CANDIDATE ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Eurycea waterlooensis*

COMMON NAME: Austin blind salamander

LEAD REGION: 2

INFORMATION CURRENT AS OF: February 2003

STATUS/ACTION (Check all that apply):
___ New candidate
_X_ Continuing candidate
_X_ Non-petitioned
___ Petitioned - Date petition received: ___
__ 90-day positive - FR date: ___
__ 12-month warranted but precluded - FR date: ___
__ Is the petition requesting a reclassification of a listed species?
___ Listing priority change
Former LP: ___
New LP: ___
Latest Date species first became a Candidate: _____
___ Candidate removal: Former LP: ___ (Check only one reason)
___ A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
___ F - Range is no longer a U.S. territory.
___ M - Taxon mistakenly included in past notice of review.
___ N - Taxon may not meet the Act=s definition of Aspecies.@
___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Amphibian, *Plethodontidae* (lungless salamander)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Texas

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Travis County, Texas

LEAD REGION CONTACT: Susan Jacobsen, 505/248-6641

LEAD FIELD OFFICE CONTACT: Austin, Texas FWS, Paige Najvar, 512/490-0057

BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

Taxonomic status - A description of the Austin blind salamander was published by Hillis et al. (2001). Juvenile salamanders had been sighted occasionally in Barton Springs and thought to be

a variation of the Barton Springs salamander (*Eurycea sosorum*). However, the observed juveniles more closely resembled the Texas blind salamander (*Eurycea rathbuni*) and it wasn=t until recently that enough specimens were available to formally describe these juveniles as a separate species using morphological and genetic characteristics (Hillis et al. 2001).

Description - The Austin blind salamander is entirely aquatic and neotenic, meaning it retains the larval, gill-breathing morphology throughout its life and does not metamorphose into a terrestrial adult. Adults are approximately 2.5 inches long from snout to tail. This species lacks external eyes (no lenses are present and the dark eye spots are covered with skin), has permanent external gills, and 12 costal grooves. The head is narrower at the eye spots that at the widest point in front of the gills, and has an extended snout. Its gills and limbs are shorter, proportionally, than those of the Texas blind or the Robust (Blanco) (*Eurycea robusta*) salamanders. The tail fins are not well developed and are only visibly present on the posterior half of the ventral surface. The fins are either missing or are very low on the anterior half of the dorsal surface (Hillis et al. 2001). Juveniles look similar to adults, but are less than 1 inch long (Lisa O=Donnell, City of Austin, pers. comm. 2002).

The skin of the Austin blind salamander appears as reflective and pearly white in color with a lavender hue. Adults collected from the wild appear to be a darker lavender than either the juveniles collected from the wild and the adults raised in captivity (Hillis et al. 2001).

Habitat/Range - The Austin blind salamander is found in three of the four Barton Springs outlets in the City of Austin=s Zilker Park, Travis County, Texas: Parthenia (Main) Spring, Eliza Spring, and Sunken Garden (Old Mill). The Main Spring forms the Barton Springs swimming pool. The Austin blind salamander has not been observed at the fourth Barton Springs outlet, known as Upper Barton Spring (Hillis et al. 2001). The only known sites have been significantly modified for human use. The area around the main spring outlet was impounded in the late 1920's to create Barton Springs Swimming Pool, and flows from Eliza and Sunken Garden springs are also retained by concrete structures, forming small pools on either side of Barton Springs Pool (USFWS 1997). These springs are fed by the Barton Springs segment of the Edwards Aquifer. This segment of the Edwards Aquifer runs under portions of two counties, with flow in the Aquifer being funneled towards the Barton Springs (see Threats section for more information on the Aquifer).

Because all but one of the Austin blind salamander specimens collected have been juveniles and the salamander is rarely seen at the surface, this salamander is thought to be more subterranean than the aquatic surface-dwelling Barton Springs salamander. The species is thought to live only in the Edwards Aquifer; all specimens collected are believed to have been accidentally flushed out of the aquifer (Hillis et al. 2001).

