



MEMORANDUM

TO: Mayor and Council Members

FROM: Joseph G. Pantalion, P.E., Director
Watershed Protection and Development Review Department

DATE: September 20, 2005

SUBJECT: 2003-2004 Annual Report to U.S. Fish and Wildlife Service

In October 1998, the U.S. Fish and Wildlife Service (the Service) issued the City of Austin an Endangered Species Act Section 10(a)(1)(B) Permit for a period of 15 years. The permit covers incidental take of the federally protected Barton Springs Salamander, *Eurycea sosorum*, that may occur during operation and maintenance of Barton Springs Pool and the adjacent springs located in Zilker Park (Eliza, Zenobia/Old Mill/Sunken Garden, and Upper Barton).

In compliance with the measures set forth in the Habitat Conservation Plan (Section 6 of the permit), the Watershed Protection and Development Review Department (WPDRD) has submitted to the Service the report for 2003-2004. This report details the City of Austin's compliance with the 41 measures listed in the permit. I would like to emphasize several of the major activities completed during the last two years.

- A detailed, three-year habitat management plan for Eliza Spring was completed.
- Extensive habitat restoration in Eliza Spring was completed and resulted in a dramatic increase in salamander abundance. The average number of salamanders found during 2003 and 2004 increased from 10 to 348. The permit report contains photographs of the habitat before and after restoration and provides detailed description of restoration activities.
- Modifications to runoff control structures at Eliza Spring were completed and resulted in complete protection of the spring pool from overland runoff.
- The outflow streambed that carries water from Sunken Garden/Zenobia Spring to lower Barton Creek was reconstructed and includes a waterfall that acts as a barrier to invasion of non-native fish into salamander habitat.
- Calibration of the gates in the dam at Barton Springs Pool has been completed. City staff can now precisely control the speed and extent of decrease in water level in the pool associated

with cleaning and flood mitigation activities. This calibration allows for more effective protection of salamanders during water level drawdowns.

- The new salamander research facility that will house the salamander captive breeding program is under construction and is expected to be ready for occupation by October 2005.

These are just a few of the City's compliance efforts that are summarized in the permit report. If you have any questions or need additional information, please contact me, 974-3413, or Laurie Dries, WPDRD Environmental Scientist, at 974-6340.

Joseph G. Pantalion, P.E., Director
Watershed Protection and Development Review Department

JP: lad

Attachments: 10(A)(1)(b) Permit Report

cc: Toby Hammett Futrell, City Manager
Laura Huffman, Assistant City Manager
Dave Anderson, Chairman, Environmental Board,
Paige Najvar, Biologist, U.S. Fish and Wildlife Service

Annual Report October 1, 2002 – September 30, 2004
Endangered Species Act Section 10(a)(1)(B) Permit for the Incidental Take of the Barton Springs Salamander (*Eurycea sosorum*) for the Operation and Maintenance of Barton Springs Pool and Adjacent Springs
Permit# PRT-839031

INTRODUCTION

This annual report summarizes the status of the City of Austin's compliance with the 41 measures listed in the Habitat Conservation Plan issued in association with the permit referenced above. Also included in this report are activities undertaken to promote the recovery and long-term persistence of *Eurycea sosorum* and protect the supporting ecosystem. Much of the work to improve environmental conditions for *E. sosorum* will also benefit the Austin Blind Salamander, *Eurycea waterlooensis*, a candidate for endangered or threatened status that lives in the same spring sites. The report is organized into sections as follows:

- A. Status of compliance with each measure listed separately
- B. Summary of salamander abundance at Upper Barton, Eliza, and Old Mill/Sunken Garden/Zenobia springs, and Barton Springs Pool/Parthenia Spring*

*Note: Old Mill/Sunken Garden/Zenobia Spring will hereafter be referred to by its oldest name, Zenobia Spring. Sunken Garden will continue to denote the entire historic structure surrounding Zenobia Spring. The distinct areas in Barton Springs Pool that comprise salamander habitat will hereafter be referred to as Parthenia Spring; these areas are the three submerged cave openings and overlying fissures from which spring water emanates, and the area known as "the beach." Barton Springs Pool will continue to denote the entire pool area between the dams that cross Barton Creek.

- C. Summary of habitat management activities

A. STATUS OF COMPLIANCE

6.0 Habitat Conservation Plan (HCP)

(HCP measures are listed in bold; compliance status is detailed in regular text.)

6.1.1 The City of Austin will coordinate the management of salamander habitat areas and be responsible for maintaining information and scientific data on the Barton Springs salamander. The City of Austin will also be responsible for the timely transmittal of information and data to the Service. The City of Austin will submit an annual report to the U.S. Fish and Wildlife Service, Austin Ecological Field Services Office, 10711 Burnet Road, Suite 200, Austin, Texas, 78758. The annual report will address the status of the salamander, provide an analysis of biological data, and review pool maintenance and management activities during the year. The City of Austin will be responsible for all measures in the HCP. In the annual report, each point of the HCP will be addressed. The permit and HCP will be for a period of 15 years. Copies of the annual report will also be submitted to the City Manager and City Council.

The City is in compliance. The City of Austin's Salamander Conservation Program of the Watershed Protection and Development Review Department coordinates with the Environmental Resource Management Division and the Parks and Recreation Department in ensuring compliance with the HCP. These groups are responsible for the management of salamander habitat, the management and maintenance of Barton Springs Pool, maintenance of scientific databases, and public education about the Barton Springs Salamander and its habitat. City salamander biologists also maintain the required federal and state scientific permits for research and collection of Barton Springs and Austin Blind salamanders. Although USFWS staff

have agreed to a variance from submitting an annual report during this reporting period, the City will request a permit amendment clarifying future report intervals.

6.1.2 The City of Austin will make daily visual inspections of all habitat areas (spring sites) and note any problem conditions such as vandalism, trash and debris, introduction of exotic fish or animals, or disturbance of habitat.

The City is in compliance. City of Austin salamander biologists currently conduct inspections of perennial spring sites five days a week and Upper Barton Spring five times weekly when water is present at the site. Barton Springs Pool is inspected seven days a week by pool staff; biologists are on call everyday, 24 hours a day, to respond to any problems. Inspections by salamander biologists are increased to seven days a week whenever unusual conditions are encountered at any of the sites. The City will request an amendment to this measure officially reducing the frequency of inspections of Eliza, Zenobia, and Upper Barton springs to five times weekly under normal conditions. Daily inspections of Barton Springs Pool will continue as specified above.

6.1.3 When the pool is lowered for cleaning and maintenance, trained City of Austin staff will visually inspect all of the exposed areas of the pool for stranded salamanders. This visual inspection will also include Eliza Spring, Old Mill Spring (Sunken Garden), and Upper Barton Spring. Any stranded salamanders will be moved to permanent water. This measure will be in place upon the issuance of this permit. Until the dam or comparable water control device is installed in the shallow end of the pool, a minimum of four biologists will be present at drawdown to search for stranded salamanders. After installation of the water control device, a minimum of two biologists will be present when the pool is lowered.

