Habitat Conservation Plan for Balmorhea State Park
Management Plan
Texas Parks and Wildlife Department

Prepared by:

Natural Resources Program
State Parks Division
Texas Parks and Wildlife Department
Austin, Texas

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Executive Summary

The Texas Parks and Wildlife Department (TPWD) (Applicant) has applied for an incidental take permit pursuant to section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (16 U.S.C. 153101544, 87 Stat. 884) (Act), from the U.S. Fish & Wildlife Service (Service) for incidental take of the endangered Comanche Springs pupfish (*Cyprinodon elegans*), Pecos gambusia (*Gambusia nobilis*), Phantom tryonia (*Tryonia cheatumi*), diminutive amphipod (*Gammarus hyalleloides*), and Phantom springsnail (*Pyrgulopsis texana*). Potential take would be incidental to normal management activities at Balmorhea State Park.

The project site is within the boundary and management unit of Balmorhea State Park. The state park is located in southern Reeves County, Texas approximately four miles southwest of the town of Balmorhea. The park covers 45.9 acres. The Applicant applied for a section 10(a)(1)(B) permit and proposes to implement this habitat conservation plan (HCP) described herein, which provides measures to mitigate for adverse effects on the two endangered fishes and the three endangered invertebrate species resulting from ongoing management activities, including park operations, visitor services, programs, and stewardship. The Applicant is requesting the permit be effective for a period of 10 years.

This HCP summarizes information about the project and identifies the responsibilities of the Service and the Applicant for implementing the actions described herein to benefit endangered fishes and other endangered aquatic organisms. The biological goals of this HCP are to minimize and mitigate for effects and contribute to conservation actions that benefit the covered species.

Section 1

Introduction and Background

1.1 Overview

Balmorhea State Park (Park) is located in Reeves County, Texas (Figure 1). The terrain is generally flat and the Park is situated at an elevation of 3,300 feet (1,006 meters). The Park is in what was once taken up by the Ciénega of San Solomon Spring and the associated riparian vegetation surrounded by desert grasslands. The Park lies at the southwestern edge of the Toyah Basin, and is situated in the west central portion of the Pecos River drainage basin with main tributaries flowing generally in a southwest to northeast direction.

The most prominent natural feature of the Park is San Solomon Spring, the largest in a series of six springs that arise in the Balmorhea area. Routine measurements taken by the Reeves County Water District #1 (District) and Bureau of Reclamation reveal that San Solomon Spring currently flows at a rate of 17 to 22 million gallons per day with fluctuations during rainy periods of up to 31 million gallons. The spring flows into a 3.5 million-gallon swimming pool constructed by the Civilian Conservation Corps (CCC) in 1936. During 1995 and 1996, a cooperative project involving several governmental, community, and non-governmental organization (NGO) foundation sponsors restored a facsimile of the original Ciénega (destroyed during construction of the swimming pool), utilizing water channeled from San Solomon Spring through an inlet gate off of the main irrigation canal. The flow of water through San Solomon Ciénega, which is maintained at a constant level, is then discharged into an overflow/drainage canal that eventually returns the unused water back to the main irrigation canal. The Comanche Springs pupfish refugium (canal) surrounding the San Solomon Courts on the north and east sides, constructed in 1975, was developed solely for the purpose of providing habitat for the Park's two endangered fish species.

Of the Park's 45.9 acres (18.6 hectares), approximately 26 acres (10.5 hectares) are formally developed for visitor use and 4.76 acres (1.9 hectares, the swimming pool) are leased from the District, leaving only about 15 acres (6 hectares) undeveloped. Miscellaneous, non-building, visitor facilities include 2 parking ots, 17 picnic sites, a playground with swings and slide, and various walking paths and trails. In addition to the swimming pool, the CCC constructed many other facilities within the park in 1936. One of those is the San Solomon Spring Courts, which is considered culturally significant due to its origin and setting. This 18 unit facility continues to be operated as a motel and is a central part of the operations of the state park. Major activities at the park include camping, swimming, scuba diving, and picnicking.

