work shall be deemed accepted 90 days after delivery, unless accepted earlier.

(f) At any time during contract performance, but no later than 6 months (or such other time as may be specified in the contract) after acceptance of all of the end items (other than designs, drawings, or reports) to be delivered under the contract, the Government may require the Contractor to replace or correct work not meeting contract requirements. Time devoted to the replacement or correction of such work shall not be included in the computation of the above time period. Except as otherwise provided in paragraph (h) of this clause, the cost of replacement or correction shall be determined as specified in the Allowable Cost and Payment clause, but not additional fee shall be paid. The Contractor shall not tender for acceptance work required to be replaced or corrected without disclosing the former requirement for replacement or correction, and, when required, shall disclose the corrective action taken.

(g)(1) If the Contractor fail to proceed with reasonable promptness to perform replacement or correction, the Government may—

(i) By contract or otherwise, perform the replacement or correction, charge to the Contractor any increased cost, or make an equitable reduction in any fixed fee paid or payable under the contract;

(ii) Require delivery of any undelivered articles and shall have the right to make an equitable reduction in any fixed fee paid or payable under the contract; or

(iii) Terminate the contract for default.

(2) Failure to agree on the amount of increased cost to be charged the Contractor or to the reduction in fixed fee shall be a dispute.

(h)(1) Notwithstanding paragraphs (f) and (g) of this clause, the Government may at any time require the Contractor to remedy by correction or replacement, without cost to the Government, any failure to comply with the requirements of this contract, if the failure is due to:

(i) Fraud, lack of good faith, or willful misconduct on the part of the Contractor's managerial personnel;

(ii) The conduct of one or more of the Contractor's employees selected or retained by the Contractor after any of the Contractor's managerial personnel has reasonable grounds to believe that the employee is habitually careless or unqualified;

(iii) The Contractor not applying best efforts toward the accomplishment of the research and development objectives of the contract (those for which success cannot be reasonably predicted at the time of contract award); or

(iv) The Contractor not following generally accepted industrial or engineering practices in performing routine operations as part of contract performance.

(2) The contractor's liability for failures due to causes listed in subparagraphs (h)(1)(iii) and (iv) is limited to the lesser of: (i) 50 percent of the cost to remedy the failure, or (ii) 10 percent of the contract value at the time the failure occurred.

(i) This clause shall apply in the same manner to a corrected or replacement end item or components as to work originally delivered.

(j) The Contractor has no obligation or liability under the contract to correct or replace articles not meeting contract requirements at time of delivery, except as provided in this clause or as may otherwise be specified in the contract.

(k) Unless otherwise provided in the contract, the Contractor's obligations to correct or replace Government-furnished property shall be governed by the clause pertaining to Government property.

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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

RIN 1018–AC22

33-94

Endangered and Threatened Wildlife and Plants; Proposal To List the Barton Springs Salamander as Endangered

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: The Fish and Wildlife Service (Service) proposes to determine endangered status for the Barton Springs salamander (*Eurycea sosorum*), known only from Barton Springs in Zilker Park, Austin, Travis County, Texas. The primary threat to this species is contamination of the waters that feed Barton Springs due to the potential for catastrophic events (such as petroleum or chemical spills) and chronic degradation resulting from urban activities. Also of concern are disturbances to the salamander's surface habitat (the waters in Barton Springs, Eliza Pool, and Sunken Garden Springs) and reduced groundwater supplies resulting from increased groundwater withdrawal. This proposal, if made final, would implement Federal protection provided by the Act for the Barton Springs salamander.

DATES: Comments from all interested parties must be received by April 18, 1994. Public hearing requests must be received by April 4, 1994.

ADDRESSES: Comments and materials concerning this proposal should be sent to the State Administrator, U.S. Fish and Wildlife Service, 611 East 6th Street, room 407, Austin, Texas 78701. Comments and materials received will be available for public inspection, by appointment, during normal business hours at the above address.

FOR FURTHER INFORMATION CONTACT: Lisa O'Donnell, U.S. Fish and Wildlife Biologist (see **ADDRESSES** section) (512/482–5436).

SUPPLEMENTARY INFORMATION:

Background

The Service proposes to list as endangered the Barton Springs salamander (*Eurycea sosorum*), under the authority of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et. seq.*). The Barton Springs salamander is entirely aquatic and neotenic, meaning it does not metamorphose into a terrestrial form and retains its bright red external gills throughout life. Adults attain an average length of 6.35 centimeters (2.5 inches). This species is slender, with slightly elongate limbs and reduced eyes. Dorsal coloration varies from pale purplish-brown or gray to yellowish-cream. Irregular spacing of dorsal pigments and pigment gaps results in a mottled, "salt and pepper" pattern (Sweet 1978, Chippindale *et al.* 1993).

The Barton Springs salamander was first collected from Barton Springs Pool in 1946 by Bryce Brown and Alvin Flury (Chippindale *et al.* 1993, Texas Parks and Wildlife Department (TPWD) 1993). Although he did not publish a formal description, Dr. Samuel Sweet (University of California at Santa Barbara) was the first to recognize the Barton Springs salamander as distinct from other central Texas *Eurycea* salamanders based on its restricted distribution and unique morphological and skeletal characteristics (such as its reduced eyes, elongate limbs, dorsal coloration, and reduced number of presacral vertebrae) (Sweet 1978, 1984). Formal description of the Barton Springs salamander, based on Sweet's work and genetic studies conducted by the University of Texas and TPWD (TPWD 1989, 1990, 1992), was published in June, 1993 (Chippindale *et al.* 1993). An adult male, collected from Barton Springs Pool in November, 1992, was selected to be the holotype.

The Barton Springs salamander is found near three of four hydrologically connected spring outlets collectively known as Barton Springs (Brune 1981). These three spring outlets are known as Parthenia, Eliza, and Sunken Garden springs and occur in Zilker Park, which is owned and operated by the City of Austin. No salamanders have been found at the fourth spring outlet, which is in Barton Creek immediately above Barton Springs Pool (Paul Chippindale and Dr. David Hillis, University of Texas at Austin; Dr. Andrew Price, TPWD; Sweet; pers. comms., 1993). The area around the main spring outlet (Parthenia Springs) was impounded in the late 1920's to create Barton Springs Pool. Flows from Eliza and Sunken Garden springs are also retained by concrete structures, forming small pools located on either side of Barton Springs Pool. The salamander has been observed under gravel and small rocks, submerged leaves, and algae; among aquatic vegetation; and buried in organic debris, at depths of about 0.1 to 5 meters (0.3 to 16 feet) of water (Chippindale *et al.* 1993, TPWD 1993). It generally does not occur on bare limestone surfaces or in silted areas (Dr. Charles Sexton, City of Austin, Environmental Conservation Services Department, unpublished data).

Hundreds of individuals were estimated to occur in Eliza Pool during the 1970's (James Reddell, University of Texas at Austin, pers. comm. in Chippindale *et al.* 1993). The numbers apparently declined over the next decade. Fewer than a dozen and occasionally no individuals were observed during surveys conducted in Eliza Pool between 1987 and 1992 (Chippindale *et al.* 1993; TPWD 1993; Price, unpubl. data).