The City is in compliance with the intent of this measure. The City ensured the presence of four biologists during the rapid, full drawdown in September of 2003 to facilitate a U. S. Geological Survey study of water composition. Two biologists were present at every other drawdown, even though the City has not installed a dam or water control device in the shallow end of the pool. Two modifications of Barton Springs Pool made by the City in compliance with measures 6.1.4 and 6.1.7 of this HCP obviate the necessity for a minimum of four biologists to rescue stranded salamanders under most conditions. The substrate in the beach area was lowered in 1999 (measure 6.1.7), which ensures it is not exposed during full or partial drawdowns, and therefore, does not require visual inspection for stranded salamanders. The installation of adjustable gates (measure 6.1.4) in the downstream dam in 2000 provides precise control over the speed and extent of drawdowns. The City opens the gates slowly, allowing the water level to decrease gradually, giving salamanders more time to move with the water. Use of the downstream gates is precise enough to expose only the shallowest end of the pool (Fig. 1), allowing pool staff to thoroughly clean the concrete and remove most of the algae and debris. Moreover, only two stranded salamanders were found during these slow, partial drawdowns (Table 1).

Figure 1. Shallow End of Barton Springs Pool - Partial Drawdown May 2003



Table 1. Listed below are the details of the full and partial drawdowns conducted at Barton Springs Pool during 2003 and 2004. BSP denotes Barton Springs Pool, Eliza denotes Eliza Spring. Edwards Aquifer discharge data from the U.S.G.S. are listed in cubic feet/second.

Date	Site	Drawdown Extent	Aquifer Discharge (cfs)	Number Stranded	Number Re-located	Number Collected Live	No. Died
2/15/03	BSP	Full	109	7	7	0	0
5/8/03	BSP	Partial	102	0	0	0	0
6/19/03	BSP	Partial	96	0	0	0	0
7/17/03	BSP	Partial	89	1	0	1	0
09/24/03	BSP	Full	68	5	3	0	2
3/3-3/8/04	BSP	Full	43	1	1	0	0
4/29/04	BSP	Partial	60	1	1	0	0
7/22/04	BSP	Partial	98	0	0	0	0
7/8/04	BSP	Full	94	0	0	0	0
7/29/04	BSP	Partial	97	0	0	0	0
10/28/04	BSP	Partial	70	0	0	0	0
9/24/03	Eliza	Full	68	47	44	2	1

The City also developed a more effective method of preventing water outflow from Eliza Spring (Fig. 2A); the water is retained in the pool during partial and full drawdowns at discharge levels as low as 43 cubic feet/second (cfs) if the water level in Barton Springs Pool is allowed to decrease gradually (Fig. 2B). As a result of the drawdown and outflow modifications, the installation of a water control device in the shallow end of Barton Springs Pool would provide little or no benefit for the salamanders, and four biologists are no longer necessary for partial and

gradual, full drawdowns. The City will request an amendment to this measure to clarify the conditions that require more than two biologists.

Figure 2: Eliza Spring During Partial Drawdown April 2004

A) Blocked Grate



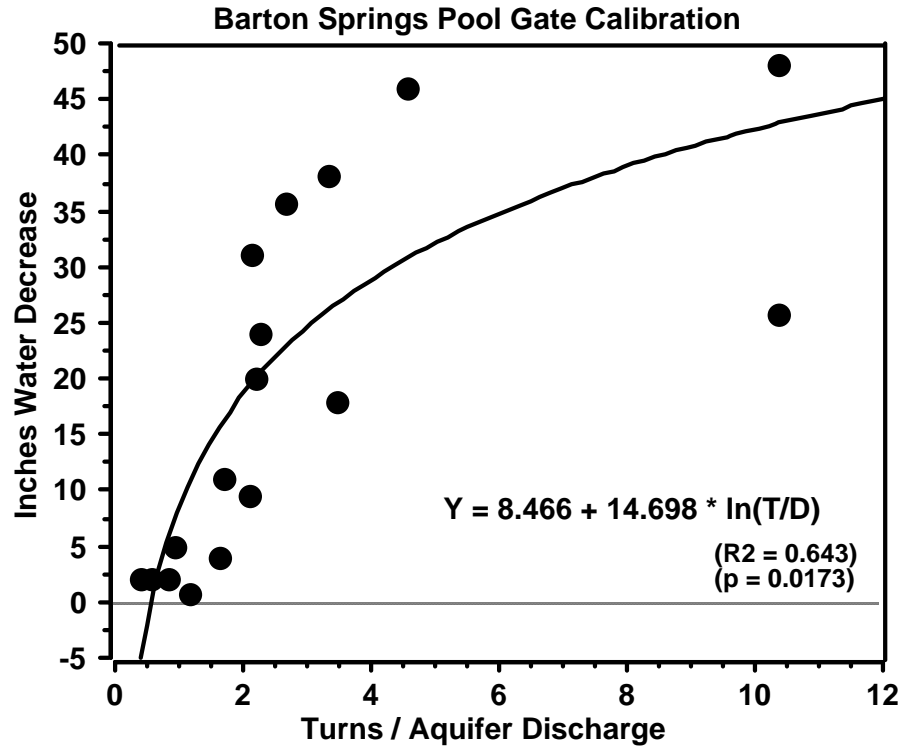
B) Water Level



6.1.4 The City of Austin will modify the existing gate system for the drawdown of the pool. The new gate system will be designed to control the rate of drawdown and the level of water in the pool. The current system is an all or nothing approach that does not allow control or manipulation of the drawdown process, which is most critical during low aquifer conditions. The new gate system will be in place within six month of the issuance of this permit. If low aquifer conditions (flows less than 54 cubic feet per second) occur during this one-year period, the City of Austin will modify or suspend pool maintenance procedures (in consultation with the Service), to minimize and mitigate incidental take of salamanders.

The City is in compliance. The City completed the installation of adjustable gates in 1999. City salamander and pool staff collected data on the amount the gates must be opened to achieve controlled, precise partial drawdowns of the water level in Barton Springs Pool. Logarithmic regression analysis of these data (Fig. 3) produced an equation that can be used to predict how many turns the gates must be opened to draw down the water level a specific amount, given the amount of aquifer discharge. The City will continue to collect similar data during future drawdowns to further refine this equation.