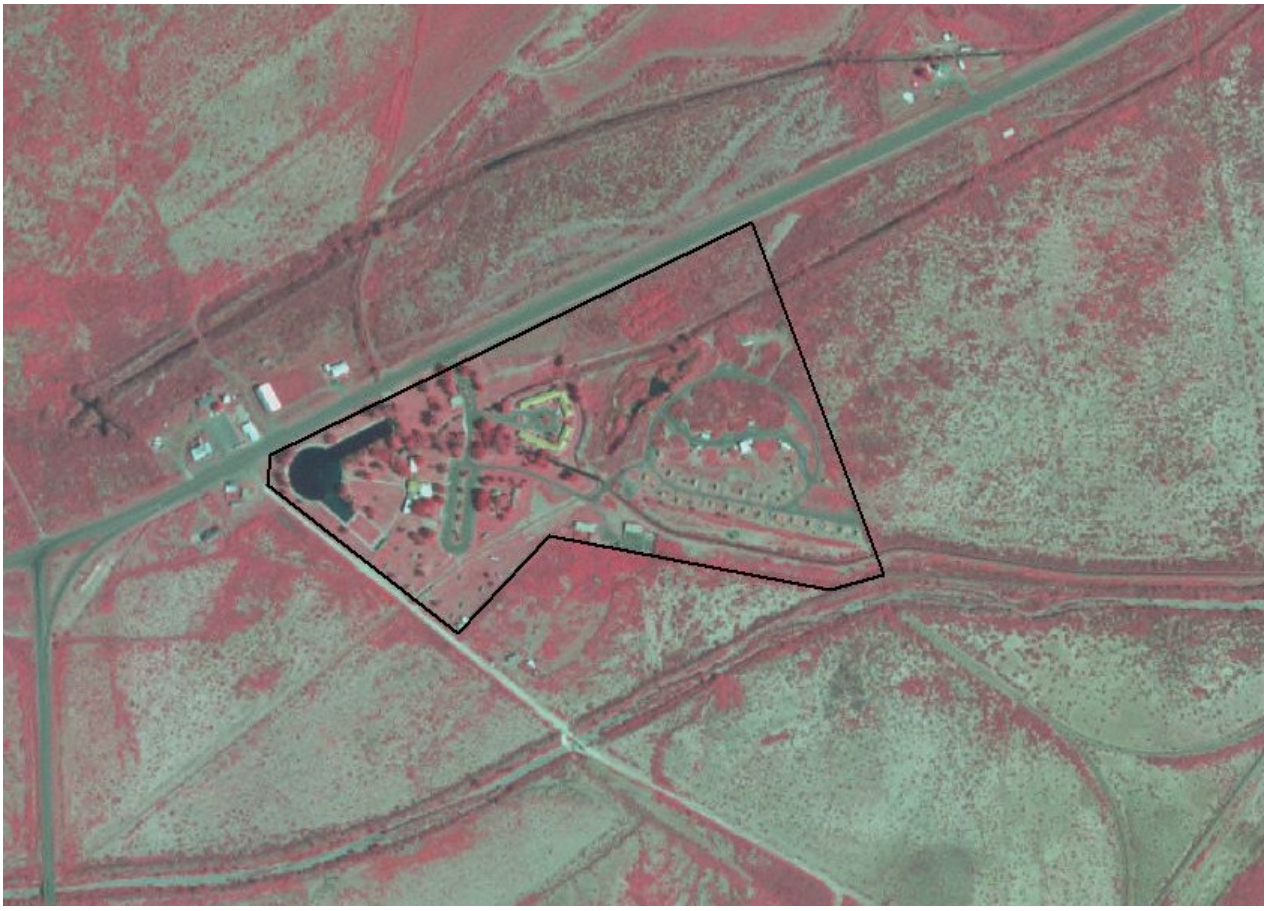

Figure 1. Balmorhea State Park, Reeves County, Texas, September 15, 2004

1.2 Permit Duration

The Applicant requests a permit duration of 10 years.

1.3 Regulatory Framework

1.3.1 Federal Endangered Species Act

The Act and its implementing regulations prohibit take of any fish or wildlife species that is federally-listed as threatened or endangered without authorization pursuant to either section 7 or section 10 of the Act. The Act defines take as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” Federal regulation 50 CFR 17.3 further defines the term “harm” in the take definition to mean any act that actually kills or injures a federally-listed species, including significant habitat modification or degradation.

Section 10(a) of the Act establishes a process for obtaining an incidental take permit, which authorizes non-Federal entities to incidentally take federally listed wildlife or fish subject to certain conditions. Incidental take is defined by the Act as take that is “incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.” Preparation of an HCP is required for all section 10(a)(1)(B) permit applications.

In conjunction with issuing a permit, the Service must conduct an internal section 7 consultation on the effects of the requested incidental take permit. The internal consultation results in a Biological Opinion prepared by the Service regarding whether implementation of this HCP will result in jeopardy to any listed species or will adversely modify critical habitat.

