



City of Austin

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Watershed Protection Department
P.O. Box 1088. Austin. Texas 78767

December 13, 2013

Ms. Vanessa Martinez
U.S. Fish and Wildlife Service
Ecological Services
PO Box 1306
Albuquerque, New Mexico 87103
Ph: 505-248-6665
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Dear Ms. Martinez:

Enclosed is the City of Austin's 2013 annual report for the U.S. Fish and Wildlife Service 10(a)1(A) permit (TE-833851) covering activities affecting *Eurycea sosorum*, the Barton Springs Salamander.

Please do not hesitate to contact me should you require additional information at 512-974-2652, or Liza Colucci, Watershed Protection Department Environmental Scientist, at 512-974-2669.

Sincerely,

Mike Personett, Assistant Director
Watershed Protection Department

2013 Annual Report
U.S. Fish and Wildlife Service Scientific Permit (TE-833851)

Reporting period: December 2012- November 2013

This report documents the activities associated with the Barton Springs salamander (*Eurycea sosorum*) that are authorized under the above federal endangered species permit for the calendar year 2013.

TE-833851, Section V., Permit Condition 6: General Annual Reporting Requirements

1) Precise locations of previously undocumented surveyed areas

None. Locations of previously document survey sites are below.

Table 1. Barton Springs GPS location data (NAD 83) for Surveyed Salamander Sites

Spring Site	State83__x	State83__y
Parthenia Spring / Barton Springs Pool	3105363.0	10068908.0
Upper Barton Spring	3104572.8	10068901.0
Old Mill / Sunken Garden	3106373.7	10068939.4
Zenobia Spring		
Eliza Spring	3105741.6	10069165.0

2) Dates of surveys conducted-see 4) below.

3a) Survey methods

Surveys of abundance of *Eurycea sosorum* (Barton Springs Salamander) and *Eurycea waterlooensis* (Austin Blind Salamander) will be conducted monthly throughout the year at the three perennial spring sites, Parthenia Spring (= Barton Springs Pool), Eliza Spring, and Zenobia Spring (=Old Mill= Sunken Garden). Monthly salamander surveys will be conducted at Upper Barton Spring whenever surface water is present. Surveys are conducted under all flow conditions; type of flow (base or storm) is noted. The time interval between surveys will be kept as close to 30 days as possible to facilitate time series analyses of the resulting data.

For each survey the date, weather, type of flow (base flow or storm flow) and aquifer discharge are recorded by the U.S. Geological Survey station at Barton Springs. Each site is divided into sections with ropes that contain marks at 5-foot intervals. The following data are collected in each section surveyed in all sites unless otherwise noted. Sediment and water depths are measured in five locations in each section at each site. Each section is searched by the drive survey method, which consists of a moving line from downstream do upstream. All substrate is searched for salamanders, rocks are removed and replaced behind the survey line, and aquatic macrophytes and bryophytes are searched without dislodgement. Every individual salamander found is identified to species and categorized by total length, <0.5", 1/2- 1", 1-1.5", 1.5- 2", 2". The total number of salamanders of each species and size class found in each section are recorded. Substrate under which each salamander is found is noted. Flow velocity at the substrate is measured in 1 – 15 locations within each spring site, except in Parthenia Spring. The water depth in Parthenia Spring is too deep to efficiently measure velocity at the substrate with Marsh-McBirney flow meters. Survey effort is quantified by the time spent searching for salamanders in each section. Dissolved gas composition is measured by saturometer and titration. Saturometer variables measured are barometric pressure (mmHg), water temperature

(°C), total gas pressure (mmHg), dissolved O₂ pressure, and used in automatic calculation of delta pressure (BP-TP), Total pressure-pressure O₂, percent total saturation, percent O₂ saturation. Dissolved CO₂ concentration is measured by titration. From these data, pressure and concentration of N₂ + Argon, and percent saturation of CO₂ and N₂ + Argon, are calculated.

Physical and biological characteristics of habitat are assessed in each section by visual observation. The goal of this approach is to obtain a rough estimate of relative changes in the environment, rather than precise measurements of each component. The physical habitat condition is characterized by the percent of transect area composed of bedrock, rocks (boulder+cobble+gravel), and concrete. The combination of percent sediment cover and average sediment depth provides a quantitative estimate of the embeddedness of the habitat. The percent volume of sand in sediment is also estimated to indicate character of sedimentary layer.