Figure 3. Graph of Partial Drawdown Data with Regression Equation



The following equation can be used to estimate the total number of turns of dam gate screws required to lower the water level in the pool the desired amount given a particular amount of aquifer discharge. For example, if aquifer discharge, D, is 78 cfs and the City wants to lower the water level 18 inches, Y, these values would be substituted into the equation below and it would be solved for T.

$$\begin{aligned}
 Y &= 8.466 + 14.698 \times \ln(T/78) \\
 18 &= 8.466 + 14.698 \times \ln(T/78) \\
 (18 - 8.466) / 14.698 &= \ln(T/78) \\
 0.649 &= \ln(T/78) \\
 e^{(0.649)} &= e^{\ln(T/78)} & e &= 2.718 \\
 2.718^{(0.649)} &= T/78 \\
 2.718^{(0.649)} \times 78 &= T \\
 1.913 \times 78 &= T \\
 T &= 149.2 \text{ turns}
 \end{aligned}$$

The answer is 149 total turns. Since there are four gates, that equals 37.25 turns per gate. To prevent dropping the water level too much, each gate would initially be opened 30 turns (4 gates x 30 turns = 120 turns). The water level would be adjusted further by opening or closing the gates in five-turn increments.

6.1.5 The City of Austin will install a pump system to provide spring water for pool maintenance. The pump system will also provide spring water for the fissures areas during pool drawdown. The pump would use spring water from the main pool. This measure will be in place within six months of issuance.

The City is in compliance. The permanent pump is used to clean salamander habitat on the beach and provide spring water to Eliza Spring if necessary. The permanent pump system installed on the downstream dam is not powerful enough to propel water upstream to the fissures. Instead, City biologists use portable, electric, submersible pumps to re-circulate spring water from the main spring outlets to the fissures during drawdowns. These portable pumps are also used to pump spring water into tanks for transport to the captive breeding facility.

6.1.6 The City of Austin will clean the shallow end of Barton Springs Pool without drawdown of the entire pool. One option is to install a water control structure between the shallow and deep ends of the pool to create a permanent barrier between the cleaning operations and the main salamander habitat. The purpose of this water control structure is to eliminate the drawdown of the deep end during routine cleaning of the shallow end. This measure will be in place within six months of permit issuance. If the installation of the water control structure is not completed within the six-month deadline due to construction delays or adverse weather conditions, the City of Austin will modify or suspend pool maintenance procedures (in consultation with the Service), to minimize and mitigate incidental take of salamanders.

The City is in compliance. The adjustable gates in the downstream dam allow the City to regularly clean the shallow end of the pool without a full drawdown of water level (see 6.1.3 – 6.1.5). Hence, an additional water control device or dam is unnecessary to accomplish the main goal of this measure. The City will request an amendment to this measure to eliminate the water barrier stipulation.

6.1.7 The City of Austin will modify the beach areas in Barton Springs Pool. Portions of the beach areas will be replaced with walkways and wading areas made of exposed aggregate concrete, limestone or other hardened surface. The remaining beach area will be lowered to a minimum depth of 2 meters (6.5 ft.) and additional salamander habitat will be created to mitigate for any loss of habitat. This measure will be in place within six months of permit issuance.

The City is in compliance. The City modified the beach by lowering it in 1999.

a) The City may clean the walkway on an as needed basis (~ 1 per week) using pressure washers (underwater) or other agreed to means.

On February 22, 1999, the City was granted permission by William Seawell and David C. Frederick of the U.S. Fish and Wildlife Service to forego construction of the walkways. The City will request an amendment to delete this measure since it is no longer relevant.

b) The salamander habitat would be cleaned using only low-pressure hoses or other agreed to means. This cleaning would be done quarterly or as needed to keep the upper 2-3 inches of habitat from becoming embedded with sediment.

The City is in compliance. Cleaning methods used are only those agreed upon and cleaning in Barton Springs Pool is done quarterly. However, limitations in staffing prevent the City from keeping the upper 2-3 inches of all salamander habitat free of sediment 100% of the time.

c) The City of Austin will maintain 11,000 square feet of “beach habitat” for the salamander. Gravel or cobble of appropriate size will be used to replace sections of the habitat that get washed out.

The City is in compliance. Replacement material has not been necessary to date.

d) The City of Austin will clean non-salamander habitat areas in the deep end of the pool quarterly or as needed using a combination of high-pressure hoses and a vacuum system.

The City is in compliance.

6.1.8 The City of Austin will not drawdown the deep end of the pool if flow in the aquifer is lower than 54 cfs. This measure will minimize the impact of low aquifer levels at the adjacent spring sites, as well as conserve water in the aquifer during low flow conditions.

The City is in compliance.

6.1.9 The City of Austin will place thin limestone slabs over fissures in the shallow section of the fissures area to minimize impacts from recreational use.

The City is in compliance. Limestone slabs were placed over the fissures in 1999. Unfortunately, the condition of salamander habitat beneath them degraded and they were frequently removed or disturbed by swimmers. The slabs were subsequently removed. An amendment that deletes this measure will be requested.

6.1.10 The City of Austin will lower the water in the deep end of the pool, if necessary, for cleaning only with Service concurrence. The water in the deep end of the pool will not be lowered when the lowering would cause Eliza Spring to go dry. This measure will be in place after the water control structure is installed or an alternative is implemented.

The City is in compliance and has developed new procedures to enhance maintenance of the water level in Eliza Spring and to maintain water over the fissures (see 6.1.3 – 6.1.6).

6.1.11 The City of Austin will maintain water over the fissure area during pool drawdown in order to minimize stranding of salamanders. The ability to retain water over the fissures will be in place at the time of permit issuance. The City of Austin will clean the fissure area quarterly or as needed, using a combination of low-pressure hoses and wire hand brushes or other agreed to means. In addition, until the water control structure is in place or the beach area is lowered, the City of Austin will use a spring water sprinkler system to keep the beach area wet during drawdown.

The City is in compliance.

6.1.12 The City of Austin will control surface water runoff around Barton Springs Pool, Eliza Springs, Old Mill Springs, and Upper Barton Springs. During heavy rains, storm water runoff can carry sediment and potential pollutants directly into Barton Springs, Eliza Springs, Old Mill, and Upper Barton Springs. Plans and schedules for the improvements, approved by the Service, will be complete within one year of the issuance of this permit. All of this work will be completed within two years of permit issuance. The City will also install temporary silt and erosion control measures in order to minimize adverse impacts due to surface water runoff. These measures will be in place upon issuance of the permit.

The City is in compliance at the three perennial spring sites. Control of runoff around Barton Springs Pool is provided by a series of improvements in storm water drainage from

Barton Hills Drive and Robert E. Lee Road were completed in 2001 and include, storm drain pipe replacement, new retaining walls, flood flow diversion berms and headwalls. In 2002, berms were constructed around the south parking lot of Zilker Park and the associated drainage slopes were stabilized with landscaping.

Improvements in runoff control delineated in the Habitat Management Plan for Eliza Spring were completed in July 2004. These include the addition of a second runoff protection berm (Fig. 4A) and reconstruction of the drainage swale leading to a nearby storm sewer (Fig. 4B).

Figure 4. New Runoff Protection Berm Around Eliza Spring

A) Protective Berm at Base of Fence



B) Reconstructed Swale



Runoff control at Zenobia Spring is provided by the stone walls of the amphitheater structure.