1.3.2 Low-Effect Habitat Conservation Plan

The Service has established a category of HCP, called a “low-effect” HCP, for projects with relatively minor or negligible impacts. Based on criteria for determining whether a low-effect HCP is appropriate, as described below and in the HCP Handbook (Service 2016), the Applicant believes this HCP qualifies as a low-effect HCP.

Low-effect HCPs are appropriate for projects that will have minor or negligible effects on federally listed, proposed, or candidate species and their habitats that are covered by the HCP and minor or negligible effects on other environmental resources. Implementation of low-effect HCPs and their associated incidental take permits, despite authorization of some small level of incidental take, individually and cumulatively have a minor or negligible effect on the species covered by the HCP.

A section 10 incidental take permit is granted upon a determination by the Service that all requirements for permit issuance have been met. Statutory criteria for issuance of the permit specify that:

- the take will be incidental;
- the impacts of incidental take will be minimized and mitigated to the maximum extent practicable;
- adequate funding for the HCP and procedures to handle unforeseen circumstances will be provided;
- the take will not appreciably reduce the likelihood of survival and recovery of the species in the wild;
- the applicant will provide additional measures that the Service requires as being necessary or appropriate; and
- the Service has received assurances, as may be required, that the HCP will be implemented.

1.3.3 National Environmental Policy Act

The National Environment Policy Act (NEPA) requires that Federal agencies analyze the environmental impacts of their actions (in this instance, issuance of an incidental take permit) and include public participation in the planning and implementation of their actions. Low-effect HCPs, as defined in the HCP Handbook, are categorically excluded under NEPA, as specified by the Department of the Interior Departmental Manual Part 516 Chapter 8 and 43 CFR 46.215.

1.4 Species to be Covered by the Permit

Comanche Springs pupfish, Pecos gambusia, Phantom tryonia, diminutive amphipod, and Phantom

springsnail will be considered “covered species” related to the permit. There are no other threatened or endangered species within or immediately adjacent to the project area. There are no other threatened or endangered species that will be affected, either directly, indirectly, or cumulatively by the effects of the proposed activity.

Section 2

Project Description/Activities Covered by Permit

2.1 Project Description

The Applicant, TPWD, proposes to implement the Balmorhea State Park Management Plan (1999). The goal of the management plan is to implement ecosystem based resource management and conservation, consistent with the Texas Parks and Wildlife Department's Environmental Policy and TPWD Code, including management and restoration of natural communities, stewardship of native habitats, maintenance of natural diversity, and protection of critical or endangered resources. The current version of the resource management plan was approved for implementation in 1999 and is scheduled to be updated to reflect information included in this HCP. The management plan divides the Park in to three management zones. Zone 1 includes all aquatic systems within the park with the goals of maintaining water quality and overall ecosystem health. Zone 2 includes all of the undeveloped (natural) areas of the Park. Natural zones are considered all areas that have not been impacted by development. The management objective for this management zone is restoration, over time, to desert basin grassland. Management Zone 3 includes the developed areas of the Park; those facilities provided for public recreational uses such as the picnic grounds, courts, campsites, restrooms, bath houses, and concession building. Much of this zone includes culturally significant CCC constructed facilities.

2.2 Activities Covered by the Permit

The following activities are requested by the Applicant for coverage by the 10(a)(1)(B) permit (referred to as the "covered activities") within the Project Area:

1. Cleaning of the swimming pool. This includes the pool normally drawn down approximately eight feet annually in early May. The purpose is to facilitate cleaning (mainly algae) from the sides, steps, and concrete floor in the west end of the pool, prior to each summer season. Cleaning is accomplished by scrapping algal mats from the concrete in concert with a pressure sprayer utilizing pure non-heated water. Because this facility contains a number of sensitive aquatic resources, the following procedures will be followed:

    a. Site management and/or the maintenance supervisor will submit to TPWD’s Natural Resources Program, a plan of action to include, but not be limited to the following: the time period for the draw down, areas to be cleaned, methods which will be utilized to clean these selected areas, other maintenance/repair to be applied (if any), and personnel involved. This plan must be submitted and approved prior to the implementation of any work at the site.

    b. No chemicals, biocides, or disinfectants of any kind are permitted in the pool area. No equipment with hydraulic systems will be permitted within the pool area. Any use of

such or any deviation thereof must be coordinated with the Park Management, the resource staff, and the Service.

