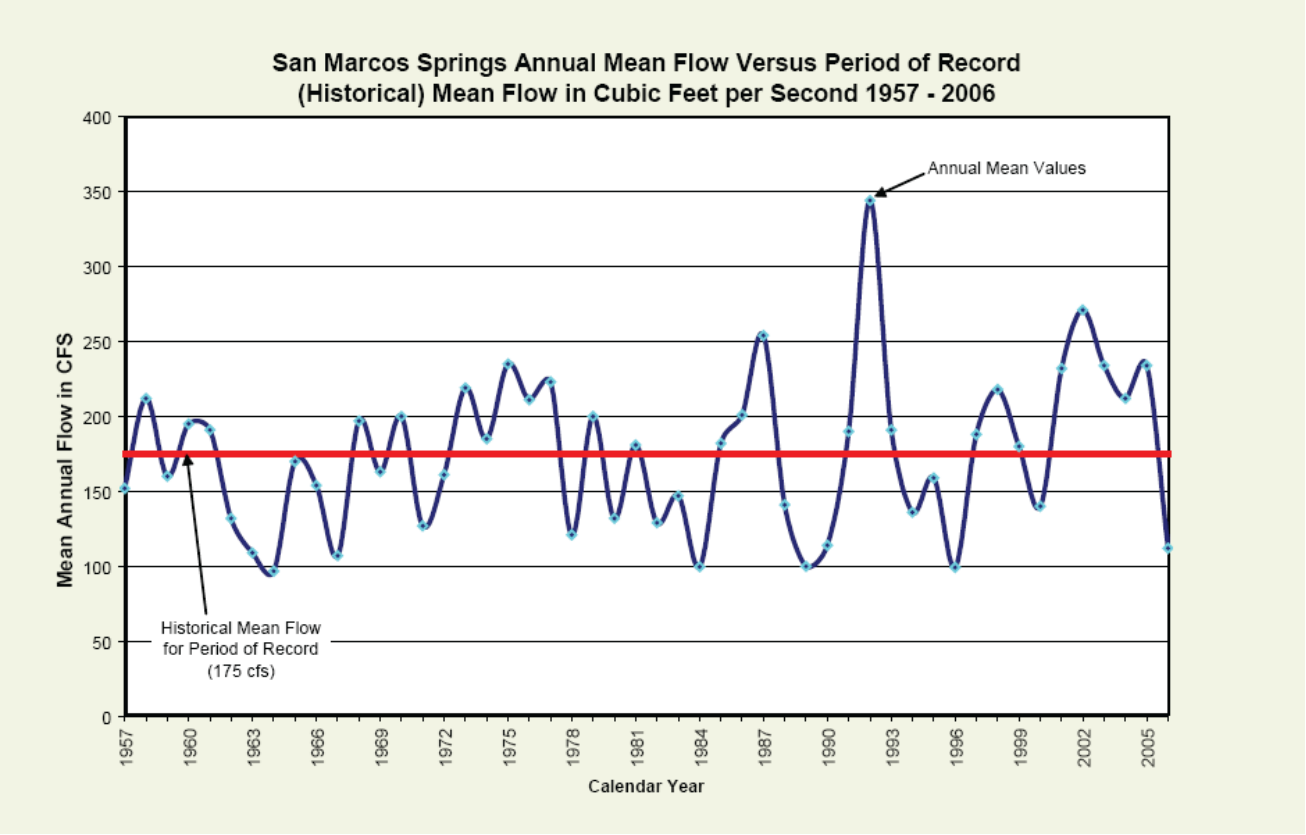

Figure 5: Comparison of San Marcos Springs annual mean flow and historical mean flows from the Edwards Aquifer Authority Hydrologic Data Report for 2006

6. Spring Lake Diversions

Water Right: TCEQ Certificate 18-3865	Max Allowed	2010 Use
• Irrigation Use	100 ac/ft/yr	26 ac/ft/yr
• Municipal Use	513 ac/ft/yr	Not Used
• Industrial Use	534 ac/ft/yr	60 ac/ft/yr
• Hydroelectric Use	30,262 ac/ft/yr	Not Used
• Artificial Waterfall	700 ac/ft/yr	Not Used

C. *Spring Lake Indicators of Ecosystem Health*

A primary objective of the River Systems Institute is to manage Spring Lake so as to protect the healthy ecosystems that exist in the Lake. This appendix will describe the key indicators that will be maintained and monitored to reflect the health of the Lake. A blue-ribbon commission of faculty and researchers will identify these indicators and establish acceptable ranges to be maintained in order to provide healthy ecosystems in the Lake.