Runoff control at Upper Barton Spring is not feasible at this time. Upper Barton Spring discharge is related to water levels in the aquifer and thus discharge from Barton Springs. This spring is completely dry when combined spring discharge drops below 40 cubic feet per second. Tracing data indicate that the area contributing water to this spring is heavily urbanized. This area is defined as roughly north of Slaughter Lane between FM 1826 and Manchaca Road and south of Williamson Creek to Texas Highway Loop One, and then narrowing northward to the springs. The heavily urbanized springshed accounts for the documented higher concentrations of many water quality constituents and presence of multiple pesticides. Staff of the City and U.S.G.S., have been collecting, and will continue to collect data on these variables and re-evaluate the potential threats and necessity of runoff control as new patterns emerge.

6.1.13 The City of Austin will modify Old Mill Spring (Sunken Garden) to restore the natural surface spring flow into Barton Creek. The pipe that currently drains the spring will be capped. This improvement will be in place within one year of issuance of this permit.

The City is in compliance. The pipe was capped in 2000 and the City restored the streambed leading from Zenobia Spring to Barton Creek in 2004 (Fig. 5A). The City also constructed a waterfall that, under most conditions, acts as a barrier to invasion of non-native predatory fish into the spring (Fig. 5B).

Figure 5. Restoration of Stream From Zenobia Spring to Barton Creek

A) Streambed Restoration



B) Waterfall Fish Barrier



6.1.14 The City of Austin will improve the efficiency of the Barton Creek bypass. As currently designed, the cleaning grate at the upstream end of the bypass quickly becomes clogged during storms. The clogging of the grate decreases the efficiency of the bypass and increases the frequency of floods that affect Barton Springs Pool. A more efficient system will be in place within one year of issuance of this permit.

The City is in compliance. Minor modifications to the grate have been made, however, additional improvements to the bypass are planned for the future.

6.1.15 The City of Austin will implement a program to increase public awareness and community support for the salamander and the Barton Springs portion of the Edwards Aquifer. The SPLASH! Exhibit at Barton Springs Pool will be a major focus of this effort.

The City is in compliance. Nearly 100,000 people of all ages have been introduced to the hydrology and biology of the springs in central Texas by SPLASH! Into The Aquifer, Earth Camp, and Salamander Conservation Program staff. The SPLASH! exhibit is open to the public, free of charge, and over 93,000 people in the last year visited the interactive displays and aquaria that contain live, native species, watched the film describing the geological history of the aquifer, and played the karst ecosystem computer games. In addition, SPLASH! staff have developed a variety of structured educational programs for children and teachers, including Make a Splash

Day, Deep Down Underground, Water Exploration Day, Mother Earth at the Springs, Project Aquatic WILD, Project Aquatic WET, and Capital Area Master Naturalist training. Over 4,600 children and adults participated in these programs during the last year. The exhibit also sponsors a lecture series and provides outreach booths at other events such as the Western Karst Preserve Day. In addition, Earth Camp has led several hundred children on aquatic ecosystem tours of Barton Springs. Finally, City scientists have conducted several outdoor seminars attended by groups of scientists from the Society of Environmental Toxicology and Chemistry and the U.S.G.S.

6.1.16 Access to Eliza Spring and Old Mill Spring (Sunken Garden) will be restricted to ensure no disturbance of salamander habitat at these spring areas. These sites will be used as outdoor educational facilities for the study of the biology and ecology of Central Texas springs. These measures will be in place within one year of permit issuance.

The City is in compliance. The City restricted access to Eliza and Zenobia springs in 1999. During 2003 and 2004 Eliza Spring has been used for numerous educational events coordinated by SPLASH! Into The Aquifer and Earth Camp staff.

6.1.17 Educational signs (kiosks) will be installed to enhance public awareness of the salamander and aquifer. Outdoor educational displays will highlight the biology and ecology of the Central Texas springs with emphasis on the Barton Springs Salamander. These measures will be in place within one year of permit issuance.

The City is in compliance. Signs outside of Barton Springs Pool have been in place since 1999. Additional educational signs have been erected at Eliza and Zenobia springs describing the salamanders, their habitat, and the history of the structures. City of Austin salamander biologists have been working with the Austin Nature and Science Center to draft an interpretive plan for educational displays associated with the new captive breeding facility, which is currently under construction (see Measure 6.1.41). The interpretive plan emphasizes the importance of Austin's aquatic salamanders, their biology, and threats. (A copy of the plan is available upon request.) The interpretive plan will be implemented after facility construction has been completed and funds become available.

6.1.18 The City of Austin will set up a fund for conservation and research efforts for the Barton Springs salamander. The City will deposit \$45,000 annually (for the term of the permit) into this fund from the revenues generated by Barton Springs Pool. This fund will also be open to donations from any group or private individual. A committee of technical representatives will decide the allocation of money from this fund. At a minimum, the committee will consist of one technical representative from the City and one technical representative from the Service. These technical representatives must be experienced in salamander biology. Other committee members could include State, County, University, or other qualified biologists and karst aquifer hydrogeologists and swimmer/stakeholder representatives. The City and the Service would retain veto power in deciding how the money is allocated. The funds will be used for study of salamander biology, captive breeding and refugia, watershed related research, improved pool cleaning techniques, education, and/or land acquisition. The committee will decide how the money will best be spent. The funding will be in place within six months of permit issuance.

The City is in compliance. In August 2002, the City Council approved a resolution to authorize negotiation and execution of an agreement with Austin Community Foundation (ACF) and the U.S. Fish and Wildlife Service. The City Council also authorized an ordinance

amendment to appropriate funds for the ACF to manage the Barton Springs Salamander Conservation Fund on behalf of the City of Austin and in coordination with the U. S. Fish and Wildlife Service.

An agreement for fund management was finalized and signed by the City, the ACF, and the U.S. Fish and Wildlife Service in November of 2003. City of Austin biologists and ACF staff developed procedures for submission, review, and disbursement of conservation funds in December of 2003. Project proposals will be reviewed by City and U.S. Fish and Wildlife Service biologists, and independent peer reviewers using a review form developed by City biologists. Information on the Salamander Conservation Fund, grant proposal guidelines, grant review procedures, and high priority research were posted on the City and ACF websites in March 2004 (<http://www.austincommunityfoundation.org/?nd=home4>).

6.1.19 The City of Austin will deposit \$10,000 (in addition to the \$45,000 mentioned above) into the conservation fund. This will mitigate for the incidental take that occurred as a result of cleaning the pool and operation from May 30, 1997 (listing effective date) to the date the permit is issued. The fund will be set up and the money deposited within 6 months of permit issuance.

The City is in compliance.

6.1.20 The City will prohibit the use of high-pressure hoses in salamander habitat.

The City is in compliance. The City will request an amendment that clarifies the intent of this measure, *i.e.*, use of water at high pressure should be prohibited, rather than the type of hose.