The Barton Springs salamander was reportedly abundant among the aquatic vegetation in the deep end of Barton Springs Pool in 1946 (Chippindale *et al.* 1993, TPWD 1993). Between 1989 and 1991, Sexton (*in litt.*, 1992) reported finding salamanders on "about one out of four [snorkeling] dives" under rock rubble immediately adjacent to the main spring outflows. On July 28, 1992, at least 50 salamanders (Hillis, pers. comm., 1993) were found over an area of roughly 400 square meters (4,300 square feet) near the spring outflows in Barton Springs Pool (TPWD 1993). Following reports of a fish kill at Barton Springs Pool on September 28, 1992 (Austin American Statesman, October 2, 1992; Daily Texan, October 13, 1992), only 10 to 11 salamanders were observed and could only be found in an area of about 5 square meters (54 square feet) in the immediate vicinity of the Parthenia Spring outflows (Chippindale *et al.* 1993, TPWD 1993). Since that event, the salamander appears to be recolonizing Barton Springs Pool, which has been attributed to recent changes in pool cleaning operations (see further discussion under Factor A). At least 80 individuals were observed during a November 16, 1992, survey and about 150 individuals were seen on November 24, 1992 (Chippindale *et al.* 1993, TPWD 1993).

The salamander was first observed at Sunken Garden Springs on January 12, 1993 (TPWD 1993). Five or fewer individuals have been sighted on any given visit to this outlet (Chippindale, pers. comm., 1993). Biologists had speculated that the salamander occurred at Sunken Garden Springs; however, no salamanders were observed during previous surveys conducted at this location between 1987 and 1992. Low water levels and the presence of large rocks and sediment in the pool reportedly make searching for salamanders difficult at this location (TPWD 1993).

The extent to which the salamander occurs in the aquifer is unknown. However, there is currently no evidence indicating that the species' range extends beyond the immediate vicinity of Barton Springs. Surveys of other spring outlets (including the spring outlet immediately above Barton Springs Pool) in the Barton Springs segment and other portions of the Edwards Aquifer have failed to locate additional populations (Chippindale *et al.* 1993; William Russell, speleologist; Hillis; Price; Sweet; pers. comms., 1993). No other species of *Eurycea* is known to occur in this portion of the aquifer.

The Barton Springs salamander's diet is believed to consist almost entirely of amphipods (Chippindale *et al.* 1993). Primary predators are believed to be fish and crayfish (Chippindale, Hillis, Price, pers. comm., 1993). Observations of larvae and females with eggs (Chippindale *et al.* 1993) indicate successful breeding is occurring. The species may breed year-round (Chippindale, pers. comm., 1993).

The water that discharges at Barton Springs originates from the Barton Springs segment of the Edwards Aquifer (hereafter referred to as the "Barton Springs segment"). The Barton Springs segment covers roughly 400 square kilometers (155 square miles) from southern Travis County to northern Hays County, Texas. The approximate boundaries are the "bad water" line to the east (where dissolved solids are less than 1,000 milligrams/l (mg/l) (1,000 parts per million) in the aquifer, but greater than this to the east); the Colorado River to the north; the geologic divide between contiguous Edwards limestones overlying the aquifer and the Glen Rose limestones to the west; and a groundwater divide occurring roughly between the Onion Creek and Blanco River watersheds to the south. The area south of the southern boundary is known as the San Antonio segment of the Edwards Aquifer and drains toward San Marcos Springs. Groundwater movement from the San Antonio segment northward to the Barton Springs segment is believed to occur only during extreme drought conditions. North of the southern boundary, the water in the aquifer moves toward Barton Springs (Slade *et al.* 1986).

Barton Springs drains about 391 square kilometers (151 square miles) of the Barton Springs segment. The remaining 10 square kilometers (4 square miles) discharge at Cold and Deep Eddy Springs and are believed to be hydrologically distinct from the area discharging to Barton Springs. Cold and Deep Eddy Springs are recharged by Dry Creek and a portion of Barton Creek. About 96 percent of all springflow from the aquifer discharges through Barton Springs. The remaining 4 percent exits through intermittent springs, most of which are located in Barton Creek between Loop 360 and Barton Springs. These springs flow only about 30 percent of the time and discharge up to 170 liters per second (l/s) (6 cubic feet per second (cfs)). The long-term mean discharge from Barton Springs is about 1,400 l/s (50 cfs), ranging from 283 l/s (10 cfs) to 4,700 l/s (166 cfs) (Slade *et al.* 1986). The mean water temperature is 20° C (68° F) (Martyn-Baker *et al.* 1992).

The Barton Springs segment is divided into two major zones, the recharge zone and artesian zone. The recharge zone is that portion of the aquifer where Edwards limestones are exposed at the surface, and covers the western 79 percent (about 233 square kilometers (90 square miles)) of the aquifer. The artesian zone is confined by an impermeable layer of Del Rio clay and covers the eastern 21 percent of the aquifer. About 85 percent of all recharge is through sinkholes, fractures, and other openings in the beds of six major creeks that cross the recharge zone, including (from north to south) Barton, Williamson, Slaughter, Bear, Little Bear, and Onion creeks. The remaining 15 percent of recharge is through tributaries and direct infiltration between the creeks (Slade *et al.* 1986).

The watersheds of the six creeks upstream (west) of the recharge zone span about 684 square kilometers (264 square miles). This area is referred to as the contributing zone and includes portions of Travis, Hays, and Blanco counties. The recharge and contributing zones make up the total area that provides water to the aquifer, which equals about 917 square kilometers (354 square miles) (Slade *et al.* 1986).

Based on streamflow studies, Onion Creek and Barton Creek contribute the greatest percentages of total recharge to the aquifer (34 percent and 28 percent, respectively). Williamson, Slaughter, Bear, and Little Bear creeks each contribute 12 percent or less to total recharge. Owing to the amount of recharge contributed by Barton Creek and its proximity to Barton Springs, this creek has a greater impact on the water quality at the springs than any other recharge source in the Barton Springs segment (Slade *et al.* 1986).

The potential of the Edwards Aquifer to rapidly transmit large volumes of water with little filtration makes it highly susceptible to pollution (Slade *et al.* 1986). The Edwards Aquifer is a "karst" aquifer, characterized by subsurface features such as caves, sinkholes, and other conduits. The aquifer is made up of limestones that have high localized permeability and porosity. Dissolution of calcium carbonate along faults and fractures in the bedrock forms solution channels similar to an underground network of pipes. Because these subsurface "pipes" are not uniformly distributed, groundwater movement in the aquifer is highly variable, being rapid in areas where the "pipes" are large and extensive and slow where permeability and porosity are low. Transmissivity (the rate at which groundwater is transmitted through the aquifer) values for the Barton Springs segment have been estimated at 0.3 to 4,000 square meters (3 to 47,000 square feet) per day and tend to increase as one moves northward toward the springs (Slade *et al.* 1985).

Karst aquifers are also more prone to pollution than other aquifers because few materials (such as sand, gravel, and organic matter) are present to filter out pollutants (U.S. Environmental Protection Agency (EPA) 1990). Furthermore, waters entering from the surface receive little filtration from the typically thin soils overlying the aquifer (Slade *et al.* 1986). As a result, increasing urban development over the area supplying recharge waters to the Barton Springs segment can threaten water quality within the aquifer. The Texas Water Commission (TWC) has identified the Edwards Aquifer as being one of the most sensitive aquifers in Texas to groundwater pollution (TWC 1989; Margaret Hart, TWC, *in litt.*, 1991).

The Barton Springs salamander has been a Category 2 candidate species on the Service's candidate notices of review since December 30, 1982 (47 FR 58454; September 18, 1985–50 FR 37958; January 6, 1989–54 FR 554; and November 21, 1991–56 FR 58804), meaning that information then available indicated that a proposal to determine endangered or threatened status was possibly appropriate, but conclusive data on biological vulnerability and threats were not then available to support such a proposal. Through publication of the candidate notices, the Service requests any additional status information that may be available. On January 22, 1992, the Service received a petition from Dr. Mark Kirkpatrick and Ms. Barbara Mahler to list the Barton Springs salamander. The Service evaluated this petition and on November 25, 1992, determined that the petition presented information on threats indicating that the requested action may be warranted. A notice of that finding was published in the **Federal Register** on December 11, 1992 (57 FR 58779). The Service continued its status review of the species and solicited information regarding the status of the salamander. Although the **Federal Register** notice requested that comments be submitted by January 11, 1993, the Service sent out numerous notification letters indicating that it recognized additional time may be needed and requesting that pertinent information be submitted by February 10, 1993. This proposed rule constitutes the final finding on the petitioned action for the Barton Springs salamander.

