FEDERAL REGISTER

Vol. 77 Thursday,
No. 159 August 16, 2012

Part III

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Endangered Status for Six West Texas Aquatic Invertebrate Species and Designation of Critical Habitat; Proposed Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R2–ES–2012–0029; 4500030113]

RIN 1018–AX70

Endangered and Threatened Wildlife and Plants; Endangered Status for Six West Texas Aquatic Invertebrate Species and Designation of Critical Habitat

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: We, the U.S. Fish and Wildlife Service, propose to list as endangered and propose critical habitat for six west Texas aquatic invertebrate species under the Endangered Species Act. These actions are being taken as the result of a court-approved settlement agreement. These are proposed regulations, and if finalized the effect of these regulations will be to conserve the species and protect their habitat under the Endangered Species Act.

DATES: We will accept comments received or postmarked on or before October 15, 2012. We must receive requests for public hearings, in writing, at the address shown in **FOR FURTHER INFORMATION CONTACT** by October 1, 2012.

ADDRESSES: You may submit comments by one of the following methods:

(1) *Electronically:* Go to the Federal eRulemaking Portal: *http://www.regulations.gov* and search for FWS–R2–ES–2012–0029, which is the docket number for this rulemaking.

(2) *By hard copy:* Submit by U.S. mail or hand-delivery to: Public Comments Processing, Attn: FWS–R2–ES–2012–0029; Division of Policy and Directives Management; U.S. Fish and Wildlife Service; 4401 N. Fairfax Drive, MS 2042–PDM; Arlington, VA 22203.

We request that you send comments only by the methods described above. We will post all comments on *http://www.regulations.gov.* This generally means that we will post any personal information you provide us (see the Public Comments section below for more information).

The coordinates, or plot points, or both from which the critical habitat maps are generated are included in the administrative record for this rulemaking and are available at (*http://www.fws.gov/southwest/es/AustinTexas/*), *http://www.regulations.gov* at Docket No. FWS–R2–ES–2012–0029, and at the Austin Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**). Any additional tools or supporting information that we may develop for this rulemaking will also be available at the Fish and Wildlife Service Web site and Field Office set out above, and may also be included in the preamble and/or at *http://www.regulations.gov.*

FOR FURTHER INFORMATION CONTACT: Adam Zerrenner, Field Supervisor, U.S. Fish and Wildlife Service, Austin Ecological Services Field Office, 10711 Burnet Road, Suite 200, Austin, TX 78758; by telephone 512–490–0057; or by facsimile 512–490–0974. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

This document consists of proposed rules to list six west Texas aquatic invertebrate species as endangered and propose critical habitat designations for the six species. The six west Texas aquatic invertebrate species are: Phantom Cave snail *(Pyrgulopsis texana),* Phantom springsnail *(Tryonia cheatumi),* diminutive amphipod *(Gammarus hyalleloides),* Diamond Y Spring snail *(Pseudotryonia adamantina),* Gonzales springsnail *(Tryonia circumstriata),* and Pecos amphipod *(Gammarus pecos).* The current range for the first three species is limited to spring outflows in the San Solomon Springs system near Balmorhea in Reeves and Jeff Davis Counties, Texas. The current range of the latter three species is restricted to spring outflow areas within the Diamond Y Spring system north of Fort Stockton in Pecos County, Texas.

Why we need to publish a rule. Under the Endangered Species Act, a species may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. In this proposal we are explaining why these six species warrant protection under the Endangered Species Act. Five of the six species of aquatic invertebrates are currently identified as candidates for listing based on threats to their habitat. The table below summarizes the status of each species:

Species	Present range	Status of species
Phantom Cave snail	San Solomon Spring system (four springs)	common in a very restricted range.
Phantom Lake springsnail	San Solomon Spring system (four springs)	very rare in a very restricted range.
diminutive amphipod	San Solomon Spring system (four springs)	common in a very restricted range.
Diamond Y Spring snail	Diamond Y Spring system (two springs)	very rare in a very restricted range.
Gonzales springsnail	Diamond Y Spring system (two springs)	very rare in a very restricted range.
Pecos amphipod	Diamond Y Spring system (two springs)	common in a very restricted range

These rules propose that all six of these species should be listed as endangered. We are proposing a listing status of endangered for these six species of aquatic invertebrates from west Texas.

The Endangered Species Act provides the basis for our action. Under the Endangered Species Act, we can determine that a species is endangered or threatened based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence. We are proposing that all six species are endangered by the combined effects of:

- Habitat loss and degradation of aquatic resources, particularly the current and ongoing decline in spring flows that support the habitat of all the species, and the potential for future water contamination at the Diamond Y Spring system.
- Inadequate existing regulatory mechanisms that allow significant threats such as groundwater withdrawal.
- Other natural or manmade factors, including the presence of nonnative snails and the small, reduced ranges of the species.

These rules also propose designation of critical habitat for each of the six species. Under the Endangered Species Act, we designate specific areas as critical habitat to foster conservation of listed species. Future actions funded, permitted, or otherwise carried out by Federal agencies will be reviewed to ensure they do not adversely modify critical habitat. Critical habitat does not affect private actions on private lands. We are proposing the following areas in Texas as critical habitat for Phantom Cave snail, Phantom springsnail, and diminutive amphipod:

Critical habitat unit	Land ownership by type	Size of unit in hectares (acres)
San Solomon Spring, Reeves County	State—Texas Parks and Wildlife Department	1.8 (4.4)
Giffin Spring, Reeves County	Private	0.7 (1.7)
East Sandia Spring, Reeves County	Private—The Nature Conservancy	1.2 (3.0)
Phantom Lake Spring, Jeff Davis County	Federal—Bureau of Reclamation	0.02 (0.05)
Total		3.7 (9.2)

Note: Area sizes may not sum due to rounding.

We are proposing the following areas as critical habitat for Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod:

Critical habitat unit	Land ownership by type	Size of unit in hectares (acres)
Diamond Y Spring System, Pecos County	Private—The Nature Conservancy	178.6 (441.4)
Total		178.6 (441.4)

We are preparing an economic analysis. We are preparing an economic analysis of the proposed designations of critical habitat to allow for consideration of the economic impacts of the proposed designations of critical habitat. We will publish an announcement and seek public comments on the draft economic analysis when it is completed.

We will request peer review of the methods used in our proposal. We are seeking comments from independent specialists with scientific expertise in these species or related fields. We have invited these peer reviewers to comment on the scientific information and methods that we used in making this proposal. Because we will consider all comments and information received during the comment period, our final determinations may differ from this proposal.

We are seeking public comment on these proposed rules. Anyone is welcome to comment on our proposal or provide additional information on the proposal that we can use in making a final determination on the status of these species. Please submit your comments and materials concerning these proposed rules by one of the methods listed in the **ADDRESSES** section. Within 1 year following the publication of this proposal, we will publish in the **Federal Register** a final determination to list one or more of these species as threatened or endangered, or withdraw the proposals if new information is provided that supports that decision.

Public Comments

We intend that any final action resulting from these proposed rules will be based on the best scientific and commercial data available and be as accurate and as effective as possible. Therefore, we request comments or information from the public, other concerned governmental agencies, Native American tribes, the scientific community, industry, or any other interested parties concerning these proposed rules. We particularly seek comments concerning:

(1) Biological, commercial trade, or other relevant data concerning any threats (or lack thereof) to this species and regulations that may be addressing those threats.

(2) Additional information concerning the historical and current status, range, distribution, and population size of this species, including the locations of any additional populations of this species.

(3) Any information on the biological or ecological requirements of the species, and ongoing conservation measures for the species and its habitat.

(4) Current or planned activities in the areas occupied by the species and possible impacts of these activities on this species.

(5) The reasons why we should or should not designate habitat as ''critical habitat'' under section 4 of the Act (16 U.S.C. 1531 *et seq.*) including whether there are threats to the species from human activity, the degree of which can be expected to increase due to the designation, and whether that increase in threat outweighs the benefit of designation such that the designation of critical habitat may not be prudent.

(6) Specific information on:

(a) The amount and distribution of habitat for the six west Texas aquatic invertebrates;

(b) What areas, that were occupied at the time of listing (or are currently occupied) and that contain features essential to the conservation of the species, should be included in the designation and why;

(c) Special management considerations or protection that may be needed in critical habitat areas we are proposing, including managing for the potential effects of climate change; and

(d) What areas not occupied at the time of listing are essential for the conservation of the species and why.

(7) Land use designations and current or planned activities in the subject areas and their possible impacts on proposed critical habitat.

(8) Information on the projected and reasonably likely impacts of climate change on the six west Texas aquatic invertebrates and proposed critical habitat.

(9) Any probable economic, national security, or other relevant impacts of designating any area that may be included in the final designation; in particular, any impacts on small entities or families, and the benefits of including or excluding areas that exhibit these impacts.

(10) Whether any specific areas we are proposing for critical habitat designation should be considered for exclusion under section 4(b)(2) of the Act, and whether the benefits of

potentially excluding any specific area outweigh the benefits of including that area under section 4(b)(2) of the Act.

(11) Whether the benefits of exclusion outweigh the benefits of including the area proposed as critical habitat around San Solomon Spring at Balmorhea State Park based on the existing habitat conservation plan or other relevant factors.

(12) Whether we could improve or modify our approach to designating critical habitat in any way to provide for greater public participation and understanding, or to better accommodate public concerns and comments.

Please note that submissions merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination, as section 4(b)(1)(A) of the Act directs that determinations as to whether any species is a threatened or endangered species must be made ''solely on the basis of the best scientific and commercial data available.''

You may submit your comments and materials concerning these proposed rules by one of the methods listed in the **ADDRESSES** section. We request that you send comments only by the methods described in the **ADDRESSES** section.

If you submit information via *http://www.regulations.gov,* your entire submission—including any personal identifying information—will be posted on the Web site. If your submission is made via a hardcopy that includes personal identifying information, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so. We will post all hardcopy submissions on *http://www.regulations.gov.* Please include sufficient information with your comments to allow us to verify any scientific or commercial information you include.

Comments and materials we receive, as well as supporting documentation we used in preparing these proposed rules, will be available for public inspection on *http://www.regulations.gov,* or by appointment, during normal business hours, at the U.S. Fish and Wildlife Service, Austin Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Previous Federal Actions

We first proposed the Phantom Cave snail and Phantom springsnail as endangered species on April 28, 1976 (41 FR 17742). At that time, the Phantom Cave snail *(Pyrgulopsis texana)* was referred to as the Reeves County snail *(Cochliopa texana),* and the Phantom springsnail was referred to as the Cheatum's snail. The proposal was withdrawn on March 6, 1979 (44 FR 12382), following 1978 amendments to the Act that made additional requirements necessary for designating critical habitat. Both species were added as candidates for listing in the May 22, 1984, Notice of Review of Invertebrate Wildlife for Listing as Endangered or Threatened Species (49 FR 21664). At that time they were categorized as Category 2 Candidates, which meant that we had information that proposed listing is possibly appropriate, but conclusive data on biological vulnerability and threats was not available to support a proposed rule at the time. They remained so designated in our subsequent annual Candidate Notices of Review (54 FR 554, January 6, 1989; 56 FR 58804, November 21, 1991; and 59 FR 58982, November 15, 1994). In the February 28, 1996, Notice (61 FR 7596), we discontinued the designation of Category 2 species as candidates, which removed these two species from the candidate list.

Both species were then added back to the candidate list on October 30, 2001 (66 FR 54808). Species on the candidate list are those fish, wildlife, and plants for which we have on file sufficient information on biological vulnerability and threats to support preparation of a listing proposal, but for which development of a listing regulation is precluded by other higher priority listing activities. Since 2001, the listing priority number for both species has been a 2, reflecting species with threats that are both imminent and high in magnitude in accordance with our priority guidance published on September 21, 1983 (48 FR 43098). These two snails remained candidates in subsequent Candidate Notices of Review (67 FR 40657, June 13, 2002; 69 FR 24876, May 4, 2004). Both species were also petitioned for listing on May 11, 2004, and were found to be warranted for listing but precluded by higher priority activities in subsequent Candidate Notice of Reviews (70 FR 24870, May 11, 2005; 71 FR 53756, September 12, 2006; 72 FR 69034, December 6, 2007; 73 FR 75176, December 10, 2008; 74 FR 57804, November 9, 2009; and 75 FR 69222, November 10, 2010). The October 26, 2011, Candidate Notice of Review (76 FR 66370) stated that we were working on proposed listing rules for these species.

We identified the Diamond Y Spring snail and Gonzales springsnail as candidates for listing in the January 6, 1989, Endangered or Threatened Wildlife and Plants, Annual Notice of Review (54 FR 554). These snails were designated as Category 1 candidates, indicating we had substantial information to support listing, but a proposed rule was precluded by other listing activities. These two species were included in all of our subsequent annual Candidate Notices of Review even after discontinuing the candidate categories (56 FR 58804, November 21, 1991, and 59 FR 58982, November 15, 1994). From 1996 to 1999 these two species had a listing priority number of 5, reflecting species with high magnitude but nonimminent threats (61 FR 7596, February 28, 1996; 62 FR 49398, September 19, 1997; and 64 FR 57534, October 25, 1999). In 2001 we elevated the listing priority number from 5 to 2 because of a new, imminent threat associated with the introduction of nonnative snails into the species' habitat. A listing priority of 2 indicates both high magnitude and imminent threats. Both species have maintained a listing priority of 2 since then (66 FR 54808, October 30, 2001; 67 FR 40657, June 13, 2002; and 69 FR 24876, May 4, 2004). These two species were also petitioned for listing on May 11, 2004, and were found to be warranted for listing but precluded by higher priority activities in subsequent Candidate Notice of Reviews (70 FR 24870, May 11, 2005; 71 FR 53756, September 12, 2006; 72 FR 69034, December 6, 2007; 73 FR 75176, December 10, 2008; 74 FR 57804, November 9, 2009; and 75 FR 69222, November 10, 2010). The October 26, 2011, Candidate Notice of Review (76 FR 66370) stated that we were working on proposed listing rules for these species.

We identified the diminutive amphipod and Pecos amphipod as Category 2 candidate species for listing in the May 22, 1984, Notice of Review of Invertebrate Wildlife for Listing as Endangered or Threatened Species (49 FR 21664). They remained so designated in our subsequent annual Candidate Notices of Review (54 FR 554, January 6, 1989; 56 FR 58804, November 21, 1991; and 59 FR 58982, November 15, 1994). In the February 28, 1996, Notice (61 FR 7596), we discontinued the designation of Category 2 species as candidates, which removed these two species from the candidate list. The diminutive amphipod was added back to the candidate list on May 11, 2005 (70 FR 24870), and has remained a candidate with a listing priority number of 2 (reflecting both high-magnitude and imminent threats) since that time (71 FR 53756, September 12, 2006; 72 FR

69034, December 6, 2007; 73 FR 75176, December 10, 2008; 74 FR 57804, November 9, 2009; and 75 FR 69222, November 10, 2010). The October 26, 2011, Candidate Notice of Review (76 FR 66370) stated that we were working on a proposed listing rule for the diminutive amphipod.

The Pecos amphipod was not included in recent candidate notices along with the other species in this proposal because of taxonomic uncertainties, which have since been resolved. In the past it was unclear whether this species range was limited to Diamond Y Spring. Recent genetic research has confirmed that the species is endemic to Diamond Y Spring (see full discussion below under *Taxonomy, Distribution, and Abundance of Amphipods,* Pecos Amphipod). The Pecos amphipod was included in the June 25, 2007, petition by WildEarth Guardians to the Service seeking the listing of 475 species in the southwestern United States. On January 6, 2009, we published a partial 90-day finding of the petition for listing 475 species which included a finding that the petition did not present substantial scientific or commercial information indicating that the listing of the Pecos amphipod may be warranted (74 FR 419). During our current review of the other species endemic to the Diamond Y Spring system, we reviewed the status of the Pecos amphipod. Based on the results of that review, we are proposing to list it as endangered.

Background

We intend to discuss below only those topics directly relevant to the consideration of the listing of the six west Texas aquatic invertebrates as endangered and proposed critical habitat designations. We have organized this **Background** section into three parts. The first part is a general description of the two primary spring systems where the six species occur. The second part is a general description of the life history and biology of the four snail species, followed by specific biological information on each of the four snail species. The third part is a general description of the life history and biology of the two amphipod species, followed by specific biological information on each of the two amphipod species.

Description of Chihuahuan Desert Springs Inhabited by Invertebrate Species

The six west Texas aquatic invertebrate species (Phantom Cave snail, Phantom springsnail, diminutive amphipod, Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod) occur within a relatively small area of the Chihuahuan Desert of the Pecos River drainage basin of west Texas. The habitats of these species are now isolated spring systems in expansive carbonate (limestone) deposit. The region includes a complex of aquifers (underground water systems) where the action of water on soluble rocks (like limestone and dolomite) has formed abundant ''karst'' features such as sinkholes, caverns, springs, and underground streams. These hydrogeological formations provide unique settings where a diverse assemblage of flora and fauna has evolved at the points where the aquifers discharge waters to the surface through spring openings. The isolated limestone and gypsum springs, seeps, and wetlands located in this part of west Texas provide the only known habitats for several endemic species of fish, plants, mollusks, and crustaceans, including the six endemic aquatic invertebrate species addressed in these proposed rules.

In the Chihuahuan Desert, spring-adapted aquatic species are distributed in isolated, geographically separate populations. They likely evolved into distinct species from parent species that once enjoyed a wider distribution during wetter, cooler climates of the Pleistocene epoch (about 10,000 to 2.5 million years before present). As ancient lakes and streams dried during dry periods (since the Late Pleistocene, within about the last 100,000 years), aquatic species in this region became patchily distributed across the landscape as geographically isolated populations exhibiting a high degree of endemism (species found only in a particular region, area, or spring). Such speciation through divergence has been reported for these species (Gervasio *et al.* 2004, p. 521; Brown *et al.* 2008, pp. 486–487; Seidel *et al.* 2009, p. 2304).

San Solomon Spring System

In these proposed rules we reference the San Solomon Spring system to include four different existing spring outflows: San Solomon Spring, Giffin Spring, Phantom Lake Spring, and East Sandia Spring. The springs in this area are also commonly referred to by some authors as Toyah Basin springs or Balmorhea area springs. All of the springs historically drained into Toyah Creek, an intermittent tributary of the Pecos River that is now dry except following large rainfall events. All four springs are located in proximity to one another; it is about 13 kilometers (km) (8 miles (mi)) between the farthest two (East Sandia Spring to Phantom Lake Spring). Brune (1981, pp. 258–259, 382–386) provides a brief overview of each of these springs and documents their declining flows during the early and middle twentieth century.

The San Solomon Spring system is located in the Chihuahuan Desert of west Texas at the foothills of the Davis Mountains near Balmorhea, Texas. Phantom Lake Spring is in Jeff Davis County (on the county boundary with Reeves County), while the other major springs in this system are in Reeves County. In addition to being an important habitat for rare aquatic fauna, area springs have served for centuries as an important source of irrigation water for local farming communities. They are all located near the small town of Balmorhea (current population of less than 500 people) in west Texas. The area is very rural with no nearby metropolitan centers. Land ownership in the region is mainly private, except as described below around the spring openings, and land use is predominantly dry-land ranching with some irrigated farmland.

The base flows from all of these springs are thought to ultimately originate from a regional groundwater flow system. Studies show that groundwater moves through geologic faults from the Salt Basin northwest of the Apache and Delaware Mountains, located 130 km (80 mi) or more to the west of the springs (Sharp 2001, pp. 42–45; Angle 2001, p. 247; Sharp *et al.* 2003, pp. 8–9; Chowdhury *et al.* 2004, pp. 341–342; Texas Water Development Board 2005, p. 106). The originating groundwater and spring outflow are moderately to highly mineralized and appear to be of ancient origin, with the water being estimated at 10,000 to 18,000 years old (Chowdhury *et al.* 2004, p. 340; Texas Water Development Board 2005, p. 89). The Salt Basin Bolson aquifer is part of the larger West Texas Bolsons and is made up of connected sub-basins underlying Wild Horse, Michigan, Lobo, and Ryan Flats, in the middle and southern Salt Basin Valley in Texas (Angle, 2001, p. 242). (The term bolson is of Spanish origin and refers to a flat-floored desert valley that drains to a playa or flat.) These aquifers, which support the base flows (flows not influenced by seasonal rainfall events) of the San Solomon Spring system, receive little to no modern recharge from precipitation (Scanlon *et al.* 2001, p. 28; Beach *et al.* 2004, pp. 6–9, 8–9). Studies of the regional flow system indicate groundwater may move from south to north through the Salt Basin from Ryan to Lobo to Wild Horse Flats before being discharged through the Capitan

Formation, into the Lower Cretaceous rocks (older than Pleistocene) via large geologic faults then exiting to the surface at the springs (LaFave and Sharp 1987, pp. 7–12; Angle 2001, p. 247; Sharp 2001, p. 42–45; Chowdhury *et al.* 2004, pp. 341–342; Beach *et al.* 2004, Figure 4.1.13, p. 4–19, 4–53). Chemical analysis and hydrogeological studies support this hypothesis, and the water elevations throughout these parts of the Salt Basin Bolson aquifer are higher in elevation than the discharge points at the springs (Chowdhury *et al.* 2004, p. 342).

In contrast to the base flows, the springs also respond with periodic short-term increases in flow rates following local, seasonal rainstorms producing runoff events through recharge areas from the Davis Mountains located to the southwest of the springs (White *et al.* 1941, pp. 112–119; LaFave and Sharp 1987, pp. 11–12; Chowdhury *et al.* 2004, p. 341). These freshwater recharge events provide very temporary increases in spring flows, sometimes resulting in flow spikes many times larger than the regular base flows. The increased flows are short-lived until the local stormwater recharge is drained away and spring flows return to base flows supported by the distant aquifers. Historically, many of the springs in this spring system were likely periodically interconnected following storm events with water flowing throughout the Toyah Creek watershed. In recent times, however, manmade structures altered the patterns of spring outflows and stormwater runoff, largely isolating the springs from one another except through irrigation canals.

San Solomon Spring is by far the largest single spring in the Toyah Basin (Brune 1981, p. 384). The artesian spring issues from the lower Cretaceous limestone at an elevation of about 1,008 meters (m) (3,306 feet (ft)). Brune (1981, p. 385) reported spring flows in the range of 1.3 to 0.8 cubic meters per second (cms) (46 to 28 cubic feet per second (cfs)) between 1900 and 1978 indicating an apparent declining trend. Texas Water Development Board (2005, p. 84) studies reported an average flow rate of about 0.85 cms (30 cfs) from data between 1965 to 2001 with a calculated slope showing a slight decline in discharge.

San Solomon Spring now provides the water for the large, unchlorinated, flow-through swimming pool at Balmorhea State Park and most of the irrigation water for downstream agricultural irrigation by the Reeves County Water Improvement District No. 1 (District). The swimming pool is concrete on the sides and natural substrates on the bottom and was originally constructed in 1936. Balmorhea State Park is owned and managed by Texas Parks and Wildlife Department and encompasses about 19 hectares (ha) (46 acres (ac)) located about 6 km (4 mi) west of Balmorhea in the historic community of Toyahvale. The Park provides recreational opportunities of camping, wildlife viewing, and swimming and scuba diving in the pool. The District holds the water rights for the spring which is channeled through an extensive system of concrete-lined irrigation channels, and much of the water is stored in nearby Lake Balmorhea and delivered through canals for flood irrigation on farms down gradient (Simonds 1996, p. 2).

Balmorhea State Park's primary wildlife resource focus is on conservation of the endemic aquatic species that live in the outflow of San Solomon Spring (Texas Parks and Wildlife Department 1999, p. 1). Texas Parks and Wildlife Department maintains two constructed ciénegas that are flow-through, earth-lined pools in the park to simulate more natural aquatic habitat conditions for the conservation of the rare species, including the Phantom Cave snail, Phantom springsnail, and diminutive amphipods. (Ciénega is a Spanish term that describes a spring outflow that is a permanently wet and marshy area.) San Solomon Spring is also inhabited by two federally listed fishes, Comanche Springs pupfish *(Cyprinodon elegans)* and Pecos gambusia *(Gambusia nobilis).* No nonnative fishes are known to occur in San Solomon Spring, but two nonnative aquatic snails, red-rim melania *(Melanoides tuberculata)* and quilted melania *(Tarebia granifera),* do occur in the spring outflows and are a cause for concern for the native aquatic invertebrate species.

Giffin Spring is on private property less than 1.6 km (1.0 mi) west of Balmorhea State Park, across State Highway 17. The spring originates from an elevation similar to San Solomon Spring. Brune (1981, p. 385) reported flow from Giffin Spring ranging from 0.07 to 0.17 cms (2.3 to 5.9 cfs) between 1919 and 1978, with a gradually declining trend. During calendar year 2011, Giffin Spring flow rates were recorded between 0.10 and 0.17 cms (3.4 and 5.9 cfs) (U.S. Geological Survey 2012, p. 1). Giffin Spring water flows are captured in irrigation earthen channels for agricultural use. Giffin Spring is also inhabited by the federally listed Comanche springs pupfish and Pecos gambusia, and the only nonnative aquatic species of concern there is the red-rim melania.

Phantom Lake Spring is at the base of the Davis Mountains about 6 km (4 mi) west of Balmorhea State Park at an elevation of 1,080 m (3,543 ft). The outflow originates from a large crevice on the side of a limestone outcrop cliff. The 7-ha (17-ac) site around the spring and cave opening is owned by the U.S. Bureau of Reclamation. Prior to 1940 the recorded flow of this spring was regularly exceeding 0.5 cms (18 cfs). Outflows after the 1940s were immediately captured in concrete-lined irrigation canals and provided water for local crops before connecting to the District's canal system in Balmorhea State Park. Flows declined steadily over the next 70 years until ceasing completely in about the year 2000 (Brune 1981, pp. 258–259; Allan 2000, p. 51; Hubbs 2001, p. 306). The aquatic habitat at the spring pool has been maintained by a pumping system since then. Phantom Lake Spring is also inhabited by the two federally listed fishes, Comanche Springs pupfish and Pecos gambusia, and the only nonnative aquatic species of concern there is the red-rim melania.

East Sandia Spring is the smallest spring in the system located in Reeves County in the community of Brogado approximately 3 km (2 mi) northeast of the town of Balmorhea and 7.7 km (4.8 mi) northeast of Balmorhea State Park. The spring is within a 97-ha (240-ac) preserve owned and managed by The Nature Conservancy—a private nonprofit conservation organization (Karges 2003, pp. 145–146). In contrast to the other springs in the San Solomon Spring system that are derived directly from a deep underground regional flow system, East Sandia Spring discharges from alluvial sand and gravel from a shallow groundwater source at an elevation of 977 m (3,224 ft) (Brune 1981, p. 385; Schuster 1997, p. 92). Water chemistry at East Sandia Spring indicates it is not directly hydrologically connected with the other springs in the San Solomon Spring system in the nearby area (Schuster 1997, pp. 92–93). Historically there was an additional, smaller nearby spring outlet called West Sandia Spring. Brune (1981, pp. 385–386) reported the combined flow of East and West Sandia Springs as declining, with measurements ranging from 0.09 to 0.02 cms (3.2 to 0.7 cfs) between 1932 and 1976. In 1976 outflow from East Sandia was 0.01 cms (0.5 cfs) of the total 0.02 cms (0.7 cfs) of the two springs. In 1995 and 1996 Schuster (1997, p. 94) reported flows from both springs ranging from 0.12 to 0.01 cms (4.07 cfs to 0.45 cfs), with an average of 0.05 cms (1.6 cfs). The outflow waters from the spring discharge to an irrigation canal within a few hundred meters from its source. East Sandia Spring is also inhabited by two federally listed fishes, Comanche Springs pupfish and Pecos gambusia, as well as the federally endangered Pecos assiminea *(Assiminea pecos)* snail and the federally threatened Pecos sunflower *(Helianthus paradoxus).* No nonnative aquatic species of concern are known from East Sandia Spring.

Historically there were other area springs along Toyah Creek that were part of the San Solomon Spring system. Saragosa and Toyah Springs occurred in the town of Balmorhea along Toyah Creek. Brune (1981, p. 386) reported historic base flows of about 0.2 cms (6 cfs) in the 1920s and 1940s, declining to about 0.06 cms (2 cfs) in the 1950s and 1960s, and no flow was recorded in 1978. Brune (1981, p. 385) reported that the flow from West Sandia Spring was about 0.01 cms (0.2 cfs) in 1976, after combined flows from East and West Sandia Springs had exceeded 0.07 cms (2.5 cfs) between the 1930s and early 1960s. The Texas Water Development Board (2005, p. 12) reported West Sandia and Saragosa Springs did not discharge sufficient flow for measurement. Karges (2003, p. 145) indicated West Sandia has only intermittent flow and harbors no aquatic fauna. It is unconfirmed whether the six aquatic invertebrates discussed in this document occurred in these now dry spring sites, but given their current distribution in springs located upstream and downstream of these historic springs, we assume that they probably did. However, because these springs have been dry for many decades, they no longer provide habitat for the aquatic invertebrates.

Diamond Y Spring System

The Diamond Y Spring system is within a tributary drainage flowing northeast to the Pecos River. Diamond Y Spring (previously called Willbank Spring) is located about 80 km (50 mi) due east of San Solomon Spring and about 12 km (8 mi) north of the City of Fort Stockton in Pecos County. The Diamond Y Spring system is composed of disjunct upper and lower watercourses, separated by about 1 km (0.6 mi) of dry stream channel.

The upper watercourse is about 1.5 km (0.9 mi) long and starts with the Diamond Y Spring head pool, which drains into a small spring outflow channel. The channel enters a broad valley and braids into numerous wetland areas and is augmented by numerous small seeps. The Diamond Y Spring outflow converges with the Leon Creek drainage and flows through a marsh-meadow, where it is then referred to as Diamond Y Draw. All of the small springs and seeps and their outflow comprise the upper watercourse. These lateral water features, often not mapped, are spread across the flat, seasonally wetted area along Diamond Y Draw. Therefore, unlike other spring systems that have a relatively small footprint, aquatic habitat covers a relatively large area along the Diamond Y draw.