6.1.21 The City of Austin may remove woody debris by any methods approved by the Service. All debris will be visually inspected for salamanders before and after removal.

The City is in compliance.

6.1.22 In the event of a flash flood or potential flash flood, it is necessary to prepare Barton Springs Pool area to limit damage. To prepare for such an event, section of fence, trashcans, railings and other items are moved to higher ground. The endangered species biologist for the City of Austin will be notified before Barton Springs Pool is lowered. Barton Springs will not be lowered if flow is lower than 54 cfs or if the City of Austin endangered species biologist indicates that Barton Springs Pool should not be lowered.

The City is in compliance. Barton Springs Pool was prepared for two floods in June and July of 2004. In both cases, aquifer discharge was greater than 54 cfs and the dam gates were opened.

6.1.23 The City of Austin may clean sediment and debris from the adjacent spring sites using low-pressure hoses or other agreed to means on an as needed basis.

The City is in compliance.

6.1.24. The City of Austin will not allow the introduction of exotic plants or animals in any springs in Zilker Park.

The City is in compliance.

6.1.25. The City of Austin will not move salamanders between spring sites.

The City is in compliance.

6.1.26. The City of Austin may manually trim aquatic vegetation that reaches the surface of the water.

The City is in compliance.

6.1.27 The City of Austin will not allow unauthorized SCUBA in any springs in Zilker Park.

The City is in compliance.

6.1.28 The City of Austin will prohibit the deliberate disturbance of substrate in the primary salamander habitat. This measure will be effective upon the issuance of this permit.

The City is in compliance. A new sign has been posted on the lifeguard stand nearest the fissures in Barton Springs Pool, and lifeguards are reminded to enforce the prohibition.

6.1.29 Sediment and debris that is collected during routine cleaning of the pool will be removed from the pool and disposed of properly. This will be accomplished by pumping the material into a vacuum truck for disposal, irrigating the lawns or other agreed to means. The sediment and debris will not be dumped into Barton Creek as a means of disposal. This measure will be effective upon the issuance of this permit.

Irrigation of lawns on a weekly basis as a method of removal was abandoned in 2001 because the ground quickly became saturated, and excess water and sediment re-entered the pool. Pumping the sediment and algae removed by underwater equipment into vacuum trucks is not feasible due to the high volume of water and the lack of suitable access for these trucks. Currently, during cleaning a high volume of water with entrained solids is discharged into deck drains on the north side of Barton Springs Pool, and then into Barton Creek. The City has not been able to develop other viable alternatives.

6.1.30 Since there is a seasonal rate of turnover in the staff involved in the pool cleaning process, the City of Austin will have professional supervisors direct and document all cleaning procedures at the pool. This measure will be in place upon the issuance of this permit.

The City is in compliance. Pool management and salamander biologists supervise cleaning activities at the pool.

6.1.31 The City of Austin will ensure that all people working at the pool lifeguards and other staff) are knowledgeable about the salamander. Yearly training will be given to teach staff about the salamanders and the ecology of the Edwards Aquifer springs. This measure will be in place upon the issuance of this permit.

The City exceeds the compliance required by this measure by training pool staff twice annually. The City is also finalizing a written manual to be kept at the pool for reference.

6.1.32 The City of Austin will ensure that all people surveying for salamanders are properly trained. The survey work should be done under the terms and conditions of a current scientific permit issued to the City of Austin. This measure will be in place upon the issuance of this permit.

The City is in compliance; the conditions of the permits are adhered to strictly.

6.1.33 The City of Austin will provide yearly spill and response training for all staff that perform maintenance activities in and around the springs in Zilker Park. The annual training will address spill and response protocols, proper containment techniques, and remediation. An annual inventory of necessary containment and remediation equipment will be conducted during the training session, and after the use of the equipment in response to any spill. This measure will be in effect upon the issuance of this permit.

The City is in full compliance. City staff is composing a reference document delineating response activities for minor spills that are not likely to cause the extirpation of Barton Springs and Austin blind salamander populations. Copies of this document will be kept in the Maintenance and Barton Springs Pool offices so that they are readily available to staff.

6.1.34 Specific areas will be designated for the fueling and maintenance of equipment and vehicles used in maintaining the spring and areas around the springs. These areas should be selected away from the springs to avoid the chance of impacts to the spring habitats. Absorbent pads will be used during all operation, fueling, and maintenance activities. This measure will be in effect upon issuance of this permit.

The City is in compliance. Large cleaning equipment that requires fuel is filled at the maintenance compound several hundred feet from the nearest spring site. Pressure washers for the pool are fueled inside a room physically separated from pool water, one hundred feet from the edge of the pool.

6.1.35 The City, with concurrence of the Service, will develop a policy for silt and gravel removal in the deep end of the pool. In the past, removal in the deep end has been necessary after the pool has been flooded by Barton Creek, but the City does not have a policy that outlines when and how the removal of material should occur. The take estimate may change due to this policy but would probably be a minor amendment to the HCP. The new policy will be in place within one year of the issuance of this permit.

The City is in compliance. The City has in place a general policy for silt and gravel removal. Development of a more specific policy is in progress with the goal of removing undesirable silt while reducing the potential for incidental take of salamanders. The City does not anticipate any changes in the HCP will be necessary as a result of this policy.

6.1.36 The City of Austin will, in concurrence with the Service, develop a catastrophic spill response plan for Barton Springs. The new plan will be in place within one year of the implementation of this permit. This plan will address spill prevention, containment, remediation, and salamander rescue.

The City is in compliance. The City submitted a draft Catastrophic Spill Response Plan to the U.S. Fish and Wildlife Service for review and approval in November of 2001. The City is currently completing a draft of a more comprehensive Catastrophic Spill Response Plan for the Barton Springs watershed that includes methods for estimating spill volume thresholds that would result in threats to the salamanders, protocols for notification and coordination of response effort, and salamander rescue.

6.1.37 Structural and habitat restoration will occur at Eliza Spring and Old Mill Spring. Habitat restoration will include enhancement of bottom substrate with clean cobble and gravel, and the establishment of native species of aquatic plants. Care will be taken to ensure that non-native invertebrates are not introduced. Old Mill Spring enhancement will include the restoration of full surface flow to the stream. All restoration efforts will be

reviewed and approved by the Service before implementation. This work will be completed within two years of the issuance of this permit.

The City is in compliance. A summary and pictures of habitat restoration conducted in Eliza Spring are included in section C (pg. 19-20).

6.1.38 The City of Austin will continue to conduct monthly surveys at all spring sites, in compliance with Federal and State Scientific Monitoring Permits.

The City is in compliance with this measure. The three perennial spring sites (Eliza, Zenobia, Parthenia) are surveyed monthly, weather permitting. Upper Barton Spring is surveyed monthly whenever water is present.