Population Status - From January 1998 to February 2002, there have been only 120 documented observations of the Austin blind salamander. During this same time frame, 2,059 Barton Springs salamanders have been observed (Hillis et al. 2001). Because this species spends a large portion of its life underground, the technology to safely and reliably mark salamanders for individual recognition has not been developed, and surveying within the Edwards Aquifer cannot be done at the current time, population estimates are not possible at this time. However, when they are found, the Austin blind salamander appears to occur in relatively low numbers. Between February 2001 and February 2002, only an average of eight Austin blind salamanders were found per survey visit (City of Austin 2002b). In addition, none of the Austin blind salamander specimens seen in the wild, or brought into captivity, have developed eggs (Lisa O=Donnell, City of Austin, pers. comm. 2002). At the present time, the presence of eggs is the only non-lethal way of determining the sex of the Austin blind salamanders.

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Primary threats include degradation of water quality and quantity due to urbanization. The Austin blind salamander, like the endangered Barton Springs salamander, depends on clean water from the Barton Springs segment of the Edwards Aquifer. The Barton Springs segment covers roughly 155 square miles (401 square kilometers) from southern Travis County to northern Hays County, Texas. It has a storage capacity of over 300,000 acre-feet (USFWS 1997). Because the Edwards Aquifer is a karst aquifer, it is significantly impacted by the quality and quantity of runoff from the recharge and contributing zones (USFWS 1997).

Travis County grew 2.5 percent between 1998 and 1999 (U.S. Census Bureau 2000). Based on population projections from the Texas State Data Center (2000), Travis County is expected to double in size between 1990 (population 576,407) and 2030 (population projection 1,362,538). The City of Austin (in Travis County) is one of the fastest growing cities in the U.S. and experienced a 17 percent growth rate between 1990 and 1998 (U.S. Census Bureau 1998).

Urbanization can dramatically alter the normal hydrologic regime and water quality of an area. As areas are cleared of natural vegetation and replaced with impervious cover, rainfall no longer percolates through the ground but instead is rapidly converted to surface runoff (Schueler 1991). Streamflow shifts from predominantly baseflow, which is derived from natural filtration processes and discharges from local groundwater supplies, to predominantly stormwater runoff. The amount of stormwater runoff tends to increase in direct proportion to the amount of impervious cover (Arnold and Gibbons 1996). With increasing stormflows, the amount of baseflow available to sustain water supplies during drought cycles is diminished and the frequency and severity of flooding increases. Increasing stormflows result in less water recharging the aquifer, thereby diminishing baseflow. The increased quantity and velocity of runoff increases erosion and streambank destabilization, which in turn leads to increased sediment loadings, channel widening, and detrimental changes in the morphology and aquatic ecology of the affected stream system (Schueler 1991, Arnold and Gibbons 1996).

Even at relatively low levels of impervious cover, "profound and often irreversible impacts to the hydrology, morphology, water quality, habitat, and biodiversity of streams" can occur

(Schueler 1994). Both nationally and locally, consistent relationships between impervious cover and water quality degradation have been documented. The extent to which impervious cover is controlled in a watershed has been linked with indices of environmental health (City of Austin 1998b, Schueler 1994).

Increases in impervious cover exceeding 10 percent are associated with measurable water quality degradation, loss of sensitive aquatic organisms, reduction in stream biodiversity, stream warming, and channel instability within a watershed (Schueler 1994). Stream aquatic life problems such as loss of species diversity, malformations, and death have been identified in watersheds having impervious cover of at least 12 percent, with severe problems in watersheds with impervious cover greater than 30 percent. Generally, stream quality impairment can be prevented if watershed imperviousness does not exceed 15 percent and for more sensitive stream ecosystems watershed imperviousness should not exceed 10 percent (Klein 1979). The Lower Colorado River Authority (LCRA 2001) conducted a water supply study of the recharge and contributing zone areas within the Barton Springs segment of the Edwards Aquifer that looked at the amount of impervious cover within the area. The eight watersheds within the area had a range of impervious cover from 3.2 percent to 28.9 percent in 2000. The projected impervious cover limits for the same eight watersheds in 2025 ranged from 4.8 percent to 31.6 percent (LCRA 2001). The two watersheds, Williamson Creek and Sunset Valley Creek (a tributary to Williamson Creek), with the highest percentage of impervious cover are also the second closest to the Barton Springs. Therefore, any negative impacts to water quality coming from those areas will likely be less diluted when entering the Springs than water received from other, farther away, watersheds.