The lower watercourse of Diamond Y Draw has a smaller head pool spring, referred to as Euphrasia Spring, with a small outflow stream as well as several isolated pools and associated seeps and wetland areas. The total length of the lower watercourse is about 1 km (0.6 mi) and has extended below the bridge at State Highway 18 during wetter seasons in the past. The upper watercourse is only hydrologically connected to the lower watercourse by surface flows during rare large rainstorm runoff events. The lower watercourse also contains small springs and seeps laterally separated from the main spring outflow channels.

Virtually all of the Diamond Y Spring area (both upper and lower watercourses and the area in between) occurs on the Diamond Y Spring Preserve, which is owned and managed by The Nature Conservancy. The Diamond Y Spring Preserve is 1,603 ha (3,962 ac) of contiguous land around Diamond Y Draw. The surrounding watershed and the land area over the contributing aquifers are all privately owned and managed as ranch land and have been developed for oil and gas extraction. In addition, a natural gas processing plant is located within 0.8 km (0.5 mi) upslope of the headpool in the upper watercourse of Diamond Y Spring. Diamond Y Spring is also inhabited by two federally listed fishes, Leon Springs pupfish *(Cyprinodon bovinus)* and Pecos gambusia, as well as the federally endangered Pecos assiminea snail and the federally threatened Pecos sunflower. The only nonnative species of concern at Diamond Y Spring is the red-rim melania, which is only known to occur in the upper watercourse.

Studies by Boghici (1997, p. *v*) indicate that the spring flow at Diamond Y Spring originates chiefly from the Rustler aquifer waters underlying the Delaware Basin to the northwest of the spring outlets (Boghici and Van Broekhoven 2001, p. 219). The Rustler aquifer underlies an area of approximately 1,200 sq km (480 sq mi) encompassing most of Reeves County and parts of Culberson, Pecos, Loving, and Ward Counties (Boghici and Van Broekhoven 2001, p. 219). Much of the water contains high total dissolved solids (Boghici and Van Broekhoven 2001, p. 219) making it difficult for agricultural or municipal use; therefore, the aquifer has experienced only limited pumping in the past (Mace 2001, pp. 7–9).

Other springs in the area may have once provided habitat for the aquatic species but limited information is generally available on historic distribution of the invertebrates. Leon Springs, a large spring that historically occurred about 14 km (9 miles) upstream along Leon Creek, historically discharged about 0.7 cms (25 cfs) in 1920, 0.5 cms (18 cfs) in the 1930s, 0.4 cms (14 cfs) in the 1940s, and no discharge from 1958 to 1971 (Brune 1981, p. 359). Nearby groundwater pumping to irrigate farm lands began in 1946, which lowered the contributing aquifer by 40 m (130 feet) by the 1970s and resulted in the loss of the spring. The only circumstantial evidence that any of the three invertebrates that occur in nearby Diamond Y Spring may have occurred in Leon Springs is that the spring is within the same drainage and an endemic fish, Leon Springs pupfish, once occurred in both Diamond Y and Leon Springs.

Comanche Springs is another large historic spring located in the City of Fort Stockton. Prior to the 1950s, this spring discharged more than 1.2 cms (42 cfs) (Brune 1981, p. 358) and provided habitat for rare species of fishes and invertebrates. As a result of groundwater pumping for agriculture, the spring ceased flowing by 1962 (Brune 1981, p. 358), eliminating all aquatic-dependent plants and animals (Scudday 1977, pp. 515–518; Scudday 2003, pp. 135–136). Although we do not have data confirming that Comanche Springs was inhabited by all of the Diamond Y Spring species, there is evidence that at least the two snails (Diamond Y Spring snail and Gonzales springsnail) occurred there at some time in the past (see *Taxonomy, Distribution, Abundance, and Habitat of Snails,* below).

Life History and Biology of Snails

The background information presented in this section applies to all four species of snails in these proposed rules: Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, and Gonzales springsnail. All four of these snails are in the family Hydrobiidae and are strictly aquatic with respiration occurring through an internal gill. These hydrobiid snails (snails in the family Hydrobiidae) typically reproduce several times during the spring to fall breeding season (Brown 1991, p. 292) and are sexually dimorphic (males and females are shaped differently), with females being characteristically larger and longer-lived than males. Snails in the *Pyrgulopsis* genus (Phantom Cave snail) reproduce through laying a single small egg capsule deposited on a hard surface (Hershler 1998, p. 14). The other three snail species are ovoviviparous, meaning the larval stage is completed in the egg capsule, and upon hatching, the snails emerge into their adult form (Brusca and Brusca 1990, p. 759; Hershler and Sada 2002, p. 256). The lifespan of most aquatic snails is thought to be 9 to 15 months (Taylor 1985, p. 16; Pennak 1989, p. 552).

All of these snails are presumably fine-particle feeders on detritus (organic material from decomposing organisms) and periphyton (mixture of algae and other microbes attached to submerged surfaces) associated with the substrates (mud, rocks, and vegetation) (Allan 1995, p. 83; Hershler and Sada 2002, p. 256; Lysne *et al.* 2007, p. 649). Dundee and Dundee (1969, p. 207) found diatoms (a group of single-celled algae) to be the primary component in the digestive tract, indicating they are a primary food source.

These hydrobiid snails from west Texas occur in mainly flowing water habitats such as small springs, seeps, marshes, spring pools, and their outflows. Proximity to spring vents, where water emerges from the ground, plays a key role in the life history of springsnails. Many springsnail species exhibit decreased abundance farther away from spring vents, presumably due to their need for stable water chemistry (Hershler 1994, p. 68; Hershler 1998, p. 11; Hershler and Sada 2002, p. 256; Martinez and Thome 2006, p. 14). Several habitat parameters of springs, such as temperature, substrate type, dissolved carbon dioxide, dissolved oxygen, conductivity, and water depth have been shown to influence the distribution and abundance of other related species of springsnails (O'Brien and Blinn 1999, pp. 231–232; Mladenka and Minshall 2001, pp. 209–211; Malcom *et al.* 2005, p. 75; Martinez and Thome 2006, pp. 12–15; Lysne *et al.* 2007, p. 650). Dissolved salts such as calcium carbonate may also be important factors because they are essential for shell formation (Pennak 1989, p. 552). Hydrobiid snails as a group are considered sensitive to water quality changes, and each species is usually found within relatively narrow habitat parameters (Sada 2008, p. 59).

Native fishes have been shown to prey upon these snails (Winemiller and Anderson 1997, pp. 209–210; Brown *et al.* 2008, p. 489), but it is unknown to what degree predatory pressure may play a role in controlling population abundances or influencing habitat use. There are currently no nonnative fishes in the springs where the species occur, so there is no unnatural predation pressure from fish suspected.

Because of their small size and dependence on water, significant dispersal (in other words, movement between spring systems) does not likely occur, although on rare occasions aquatic snails have been transported by becoming attached to the feathers and feet of migratory birds (Roscoe 1955, p. 66; Dundee *et al.* 1967, pp. 89–90). In general, the species have little capacity to move beyond their isolated aquatic environments.

Taxonomy, Distribution, Abundance, and Habitat of Snails

Phantom Cave Snail *(Pyrgulopsis texana* Pilsbry 1935)

The Phantom Cave snail was first described by Pilsbry (1935, pp. 91–92). It is a very small snail, measuring only 0.98 to 1.27 millimeters (mm) (0.04 to 0.05 inches (in)) long (Dundee and Dundee 1969, p. 207). Until 2010, the species was placed in the genus *Cochliopa* (Dundee and Dundee 1969, p. 209; Taylor 1987, p. 40). Hershler *et al.* (2010, pp. 247–250) reviewed the systematics of the species and transferred Phantom Cave snail to the genus *Pyrgulopsis* after morphological and mitochondrial DNA analysis. Hershler *et al.* (2010, p. 251) also noted some minimal differences in shell size (individuals were smaller at East Sandia Spring) and mitochondrial DNA sequence variation among populations of Phantom Cave snails in different springs. The low level of variation (small differences) among the populations did not support recognizing different conservation units for the species. Hershler *et al.* (2010, p. 251) expected this small difference among the populations because of their proximity (separated by 6 to 13 km (4 to 8 mi)) and the past connectedness of the aquatic habitats by Toyah Creek that would have allowed mixing of the populations before human alterations and declining flows. Based on these published studies we conclude that Phantom Cave snail is a listable entity under the Act.

The Phantom Cave snail only occurs in the four remaining desert spring outflow channels associated with the San Solomon Spring system (San Solomon, Phantom, Giffin, and East Sandia springs). Hershler *et al.* (2010, p. 250) did not include Giffin Spring in this species distribution, but unpublished data from Lang (2011, p. 5) confirms that the species is also found in Giffin Spring outflows as well as the other three springs in the San Solomon Spring system. The geographic extent of the historic range for the Phantom Cave snail was likely not larger than the present range, but the species may have occurred in additional small springs contained within the current range of the San Solomon Spring system, such as Saragosa and Toyah Springs. It likely also had a larger distribution within Phantom Lake Spring and San Solomon Spring before the habitat there was modified and reduced in conversion of spring outflow channels into irrigation ditches.

Within its current, limited range, Phantom Cave snails can exist in very high densities. Dundee and Dundee (1969, pp. 207) described the abundance of the Phantom Cave snails at Phantom Lake Spring in 1968 as persisting ''in such tremendous numbers that the bottom and sides of the canal appear black from the cover of snails.'' Today the snails are limited to the small pool at the mouth of Phantom Cave and cannot be found in the irrigation canal downstream. At San Solomon Spring, Taylor (1987, p. 41) reported the Phantom Cave snail was abundant and generally distributed in the canals from 1965 to 1981. Density data and simple population size estimates based on underwater observations indicate there may be over 3.8 million individuals of this species at San Solomon Spring (Bradstreet 2011, p. 55). Lang (2011) also reported very high densities (not total population estimates) of Phantom Cave snails (with ± standard deviations): San Solomon Spring from 2009 sampling in the main canal, 71,740 per sq m (6,672 per sq ft; ±47,229 per sq m, ±4,393 per sq ft); Giffin Spring at road crossing in 2001, 4,518 per sq m (420 per sq ft; ±4,157 per sq m, ±387 per sq ft); East Sandia Spring in 2009, 41,215 per sq m (3,832 per sq ft; ±30,587 per sq m, ±2,845 per sq ft); and Phantom Lake Spring in 2009, 1,378 per sq m (128 per sq ft; ±626 per sq m, ±58 per sq ft). From these data, it is evident that when conditions are favorable Phantom Cave snails can reach tremendous population sizes in very small areas.

Phantom Cave snails are found concentrated near the spring source (Hershler *et al.* 2010, p. 250) and can occur as far as a few hundred meters downstream of a large spring outlet like San Solomon Spring. Despite its common name, it has not been found within Phantom Cave proper, but only within the outflow of Phantom Lake Spring. Bradstreet (2011, p. 55) found the highest abundances of Phantom Cave snails at San Solomon Spring outflows in the high-velocity areas in the irrigation canals and the lowest abundances in the San Solomon Ciénega. The species was not collected from the newest constructed ciénega in 2010. Habitat of the species is found on both soft and firm substrates on the margins of spring outflows (Taylor 1987, p. 41). They are also commonly found attached to plants, particularly in dense stands of submerged vegetation *(Chara* sp.). Field and laboratory experiments have suggested Phantom Cave snails prefer substrates harder and larger in size (Bradstreet 2011, p. 91).

Phantom Springsnail *(Tryonia cheatumi* Pilsbry 1935)

The Phantom springsnail was first described by Pilsbry (1935, p. 91) as *Potamopyrgus cheatumi.* The species was later included in the genus *Lyrodes* and eventually placed in the genus *Tryonia* (Taylor 1987, pp. 38–39). It is a small snail measuring only 2.9 to 3.6 mm (0.11 to 0.14 in) long (Taylor 1987, p. 39). Systematic studies of *Tryonia* snails in the Family Hydrobiidae using mitochondrial DNA sequences and morphological characters confirms the species is a ''true *Tryonia,''* in other words, it is appropriately classified in the genus *Tryonia* (Hershler *et al.* 1999, p. 383; Hershler 2001, p. 6; Hershler *et al.* 2011, pp. 5–6). Based on these published studies, we conclude that Phantom springsnail is a listable entity under the Act.

The Phantom springsnail only occurs in the four remaining desert spring outflow channels associated with the San Solomon Spring system (San Solomon, Phantom, Giffin, and East Sandia springs) (Taylor 1987, p. 40; Allan 2011, p. 1; Lang 2011, entire). The historic range for the Phantom springsnail was likely not larger than present, but the species may have occurred in other springs within the San Solomon Spring system, such as Saragosa and Toyah Springs. It likely also had a wider distribution within Phantom Lake Spring and San Solomon Spring before the habitat there was modified and reduced.

Within its current, limited range, Phantom springsnails can have moderate densities of abundance, but have never been recorded as high as the Phantom Cave snail. In the 1980s, Taylor (1987, p. 40) described Phantom springsnails as abundant in the outflow ditch several hundred meters downstream of Phantom Lake Spring. The snails are now limited to low densities in the small pool at the mouth of Phantom Cave and cannot be found in the irrigation canal downstream as it does not have water (Allan 2009, p. 1). Density data and simple population size estimates based on underwater observations indicate there may be over 460,000 individuals of this species at San Solomon Spring (Bradstreet 2011, p. 55). Lang (2011) reports the following densities (not population estimates) of Phantom springsnails (with ± standard deviations): San Solomon Spring from 2009 sampling in the main canal, 11,681 per sq m (1,086 per sq ft; ±11,925 per sq m, ±1,109 per sq ft); Giffin Spring at road crossing in 2001, 3,857 per sq m (358 per sq ft; ±6,110 per sq m, ±568 per sq ft); East Sandia Spring in 2009, 65,845 per sq m (6,123 per sq ft; ±60,962 per sq m, ±5,669 per sq ft); and Phantom Lake Spring in 2009, 31,462 per sq m (2,926 per sq ft; ±20,251 per sq m, ±1,883 per sq ft). Phantom springsnails can reach high population sizes in very small areas with favorable conditions.

Phantom springsnails are usually found concentrated near the spring source but once occurred as far as a few hundred meters downstream when Phantom Lake Spring was a large flowing spring (Dundee and Dundee 1969, p. 207; Taylor 1987, p. 40). The species is most abundant in the swimming pool at Balmorhea State Park, but has not been found in either of the constructed ciénegas at the Park in 2010 and 2011 (Allan 2011, p. 3; Bradstreet 2011, pp. 55). The species is found on both soft and firm substrates on the margins of spring outflows (Taylor 1987, p. 41), and they are also commonly found attached to plants, particularly in dense stands of submerged vegetation (*Chara* sp.).

Diamond Y Spring Snail *(Pseudotryonia adamantina* Taylor 1987)

The Diamond Y Spring snail was first described by Taylor (1987, p. 41) as *Tryonia adamantina.* It is a small snail measuring only 2.9 to 3.6 mm (0.11 to 0.14 in) long (Taylor 1987, p. 41). Systematic studies (Hershler *et al.*1999, p. 377; Hershler 2001, pp. 7, 16) of these snails have been conducted using mitochondrial DNA sequences and morphological characters. These analyses resulted in the Diamond Y Spring snail being reclassified into the new genus *Pseudotryonia* (Hershler 2001, p. 16). Based on these published studies, we conclude that Diamond Y Spring snail is a listable entity under the Act.

Taylor (1985, p. 1; 1987, p. 38) was the earliest to document the distribution and abundance of aquatic snails in the Diamond Y Spring system, referencing surveys from 1968 to 1984. In 1968, the Diamond Y Spring snail was considered abundant in the outflow of Diamond Y Spring in the upper watercourse for about 1.6 km (1 mi) downstream of the spring head pool, but by 1984 the species was present in only areas along stream margins (near the banks) (Taylor 1985, p. 1). Average density estimates in 1984 at 12 of 14 sampled sites in the upper watercourse ranged from 500 to 93,700 individuals per sq m (50 to 8,700 per sq ft), with very low densities in the upstream areas near the headspring (Taylor 1985, p. 25). However, the Diamond Y Spring snail was largely absent from the headspring and main spring flow channel where it had been abundant in 1968 surveys (Taylor 1985, p. 13). Instead it was most common in small numbers along the outflow stream margins and lateral springs (Taylor 1985, pp. 13–15). Over time, the distribution of the Diamond Y Spring snail in the upper watercourse has continued to recede so that it is no longer found in the outflow channel at all but may be restricted to small lateral spring seeps disconnected from the main spring flow channel (Landye 2000, p. 1; Echelle *et al.* 2001, pp. 24–25). Surveys by Lang (2011, pp. 7–8) in 2001 and 2003 found only 2 and 7 individuals, respectively, in the outflow channel of Diamond Y Spring. Additional surveys in 2009 and 2010 (Ladd 2010, p. 18; Lang 2011, p. 12) did not find Diamond Y Spring snails in the upper watercourse. However, neither researcher surveyed extensively in the lateral spring seeps downstream from the main spring outflow.

The Diamond Y Spring snail was not previously reported from the lower watercourse until first detected there in 2001 at the outflow of Euphrasia Spring (Lang 2011, p. 6). It was confirmed there again in 2009 (Lang 2011, p. 13) and currently occurs within at least the first 50 m (160 feet) in the outflow channel of Euphrasia Spring (Ladd 2010, p. 18). Ladd (2010, p. 37) roughly estimated the total number of Diamond Y Spring snails in the lower watercourse to be about 35,000 individuals with the highest density reported as 2,500 individuals per sq m (230 per sq ft). Lang (2011, p. 13) estimated densities of Diamond Y Spring snails in 2009 at 16,695 per sq m (1,552 per sq ft; ±18,212 per sq m, ±1,694 per sq ft) in Euphrasia Spring outflow, which suggests a much larger population than that estimated by Ladd (2010, p. 37).

In summary, the Diamond Y Spring snail was historically common in the upper watercourse and absent from the lower watercourse. Currently it is very rare in the upper watercourse and limited to small side seeps (and may be extirpated), and it occurs in the lower watercourse in the outflow of Euphrasia Spring. The historic distribution of this species may have been larger than the present distribution. Other area springs nearby such as Leon and Comanche Springs may have harbored the species. There is one collection of very old, dead shells of the species that was made from Comanche Springs in 1998 (Worthington 1998, unpublished data) whose identification was recently confirmed as Diamond Y Spring snail (Hershler 2011, pers. comm.). However, because these springs have been dry for more than four decades and shells can remain intact for thousands of years, it is impossible to know how old the shells might be. Therefore, we are unable to confirm if the recent historic distribution included Comanche Springs.

Habitat of the species is primarily soft substrates on the margins of small springs, seeps, and marshes in shallow flowing water associated with emergent bulrush *(Scirpus americanus)* and saltgrass *(Distichlis spicata)* (Taylor 1987, p. 38; Echelle *et al.* 2001, p. 5).

Gonzales Springsnail *(Tryonia circumstriata* Leonard and Ho 1960)

The Gonzales springsnail was first described as a late Pleistocene fossil record, *Calipyrgula circumstriata,* from the Pecos River near Independence Creek in Terrell County, Texas (Leonard and Ho 1960, p. 126). The snail from Diamond Y Spring area was first described as *Tryonia stocktonensis* by Taylor (1987, p. 37). It is a small snail, measuring only 3.0 to 3.7 mm (0.11 to 0.14 in) long. Systematic studies later changed the name to *Tryonia circumstriata,* integrating it with the fossilized snails from the Pecos River (Hershler 2001, p. 7), and confirming the species as a ''true *Tryonia,*'' in other words, it is appropriately classified in the genus *Tryonia* (Hershler *et al.* 2011, pp. 5–6). Based on these published studies, we conclude that Gonzales springsnail is a listable entity under the Act.

Taylor (1985, pp. 18–19; 1987, p. 38) found Gonzales springsnail only in the first 27 m (90 ft) of the outflow from Euphrasia Spring. The species has been consistently found in this short stretch of spring outflow channel since then (Echelle *et al.* 2001, p. 20; Lang 2011, pp. 6, 13). Ladd (2010, pp. 23–24) reported that Gonzales springsnails no longer occurred in the lower watercourse and had been replaced by Diamond Y Spring snails. However, reevaluation of voucher specimens collected by Lang (2011, p. 13) concurrently in 2009 with those by Ladd (2010, p. 14) confirmed the species is still present in the Euphrasia Spring outflow channel of the lower watercourse.

Gonzales springsnail was first reported in the upper watercourse in 1991 during collections from one site in the Diamond Y Spring outflow and one small side seep near the spring head (Fullington and Goodloe 1991, p. 3). The species has since been collected from this area (Lang 2011, pp. 7–9), and Echelle *et al.* (2001, p. 20) found it to be the most abundant snail for the first 430-m (1,400-ft) downstream from the spring head. Ladd (2010, p. 18) also found Gonzales springsnail in the outflow of Diamond Y Spring, but only from 125 to 422 m (410 to 1,384 ft) downstream of the spring head (Ladd 2011, pers. comm.). The Gonzales springsnail appears to have replaced the Diamond Y Spring snail in some of the habitat in the upper watercourse (Brown 2008, p. 489) since 1991.

Taylor (1985, p. 19) calculated densities for Gonzales springsnails in the outflow of Euphrasia Spring in the range of 50,480 to 85,360 individuals per sq m (4,690 to 7,930 individuals per sq ft) and estimated the population size in that 27-m (90-ft) stretch to be at least 162,000 individuals and estimated the total population of over one million individuals as a reasonable estimate. Lang (2011, p. 13) estimated the density of Gonzales springsnails in the Euphrasia Spring outflow to be 3,086 individuals per sq m (287 per sq ft; ±5,061 per sq m, ±471per sq ft). Ladd (2010, p. 37) estimated the population of Gonzales springsnails in the upper watercourse to be only about 11,000 individuals.

As with the Diamond Y Spring snail, the historic distribution of the Gonzales springsnail may have been larger than the present distribution. Other area springs nearby such as Leon and Comanche Springs may have harbored the species. There is one collection of dead shells of the species that was made from Comanche Springs in 1998 (Worthington 1998, unpublished data) whose identification was recently confirmed as Gonzales springsnail (Hershler 2011, pers. comm.). However, because these springs have been dry for more than four decades and shells can remain intact for thousands of years, it is impossible to know how old the shells might be. Therefore, we are unable to confirm if the recent historic distribution included Comanche Springs.

Habitat of the species is primarily soft substrates on the margins of small springs, seeps, and marshes in shallow flowing water associated with emergent bulrush and saltgrass (Taylor 1987, p. 38; Echelle *et al.* 2001, p. 5).

Life History, Biology, and Habitat of Amphipods

The background information presented here applies to both species of amphipods in these proposed rules: diminutive amphipod and Pecos amphipod. These amphipods, in the family Gammaridae, are small freshwater inland crustaceans sometimes referred to as freshwater shrimp. Gammarids commonly inhabit shallow, cool, well-oxygenated waters of streams, ponds, ditches, sloughs, and springs (Smith 2001, p. 574). These bottom-dwelling amphipods feed on algae, submergent vegetation, and decaying organic matter (Smith 2001, p. 572). Amphipod eggs are held within a marsupium (brood pouch) within the female's exoskeleton (Smith 2001, p. 573). Most amphipods complete their life cycle in 1 year and breed from February to October, depending on water temperature (Smith 2001, p. 572). Amphipods form breeding pairs that remain attached for 1 to 7 days at or near the substrate while continuing to feed and swim (Bousfield 1989, p. 1721). They can produce from 15 to 50 offspring, forming a ''brood.'' Most amphipods produce one brood, but some species produce a series of broods during the breeding season (Smith 2001, p. 573).

These two species, diminutive amphipod and Pecos amphipod, are part of a related group of amphipods, referred to as the *Gammarus pecos* species complex, that are restricted to desert spring systems from the Pecos River Basin in southeast New Mexico and west Texas (Cole 1985, p. 93; Lang *et al.* 2003, p. 47; Gervasio *et al.* 2004, p. 521). Similar to the snails, it is thought that these freshwater amphipods are derived from a widespread ancestral marine amphipod that was isolated inland during the recession of the Late Cretaceous sea, about 66 million years ago (Holsinger 1967, pp. 125–133; Lang *et al.* 2003, p. 47). They likely evolved into distinct species during recent dry periods (since the Late Pleistocene, about 100,000 years ago) through allopatric speciation (that is, speciation by geographic separation) following separation and isolation in the remnant aquatic habitats associated with springs (Gervasio *et al.* 2004, p. 528).

Amphipods in the *Gammarus pecos* species complex only occur in desert spring outflow channels on substrates, often within interstitial spaces on and underneath rocks and within gravels (Lang *et al.* 2003, p. 49) and are most commonly found in microhabitats with flowing water. They are also commonly found in dense stands of submerged vegetation (Cole 1976, p. 80). Because of their affinity for constant water temperatures, they are most common in the immediate spring outflow channels, usually only a few hundred meters downstream of spring outlets.

Amphipods play important roles in the processing of nutrients in aquatic ecosystems and are also considered sensitive to changes in aquatic habitat conditions (for example, stream velocities, light intensity, zooplankton availability, and the presence of heavy metals) and are often considered ecological indicators of ecosystem health and integrity (Covich and Thorpe 1991, pp. 672–673, 679; Lang *et al.* 2003, p. 48). Water chemistry parameters, such as salinity, pH, and temperature, are also key components to amphipod habitats (Covich and Thorpe 1991, pp. 672–673).

Taxonomy, Distribution, and Abundance of Amphipods

Diminutive Amphipod *(Gammarus hyalleloides* Cole 1976)

W.L. Minckley first collected the diminutive amphipod from Phantom Lake Spring in the San Solomon Spring system in 1967, and the species was first formally described by Cole (1976, pp. 80–85). The name comes from the species being considered the smallest of the known North American freshwater *Gammarus* amphipods. Adults generally range in length from 5 to 8 mm (0.20 to 0.24 in).

There has been some disparity in the literature regarding the taxonomic boundaries for the amphipods from the San Solomon Spring system. In Cole's (1985, pp. 101–102) description of the *Gammarus pecos* species complex of amphipods based solely on morphological measurements, he considered the diminutive amphipod to be endemic only to Phantom Lake Spring, and amphipods from San Solomon and Diamond Y Springs were both considered to be the Pecos amphipod *(G. pecos).* This study did not include samples of amphipods from East Sandia or Giffin Springs. However, allozyme electrophoresis data on genetic variation strongly support that the populations from the San Solomon Spring system form a distinct group from the Pecos amphipod at Diamond Y Spring (Gervasio *et al.* 2004, pp. 523–530). Based on these data, we consider the Pecos amphipod to be limited to the Diamond Y Spring system.

The results of these genetic studies also suggested that the three *Gammarus* amphipod populations from San Solomon, Giffin, and East Sandia Springs are a taxonomically unresolved group differentiated from the diminutive amphipod at Phantom Lake Spring (Gervasio *et al.* 2004, pp. 523–530). Further genetic analysis using mitochondrial DNA (mtDNA) by Seidel *et al.* (2009, p. 2309) also indicates that the diminutive amphipod may be limited to Phantom Lake Spring and the *Gammarus* species at the other three springs should be considered a new and undescribed species. However, the extent of genetic divergence measured between these populations is not definitive. For example, the 19-base pair divergence between the population at Phantom Lake Spring and the other San Solomon Spring system populations (Seidel *et al.* 2009, Figure 3, p. 2307) represents about 1.7 percent mtDNA sequence divergence (of the 1,100 base pairs of the mitochondrial DNA sequenced (using the cytochrome c oxidase I (COI) gene). This is a relatively low level of divergence to support species separation, as a recent review of a multitude of different animals (20,731 vertebrates and invertebrates) suggested that the mean mtDNA distances (using the COI gene) between subspecies is 3.78 percent (±0.16) divergence and between species is 11.06 percent (±0.53) divergence (Kartavtsev 2011, pp. 57–58).

Recent evaluations of species boundaries of amphipods from China suggest mtDNA genetic distances of at least 4 percent were appropriate to support species differentiation, and the species they described all exceeded 15 percent divergence (Hou and Li 2010, p. 220). In addition, no species descriptions using morphological or ecological analysis have been completed for these populations, which would be important information in any taxonomic revision (Hou and Li 2010, p. 216). Therefore, the data available does not currently support taxonomically separating the amphipod population at Phantom Lake Spring from the populations at San Solomon, Giffin, and East Sandia Springs into different listable entities under the Act. So, for the purposes of these proposed rules, based on the best available scientific information, we are including all four populations of *Gammarus* amphipods from the San Solomon Spring system as part of the *Gammarus hyalleloides* species (diminutive amphipod), and we consider diminutive amphipod a listable entity under the Act. We recognize that the taxonomy of these populations could change as additional information is collected and further analyses are published.

The diminutive amphipod only occurs in the four springs from the San Solomon Spring system (Gervasio *et al.* 2004, pp. 520–522). There is no available information that the species' historic distribution was larger than the present distribution, but other area springs (such as Saragosa, Toyah, and West Sandia Springs) may have contained the species. However, because these springs have been dry for many decades, if the species historically occurred there, they are now extirpated. There is no opportunity to determine the full extent of the historic distribution of these amphipods because of the lack of historic surveys and collections.

Within its limited range, diminutive amphipod can be very abundant. For example, in May 2001, Lang *et al.* (2003, p. 51) estimated mean densities at San Solomon, Giffin, and East Sandia Springs of 6,833 amphipods per sq m (635 per sq ft; standard deviation ±5,416 per sq m, ±504 per sq ft); 1,167 amphipods per sq m (108 per sq ft; ±730 per sq m, ±68 per sq ft), and 4,625 amphipods per sq m (430 per sq ft; ±804 per sq m, ±75 per sq ft), respectively. In 2009 Lang (2011, p. 11) reported the density at Phantom Lake Spring as 165 amphipods per sq m (15 per sq ft; ±165 per sq m, ±15 per sq ft).