6.1.39 The City of Austin will form an Advisory Committee of local and regional experts that will meet at least annually to discuss and refine pool maintenance activities. A variety of interests including swimmers, biology and hydrogeology will be represented on this committee. In addition, this committee will review this HCP and make suggestions for needed amendments as deemed necessary. The Advisory Committee will also be responsible for refining the habitat conservation plan through adaptive management. Data collected will be used to adapt management actions. The City of Austin will be responsible for implementation of adaptive management changes.

The City is in compliance. The 2003-2004 Advisory Committee includes a stream ecologist, a swimmer/physician, a hydrogeologist, a limnologist and a salamander biologist.

6.1.40 The City of Austin must reduce loadings of petroleum hydrocarbons, heavy metals and sediments to Barton Springs from current development and other activities located within the Barton Springs Zone, within the City limits, and subject to the City's jurisdiction. This reduction in loadings will be achieved through the measures set out in the NPDES storm water permit and its reasonable and prudent measures listed in Appendix A of the EA/HCP.

The City is in compliance. This includes compliance with the reasonable and prudent measures incorporated into the area-specific storm water management program included in the City's NPDES MS4 storm water permit. The City reported annually to the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service on the area-specific compliance activities completed throughout the five-year permit term (1998 – 2003). Most notably, the source of PAH (polycyclic aromatic hydrocarbon) contamination in the pool and upstream in Barton Creek has been identified. Public information to minimize the source (coal-tar pavement sealers) has been disseminated; City staff are evaluating regulatory control strategies.

6.1.41 The City of Austin will maintain a viable captive breeding population of Barton Springs salamanders. The City will designate a staff biologist and dedicate a minimum of \$20,000 annually to the development and maintenance of this program. The purpose of this program is to provide a contingency plan for the species if a catastrophic event were to occur. Funding and design of the new program will be in place within six months of the issuance of this permit.

The City is in compliance, and a summary of progress in this program is presented below.

Salamander Breeding Program Summary

The City's salamander captive breeding program currently supports approximately 150 salamanders, including 130 Barton Springs salamanders (*Eurycea sosorum*) and 20 Austin blind salamanders (*Eurycea waterlooensis*). Highlights of 2003 and 2004 include the planning and early construction phases of a permanent home for the program, moving the program to a new temporary location, 22 egg-laying events (including the first by an Austin blind salamander), and the development of a "marking" technique using photographs that can be utilized to learn about individuals and populations in captivity as well as the wild.



In early 2003, the salamander captive breeding program reached its maximum capacity at the University of Texas campus and City biologists searched for a new suitable location to house the program. In summer 2003, City of Austin Building Services offered temporary space, and captive breeding staff moved the program to that facility located on Chicon Street.

The Chicon location has provided the opportunity to expand the program. This expansion included setting up additional breeding tanks as well as space to house eggs and juveniles separate from adults. Although this location has provided room to expand to some extent, it is temporary and may not provide adequate space in the future. Additional space is essential; preliminary data indicate that growth and maturity of juveniles may be delayed when they are housed in small tanks. The numerous egg-laying events as well the need to collect animals in the event of a catastrophic spill underscores the necessity to continue to expand. In addition, City staff will add the Jollyville Plateau salamander, *Eurycea tonkawae*, to the captive breeding program in 2005. While moving the program has proven to be beneficial, it has been time-consuming and delayed rapid progress toward the goals of breeding and gaining new information about the salamanders. Thus, a larger, permanent facility is needed to provide adequate space to support viable captive populations of each salamander species, and to conduct additional research to better understand the needs of each species.

In 2003 and 2004, City staff worked with an architectural and engineering firm (Martinez, Wright, and Mendez) and City of Austin Parks and Recreation Department staff to design and build a new facility at the Austin Nature and Science Center. The Austin Nature and Science Center provides a groundwater source and public outreach opportunities. In addition, captive breeding biologists have been designing tank and monitoring systems for the new facility as well as purchasing the necessary equipment to outfit the facility. This includes emergency contingency plans for system failures. Finally, Building Services staff at Chicon has provided critical expertise in designing and meeting the HVAC (Heating Ventilation Air Conditioning), electrical, and security needs at the new facility.

In 2003, breeding tanks were established that included diverse habitat and simulate aquifer, spring, and spring run conditions. However, the salamanders' diet was changed; use of commercially obtained blackworms (*Lumbriculus variegatus*) was discontinued. Invertebrates (mostly amphipods and ostracods) collected from the springs were fed to the salamanders

throughout 2003 but maintaining enough food for the entire salamander population in captivity without the blackworms proved difficult. In December 2003, frozen chironomids (fortified with vitamins) were added to the salamanders' diet. Soon after being placed on the new diet, the salamanders appeared healthy and robust and many females quickly developed eggs. In addition, captive breeding biologists have been collecting data on the salamander's diet in the wild by examining fecal pellets from newly collected salamanders. The diet of wild salamanders includes chironomids but data indicate that their diet is dominated by freshwater crustaceans. Freshwater crustaceans are fed to young juvenile salamanders in captivity and also used to supplement the diet of the adult salamanders.

Staff biologists continue to document salamander behavior using video and photography. City of Austin biologists have developed a pattern recognition technique to recognize individual salamanders by photographing unique patterns on the head and body. This provides researchers with the opportunity to track individual behaviors, including egg-laying and courtship. City biologists are applying this same technique to wild populations where individuals also appear to have unique markings. Staff biologists plan to confirm the stability and reliability of the markings on wild animals by supplementing photographs with elastomer marking. A mark-recapture program will provide better population estimates and allow wild individuals to be tracked through space and time.

The captive breeding program continues to play a role at the springs. Staff collected and attempted to rehabilitate three salamanders with gas bubble trauma found at Upper Barton Spring in early 2003 and one in September 2004. The three salamanders found in 2003 died and were sent to a pathologist at Texas A&M University along with several fish that exhibited health problems. The pathologist confirmed gas bubble trauma in the salamanders as well as the fish. The salamander found with gas bubble trauma in 2004 recovered and is now part of the captive breeding program.