In addition, sediments discharging from karst aquifers play a fundamental role in determining water quality (Mahler *et al.* 1999). Sediments have both a direct impact on habitat quality and can act as a sink and transport mechanism for other contaminants (Menzer and Nelson 1980). Karst systems are more vulnerable to the effects of pollution because of their thin surface soils, high groundwater flow velocities, and the relatively short time water is resident within the system (Ford and Williams 1994). Surface derived sediments have the greatest potential to concentrate and transport contaminants because of their high organic carbon content and their potential exposure to contaminants at the surface (Mahler and Lynch 1999).

Because stormwater moves sediment through karst systems in a pulsed fashion, impacts to the aquifer are not limited to the relatively short duration of runoff events. Generally, stormwater pollutants attach to sediments and become part of the sediment system (Burton 1992). The term "attach" is used to describe the processes of complexation, adsorption, absorption, and secondary physical and chemical processes that incorporate pollutants into the inorganic and organic matrices of soil and sediment. Sediment is moved through the Barton Springs segment of the Edwards Aquifer in pulses caused by storm events (Mahler and Lynch 1999). Sediments (with

attached pollutants) may deposit within the aquifer and be resuspended during subsequent storm events.

In an analysis performed by the City of Austin (2000), significant changes over time were reported for several chemical constituents and physical parameters in Barton Springs Pool. Conductivity, turbidity, sulfates, and total organic carbon have increased while the concentration of dissolved oxygen has decreased. The significance and presence of trends are variable depending on flow conditions (baseflow vs. stormflow, recharge vs. non-recharge) and could be attributed to impacts from watershed urbanization (City of Austin 2000). These data indicate a long-term trend of water quality degradation at Barton Springs over the past 25 years (USFWS 2001).

Four pesticides (atrazine, carbaryl, diazinon, and simazine) were documented at Barton Springs Pool and Eliza Spring in samples taken during and after a two-day storm event (USGS 2000). Atrazine, carbaryl, diazinon, and simazine at the springs were found at levels below the exhibited toxicity to aquatic animals. Although concentrations of these pesticides are below criteria set in the aquatic life protection in the Texas Surface Water Quality Standards, increases in pesticide concentrations could adversely affect aquatic organisms (USFWS 2001).

Several heavy metals, including arsenic, cadmium, copper, lead, nickel, and zinc and sediment of possible anthropogenic origin, have also been detected in Barton Springs (City of Austin 1997). Dissolved lead is very toxic in aquatic environments, and adverse effects on aquatic invertebrates and fish, including reduced survival, impaired reproduction, and reduced growth, have been reported at concentrations of 0.001 to 0.005 milligrams per liter (Eisler 1988). Sources of lead in water include industrial discharges, urban runoff, and sewage effluent (Pain 1995). Although measured concentrations for lead at Sunken Garden Spring are approximately one-half the LC_{50} (concentration or dose that kills 50 percent of the observed population) reported by Birge (1978), chronic and sublethal effects to amphibians, such as the salamanders, from lead could occur at much lower concentrations. However, hardness can effect the availability of dissolved lead and may provide some buffer to toxicity in a high alkalinity system like Barton Springs (USFWS 2001).

The EPA (1997) has proposed screening values for sediment concentrations for chemicals as evaluated in their national sediment quality survey. Sediment samples were taken from the bottom of Barton Springs and Barton Creek during normal flow periods and from storm flow of the springs and the creek during periods of heavy precipitation. Contaminated sediments were found in all pathways that lead to Barton Springs and in salamander habitat, and six heavy metals exceeded at least one sediment screening criterion on 17 occasions (USFWS 2001). Adverse effects to the Barton Spring salamander, and therefore the Austin blind salamander, and its prey may be occurring by exceeding sediment criteria suggested by EPA (1997), MacDonald et al. (2000), and TNRCC (2000). These adverse effects to the salamanders may include differences in growth, weight, and behavior; morphological and developmental aberrations; and lowered reproduction (USFWS 2001).

B. <u>Overutilization for commercial, recreational, scientific, or educational purposes</u>.

Because the Austin blind salamander is a newly described species and is currently unprotected

through regulatory mechanisms, collectors may be interested in obtaining specimens. However, the City of Austin monitors the sites where both Austin blind and Barton Springs salamanders are found on a regular basis, so the threat of collection is probably small.

The City of Austin has included the Austin blind salamander in its captive breeding efforts for the Barton Springs salamander. In 2001, City of Austin Watershed Protection Division personnel in charge of the captive breeding program collected 14 Austin blind salamanders for inclusion in the captive breeding program (City of Austin 2002a), but six subsequently died of unknown causes.

C. Disease or predation.

None known.