Summary of Comments and Recommendations

The Service received 205 letters from individuals and agencies providing information and comments on the petition and the 90-day finding. Of the letters received, 104 were form letters stating opposition to listing, 80 were other letters opposing listing, 14 supported listing, and 7 were neutral. Some of the letters provided additional new, substantive information, which was considered in making a final determination on the petition. Major comments of a similar nature or point are grouped into a number of general issues and are presented and discussed here.

Issue 1: Several commenters requested that the Service delay or preclude listing the Barton Springs salamander because too little is known about the salamander's biology, including factors such as its range, population size and status, dietary needs, predators, longevity, reproductive success, and sensitivity to contaminants and other water quality constituents.

Response: The known range of the Barton Springs salamander is based on the most recent information available, including status surveys conducted by the University of Texas at Austin and TPWD pursuant to section 6 of the Act,, and through personal communication with biologists who conducted surveys at other springs in central Texas. No new information was provided to contradict the finding that the salamander is endemic to the immediate vicinity of Barton Springs. Regarding other aspects of the species' biology, such as its population status, the Act requires a species to be determined endangered or threatened if one or more of the five factors described in section 4(a)(1) causes it to qualify under the Act's definition. Absolute population number may not be as significant in determining whether a species is endangered or threatened as knowledge that the species' entire range is threatened and cannot be preserved (see Factor A, "The present or threatened destruction, modification, or curtailment of its habitat or range," and Factor D, "The inadequacy of existing regulatory mechanisms"). Although there are still biological questions regarding the Barton Springs salamander, the Service believes that the available scientific information is sufficient for status determination and strongly supports the need to designate the salamander as an endangered species. The data that support this conclusion are presented and discussed in the "Summary of Factors Affecting the Species" section of this rule, particularly under Factor A (loss of habitat). Available information on the sensitivity of the salamander and its prey base (amphipods) to water quality deterioration is discussed under Factors A and E ("Other natural or manmade factors affecting its continued existence"). Once a species becomes listed as threatened or endangered, section 4(f) of the Act directs the Service to develop and implement a recovery plan for that species. Recovery is the process by which the decline of a listed species is arrested or reversed, and threats to its survival are eliminated or neutralized, so that its long-term survival in nature can be ensured. Further research is very often an essential component of recovery plans. The Service envisions that conducting research on the salamander's biology and other factors, such as those mentioned in this comment, will be an important part of the recovery process for this species (see Available Conservation Measures).

Issue 2: Several individuals questioned the taxonomic status of the salamander, asserting that it is still an undescribed species and may be part of the central Texas salamander (*Eurycea neotenes*) complex.

Response: Formal description of the salamander as a distinct species has withstood peer-review and was published in June, 1993 (see discussion in the Background section).

Issue 3: Several commenters stated that water quality data at Barton Springs show no demonstrable deterioration, despite development immediately upstream from the springs, much of which occurred prior to implementation of water quality controls.

Response: The Service recognizes that, other than high levels of fecal-group bacteria and turbidity immediately following storm events, water quality at Barton Springs is considered to be very good. However, only about 3 to 4 percent of the recharge and contributing zones is currently developed. As urban development over the recharge and contributing zones increases, the threat of water quality degradation from point-source and non-point-source pollution will increase. The threat of increased urbanization over these areas and impacts on water quality in the aquifer and at Barton Springs are discussed in Factor A.

Issue 4: Most commenters opposed to the listing stated that existing State and local rules and regulations are adequate to protect the salamander and its habitat from groundwater degradation and depletion.

Response: This issue is presented and discussed in Factor D. The Service recognizes that there are several rules and regulations aimed at protecting water quality and quantity within the aquifer, and that these rules and regulations will provide some benefits to the Barton Springs salamander if adequately enforced. However, no information was presented to show that these existing rules and regulations will ensure long-term protection of water quality and quantity at Barton Springs and will be adequate to protect the salamander and its habitat. Furthermore, there are no assurances that the existing rules and regulations will remain in place and be enforced. Regarding water quantity, the Barton Springs/Edwards Aquifer Conservation District (BS/EACD) has limited enforcement authority and does not regulate 30 to 40 percent of the total volume that is pumped from the Barton Springs segment.

Issue 5: Several individuals expressed concern that listing the salamander could impose restrictions on the recreational use of Barton Springs Pool.

Response: This issue is discussed under Factor B ("Overutilization for commercial, recreational, scientific, or educational purposes"). There is currently no evidence suggesting that swimming in Barton Springs Pool will adversely impact the Barton Springs salamander. The Service maintains the position that if pool maintenance activities are conducted in such a way as to avoid impacting the salamander and its habitat (such as avoiding the application of chemicals and the use of high pressure fire hoses to clean areas inhabited by salamanders), then activities associated with swimming at Barton Springs Pool should not disturb the salamander.

Issue 6: The salamander has persisted despite past droughts, low springflows, and pollution events over the aquifer and its contributing zone and at Barton Springs (elevated fecal coliform bacteria and turbidity).

Response: The Service acknowledges that these events have occurred and that the frequency of such events is likely to increase with increasing development over the aquifer and its contributing zone. Although the salamander has survived these past events, the point at which declining water quality and quantity would cause extinction of the salamander is uncertain. Amphibians in general are highly sensitive to changes in water chemistry, and the salamander's restricted range makes it especially vulnerable to water quality deterioration. A major pollution event has the potential of eliminating the entire species and/or its prey base. Amphipods, which comprise most of the salamander's diet, are especially sensitive to water pollution (see discussion in Factor E).

Issue 7: A few commenters stated that the threat of declining aquifer levels is not substantial at Barton Springs and, in any event, no demonstrable evidence exists that lowered aquifer levels will cause a threat to the continued existence of the salamander.

Response: This issue is addressed in Factor A. Although the Service recognizes that cessation of flows is not likely at Barton Springs in the near future, increased groundwater withdrawal and resulting reduced flows are expected due to increasing urbanization over the aquifer. Reduced aquifer levels may lead to the encroachment of the "bad water" line and increased concentrations of pollutants in the aquifer.

Issue 8: Many individuals opposed listing of the salamander on the grounds that listing would undermine the success of the Balcones Canyonlands Conservation Plan (BCCP).

Response: The BCCP currently proposes to acquire land in the Barton Creek watershed, which will provide some benefits to the salamander by preserving the natural integrity of the landscape and positively contributing to water quality in Barton Creek and Barton Springs. The BCCP participants are currently working toward providing additional water quality protection for the Barton Springs salamander, including retrofitting of existing developments with non-point-source pollution control structures and protecting the aquifer and Barton Springs from catastrophic pollution events (see discussion in Factor D).

Issue 9: Some commenters expressed concern regarding economic impacts of listing the salamander and stated that economic impacts should be considered.

Response: Under section 4(b)(1)(A) of the Act, the listing process must be based solely on the best scientific information available, and economic considerations are not applicable. The legislative history of the Act clearly states the intent of Congress to "ensure" that listing decisions are "based solely upon biological criteria and to prevent non-biological considerations from affecting such decisions" (H.R. Conf. Rep. No. 97–835 for the 1982 amendments). Because the Service is specifically precluded from considering economic impacts in the listing process, the Service has not addressed such impacts in proposing to list this species.