D. *Spring Lake Endangered Species*

The U.S. Fish and Wildlife service, through authority granted by the Endangered Species Act of 1973, have listed the following species, found in Spring Lake, as endangered or threatened:

Endangered Species	Threatened	Extinct	Date Listed	Where they are found
Fountain Darter – Etheostoma fonticola			10/13/1970	Upper 3 miles of the San Marcos River and the Comal River
Texas Wild Rice – Zizania texana			5/27/1978	Upper 1.5 miles of the San Marcos River
Texas Blind Salamander			3/11/1967	Edwards Aquifer under San Marcos
	San Marcos Salamander – Eurycea nana		7/14/1980	Spring Lake and immediately below Dam (in rocky areas 150 m below)
Comal Springs Dryopid Beetle			12/18/1997	Historically, from headwaters to Thompson's Island
Comal Springs Riffle Beetle			12/18/1997	Historically, from headwaters to Thompson's Island
Peck's Cove Amphipod			12/18/1997	Historically, from headwaters to Thompson's Island
		Gambusia – Gambusia georgei	7/14/1980	Historically, from headwaters to Thompson's Island

E. *Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan*

The following information, pertaining to activities in Spring Lake, have been excerpted from the draft Edwards Aquifer Recovery Implementation Program Habitat Conservation Plan. A copy of the entire plan can be found at http://earip.org/Resources.aspx under "Revised Final Draft of HCP".

Chapter 5 MINIMIZATION AND MITIGATION MEASURES SPECIFICALLY DESIGNED TO CONTRIBUTE TO RECOVERY

The ESA requires the HCP to specify what steps the applicants will take to minimize and mitigate the impacts which will likely result from the anticipated incidental take associated with the Covered Activities. 16 U.S.C § 1539(a)(2)(A). In order to issue and incidental take permit, FWS must find that the applicants "will, to the maximum extent practicable, minimize and mitigate the impacts of such taking." *Id.* at § 1539(a)(2)(A)(B)(ii).

This chapter presents the conservation measures that the Applicants commit to carry out to minimize and mitigate the incidental take resulting from the Covered Activities to the maximum extent practicable. Additionally, some measures identified in the Sections below go beyond the "minimize and mitigate" standard and actually contribute to the recovery of the Covered Species. Each measure identifies the impact of the anticipated incidental take to be addressed and how the measure positively addresses that impact.

5.4 Texas State University

5.4.1 Texas Wild-Rice Enhancement and Restoration

Texas State University will partner with the City of San Marcos to undertake a program of Texas wild-rice enhancement and restoration in Spring Lake and the San Marcos River within the University's campus boundaries as described in Section 5.3.1 above.

5.4.2 Management of Recreation in Key Areas

Texas State University will partner with the City of San Marcos to control recreation in Spring Lake and the San Marcos River within Texas State University campus boundaries. To minimize the impacts from recreation, Texas State University will establish permanent access points on the east and west banks of the San Marcos River between Spring Lake dam and the Aquarena Drive bridge, and other areas as determined during the AMP. These areas will serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc. Areas between access points will be planted with vegetation that discourages streamside access (*e.g.*, prickly pear and acacia). Additionally, TPWD intends to create State Scientific Area in the San Marcos Springs ecosystem and River that would limit recreation in these areas during low flow conditions. (*See* Section 5.6.1). With the exception of the eastern spillway immediately below Spring Lake Dam, none of the protected areas would extend across the entire river channel which would allow longitudinal connectivity throughout the river. Kiosks showing access points, exclusion zones, and associated educational components will be installed at key locations.