Biological habitat condition is represented by percentages of bryophytes, macrophytes, loosely attached nuisance algae (filamentous green algae and cyanobacteria), and tightly attached, periphytic algae with each type of alga noted. The relative abundance of adult (>1") and juvenile (<1") crayfish is rated according to the following scale: 1=low <20, 2=medium 21-50, 3=high ≥50. Abundance of amphipods is estimated to the nearest ten/square foot. Other fauna are noted as present or absent (water pennies (coleopterans), mayfly larvae (ephemeropterans), caddisfly larvae (trichopterans), midge and fly larvae (dipterans), damselflies, dragonflies (odonates), worms, planaria, leeches, snails and limpets (gastropods), and fishes).

Any injury or death of a salamander is noted. If a salamander is found dead, its body is preserved in 95-100% EtOH or DMSO salt solution for DNA analysis if possible. Other relevant observations are noted.

3b) Salamander collection methods

Salamanders are captured using small dipnets or net bags and placed into containers with clean groundwater and secure lids. During transport, water and temperature quality in containers with salamanders are monitored and maintained by small exchange with groundwater from containers without salamanders. Aeration and substrate are provided such that the salamander can place itself anywhere in the water column and off-gas, if necessary, in order to prevent accumulation of gas bubbles beneath the skin.

4) Survey results

The number of *E. sosorum* found in the Barton Springs complex during monthly surveys are presented in the table below.

Table 2. Barton Springs Salamander Abundance December 2012 -November 2013. Parthenia Spring is located within Barton Springs Pool. Old Mill Spring/Sunken Garden is represented by OMS/SG, and Upper Barton Spring, by UBS. Salamanders observed whose size was not estimated are listed under No Size and included in the total number. Upper Barton Spring was dry from November 2012 through October 2013.

Site	Date	Juveniles (<1"TL)	Young Adults (1-2" TL)	Adults (>2" TL)	No Size	Total
Eliza	11/15/12	41	72	34	2	149
Eliza	12/13/12	58	74	43	6	181
Eliza	1/10/13	96	136	62	5	299
Eliza	2/13/13	176	189	53	3	421
Eliza	3/14/13	122	265	38	3	428
Eliza	4/11/13	97	354	78	0	529
Eliza	5/9/13	62	353	93	3	511
Eliza	6/13/13	51	268	108	3	430
Eliza	7/11/13	48	201	43	8	300
Eliza	8/15/13	20	159	28	1	208
Eliza	9/12/13	11	89	40	5	145
Parthenia	11/29/12	9	9	2	0	20
Parthenia	12/27/12	41	37	4	1	83
Parthenia	1/24/13	22	39	0	0	61
Parthenia	2/28/13	21	39	3	1	64
Parthenia	3/28/13	38	78	4	0	120
Parthenia	4/25/13	17	20	0	0	37
Parthenia	5/23/13	26	23	2	0	51
Parthenia	6/27/13	7	4	0	0	11
Parthenia	7/25/13	9	10	2	1	22
Parthenia	9/26/13	8	14	0	0	22
OMS/SG	1/17/13	0	1	0	0	1
OMS/SG	3/21/13	0	0	3	0	3
OMS/SG	4/18/13	0	2	1	0	3
OMS/SG	5/16/13	0	2	1	0	3
OMS/SG	6/20/13	0	1	1	0	2
OMS/SG	7/18/13	0	2	1	0	3
OMS/SG	8/22/13	0	0	0	0	0
OMS/SG	11/14/13	0	0	0	0	0

5) Results of species identifications

No new animals found.

6) Number of salamanders collected from the wild

None.

7) Number of salamanders handled and marked with elastomers

None.

8) Observations of abnormal behavior or condition of salamanders handled/ marked;

None.

9) Results of any mark-recapture methods

During 2007 and early 2008, 48 *E. sosorum* in Upper Barton Spring were marked by City of Austin staff using fluorescent elastomers. All salamanders were given a batch mark, a single orange dot on the left dorsal area of the tail. No marked salamanders were observed in any spring site from December 2012 through November 2013

10) Results of genetic research conducted as a result of tail-clipping

None.