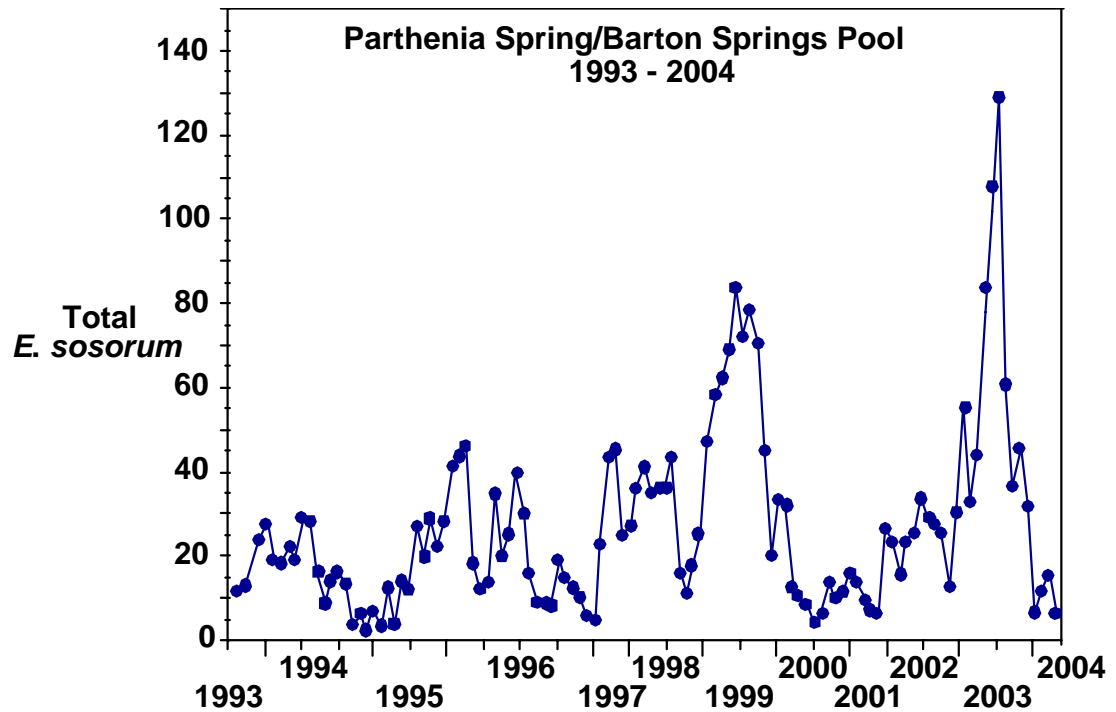
In addition, salamanders are on display at the Splash! Into the Edwards Aquifer Educational Exhibit, which provides public educational opportunities. Captive breeding biologists work with Austin Nature and Science Center staff that direct and maintain the exhibit.

B. SALAMANDER ABUNDANCE

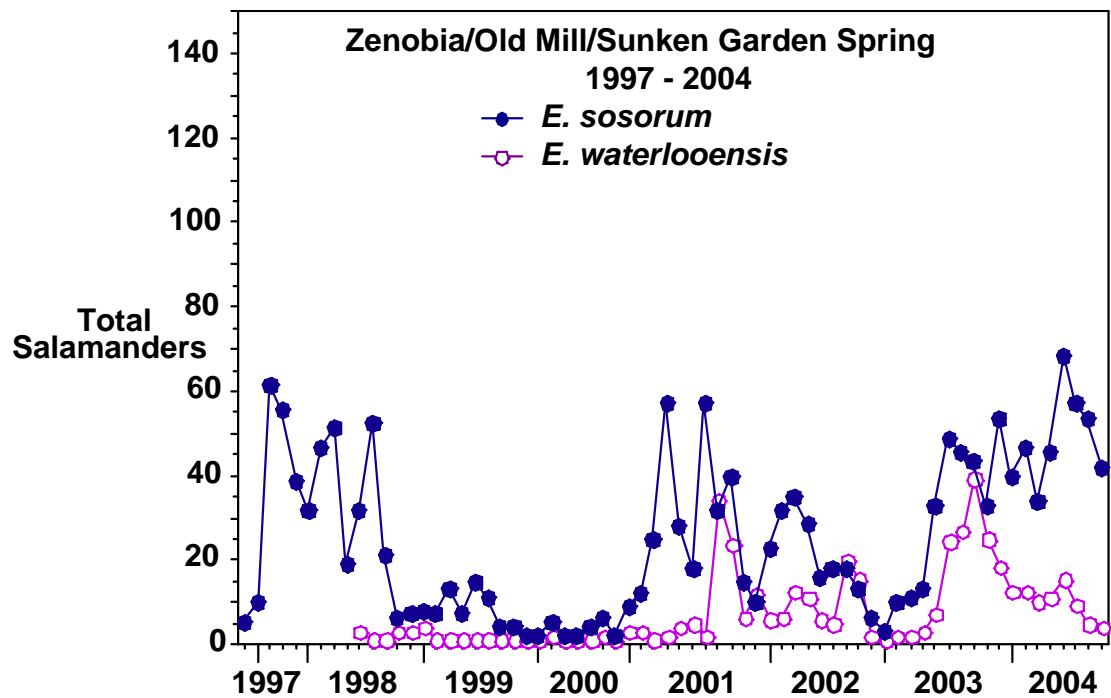
Depicted below are the abundances of *E. sosorum* and *E. waterlooensis* salamanders in all four springs. Note the large increase in abundance in Eliza Spring after habitat restoration in 2003.

Figure 3. Salamander Abundance

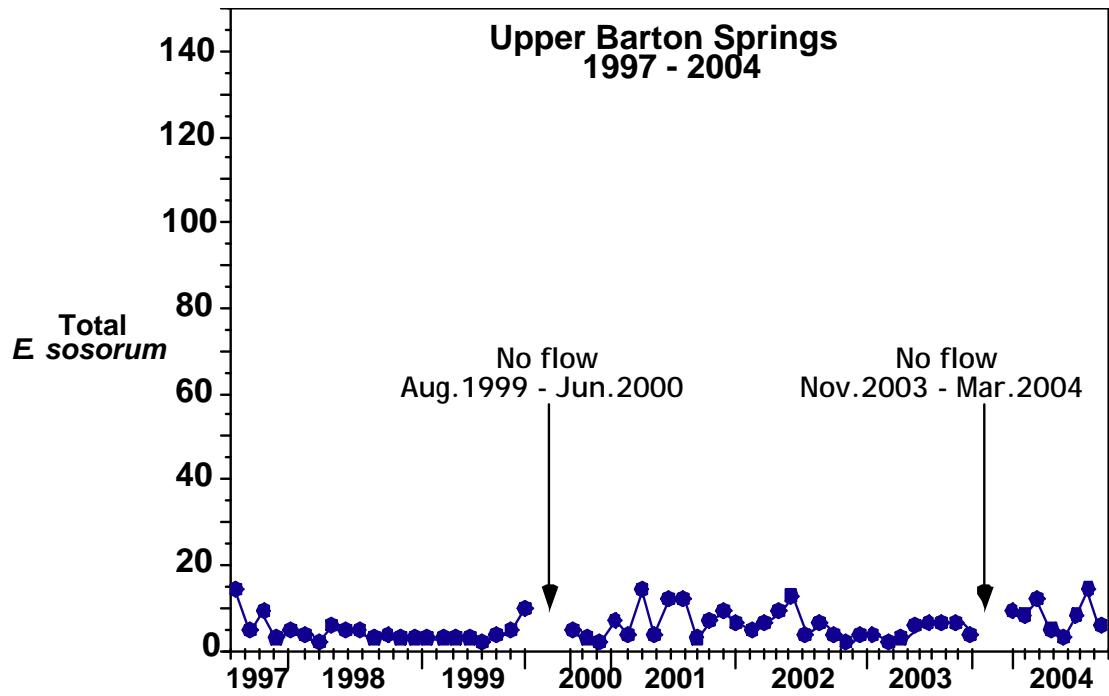
A)