Issue 10: The Service received one comment letter requesting that the Barton Springs salamander be emergency listed.

Response: In accordance with section 4(b)(7) of the Act, a species may be listed as threatened or endangered on an emergency basis if a significant risk to the well-being of the species is identified. Although the Service has determined that multiple threats to the salamander exist (see discussion in "Summary of Factors" section), the Service is not able to justify an emergency determination since these threats are not of such an immediate nature that the delay during the period between this proposed rule and any final rule might pose a significant risk to the well-being of the species.

Issue 11: A few commenters questioned the validity of the information and findings presented in several reports prepared by the U.S. Geological Survey (USGS) (including Slade *et al.* 1985 and 1986, Veenhuis and Slade 1990).

Response: The Service has reviewed the USGS reports used in preparation of this rule and has determined that the data were gathered and analyzed in accordance with sound scientific principles. The Service accepts these reports as valid and relevant scientific information and accepts their findings.

Issue 12: A few individuals cited a 1922 report stating that elevated levels of fecal coliform bacteria have been documented at Barton Springs since 1922 (T.U. Taylor, Austin City Water Survey, *in litt.*, 1922).

Response: According to the City of Austin's review of the 1922 report, the method used to measure bacterial counts at the time the report was prepared is different from that used today, and thus "the bacterial counts are not directly comparable to * * * current sampling" techniques (Austin Librach, City of Austin Environmental Conservation Services Department, *in litt.*, 1991). Elevated counts during the 1920's may have been due to ranching activities or poor sanitary disposal of human wastes, as well as natural sources (Librach, *in litt.*, 1991).

Summary of Factors Affecting the Species

Section 4 of the Endangered Species Act and regulations (50 CFR part 424) promulgated to implement the listing provisions of the Act set forth the procedures for adding species to the Federal lists. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1). These factors and their application to the Barton Springs salamander (*Eurycea sosorum*) are as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range.* The primary threat to the Barton Springs salamander is contamination of the waters that feed Barton Springs. A discussion of some potential effects of contaminants on the salamander and its prey base (amphipods) is provided in this section and under Factor D. Potential factors contributing to contamination of this portion of the Edwards Aquifer are catastrophic events (such as hazardous material spills) and chronic degradation resulting from urban activities. Water quality degradation can result from point-source and/or non-point-source pollution. Point-source pollution originates from identifiable areas, such as leaking pipelines. Non-point-source pollution enters the water supply through diffuse sources, such as runoff from urban areas. The EPA (1990) and TWC (1989) have identified several major potential sources of groundwater contamination, including leaking underground storage tanks, pipelines, septic tanks, and pesticide and fertilizer use. Other threats to the salamander are disturbances to its surface habitat and reduced groundwater supplies owing to increased groundwater withdrawal.

Due to the Barton Springs salamander's restricted range, one or more catastrophic spills has the potential to impact the entire species and its habitat. Catastrophic spills may result from leaking underground storage tanks, pipeline ruptures, transportation accidents, and/or other sources. Spilled materials reported to the TWC for Travis and Hays counties between 1986 and 1992 included oils, sewage, pesticides, ammonia, sodium hydroxide, hydrochloric acid, ferrous sulfate, trichloroethane, and perchloroethene. About a third of the spills involved gasoline or diesel fuel, most of which resulted from underground storage tank leaks and transportation accidents. Leaking underground storage tanks "are considered to be one of the most significant sources of groundwater contamination" in Texas (TWC 1989). The Texas Department of Agriculture (TDA) (1987) has estimated that thousands of underground storage tanks in Texas may be leaking. According to the EPA (1990), "a growing problem of substantial potential consequences is leakage from underground storage tanks and from pipelines leading to them * * * gasoline leakage has caused severe hazardous difficulties throughout the nation." The EPA (in TWC 1989) has estimated that at least 25 percent of the underground storage tanks in Texas "will ultimately be confirmed as leakers."

According to the TWC (1989), "substances spilled on the land surface can be a serious threat if the surface and subsurface materials are sufficiently permeable to permit downward movement" and if spilled materials are not promptly or adequately remediated. Transportation accidents involving hazardous materials at bridge crossings are of particular concern, since creek beds can transport spilled materials directly into the aquifer. For example, if a contaminant spill occurred at the Loop 360 bridge crossing over Barton Creek, less than 5 kilometers (3 miles) south of Barton Springs, the contaminant could reach Barton Springs within hours. The Barton Springs Task Force report to the TWC (City of Austin 1991) states that "the major fault that creates the discharge for Barton Springs crosses Barton Creek in the vicinity of Loop 360 and appears to be a significant point of recharge which may provide direct transmission, similar to pipe flow, to the Springs." Loop 360 provides a major route for transportation of petroleum and gasoline products to service stations in the Austin area.

Oil pipeline ruptures also represent a potential source of groundwater contamination. Three oil pipelines run roughly parallel to each other across the Barton Springs segment and its contributing zone and cross Barton Creek near the Hays/Travis county line. Two of these lines ruptured within the recharge zone during the 1980's, about 13 kilometers (8 miles) south of Barton Springs. These two spills constitute the largest spills reported from Hays and Travis counties between 1986 and 1992 (TWC, unpubl. data). The first major spill occurred in 1986, about 270 meters (300 yards) from Slaughter Creek, when an oil pipeline was severed during a construction operation and released about 366,000 liters (96,600 gallons) of oil. The equipment necessary to contain the spill was on-site at the time the spill occurred (Russell 1987), and about 91 percent of the spill was recovered (Rose 1986). The second pipeline break occurred in 1987 near the first spill site and released over 185,000 liters (49,000 gallons) of oil. According to the TWC database, more than 97 percent of this spill was recovered (TWC, unpubl. data). Although the effects of these two spills on the Barton Springs salamander are unknown, similar spills that are not immediately remediated could adversely impact the salamander and its habitat.

Peter Rose (1986), a geologist who has studied the effects of pipeline oil spills on the Edwards Aquifer, has estimated that oil spills of 160,000 liters (42,000 gallons) or more pose a "reasonable danger" of entering and contaminating the Edwards Aquifer. "Free oil entering an unconfined aquifer would be expected to spread and travel in the direction of water flow, emerging eventually at springs * * *" (Rose 1986). Oil is highly toxic to aquatic life (Pyastolova and Danilova 1987). A study of the effects of oil on the sharp-snouted frog (*Rana arvalis*) showed that "the presence of crude oil in an aquatic environment, even in small amounts (0.05 ml/l) exerts an unfavorable influence on both embryonic and larval development" of the frog, including increased mortality and appearance of deformities (Pyastolova and Danilova 1987). Because of physiological similarities among amphibian larvae, the Barton Springs salamander may exhibit similar or possibly more severe reactions.

The conveyance and treatment of sewage in the watershed, particularly in the recharge zone, may also result in the impairment of local water quality and negative effects to the Barton Springs salamander. In 1982, high levels of fecal coliform bacteria at Barton Springs were attributed to a sewerline leak upstream from Barton Springs Pool. While fecal coliform bacteria are believed to be harmless, they may indicate the presence of other organisms that are pathogenic to aquatic life (Slade *et al.* 1986), some of which may pose a threat to salamanders and/or their prey base.

The USGS has stated that because "there are many sewerlines near the springs, fecal coliform contamination of the springs may be a recurring problem" (Slade *et al.* 1986). There are over 145 kilometers (90 miles) of wastewater lines in the recharge zone of the Barton Springs segment (Maureen McReynolds, City of Austin Water and Wastewater Utility, pers. comm., 1993).