Pecos Amphipod *(Gammarus pecos* Cole and Bousfield 1970)

The Pecos amphipod was first collected in 1964 from Diamond Y Spring and was described by Cole and Bousfield (1970, p. 89). Cole (1985, p. 101) analyzed morphological characteristics of the *Gammarus pecos* species complex and suggested the *Gammarus* amphipod from San Solomon Spring should also be included as Pecos amphipod. However, updated genetic analyses based on allozymes (Gervasio *et al.* 2004, p. 526) and mitochondrial DNA (Seidel *et al.* 2009, p. 2309) have shown that Pecos amphipods are limited in distribution to the Diamond Y Spring system. In addition, Gervasio *et al.* (2004, pp. 523, 526) evaluated amphipods from three different locations within the Diamond Y Spring system and found no significant differences in genetic variation, indicating they all represented a single species. Based on these published studies, we conclude that Pecos amphipod is a listable entity under the Act.

The Pecos amphipod is generally found in all the flowing water habitats associated with the outflows of springs and seeps in the Diamond Y Spring system (Echelle *et al.* 2001, p. 20; Lang *et al.* 2003, p. 51; Allan 2011, p. 2; Lang 2011, entire). There is no available information to determine if the species' historic distribution was larger than the present distribution. Other area springs, such as Comanche and Leon Springs, may have contained the same or similar species of amphipod, but because these springs have been dry for many decades (Brune 1981, pp. 256–263, 382–386), there is no opportunity to determine the potential historic occurrence of amphipods. Pecos amphipods are often locally abundant, with reported mean densities ranging from 2,208 individuals per sq m (205 per sq ft; ±1,585 per sq m, ±147 per sq ft) to 8,042 individuals per sq m (748 per sq ft; ±7,229 per sq m, ±672 per sq ft) (Lang *et al.* 2003, p. 51).

Summary of Factors Affecting the Species

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, the Service determines whether a species is endangered or threatened because of any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

Based on the similarity in geographic ranges and threats to habitats, we have divided this analysis into two sections, one covering the three species from the San Solomon Spring system and then a second analysis covering the three species from the Diamond Y Spring system. After each analysis we provide proposed determinations for each species.

San Solomon Spring Species—Phantom Cave Snail, Phantom Springsnail, and Diminutive Amphipod

The following analysis applies to the three species that occur in the San Solomon Spring system in Reeves and Jeff Davis Counties, Texas: Phantom Cave snail, Phantom Lake springsnail, and diminutive amphipod.

A. The Present or Threatened Destruction, Modification, or Curtailment of Their Habitat or Range (San Solomon Spring Species)

The three species in the San Solomon Spring system are threatened by the past and future destruction of their habitat and reduction in their range. The discussion below evaluates the stressors of: (1) Spring flow declines; (2) water quality changes and contamination; and (3) modification of spring channels.

Spring Flow Declines

The primary threat to the continued existence of the San Solomon Spring species is the degradation and potential future loss of aquatic habitat (flowing water from the spring outlets) due to the decline of groundwater levels in the aquifers that support spring surface flows. Habitat for these species is exclusively aquatic and completely dependent on spring flows emerging to the surface from underground aquifer sources. Spring flows throughout the San Solomon Spring system have and continue to decline in flow rate, and as spring flows decline, available aquatic habitat is reduced and altered. If one spring ceases to flow continually, all habitats for the Phantom Cave snail, Phantom Lake springsnail, and diminutive amphipod are lost, and the populations will be extirpated. If all of the springs lose consistent surface flows, all natural habitats for these aquatic invertebrates will be gone, and the species will become extinct.

The springs do not have to cease flowing completely to have an adverse effect on invertebrate populations. The small size of the spring outflows at Phantom, Giffin, and East Sandia Springs makes them particularly susceptible to changes in water chemistry, increased water temperatures during the summer and freezing in the winter. Because these springs are small, any reductions in the flow rates from the springs can reduce the quantity and quality of available habitat for the species, which decreases the number of individuals available and increases the risk of extinction. Water temperatures and chemical factors in springs, such as dissolved oxygen and pH, do not typically fluctuate to a large degree (Hubbs 2001, p. 324), and invertebrates are narrowly adapted to spring conditions and are sensitive to changes in water quality (Hershler 1998, p. 11; Sada 2008, p. 69). Spring flow declines can lead to the degradation and loss of aquatic invertebrate habitat and present a substantial threat to these species.

The precise reason for the declining spring flows remains uncertain, but it is presumed to be related to a combination of groundwater pumping, mainly for agricultural irrigation, and a lack of natural recharge to the supporting aquifers due to limited rainfall and geologic circumstances that prevent recharge. In addition, future changes in the regional climate are expected to exacerbate declining flows. The San Solomon Spring system historically may have had a combined discharged of about 2.8 cms (100 cfs) or 89 million cubic meters per year (cmy) (72,000 acre-feet per year (afy)) (Beach *et al.* 2004, p. 4–53), while today the total discharge is roughly one-third that amount. Some smaller springs, such as Saragosa, Toyah, and West Sandia Springs have already ceased flowing and likely resulted in the extirpation of local populations of these species (assuming they were present there historically). The most dramatic recent decline in flow rates have been observed at Phantom Lake Spring, which is the highest elevation spring in the system and, not unexpectedly, was the first large spring to cease flowing.

Phantom Lake Spring was a historically large desert ciénega with a pond of water more than several acres in size (Hubbs 2001, p. 307). The spring outflow is at about 1,080 m (3,543 ft) in elevation and previously provided habitat for the endemic native aquatic fauna. The outflow from Phantom Lake Spring was originally isolated from the other surface springs in the system, as the spring discharge quickly recharged back underground (Brune 1981, p. 258). Human modifications to the spring outflow captured and channeled the spring water into a canal system for use by local landowners and irrigation by the local water users (Simonds 1996, p. 3). The outflow canal joins the main San Solomon canal within Balmorhea State Park. Despite the significant habitat alterations, the native aquatic fauna (including these three invertebrates) have persisted, though in much reduced numbers of total individuals, in the small pool of water at the mouth of the spring.

Flows from Phantom Lake Spring have been steadily declining since measurements were first taken in the 1930s (Brune 1981, p. 259). Discharge data have been recorded from the spring at least six to eight times per year since the 1940s by the U.S. Geological Survey, and the record shows a steady decline of base flows from greater than 0.3 cms (10 cfs) in the 1940s to 0 cms (0 cfs) in 1999 (Service 2009b, p. 23). The data also show that the spring can have short-term flow peaks resulting from local rainfall events in the Davis Mountains (Sharp *et al.* 1999, p. 4;

Chowdhury *et al.* 2004, p. 341). These flow peaks are from fast recharge of the local aquifer system and discharge through the springs. The flow peaks do not come from direct surface water runoff because the outflow spring is within an extremely small surface drainage basin that is not connected to surface drainage basins from the Davis Mountains upslope. However, after each flow increase, the base flow has returned to the same declining trend within a few months.

Exploration of Phantom Cave by cave divers has led to additional information about the nature of the spring and its supporting aquifer. Over 2,440 m (8,000 ft) of the underwater cave have been mapped. Beyond the entrance, the cave is a substantial conduit that transports a large volume of water, in the 0.6 to 0.7 cms (20 to 25 cfs) range, generally from the northwest to the southeast (Tucker 2009, p. 8), consistent with regional flow pattern hypothesis (Chowdhury *et al.* 2004, p. 319). The amount of water measured is in the range of the rate of flow at San Solomon Spring and, along with water chemistry data (Chowdhury *et al.* 2004, p. 340), confirms that the groundwater flowing by Phantom Lake Spring likely discharges at San Solomon Spring. Tucker (2009, p. 8) recorded a 1-m (3-ft) decline in the water surface elevation within the cave between 1996 and 2009 indicating a decline in the amount of groundwater flowing through Phantom Cave.

Phantom Lake Spring ceased flowing in about 1999 (Allan 2000, p. 51; Service 2009b, p. 23). All that remained of the spring outflow habitat was a small pool of water with about 37 sq m (400 sq ft) of wetted surface area. Hubbs (2001, pp. 323–324) documented changes in water quality (increased temperature, decreased dissolved oxygen, and decreased coefficient of variation for pH, turbidity, ammonia, and salinity) and fish community structure at Phantom Lake Spring following cessation of natural flows. In May 2001, the U.S. Bureau of Reclamation, in cooperation with the Service, installed an emergency pump system to bring water from within the cave to the springhead in order to prevent complete drying of the pool and loss of the federally listed endangered fishes and candidate invertebrates that occur there. Habitat for the San Solomon Spring system invertebrates continues to be maintained at Phantom Lake Spring, and in 2011 the small pool was enlarged, nearly doubling the amount of aquatic habitat available for the species (Service 2012, entire).

The three San Solomon Spring species have maintained minimal populations at Phantom Lake Spring despite the habitat being drastically modified from its original state and being maintained by a pump system since 2000. However, because the habitat is sustained with a pump system, the risk of extirpation of these populations continues to be extremely high from the potential for a pump failure or some unforeseen event. For example, the pump system failed several times during 2008, resulting in stagnant pools and near drying conditions, placing severe stress on the invertebrate populations (Allan 2008, pp. 1–2). Substantial efforts were implemented in 2011 to improve the reliability of the pump system and the quality of the habitat (Service 2012, pp. 5–9). However, because the habitat is completely maintained by artificial means, the potential loss of the invertebrate population will continue to be an imminent threat of high magnitude to the populations at Phantom Lake Spring.

Although long-term data for San Solomon Spring flows are limited, they appear to have declined somewhat over the history of record, though not as severely as Phantom Lake Spring (Schuster 1997, pp. 86–90; Sharp *et al.* 1999, p. 4). Some recent declines in overall flow have likely occurred due to drought conditions and declining aquifer levels (Sharp *et al.* 2003, p. 7). San Solomon Spring discharges are usually in the 0.6 to 0.8 cms (25 to 30 cfs) range (Ashworth *et al.* 1997, p. 3; Schuster 1997, p. 86) and are consistent with the theory that the water bypassing Phantom Lake Spring discharges at San Solomon Spring.

In Giffin Spring, Brune (1981, pp. 384–385) documented a gradual decline in flow between the 1930s and 1970s, but the discharge has remained relatively constant since that time, with outflow of about 0.08 to 0.1 cms (3 to 4 cfs) (Ashworth *et al.* 1997, p. 3; U.S. Geological Survey 2012, p. 2). Although the flow rates from Giffin Spring appear to be steady in recent years, its small size makes the threat of spring flow loss imminent and of high magnitude because even a small decline in flow rate may have substantial impacts on the habitat provided by the spring flow. Also, it would only take a small decline in spring flow rates to result in desiccation of the spring.

Brune (1981, p. 385) noted that flows from Sandia Springs (combining East and West Sandia Springs) were declining up until 1976. East Sandia may be very susceptible to over pumping of the local aquifer in the nearby area that supports the small spring. Measured discharges in 1995 and 1996 ranged from 0.013 to 0.12 cms (0.45 to 4.07 cfs) (Schuster 1997, p. 94). Like the former springs of West Sandia and Saragosa, which also originated in shallow aquifers and previously ceased flowing (Ashworth *et al.* 1997, p. 3), East Sandia Spring's very small volume of water makes it particularly at risk of failure from any local changes in groundwater conditions.

The exact causes for the decline in flow from the San Solomon Spring system are unknown. Some of the possible reasons, which are likely acting together, include groundwater pumping of the Salt Basin Bolson aquifer areas west of the springs, long-term climatic changes, or changes in the geologic structure that permits regional interbasin flow of groundwater (Sharp *et al.* 1999, p. 4; Sharp *et al.* 2003, p. 7). Studies indicate that the base flows originate from ancient waters to the west (Chadhury *et al.* 2004, p. 340) and that many of the aquifers in west Texas receive little to no recharge from precipitation (Scanlon *et al.* 2001, p. 28) and are influenced by regional groundwater flow patterns (Sharp 2001, p. 41).

Ashworth *et al.* (1997, entire) provided a brief study to examine the cause of declining spring flows in the San Solomon Spring system. They concluded that declines in spring flows in the 1990s were more likely the result of diminished recharge due to the extended dry period rather than from groundwater pumpage (Ashworth *et al.* 1997, p. 5). Although possibly a factor, drought is unlikely the only reason for the declines because the drought of record in the 1950s had no measurable effect on the overall flow trend at Phantom Lake Spring (Allan 2000, p. 51; Sharp 2001, p. 49) and because the contributing aquifer receives virtually no recharge from most precipitation events (Beach *et al.* 2004, pp. 6–9, 8–9). Also, Ashworth *et al.* (1997, entire) did not consider the effects of the regional flow system in relation to the declining spring flows. Further, an assessment of the springs near Balmorhea by Sharp (2001, p. 49) concluded that irrigation pumpage since 1945 has caused many springs in the area to cease flowing, lowering water-table elevations and creating a cone of depression in the area (that is, a lowering of the groundwater elevation around pumping areas).

The Texas Water Development Board (2005, entire) completed a comprehensive study to ascertain the potential causes of spring flow declines in the San Solomon Spring system, including a detailed analysis of historic regional groundwater pumping trends. The study was unable to quantify direct correlations between changes in groundwater pumping in the surrounding counties and spring flow decline over time at Phantom Lake Spring (Texas Water Development Board 2005, p. 93). However, they suggested that because of the large distance between the source groundwater and the springs and the long travel time for the water to reach the spring outlets, any impacts of pumping are likely to be reflected much later in time (Texas Water Development Board 2005, p. 92). The authors did conclude that groundwater pumping will impact groundwater levels and spring flow rates if it is occurring anywhere along the flow path system (Texas Water Development Board 2005, p. 92).

Groundwater pumping for irrigated agriculture has had a measurable effect on groundwater levels in the areas that likely support the spring flows at the San Solomon Spring system. For example, between the 1950s and 2000 the Salt Basin Bolson aquifer in Lobo Flat fell in surface elevation in the range of 15 to 30 m (50 to near 100 ft), and in Wild Horse Flat from 6 to 30 m (20 to 50 ft) (Angle 2001, p. 248; Beach *et al.* 2004, p. 4–9). Beach *et al.* (2004, p. 4–10) found significant pumping, especially in the Wild Horse Flat area, locally influences flow patterns in the aquifer system. The relationship of regional flow exists because Wild Horse Flat is located in the lowest part of the hydraulically connected Salt Basin Bolson aquifer, and next highest is Lobo, followed by Ryan Flat, which is at the highest elevations (Beach *et al.* 2004, p. 9–32). This means that water withdrawn from any southern part of the basin (Ryan and Lobo Flats) may affect the volume of water discharging out of Wild Horse Flat toward the springs. Because these bolson aquifers have little to no direct recharge from precipitation (Beach *et al.* 2004, pp. 6–9, 8–9), these groundwater declines can be expected to permanently reduce the amount of water available for discharge in the springs in the San Solomon Spring system. This is evidenced by the marked decline of groundwater flow out of the Wild Horse Flat toward the southeast (the direction of the springs) (Beach *et al.* 2004, p. 9–27). Based on this information, it appears reasonable that past and future groundwater withdrawals in the Salt Basin Bolson aquifers are likely one of the causes of decreased spring flows in the San Solomon Spring system.

Groundwater pumping withdrawals in Culberson, Jeff Davis, and Presidio Counties in the Salt Basin Bolson aquifer are expected to continue in the future mainly to support irrigated agriculture (Region F Water Planning Group 2010, pp. 2–16–2–19) and will result in continued lowering of the groundwater levels in the Salt Basin Bolson aquifer. The latest plans from Groundwater Management Area 4 (the planning group covering the relevant portion of the Salt Basin Bolson aquifer) expect over 69 million cubic m (56,000 af) of groundwater pumping per year for the next 50 years, resulting in an average drawdown of 22 to 24 m (72 to 78 feet) in the West Texas Bolsons (Salt Basin) aquifer by 2060 (Adams 2010, p. 2; Oliver 2010, p. 7). There have been no studies evaluating the effects of this level of anticipated drawdown on spring flows. The aquifer in the Wild Horse Flat area (the likely spring source) can range from 60 to 300 m (200 to 1,000 ft) thick. So although it is impossible to determine precisely, we anticipate the planned level of groundwater drawdown will likely result in continued future declines in spring flow rates in the San Solomon Spring system.

Another reason that spring flows may be declining is from an increase in the frequency and duration of local and regional drought associated with climatic changes. The term ''climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a, p. 78). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007a, p. 78).

Although the bulk of spring flows appear to originate from ancient water sources with limited recent recharge, any decreases in regional precipitation patterns due to prolonged drought will further stress groundwater availability and increase the risk of diminishment or drying of the springs. Drought affects both surface and groundwater resources and can lead to diminished water quality (Woodhouse and Overpeck 1998, p. 2693) in addition to reducing groundwater quantities. Lack of rainfall may also indirectly affect aquifer levels by resulting in an increase in groundwater pumping to offset water shortages from low precipitation (Mace and Wade 2008, p. 665).

Recent drought conditions may be indicative of more common future conditions. The current, multiyear drought in the western United States, including the Southwest, is the most severe drought recorded since 1900 (Overpeck and Udall 2010, p. 1642). In 2011, Texas experienced the worst annual drought since recordkeeping began in 1895 (NOAA 2012, p. 4), and only one other year since 1550 (the year 1789) was as dry as 2011 based on tree-ring climate reconstruction (NOAA 2011, pp. 20–22). In addition, numerous climate change models predict an overall decrease in annual precipitation in the southwestern United States and northern Mexico.

Future global climate change may result in increased magnitude of droughts and further contribute to impacts on the aquatic habitat from reduction of spring flows. There is high confidence that many semi-arid areas like the western United States will suffer a decrease in water resources due to ongoing climate change (IPCC 2007b, p. 7; Karl *et al.* 2009, pp. 129–131), as a result of less annual mean precipitation. Milly *et al.* (2005, p. 347) also project a 10 to 30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models. Even under lower greenhouse gas emission scenarios, recent projections forecast a 10 percent decline in precipitation in western Texas by 2080 to 2099 (Karl *et al.* 2009, pp. 129–130). Assessments of climate change in west Texas suggest that the area is likely to become warmer and at least slightly drier (Texas Water Development Board 2008, pp. 22–25).

The potential effects of future climate change could reduce overall water availability in this region of western Texas and compound the stressors associated with declining flows from the San Solomon Spring system. As a result of the effects of increased drought, spring flows could decline indirectly as a result of increased pumping of groundwater to accommodate human needs for additional water supplies (Mace and Wade 2008, p. 664; Texas Water Development Board 2012c, p. 231).

In conclusion, the Phantom Cave snail, Phantom springsnail, and diminutive amphipod all face significant threats from the current and future loss of habitat associated with declining spring flows. Some springs in the San Solomon Spring system have already gone dry, and aquatic habitat at Phantom Lake Spring has not yet been lost only because of the maintenance of a pumping system. While the sources of the stress of declining spring flows are not known for certain, the best available scientific information indicates that it is the result of a combination of factors including past and current groundwater pumping, the complex hydrogeologic conditions that produce these springs (ancient waters from a regional flow system), and climatic changes (decreased precipitation and recharge). The threat of habitat loss from declining spring flows affects all four of the remaining populations, as all are at risk of future loss from declining spring flows. All indications are that the source of this threat will persist into the future and will result in continued degradation of the species' habitats, putting the Phantom Cave snail, Phantom springsnail, and diminutive amphipod at a high risk of extinction.

Water Quality Changes and Contamination

Another potential factor that could impact habitat of the San Solomon Spring species is the potential degradation of water quality from point and nonpoint pollutant sources. This can occur either directly into surface water or indirectly through contamination of groundwater that discharges into spring run habitats used by the species. The primary threat for contamination in these springs comes from herbicide and pesticide use in nearby agricultural areas. There are no oil and gas operations in the area around the San Solomon Spring system.

These aquatic invertebrates are sensitive to water contamination. Hydrobiid snails as a group are considered sensitive to water quality changes, and each species is usually found within relatively narrow habitat parameters (Sada 2008, p. 59). Amphipods generally do not tolerate habitat desiccation (drying), standing water, sedimentation, or other adverse environmental conditions; they are considered very sensitive to habitat degradation (Covich and Thorpe 1991, pp. 676–677).

The exposure of the spring habitats to pollutants is limited because most of the nearby agricultural activity mainly occurs in downstream areas where herbicide or pesticide use would not likely come into contact with the species or their habitat in upstream spring outlets. To ensure these pollutants do not affect these spring outflow habitats, their use has been limited in an informal protected area in the outflows of San Solomon and Giffin Springs (Service 2004, pp. 20–21). This area was developed in cooperation with the U.S. Environmental Protection Agency and the Texas Department of Agriculture. While there are more agriculture activities far upstream in the aquifer source area, there is no information indicating concerns about contaminants from those sources.

In addition, Texas Parks and Wildlife Department completed a Habitat Conservation Plan and received an incidental take permit (Service 2009a, entire) in 2009 under section 10(a)(1)(B) (U.S.C. 1539(a)(1)(B)) of the Act for management activities at Balmorhea State Park (Texas Parks and Wildlife Department 1999, entire). The three aquatic invertebrate candidate species from the San Solomon Spring system were all included as covered species in the permit (Service 2009a, pp. 20–22). This permit authorizes ''take'' of the invertebrates (which were candidates at the time of issuance) in the State Park for ongoing management activities while minimizing impacts to the aquatic species. The activities included in the Habitat Conservation Plan are a part of Texas Parks and Wildlife Department's operation and maintenance of the State Park, including the drawdowns associated with cleaning the swimming pool and vegetation management within the refuge canal and ciénega. The Habitat Conservation Plan also calls for restrictions and guidelines for chemical use in and near aquatic habitats to avoid and minimize impacts to the three aquatic invertebrate species (Service 2009a, pp. 9, 29–32).

Because the use of potential pollutants is very limited within the range of the San Solomon Spring species, at this time we do not find that the Phantom Cave snail, Phantom springsnail, and diminutive amphipod are at a heightened risk of extinction from water quality changes or contamination.

Modification of Spring Channels

The natural ciénega habitats of the San Solomon Spring system have been heavily altered over time primarily to accommodate agricultural irrigation. Most significant was the draining of wetland areas and the modification of spring outlets to develop the water resources for human use. San Solomon and Phantom Lake Springs have been altered the most severely through capture and diversion of the spring outlets into concrete irrigation canals. Giffin Spring appears to have been dredged in the past, and the outflow is now immediately captured in high-banked, earthen-lined canals. The outflow of East Sandia Spring does not appear to have been altered in an appreciable way, but it may have been minimally channelized to connect the spring flow to the irrigation canals.

The Reeves County Water Improvement District No. 1 maintains an extensive system of about 100 km (60 mi) of irrigation canals that now provide only minimal aquatic habitat for the invertebrate species near the spring sources. Most of the canals are concrete-lined with high water velocities and little natural substrate available. Many of the canals are also regularly dewatered as part of the normal water management operations. Before the canals were constructed, the suitable habitat areas around the spring openings, particularly at San Solomon Spring, were much larger in size. The conversion of the natural aquatic mosaic of habitats into linear irrigation canals represents a past impact resulting in significant habitat loss and an increase in the overall risk of extinction by lowering the amount of habitat available to the species and, therefore, lowering the overall number of individuals in the populations affected. These reductions in population size result in an increase in the risk of extirpation of local populations and, ultimately, the extinction of the species as a whole. Because the physical conditions of the spring channels have changed dramatically in the past, the species are now at a greater risk of extinction because of the alterations to the ecosystem and the overall lower number of individuals likely making up the populations.

A number of efforts have been undertaken at Balmorhea State Park to conserve and maintain aquatic habitats at some of the spring sites to conserve habitat for the native aquatic species. First, a refuge canal encircling the historic motel was built in 1974 to create habitat for the endangered fishes, Comanche Springs pupfish and Pecos gambusia (Garrett 2003, p. 153). Although the canal was concrete-lined, it had slower moderate water velocities, and natural substrates covered the wide concrete bottom and provided usable habitat for the aquatic invertebrates. Second, the 1-ha (2.5-ac) San Solomon Ciénega was built in 1996 to create an additional flow-through pond of water for habitat of the native aquatic species (Garrett 2003, pp. 153–154). Finally, during 2009 and 2010, a portion of the deteriorating 1974 refuge canal was removed and relocated away from the motel. The wetted area was expanded to create a new, larger ciénega habitat. This was intended to provide additional natural habitat for the federally listed endangered fishes and candidate invertebrates (Service 2009c, p. 3; Lockwood 2010, p. 3). All of these efforts have been generally successful in providing additional habitat areas for the aquatic invertebrates, although neither the snails nor amphipods have been shown to use the newest ciénega pond to date (Allan 2011, p. 3).

At Phantom Lake Spring, a pupfish refuge canal was built in 1993 (Young *et al.* 1993, pp. 1–3) to increase the available aquatic habitat that had been destroyed by the irrigation canal. Winemiller and Anderson (1997, pp. 204–213) showed that the refuge canal was used by endangered fish species when water was available. Stomach analysis of the endangered pupfish from Phantom Lake Spring showed that the Phantom Cave snail and diminutive amphipod were a part of the fish's diet (Winemiller and Anderson 1997, pp. 209–210), indicating that the invertebrates also used the refuge canal. The refuge canal was constructed for a design flow down to about 0.01 cms (0.5 cfs), which at the time of construction was the lowest flow ever recorded out of Phantom Lake Spring. The subsequent loss of spring flow eliminated the usefulness of the refuge canal because the canal went dry beginning in about 2000.

All the water for the remaining spring head pool at Phantom Lake Spring is being provided by a pump system to bring water from about 23 m (75 ft) within the cave out to the surface. The small outflow pool was enlarged in 2011 (U.S. Bureau of Reclamation 2011, p. 1; Service 2012, entire) to encompass about 75 sq m (800 sq ft) of wetted area. In 2011, the pool was relatively stable and all three of the San Solomon Spring invertebrates were present (Allan 2011, p. 3; Service 2012, p. 9).

In summary, the modifications to the natural spring channels at San Solomon, Phantom Lake, and Giffin Springs represent activities that occurred in the past and resulted in a deterioration of the available habitat for the Phantom Cave snail, Phantom springsnail, and diminutive amphipod. Actions by conservation agencies over the past few decades have mitigated the impacts of those actions by restoring some natural functions to the outflow channels. While additional impacts from modifications are not likely to occur in the future because of land ownership by conservation entities at three of the four spring sites, the past modifications have contributed to the endangerment of these species by reducing the overall quantity of available habitat and, therefore, reducing the number of individuals of each species that can inhabit the spring outflows. The lower the overall number of individuals of each species and the lower the amount of available habitat, the greater the risk of extinction. Therefore, the modification of spring channels contributes to increased risk of extinction in the future as a consequence of the negative impacts of the past actions.

Other Conservation Efforts

All four of these springs in the San Solomon Spring system are inhabited by two fishes federally listed as endangered—Comanche Springs pupfish (Service 1981, pp. 1–2) and Pecos gambusia (Service 1983, p. 4). Critical habitat has not been designated for either species. In addition, East Sandia Spring is also inhabited by the federally threatened Pecos sunflower (Service 2005, p. 4) and the federally endangered Pecos assiminea snail (Service 2010, p. 5). Both the Pecos sunflower and the Pecos assiminea snail also have critical habitat designated at East Sandia Spring (73 FR 17762, April 1, 2008; 76 FR 33036, June 7, 2011, respectively).

The Phantom Cave snail, Phantom springsnail, and diminutive amphipod have been afforded some protection indirectly in the past due to the presence of these other listed species in the same locations. Management and protection of the spring habitats by Texas Parks and Wildlife Department at San Solomon Spring, U.S. Bureau of Reclamation at Phantom Lake Spring, and The Nature Conservancy at East Sandia Spring have benefited the aquatic invertebrates. However, the primary threat from the loss of habitat due to declining spring flows related to groundwater changes have not been abated by the Federal listing of the fish or other species. Therefore, the conservation efforts provided by the concomitant occurrence of species already listed under the Act have not prevented the past and ongoing habitat loss, nor is it expected to prevent future habitat loss.

Summary of Factor A

Based on our evaluation of the best available information, we conclude that the present and future destruction and modification of the habitat of the Phantom Cave snail, Phantom springsnail, and diminutive amphipod is a significant threat. Some of these impacts occurred in the past from the loss of natural spring flows at several springs likely within the historic range. The impacts are occurring now and are likely to continue in the future throughout the current range as groundwater levels decline and increase the possibility of the loss of additional springs. As additional springs are lost, the number of populations will decline and further increase the risk of extinction of these species. The sources of this threat are not confirmed but are presumed to include a combination of factors associated with groundwater pumping, hydrogeologic structure of the supporting groundwater, and climatic changes. The risk of extinction is also heightened by the past alteration of spring channels reducing the available habitat and the number of individuals in each population.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes (San Solomon Spring Species)

There are very few people who are interested in or study springsnails and amphipods, and those who do are sensitive to their rarity and endemism. Consequently, collection for scientific or educational purposes is very limited. There are no known commercial or recreational uses of these invertebrates. For these reasons we conclude that overutilization for commercial, recreational, scientific, or educational purposes is currently not a threat to the Phantom Lake snail, Phantom springsnail, and diminutive amphipod, and we have no indication that these factors will affect these species in the future.

C. Disease or Predation (San Solomon Spring Species)

The San Solomon Spring species are not known to be affected by any disease. These invertebrates are likely natural prey species for fishes and crayfishes that occur in their habitats. Native snails and amphipods have been found as small proportions of the diets of native fishes at San Solomon and Phantom Lake Springs (Winemiller and Anderson 1997, p. 201; Hargrave 2010, p. 10), and crayfish are a known predator of snails (Hershler 1998, p. 14). Bradstreet (2011, p. 98) assumed that snails at San Solomon Spring were prey for both fishes and crayfishes and suspected that the native snails may be more susceptible than the nonnative snails because of their small body size and thinner shells. In addition, Ladd and Rogowski (2012, p. 289) suggested that the nonnative red-rim melania *(Melanoides tuberculata)* may prey upon native snail eggs of a different species. However, our knowledge of such predation is very limited, and the extent to which the predation might affect native springsnails is unknown. For more discussion about red-rim melania see ''Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence.'' We are not aware of any other information indicating that the San Solomon Spring species are affected by disease or predation factors. For these reasons we conclude that disease or predation are not significant threats to the Phantom Lake snail, Phantom springsnail, and diminutive amphipod, and we have no indication that these factors will affect these species more severely in the future.