11) Results of any research of management activities authorized by this permit and approved through the submission of study plans to the CPI Branch of the Austin ESFO

a. City of Austin monitors water quality in the Barton Springs Complex under this permit to meet the requirements of the Habitat Conservation Plan contained in the USFWS IO(a)(1)(B) permit PRT-839031 and the Texas Pollutant Discharge Elimination System permit WQ0004705000 (EPA NPDES TXS000401). Permitted staff collect water samples from each perennial spring, and Upper Barton Spring when flowing (January 25 to October 22, 2012). Samples are analyzed for the following parameters at designated frequencies (Table 3). Biweekly tested parameters are total suspended solids, volatile suspended solids, NO₃+NO₂-N, NH₃-N, Ortho-P, chlorophyll-a, temperature, dissolved oxygen, pH, conductivity, and turbidity. Quarterly sampling includes biweekly parameters plus alkalinity, Ca, Na, K, Mg, Cl, SO₄, F, As, Cu, Fe, Pb, Ni, Zn. TPDES annual sampling includes all of the above plus Hardness, Ag, Cd, Cr, Hg, TOC, oil & grease, total polycyclic aromatic hydrocarbons, bromacil, organophosphate pesticides, chlorinated herbicides, volatiles, and semi-volatiles.

Table 3. Water Quality Sampling Dates. BSP refers to Barton Springs Pool (Parthenia Spring), OMS to Old Mill Spring (Sunken Garden/Zenobia), UBS to Upper Barton Spring. An asterisk (*) denotes scheduled future sampling.

<u>Date</u>	<u>Sampling Site</u>	<u>Frequency</u>
12/26/12	BSP	Biweekly
1/24/13	BSP	Biweekly
1/31/13	BSP	Biweekly
2/28/13	BSP	Biweekly
3/26/13	BSP, OMS, Eliza, UBS	Quarterly
5/9/13	BSP	Biweekly
5/23/13	BSP	Annually
6/6/13	BSP	Biweekly
6/26/13	BSP, OMS, Eliza	Quarterly
7/11/13	BSP	Biweekly
7/25/13	BSP	Biweekly
8/08/13	BSP	Biweekly
8/18/13	BSP, OMS, Eliza	Quarterly
9/19/13	BSP	Biweekly
10/10/13	BSP	Biweekly
10/24/13	BSP	Biweekly
11/20/13	BSP, OMS, Eliza	Quarterly

- b. U.S. Geological Survey deploys and maintains water quality sampling equipment in Parthenia Spring. Dates of service for this reporting period were 1/16/2013, 2/14/2013, 3/14/2013, 4/18/2013, 5/16/2013, 6/26/2013, 7/27/2013, 8/15/2013, 9/5/2013, 9/27/2013, 10/30/2013, 11/14/2013, and 12/19/2013*.
- c. City of Austin staff collect sediment samples for testing to meet requirements of the City's TPDES permit. These samples were collected 2/1/2013 and 8/12/2013.

TE-833851, Section V., Permit Condition 7: Captive Breeding Annual Reporting Requirements

1) Inventory of *Eurycea sosorum* held at the captive breeding facility (including the number of wild-caught and captive-bred individuals from each spring site collected)

Table 4. Inventory of salamanders in Captive Breeding Program.

Spring of Origin	No. Wild-Caught	No. Captive-Bred > 6 months of age	No. Captive-Raised < 6 months of age
Barton Springs Pool	15	53	20
Sunken Garden Spring	13	239	0
Eliza Spring	44	142	36
Upper Barton Spring	3	18	0
Salamanders from the Dallas Aquarium lineage* ¹	NA	6	0
Total	75	458	56

*¹ Founder salamanders for the Dallas Aquanum capttve populatton were collected from more than one spnng site (Barton Springs Pool and Sunken Gardens) and mixed together. The City of Austin has Fl 's from the Dallas Aquarium as well as their offspring; these animals have been used for educational purposes at the Splash! Into the Edwards Aquifer exhibit at Barton Springs in Zilker Park.