5.4.3 Management of Vegetation

5.4.3.1 Management of Submerged and Floating Aquatic Vegetation in Spring Lake

To mitigate the impacts of incidental take on Covered Species from recreation, Texas State University will manage aquatic vegetation in Spring Lake through use of its harvester boat and through hand cutting of vegetation by divers authorized to dive in Spring Lake. Each week about five springs will be cut, thus returning to cut the same springs every two to three weeks. During summer algal blooms, the springs will be managed more frequently (up to four springs per day), but mostly to remove algae. Texas State employees and supervised volunteers will fin the area around the springs to remove accumulated sediment, and then clear a 1.5-meter radius around each spring opening in Spring Lake with a scythe. Over the next 1.5-meter radius around the spring opening, they will shear vegetation to a height of 30 cm, and then to one meter over the following three meter radius. Plant material will not be collected, but carried away by the current. Cumulatively, about six meters of vegetation around each spring opening will be modified. Mosses will not be cut. The volume of plant material to be removed will vary by the amount of time between cuttings, and season. The harvester boat will remove a range of 15-to-20 boatloads of plant material a month from Spring Lake. The harvester will clear the top meter of the water column, cutting vegetation from sections one, two, and three once a week. (*See* Figure 5.2). The harvested vegetation will be visually checked by driver for fauna caught in the vegetation. If the driver observes fauna, he/she will stop work and put the animal(s) back into Spring Lake if appropriate. Texas State employees and supervised volunteers are trained to recognize the Covered Species through the Diving for Science program (Section 5.4.8.1), and avoid contact with them. Vegetation mats will be removed from zones four and five on an as-needed basis. (Figure 5-2). The total area cut will equal about nine surface acres. One permanent full-time person (Spring Lake Area Supervisor) is responsible for running the harvester and managing the removal of vegetation around the spring openings. The Spring Lake Area Supervisor also schedules cleanup of nuisance floating species such as water hyacinth and water lettuce from Spring Lake. The floating plants will be collected by hand and shaken prior to removal from the river to dislodge any aquatic species caught in the plant. The plants will be deposited into dump trucks and taken to the River System Institute compost area.

5.4.3.2 Management of Aquatic Vegetation from Sewell Park to City Park

To mitigate the impacts of incidental take from recreational activities, Texas State University will push floating vegetation downstream of any Texas wild-rice stands. Inorganic litter will be picked up weekly from the San Marcos River from Sewell Park to City Park during the recreational season (Memorial Day to Labor Day) and monthly during offseason. Texas State University will monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation. Divers will not pick up litter in or around Texas wild-rice stands. University employees or others will be trained by the TPWD to recognize Texas wild-rice and to protect the plant stand while removing the accumulated floating plant material. On Texas wild-rice stands, Texas State University employees will lift (not push) the floating material from the top of the Texas wild-rice stands and allow it to float downstream. Downstream accumulations of plant material will be removed by the City of San Marcos to avoid impacts to Texas wild-rice further downstream.

Figure 5.2: Aquatic Harvester Zones
Zone 1_Headwater Springs; Crater Bottom, Salt and Pepper 1&2, Weissmuller
Zone 2_ Boat Path; Diversion, Cream of Wheat, Ossified Forest
Zone 3_Boat Path; River Bed, Catfish Hotel, Deep Hole, Harvester Channel
Zone 4_Boat Path; Archeology Site, Kettleman's, University Seminar Boat Path and Dock
Zone 5_ Sink Creek/slough channel