D. The Inadequacy of Existing Regulatory Mechanisms (San Solomon Spring Species)

Under this factor, we examine whether existing regulatory mechanisms are inadequate to address the threats to the species discussed under Factors A and E. Section 4(b)(1)(A) of the Endangered Species Act requires the Service to take into account ''those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species * * *.'' We interpret this language to require the Service to consider relevant Federal, State, and Tribal laws or regulations that may minimize any of the threats we describe in threat analyses under the other four factors, or otherwise enhance conservation of the species. An example would be the terms and conditions attached to a grazing permit that describe how a permittee will manage livestock on a BLM allotment. They are nondiscretionary and enforceable, and are considered a regulatory mechanism under this analysis. Other examples include State governmental actions enforced under a State statute or constitution, or Federal action under statute.

Having evaluated the significance of the threat as mitigated by any such conservation efforts, we analyze under Factor D the extent to which existing regulatory mechanisms are inadequate to address the specific threats to the species. Regulatory mechanisms, if they exist, may reduce or eliminate the impacts from one or more identified threats. In this section, we review existing State and Federal regulatory mechanisms to determine whether they effectively reduce or remove threats to the three San Solomon Spring species.

Texas laws provide no specific protection for these invertebrate species, as they are not listed as threatened or endangered by the Texas Parks and Wildlife Department. However, even if they were listed by the State, those regulations (Title 31 Part 2 of Texas Administrative Code) would only prohibit the taking, possession, transportation, or sale of any animal species without the issuance of a permit. The State makes no provision for the protection of the habitat of listed species, which is the main threat to these aquatic invertebrates.

Some protection for the habitat of this species is provided with the land ownership of the springs by Federal (Phantom Lake Spring owned by the U.S. Bureau of Reclamation) and State (San Solomon Spring owned by Texas Parks and Wildlife Department) agencies, and by The Nature Conservancy (East Sandia Spring). However, this land ownership only protects the spring outflow channels and provides no protection for maintaining groundwater levels to ensure continuous spring flows.

In the following discussion, we evaluate the existing local regulations related to groundwater management within areas that might provide indirect benefits to the species' habitats through management of groundwater levels.

Local Groundwater Regulations

One regulatory mechanism that could provide some protection to the spring flows for these species comes from local groundwater conservation districts. Groundwater in Texas is generally governed by the rule of capture unless there is a groundwater district in place. The rule of capture allows a landowner to produce as much groundwater as he or she chooses, as long as the water is not wasted (Mace 2001, p. 11). However, local groundwater conservation districts have been established throughout much of Texas and are now the preferred method for groundwater management in the State (Texas Water Development Board 2012, pp. 23–258). Groundwater districts ''may regulate the location and production of wells, with certain voluntary and mandatory exemptions'' (Texas Water Development Board 2012, p. 27).

There are currently four local groundwater districts in the area west of the springs (Texas Water Development Board 2011, p. 1) that could possibly manage groundwater to protect spring flows in the San Solomon Spring system. The Culberson County Groundwater Conservation District covers the southwestern portion of Culberson County and was confirmed (established by the Texas legislature and approved by local voters) in 1998. The Jeff Davis County Underground Water Conservation District covers all of Jeff Davis County and was confirmed in 1993. The Presidio County Underground Water Conservation District covers all of Presidio County and was confirmed in 1999. The Hudspeth County Underground Water District No. 1 covers the northwest portion of Hudspeth County and was confirmed in 1957. This area of Hudspeth County manages the Bone Spring-Victoria Peak aquifer (Hudspeth County Underground Water District No. 1 2007, p. 1), which is not known to contribute water to the regional flow that supplies the San Solomon Spring system (Ashworth 2001, pp. 143–144). Therefore, we will not further consider that groundwater district.

In 2010 the Groundwater Management Area 4 established ''desired future conditions'' for the aquifers occurring within the five-county area of west Texas (Adams 2010, entire; Texas Water Development Board 2012a, entire). These projected conditions are important because they guide the plans for water use of groundwater within groundwater conservation districts in order to attain the desired future condition of each aquifer they manage (Texas Water Development Board 2012c, p. 23). In the following discussion we review the plans and desired future conditions for the groundwater conservation districts in Culberson, Jeff Davis, and Presidio Counties relative to the potential regulation of groundwater for maintaining spring flows and abating future declines in the San Solomon Spring system.

The Culberson County Groundwater Conservation District seeks to implement water management strategies to ''prevent the extreme decline of water levels for the benefit of all water right owners, the economy, our citizens, and the environment of the territory inside the district'' (Culberson County Groundwater Conservation District 2007, p. 1). The missions of Jeff Davis County Underground Water District and Presidio County Underground Water Conservation District are to ''strive to develop, promote, and implement water conservation and management strategies to protect water resources for the benefit of the citizens, economy, and environment of the District'' (Jeff Davis County Underground Water Conservation District 2008, p. 1; Presidio County Underground Water Conservation District 2009, p. 1). However, all three management plans specifically exclude addressing natural resources issues as a goal because, ''The District has no documented occurrences of endangered or threatened species dependent upon groundwater resources'' (Culberson County Groundwater Conservation District 2007, p. 10; Jeff Davis County Underground Water Conservation District 2008, p. 19; Presidio County Underground Water Conservation District 2009, p. 14). This lack of acknowledgement of the relationship of the groundwater resources under the Districts' management to the conservation of the spring flow habitat at the San Solomon Spring system prevents any direct benefits of their management plans for the three aquatic invertebrates.

We also considered the desired future condition of the relevant aquifer that supports San Solomon Spring system flows. The Culberson County Groundwater Conservation District manages the groundwater where the bulk of groundwater pumping occurs in the Salt Basin Bolson aquifer (part of the West Texas Bolson, the source of the water for the San Solomon Spring system) (Oliver 2010, p. 7). The desired future condition for aquifers within the Culberson County Groundwater Conservation District area includes a 24-m (78-ft) drawdown for the West Texas Bolsons (Salt Basin Bolson aquifer in Wild Horse Flat) to accommodate an average annual groundwater pumping of 46 million cm (38,000 af) (Adams 2010, p. 2; Oliver 2010, p. 7). The desired future condition for the West Texas Bolsons for Jeff Davis County Underground Water Conservation District includes a 72-ft (22-m) drawdown over the next 50 years to accommodate an average annual groundwater pumping of 10 million cm (8,075 af) (Adams 2010, p. 2; Oliver 2010, p. 7). The desired future condition for the West Texas Bolsons for Presidio County Underground Water District also includes a 72-ft (22-m) drawdown over the next 50 years to accommodate an average annual groundwater pumping of 12 million cm (9,793 af) (Adams 2010, p. 2; Oliver 2010, p. 7). These drawdowns are based on analysis using groundwater availability models developed for the Texas Water Development Board (Beach *et al.* 2004, p. 10–6–10–8; Oliver 2010, entire). We expect that these groundwater districts will use their district rules to regulate water withdrawals in such a way as to implement these desired future conditions.

The Salt Basin Bolson aquifer in the Wild Horse Flat area (the likely spring source) can range from 60 to 300 m (200 to 1,000 ft) thick. So although it is impossible to determine precisely, we anticipate the planned level of groundwater drawdown will likely result in continued future declines in spring flow rates in the San Solomon Spring system. Therefore, we expect that continued drawdown of the aquifers as identified in the desired future conditions will contribute to ongoing and future spring flow declines. Based on these desired future conditions from the groundwater conservation districts, we conclude that the regulatory mechanisms available to the groundwater districts directing future groundwater withdrawal rates from the aquifers that support spring flows in the San Solomon Spring system are inadequate to protect against ongoing and future modification of habitat for the Phantom Cave snail, Phantom springsnail, and diminutive amphipod.

Summary of Factor D

Although there are some regulatory mechanisms in place, such as the existence of groundwater conservation districts, we find that the mechanisms are not serving to alleviate or limit the salient threats to the Phantom Cave snail, Phantom springsnail, or diminutive amphipod. We, therefore, conclude that these existing regulatory mechanisms are inadequate to sufficiently reduce the identified threats to the Phantom Cave snail, Phantom springsnail, and diminutive amphipod now and in the future.

E. Other Natural or Manmade Factors Affecting Their Continued Existence (San Solomon Spring Species)

We considered three other factors that may be affecting the continued existence of the San Solomon Spring species: nonnative snails, other nonnative species, and the small, reduced ranges of the three San Solomon Spring species.

Nonnative Snails

Another factor that may be impacting the San Solomon Spring species is the presence of two nonnative snails that occur in a portion of their range. The red-rim melania and quilted melania both occur at San Solomon Spring, and the red-rim melania also occurs at Phantom Lake and Giffin Springs (Allan 2011, p. 1; Bradstreet 2011, pp. 4–5; Lang 2011, pp. 4–5, 11). Both species are native to Africa and Asia and have been imported into the United States as aquarium species. They are now established in various locations across the southern and western portions of the United States (Bradstreet 2011, pp. 4–5; U.S. Geological Survey 2009, p. 2; Benson 2012, p. 2).

The red-rim melania was first reported from Phantom Lake Spring during the 1990s (Fullington 1993, p. 2; McDermott 2000, pp. 14–15) and was first reported from Giffin Spring in 2001 (Lang 2011, pp. 4–5). The species has been at San Solomon Spring for some time longer (Texas Parks and Wildlife Department 1999, p. 14), but it is not found in East Sandia Spring (Lang 2011, p. 10; Allan 2011, p. 1). Bradstreet reported the red-rim melania in all of the habitats throughout San Solomon Spring at moderate densities compared to other snails, with a total population estimate of about 390,000 snails (± 350,000) (Bradstreet 2011, pp. 45–55). Lang (2011, pp. 4–5) also found moderate densities of red-rim melania at Giffin Spring in both the headspring area and downstream spring run area.

The quilted melania was first reported as being at San Solomon Spring in 1999 (Texas Parks and Wildlife Department 1999, p. 14) from observations in 1995 (Bowles 2012, pers. comm.). It was later collected in 2001 (Lang 2011, p. 4), but not identified until Bradstreet (2011, p. 4) confirmed its presence there. The species is not found in any other springs in the San Solomon Spring system, but occurs in all habitats throughout San Solomon Spring at moderate densities compared to other snails, with a total population estimate of about 840,000 snails (±1,070,000) (Bradstreet 2011, pp. 45–55).

The mechanism and extent of potential effects of the two nonnative snails on the native invertebrates have not been studied directly. However, because both nonnative snails occur in relatively high abundances, it is reasonable to presume that they are likely competing for space and food resources in the limited habitats in which they occur. Rader *et al.* (2003, pp. 651–655) reviewed the biology and possible impacts of red-rim melania and suggested that the species had already displaced some native springsnails in spring systems of the Bonneville Basin of Utah. Appleton *et al.* (2009, entire) reviewed the biology and possible impacts of the quilted melania and found potentially significant impacts likely to occur to the native benthic invertebrate community in aquatic systems in South Africa. Currently, East Sandia Spring has remained free of nonnative snails, but their invasion there is a continuing concern (Bradstreet 2011, p. 95). We conclude that these two snails may be having some negative effects on the Phantom Cave snail, Phantom springsnail, and diminutive amphipod based on a potential for competition for spaces and food resources.

Other Nonnative Species

A potential future threat to these species comes from the possible introduction of additional nonnative species into their habitat. In general, introduced species are a serious threat to native aquatic species (Williams *et al.* 1989, p. 18; Lodge *et al.* 2000, p. 7). The threat is particularly elevated at San Solomon Spring where the public access to the habitat is prolific by the thousands of visitors to the Balmorhea State Park who swim in the spring outflow pool. Unfortunately, people will sometimes release nonnative species into natural waters, intentionally or unintentionally, without understanding the potential impacts to native species. In spite of regulations that do not permit it, visitors to the Park may release nonnative species into the outflow waters of San Solomon Spring. This is presumably how the two nonnative snails became established there. Nonnative fishes are sometimes seen and removed from the water by Park personnel (Texas Parks and Wildlife Department 1999, pp. 46–47). The Park makes some effort to minimize the risk of nonnative species introductions by prohibiting fishing (so no live bait is released) and by taking measures to educate visitors about the prohibition of releasing species into the water (Texas Parks and Wildlife Department 1999, pp. 48). In spite of these efforts, there is an ongoing risk, which cannot be fully determined, that novel and destructive nonnative species could be introduced in the future. This risk is much lower at the other three springs in the San Solomon Spring system because of the lack of public access to these sites.

We conclude that the future introduction of any nonnative species represents an ongoing concern to the aquatic invertebrates, however, the immediacy of this happening is relatively low because it is only a future possibility. In addition, the severity of the impact is also relatively low because it is most likely to occur only at San Solomon Spring and the actual effects of any nonnative species on the Phantom Cave snail, Phantom springsnail, and diminutive amphipod are unknown at this time.

Small, Reduced Range

One important factor that contributes to the high risk of extinction for these species is their naturally small range that has been reduced from past destruction of their habitat. While the overall extent of geographic range of the species has not changed, the number and distribution of local populations within their range has likely been reduced when other small springs within the San Solomon Spring system (such as Saragosa, Toyah, and West Sandia Springs) ceased to flow (Brune 1981, p. 386; Karges 2003, p. 145). These species are now currently limited to four small spring outflow areas, with the populations at Phantom Lake Spring in imminent threat of loss.

The geographically small range with only four populations of these invertebrate species increases the risk of extinction from any effects associated with other threats or stochastic events. When species are limited to small, isolated habitats, they are more likely to become extinct due to a local event that negatively affects the populations (Shepard 1993, pp. 354–357; McKinney 1997, p. 497; Minckley and Unmack 2000, pp. 52–53). In addition, the species are restricted to aquatic habitats in small spring systems and have minimal mobility and no other habitats available for colonization, so it is unlikely their range will ever expand beyond the current extent. This situation makes the magnitude of impact of any possible threat very high. In other words, the resulting effects of any of the threat factors under consideration here, even if they are relatively small on a temporal or geographic scale, could result in complete extinction of the species. While the small, reduced range does not represent an independent threat to these species, it does substantially increase the risk of extinction from the effects of other threats, including those addressed in this analysis and those that could occur in the future from unknown sources.

Summary of Factor E

The potential impacts of these nonnative snails and any future introductions of other nonnative species on the Phantom Cave snail, Phantom springsnail, and diminutive amphipod are largely unknown with the current available information. But the nonnative snails are presumed to have some negative consequences to the native snails through competition for space and resources. The effects on the diminutive amphipod are even less clear, but competition could still be occurring. These nonnative snails have likely been co-occurring for at least 20 years at three of the four known locations for these species, and there is currently nothing preventing the invasion of the species into East Sandia Spring. Considering the best available information, we conclude that the presence of these two nonnative snails and the potential future introductions of nonnative species currently represent a low-intensity threat to the Phantom Cave snail, Phantom Lake springsnail, and diminutive amphipod. In addition, the small, reduced ranges of these species limit the number of available populations and increase the risk of extinction from other threats. In combination with the past and future threats from habitat modification and loss, these factors contribute to the increased risk of extinction to the three native species.

Proposed Determination—San Solomon Spring Species

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the Phantom Cave snail, Phantom springsnail, and diminutive amphipod. We find the species are in danger of extinction due to the current and ongoing modification and destruction of their habitat and range (Factor A) from the ongoing and future decline in spring flows, and historic modification of spring channels. The most significant factor threatening these species is a result of historic and future declines in regional groundwater levels that have caused some springs to cease flowing and threatens the remaining springs with the same fate. We did not find any significant threats to the species under Factors B or C. We found that existing regulatory mechanisms are inadequate to provide protection to the species through groundwater management by groundwater conservation districts (Factor D) from existing and future threats. Finally, two nonnative snails occur in portions of the species' range that could be another factor negatively affecting the species (Factor E). The severity of the impact from these nonnative snails or other future introductions of nonnative species is not known, but such introductions may contribute to the risk of extinction from the threats to habitat through reducing the abundance of the three aquatic invertebrates through competition for space and resources. The small, reduced ranges (Factor E) of these species, when coupled with the presence of additional threats, also put them at a heightened risk of extinction.

The elevated risk of extinction of the Phantom Cave snail, Phantom springsnail, and diminutive amphipod is a result of the cumulative nature of the stressors on the species and their habitats. For example, the past reduction in available habitat through modification of spring channels resulted in a lower number of individuals contributing to the sizes of the populations. In addition, the loss of other small springs that may have been inhabited by the species reduced the number of populations that would contribute to the species' overall viability. In this diminished state, the species are also facing future risks from the impacts of continuing declining spring flows, exacerbated by potential extended future droughts resulting from global climate change, and potential effects from nonnative species. All of these factors contribute together to heighten the risk of extinction and lead to our finding that the Phantom Cave snail, Phantom springsnail, and diminutive amphipod are in danger of extinction throughout all of their ranges and warrant listing as endangered species.

The Act defines an endangered species as any species that is ''in danger of extinction throughout all or a significant portion of its range'' and a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the species, and have determined that the Phantom Cave snail, Phantom springsnail, and diminutive amphipod all meet the definition of endangered species under the Act. Significant threats are occurring now and in the foreseeable future, at a high intensity, and across the species' entire range, placing them on the brink of extinction at the present time. Because the threats are placing the species in danger of extinction now and not only in the foreseeable future, we have determined that they meet the definition of endangered species rather than threatened species. Therefore, on the basis of the best available scientific and commercial information, we propose listing the Phantom Cave snail, Phantom springsnail, and diminutive amphipod as endangered species in accordance with sections 3(6) and 4(a)(1) of the Act.

Under the Act and our implementing regulations, a species may warrant listing if it is threatened or endangered throughout all or a significant portion of its range. The species proposed for listing in this rule are highly restricted within their range, and the threats occur throughout their range. Therefore, we assessed the status of the species throughout their entire range. The threats to the survival of the species occur throughout the species' range and are not restricted to any particular significant portion of that range. Accordingly, our assessment and proposed determination applies to the species throughout their entire range.

Diamond Y Spring Species—Diamond Y Spring Snail, Gonzales Springsnail, and Pecos Amphipod

The following five-factor analysis applies to the three species that occur in the Diamond Y Spring system in Pecos County, Texas: Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod.

A. The Present or Threatened Destruction, Modification, or Curtailment of Their Habitat or Range (Diamond Y Spring Species)

Spring Flow Decline

The primary threat to the continued existence of the Diamond Y Spring species is the degradation and potential future loss of aquatic habitat (flowing water from the spring outlets) due to the decline of groundwater levels in the aquifers that support spring surface flows. Habitat for these species is exclusively aquatic and completely dependent upon spring outflows. Spring flows in the Diamond Y Spring system appear to have declined in flow rate over time, and as spring flows decline available aquatic habitat is reduced and altered. When a spring ceases to flow continually, all habitats for these species are lost, and the populations will be extirpated. When all of the springs lose consistent surface flows, all natural habitats for these aquatic invertebrates will be gone, and the species will become extinct. We know springs in this area can fail due to groundwater pumping, because larger nearby springs, such as Comanche and Leon Springs have already ceased flowing and likely resulted in the extirpation of local populations of these species (assuming they were present historically).

The springs do not have to cease flowing completely to have an adverse effect on invertebrate populations. The small size of the spring outflows in the Diamond Y Spring system makes them particularly susceptible to changes in water chemistry, increased water temperatures, and freezing. Because these springs are small, any reductions in the flow rates from the springs can reduce the available habitat for the species, decreasing the number of individuals and increasing the risk of extinction. Water temperatures and chemical factors such as dissolved oxygen in springs do not typically fluctuate (Hubbs 2001, p. 324); invertebrates are narrowly adapted to spring conditions and are sensitive to changes in water quality (Hershler 1998, p. 11). Spring flow declines can lead to the degradation and loss of aquatic invertebrate habitat and present a substantial threat to the species.

There have been no regular recordings of spring flow discharge at Diamond Y Spring to quantify any trends in spring flow. The total flow rates are very low, as Veni (1991, p. 86) estimated total discharge from the upper watercourse at 0.05 to .08 cms (2 to 3 cfs) and from the lower watercourse at 0.04 to 0.05 cms (1 to 2 cfs). The nature of the system with many diffuse and unconfined small springs and seeps makes the estimates of water quantity discharging from the spring system difficult to obtain. However, many authors (Veni 1991, p. 86; Echelle *et al.* 2001, p. 28; Karges 2003, pp. 144–145) have described the reductions in available surface waters observed compared to older descriptions of the area (Kennedy 1977, p. 93; Hubbs *et al.* 1978, p. 489; Taylor 1985, pp. 4, 15, 21). The amount of aquatic habitat may vary to some degree based on annual and seasonal conditions, but the overall trend in the reduction in the amount of surface water over the last several decades is apparent.

A clear example of the loss in aquatic habitat comes from Kennedy's (1977, p. 93) description of one of his study sites in 1974. Station 2 was called a ''very large pool'' near Leon Creek of about 1,500 to 2,500 sq m (16,000 to 27,000 sq ft) with shallow depths of 0.5 to 0.6 m (1.6 to 2.0 ft), with a small 2-m (6.6-ft) deep depression in the center. Today very little open water is found in this area, only marshy soils with occasional trickles of surface flow. This slow loss of aquatic habitat has occurred throughout the system over time and represents a substantial threat to the continued existence of the Diamond Y Spring snail, Gonzales springsnail, and the Pecos amphipod.

The precise reason for the declining spring flows remains uncertain, but it is presumed to be related to a combination of groundwater pumping, mainly for agricultural irrigation, and a lack of natural recharge to the supporting aquifers. In addition, future changes in the regional climate are expected to exacerbate declining flows.

Initial studies of the Diamond Y Spring system suggested that the Edwards-Trinity aquifer was the primary source of flows (Veni 1991, p. 86). However, later studies seem to confirm that the Rustler aquifer is instead more likely the chief source of water (Boghici 1997, p. 107). The Rustler aquifer is one of the less-studied aquifers in Texas and encompasses most of Reeves County and parts of Culberson, Pecos, Loving, and Ward Counties in the Delaware Basin of west Texas (Boghici and Van Broekhoven 2001, pp. 209–210). The Rustler strata are thought to be between 75 to 200 m (250 to 670 ft) thick (Boghici and Van Broekhoven 2001, p. 207). Very little recharge to the aquifer likely comes from precipitation in the Rustler Hills in Culberson County, but most of it may be contributed by cross-formational flows from old water from deeper aquifer formations (Boghici and Van

Broekhoven 2001, pp. 218–219). Groundwater planning for the Rustler aquifer anticipates no annual recharge (Middle Pecos Groundwater Conservation District 2010b, p. 18).

Historic pumping from the Rustler aquifer in Pecos County may have contributed to declining spring flows, as withdrawals of up to 9 million cm (7,500 af) in 1958 were recorded, with estimates from 1970 to 1997 suggesting groundwater use averaged between 430,000 cm (350 af) to 2 million cm (1,550 af) per year (Boghici and Van Broekhoven 2001, p. 218). As a result, declines in water levels in Pecos County wells in the Rustler aquifer from the mid-1960s through the late 1970s of up to 30 m (100 ft) have been recorded (Boghici and Van Broekhoven 2001, p. 213). We assume that groundwater pumping has had some impacts on spring flows of the Diamond Y Spring system in the past; however, they have not yet been substantial enough to cause the main springs to cease flowing.

Future groundwater withdrawals may further impact spring flow rates if they occur in areas of the Rustler Aquifer that affect the spring source areas. Groundwater pumping withdrawals in Pecos County are expected to continue in the future mainly to support irrigated agriculture (Region F Water Planning Group 2011, pp. 2-16–2-19) and will result in continued lowering of the groundwater levels in the Rustler aquifer. The latest plans from Groundwater Management Area 3 (the planning group covering the relevant portion of the Rustler Aquifer) allows for a groundwater withdrawal in the Rustler Aquifer not to exceed 90 m (300 ft) in the year 2060 (Middle Pecos Groundwater Conservation District 2010a, p. 2). This level of drawdown will accommodate 12.9 million cm (10,508 af) of annual withdrawals by pumping (Middle Pecos Groundwater Conservation District 2010b, p. 15). This level of pumping would be 30 times more than the long-term average and could result in an extensive reduction in the available groundwater in the aquifer based on the total thickness of the Rustler strata. Therefore, we anticipate this level of groundwater drawdown may contribute to continued declines in spring flow rates in the Diamond Y Spring system.

Another factor possibly contributing to declining spring flows is climatic changes that may increase the frequency and duration of local and regional drought. The term ''climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a, p. 78). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007a, p. 78).

Although the bulk of spring flows probably originates from water sources with limited recent recharge, any decreases in regional precipitation patterns due to prolonged drought will further stress groundwater availability and increase the risk of diminishment or drying of the springs. Drought affects both surface and groundwater resources and can lead to diminished water quality (Woodhouse and Overpeck 1998, p. 2693; MacRae *et al.* 2001, pp. 4, 10) in addition to reducing groundwater quantities. Lack of rainfall may also indirectly affect aquifer levels by resulting in an increase in groundwater pumping to offset water shortages from low precipitation (Mace and Wade 2008, p. 665).

Recent drought conditions may be indicative of more common future conditions. The current, multiyear drought in the western United States, including the Southwest, is the most severe drought recorded since 1900 (Overpeck and Udall 2010, p. 1642). In 2011, Texas experienced the worst annual drought since recordkeeping began in 1895 (NOAA 2012, p. 4), and only 1 other year since 1550 (the year 1789) was as dry as 2011 based on tree-ring climate reconstruction (NOAA 2011, pp. 20–22). In addition, numerous climate change models predict an overall decrease in annual precipitation in the southwestern United States and northern Mexico.

Future global climate change may result in increased severity of droughts and further contribute to impacts on the aquatic habitat from reduction of spring flows. There is high confidence that many semiarid areas like the western United States will suffer a decrease in water resources due to ongoing climate change (IPCC 2007b, p. 7; Karl *et al.* 2009, pp. 129–131), as a result of less annual mean precipitation. Milly *et al.* (2005, p. 347) also project a 10 to 30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models. Even under lower greenhouse gas emission scenarios, recent projections forecast a 10 percent decline in precipitation in western Texas by 2080 to 2099 (Karl *et al.* 2009, pp. 129–130). Assessments of climate change in west Texas suggest that the area is likely to become warmer and at least slightly drier (Texas Water Development Board 2008, pp. 22–25).

The potential effects of future climate change could reduce overall water availability in this region of western Texas and compound the stressors associated with declining flows from the Diamond Y Spring system. As a result of the effects of increased drought, spring flows could decline indirectly as a result of increased pumping of groundwater to accommodate human needs for additional water supplies (Mace and Wade 2008, p. 664; Texas Water Development Board 2012c, p. 231).

In conclusion, the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod are in danger of extinction because of the past and expected future loss of habitat associated with declining spring flows. Some nearby springs have already gone dry. While the sources of the stress of declining spring flows are not known for certain, the best available scientific information would indicate that it is the result of a combination of factors including past and current groundwater pumping and climatic changes (decreased precipitation and recharge). The threat of habitat loss from declining spring flows affects all the entire range of all three species, as all are at risk of future loss due to declining spring flows. All indications are that the source of this threat will persist into the future and will result in continued degradation of the species' habitats, placing them at a high risk of extinction.

Water Quality Changes and Contamination

Another potential factor that could impact habitat of the Diamond Y Spring species is the potential degradation of water quality from point pollutant sources. This can occur either directly into surface water or indirectly through contamination of groundwater that discharges into spring run habitats used by the species. The primary threat for contamination in these springs comes from activities related to oil and gas exploration, extraction, transportation, and processing.

Oil and gas activities are a source of significant threat to the Diamond Y Spring species because of the potential groundwater or surface water contamination from pollutants (Veni 1991, p. 83; Fullington 1991, p. 6). The Diamond Y Spring system is within an active oil and gas extraction field that has been operational for many decades. In 1990, there were 45 active and plugged wells within the Diamond Y Preserve and an estimated 800 to 1,000 wells perforated the aquifers within the springs' drainage basins (Veni 1991, p. 83). At this time there are still many active wells located within about 100 m (about 300 ft) of surface waters. In addition, a natural gas processing plant, known as the Gomez Plant, is located within 0.8 km (0.5 mi) upslope of Diamond Y Spring. Oil and gas pipelines cross the habitat, and many oil extraction wells are located near the occupied habitat. Oil and gas drilling also occurs throughout the area of supporting groundwater providing another potential source of contamination through the groundwater supply. The Gomez Plant, which collects and processes natural gas is located about 350 m (1,100 feet) up gradient from the head pool of Diamond Y Spring (Hoover 2011, p. 1). Taylor (1985, p. 15) suggested that an unidentified groundwater pollutant may have been responsible for reductions in abundance of Diamond Y Spring snail in the headspring and outflow of Diamond Y Spring, although there never were any follow-up studies done to investigate the presumption. The potential for an event catastrophic to the Diamond Y Spring species from a contaminant spill or leak is possible at any time (Veni 1991, p. 83).

As an example of the possibility for spills, in 1992 approximately 10,600 barrels of crude oil were released from a 15-cm (6-in) pipeline that traverses Leon Creek above its confluence with Diamond Y Draw. The oil was from a pipeline, which ruptured at a point several hundred feet away from the Leon Creek channel. The spill site itself is about 1.6 km (1 mi) overland from Diamond Y Spring. The pipeline was operated at the time of the spill by the Texas-New Mexico Pipeline Company, but ownership has since been transferred to several other companies. The Texas Railroad Commission has been responsible for overseeing cleanup of the spill site. Remediation of the site initially involved aboveground land farming of contaminated soil and rock strata to allow microbial degradation. In later years, remediation efforts focused on vacuuming oil residues from the surface of groundwater exposed by trenches dug at the spill site. No impacts on the rare fauna of Diamond Y Springs have been observed, but no specific monitoring of the effects of the spill was undertaken (Industrial Economics, Inc. 2005, p. 4–12).