D. The inadequacy of existing regulatory mechanisms.

The conspecific Barton Springs salamander is federally and State listed as endangered, and the City of Austin is covered for incidental take of the Barton Springs salamander from its swimming pool maintenance activities though an Endangered Species Act section 10(a)(1)(B) permit and the associated Habitat Conservation Plan (City of Austin 1998a). The Austin blind salamanders that exit the aquifer and enter the pool also benefit from these protection measures.

Controls of nonpoint source pollution in the watershed consist of a variety of local ordinances, which range from relatively strict controls by the City of Austin in its Extraterritorial Jurisdiction to lesser controls in outlying areas, and adoption of the AEdwards Rules@(water quality protection measures for the recharge and contributing zones of the Edwards Aquifer) by the Texas Natural Resources Conservation Commission (TNRCC) in 1995 and 1997. However, the Service believes that these improvements have not provided adequate protection for the Austin blind salamander because the Texas state legislature Agrandfathered@existing projects in the watershed in 1999, which further weakened existing water quality protection (USFWS 20001). The Village of Bee Caves and the Village of Dripping Springs also have regulations in place that offer some water quality protection. These protections include riparian buffers and impervious cover limitations of up to 55 percent (USFWS 2001). In recent months, there has been an unexplained die-off of Barton Springs salamanders in Sunken Garden, where the Austin blind salamander is also found, and Upper Barton Springs. The Service, City of Austin, U.S. Geological Survey, and U.S. Environmental Protection Agency are still awaiting lab results on water, sediment, and tissue samples. At this point it is unclear whether gas bubble disease (which has never been seen before in amphibians in the wild), gas bubble disease in conjunction with some other water quality factor, or some other agent is responsible for the deaths of 13 Barton Springs salamanders (City of Austin 2002b, Lisa O=Donnell, City of Austin, 2002, pers. comm.)

E. Other natural or manmade factors affecting its continued existence.

The Austin blind salamander has a very limited distribution. Amphibians, particularly during egg and larval stages, are sensitive to many pollutants, such as heavy metals; certain insecticides,

particularly cyclodienes (endosulfan, endrin, toxaphene, and dieldrin), and certain organophosphates (parathion, malathion); nitrite; salts; and petroleum hydrocarbons (Harfenist et al. 1989). Because of their semipermeable skin, the development of their eggs and larvae in water, and their position in the food web, amphibians can be exposed to waterborne and airborne pollutants in their breeding and foraging habitats. Toxic effects to amphibians from pollutants may be either lethal or sublethal, including morphological and developmental aberrations, lowered reproduction and survival, and changes in behavior and certain biochemical processes. Because the salamander is fully aquatic, it cannot escape from contamination or other threats to its habitat. Crustaceans, particularly amphipods, on which the salamander feeds are especially sensitive to water pollution (Mayer and Ellersieck 1986; Phipps et al. 1995; Burton and Ingersoll 1994).

BRIEF SUMMARY OF REASONS FOR REMOVAL OR LISTING PRIORITY CHANGE:

NA

FOR RECYCLED PETITIONS: NA

a. Is listing still warranted? ___
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? __
c. Is a proposal to list the species as threatened or endangered in preparation? ___
d. If the answer to c. above is no, provide an explanation of why the action is still precluded.

LAND OWNERSHIP (Estimate proportion Federal/state/local government/private, identify non-private owners): The known location for the Austin blind salamander is operated as a City Park by the City of Austin Parks Department. The recharge and contributing zones of the Barton Springs segment of the Edwards Aquifer are a combination of municipal and private lands.

PRELISTING (Describe status of conservation agreements or other conservation activities): The City of Austin has included the Austin blind salamander in its captive breeding program along with the Barton Springs salamander.

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LISTING PRIORITY

THREAT

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2*
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: Limited distribution of this species makes it extremely vulnerable to extinction from degradation of water quality and decreased water quantity.

Imminence: This species occurs in one of the most rapidly growing regions in the United States, making the loss of spring flow and degradation of water quality an imminent threat of total habitat loss.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, annual retentions of candidates, removal of candidates, and listing priority changes.

Approve: Tom Bauer _____ March 14, 2003
Acting Regional Director, Fish and Wildlife Service Date

Concur: _____
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Director's Remarks: _____

_____

Date of annual review: February 2003

Conducted by: Paige Najvar

Comments: _____

_____

(rev. 7/02)