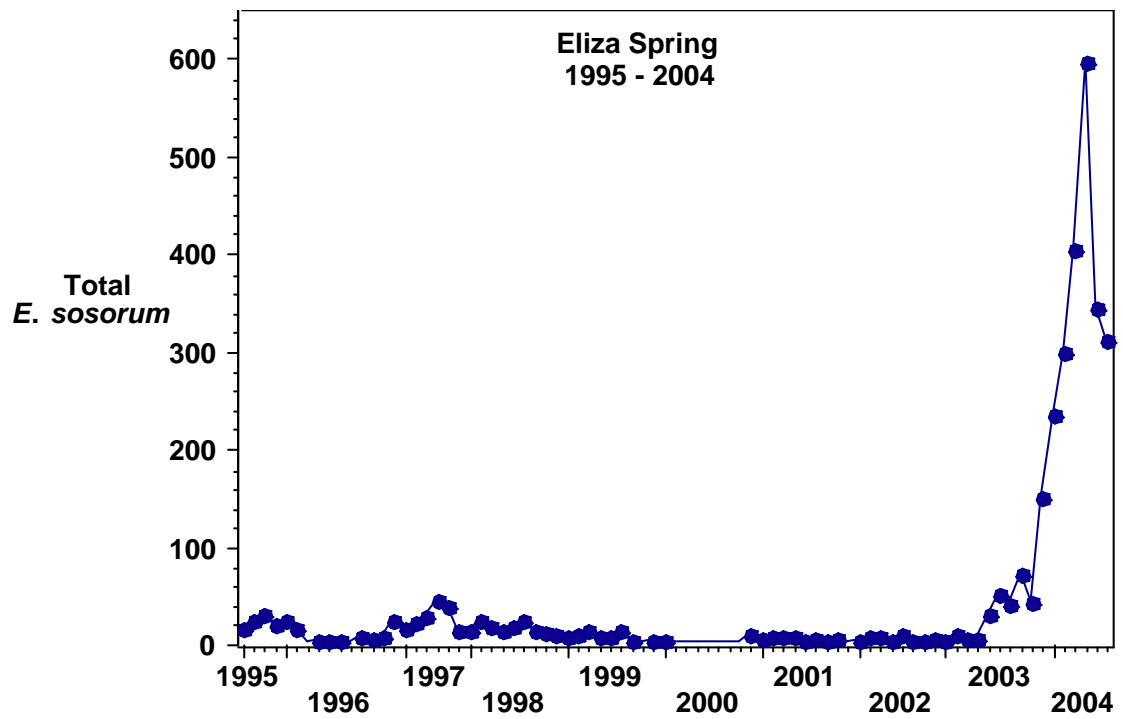
B)



C)



D)



C. HABITAT MANAGEMENT AND RESTORATION ACTIVITIES

In 2003, a detailed Habitat Management Plan for Eliza Spring was developed that outlines problems to be addressed, potential solutions, risk of incidental take of salamanders, potential beneficial impact on salamanders, feasibility, cost of implementation, and time frame. Several of the proposed restoration activities were implemented in 2003 and 2004. A summary of these activities and the resulting changes in salamander abundance and ecosystem character are described below. These results are being used to develop similar plans for Zenobia, Upper Barton, and Parthenia springs (The entire Eliza Spring Habitat Management Plan is available upon request from Dr. Laurie Dries, 974-6340.)

Eliza Spring Background

Eliza Spring is a natural spring water outlet of the Barton Springs segment of the Edwards Aquifer. Historical photographs suggest the natural terrain of this spring was a deep depression in the earth with numerous upwellings and overland stream flow to Barton Creek. The historical ecology of the site was likely similar to other cold, constant temperature springs and streams in other areas of the Edwards Aquifer Plateau. In 1917, human alteration of the spring site began with the construction of the Eliza Spring Amphitheater around the spring pool. Andrew Zilker built the amphitheater to serve as a naturally cool meeting place for the Elks Club and the community. The amphitheater is a series of 5 concentric incomplete oval benches around the spring pool, enclosed within a wall. The spring pool and stream outflow were largely unaltered. Sometime prior to the late 1970s, aggregate concrete was poured over the natural substrate to form an artificial bottom within the amphitheater that contains circular holes, which direct spring water to the surface. At this time the overland stream was eliminated and outflow water was diverted into an underground concrete pipe that carries water into the Barton Creek Bypass tunnel and on into Barton Creek downstream of Barton Springs Pool.

In the last few decades, the ecological character of Eliza Spring changed from a spring fed stream to a pond. Directional flow was reduced, native plants and fauna disappeared, and sediment began to accumulate. As sediment depth increased, entrained oxygen decreased until there was a drastic loss of aerobic life in the benthic environment. The invertebrates that live on and in the sediment are either food for salamanders, or food for salamander prey. The aquatic fauna became dominated by species tolerant of degraded habitats (e.g., crayfish: *Procambarus clarkii*, mosquitofish: *Gambusia affinis*, *Oscillatoria* algae)(Fig. 4).

Figure 4. Salamander Habitat in Eliza Spring, July 2001, Before Restoration



These changes in the sediment quality and aquatic environment were concomitant with severe decreases in salamander abundance. Historic salamander abundance is largely undocumented, but there are numerous anecdotal recollections of “hundreds” of salamanders several decades ago. From 1989 to 1992 very few salamanders were found during population

surveys (one or two; Chippindale et al 1993). Subsequent surveys of salamander abundance by the City of Austin documented less than 20 salamanders per month on average from 1995 – 1998, and less than 10 from 1999 until late 2003. The highest number of salamanders found in the last decade was during a drawdown of Barton Springs Pool in 1997, when 188 salamanders in Eliza Spring were stranded by the receding water. In 2003, implementation of the restoration activities listed in the Eliza Spring Habitat Management Plan resulted in an increase in salamander abundance in this site. Restoration focused on enhancement of directional flow, reduction of sediment depth, addition of native plants, a return to a more natural shallow water depth, and relocation of problematic native species (crayfish, *Procambarus clarkii*, and mosquitofish, *Gambusia affinis*). These changes improved the habitat in the spring pool (Fig.5) and the community of aquatic organisms has begun to recover. After the initial dramatic increase in salamander abundance (Fig. 3D), the population appears to be approaching a stable size of 200-400 salamanders. There are still improvements to be made to this site to promote further stability of salamander abundance and ecological diversity of the habitat, but this initial success suggests that endangered salamanders have benefited from the restoration effort.

Figure 5. Salamander Habitat in Eliza Spring, January 2004, After Restoration