Once an aquifer is contaminated, it can be very difficult to remediate. TDA (1987) maintains that "contaminated groundwater can be extremely difficult and expensive, and in some cases even impossible, to clean up. The only way to maintain groundwater quality is to prevent contamination in the first place." Regarding the effects of oil pipeline spills on the Edwards Aquifer, "* * * for all practical purposes, once spilled oil has been introduced into a cavernous carbonate aquifer, only time and nature can take care of the cleanup job" (Rose 1986).

Major contaminant spills that are not quickly remediated could enter the aquifer and contaminate the waters feeding Barton Springs. Response times to hazardous materials spills vary, depending on several factors, including detection capability, location and size of the spill, weather conditions, whether or not the spill is reported, and the party performing the cleanup. Generally, cleanup is initiated within several hours following detection of a spill, but many weeks may be necessary to complete the effort. In some cases in Travis County, cleanup of leaking storage tanks was not initiated until two months following leak detection (Philip Winsborough, TWC, pers. comm., 1993). In other cases, such as the oil pipeline ruptures that occurred within the recharge zone, cleanup was initiated the same day the spill was detected and completed the following day.

Chronic water quality degradation of the aquifer resulting from increasing urban activities (including roadway, residential, commercial, and industrial development) may also lead to contamination of the waters feeding Barton Springs (see also discussion under Factor D). Because of the characteristics of karst aquifers discussed in the Background section, Barton Springs is believed to be "heavily influenced by the quality and quantity of runoff," particularly in the recharge zone (City of Austin 1991). A report by USGS (Veenhuis and Slade 1990) on the relationship between urbanization and surface water quality in several streams throughout the Austin area (10 of 18 sample sites were along streams in the Barton Springs segment and its contributing zone) demonstrates that increases in impervious cover can lead to large increases in pollutant runoff. This is indicated in several streams with increased levels of suspended solids, biochemical oxygen demand, total organic carbon, total nitrogen, total phosphorus, fecal-group bacteria, inorganic trace elements, and synthetic compounds. A preliminary review of water quality data for 15 wells in the Barton Springs segment also suggests that increasing impervious cover has resulted in increased concentrations of certain water quality constituents in the groundwater, including total nitrogen and total phosphorus (USGS 1992). These changes in groundwater quality may indicate future water quality changes at Barton Springs as development increases across the recharge and contributing zones.

Of the six creeks providing recharge to Barton Springs, Barton Creek has received the most intense development. The TWC has identified nutrients, fecal coliform bacteria, sediment, oil, and grease in Barton Creek, originating from rangeland, golf course runoff, highway construction, and highway runoff (Barbara Britton, TWC, *in litt.*, 1992). Increases in fecal coliform bacteria, nutrients (nitrogen and phosphorus), turbidity, and algal growth have been documented along Barton Creek between Highway 71 and Loop 360 and are primarily due to sewage effluent irrigation and construction activities in this area (City of Austin 1991; Librach, *in litt.*, 1990). Changes in the aquatic invertebrate community along this portion of Barton Creek have also been attributed to golf course runoff (Librach, *in litt.*, 1990) and insecticide use (Dr. Chris Durden, Texas Memorial Museum, *in litt.*, 1991). These reported changes are significant because water quality at Barton Springs responds rapidly to changes in the quality of water contributed by Barton Creek. Groundwater originating from Barton Creek remains in the aquifer for short periods before discharging at the springs. Thus, there is little time for dilution or chemical breakdown of pollutants before discharging at Barton Springs (Slade *et al.* 1986).

Existing land use in the recharge and contributing zones has resulted in recurring fecal-group bacteria contamination and high turbidity (a measure of suspended solids or sediment) at Barton Springs (Slade *et al.* 1986). Data suggest that bacteria and turbidity at Barton Springs increase significantly during storm events. Stormwater runoff has been identified as the major source of fecal coliform pollution at Barton Springs (City of Austin 1991). The level of nitrates at Barton Springs has also increased slightly from about 1.0 mg/l (measured as nitrate nitrogen) prior to 1955 to the current level of about 1.5 mg/l (Slade *et al.* 1986). Increased nutrients may promote the growth of bacteria, algae, and nuisance aquatic plants (Slade *et al.* 1986), which could reduce the dissolved oxygen available to the salamander. In Barton Springs Pool, the routine cleaning procedure necessary to remove algal growth may itself adversely impact the salamander and its habitat (see further discussion later in this section).

High turbidity at Barton Springs has been attributed to construction activity in the Barton Springs segment (Slade *et al.* 1986, City of Austin 1991). Sources of turbidity are believed to be "primarily limited to 126 square miles [326 square kilometers] of the Barton Creek and immediately adjacent watersheds in the recharge zone" (City of Austin 1991). Sediments have been observed emanating directly from the spring outlets in Barton Springs Pool (Doyle Mosier, LCRA; Debbie Dorsey, City of Austin Parks and Recreation Department; pers. comms., 1993). Potential problems resulting from increased sediment loads include (1) reduction of the salamander's habitat by covering substrates on which salamanders, their prey, and/or certain aquatic plants occur; (2) clogging of the salamander's gills, causing asphyxiation (Garton 1977), and smothering of eggs; (3) filling and blocking of underground conduits, restricting groundwater availability and movement; and (4) exposure of aquatic life to certain heavy metals and other toxins that readily bind to sediments. Contaminants that adsorb to the surface of sediments may be transported through the aquifer and later be released back into the water column.

Aside from high levels of fecal-group bacteria and turbidity immediately following storm events, the water quality at Barton Springs is considered to be very good (Slade *et al.* 1986, City of Austin 1991). However, only about 3 to 4 percent of the recharge and contributing zones is currently developed (USGS 1992), and both of these areas are under increasing pressure from urbanization (City of Austin 1988, Veenhuis and Slade 1990). The City of Austin has projected that the Austin metropolitan area will support a population of about 1.9 million by the year 2020, up from 577,000 in 1982 (City of Austin Planning Department, in Veenhuis and Slade 1990). Further development or urbanization in the recharge and contributing zones of the Barton Springs segment is likely to increase the chance of a major pollution event as well as chronic water quality decline in this area and thus increase the levels of pollutants reaching Barton Creek, other creeks serving as recharge paths, and Barton Springs (see also discussion under Factor D). The USGS (1992) has stated that "much development is projected for the source area of Barton Springs * * *. [Thus] changes in water quality of Barton Springs * * * [are] possible in the near future."

Water quality is highly variable throughout the Barton Springs segment and waters flowing from Barton Springs represent a mixture of these waters, originating primarily from the six streams crossing the recharge zone. Although much development has occurred along Barton Creek near Barton Springs, these waters are diluted by recharge waters from less developed watersheds, such as Onion Creek. Little development has occurred along Onion Creek, which, although farthest from the springs, contributes about 34 percent of the recharge waters (Slade *et al.* 1986). According to the Capital Area Planning Council (CAPCO), Hays County experienced "tremendous growth" in the 1980's and has the second highest growth rate in the 10-county CAPCO region. Dripping Springs, which is located in the contributing zone between Onion Creek and Barton Creek, "will likely continue to experience a high rate of growth as development continues along U.S. 290 from the Oak Hill area westward" (CAPCO 1990). As development across these watersheds increases, the ability of the aquifer to dilute pollutants will continue to decrease. This decreased ability will likely be further compounded by increased pumping and/or drought conditions.