5.4.4 Sediment Removal in Spring Lake and from Spring Lake Dam to City Park

Monitoring of the San Marcos River since 1990 reveals that sediment production has increased from 160 m3/yr to 920 m3/yr due to a combination of upstream flood control dams and sediment inflow increases (Earl and Wood 2002). Deposition of sediments on or around Texas wild-rice strands causes direct mortality by smothering or burying strands. Texas State University will mitigate the impacts of incidental take from diving activities, research activities, recreation and pumping during low flow periods by removing sediment from key areas of Texas wild-rice habitat in Spring Lake and from Spring Lake dam to City Park. Hydrosuction will be used to remove accumulations of sediment. The silt will be vacuumed using a hose that has an end piece covered by a 0.25-inch mesh screen to prevent suctioning biota greater than 0.25 inch in diameter. The divers doing the hydrosuctioning will take the following measures to minimize loss/harm of biota in the area. Vegetation will be finned before turning on the pump. Finning will encourage the darters and other biota to move out of the area. Divers will be trained to recognize all stages of listed species from larval to adult. The nozzle of the vacuum will be kept down in the soil and not allowed to swing through the water column during the operation. In addition, placement of stakes around the area to be suctioned will keep divers away from stands of Texas wild-rice. An observer will be on the bank to monitor the effluent for presence of listed species and all other biota, as well as for the safety of the diver. Sediment samples will be sent to TCEQ for contaminant testing per TCEQ requirements.

5.4.5 Diversion of Surface Water

Under TCEQ Certificates 18-3865 and 18-3866, Texas State University's total diversion rate from the headwaters of the San Marcos River for consumptive use is limited to 8.1 cfs. (*See* Section 2.5.5). The total diversion rate from Spring Lake is limited to 4.88 cfs; the total diversion rate from the San Marcos River at Sewell Park is limited to 3.22 cfs. (*See* Section 2.5.5.1 and 2.5.5.2 respectively). To minimize the impacts of these diversions, when flow at the USGS gauge at the University Bridge reaches 80 cfs, Texas State University will reduce the total rate of surface water diversion by 2 cfs, *i.e.*, to a total of approximately 6.1 cfs. This reduction in pumping will occur at the pump just below Spring Lake Dam in order to maximize the benefits to salamanders, Texas wild-rice, and other aquatic resources in the San Marcos River below Spring Lake Dam. The University will reduce the total rate of surface water diversion by an additional 2 cfs when the USGS gauge reaches 60 cfs. The additional 2 cfs reduction will be made from the pumps located in the slough arm of Spring Lake, and, therefore, maximize the benefits to the aquatic resources within the main stem San Marcos River below Spring Lake Dam. When the USGS gauge reaches 49 cfs, Texas State University will reduce the total diversion rate to 1 cfs. This further reduction will be made by restricting the pumps located in the Sewell Park reach. The diversion of water will be suspended when the springflow reaches 45 cfs.

Figure 5-3. Texas State University Surface Water Diversions. The diversions are identified with stick pins. The diversions at the pump house (slough arm of Spring Lake) and industrial cooling towers are permitted under TCEQ Certificate 18-3865. The diversions at Sewell Park and the "ponds" are permitted under TCEQ Certificate 18-3866. (*See* Sections 2.5.5.1 and 2.5.5.2 respectively). The reductions in Texas State University's total diversion rate for consumptive use is summarized in Table 5-4 below:

Streamflow (cfs)	Spring Lake Diversions (cfs) Cert. No. 18-3865	San Marcos River Diversions (cfs) Cert. No. 18-3866	Total Diversion Rate (cfs)
>80	4.9	3.2	8.1
80-60	2.9	3.2	6.1
60-49	0.9	3.2	4.1
49-45	1.0	0	1.0
<45	0	0	0

Figure 5-4. Reductions in Surface Water Diversion Rates during Low Flow Conditions under Texas State University's TCEQ Certificates 18-3865 and 18-3866.

Texas State University uses a 0.25-inch mesh screen to cover the intake for surface water diversions. These screens are routinely inspected and cleaned. Fountain darters have not been observed when the screen is cleaned; however, there is a possibility for capture of adults against the screen, but not pulled into the pipeline. To avoid or minimize the impacts of the surface water diversions, the University will routinely monitor the screens to determine if any entrainment occurs and will make any necessary modifications to the screens to minimize any incident take from the operation of the diversions.