2) Number of Observations of Courtship Behavior, Spermatophores, Spermatophore Depositions, Sperm Transfers, and Ovipositions

In 2013, courtship behavior was observed in both wild-caught and captive-bred salamanders. In general, salamanders are not disturbed by City staff during courtship. Because the Barton Springs Salamander can store sperm, observed courtship behavior does not necessarily result in immediate egg-laying. Each oviposition with viable offspring represents at least one sperm transfer, and possibly multiple transfers. Oviposition data are presented with hatching data in Tables 5 and 6.

Table 5. Ovipositions in Captivity 12/1/12-11/1/13. Tank I.D. indicates spring site of origin, reproductive group, and wild-caught or captive-bred status. Individuals in reproductive groups are recorded in order to follow actual or potential dams and sires. BSP denotes groups from Parthenia Spring, E, groups from Eliza Spring, SG, groups from Sunken Garden/Old Mill Spring, UBS, groups from Upper Barton Spring, and F, captive-bred salamanders.

Oviposition Date	Tank ID	Clutch Size	No. Hatched
12/7/12	E2 (C37)	17	14
12/9/12	BSPF1 (Splash tank)	10	0
12/11/12	SG1F1 (C176)	13	12
12/13/12	E3F1 (C160)	10	9
12/14/12	E2F1 (C150)	22	15
12/14/12	SG2F1 (C82-2)	9	1
12/14/12	SG2F1 (C93)	17	6
12/18/12	E2F1 (C147)	25	18
12/18/12	SG1F1 (C52)	7	0
12/18/12	SG1F1 (C86#2)	10	5
12/18/12	E2F1 (C98)	11	3
12/28/12	SG2F1 (C159)	14	0
1/23/13	SG1F1 (C176)	20	15
1/27/13	SG2F1 (C182)	14	NA ^{*2}
1/24/13	E3 (C175)	9	0
2/13/13	SG1F2 (C184)	3	NA ^{*2}
2/19/13	BSP1 (C127)	22	9
2/26/13	SG2F1 (C159)	17	NA ^{*2}
3/6/13	BSPF1 (Splash tank)	15	1
3/7/13	SG1F1 (C176)	18	NA ^{*2}
4/11/13	UBSF1 (C95)	7	0
4/23/13	SG2F1 (C88)	17	NA ^{*2}
4/26/13	E3F1 (C160B)	8	0
5/8/13	BSP (C127)	23	16
5/8/13	E2F1 (C150)	13	8
5/12/13	SG2F1 (C182)	10	NA ^{*2}
5/15/13	SG1F1 (C99)	12	NA ^{*2}
5/23/13	BSPF1 (Splash tank)	10	1
5/28/13	SG1F2 (C87)	1	NA ^{*2}
6/1/13	E2 (C37)	11	10
6/3/13	SG2F2 (C152)	7	NA ^{*2}
8/14/13	E1 (C03C)	24	18
8/18/13	BSPF1 (Splash tank)	22	3
10/22/13	BSPF1 (Splash tank)	7	NA

^{*2} Some or all eggs of a clutch preserved to manage the population size and genetic diversity (prevent a disproportionate number of offspring produced from a single reproductive group, or to minimize inbreeding).

3) Information on Clutch Sizes (range, mean, and standard deviation) See Table 6 below.

4) Information on Hatching Success (range, mean, and standard deviation)

Table 6. Barton Springs Salamander - Clutch Size and Hatching Success – 12/1/12-11/1/13

	Range	Mean	Standard Deviation
Clutch size	1-25	13.4	6.1
No. Hatched	0-18	6.8	6.5
% Hatching	0-92	40.5	35.3

5) Salamander Mortalities (including age and cause of death, if known)

Table 7. Wild-Caught Barton Springs Salamander Mortalities 12/1/12–11/1/13

Age is estimated based on size at collection. Salamanders collected that are 1-2” are estimated to be 6 months to a year in age; salamanders that are collected at >2” in total length are assumed to be at least 1 year in age.