Another threat to the salamander is the degradation of its surface habitat, particularly at Barton Springs Pool and Eliza Pool. Following reports of a fish kill in Barton Springs Pool on September 28, 1992 (Austin American Statesman, October 2, 1992; Daily Texan, October 13, 1992), the salamander's surface range contracted from about a 400 square meter (4,300 square foot) area to about a 5 square meter (50 square foot) area immediately around the outflow of the spring (see discussion in Background). The fish kill has been attributed to the improper application of chlorine used to clean Barton Springs Pool (Chippindale et al. 1993, TPWD 1993). Previous fish kills, although rare events, have also occurred at Barton Springs Pool (Robert Sapronyi, City of Austin Parks and Recreation Department, pers. comm., 1992). Other cleaning procedures and park operations that may have had adverse impacts on the salamander and its surface habitat include lowering the water levels in Barton Springs Pool and Eliza Pool for cleaning, use of high pressure fire hoses in areas where salamanders are found, and removal of aquatic vegetation from Eliza Pool. Runoff from the area above Eliza Pool, which includes a maintenance area and concession stand for the Zilker Eagle train, may also have contributed to the decline in numbers of salamanders found at this location.

Following the September 28 fish kill, the City of Austin discontinued the use of chlorine to clean Barton Springs Pool and Eliza Pool. The City of Austin is continuing to revise its pool maintenance practices in order to protect the salamander and its habitat, as well as maintain a safe environment for swimmers (Camille Barnett, City of Austin, *in litt.*, 1993). Cleaning practices at Eliza Pool and other park operations near this pool are also being reevaluated.

Another change that has been observed at Barton Springs is the loss of aquatic vascular plants in Barton Springs Pool, where salamanders were reportedly abundant in 1946. The plants disappeared during the late 1980's (Chippindale et al. 1993). The cause of the disappearance is unknown and may be due to changes in water quality originating upstream (such as increased turbidity), certain pool maintenance operations, and/or other factors. Aquatic plants are important because they provide cover where salamanders can hide from predators. Amphipods and other invertebrates that form the diet of salamanders also depend on aquatic vegetation (Hillis and Chippindale 1992).

Reduced water levels in the Barton Springs segment could also adversely impact the Barton Springs salamander. The volume of springflow is self-regulated by the level of water in the aquifer. Discharge decreases as water storage in the aquifer drops, which historically has been due primarily to the lack of recharging rains rather than groundwater withdrawal for public consumption (Slade et al. 1986). Reduced aquifer levels may lead to the movement of water with high levels of total dissolved solids from the "bad water" zone to the freshwater zone of the Barton Springs segment, including Barton Springs (Slade et al. 1986). The increased concentration of dissolved solids resulting from this encroachment of "bad water" could have negative impacts on the plants and animals associated with Barton Springs. Reduced groundwater levels would also increase the concentration of pollutants in the aquifer.

The potential for "bad water" encroachment is increased with (a) pumpage of the aquifer and (b) extended low recharge or low flow conditions (Slade et al. 1986). Barton Springs lies near the "bad water" line. Under low flow conditions, Barton Springs and a well near the "bad water" line (YD–58–50–216) show increased dissolved solid concentrations, particularly sodium and chloride, indicating that some encroachment of "bad water" has occurred at Barton Springs in the past (Slade et al. 1986).

According to the Barton Springs/Edwards Aquifer Conservation District (BS/EACD) (1990), pumpage from the aquifer has increased in recent years, resulting in decreased discharges from Barton Springs. The USGS has stated that groundwater withdrawal in the area is expected to increase because of further urbanization in outlying areas of Austin. Currently, discharge from the Barton Springs segment (withdrawal plus springflow) is roughly equal to recharge. Thus, an increase in groundwater withdrawal is likely to cause a decrease in the quantity of water in the aquifer and discharge from Barton Springs (Slade et al. 1986). Based on the current population projection, water demands could almost double by the year 2000 (from about 470 hectare-meters/year (3,800 acre-feet/year) in 1982 to about 760 hectare-meters/year (6,200 acre-feet/year)) (Slade et al. 1986).

B. *Overutilization for commercial, recreational, scientific, or educational purposes.* No threat from overutilization of this species is known to exist at this time. Several citizens have expressed concern over impacts to the salamander from recreational use of Barton Springs Pool for swimming. However, no evidence exists to indicate that swimming in Barton Springs Pool poses a threat to the salamander population. Provided that pool maintenance activities do not adversely impact the salamander and its habitat (see discussion under Factor A), swimming at Barton Springs Pool is not likely to disturb the salamander.

C. *Disease or predation.* Certain naturally occurring populations as well as captive individuals of *Eurycea neotenes* have shown symptoms of redleg, a bacterial (*Aeromonas* sp.) infection (Sweet 1978). The Barton Springs salamander may also be susceptible to this disease, although no diseases or parasites of the Barton Springs salamander have been reported. Primary predators of the Barton Springs salamander are believed to be fish and crayfish; however, no information exists to indicate that predation poses a major threat to this species.

D. *The inadequacy of existing regulatory mechanisms.* No existing rules or regulations specifically require protection of the Barton Springs salamander or its habitat. The salamander is not included on the TPWD's list of threatened and endangered species, and thus the species is not afforded protection by that agency. Several individuals who provided comments on the 90-day finding stated that existing state and local regulations are sufficient to mitigate potential water quality threats resulting from development activities in the Barton Springs segment and contributing zone. However, while there are many existing rules and regulations in place that will likely contribute positively to water quality and quantity, there are no assurances that they are adequate to protect the salamander and its habitat. Furthermore, whether the existing rules and regulations can provide long-term protection of the quality and quantity of the waters feeding Barton Springs is unknown.

There are few measures in place to prevent the risk of hazardous material spills across the recharge and contributing zones. No regulations prohibit the transportation of hazardous materials across the Barton Springs segment (Tom Word, Texas Department of Transportation (TxDOT), pers. comm., 1993), and few existing roads have water quality control structures (such as hazardous materials traps, sediment basins, and filters) to protect against non-point-source pollution and chemical spills (Shyra Darr, Travis County Public Improvements and Transportation Department (PITD), *in litt.*, 1993; Barnett, *in litt.*, 1993; Roland Gamble, TxDOT, *in litt.*, 1993). Travis County and TxDOT have agreed to install water quality devices on new State and county roadway construction projects in the recharge zone (Barnett, *in litt.*, 1993; David Pimentel, PITD, *in litt.*, 1993; Gamble, *in litt.*, 1993). However, no program is currently in place to retrofit these water quality control structures on existing roadways in the Barton Springs segment (Barnett, *in litt.*, 1993). In addition, the effectiveness of these water quality control structures has not yet been determined (Gamble, *in litt.*, 1993).

The major regulations affecting water quality in the Barton Springs segment include the Edwards Rules (31 Texas Administrative Code, Chapter 313), which are promulgated and enforced by the TWC, and the City of Austin's water quality protective ordinances (Williamson Creek Ordinance (1980), Barton Creek Watershed Ordinance (1981), Lower Watersheds Ordinance (1981), Comprehensive Watersheds Ordinance (1986), "Composite Ordinance" (1991), and the "Save Our Springs" ("SOS") Ordinance (1992)). These ordinances are only implemented within Austin's city limits and five-mile extra-territorial jurisdiction, which is about a third of the entire area affecting Barton Springs. Each ordinance includes impervious cover limitations, development setbacks from water quality zones, erosion control measures, restricted or prohibited development on steep slopes, and other water quality protective measures. However, none of the ordinances include retrofit provisions for existing developments or land use regulations (Barnett, *in litt.*, 1993). Furthermore, the ordinances can be rendered ineffective by variance provisions and exemptions. The SOS Ordinance requires greater impervious cover limitations, further development restrictions in the water quality zones of Barton Creek, and limitations of exemptions from the ordinance provisions, and will attempt to reduce the risk of accidental contamination (Barnett, *in litt.*, 1993).