5.4.6 Sessom Creek Sand Bar Removal

For decades, a sand and gravel bar has been building with each major rain event at the confluence of Sessom Creek and the San Marcos River. The bar is about two-thirds meter deep, 7 meters wide, and 21 meters long (98.5 m3). Over time it has widened, deepened, and constricted the river channel; furthermore, the continued expansion has covered a stand of Texas wild-rice. The bar has become vegetated with both littoral and terrestrial plants, and is used heavily by recreationists as it provides a shallow swimming area. To minimize and mitigate the impacts of incidental take from recreation, Texas State University and the City of San Marcos will conduct a study of sediment removal options to determine the best procedure to remove this sand and gravel bar that minimizes impacts to listed species. Texas State University will submit the study for review though the AMP and implement the actions coming out of that process. A separate sediment retention pond has been constructed to minimize additional deposition to this area and will be maintained to maintain an effective level of performance.

5.4.7 Diving Classes in Spring Lake

5.4.7.1 The Diving for Science Program

To minimize the impacts of the Diving for Science Program that trains and authorizes individuals to dive in Spring Lake, individuals authorized through this program must demonstrate a knowledge of listed species found in the lake and their habitat, laws and regulations impacting these species, good buoyancy control, the ability to avoid contact with listed species, the ability to avoid disturbing critical habitat, and the ability to stay off the bottom of the lake. The program is taught as a two-day class with a maximum class size of 20 and is taught in the Dive Training Area. The program averages 350 trainees per year. Upon completion of this class, divers are allowed anywhere in Spring Lake to perform specific volunteer tasks such as finning spring areas covered with algae, and picking up litter. Projects are structured to minimize contact with listed species in an effort to ensure protection of listed species and their habitat. The Diving Supervisor coordinates and supervises all volunteer diving. No more than sixteen volunteer divers will be allowed in the lake per day, with no more than eight at one time. Any individual diving outside of the Dive Training Area has to have completed the Diving for Science Program.

5.4.2 Texas State University Continuing Education

Texas State University Continuing Education classes for check-out dives will be conducted in the Dive Training Area. To minimize the impacts of these classes, class size will be limited to 12 students and no more than three classes will be conducted per day.

5.4.7.3 Texas State SCUBA Classes

Texas State SCUBA classes will be conducted in the Dive Training Area. To minimize the impacts of these classes, class size will be limited to 12 students and no more than three classes will be conducted per day.

5.4.8 Research Programs in Spring Lake

To minimize the impacts of its research programs, all proposals to conduct research in Spring Lake will be reviewed by the River Systems Institute to ensure there is no impact on Covered Species or their habitat. If incidental take cannot be avoided, it will be minimized by educating the researchers as to the area where the listed species are located and by requiring measures to minimize any potential impacts. All diving in support of a research study will be provided by individuals who have completed the Diving for Science program. Nothing herein is intended to obviate the need for individual research projects to obtain a permit under 16 U.S.C. § 1539(a)(1).

5.4.9 Management of Golf Course and Grounds

To minimize any impacts of the use of fertilizers and pesticides to maintain the golf course and grounds, Texas State University will develop a golf course management plan that will document current practices and include an Integrated Pest Management Plan (IPMP). The golf course management plan and IPMP will incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the ecosystem. Expanded water quality sampling targeted at Golf Course operations will be conducted as described in Section of 5.7.2. of the HCP. Changes in golf course management will be addressed through the AMP as set out in Article 7 of the FMA.

5.4.10 Boating in Spring Lake and Sewell Park

To minimize the impacts of boating on the Covered Species' habitat in Spring Lake, boats in Spring Lake will be confined to areas that are mowed by the harvester, thereby not impacting vegetation and specifically avoiding Texas wild-rice stands. Individuals will enter and exit boats at specified access points to avoid impacting the flora and fauna along the bank. All boats launched into Spring Lake will undergo a USFWSapproved process for cleaning. Further, canoeing/kayaking classes in the lake will be limited to no more than 2 classes per day and each class will be in the water no more than 1 hour. Classes will have a maximum of 20 students in 10 canoes. All classes will be supervised. To minimize the impacts of boating on the Covered Species' habitat in Sewell Park, canoeing/kayaking classes in Sewell Park will be confined to the region between Sewell Park and Rio Vista dam. Students will enter/exit canoes/kayaks at specified access points to avoid impacting the flora and fauna along the bank. Classes will be no longer than two hours and up to three classes will be held per day. Classes will have a maximum of 20 students in 10 canoes. All classes will be supervised.