If a contaminant were to leak into the habitat of the species from any of the various sources, the effects of the contamination could result in death to exposed individuals, reductions in food availability, or other ecological impacts (such as long-term alteration to water or soil chemistry and the microorganisms that serve as the base of food web in the aquatic ecosystem). The effects of a surface spill or leak might be contained to a local area and only affect a portion of the populations; however, an event that contaminated the groundwater could impact both the upper and lower watercourses and eliminate the entire range of all three species. There is currently no regular monitoring of the water quality occurring for these species or their habitats, so it is unlikely that the effects would be detected quickly to allow for a timely response.

These invertebrates are sensitive to water contamination. Hydrobiid snails as a group are considered sensitive to water quality changes, and each species is usually found within relatively narrow habitat parameters (Sada 2008, p. 59). Taylor (1985, p. 15) suggested that an unidentified groundwater pollutant may have been responsible for reductions in abundance of Diamond Y Spring snails in the headspring and outflow of Diamond Y Spring, although no follow-up studies were ever conducted to investigate the presumption. Additionally, amphipods generally do not tolerate habitat desiccation (drying), standing water, sedimentation, or other adverse environmental conditions; they are considered very sensitive to habitat degradation (Covich and Thorpe 1991, pp. 676–677).

Several conservation measures have been implemented in the past to reduce the potential for a contamination event. In the 1970s the U.S. Department of Agriculture, Natural Resources Conservation Service (then the Soil Conservation Service) built a small berm encompassing the south side of Diamond Y Spring to prevent a surface spill from the Gomez Plant from reaching the spring head. After The Nature Conservancy purchased the Diamond Y Springs Preserve in 1990, oil and gas companies undertook a number of conservation measures to minimize the potential for contamination of the aquatic habitats. These measures included decommissioning buried corrodible metal pipelines and replacing them with synthetic surface lines, installing emergency shut-off valves, building berms around oil pad sites, and removing abandoned oil pad sites and their access roads that had been impeding surface water flow (Karges 2003, p. 144).

Presently, there is no evidence of habitat destruction or modification due to groundwater or surface water contamination from leaks or spills, and no major spills affecting the habitat have been reported in the past (Veni 1991, p. 83). However, the potential for future adverse effects from a catastrophic event is an ongoing threat of high severity of potential impact but not immediate.

Modification of Spring Channels

The spring outflow channels in the Diamond Y Spring system have remained mostly intact. The main subtle changes in the past were a result of some cattle grazing before The Nature Conservancy discontinued livestock use in 2000, and roads and well pads that were constructed in the spring outflow areas. Most of these structures were removed by the oil and gas industry following The Nature Conservancy's ownership in 1990. Several caliche (hard calcium carbonate material) roads still cross the spring outflows with small culverts used to pass the restricted flows.

A recent concern has been raised regarding the encroachment of bulrush into the spring channels. Bulrush is an emergent plant that grows in dense stands along the margins of spring channels. (An emergent plant is one rooted in shallow water and having most of its vegetative growth above the water.) When flow levels decline, reducing water depths and velocities, bulrush can become very dense and dominate the wetted channel. In 1998, bulrush made up 39 percent (± 33 percent) of the plant species in the wetted marsh areas of the Diamond Y Draw (Van Auken *et al.* 2007, p. 54). Observations by Itzkowitz (2008, p. 5; 2010, pp. 13–14) found that bulrush were increasing in density at several locations within the upper and lower watercourses in Diamond Y Draw resulting in the loss of open water habitats. Itzkowitz (2010, pp. 13–14) also noted a positive response by bulrush following a controlled fire for grassland management.

In addition to water level declines, the bulrush encroachment may have been aided by a small flume that was installed in 2000 about 100 m (300 ft) downstream of the springhead pool at Diamond Y Spring (Service 1999, p. 2). The purpose of the flume was to facilitate spring flow monitoring, but the instrumentation was not maintained. The flume remains in place and is now being used for flow measurements by the U.S. Geological Survey. The installation of the flume may have slightly impounded the water upstream creating shallow, slow overflow areas along the bank promoting bulrush growth. This potential effect of the action was not foreseen (Service 1999, p. 3). Whether or not the flume was the cause, the area upstream of it is now overgrown with bulrush, and the two snails have not been found in this section for some time.

There are several ways in which dense bulrush stands may alter habitat for the invertebrates. Bulrush grows to a height of about 0.7 m (2 ft) tall in very dense stands. Dense bulrush thickets will result in increased shading of the water surface, which is likely to reduce the algae and other food sources for the invertebrates. In addition, the stems will slow the water velocity, and the root masses will collect sediments and alter the substrates in the stream. These small changes in habitat conditions may result in proportionally large areas of the spring outflow channels being unsuitable for use by the invertebrates, particularly the springsnails. Supporting this idea is the reported distributions of the snails that found them in highest abundance in areas with more open flowing water not dominated by bulrush (Allan 2011, p. 2). The impacts of dense bulrush stands as a result of declining spring flow rates may be negatively affecting the distribution and abundance of the invertebrates within the Diamond Y Spring system.

Another recent impact to spring channels comes from disturbance by feral hogs *(Sus scrofa).* These species have been released or escaped from domestic livestock and have become free-ranging over time (Mapston 2005, p. 6). They have been in Texas for about 300 years and occur throughout the State. The area around Diamond Y Spring has not previously been reported as within their distribution (Mapston 2005, p. 5), but they have now been confirmed there (Allan 2011, p. 2). The feral hogs prefer wet and marshy areas and damage spring channels by creating wallows, muddy depressions used to keep cool and coat themselves with mud (Mapston 2005, p. 15). In 2011, wallows were observed in spring channels formerly inhabited by the invertebrates in both the upper and lower watercourses at the Diamond Y Preserve (Allan 2011, p. 2). The alterations in the spring channels caused by the wallows make the affected area uninhabitable by the invertebrates. The effects of feral hog wallows are limited to small areas but act as another stressor on the very limited habitat of these three Diamond Y Spring species.

Some protection for the spring channel habitats for the Diamond Y Spring species is provided with the ownership and management of the Diamond Y Spring Preserve by The Nature Conservancy (Karges 2003, pp. 143–144). Their land stewardship efforts ensure that intentional or direct impacts to the spring channel habitats will not occur. However, land ownership by The Nature Conservancy provides limited ability to prevent changes such as increases in bulrush or to control feral hogs. Moreover, the Nature Conservancy can provide little protection from the main threats to this species—the loss of necessary groundwater levels to ensure adequate spring flows or contamination of groundwater from oil and gas activities (Taylor 1985, p. 21; Karges 2003, pp. 144–145).

In summary, the modifications to the natural spring channels at the Diamond Y Spring system represent activities that are occurring now and will likely continue in the future through the continued encroachment of bulrush as spring flows continue to decline and through the effects of feral hog wallows. Conservation actions over the past two decades have removed and minimized some past impacts to spring channels by removing livestock and rehabilitating former oil pads and access roads. While additional direct modifications are not likely to occur in the future because of land ownership by The Nature Conservancy, future modifications from bulrush encroachment and feral hog wallows contribute to the suite of threats to the species' habitat by reducing the overall quantity of available habitat and, therefore, reducing the number of individuals of each species that can inhabit the springs. The lower the overall number of individuals of each species and the less available habitat, the greater the risk of extinction. Therefore, the modification of spring channels contributes to increased risk of extinction in the future as a consequence of ongoing and future impacts.

Other Conservation Efforts

The Diamond Y Spring system is inhabited by two fishes federally listed as endangered—Leon Springs pupfish (Service 1985, pp. 3) and Pecos gambusia (Service 1983, p. 4). In addition, the area is also inhabited by the federally threatened Pecos sunflower (Service 2005, p. 4) and the federally endangered Pecos assiminea snail (Service 2010, p. 5). Critical habitat has not been designated for Pecos gambusia. The Diamond Y Spring has been designated as critical habitat for Leon Springs pupfish, Pecos sunflower, and Pecos assiminea snail (45 FR 54678, August 15, 1980; 73 FR 17762, April 1, 2008; 76 FR 33036, June 7, 2011, respectively).

The three Diamond Y Spring species have been afforded some protection indirectly in the past due to the presence of these other listed species in the same locations. Management and protection of the spring habitats by Texas Parks and Wildlife Department, The Nature Conservancy, and the Service has benefited the aquatic invertebrates (Karges 2007, pp. 19–20). However, the primary threat from the loss of habitat due to declining spring flows related to groundwater changes have not been abated by the Federal listing of the fish or other species. Therefore, the conservation efforts provided by the concomitant occurrence of species already listed under the Act have not prevented past and current habitat loss, nor are they expected to do so in the future.

Summary of Factor A

Based on our evaluation of the best available information, we conclude that the present and future destruction and modification of the habitat of the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod is a significant threat. These impacts in the past have come from the loss of natural spring flows at several springs likely within the historic range, and the future threat of the loss of additional springs as groundwater levels are likely to decline in the future. As springs decline throughout the small range of these species, the number of individuals and populations will decline and continue to increase the risk of extinction of these species. The sources of this threat are not confirmed but are presumed to include a combination of factors associated with groundwater pumping and climatic changes. The potential for a spill of contaminants from oil and gas operations presents a constant future threat to the quality of the aquatic habitat. Finally, the risk of extinction is heightened by the ongoing and future modification of spring channels, which reduces the number of individuals in each population, from the encroachment of bulrush and the presence of feral hogs.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes (Diamond Y Spring Species)

There are very few people who are interested in or study springsnails and amphipods, and those who do are sensitive to their rarity and endemism. Consequently, collection for scientific or educational purposes is very limited. There are no known commercial or recreational uses of these invertebrates. For these reasons we conclude that overutilization for commercial, recreational, scientific, or educational purposes are not a threat to the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod, and we have no indication that these factors will affect these species in the future.

C. Disease or Predation (Diamond Y Spring Species)

The Diamond Y Spring species are not known to be affected by any disease. These invertebrates are likely natural prey species for fishes that occur in their habitats. There are no known nonnative predatory fishes within their spring habitats, but there are crayfish, which are known to prey on snails (Hershler 1998, p. 14). Ladd and Rogowski (2012, p. 289) suggested that the nonnative red-rim melania may prey upon different species of native snail eggs. However, the evidence of such predation is very limited, and the extent to which the predation might affect native snails is unknown. For more discussion about red-rim melania, see ''Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence (Diamond Y Spring Species).'' We are not aware of any other information indicating that the Diamond Y Spring species are affected by disease or predation. For these reasons we conclude that neither disease nor predation are threats to the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod, and we have no indication that these factors will affect these species in the future.

D. The Inadequacy of Existing Regulatory Mechanisms (Diamond Y Spring Species)

Under this factor, we examine whether existing regulatory mechanisms are inadequate to address the threats to the species discussed under the other four factors. Section 4(b)(1)(A) of the Endangered Species Act requires the Service to take into account ''those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species * * *.'' We interpret this language to require the Service to consider relevant Federal, State, and Tribal laws and regulations that may minimize any of the threats we describe in threat analyses under the other four factors, or otherwise enhance conservation of the species. An example would be the terms and conditions attached to a grazing permit that describe how a permittee will manage livestock on a BLM allotment. They are nondiscretionary and enforceable, and are considered a regulatory mechanism under this analysis. Other examples include State governmental actions enforced under a State statute or constitution, or Federal action under statute.

Having evaluated the significance of the threat as mitigated by any such conservation efforts, we analyze under Factor D the extent to which existing regulatory mechanisms are inadequate to address the specific threats to the species. Regulatory mechanisms, if they exist, may reduce or eliminate the impacts from one or more identified threats. In this section, we review existing State and Federal regulatory mechanisms to determine whether they effectively reduce or remove threats to the three San Solomon Spring species.

Texas laws provide no specific protection for these invertebrate species, as they are not listed as threatened or endangered by the Texas Parks and Wildlife Department. However, even if they were listed by the State, those regulations (Title 31 Part 2 of Texas Administrative Code) would only prohibit the taking, possession, transportation, or sale of any animal species without the issuance of a permit. The State makes no provision for the protection of the habitat of listed species, which is the main threat to these aquatic invertebrates.

Some protection for the habitat of this species is provided with the land ownership of the springs by The Nature Conservancy. However, this land ownership only protects the spring outflow channels and provides no protection for maintaining groundwater levels to ensure continuous spring flows.

In the following discussion we evaluate the local regulations related to groundwater management within areas that might provide indirect benefits to the species' habitats through management of groundwater withdrawals, and Texas regulations for oil and gas activities.

Local Groundwater Regulations

One regulatory mechanism that could provide some protection to the spring flows for these species comes from local groundwater conservation districts. Groundwater in Texas is generally governed by the rule of capture unless there is a groundwater district in place. The rule of capture allows a landowner to produce as much groundwater as he or she chooses, as long as the water is not wasted (Mace 2001, p. 11). However, local groundwater conservation districts have been established throughout much of Texas and are now the preferred method for groundwater management in the State (Texas Water Development Board 2012, pp. 23–258). Groundwater districts ''may regulate the location and production of wells, with certain voluntary and mandatory exemptions'' (Texas Water Development Board 2012, p. 27).

There is currently one local groundwater district in the area (Texas Water Development Board 2011, p. 1) that could possibly manage groundwater to protect spring flows in the Diamond Y Spring system. The Middle Pecos Groundwater Conservation District covers all of Pecos County and was confirmed in 2002. The Middle Pecos County Groundwater Conservation District seeks to implement water management strategies to ''help maintain a sustainable, adequate, reliable, cost effective and high quality source of groundwater to promote the vitality, economy and environment of the District'' (Middle Pecos Groundwater Conservation District 2010b, p. 1). However, the management plan provides no objectives to maintain spring flow at Diamond Y Spring or to otherwise conserve the three aquatic invertebrates. This lack of acknowledgement of the relationship between the groundwater resources under the Districts' management to the conservation of the spring flow habitat at the Diamond Y Spring system limits any direct benefits of the management plan for the three aquatic invertebrates.

In 2010 the Groundwater Management Area 3 established ''desired future conditions'' for the aquifers occurring within a six-county area of west Texas (Texas Water Development Board 2012b, entire). These projected conditions are important because they guide the plans for water use of groundwater within groundwater conservation districts in order to attain the desired future condition of each aquifer they manage (Texas Water Development Board 2012c, p. 23). The latest plans from Groundwater Management Area 3 (the planning group covering the relevant portion of the Rustler aquifer) allows for a groundwater withdrawal in the Rustler aquifer not to exceed a 90 m (300 ft) drawdown in the year 2060 (Middle Pecos Groundwater Conservation District 2010a, p. 2). The Rustler strata are thought to be between only about 75 and 200 m (250 and 670 ft) thick. This level of drawdown will accommodate 12.9 million cm (10,508 af) of annual withdrawals by pumping (Middle Pecos Groundwater Conservation District 2010b, p. 15; Williams 2010, pp. 3–5). We expect that the groundwater district will use their district rules to regulate water withdrawals in such a way as to implement these desired future conditions.

We expect that continued drawdown of the Rustler aquifer as identified in the desired future conditions will contribute to ongoing and future spring flow declines. Based on these desired future conditions from the groundwater conservation district, we find that the regulatory mechanisms directing future groundwater withdrawal rates from the aquifer that supports spring flows in the Diamond Y Spring system are inadequate to protect against ongoing and future modification of habitat for the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod.

Texas Regulations for Oil and Gas Activities

The Railroad Commission of Texas has regulations that govern many activities by the oil and gas industries to minimize the opportunity for the release of contaminants into the surface water or groundwater in Texas (Texas Administrative Code, Title 16. Economic Regulation, Part 1). While the many regulations in place may be effective at reducing the risk of contaminant releases, they cannot remove the threat of a catastrophic event that could lead to the extinction of the aquatic invertebrates. Therefore, because of the inherent risk associated with oil and gas activities in proximity to the habitats of the three Diamond Y Spring species, and the severe consequences to the species of any contamination, Texas regulations for oil and gas activities cannot remove or alleviate the threats associated with water contamination from an oil or gas spill.

Summary of Factor D

Although there are regulatory mechanisms in place, such as the existence of a local groundwater conservation district and State regulations of oil and gas operations, we find that the mechanisms are not serving to alleviate or limit the threats to the Diamond Y Spring snail, Gonzales springsnail, or Pecos amphipod. We, therefore, conclude that these mechanisms are inadequate to sufficiently reduce the identified threats to these species.

E. Other Natural or Manmade Factors Affecting Their Continued Existence (Diamond Y Spring Species)

We considered four other factors that may be affecting the continued existence of the Diamond Y Spring species: nonnative fish management, nonnative snail, other nonnative species, and the small, reduced ranges of the three Diamond Y Spring species.

Nonnative Fish Management

Another source of potential impacts to these species comes from the indirect effect of management to control nonnative fishes in Diamond Y Spring. One of the major threats to the endangered Leon Springs pupfish, which is also endemic to the Diamond Y Spring system, is hybridization with the introduced, nonnative sheepshead minnow *(Cyprinodon variegatus).* On two separate occasions efforts to eradicate the sheepshead minnow have incorporated the use of fish toxicants in the upper watercourse to kill and remove all the fish and restock with pure Leon Springs pupfish. The first time was in the 1970s when the chemical rotenone was used (Hubbs *et al.* 1978, pp. 489–490) with no documented conservation efforts or monitoring for the invertebrate community.

A second restoration effort was made in 1998 when the fish toxicant Antimycin A was used (Echelle *et al.* 2001, pp. 9–10) in the upper watercourse. In that effort, actions were taken to preserve some invertebrates (holding them in tanks) during the treatment, and an intense monitoring effort was conducted to measure the distribution and abundance of the invertebrates immediately before and for 1 year after the chemical treatment (Echelle *et al.* 2001, p. 14). The results suggested that the Antimycin A had an immediate and dramatic negative effect on Pecos amphipods; however, their abundance returned to pretreatment levels within 7 months (Echelle *et al.* 2001, p. 23). Gonzales springsnail also showed a decline in abundance that persisted during the 1 year of monitoring following the treatment at both treated and untreated sites (Echelle *et al.* 2001, pp. 23, 51).

There is no information available on the impacts of the initial rotenone treatment, but we suspect that, like the later Antimycin A treatment, there were at least short-term effects on the individuals of the Diamond Y Spring species. Both of these chemicals kill fish and other gill-breathing animals (like the three invertebrates) by inhibiting their use of oxygen at the cellular level (U.S. Army Corps of Engineers 2009, p. 2). Both chemicals are active for only a short time, degrade quickly in the environment, and are not toxic beyond the initial application. The long-term effects of these impacts are uncertain, but the available information indicates that the Gonzales springsnail may have responded negatively over at least 1 year. This action was limited to the upper watercourse populations, and the effects were likely short-term in nature.

The use of fish toxicants represents past stressors that are no longer directly affecting the species but may have some lasting consequences to the distribution and abundance of the snails. Currently the Gonzales springsnail occurs in this area of the upper watercourse in a very narrow stretch of the outflow channel from Diamond Y Spring, and the Diamond Y Spring snail may no longer occur in this stretch. Whether or not the application of the fish toxicants influenced these changes in distribution and the current status of the Gonzales springsnail is unknown. However, there is some possibility that these actions could have contributed to the current absence of the Diamond Y Spring snail from this reach and the restricted distribution of the Gonzales springsnail that now occurs in this reach. These actions only occurred in the past, and we do not anticipate them occurring again in the future. If the sheepshead minnow were to invade this habitat again, we do not expect that chemical treatment would be used due to a heightened concern about conservation of the invertebrates. Therefore, we consider this threat relatively insignificant because it was not severe in its impact on the species, and it is not likely to occur again in the future.

Nonnative Snail

Another factor that may be impacting the Diamond Y Spring species is the presence of the nonnative red-rim melania, an invertebrate species native to Africa and Asia that has been imported as an aquarium species and is now established in various locations across the southern and western portions of the United States (Benson 2012, p. 2).

The red-rim melania became established in Diamond Y Spring in the mid 1990s (Echelle *et al.* 2001, p. 15; McDermott 2000, p. 15). The exotic snail is now the most abundant snail in the Diamond Y Spring system (Ladd 2010, p. 18). It only occurs in the first 270 m (890 ft) of the upper watercourse of the Diamond Y Spring system, and it has not been detected in the lower watercourse (Echelle *et al.* 2001, p. 26; Ladd 2010, p. 22).

The mechanism and extent of potential effects of this nonnative snail on the native invertebrates have not been studied directly. However, because the snail occurs in relatively high abundances, it is reasonable to presume that it is likely competing for space and food resources in the limited habitats within which they occur. Rader *et al.* (2003, pp. 651–655) reviewed the biology and possible impacts of red-rim melania and suggested that the species had already displaced some native springsnails in spring systems of the Bonneville Basin of Utah. In the upper watercourse where the red-rim melania occurs, only the Gonzales springsnail occurs there now in very low abundance in the area of overlap, and the Diamond Y Spring snail does not occur in this reach any longer (Ladd 2010, p. 19).

The potential impacts of the red-rim melania on the three aquatic invertebrate species in the Diamond Y Spring system are largely unknown with the current available information, but the nonnative snail is presumed to have some negative consequences to the native snails through competition for space and resources. The effects on the Pecos amphipod is even less clear, but competition could still be occurring. The red-rim melania has been present in the upper watercourse since the mid 1990s, and there is currently nothing preventing the invasion of the species into Euphrasia Spring in the lower watercourse by an incidental human introduction or downstream transport during a flood. Considering the best available information, we conclude that the presence of this nonnative snail represents a moderate threat to the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod.

Other Nonnative Species

A potential future threat to these species comes from the possible introduction of additional nonnative species into their habitat. In general, introduced species are a serious threat to native aquatic species (Williams *et al.* 1989, p. 18; Lodge *et al.* 2000, p. 7). The threat is moderated by the limited public access to the habitat on The Nature Conservancy's preserve. Unfortunately, the limited access did not prevent the introduction of the nonnative sheepshead minnow on two separate occasions (Echelle *et al.* 2001, p. 4). In addition, invertebrates could be inadvertently moved by biologists conducting studies in multiple spring sites (Echelle *et al.* 2001, p. 26).

While the introduction of any future nonnative species could represent a threat to the aquatic invertebrates, the likelihood of this happening is relatively low because it is only a future possibility. In addition the extent of the impacts of any future nonnative species on the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod are unknown at this time.

Small, Reduced Range

One important factor that contributes to the high risk of extinction for these species is their naturally small range that has likely been reduced from past destruction of their habitat. The overall geographic range of the species may have been reduced from the loss of Comanche Springs (where the snails once occurred and likely the Pecos amphipod did as well) and from Leon Springs (if they historically occurred there). And within the Diamond Y Spring system, their distribution has been reduced as flows from small springs and seeps have declined and reduced the amount of wetted areas in the spring outflow. These species are now currently limited to two small spring outflow areas.

The geographically small range and only two proximate populations of these invertebrate species increases the risk of extinction from any effects associated with other threats or stochastic events. When species are limited to small, isolated habitats, they are more likely to become extinct due to a local event that negatively effects the populations (Shepard 1993, pp. 354–357; McKinney 1997, p. 497; Minckley and Unmack 2000, pp. 52–53). In addition, the species are restricted to aquatic habitats in small spring systems and have minimal mobility and no other habitats available for colonization, so it is unlikely their range will ever expand beyond the current extent. This situation makes the severity of impact of any possible separate threat very high. In other words, the resulting effects of any of the threat factors under consideration here, even if they are relatively small on a temporal or geographic scale, could result in complete extinction of the species. While the small, reduced range does not represent an independent threat to these species, it does substantially increase the risk of extinction from the effects of other threats, including those addressed in this analysis, and those that could occur in the future from unknown sources.

Summary of Factor E

We considered four additional stressors as other natural or manmade factors that may be affecting these species. The effects from management actions to control nonnative fish species are considered low because they occurred in the past, with limited impact, and we do not expect them to occur in the future. The potential impacts of the nonnative snail red-rim melania and any future introductions of other nonnative species on the Phantom Cave snail, Phantom springsnail, and diminutive amphipod are largely unknown with the current available information. But the nonnative snail is presumed to have some negative consequences to the native snails through competition for space and resources. The effects on the Pecos amphipod are even less clear, but competition could still be occurring. These nonnative snails have likely been co-occurring for up to 20 years at one of the two known locations for these species, and there is currently nothing preventing the invasion of the species into Euphrasia Spring by an incidental human introduction or downstream transport during a flood. Considering the best available information, we conclude that the presence of the nonnative snail and the potential future introductions of nonnative species represent a low magnitude threat to the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod. In addition, the effects of the small, reduced ranges of these species limits the number of available populations and increases the risk of extinction from other threats. In combination with the past and future threats from habitat modification and loss, these factors contribute to the increased risk of extinction to the three native species.

Proposed Determination—Diamond Y Spring Species

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod. We find the species are in danger of extinction due to the current and ongoing modification and destruction of their habitat and range (Factor A) from the ongoing and future decline in spring flows, ongoing and future modification of spring channels, and threats of future water contamination from oil and gas activities. The most significant factor threatening these species is a result of historic and future declines in regional groundwater levels that have caused the spring system to have reduced surface aquatic habitat and threaten the remaining habitat with the same fate. We did not find any significant threats to the species under Factors B or C. We found that existing regulatory mechanisms that could provide protection to the species through groundwater management by groundwater conservation districts and Texas regulations of the oil and gas activities (Factor D) are inadequate to protect the species from existing and future threats. Finally, the past management actions for nonnative fishes, the persistence of the nonnative red-rim melania, and the future introductions of other nonnative species are other factors that have or could negatively affect the species (Factor E). The severity of the impact from the red-rim melania is not known, but it and future introductions may contribute to the risk of extinction from the threats to habitat by reducing the abundance of the three aquatic invertebrates through competition for space and resources. The small, reduced ranges (Factor E) of these species, when coupled with the presence of additional threats, also put them at a heightened risk of extinction.

The elevated risk of extinction of the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod is a result of the cumulative nature of the stressors on the species and their habitats. For example, the past reduction in available habitat from declining surface water in the Diamond Y Spring system results in lower numbers of individuals contributing to the sizes of the populations. In addition, the loss of other spring systems that may have been inhabited by these species reduced the number of populations that would contribute to the species' overall viability. In this diminished state, the species are also facing future risks from the impacts of continuing declining spring flows, exacerbated by potential extended future droughts resulting from global climate change, and potential effects from nonnative species. All of these factors contribute together to heighten the risk of extinction and lead to our finding that the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod are in danger of extinction throughout all of their ranges and warrant listing as endangered species.

The Act defines an endangered species as any species that is ''in danger of extinction throughout all or a significant portion of its range'' and a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the species, and have determined that the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod all meet the definition of endangered under the Act. They do not meet the definition of threatened species, because significant threats are occurring now and in the foreseeable future, at a high magnitude, and across the species' entire range, placing them on the brink of extinction at the present time. Because the threats are placing the species on the brink of extinction now and not only in the foreseeable future, we have determined that they meet the definition of endangered species rather than threatened species. Therefore, on the basis of the best available scientific and commercial information, we propose listing the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod as endangered species in accordance with sections 3(6) and 4(a)(1) of the Act.

Under the Act and our implementing regulations, a species may warrant listing if it is threatened or endangered throughout all or a significant portion of its range. The species proposed for listing in this rule are highly restricted in their range, and the threats occur throughout their ranges. Therefore, we assessed the status of these species throughout their entire ranges. The threats to the survival of these species occur throughout the species' ranges and are not restricted to any particular significant portion of their ranges. Accordingly, our assessments and proposed determinations apply to these species throughout their entire ranges.

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 results in public awareness and conservation by Federal, state, tribal, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed, preparation of a draft and final recovery plan, and revisions to the plan as significant new information becomes available. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. The recovery plan identifies site-specific management actions that will achieve recovery of the species, measurable criteria that determine when a species may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (comprising species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the final recovery plan will be available on our Web site (*http://www.fws.gov/endangered*), or from our Austin Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

If these species are listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the State of Texas would be eligible for Federal funds to implement management actions that promote the protection and recovery of these species. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Although the six aquatic invertebrates are only proposed for listing under the Act at this time, please let us know if you are interested in participating in recovery efforts for this species. Additionally, we invite you to submit any new information on this species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act 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 designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) of the Act 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) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or 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.

Federal agency actions within the species habitat that may require conference or consultation or both as described in the preceding paragraph include management and any other landscape altering activities on Federal lands administered by the U.S. Bureau of Reclamation; issuance of section 404 Clean Water Act permits by the Army Corps of Engineers; construction and management of gas pipeline and power line rights-of-way by the Federal Energy Regulatory Commission; and construction and maintenance of roads or highways by the Federal Highway Administration.

The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered wildlife. The prohibitions of section 9(a)(2) of the Act, codified at 50 CFR 17.21 for endangered wildlife, 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, 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. Under the Lacey Act (18 U.S.C. 42–43; 16 U.S.C. 3371–3378), it is also 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.

We may issue permits to carry out otherwise prohibited activities involving endangered and threatened wildlife species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.22 for endangered species, and at 17.32 for threatened species. With regard to endangered wildlife, a permit must be issued for the following purposes: for scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities.

It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a proposed listing on proposed and ongoing activities within the range of species proposed for listing. The following activities could potentially result in a violation of section 9 of the Act; this list is not comprehensive:

(1) Unauthorized collecting, handling, possessing, selling, delivering, carrying, or transporting of the species, including import or export across State lines and international boundaries, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act;

(2) Introduction into the habitat of the six west Texas aquatic invertebrate species of nonnative species that compete with or prey upon any of the six west Texas aquatic invertebrate species;

(3) The unauthorized release of biological control agents that attack any life stage of these species;

(4) Unauthorized modification of the springs or spring outflows inhabited by the six west Texas aquatic invertebrates; and

(5) Unauthorized discharge of chemicals or fill material into any waters in which these species are known to occur.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Austin Ecological Services Office (see **FOR FURTHER INFORMATION CONTACT**).