The Edwards Rules regulate construction-related activities on the recharge zone that may "alter or disturb the topographic, geologic, or existing recharge characteristics of a site" as well as any other activity "which may pose a potential for contaminating the Edwards Aquifer," including sewage collection systems and hazardous materials storage tanks. The Edwards Rules regulate construction activities through review of Water Pollution Abatement Plans (WPAPs). The WPAPs do not require site-specific water quality performance standards for developments over the recharge zone nor do they address land use, impervious cover limitations, or retrofitting for developments existing prior to the implementation of the Rules. (Travis County was not incorporated into the Rules until March, 1990; Hays County was incorporated in 1984.) The WPAPs also do not regulate development activities in the aquifer's contributing zone. As yet, the Edwards Rules do not include a comprehensive plan to address the effects of cumulative impacts on water quality in the aquifer.

The long-term success of the watershed ordinances and the Edwards Rules in protecting water quality is unknown. Based on the water quality data and changes observed in Barton Creek (see discussion under Factor A), some level of water quality degradation in this area has already occurred (City of Austin 1991; Librach, *in litt.*, 1990). Even if the Edwards Rules and the watershed ordinances are determined to be effective at protecting water quality, about 50 percent of the area (most of which occurs in Hays County) affecting the waters of the aquifer and Barton Springs is not covered by these City and State rules and regulations. Hays County recently filed a lawsuit against the City of Austin to remove Hays County from the city's extra-territorial jurisdiction, which would further reduce the area covered by the watershed ordinances.

Furthermore, there is no guarantee that the SOS Ordinance or any of the preceding ordinances will remain in effect. A lawsuit has been filed to invalidate the SOS Ordinance. Several bills have also been proposed in the Texas Legislature aimed at restricting local environmental regulatory powers, and could prevent the City of Austin and other local governments from implementing water quality protection ordinances such as the SOS ordinance.

The Balcones Canyonlands Conservation Plan (BCCP) is being developed for Travis County to obtain a section 10(a)(1)(B) permit allowing incidental taking of certain endangered species. Parties involved in the preparation of the BCCP are TPWD, City of Austin, Travis County, and Lower Colorado River Authority. The current draft regional plan does not explicitly provide for conservation of the Barton Springs salamander (City of Austin *et al.* 1993). Proposals to acquire land within the Barton Creek watershed will provide benefits to the salamander by preserving the natural integrity of the landscape and positively contributing to water quality in Barton Creek and Barton Springs. The BCCP participants are currently working toward providing additional surface and groundwater quality protection, including retrofitting existing developments with non-point pollution controls and protecting the aquifer and Barton Springs from catastrophic pollution events. The BCCP has not yet been completed or approved and applies only to Travis County. The BCCP does not remove threats from development activities in Hays County.

While the City of Austin has voluntarily committed to revising pool cleaning and other maintenance operations in Zilker Park to assist in protecting the salamander and its surface habitat, no legal agreement or other incentive is in place to ensure that these efforts will continue for the long term.

To protect water quantity in the Barton Springs segment, the BS/EACD has developed a Drought Contingency

Plan. Barton Springs has always flowed during recorded history and one of the BS/EACD's goals is to assure Barton Springs springflow "does not fall appreciably below historic low levels" (BS/EACD 1990). The BS/EACD regulates municipal and industrial wells that pump more than 10,000 gallons per day (about 60–70 percent of the total volume that is pumped from the Barton Springs segment) and has the ability to limit development of new wells, impose water conservation measures, and curtail pumpage from these wells during drought conditions. According to the BS/EACD (Bill Couch, BS/EACD, pers. comm., 1992), water well production in the higher elevations of the Barton Springs segment has been limited during periods of lower aquifer levels in recent years. However, the ability of the BS/EACD to ensure the plan's success is limited, since it has limited enforcement authority and does not regulate 30 to 40 percent of the total volume that is pumped from the Barton Springs segment. Furthermore, the BS/EACD is not authorized to curtail groundwater withdrawal specifically for the protection of the Barton Springs salamander and its habitat.

E. *Other natural or manmade factors affecting its continued existence.* The very restricted range of the Barton Springs salamander makes this species especially vulnerable to acute and/or chronic groundwater contamination. Since the salamander is an aquatic species, there is no possibility for escape from contamination or other threats to its habitat. A single incident (such as a contaminant spill) has the potential to eliminate the entire species and/or its prey base. Crustaceans, particularly amphipods, on which the salamander feeds, are especially sensitive to water pollution (Mayer and Ellersieck 1986). Based on acute static toxicity data for 63 species tested against 174 chemicals, the Service (Mayer and Ellersieck 1986) has identified amphipods as being the third most sensitive taxonomic group tested.

The effects of environmental contaminants on amphibians has not been well documented, and the toxic effects of most chemicals is unknown. However, current research indicates that amphibians, particularly their eggs and larvae, are sensitive to many of the pollutants that have been tested, such as heavy metals; certain insecticides, particularly cyclodienes (endosulfan, endrin, toxaphene, and dieldrin) and certain organophosphates (parathion, malathion); nitrite; salts; and oil (Harfenist *et al.* 1989). Regarding pesticides, Christine Bishop (Canadian Wildlife Service) states that "the health of amphibians can suffer from exposure to pesticides (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 * * * [Furthermore] pesticides probably change the quality and quantity of amphibian food and habitat" (Bishop and Pettit 1992). Toxic effects to amphibians from pollutants may include morphological and developmental aberrations, lowered reproduction and survival, and changes in behavior and certain biochemical processes.

Available information on the effects of contaminants on central Texas *Eurycea* salamanders indicates that these species are very sensitive to changes in water quality. Captive *Eurycea* species, including the Barton Springs salamander, appear to be especially sensitive to changes in water quality and are "quite delicate and difficult to keep alive" (Sweet, *in litt.*, 1993). Sweet reported that captive individuals exhibit toxic reactions to plastic containers, aged tapwater, and detergent residues. The water in which these salamanders are kept also requires frequent changing. The lack of success in attempts at captive propagation of the Barton Springs salamander (Price, pers. comm., 1992) and the San Marcos salamander (*Eurycea nana*) (Janet Nelson, Southwest Texas State University, pers. comm., 1992) may be due to these species' sensitivity to environmental stress. As discussed under Factor A, the Barton Springs salamander also appears to be sensitive to chlorine (Chippindale *et al.* 1993, TPWD 1993).

Recent contamination at Stillhouse Hollow Preserve also demonstrates the sensitivity of *Eurycea* salamanders to changes in water quality. This event appears to have resulted in the decline of a spring population of another species of *Eurycea* found north of the Colorado River (locally known as the "Jollyville Plateau salamander"). The preserve contains two spring outlets, the larger of which has supported an abundant salamander population; a few individuals are typically found at the smaller spring (Hillis and Price, pers. comms., 1993). During a routine inspection of this property on November 19, 1992, a City of Austin employee reported "large amounts of foam" emanating from the larger spring outlet (Mike Kalender, City of Austin Parks and Recreation Department, pers. comm., 1993). The type and source of the contaminant is unknown (Chuck Lesniak, City of Austin Environmental and Conservation Services Department, pers. comm., 1993). Despite repeated search efforts following the incident, no salamanders were observed at or below this spring outlet until over three months later (February 24, 1993), when two individuals were observed (Hillis, Kalender, and Price, pers. comms., 1993).

The Service has carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by this species in determining to propose this rule. The best scientific data indicate that the Barton Springs salamander faces multiple threats from declining water quality and quantity and therefore warrants listing. Based on this evaluation, the preferred action is to list the Barton Springs salamander as endangered. A decision to take no action would constitute failure to properly classify this species pursuant to the Endangered Species Act and would exclude the salamander from protection provided by the Act. A decision to propose threatened status would not adequately reflect its restricted distribution, vulnerability of habitat, and multiplicity of threats that confront it. For the reason given below, critical habitat designation for the Barton Springs salamander is not being proposed.