5.4.11 Reduction of Non-Native Species Introduction

Texas State University will limit introductions of non-native species by aquarium dumps. Dumping aquariums into the San Marcos River and its tributaries will be minimized through education, including signage and brochures, and offering alternative disposal to citizens wanting to get rid of unwanted aquatic pets. Texas State University will partner with the City of San Marcos and local citizen groups to help distribute educational materials. Partnerships with the school districts will also be considered. Educational materials will also be provided to local pet shops.

5.4.12 Control of Non-Native Plant Species

Texas State University will partner with the City of San Marcos to implement a non-native plant replacement program for Spring Lake and the San Marcos River within the University's campus boundaries as described in Section 5.3.8 above.

5.4.13 Control of Harmful Non-Native and Predator Species

Texas State University will partner with the City of San Marcos to undertake a program of non-native and predator species control for Spring Lake and the San Marcos River within the University's campus boundaries as described in Section 5.3.9 above.

F. *Activities in Spring Lake*

The following activities were conducted in Spring Lake during 2009-2010:
Teaching Activities

Teaching				
Class	Enrollment	Duration	Description	Damage to Lake
HHP				
Beginning Scuba	20	November, 2009	Six open water dives	Minimal
Beginning Scuba	20	November, 2009	Six open water dives	Minimal
Beginning Scuba	20	November ,2009	Six open water dives	Minimal
Beginning Scuba	20	November, 2009	Six open water dives	Minimal
Beginning Scuba	20	June, 2010	Six open water dives	Minimal
Beginning Scuba	20	June, 2010	Six open water dives	Minimal
Beginning Scuba	20	June, 2010	Six open water dives	Minimal
Beginning Scuba	20	June, 2010	Six open water dives	Minimal
Beginning Scuba	20	June, 2010	Six open water dives	Minimal
Beginning Scuba	14	June, 2010	Six open water dives	Minimal
Beginning Scuba	14	June, 2010	Six open water dives	Minimal

Research Activities

Research				
Principal Investigator	Agency	Duration	Description	Damage to Lake
Drew Davis	Biology	4/26-5/9/2010	Collect Rio Grande cicls	
Carole Leezer	CAS	4/29-5/6/2010	Archaelogical shovel tests	None
Cassi Otera	USGS	5/25/2010	Install real time monitor	Minimal
Diane Wassenich	SMRF	5/31/2010	Removal of water hyacinth	Minimal
Brian Hunt	BSEACD	6/21-7/12/2010	Dye trace study	
Ben Hutchins	Biology	8/3/2010	Install sondes in springs	Minimal

Public Service Activities

Public Service				
Organization	Participants	Duration	Description	Damage to Lake
RSI	9	9/4-9/5/2009	Diving for Science	Minimal
RSI	10	10/2-10/3/2009	Diving for Science	Minimal
RSI	10	10/9-10/10/2009	Diving for Science	Minimal
RSI	10	10/23-10/24/2009	Diving for Science	Minimal
RSI	10	11/6-11/7/2009	Diving for Science	Minimal
RSI	11	11/13-11/14/2009	Diving for Science	Minimal
RSI	12	12/4-12/5/2009	Diving for Science	Minimal
RSI	8	1/8-1/9/2010	Diving for Science	Minimal
RSI	8	1/15-1/16/2010	Diving for Science	Minimal
RSI	8	2/13-2/14/2010	Diving for Science	Minimal
RSI	10	3/6-3/7/2010	Diving for Science	Minimal
RSI	10	3/20-3/21/2010	Diving for Science	Minimal
RSI	8	4/10-4/11/2010	Diving for Science	Minimal
RSI	9	5/8-5/9/2010	Diving for Science	Minimal
RSI	10	6/5-6/6/2010	Diving for Science	Minimal
RSI	13	6/19-6/20/2010	Diving for Science	Minimal
RSI	10	7/10-7/11/2010	Diving for Science	Minimal
RSI	12	7/17-7/18/2010	Diving for Science	Minimal
RSI	10	7/24-7/25/2010	Diving for Science	Minimal
RSI	12	8/7-8/8/2010	Diving for Science	Minimal
RSI	12	8/14-8/15/2010	Diving for Science	Minimal
RSI	12	8/21-8/22/2010	Diving for Science	Minimal
RSI	13	8/28-8/29/2010	Diving for Science	Minimal
Dive Schools	Total of: 2500	Varies during year	Open water check-out dive	Minimal
Southwest Aqua				