Critical Habitat

Prudency Determination

Section 4 of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, the Secretary designate critical habitat at the time the species is determined to be endangered or threatened. Our regulations at 50 CFR 424.12(a)(1) state that the designation of critical habitat is not prudent when one or both of the following situations exist: (1) The species is threatened by taking or other activity and the identification of critical habitat can be expected to increase the degree of threat to the species; or (2) the designation of critical habitat would not be beneficial to the species.

There is no indication that the six species of west Texas invertebrates are threatened by collection and there are no likely increases in the degree of threats to the species if critical habitat were designated. These species are not targets of collection and the areas proposed for designation either have restricted public access or are already readily open to the public (i.e., Balmorhea State Park). None of the threats identified to the species are associated with human access to the sites, with the possible exception of the potential for introducing nonnative species at San Solomon Spring in Balmorhea State Park. This threat, or any other identified threat, is not expected to increase as a result of critical habitat designation because the San Solomon Spring swimming pool is already heavily visited, the Balmorhea State Park take proactive measures to prevent introduction of non-native species, and the designation of critical habitat will not change the situation.

In the absence of finding that the designation of critical habitat would increase threats to a species, if there are any benefits to a critical habitat designation, then a prudent finding is warranted. The potential benefits of critical habitat to the six west Texas invertebrates include: (1) Triggering consultation under section 7 of the Act, in new areas for actions in which there may be a Federal nexus where it would not otherwise occur, because, for example, Federal agencies were not aware of the potential impacts of an action on the species; (2) focusing conservation activities on the most essential features and areas; (3) providing educational benefits to State or county governments or private entities; and (4) preventing people from causing inadvertent harm to the species. Therefore, because we have determined that the designation of critical habitat will not likely increase the degree of threat to any of the six species and may provide some measure of benefit, we find that designation of critical habitat is prudent for the Phantom Cave snail, Phantom springsnail, diminutive amphipod, Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod.

Background

It is our intent to discuss below only those topics directly relevant to the designation of critical habitat for six aquatic invertebrates in this section of the proposed rules.

Critical habitat is defined in section 3 of the Act as:

(1) The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical or biological features;

(a) Essential to the conservation of the species; and

(b) Which may require special management considerations or protection; and

(2) Specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Conservation, as defined under section 3 of the Act, means to use and the use of all methods and procedures that are necessary to bring an endangered or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

Critical habitat receives protection under section 7 of the Act through the requirement that Federal agencies ensure, in consultation with the Service, that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat. The designation of critical habitat does not affect land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designation does not allow the government or public to access private lands. Such designation does not require implementation of restoration, recovery, or enhancement measures by non-Federal landowners. Where a landowner requests Federal agency funding or authorization for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) of the Act would apply, but even in the event of a destruction or adverse modification finding, the obligation of the Federal action agency and the landowner is not to restore or recover the species, but to implement reasonable and prudent alternatives to avoid destruction or adverse modification of critical habitat.

Under the first prong of the Act's definition of critical habitat, areas within the geographic area occupied by the species at the time it was listed are included in a critical habitat designation if they contain physical or biological features (1) which are essential to the conservation of the species and (2) which may require special management considerations or protection. For these areas, critical habitat designations identify, to the extent known using the best scientific and commercial data available, those physical or biological features that are essential to the conservation of the species (such as space, food, cover, and protected habitat). In identifying those physical and biological features within an area, we focus on the principal biological or physical constituent elements (primary constituent elements such as roost sites, nesting grounds, seasonal wetlands, water quality, tide, soil type) that are essential to the conservation of the species. Primary constituent elements are the elements of physical or biological features that, when laid out in the appropriate quantity and spatial arrangement to provide for a species' life-history processes, are essential to the conservation of the species.

Under the second prong of the Act's definition of critical habitat, we can designate critical habitat in areas outside the geographic area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. For example, an area currently occupied by the species but that was not occupied at the time of listing may be essential to the conservation of the species and may be included in the critical habitat designation. We designate critical habitat in areas outside the geographic area occupied by a species only when a designation limited to its range would be inadequate to ensure the conservation of the species.

Section 4 of the Act requires that we designate critical habitat on the basis of the best scientific data available. Further, our Policy on Information Standards Under the Endangered Species Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines, provide criteria, establish procedures, and provide guidance to ensure that our decisions are based on the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

When we are determining which areas should be designated as critical habitat, our primary source of information is generally the information developed during the listing process for the species. Additional information sources may include the recovery plan for the species, articles in peer-reviewed journals, conservation plans developed by States and counties, scientific status surveys and studies, biological assessments, other unpublished materials, or experts' opinions or personal knowledge.

Habitat is dynamic, and species may move from one area to another over time. We recognize that critical habitat designated at a particular point in time may not include all of the habitat areas that we may later determine are necessary for the recovery of the species. For these reasons, a critical habitat designation does not signal that habitat outside the designated area is unimportant or may not be needed for recovery of the species. Areas that are important to the conservation of the species, both inside and outside the critical habitat designation, will continue to be subject to: (1) Conservation actions implemented under section 7(a)(1) of the Act, (2) regulatory protections afforded by the requirement in section 7(a)(2) of the Act for Federal agencies to ensure their actions are not likely to jeopardize the continued existence of any endangered or threatened species, and (3) the prohibitions of section 9 of the Act if actions occurring in these areas may affect the species. Federally funded or permitted projects affecting listed species outside their designated critical habitat areas may still result in jeopardy findings in some cases. These protections and conservation tools will continue to contribute to recovery of this species. Similarly, critical habitat designations made on the basis of the best available information at the time of designation will not control the direction and substance of future recovery plans, habitat conservation plans, or other species conservation planning efforts if new information available at the time of these planning efforts calls for a different outcome.

Physical or Biological Features

In accordance with section 3(5)(A)(i) and 4(b)(1)(A) of the Act and regulations at 50 CFR 424.12, in determining which areas within the geographic area occupied by the species at the time of listing to designate as critical habitat, we consider the physical or biological features that are essential to the conservation of the species and which may require special management considerations or protection. These include, but are not limited to:

(1) Space for individual and population growth and for normal behavior;

(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) Cover or shelter;

(4) Sites for breeding, reproduction, or rearing (or development) of offspring; and

(5) Habitats that are protected from disturbance or are representative of the historical, geographic, and ecological distributions of a species.

We derive the specific physical or biological features required for the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod from studies of the species' habitat, ecology, and life history as described below. We have determined that the following physical or biological features are essential for the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod.

Space for Individual and Population Growth and for Normal Behavior

The aquatic environment associated with spring outflow channels and marshes provide the habitat for Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod growth and normal behavior. The areas must contain permanent flowing water to provide for the biological needs of the species. Each of the species completes all of their life-history functions in the water and cannot exist for any time outside of the aquatic environment.

Several habitat parameters of springs, such as temperature, dissolved carbon dioxide, dissolved oxygen, conductivity, substrate type, and water depth have been shown to influence the distribution and abundance of other related species of springsnails (O'Brien and Blinn 1999, pp. 231–232; Mladenka and Minshall 2001, pp. 209–211; Malcom *et al.* 2005, p. 75; Martinez and Thome 2006, pp. 12–15; Lysne *et al.* 2007, p. 650). Dissolved salts such as calcium carbonate may also be important factors because they are essential for shell formation for the snails (Pennak 1989, p. 552). Salinity levels are also relevant, particularly at Diamond Y Spring because elevated salinity levels (3 to 6 parts per thousand (Hubbs 2001, p. 314) of dissolved salts) may prevent other more freshwater-adapted species from competing with the native species adapted to higher salinity levels.

The six invertebrates inhabit springs and spring-fed aquatic habitats with low variability in water temperatures. For example, Hubbs (2001, pp. 311–312, 314–315) reported that the spring outflow temperatures had very low variability with average readings of 20 degrees Celsius (°C) (68 degrees Fahrenheit (°F)) at Diamond Y Spring and 19°C (66 °F) at East Sandia Spring with a range between 11 and 25 °C (52 to 77 °F). Spring measurements from 2001 to 2003 at the four springs in the San Solomon Spring complex found water temperatures ranging from 17 to 27 °C (63 to 81 °F) (Texas Water Development Board 2005, p. 38). Proximity to spring vents, where water emerges from the ground, plays a key role in the life history of the six west Texas aquatic invertebrates. For example, many springsnail species exhibit decreased abundance farther away from spring vents, presumably due to their need for stable water chemistry (Hershler 1994, p. 68; Hershler 1998, p. 11; Hershler and Sada 2002, p. 256; Martinez and Thome 2006, p. 14).

The six west Texas aquatic invertebrates are sensitive to water contamination. Hydrobiid snails as a group are considered sensitive to water quality changes, and each species is usually found within relatively narrow habitat parameters (Sada 2008, p. 59). Taylor (1985, p. 15) suggested that an unidentified groundwater pollutant may have been responsible for reductions in abundance of Diamond Y Spring snail in the headspring and outflow of Diamond Y Spring, although no follow-up studies have been conducted to investigate the presumption. Additionally, amphipods generally do not tolerate habitat desiccation (drying), standing water, sedimentation, or other adverse environmental conditions; they are considered very sensitive to habitat degradation (Covich and Thorpe 1991, pp. 676–677).

All six species are most commonly found in flowing water, presumably where dissolved oxygen levels are higher. The species are often found in moderate flowing water along the spring outflow margins rather than in central channels. Water depths where the species occur are generally very shallow, usually less than 1 m (3 ft) deep. An exception to this is the bottom of the San Solomon Spring pool where, because of the construction of the swimming pool, water depths are much greater, exceeding 5 m (15 ft). In San Solomon, Giffin, and Phantom Lake Springs, the habitats for the species are limited to the spring outflow channels because past alteration of the system (building of ditches) has eliminated any small spring openings. However, at Diamond Y Spring (and to a limited extent, East Sandia Spring) the spring outflows have not been severely modified so that small springs, seeps, and marshes still provide diffuse shallow flowing water habitat associated with emergent bulrush and saltgrass (Taylor 1987, p. 38; Echelle *et al.* 2001, p. 5). While these areas are more difficult to map, measure, and survey, these small springs and seeps are important habitat for the three invertebrate species at Diamond Y Spring as long as they provide flowing water.

Therefore, based on the information above, we identify permanent, flowing, unpolluted water (free from contamination) within natural temperature variations, emerging from the ground and flowing on the surface, to be a physical or biological feature necessary for these species.

Food, Water, Air, Light, Minerals, or Other Nutritional or Physiological Requirements

Invertebrates in small spring ecosystems depend on food from two sources: that which grows in or on the substrate (aquatic and attached plants and algae) and that which falls or is blown into the system (primarily leaves). Water is also the medium necessary to provide the algae, detritus (dead or partially decayed plant materials or animals), bacteria, and submergent vegetation on which all six species depend as a food resource. Abundant sunlight is necessary to promote the growth of algae upon which all six west Texas aquatic invertebrates feed.

All four snails are presumably fine-particle feeders on detritus (organic material from decomposing organisms) and periphyton (mixture of algae and other microbes attached to submerged surfaces) associated with the substrates (mud, rocks, and vegetation) (Allan 1995, p. 83; Hershler and Sada 2002, p. 256; Lysne *et al.* 2007, p. 649). Dundee and Dundee (1969, p. 207) found diatoms (a group of single-celled algae) to be the primary component in the digestive tract of the Phantom Cave snail and Phantom springsnail, indicating diatoms are a primary food source. Spring ecosystems occupied by these snail species must support the periphyton upon which springsnails graze. Additionally, submergent vegetation contributes the necessary nutrients, detritus, and bacteria on which these species forage.

Amphipods are omnivorous, feeding on algae, submergent vegetation, and decaying organic matter (Smith 2001, p. 572). Both species of amphipod are often found in beds of submerged aquatic plants (Cole 1976, p. 80), indicating that they probably feed on a surface film of algae, diatoms, bacteria, and fungi (Smith 2001, p. 572). Young amphipods depend on microbial foods, such as algae and bacteria, associated with aquatic plants (Covich and Thorp 1991, p. 677).

Therefore, based on the information above, we identify the presence of abundant food, consisting of algae, bacteria, decaying organic material, and submergent vegetation that contributes the necessary nutrients, detritus, and bacteria on which these species forage to be a physical or biological feature for these species.

Sites for Cover or Shelter and for Breeding, Reproduction, or Rearing (or Development) of Offspring

The six west Texas aquatic invertebrates occur across a wide range of substrate types. The Phantom Cave snail is most commonly attached to hard surfaces, especially large algae-covered rocks, submerged vegetation, or even concrete walls of the irrigation ditches, and found in areas of higher water velocities (Bradstreet 2011, pp. 73, 91). The other springsnails may also be attached to hard surfaces but will also often be found in the softer substrate at the margins of the stream flows. Suitable substrates for egg laying by the snails are typically firm, characterized by cobble, gravel, sand, woody debris, and aquatic vegetation. These substrates increase productivity by providing suitable egg-laying sites for the snails.

The amphipods, in the absence of predatory fishes, will swim over any open substrate on the channel bottom, but in circumstances where fishes are abundant they may be found in greater abundance underneath large rocks, embedded in gravels, or associated with submerged vegetation. Amphipods do not lay eggs upon a surface; instead, the eggs are held within a marsupium (brood pouch) within the female's exoskeleton.

Therefore, based on the information above, we identify substrates that include cobble, gravel, pebble, sand, silt, and aquatic vegetation, for breeding, egg laying, maturing, feeding, and escape from predators to be a physical or biological feature for these species.

Habitats Protected From Disturbance or Representative of the Historical, Geographic, and Ecological Distributions of the Species

The Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod have a very restricted geographic distribution. Endemic species whose populations exhibit a high degree of isolation are extremely susceptible to extinction from both random and nonrandom catastrophic natural or human-caused events. Therefore, it is essential to maintain the spring systems in which they are currently found and upon which these species depend. Adequate spring sites, free of inappropriate disturbance, must exist to promote population expansion and viability. This means protection from disturbance caused by water depletion, water contamination, springhead alteration, or nonnative species. These species must, at a minimum, sustain their current distributions if ecological representation of these species is to be ensured.

As discussed above (see *Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence*), introduced species are a moderate threat to native aquatic species (Williams *et al.* 1989, p. 18; Lodge *et al.* 2000, p. 7), including the six west Texas aquatic invertebrates. The red-rim melania already competes with all six species where they occur, and the quilted melania has been introduced into habitats occupied by the San Solomon Spring species. Feral hogs cause local spring channel destruction within the Diamond Y Spring system. Because the distribution of the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod is so limited, and their habitat so restricted, introduction of additional nonnative species into their habitat could be devastating.

Therefore, based on the information above, we identify either an absence of nonnative predators and competitors or nonnative predators and competitors at low population levels to be a physical or biological feature necessary for these species.

Primary Constituent Elements

Under the Act and its implementing regulations, we are required to identify the physical or biological features essential to the conservation of the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod in areas occupied at the time of listing, focusing on the features' primary constituent elements. We consider primary constituent elements to be the elements of physical or biological features that provide for a species' life-history processes and are essential to the conservation of the species.

Based on our current knowledge of the physical or biological features and habitat characteristics required to sustain the species' life-history processes, we determine that the primary constituent elements specific to the Phantom Cave snail, Phantom springsnail, diminutive amphipod, Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod are springs and spring-fed aquatic systems that contain:

a. Permanent, flowing, unpolluted water (free from contamination) emerging from the ground and flowing on the surface;

b. Water temperatures that vary between 11 and 27 °C (52 to 81 °F) with natural seasonal and diurnal variations slightly above and below that range;

c. Substrates that include cobble, gravel, pebble, sand, silt, and aquatic vegetation, for breeding, egg laying, maturing, feeding, and escape from predators;

d. Abundant food, consisting of algae, bacteria, decaying organic material, and submergent vegetation that contributes the necessary nutrients, detritus, and bacteria on which these species forage; and

e. Either an absence of nonnative predators and competitors or nonnative predators and competitors at low population levels.

With this proposed designation of critical habitat, we intend to identify the physical or biological features essential to the conservation of the species, through the identification of the appropriate quantity and spatial arrangement of the primary constituent elements sufficient to support the life-history processes of the species. All units and subunits proposed to be designated as critical habitat are currently occupied by the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod and contain the primary constituent elements in the appropriate quantity and spatial arrangement sufficient to support the life history needs of the species.

Special Management Considerations or Protection

When designating critical habitat, we assess whether the specific areas within the geographic area occupied by the species at the time of listing contain features that are essential to the conservation of the species and which may require special management considerations or protection. The features essential to the conservation of the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod may require special management considerations or protection to reduce threats, such as reducing or eliminating water in suitable or occupied habitat through drought or groundwater pumping; introducing pollutants to levels unsuitable for the species; and introducing nonnative species into the inhabited spring systems such that suitable habitat is reduced or eliminated. Special management considerations or protection are required within critical habitat areas to address these threats (See Summary of Factors Affecting the Species). Management activities that could ameliorate these threats include management of groundwater levels to ensure the springs remain flowing (all spring sites), managing oil and gas activities to eliminate the threat of groundwater or surface water contamination (Diamond Y Spring), maintaining the pump within Phantom Lake Spring to ensure consistent flow, managing existing nonnative species, red-rim melania, quilted melania, and feral hogs (San Solomon, Giffin, Phantom Lake, and Diamond Y Springs), and preventing the introduction of additional nonnative species (all spring sites).

Criteria Used To Identify Critical Habitat

As required by section 4(b)(2) of the Act, we use the best scientific data available to designate critical habitat. We review available information pertaining to the habitat requirements of the species. In accordance with the Act and its implementing regulation at 50 CFR 424.12(e), we consider whether designating additional areas—outside those currently occupied as well as those occupied at the time of listing—are necessary to ensure the conservation of the species. We are not currently proposing to designate any areas outside the geographic area occupied by the species because none of the historically occupied areas (or those that may have been occupied) were found to be essential for the conservation of the species (see discussion below).

We relied on information from knowledgeable biologists and recommendations contained in state wildlife resource reports (Dundee and Dundee 1969, entire; Cole and Bousfield 1970, entire; Cole 1976, entire; Cole 1985, entire; Taylor 1985, entire; Henry 1992, entire; Bowles and Arsuffi 1993, entire; Seidel *et al.* 2009, entire; Hershler *et al.* 2010, entire; Ladd 2010, entire; Allan 2011, entire; Bradstreet 2011, entire; Hershler 2011, p. 1) in making this determination. We also reviewed the available literature pertaining to habitat requirements, historic localities, and current localities for these species. This includes regional geographic information system (GIS) coverages.

Areas Occupied at the Time of Listing

For the purpose of designating critical habitat for the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod, we defined the occupied area based on the most recent surveys available, which includes the Diamond Y and San Solomon Spring systems. We then evaluated whether these areas contain the primary constituent elements for the species and whether they require special management. Next we considered areas historically occupied, but not currently occupied. While the west Texas aquatic invertebrates may have inhabited other springs in the area (such as Saragosa and Toyah Springs, for the San Solomon Spring species, and Leon and Comanche Springs for the Diamond Y Spring species), we only have confirmation that the Diamond Y Spring snail and Gonzales springsnail occurred in Comanche Spring at some point in the past. We evaluated these areas to determine whether they were essential for the conservation of the species.

To determine if currently occupied areas contain the primary constituent elements, we assessed the life-history components of the species as they relate to habitat. All of the west Texas aquatic invertebrate species require unpolluted spring water in the springheads and spring outflows; periphyton and decaying organic material for food; a combination of soft and hard substrates for maturation, feeding, egg laying by snails, and escape from predators; and absence of nonnative predators and competitors (see discussion on *Physical or Biological Features*).

Areas Unoccupied at the Time of Listing

To determine if the sites that may have been historically occupied by the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod are essential for their conservation, we considered: (1) The importance of the site to the overall status of the species to prevent extinction and contribute to future recovery of each species; (2) whether the area could be restored to contain the necessary physical and biological features to support the species; and (3) whether a population of the species could be reestablished at the site.

The Phantom Cave snail, Phantom springsnail, and diminutive amphipod occur in the San Solomon Spring system, which includes San Solomon Spring, Giffin Spring, East Sandia Spring, and Phantom Spring. These species may have occurred in other springs within the system, including Saragosa, Toyah, and West Sandia Springs. These springs now lack water flow and the physical or biological features necessary to support the San Solomon Spring system invertebrates—mainly the lack of flowing water. We do not foresee these features being restorable to the point where populations of the Phantom Cave snail, Phantom springsnail, and diminutive amphipod could be reestablished. These springs are not restorable because we do not foresee an opportunity for groundwater levels to rise sufficiently in the future to restore permanent spring flows because the supporting aquifers are of ancient origin and do not receive substantial modern recharge. Therefore, even if current pumping activities were to be managed for the benefit of spring flows, it is doubtful that aquifer levels would rise sufficiently to provide restoration of permanent aquatic habitat at these sites. For these reasons, we are not proposing Saragosa Spring, Toyah Spring, or West Sandia Spring or any other unoccupied areas as critical habitat for the San Solomon Spring system invertebrates.

The Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod occur in the Diamond Y Spring system. The Diamond Y Spring snail and Gonzales springsnail historically occurred at Comanche Spring, and the Pecos amphipod may have occurred there as well. All three species may have occurred at Leon Spring. Both Comanche Spring and Leon Spring, which have aquifer sources that may be different or more localized than that of Diamond Y Spring, are dry or nearly so and have been altered to such a degree that they no longer contain the physical or biological features necessary to support the Diamond Y Spring invertebrates—mainly the lack of flowing water. Natural flow conditions from these springs do not appear to be restorable to the point where populations of the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod could be reestablished. For these reasons, we are not proposing Leon Spring or Comanche Spring as critical habitat for the Diamond Y Spring invertebrates.

Mapping

For the areas we are proposing as critical habitat, we plotted the known occurrences of the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod in springheads and spring outflows on 2010 aerial photography from U.S. Department of Agriculture, National Agriculture Imagery Program base maps using ArcMap (Environmental Systems Research Institute, Inc.), a computer geographic information system (GIS) program. We drew the boundaries around the water features that make up the critical habitat in each area. Other than at San Solomon Spring, there are no known developed areas such as buildings, paved areas, and other structures that lack the biological features for the springsnail within the proposed critical habitat areas.

When determining proposed critical habitat boundaries, we made every effort to avoid including developed areas such as lands covered by buildings, pavement, and other structures because such lands lack physical or biological features for the species. The scale of the maps we prepared under the parameters for publication within the Code of Federal Regulations may not reflect the exclusion of such developed lands within Balmorhea State Park at San Solomon Spring. Any such lands left inside critical habitat boundaries shown on the maps of these proposed rules (such as the asphalt and concrete-paved dry surfaces in Balmorhea State Park) have been excluded by text in these proposed rules and are not proposed for designation as critical habitat. Therefore, if the critical habitat is finalized as proposed, a Federal action involving these lands would not trigger section 7 consultation with respect to critical habitat and the requirement of no adverse modification unless the specific action would affect the physical or biological features in the adjacent critical habitat.

Summary

We are proposing for designation of critical habitat lands that we have determined are occupied at the time of listing and contain sufficient elements of physical or biological features to support life-history processes essential for the conservation of the species. Units were proposed for designation based on sufficient elements of physical or biological features being present to support the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod life-history processes. Some units contain all of the identified elements of physical or biological features and supported multiple life-history processes. Some segments contained only some elements of the physical or biological features necessary to support the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod particular use of that habitat.

Proposed Critical Habitat Designation

We are proposing four areas as critical habitat for the Phantom Cave snail, Phantom springsnail, and diminutive amphipod. We are proposing one area as critical habitat for the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod. The critical habitat areas we describe below constitute our current best assessment of areas that meet the definition of critical habitat for the species. The five areas we propose as critical habitat are: (1) San Solomon Spring, (2) Giffin Spring, (3) East Sandia Spring, (4) Phantom Lake Spring, and (5) the Diamond Y Spring System. Phantom Cave snail, Phantom springsnail, and diminutive amphipod all occur in the first 4 units and they are listed in Table 1. Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod occur in the Diamond Y Spring Unit and it is listed in Table 2.

TABLE 1—PROPOSED CRITICAL HABITAT UNITS FOR PHANTOM CAVE SNAIL, PHANTOM SPRINGSNAIL, AND DIMINUTIVE AMPHIPOD

[Area estimates reflect all land within critical habitat unit boundaries]

Critical habitat unit	Land ownership by type	Size of unit in hectares (acres)
San Solomon Spring	State—Texas Parks and Wildlife Department	1.8 (4.4)
Giffin Spring	Private	0.7 (1.7)
East Sandia Spring	Private—The Nature Conservancy	1.2 (3.0)
Phantom Lake Spring	Federal—Bureau of Reclamation	0.02 (0.05)
Total		3.7 (9.2)

Note: Area sizes may not sum due to rounding.

TABLE 2—PROPOSED CRITICAL HABITAT UNIT FOR DIAMOND Y SPRING SNAIL, GONZALES SPRINGSNAIL, AND PECOS AMPHIPOD

[Area estimate reflects all land within critical habitat unit boundaries]

Critical habitat unit	Land ownership by type	Size of unit in hectares (acres)
Diamond Y Spring System	Private—The Nature Conservancy	178.6 (441.4)
Total		178.6 (441.4)

We present brief descriptions of all units, and reasons why they meet the definition of critical habitat below.

San Solomon Spring Unit

The San Solomon Spring Unit consists of 1.8 ha (4.4 ac) that is currently occupied by the Phantom Cave snail, Phantom springsnail, and diminutive amphipod and contains all of the features essential to the conservation of these species. It is located in Reeves County, near Balmorhea, Texas. San Solomon Spring provides the water for the large swimming pool at Balmorhea State Park, which is owned and managed by Texas Parks and Wildlife Department. The proposed designation includes all springs, seeps, and outflows of San Solomon Spring, including the part of the concrete-lined pool that has a natural substrate bottom and irrigation ditch, and two constructed ciénegas. While the ditches do not provide all of the physical or biological features (such as submerged vegetation), there are sufficient features (including natural substrates on the ditch bottoms) to provide for the life-history processes of the species. Habitat in this unit is threatened by future declining spring flows due to drought or groundwater withdrawals, the presence of nonnative snails, and the introduction of other nonnative species. Therefore, the primary constituent elements in this unit may require special management considerations or protection to minimize impacts resulting from these threats.

Giffin Spring Unit

Giffin Spring Unit consists of 0.7 ha (1.7 ac) that is currently occupied by the Phantom Cave snail, Phantom springsnail, and diminutive amphipod and contains all of the features essential to the conservation of these species. It is located on private property in Reeves County, near Balmorhea, Texas, and its waters are captured in irrigation earthen channels for agricultural use. The proposed designation includes all springs, seeps, sinkholes, and outflows of Giffin Spring. The unit contains most all of the identified physical and biological features. Habitat in this unit is threatened by declining spring flows due to drought or groundwater withdrawals, the presence of nonnative snails, the introduction of other nonnative species, and further modification of spring outflow channels. Therefore, the primary constituent elements in this unit may require special management considerations or protection to minimize impacts resulting from these threats.

East Sandia Spring Unit

East Sandia Spring consists of 1.2 ha (3.0 ac) that is currently occupied by the Phantom Cave snail, Phantom springsnail, and diminutive amphipod and contains all of the features essential to the conservation of these species. This unit is included within a preserve owned and managed by The Nature Conservancy (Karges 2003, p. 145) in Reeves County just east of Balmorhea, Texas. The proposed designation includes the springhead itself and surrounding seeps and outflows. The unit contains all of the identified physical and biological features. Habitat in this unit is threatened by declining spring flows due to drought or groundwater withdrawals, the introduction of nonnative species, and modification of spring outflow channels. Therefore, the primary constituent elements in this unit may require special management considerations or protection to minimize impacts resulting from these threats.

Phantom Lake Spring Unit

Phantom Lake Spring consists of a small pool about 0.02 ha (0.05 ac) in size that is currently occupied by the Phantom Cave snail, Phantom springsnail, and diminutive amphipod and contains the features essential to the conservation of these species. Phantom Lake Spring is owned by the U.S. Bureau of Reclamation about 6 km (4 mi) west of Balmorhea State Park in Jeff Davis County, Texas. The proposed designation includes only the springhead pool. The physical or biological features of the habitat at Phantom Lake Spring have been maintained since 2000 by a pumping system and subsequent reconstruction of the spring pool. Although artificially maintained, the site continues to provide sufficient physical or biological features to provide for all the life-history processes of the three invertebrate species. Habitat in this unit is threatened by future declining spring flows due to drought or groundwater withdrawals, the presence of nonnative snails, and the introduction of other nonnative species. Therefore, the primary constituent elements in this unit may require special management considerations or protection to minimize impacts resulting from these threats.

Diamond Y Spring Unit

Diamond Y Spring Unit consists of 178.6 ha (441.4 ac) that is currently occupied by the Diamond Y Spring snail, Gonzales springsnail, and Pecos amphipod and contains all of the features essential to the conservation of these species. Diamond Y Spring and surrounding lands are owned and managed by The Nature Conservancy. The proposed designation includes the Diamond Y Spring and approximately 6.8 km (4.2 mi) of its outflow, including both upper and lower watercourses, ending at approximately 0.8 km (0.5 mi) downstream of the State Highway 18 bridge crossing. Also included in this proposed unit is approximately 0.8 km (0.5 mi) of Leon Creek upstream of the confluence with Diamond Y Draw. The boundaries of this unit extend out laterally beyond the mapped spring outflow channels to incorporate any and all small springs and seeps that may not be mapped or surveyed but are expected to contain the species and the necessary physical or biological features. The unit contains all of the identified physical and biological features. Habitat in this unit is threatened by declining spring flows due to drought or groundwater withdrawals, subsurface drilling and other oil and gas activities that could contaminate surface drainage or aquifer water, the presence of nonnative snails and feral hogs, the introduction of other nonnative species, and modification of spring outflow channels. Therefore, the primary constituent elements in this unit may require special management considerations or protection to minimize impacts resulting from these threats.

Effects of Critical Habitat Designation

Section 7 Consultation

Section 7(a)(2) of the Act requires Federal agencies, including the Service, to ensure that any action they fund, authorize, or carry out is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat of such species. In addition, section 7(a)(4) of the Act requires Federal agencies to confer with the Service on any agency action that is likely to jeopardize the continued existence of any species proposed to be listed under the Act or result in the destruction or adverse modification of proposed critical habitat.