Spring Site of Origin	Age	Cause of Death (Health Conditions Observed)	# Mortalities
Eliza	~5-7	Unknown	6
Eliza	8-11	Senescence (scoliosis)	4
Barton Springs Pool	~8.5	Senescence	2
Sunken Gardens	~10.5	Senescence (edema)	1
UBS	~10.5, ~13, ~14	Senescence	3

Table 8. Captive-Raised (>6 months) Barton Springs Salamander Mortalities 12/1/12–11/1/13

Age Range (years)	0.5-1	1-3	3-5	5-7	7-9	9-11	11+
# Mortalities	1	1	2	1	0	0	1 ^{*3}

^{*3} 12 years in age, observed condition: edema.

6) Information on Obvious Health Conditions or Behavioral Aberrations

Staff continue to investigate a toe/foot loss condition that has occurred in the captive population and a report is currently being drafted.

7) Special Projects/Research Activities

a. Education/Outreach and Research

The Splash Into the Edwards Aquifer Educational Exhibit continues to provide public education regarding the Barton Springs Salamander. The captive breeding program provides support and salamanders for the public display tank at the Splash! Exhibit. In addition, in 2013, WPD and Splash! staff continued to participate in outreach opportunities by giving presentations to primary/secondary school and university groups as well as ANSC education staff.

WPD staff share information, as needed, with other entities that house the Barton Springs Salamander for the purpose of public education. The Houston Zoo and the Fort Worth Zoo’s Museum of Living Art house and display *E. sosorum* individuals raised in the City of Austin’s program. Both of these entities hold USFWS 10a1A scientific permits for *E. sosorum* and details on these captive populations

are included in the permit reports of the respective organizations.

b. Population/Breeding Group Management

Managing the population, including establishing breeding and non-breeding groups, is an on-going project. This includes determining the sex of individual salamanders by examining the animals for the presence/absence of visible testes or eggs. This method can be unreliable in that the testes are not always easily visible. Staff are currently examining salamanders in search of external characters that may be utilized as the basis for an additional method to identify the sex of individuals.

c. U.S. Geological Survey conducted a special study measuring time-varying concentrations of two herbicides (atrazine and glyphosphate) and one estrogen (17beta-estradiol) in the discharges from the Barton Springs Complex. Twenty mL of spring water were collected at each spring orifice and physicochemical parameters (temperature, pH, specific conductance, and dissolved oxygen) were recorded. These samples were collected 6/3/2013, 6/10/2013, 6/24/2013, 7/1/2013, 7/8/2013, 7/15/2013, 7/22/2013, and 7/29/2013. The data from this study is currently being processed and results are unavailable at this time.

Section W., Karst Invertebrates

During hydrogeological investigations, City of Austin permitted staff entered several caves that may harbor protected karst invertebrates. These caves, the dates of entry, City personnel, purpose of visit, and relevant observations are presented in the table below. Karst faunal surveys were conducted by City staff permitted under the Austin Water Utility's U.S. Fish and Wildlife Service endangered species permits for the Balcones Canyonlands Conservation Preserve. Data from those surveys are available in the 2011 BCCP permit report.

Table 9. Karst Cave Entry Information. Summary data from of karst cave entries December 2012 – November 2013 are presented below. All caves entered were in Travis County.

Karst Cave	Date	City Personnel	Purpose	Karst Invertebrates Observed
Pennies Cave	1/16/13	Nico Hauwert,		See BCCP Report
Goat Cave	2/16/13	Scott Hiers Nico Hauwert	cave map	See BCCP Report
Spanish Whirlpool Cave	5/28/13 6/7/13	Nico Hauwert Nico Hauwert, Mark Sanders	cave map staff cave skills	See BCCP Report See BCCP Report
Starks Mine	9/10/13	Nico Hauwert, Mark Sanders	cave map	See BCCP Report
Maple Run	9/20/13	Nico Hauwert	hydrogeolog y study	See BCCP Report
Maple Run	9/21/13	Nico Hauwert	hydrogeolog y study	See BCCP Report
Maple Run	9/22/13	Nico Hauwert	hydrogeolog y study	See BCCP Report
Maple Run	9/23/13	Nico Hauwert	hydrogeolog y study	See BCCP Report
Starks Mine	10/18/13	Nico Hauwert	cave map	See BCCP Report