Public Service				
Organization	Participants	Duration	Description	Damage to Lake
Sport				
Hydrosports				
Copelands				
Ascuba Venture				
Dive World San Antonio				
Divemasters				
Deep Blue Adventures				
The Dive Shop				
Houston Scuba Academy				
Scuba Houston				
Oceanic Ventures				
Gigglin Marlin Divers				
Scuba Divers Paradise				
Island Divers				
Lone Star				
Arlington Scuba Center				
Dive West				
Aqua Adventures				
Scuba Sphere				
We B Divin				
Surface Interval				
Extreme Scuba				
International Scuba				
Scuba Center				
Scuba Schools				
Blue Dolphin Scuba				
Lake Air Scuba				
Toms Dive & Swim				
Oak Hill Scuba				
Dive World Austin				
ScubaLand				
Texas Water	199	6/22/2010	Launch of canoe	Minimal

Public Service				
Organization	Participants	Duration	Description	Damage to Lake
Safari			race to Texas Coast	
Texas State Triathlon	327	4/10/2010	500 meter swim component of triathlon	Minimal

G. *Species Inventory – Spring Lake*

Fish

Scientific Name	Common Name
Astyanax mexicanus	Mexican tetra (introduced)
Dionda episcopa	Roundnose minnow
Gambusia affinis	Western mosquitofish
Micropterus salmoides	Largemouth bass
Lepomis microlophus	Redear sunfish
Lepisosteus oculatus	Spotted gar
Etheostoma fonticola	Fountain darter
Lepisosteus osseus	Longnose gar
Fundulus notatus	Blackstripe topminnow
Gambusia geiseri	Largespring gambusia
Cyprinella venusta	Blacktail shiner
Notropis amabilis	Texas shiner
Notropis volucellus	Mimic shiner
Ictalurus punctatus	Channel catfish
Ameiurus melas	Black bullhead
Hypostomus plecostomus	Suckermouth catfish
Micropterus punctulatus	Spotted bass
Lepomis megalotis	Longear sunfish
Lepomis macrochirus	Bluegill
Lepomis cyanellus	Green sunfish
Lepomis auritus	Redbreast sunfish (introduced)
Cichlasoma cyanoguttatum	Rio Grande cichlid (introduced)
Oreochromis aureus	Blue tilapia (introduced)
Anguilla rostrata	American eel
Myleus pacu	Pacu (introduced)
Poecilia latipinna	Sailfin molly (introduced)
Poecilia formosa	Amazon molly
Hypostomus plecostomus	Suckermouth catfish (Introduced)

Macrophytes

Submerged

Scientific Name	Common Name
Sagittaria platyphylla	Delta arrowhead (native)
Vallisneria americana	American eelgrass (native)
Cabomba caroliniana	Fanwort (native)
Ceratophyllum demersum	Coontail (native)
Ludwigia repens	Water primrose (native)
Myriophyllum heterophyllum	Water-Milfoil (native)
Najas guadalupensis	Southern naiad (native)
Chara spp.	Stoneworts (native)
Amblystegium riparium	Aquatic moss (native)
Ricciocarpus natans	Liverwort (native)
Myriophyllum spicatum	Eurasian water milfoil (introduced)
Myriophyllum aquaticum	Parrot feather (introduced)
Hydrilla verticillata	Hydrilla (introduced)
Egeria densa	Brazilian elodea (introduced)
Hygrophila polysperma	Miramar weed (introduced)

Floating

Scientific Name	Common Name
Azolla caroliniana	Mosquito fern
Ceratopteris thalictroides	Watersprite (introduced)
Pistia stratiotes	Water lettuce (introduced)
Nuphar luteum	Spatterdock cow lilly
Eichhornia crassipes	Water Hyacinth (introduced)
Spirodela polyrrhiza	Duckmeat
Lemna minor	Common duckweed
Wolffia papulifera	Watermeal