Decisions by the 5th and 9th Circuit Courts of Appeals have invalidated our regulatory definition of ''destruction or adverse modification'' (50 CFR 402.02) (see *Gifford Pinchot Task Force* v. *U.S. Fish and Wildlife Service,* 378 F. 3d 1059 (9th Cir. 2004) and *Sierra Club* v. *U.S. Fish and Wildlife Service et al.,* 245

F.3d 434, 442 (5th Cir. 2001)), and we do not rely on this regulatory definition when analyzing whether an action is likely to destroy or adversely modify critical habitat. Under the statutory provisions of the Act, we determine destruction or adverse modification on the basis of whether, with implementation of the proposed Federal action, the affected critical habitat would continue to serve its intended conservation role for the species.

If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency (action agency) must enter into consultation with us. Examples of actions that are subject to the section 7 consultation process are actions on State, tribal, local, or private lands that require a Federal permit (such as a permit from the U.S. Army Corps of Engineers under section 404 of the Clean Water Act (33 U.S.C. 1251 *et seq.*) or a permit from the Service under section 10 of the Act) or that involve some other Federal action (such as funding from the Federal Highway Administration, Federal Aviation Administration, or the Federal Emergency Management Agency). Federal actions not affecting listed species or critical habitat, and actions on State, tribal, local, or private lands that are not federally funded or authorized, do not require section 7 consultation.

As a result of section 7 consultation, we document compliance with the requirements of section 7(a)(2) through our issuance of:

(1) A concurrence letter for Federal actions that may affect, but are not likely to adversely affect, listed species or critical habitat; or

(2) A biological opinion for Federal actions that may affect, or are likely to adversely affect, listed species or critical habitat.

When we issue a biological opinion concluding that a project is likely to jeopardize the continued existence of a listed species and/or destroy or adversely modify critical habitat, we provide reasonable and prudent alternatives to the project, if any are identifiable, that would avoid the likelihood of jeopardy and/or destruction or adverse modification of critical habitat. We define ''reasonable and prudent alternatives'' (at 50 CFR 402.02) as alternative actions identified during consultation that:

(1) Can be implemented in a manner consistent with the intended purpose of the action,

(2) Can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction,

(3) Are economically and technologically feasible, and

(4) Would, in the Director's opinion, avoid the likelihood of jeopardizing the continued existence of the listed species and/or avoid the likelihood of destroying or adversely modifying critical habitat.

Reasonable and prudent alternatives can vary from slight project modifications to extensive redesign or relocation of the project. Costs associated with implementing a reasonable and prudent alternative are similarly variable.

Regulations at 50 CFR 402.16 require Federal agencies to reinitiate consultation on previously reviewed actions in instances where we have listed a new species or subsequently designated critical habitat that may be affected and the Federal agency has retained discretionary involvement or control over the action (or the agency's discretionary involvement or control is authorized by law). Consequently, Federal agencies sometimes may need to request reinitiation of consultation with us on actions for which formal consultation has been completed, if those actions with discretionary involvement or control may affect subsequently listed species or designated critical habitat.

Application of the ''Adverse Modification'' Standard

The key factor related to the adverse modification determination is whether, with implementation of the proposed Federal action, the affected critical habitat would continue to serve its intended conservation role for the species. Activities that may destroy or adversely modify critical habitat are those that alter the physical or biological features to an extent that appreciably reduces the conservation value of critical habitat for the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod. As discussed above, the role of critical habitat is to support the life-history needs of the species and provide for the conservation of the species.

Section 4(b)(8) of the Act requires us to briefly evaluate and describe, in any proposed or final regulation that designates critical habitat, activities involving a Federal action that may destroy or adversely modify such habitat, or that may be affected by such designation.

Activities that may affect critical habitat, when carried out, funded, or authorized by a Federal agency, should result in consultation for the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod. These activities include, but are not limited to:

(1) Actions that would reduce the quantity of water flow within the spring systems proposed as critical habitat.

(2) Actions that would contaminate or cause significant degradation of water quality within the spring systems proposed as critical habitat, including surface drainage water or aquifer water quality.

(3) Actions that would modify the springheads or outflow channels within the spring systems proposed as critical habitat.

(4) Actions that would reduce or alter the availability of aquatic substrates within the spring systems that are proposed as critical habitat.

(5) Actions that would reduce the occurrence of native aquatic periphyton within the spring systems proposed as critical habitat.

(6) Actions that would introduce, promote, or maintain nonnative predators and competitors within the spring systems proposed as critical habitat.

Exemptions

Application of Section 4(a)(3) of the Act

The National Defense Authorization Act for Fiscal Year 2004 (Pub. L. 108–136) amended the Act to limit areas eligible for designation as critical habitat on some Department of Defense lands. There are no Department of Defense lands within or near the proposed critical habitat designation, so section 4(a)(3)(B)(i) of the Act does not apply.

Exclusions

Application of Section 4(b)(2) of the Act

Section 4(b)(2) of the Act states that the Secretary shall designate and make revisions to critical habitat on the basis of the best available scientific data after taking into consideration the economic impact, national security impact, and any other relevant impact of specifying any particular area as critical habitat. The Secretary may exclude an area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless he determines, based on the best scientific data available, that the failure to designate such area as critical habitat will result in the extinction of the species. In making that determination, the statute on its face, as well as the legislative history, are clear that the Secretary has broad discretion regarding which factor(s) to use and how much weight to give to any factor.

Under section 4(b)(2) of the Act, we may exclude an area from designated critical habitat based on economic impacts, impacts on national security, or any other relevant impacts. In considering whether to exclude a particular area from the designation, we identify the benefits of including the area in the designation, identify the benefits of excluding the area from the designation, and evaluate whether the benefits of exclusion outweigh the benefits of inclusion. If the analysis indicates that the benefits of exclusion outweigh the benefits of inclusion, the Secretary may exercise his discretion to exclude the area only if such exclusion would not result in the extinction of the species.

Exclusions Based on Economic Impacts

Under section 4(b)(2) of the Act, we consider the economic impacts of specifying any particular area as critical habitat. In order to consider economic impacts, we are preparing an analysis of the economic impacts of the proposed critical habitat designation and related factors. Potential land use sectors that may be affected by critical habitat designation include oil and gas development near the Diamond Y Spring system and agriculture (irrigated lands using groundwater withdrawals) at both spring systems. We also consider any social impacts that might occur because of the designation.

We will announce the availability of the draft economic analysis as soon as it is completed, at which time we will seek public review and comment. At that time, copies of the draft economic analysis will be available for downloading from the Internet at *http://www.regulations.gov,* or by contacting the Austin Ecological Services Field Office directly (see **FOR FURTHER INFORMATION CONTACT** section). During the development of a final designation, we will consider economic impacts, public comments, and other new information, and areas may be excluded from the final critical habitat designation under section 4(b)(2) of the Act and our implementing regulations at 50 CFR 424.19.

Exclusions Based on National Security Impacts

Under section 4(b)(2) of the Act, we consider whether there are lands owned or managed by the Department of Defense where a national security impact might exist. In preparing this proposal, we have determined that the lands within the proposed designation of critical habitat for the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod are not owned or managed by the Department of Defense, and, therefore, we anticipate no impact on national security. Consequently, the Secretary does not propose to exert his discretion to exclude any areas from the final designation based on impacts on national security.

Exclusions Based on Other Relevant Impacts

Under section 4(b)(2) of the Act, we consider any other relevant impacts, in addition to economic impacts and impacts on national security. We consider a number of factors, including whether the landowners have developed any habitat conservation plans or other management plans for the area, or whether there are conservation partnerships that would be encouraged by designation of, or exclusion from, critical habitat. In addition, we look at any tribal issues, and consider the government-to-government relationship of the United States with tribal entities. We also consider any social impacts that might occur because of the designation.

We are not proposing any exclusions at this time from the proposed critical habitat designation under section 4(b)(2) of the Act based on partnerships, management, or protection afforded by cooperative management efforts. However, we are considering excluding the San Solomon Spring Unit that is currently covered under a habitat conservation plan with Texas Parks and Wildlife Department for the Phantom Cave snail, Phantom springsnail, and diminutive amphipod for management activities at Balmorhea State Park. This permit authorizes ''take'' of the invertebrates (which were candidates at the time of issuance) in the State Park for ongoing management activities while minimizing impacts to the aquatic species. The activities included in the habitat conservation plan are a part of Texas Parks and Wildlife Department's operation and maintenance of the State Park, including the drawdowns associated with cleaning the swimming pool and vegetation management within the refuge canal and ciénega. The habitat conservation plan also calls for restrictions and guidelines for chemical use in and near aquatic habitats to avoid and minimize impacts to the three aquatic invertebrate species (Service 2009a, pp. 9, 29–32). The habitat conservation plan, however, provides no protection from the main threat to this critical habitat unit—future declining spring flows due to drought or groundwater withdrawals. In these proposed rules, we are seeking input from the public as to whether or not the Secretary should exclude the area within this habitat conservation plan or other such areas under management that benefit the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod from the final critical habitat designation. (Please see the Public Comments section of this document for instructions on how to submit comments).

Peer Review

In accordance with our joint policy on peer review published in the **Federal Register** on July 1, 1994 (59 FR 34270), we will seek the expert opinions of at least three appropriate and independent specialists regarding these proposed rules. The purpose of peer review is to ensure that our critical habitat designation is based on scientifically sound data, assumptions, and analyses. We have invited these peer reviewers to comment during this public comment period on our specific assumptions and conclusions in these proposed designations of critical habitat.

We will consider all comments and information received during this comment period on these proposed rules during our preparation of a final determination. Accordingly, the final decision may differ from this proposal.

Public Hearings

Section 4(b)(5) of the Act provides for one or more public hearings on this proposal, if requested. Requests must be received within 45 days after the date of publication of these proposed rules in the **Federal Register**. Such requests must be sent to the address shown in **FOR FURTHER INFORMATION CONTACT**. We will schedule public hearings on this proposal, if any are requested, and announce the dates, times, and places of those hearings, as well as how to obtain reasonable accommodations, in the **Federal Register** and local newspapers at least 15 days before the hearing.

Required Determinations

Regulatory Planning and Review—Executive Orders 12866 and 13563

Executive Order 12866 provides that the Office of Information and Regulatory Affairs (OIRA) will review all significant rules. The Office of Information and Regulatory Affairs has determined that this rule is not significant.

Executive Order 13563 reaffirms the principles of E.O. 12866 while calling for improvements in the nation's regulatory system to promote predictability, to reduce uncertainty, and to use the best, most innovative, and least burdensome tools for achieving regulatory ends. The executive order directs agencies to consider regulatory approaches that reduce burdens and maintain flexibility and freedom of choice for the public where these approaches are relevant, feasible, and consistent with regulatory objectives. E.O. 13563 emphasizes further that regulations must be based on the best available science and that the rulemaking process must allow for public participation and an open exchange of ideas. We have developed this rule in a manner consistent with these requirements.

Regulatory Flexibility Act (5 U.S.C. 601 et seq.)

Under the Regulatory Flexibility Act (RFA; 5 U.S.C. 601 *et seq.*) as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 (5 U.S.C 801 *et seq.*), whenever an agency must publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effects of the rule on small entities (small businesses, small organizations, and small government jurisdictions). However, no regulatory flexibility analysis is required if the head of the agency certifies the rule will not have a significant economic impact on a substantial number of small entities. The SBREFA amended the RFA to require Federal agencies to provide a certification statement of the factual basis for certifying that the rule will not have a significant economic impact on a substantial number of small entities.

At this time, we lack the available economic information necessary to provide an adequate factual basis for the required RFA finding. Therefore, we defer the RFA finding until completion of the draft economic analysis prepared under section 4(b)(2) of the Act and Executive Order 12866. This draft economic analysis will provide the required factual basis for the RFA finding. Upon completion of the draft economic analysis, we will announce availability of the draft economic analysis of the proposed designation in the **Federal Register** and reopen the public comment period for the proposed designation. We will include with this announcement, as appropriate, an initial regulatory flexibility analysis or a certification that the rule will not have a significant economic impact on a substantial number of small entities accompanied by the factual basis for that determination. We have concluded that deferring the RFA finding until completion of the draft economic analysis is necessary to meet the purposes and requirements of the RFA. Deferring the RFA finding in this manner will ensure that we make a sufficiently informed determination based on adequate economic information and provide the necessary opportunity for public comment.

Energy Supply, Distribution, or Use—Executive Order 13211

Executive Order 13211 (Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use) requires agencies to prepare Statements of Energy Effects when undertaking certain actions. We do not expect the designation of this proposed critical habitat to significantly affect energy supplies, distribution, or use due to the small amount of habitat we are proposing for designation and the lack of Federal activities that would be affected by the designation. Therefore, this action is not a significant energy action, and no Statement of Energy Effects is required. However, we will further evaluate this issue as we conduct our economic analysis, and review and revise this assessment as necessary.

Unfunded Mandates Reform Act (2 U.S.C. 1501 et seq.)

In accordance with the Unfunded Mandates Reform Act (2 U.S.C. 1501 *et seq.*), we make the following findings:

(1) This rule will not produce a Federal mandate. In general, a Federal mandate is a provision in legislation, statute, or regulation that would impose an enforceable duty upon State, local, or tribal governments, or the private sector, and includes both ''Federal intergovernmental mandates'' and ''Federal private sector mandates.'' These terms are defined in 2 U.S.C. 658(5)-(7). ''Federal intergovernmental mandate'' includes a regulation that ''would impose an enforceable duty upon State, local, or tribal governments'' with two exceptions. It excludes ''a condition of Federal assistance.'' It also excludes ''a duty arising from participation in a voluntary Federal program,'' unless the regulation ''relates to a then-existing Federal program under which $500,000,000 or more is provided annually to State, local, and tribal governments under entitlement authority,'' if the provision would ''increase the stringency of conditions of assistance'' or ''place caps upon, or otherwise decrease, the Federal Government's responsibility to provide funding,'' and the State, local, or tribal governments ''lack authority'' to adjust accordingly. At the time of enactment, these entitlement programs were: Medicaid; Aid to Families with Dependent Children work programs; Child Nutrition; Food Stamps; Social Services Block Grants; Vocational Rehabilitation State Grants; Foster Care, Adoption Assistance, and Independent Living; Family Support Welfare Services; and Child Support Enforcement. ''Federal private sector mandate'' includes a regulation that ''would impose an enforceable duty upon the private sector, except (i) a condition of Federal assistance or (ii) a duty arising from participation in a voluntary Federal program.''

The designation of critical habitat does not impose a legally binding duty on non-Federal Government entities or private parties. Under the Act, the only regulatory effect is that Federal agencies must ensure that their actions do not destroy or adversely modify critical habitat under section 7. While non-Federal entities that receive Federal funding, assistance, or permits, or that otherwise require approval or authorization from a Federal agency for an action, may be indirectly impacted by the designation of critical habitat, the legally binding duty to avoid destruction or adverse modification of critical habitat rests squarely on the Federal agency. Furthermore, to the extent that non-Federal entities are indirectly impacted because they receive Federal assistance or participate in a voluntary Federal aid program, the Unfunded Mandates Reform Act would not apply, nor would critical habitat shift the costs of the large entitlement programs listed above onto State governments.

(2) We do not believe that this rule will significantly or uniquely affect small governments because the land proposed for designation is either privately owned or owned by U.S. Bureau of Reclamation or the State of Texas. None of these government entities fit the definition of ''small governmental jurisdiction.'' Therefore, a Small Government Agency Plan is not required. However, we will further evaluate this issue as we conduct our economic analysis, and review and revise this assessment if appropriate.

Takings—Executive Order 12630

In accordance with Executive Order 12630 (Government Actions and Interference with Constitutionally Protected Private Property Rights), we will analyze the potential takings implications of designating critical habitat for the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod in a takings implications assessment. Critical habitat designation does not affect landowner actions that do not require Federal funding or permits, nor does it preclude development of habitat conservation programs or issuance of incidental take permits to permit actions that do require Federal funding or permits to go forward. The takings implications assessment will analyze whether this proposed designation of critical habitat for the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod poses significant takings implications for lands within or affected by the designation.

Federalism—Executive Order 13132

In accordance with Executive Order 13132 (Federalism), these proposed rules do not have significant Federalism effects. A Federalism assessment is not required. In keeping with Department of the Interior and Department of Commerce policy, we requested information from, and coordinated development of, these proposed critical habitat designations with appropriate State resource agencies in Texas. The designation of critical habitat in areas currently occupied by the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod imposes no additional restrictions to those currently in place and, therefore, has little incremental impact on State and local governments and their activities. The designation may have some benefit to these governments because the areas that contain the physical or biological features essential to the conservation of the species are more clearly defined, and the elements of the features of the habitat necessary to the conservation of the species are specifically identified. This information does not alter where and what federally sponsored activities may occur. However, it may assist local governments in long-range planning (rather than having them wait for case-by-case section 7 consultations to occur).

Where State and local governments require approval or authorization from a Federal agency for actions that may affect critical habitat, consultation under section 7(a)(2) would be required. While non-Federal entities that receive Federal funding, assistance, or permits, or that otherwise require approval or authorization from a Federal agency for an action, may be indirectly impacted by the designation of critical habitat, the legally binding duty to avoid destruction or adverse modification of critical habitat rests squarely on the Federal agency.

Civil Justice Reform—Executive Order 12988

In accordance with Executive Order 12988 (Civil Justice Reform), the Office of the Solicitor has determined that the rule does not unduly burden the judicial system and that it meets the requirements of sections 3(a) and 3(b)(2) of the Order. We have proposed designating critical habitat in accordance with the provisions of the Act. These proposed rules use standard mapping technology and identify the elements of physical or biological features essential to the conservation of the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod within the designated areas to assist the public in understanding the habitat needs of the species.

Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.)

This rule does not contain any new collections of information that require approval by OMB under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*). This rule will not impose recordkeeping or reporting requirements on State or local governments, individuals, businesses, or organizations. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*), need not be prepared in connection with listing a species as endangered or threatened under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

It is our position that, outside the jurisdiction of the U.S. Court of Appeals for the Tenth Circuit, we do not need to prepare environmental analyses pursuant to NEPA in connection with designating critical habitat under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244). This position was upheld by the U.S. Court of Appeals for the Ninth Circuit (*Douglas County* v. *Babbitt,* 48 F.3d 1495 (9th Cir. 1995), cert. denied 516 U.S. 1042 (1996)). The range of the Phantom Cave snail, Phantom springsnail, Diamond Y Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod does not occur in the Tenth Circuit, so a NEPA analysis will not be conducted.

Clarity of the Rule

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must:

(1) Be logically organized;

(2) Use the active voice to address readers directly;

(3) Use clear language rather than jargon;

(4) Be divided into short sections and sentences; and

(5) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in the **ADDRESSES** section. To better help us revise the rule, your comments should be as specific as possible. For example, you should tell us the numbers of the sections or paragraphs that are unclearly written, which sections or sentences are too long, the sections where you feel lists or tables would be useful, etc.

Government-to-Government Relationship with Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes.

We determined that there are no tribal lands within or near the current or historic ranges of the Phantom Cave snail, Phantom springsnail, Diamond Y

Spring snail, Gonzales springsnail, diminutive amphipod, and Pecos amphipod that contain the features essential for conservation of the species. Therefore, we are not proposing to designate critical habitat on tribal lands.

References Cited

A complete list of references cited in this rulemaking is available on the Internet at *http://www.regulations.gov* at Docket No. FWS–R2–ES–2012–0029 and upon request from the Austin Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this package are the staff members of the Southwest Region of the Service.

List of Subjects in 50 CFR Part 17

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

Proposed Regulation Promulgation

Accordingly, we propose 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. In § 17.11(h) add entries for ''Snail, Diamond Y Spring'', ''Snail, Phantom Cave'', ''Springsnail, Gonzales'', and ''Springsnail, Phantom'' under ''SNAILS'' and ''Amphipod, diminutive'' and ''Amphipod, Pecos'' under ''CRUSTACEANS'' to the List of Endangered and Threatened Wildlife in alphabetical order to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species: Common name	Species: Scientific name	Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
* *	*	*	*	*		*	
SNAILS:							
* *	*	*	*	*		*	
Snail, Diamond Y Spring	*Pseudotryonia adamantina*	U.S.A. (TX)	NA	E		17.95(f)	NA
* *	*	*	*	*		*	
Snail, Phantom Cave	*Pyrgulopsis texana*	U.S.A. (TX)	NA	E		17.95(f)	NA
* *	*	*	*	*		*	
Springsnail, Gonzales	*Tryonia circumstriata*	U.S.A. (TX)	NA	E		17.95(f)	NA
* *	*	*	*	*			
Springsnail, Phantom	*Tryonia cheatumi*	U.S.A. (TX)	NA	E		17.95(f)	NA
* *	*	*	*	*		*	
CRUSTACEANS:							
Amphipod, diminutive	*Gammarus hyalleloides*	U.S.A. (TX)	NA	E		17.95(h)	NA
* *	*	*	*	*		*	
Amphipod, Pecos	*Gammarus pecos*	U.S.A. (TX)	NA	E		17.95(h)	NA
* *	*	*	*	*		*	

3. Amend § 17.95 by:

a. In paragraph (f), adding an entry for ''Diamond Y Spring snail *(Pseudotryonia adamantina)* and Gonzales springsnail *(Tryonia circumstriata)''* followed by an entry for ''Phantom Cave snail *(Pyrgulopsis texana)* and Phantom springsnail *(Tryonia cheatumi)''* after the entry for ''Interrupted Rocksnail *(Leptoxis foremani)'',* to read as follows*:*

b. In paragraph (h), adding an entry for ''Diminutive amphipod *(Gammarus hyalleloides)''* and an entry for ''Pecos amphipod *(Gammarus pecos)''* in the same alphabetical order that these species appear in the table at § 17.11(h), to read as follows.

§ 17.95 Critical habitat—fish and wildlife.

* * * * *

(f) *Clams and Snails.*

* * * * *

Diamond Y Spring snail *(Pseudotryonia adamantina)* and Gonzales springsnail *(Tryonia circumstriata)*

(1) A critical habitat unit is depicted for Pecos County, Texas, on the map below.

(2) Within this area, the primary constituent elements of the physical or biological features essential to the conservation of Diamond Y Spring snail and Gonzales springsnail are springs and spring-fed aquatic systems that contain:

(i) Permanent, flowing, unpolluted water (free from contamination) emerging from the ground and flowing on the surface;

(ii) Water temperatures that vary between 11 and 27 °C (52 to 81 °F) with natural seasonal and diurnal variations slightly above and below that range;

(iii) Substrates that include cobble, gravel, pebble, sand, silt, and aquatic vegetation, for breeding, egg laying, maturing, feeding, and escape from predators;

(iv) Abundant food, consisting of algae, bacteria, decaying organic material, and submergent vegetation that contributes the necessary nutrients, detritus, and bacteria on which these species forage; and

(v) Either an absence of nonnative predators and competitors or nonnative predators and competitors at low population levels.

(3) Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on the effective date of this rule.

(4) *Critical habitat map unit.* Data layers defining the map unit were created on 2010 aerial photography from U.S. Department of Agriculture, National Agriculture Imagery Program base maps using ArcMap (Environmental Systems Research Institute, Inc.), a computer geographic information system (GIS) program. The maps in this entry, as modified by any accompanying regulatory text, establish the boundaries of the critical habitat designation. The coordinates or plot points or both on which each map is based are available to the public at the Service's internet site, (*http://www.fws.gov/southwest/es/AustinTexas/*), Regulations.gov (*http://www.regulations.gov* at Docket No. FWS–R2–ES–2012–0029) and at the field office responsible for this designation. You may obtain field office location information by contacting one of the Service regional offices, the addresses of which are listed at 50 CFR 2.2.

(5) Diamond Y Spring Unit, Pecos County, Texas. Map of Diamond Y Spring Unit follows:

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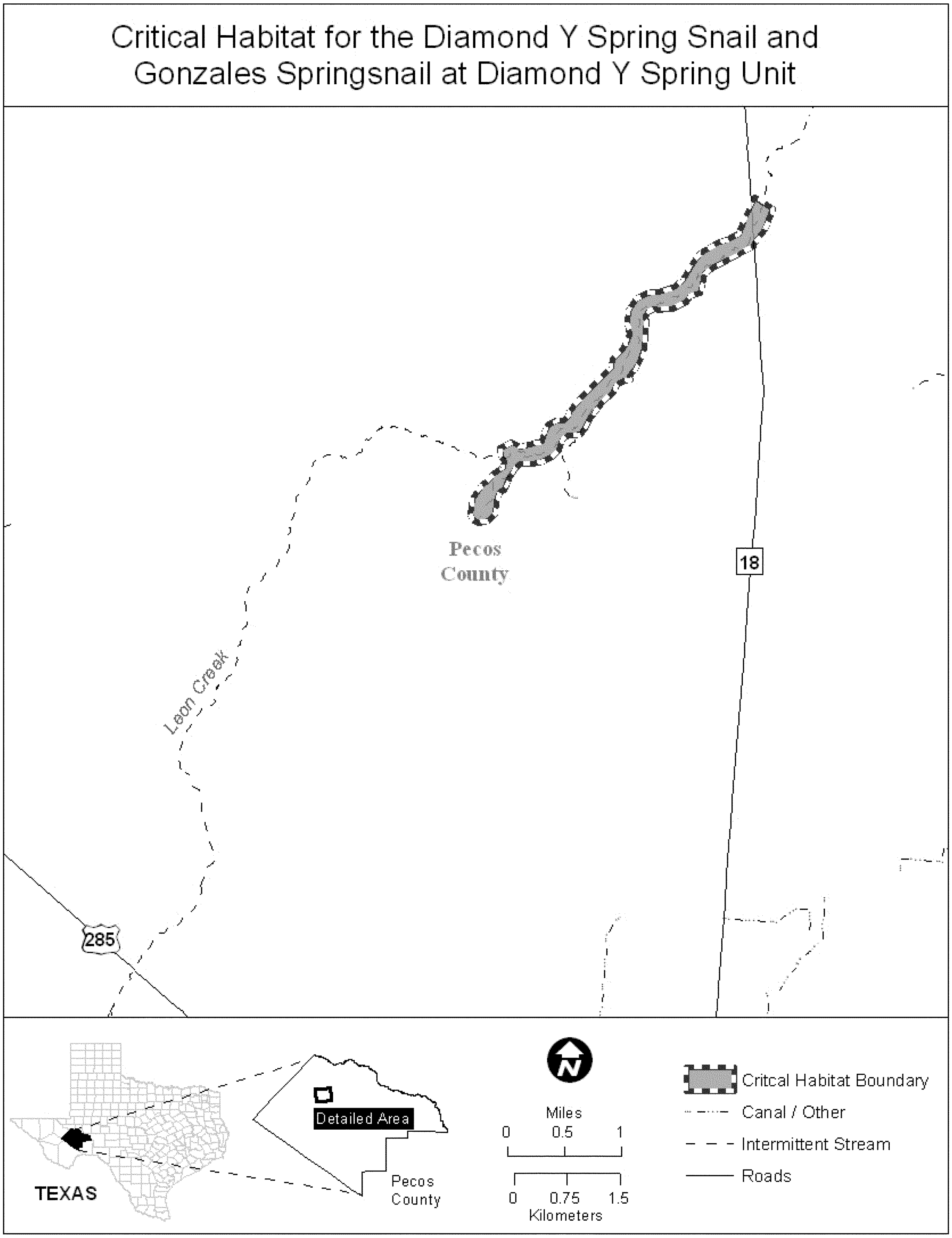


Phantom Cave snail *(Pyrgulopsis texana)* and Phantom springsnail *(Tryonia cheatumi)*

(1) Critical habitat units are depicted for Jeff Davis County and Reeves County, Texas, on the maps below.