Critical Habitat

Section 4(a)(3) of the Act, as amended, requires that, to the maximum extent prudent and determinable, the Secretary propose critical habitat at the time the species is proposed to be endangered or threatened. The Service's listing regulations at 50 CFR 424.12(a)(1) specify that designation of critical habitat is not prudent when such designation would not be beneficial to the species. The Service finds that designation of the springs occupied by the Barton Springs salamander as critical habitat would not be prudent because it would not provide a conservation benefit to the species, and would actually be detrimental to the species by suggesting a misleadingly restricted view of its true conservation needs.

Designation of Barton Springs as critical habitat would not provide a conservation benefit to the Barton Springs salamander beyond benefits provided by listing and the subsequent evaluation of activities under section 7 of the Act for possible jeopardy to the species. In the Service's section 7 regulations at 50 CFR 402, the definition of "jeopardize the continuing existence" includes "to reduce appreciably the likelihood of both the survival and recovery of the listed species," and "adverse modification" is defined as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species." Because the species is endemic to such a highly localized area, actions that appreciably diminish water quality and quantity at Barton Springs would be fully evaluated for their effects on the salamander through analysis of whether the actions would be likely to jeopardize the continuing existence of the species. Any action that would appreciably diminish the value, in quality or quantity, of flows from Barton Springs would also reduce appreciably the likelihood of survival and recovery of the Barton Springs salamander. The analysis for possible jeopardy applied to the Barton Springs salamander would therefore be identical to the section 7 analysis for determining adverse modification or destruction of critical habitat; no distinction between jeopardy and adverse modification for activities impacting the waters of Barton Springs can be made at this time. Application of section 7 relative to critical habitat would therefore not add measurable protection to the species beyond what is achievable through review for jeopardy.

Designation of the springs and their immediate environment as critical habitat would actually be detrimental to conservation efforts for the Barton Springs salamander, because it would promote the misconception that the Barton Springs are the only areas important to the conservation of the species. Conservation efforts for the species must address a wide variety of federally funded or authorized activities (summarized in the "Available Conservation Measures" section of this proposed rule) that affect the quality and quantity of water available to the species through their effects on the recharge sources and aquifer that supply water to the habitat of the salamander. Nearly all of these activities will occur beyond the immediate vicinity of Barton Springs, and some will occur several miles away. Designation of Barton Springs as critical habitat would be misleading in implying to federal agencies whose activities may affect the Barton Springs salamander that the Service's concern for the species is limited only to activities taking place at the springs occupied by the species. Designation of Barton Springs as critical habitat would therefore not be prudent.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing encourages and results in conservation actions by Federal, State, and private agencies, groups, and individuals. The Act provides for possible land acquisition and cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required of Federal agencies and the prohibitions against taking and harm are discussed, in part, below.

Conservation and management of the Barton Springs salamander is likely to involve removing threats to the survival of the salamander, including (1) protecting the quality of springflow from Barton Springs by implementing comprehensive programs to control and reduce point sources and non-point sources of pollution throughout the Barton Springs segment of the Edwards Aquifer, (2) minimizing the likelihood of pollution events that would affect groundwater quality, (3) continuing to protect groundwater and springflow quantity by implementing water conservation and drought contingency plans throughout the Barton Springs segment, and (4) continuing to examine and implement pool cleaning practices and other park operations that protect and perpetuate the salamander's surface habitat and population. It is also anticipated that listing will encourage research on the Barton Springs salamander's distribution within the aquifer and critical aspects of its biology (e.g., longevity, natality, sources of mortality, feeding ecology, and sensitivity to contaminants and other water quality constituents).

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is being designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Potential activities that may affect the salamander and its habitat include (1) urban development over the recharge and contributing zones that may lead to contamination of the species' water supply through one or more accidental contaminant spills or chronic water quality degradation, (2) increased groundwater withdrawal leading to reduced groundwater levels and springflow (compounded if drought occurs), and (3) certain pool maintenance practices or other activities that may impact the salamander and its surface habitat (such as use of chemicals and high pressure hoses in areas occupied by salamanders and removal of substrates used for cover). Federal agency actions that may require conference and/or consultation as described in the preceding paragraph include Army Corps of Engineers involvement in projects such as the construction of roads, bridges, and dredging projects subject to section 404 of the Clean Water Act (33 U.S.C. 1344 *et seq.*) and section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 401 *et seq.*), pipeline projects, U.S. Environmental Protection Agency authorized discharges under the National Pollutant Discharge Elimination System (NPDES), and Soil Conservation Service and U.S. Housing and Urban Development projects.

The Act and its implementing regulations found at 50 CFR 17.21 set forth a series of general prohibitions and exceptions that apply to all endangered wildlife. These prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these), import or export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. It also is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to agents of the Service and State conservation agencies.

Permits may be issued to carry out otherwise prohibited activities involving endangered wildlife species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.22 and 17.23. Such permits are available for scientific purposes, to enhance the propagation or survival of the species, and/or for incidental take in the course of otherwise lawful activities. This species is not in trade, and such permit requests are not expected.

Requests for copies of the regulations regarding listed wildlife and inquiries regarding prohibitions and permits may be addressed to the Office of Management Authority, U.S. Fish and Wildlife Service, room 420C, 4401 N. Fairfax Drive, Arlington, Virginia 22203 (703/358–2104; FAX 703/358–2281).

Public Comments Solicited

The Service intends that any final action resulting from this proposal will be as accurate and as effective as possible. Therefore, comments or suggestions from the public, other concerned governmental agencies, the scientific community, industry, or any other interested party concerning this proposed rule are hereby solicited. Comments particularly are sought concerning:

(1) Biological, commercial trade, or other relevant data concerning any threat (or lack thereof) to the Barton Springs salamander;

(2) The location of any additional populations of this species and the reasons why any habitat should or should not be determined to be critical habitat as provided by section 4 of the Act;

(3) Additional information concerning the range, distribution, and population size of this species; and

(4) Current or planned activities in the Barton Springs segment of the Edwards Aquifer, its contributing zone, and the area around Barton Springs and possible impacts on this species resulting from these activities.

Final promulgation of the regulations on this species will take into consideration the comments and any additional information received by the Service, and such communications may lead to a final regulation that differs from this proposal.

The Endangered Species Act provides for one or more public hearings on this proposal, if requested. Requests must be received within 45 days of the date of publication of the proposal in the **Federal Register**. Such requests must be made in writing and be addressed to State Administrator, U.S. Fish and Wildlife Service (see **ADDRESSES** section).

National Environmental Policy Act

The Fish and Wildlife Service has determined that an Environmental Assessment and Environmental Impact Statements, as defined under the authority of the National Environmental Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Endangered Species Act of 1973, as amended. A notice outlining the Service's reasons for this determination was published in the **Federal Register** on October 25, 1983 (48 FR 49244).

References Cited

A complete list of all references cited herein is available upon request from the Austin Ecological Services Office (see **ADDRESSES** section).

Author

The primary author of this proposed rule is Lisa O'Donnell, U.S. Fish and Wildlife Service (see **ADDRESSES** section) (512/482–5436).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Proposed Regulation Promulgation

Accordingly, the Service hereby proposes to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500, unless otherwise noted.

2. § 17.11(h) is amended by adding the following, in alphabetical order under Amphibians, to the List of Endangered and Threatened Wildlife, to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Amphibians							
*	*	*	*	*		*	*
Salamander, Barton Springs.	*Eurycea sosorum*	U.S.A. (TX)	Entire	E	....	NA	NA
*	*	*	*	*		*	*

Dated: February 9, 1994.

Mollie H. Beattie,

Director, U.S. Fish and Wildlife Service.

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