Emergent

Scientific Name	Common Name
Typha domingensis	Tule, Southern cattail
Typha latifolia	Common cattail
Colocasia esculenta	Elephant Ear (introduced)
Echinodorus rostratus	Burhead
Limnophila sessiliflora	Ambulia (introduced)
Hydrocotyle umbellata	Water pennywort
Arundo donax	Giant reed (introduced)
Ranunculus sceleratus	Cursed buttercup (introduced)

Algae

Scientific Name	Common Name
Basicladia crassa	Chlorophyta
Basicladia chelonum	Chlorophyta
Cladophora glomerata	Chlorophyta
Closterium sp.	Chlorophyta
Gloeocystis sp.	Chlorophyta
Oedogonium sp.	Chlorophyta
Rhizoclonium hieroglyphicum	Chlorophyta
Symploca sp.	Chlorophyta
Lyngbya sp.	Cyanophyta
Calothrix sp.	Cyanophyta
Spirogyra sp.	Chlorophyta
Batrachospermum involutum	Rhodophyta
Compsopogon coeruleus	Rhodophyta
Compsopogon coeruleus	Rhodophyta
Sirodotia huillensis	Rhodophyta
Chaetophora elegans	Chlorophyta
Bulbochaete sp.	Chlorophyta
Ulothrix zonata	Chlorophyta
Coleochaete scutata	Chlorophyta

Invertebrates

Scientific Name	Common Name
Macrobrachium rosenbergii	Giant river prawn
Corbicula fluminea	Asian Clam (introduced)
Marisa cornuarietis	Giant Rams horn Snail (introduced)
Melanoides tuberculatus	Red rimmed melania (introduced)
Tarebia granifera	Quilted melania (introduced)
Elimia comalensis	Comal snail
Corydalus spp.	Dobsonfly
Order: Ephemeroptera	Dameselfly, Mayflies
Pentagenia robusta	Robust burrowing mayfly
Hydra spp.	Hydra
Astacoidea spp.	Crayfish
Amphipoda spp.	Side swimmers/ scuds
Macrobdella spp.	leech
Order: Anisoptera	Dragonfly

Turtles

Scientific Name	Common Name
Trachemys s. elegans	Red-eared slider
Pseudemys texana	Texas River Cooter

Sternotherus odoratus	Musk Turtle
Chelydra s. serpentina	Common Snapper
Apalone ferox	Florida soft shell (introduced)
Pseudemys nelsoni	Florida red-belly (introduced)

Endangered/Threatened Species

Scientific Name	Common Name
Eurycea rathbuni	Texas Blind Salamander
Eurycea nana	San Marcos Salamander
Etheostoma fonticola	Fountain Darter
Elmidae spp.	Riffle beetle

Birds

Scientific Name	Common Name
Ardea herodias	Great Blue heron
Butorides Virescens	Green Heron
Phalacrocorax auritus	Double-Crested Cormorant
Buteo lineatus	Red Shouldered Hawk
Chloroceryle americana	Kingfisher
Coragyps atratus	Black Vulture
Tyrannus forficatus	Scissor-tailed Flycatcher
Ardea alba	Great Egret
Fulica americana	American Coot
Quiscalus mexicanus	Great-tailed Grackle
Bombycilla cedrorum	Cedar waxwing
Cathartes aura	Turkey Vulture
Nyctanassa violacea	Yellow Crowned Night Heron
Nycticorax nycticorax	Black Crowned Night Heron
Pandion haliaetus	Osprey
Melanerpes aurifrons	Golden-fronted Woodpecker
Melanerpes carolinus	Red Bellied Woodpecker
Picoides scalaris	Ladder-backed Woodpecker
Colaptes auratus	Northern Flicker
Picoides pubescens	Downy Woodpecker
Sayornis phoebe	Eastern Phoebe
Myiarchus crinitus	Great Crested Flycatcher
Tyrannus verticalis	Western Kingbird
Tyrannus tyrannus	Eastern Kingbird
Lanius ludovicianus	Loggerhead Shrike