(2) Within these areas, the primary constituent elements of the physical or biological features essential to the conservation of Phantom Cave snail and Phantom springsnail are springs and spring-fed aquatic systems that contain:

(i) Permanent, flowing, unpolluted water (free from contamination) emerging from the ground and flowing on the surface;

(ii) Water temperatures that vary between 11 and 27 °C (52 to 81 °F) with natural seasonal and diurnal variations slightly above and below that range;

(iii) Substrates that include cobble, gravel, pebble, sand, silt, and aquatic vegetation, for breeding, egg laying, maturing, feeding, and escape from predators;

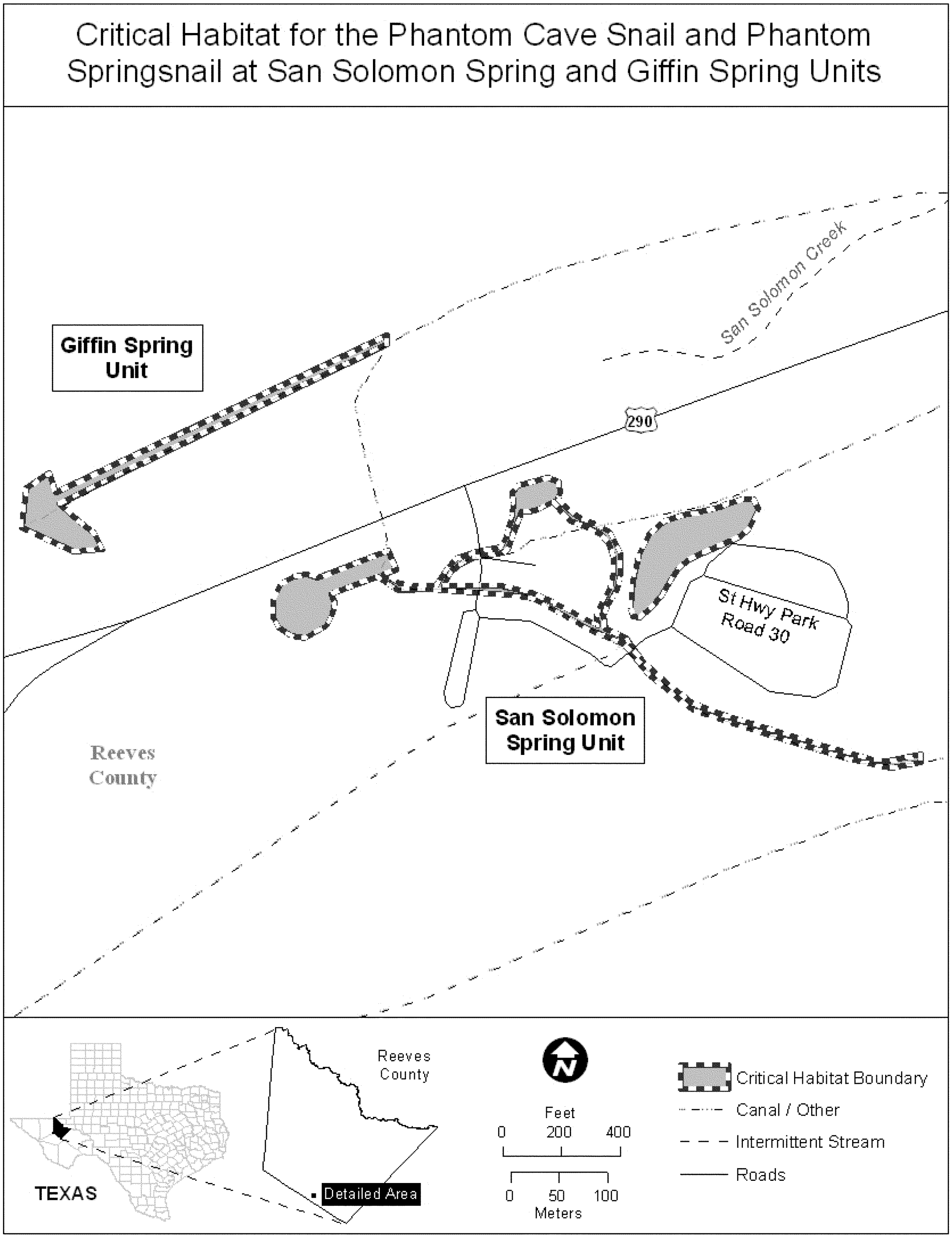
(iv) Abundant food, consisting of algae, bacteria, decaying organic material, and submergent vegetation that contributes the necessary nutrients, detritus, and bacteria on which these species forage; and

(v) Either an absence of nonnative predators and competitors or nonnative predators and competitors at low population levels.

(3) Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on the effective date of this rule.

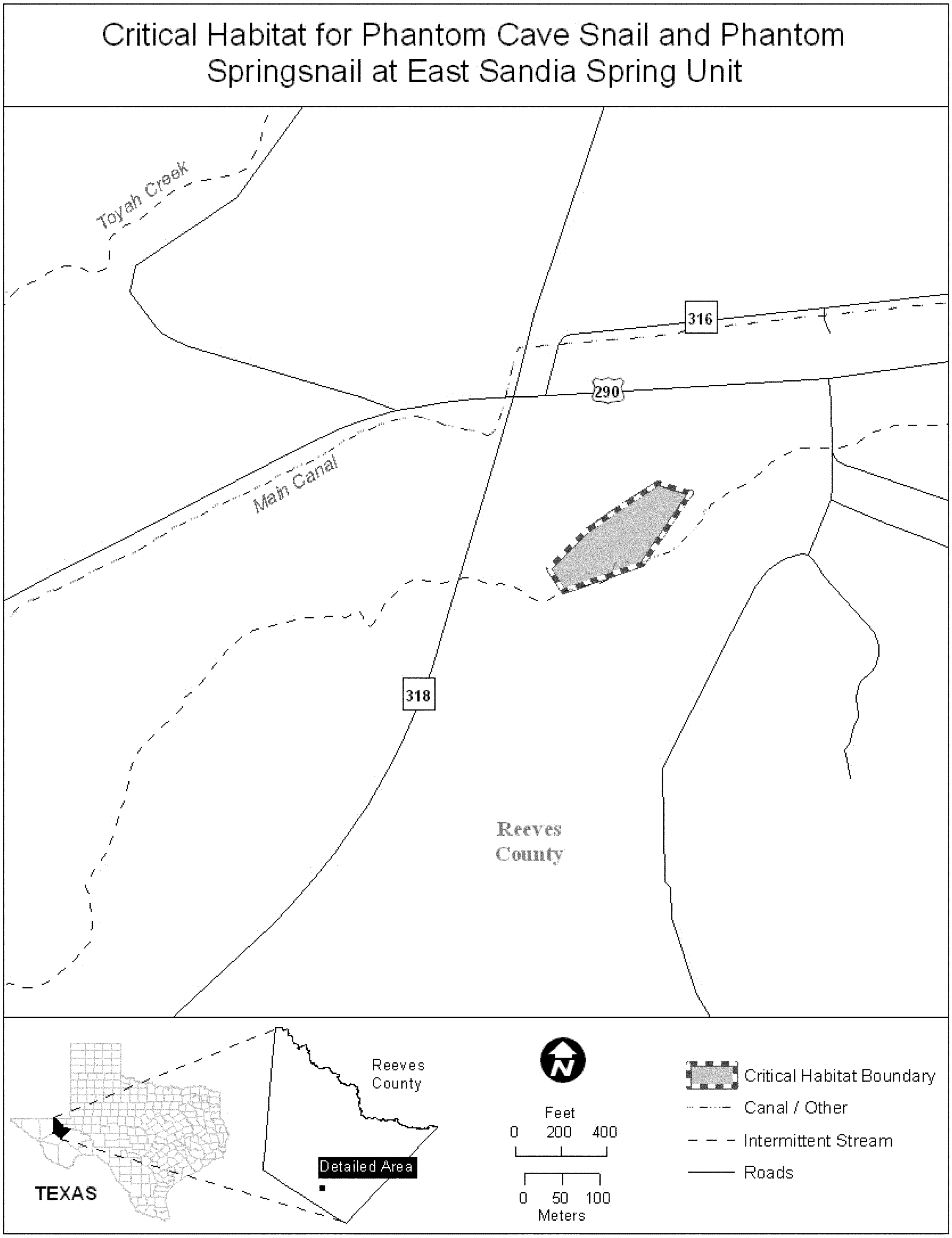
(4) *Critical habitat map units.* Data layers defining map units were created on 2010 aerial photography from U.S. Department of Agriculture, National Agriculture Imagery Program base maps using ArcMap (Environmental Systems Research Institute, Inc.), a computer geographic information system (GIS) program. The maps in this entry, as modified by any accompanying regulatory text, establish the boundaries of the critical habitat designation. The coordinates or plot points or both on which each map is based are available to the public at the Service's Internet site (*http://www.fws.gov/southwest/es/AustinTexas/*), Regulations.gov (*http://www.regulations.gov* at Docket No. FWS–R2–ES–2012–0029) and at the field office responsible for this designation. You may obtain field office location information by contacting one of the Service regional offices, the addresses of which are listed at 50 CFR 2.2.

(5) San Solomon Spring Unit, Reeves County, Texas. Map of San Solomon Spring Unit follows:

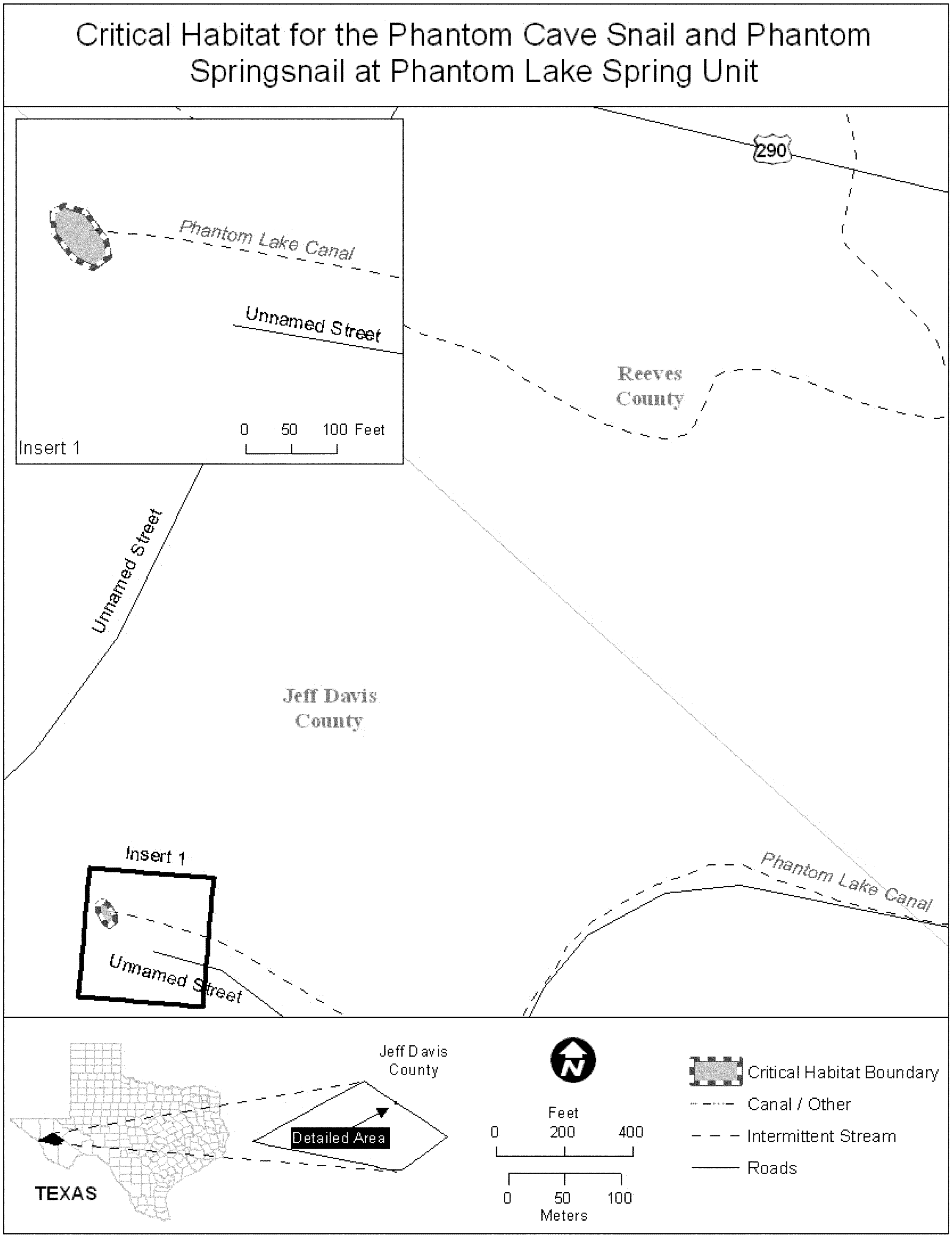


(6) Giffin Spring Unit, Reeves County, Texas. Map of Giffin Spring Unit is provided at subparagraph (5) of this entry.

(7) East Sandia Spring Unit, Jeff Davis County, Texas. Map of East Sandia Spring Unit follows:



(8) Phantom Lake Spring Unit, Jeff Davis County, Texas. Map of Phantom Lake Spring Unit follows:



* * * * *

(h) *Crustaceans.*

Diminutive amphipod *(Gammarus hyalleloides)*

(1) Critical habitat units are depicted for Jeff Davis County and Reeves County, Texas, on the maps below.

(2) Within these areas, the primary constituent elements of the physical or biological features essential to the conservation of diminutive amphipod are springs and spring-fed aquatic systems that contain:

(i) Permanent, flowing, unpolluted water (free from contamination) emerging from the ground and flowing on the surface;

(ii) Water temperatures that vary between 11 and 27 °C (52 to 81 °F) with natural seasonal and diurnal variations slightly above and below that range;

(iii) Substrates that include cobble, gravel, pebble, sand, silt, and aquatic vegetation, for breeding, maturing, feeding, and escape from predators;

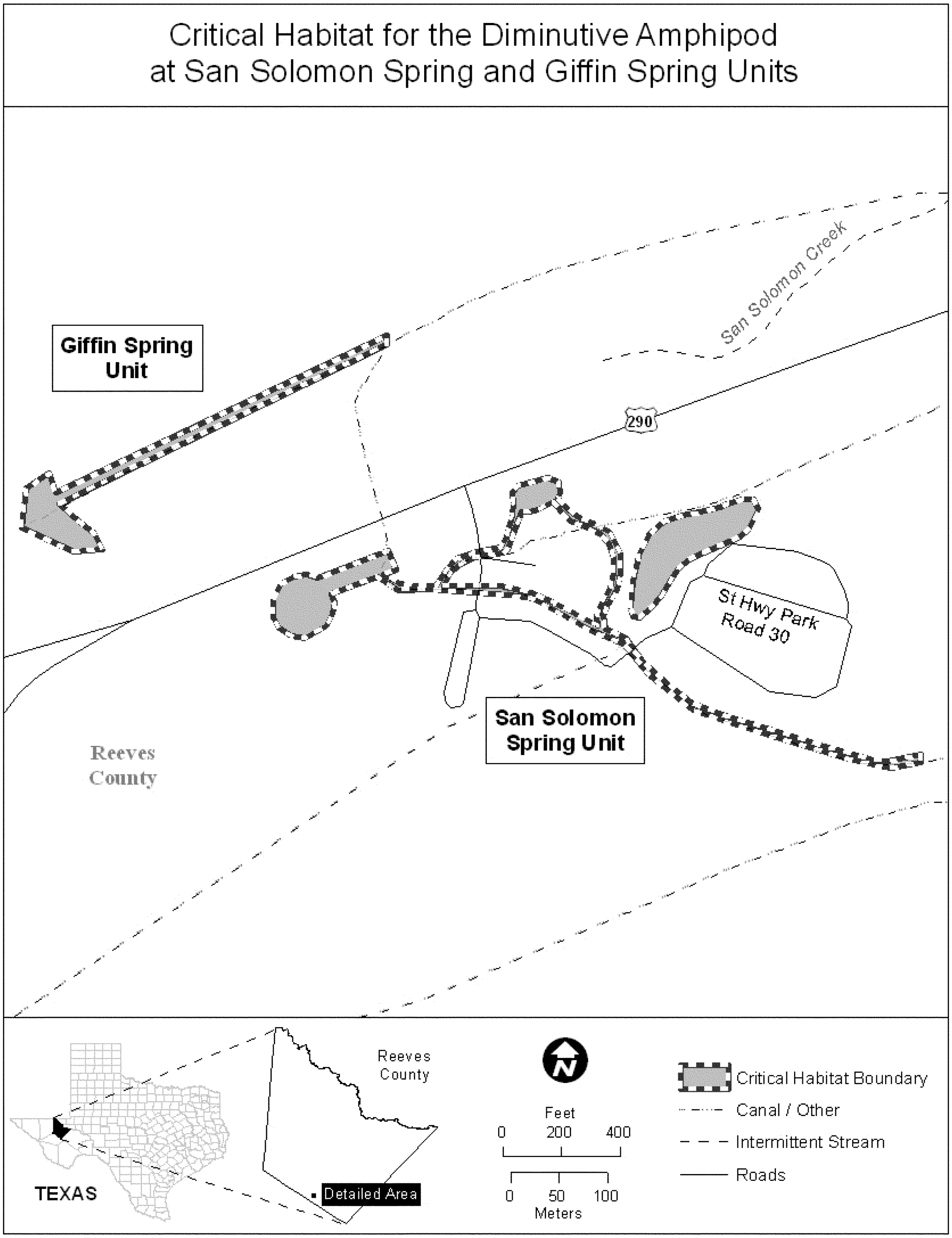
(iv) Abundant food, consisting of algae, bacteria, decaying organic material, and submergent vegetation that contributes the necessary nutrients, detritus, and bacteria on which these species forage; and

(v) Either an absence of nonnative predators and competitors or nonnative predators and competitors at low population levels.

(3) Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on the effective date of this rule.

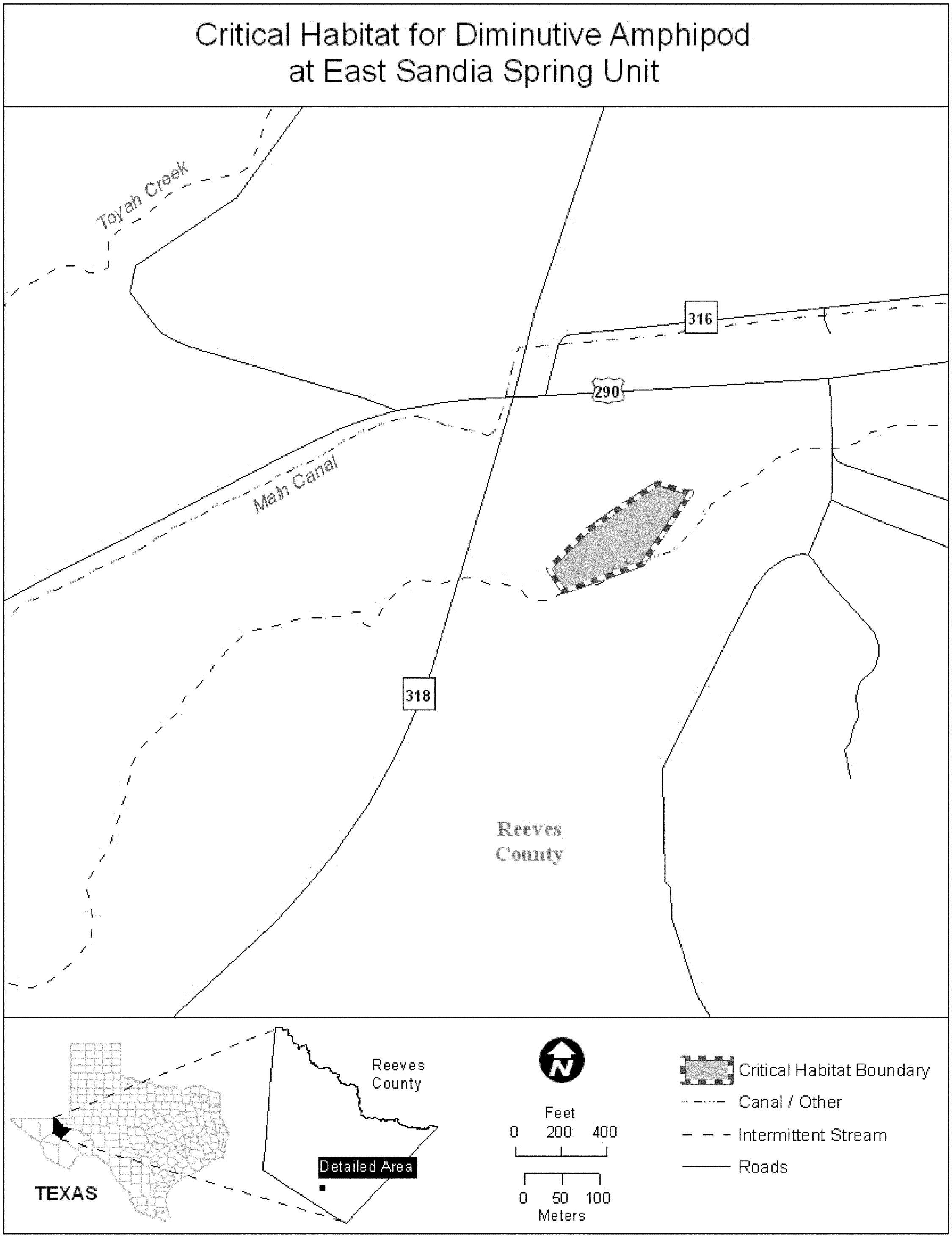
(4) *Critical habitat map units.* Data layers defining map units were created on 2010 aerial photography from U.S. Department of Agriculture, National Agriculture Imagery Program base maps using ArcMap (Environmental Systems Research Institute, Inc.), a computer geographic information system (GIS) program. The maps in this entry, as modified by any accompanying regulatory text, establish the boundaries of the critical habitat designation. The coordinates or plot points or both on which each map is based are available to the public at the Service's Internet site (*http://www.fws.gov/southwest/es/AustinTexas/*), Regulations.gov (*http://www.regulations.gov* at Docket No. FWS–R2–ES–2012–0029) and at the field office responsible for this designation. You may obtain field office location information by contacting one of the Service regional offices, the addresses of which are listed at 50 CFR 2.2.

(5) San Solomon Spring Unit, Reeves County, Texas. Map of San Solomon Spring Unit follows:

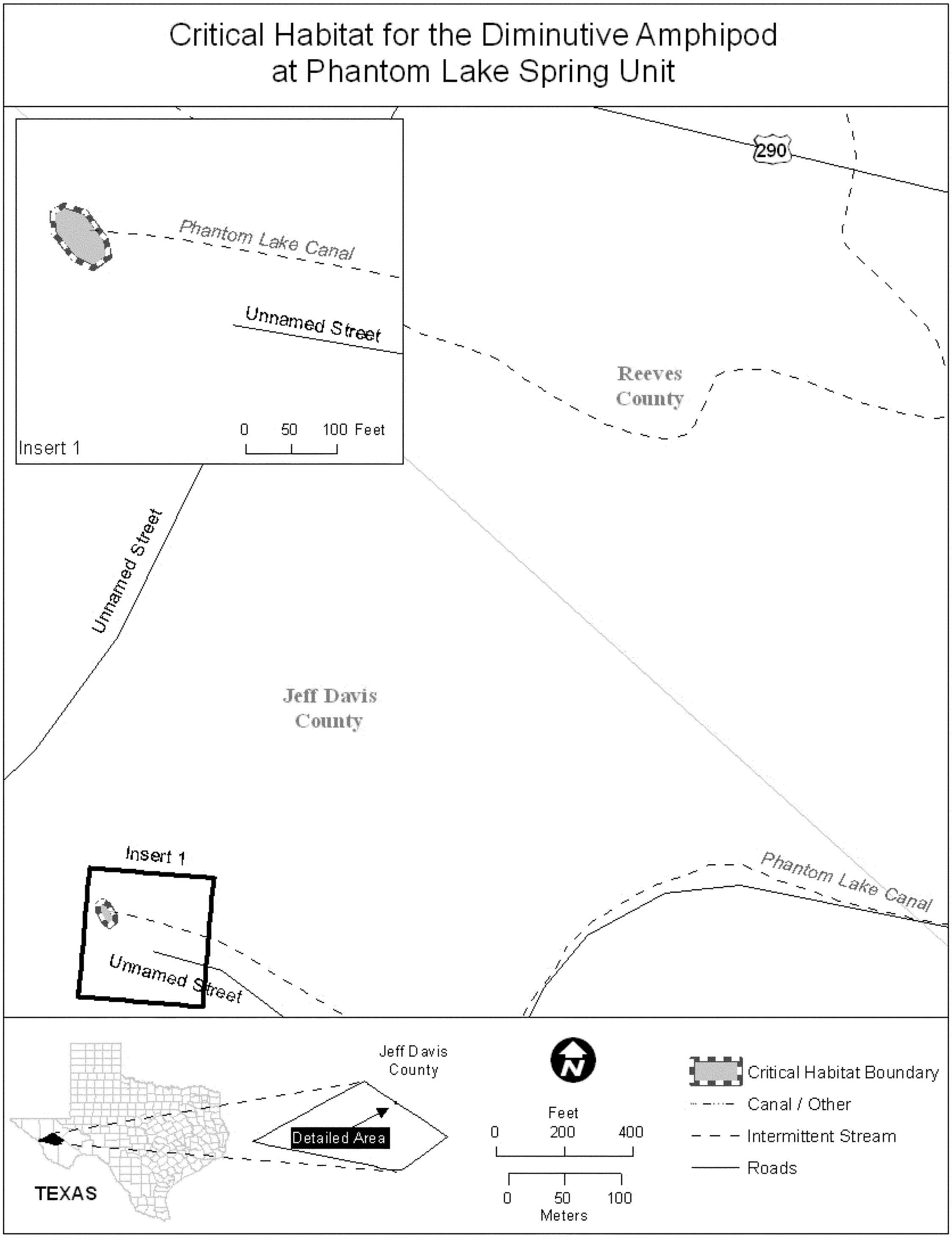


(6) Giffin Spring Unit, Reeves County, Texas. Map of Giffin Spring Unit is provided at paragraph (5) of this entry.

(7) East Sandia Spring Unit, Jeff Davis County, Texas. Map of East Sandia Spring Unit follows:



(8) Phantom Lake Spring Unit, Jeff Davis County, Texas. Map of Phantom Lake Spring Unit follows:



* * * * *

Pecos amphipod *(Gammarus pecos)*

(1) The critical habitat unit is depicted for Pecos County, Texas, on the map below.

(2) Within this area, the primary constituent elements of the physical or biological features essential to the conservation of Pecos amphipod are springs and spring-fed aquatic systems that contain:

(i) Permanent, flowing, unpolluted water (free from contamination) emerging from the ground and flowing on the surface;

(ii) Water temperatures that vary between 11 and 27 °C (52 to 81 °F) with natural seasonal and diurnal variations slightly above and below that range;

(iii) Substrates that include cobble, gravel, pebble, sand, silt, and aquatic vegetation, for breeding, maturing, feeding, and escape from predators;

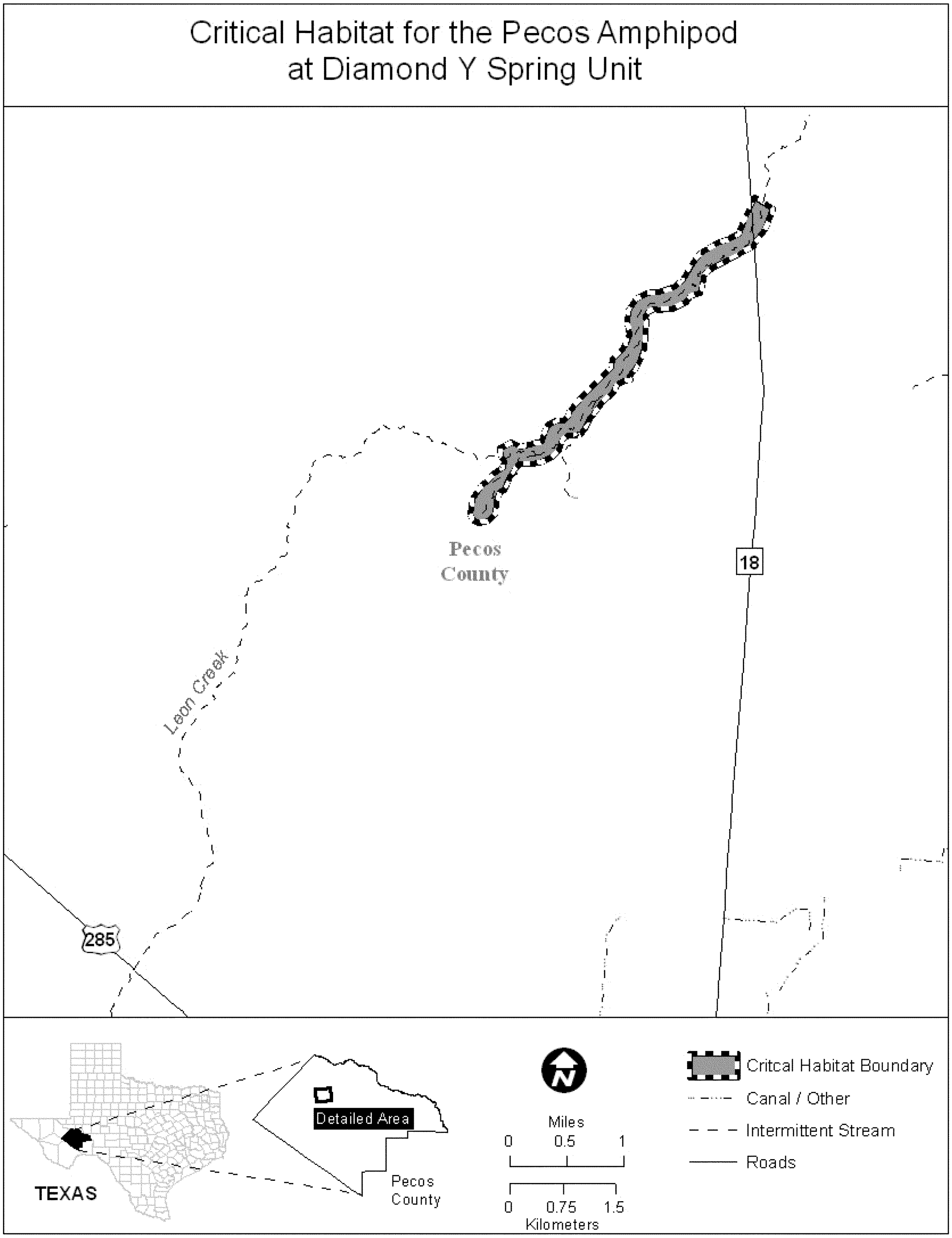
(iv) Abundant food, consisting of algae, bacteria, decaying organic material, and submergent vegetation that contributes the necessary nutrients, detritus, and bacteria on which these species forage; and

(v) Either an absence of nonnative predators and competitors or nonnative predators and competitors at low population levels.

(3) Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on the effective date of this rule.

(4) *Critical habitat map units.* Data layers defining map units were created on 2010 aerial photography from U.S. Department of Agriculture, National Agriculture Imagery Program base maps using ArcMap (Environmental Systems Research Institute, Inc.), a computer geographic information system (GIS) program. The maps in this entry, as modified by any accompanying regulatory text, establish the boundaries of the critical habitat designation. The coordinates or plot points or both on which each map is based are available to the public at the Service's Internet site (*http://www.fws.gov/southwest/es/AustinTexas/*), Regulations.gov (*http://www.regulations.gov* at Docket No. FWS–R2–ES–2012–0029) and at the field office responsible for this designation. You may obtain field office location information by contacting one of the Service regional offices, the addresses of which are listed at 50 CFR 2.2.

(5) Diamond Y Spring Unit, Pecos County, Texas. Map of Diamond Y Spring Unit follows:



* * * * *

Dated: August 2, 2012.

Eileen Sobeck,

Deputy Assistant Secretary for Fish and Wildlife and Parks.

[FR Doc. 2012–19829 Filed 8–15–12; 8:45 am]

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