2. Drawdowns required for unexpected or other reasons will be coordinated immediately with the Complex Manager and the Natural Resources coordinator. The Service will be informed of any such actions. Reasons for such actions include maintenance of the canal flow control gates on the swimming pool, Hubbs Ciénega, and San Solomon Ciénega;

3. Drawdowns required for maintenance actions within the pool, such as stabilization of the sides of the pool. There is a constant sloughing of materials from the sides of the pool that at times compromises the stability of the CCC era constructed pool edge. A major construction project in 2002 stabilized the sides of the pool, but it is inevitable that other such actions will be required. The same restrictions for the use of chemicals of heavy equipment specified above in the pool cleaning apply to all pool maintenance projects.

4. Removal of aquatic vegetation to maintain the pupfish refugium. Aquatic vegetation will be removed, mostly by hand using rakes, when plant cover exceeds 50 feet (15.24 meters) of continuous growth along the channel's edge. Ten-foot (3 meter) wide swaths will be removed perpendicular to the channel for every 50 feet of aquatic plants throughout the length of the refugium. The location of swaths removed will be rotated so as to remove aquatic plants where they are most dense. At times, Cattails and other emergent vegetation may become too dense to be managed by hand and will be mechanically removed by a small tractor operated from the bank of the refugium.

5. Herbicides and/or fertilizers may only be used with strict adherence to the manufacturer's product labeling of the chemical and with prior approval of Park Operations and the Resource Program. Chemicals may not be used in areas and in any manner where runoff or drift is likely to enter areas unintended for treatment.

6. Control of cattails within Hubbs and San Solomon ciénegas will be achieved in accordance with best management practices and following manufacturers label instructions/guidelines. Control methods will primarily be centered on prescription burning followed by treatment with the approved herbicide, Rodeo. Structures such as the observation deck and other vegetation (particularly cottonwoods) must be protected during prescription burns and during application of the herbicide Rodeo of which the only authorized application will be by wicking, not spraying.

7. Perform window maintenance in the San Solomon Ciénega which entails cleaning the inside and outside of the windows daily and power washing the windows every six (6) months, or as needed.

8. Irrigation of the camping area is accomplished by pumping water out of the main outflow canal using a small irrigation pump with a 1/32 inch (0.8 millimeter) mesh screen over the out-take hose.

9. Chemical treatments that are the result of any construction activities within the Park that could result in contamination of aquatic systems, includes road maintenance (including seal coating), painting of structures near water systems, etc. All such activities will require a plan for contaminate containment, erosion control, runoff, and spill contingency.

Section 3

Environmental Setting/Biological Resources

3.1 Environmental Settings

3.1.1 Topography/Geology

The Park encompasses 45.9 acres and is located on the Toyahvale 7.5' U.S.G.S. quadrangle topographic map. It is situated on a gently sloping outwash plain on the north side of the Davis and Barilla Mountains. Topographically the park is essentially flat with an elevation range of 3,300-3,320 feet.

The bedrock in the vicinity of the Park is comprised of Lower and Upper Cretaceous sediments (limestones, marls, and clays), Tertiary volcanic deposits of lava flows, and Quaternary alluvial deposits. San Solomon Spring is part of a group of artesian and gravity springs formed by subsurface faulting in the Balmorhea area (Maxwell 1979, Caran 1994, 1998). These springs discharge from gravel overlying porous Lower Cretaceous limestone bounded laterally by downfaulted Upper Cretaceous strata with generally low permeability (Caran, 1998).

3.1.2 Hydrology/Streams, Rivers, Drainages

The base flows from springs of the Balmorhea area are likely discharge points of a regional flow system from aquifers associated with the Salt Basin, west of the Delaware Mountains, and Wildhorse Flat, west of the Apache Mountains, Culberson County (Sharp 2001, Sharp et al. 2003, Texas Water Development Board, unpublished data). The relationships of the supporting aquifers for the springs are not well defined. Recent studies (LaFave and Sharp 1987, Schuster 1997, Sharp et al. 1999) indicate that “base flow” comes from a regional groundwater system, while the springs are locally recharged by runoff from the Davis Mountains, resulting in the flow spikes. Similar water chemistry, water age, and near constant temperatures of about 79° F), among these three springs (Phantom Lake, San Solomon, and Giffin), indicate that their waters originate from the same source of Cretaceous Limestone (Schuster 1997).

An assessment of the springs near Balmorhea by Sharp (2001) concluded: “The effects of humans on the Toyah Basin aquifer have been significant. Irrigation pumpage increased rapidly after 1945. Many springs in the area have since ceased to flow (Brune 1981). Irrigation pumpage from the Toyah Basin lowered water-table elevations and created a cone of depression. Thus, pumpage totals altered the regional flow-system discharge zone from the Pecos River to irrigation wells within the Toyah Basin (LaFave and Sharp 1987, Schuster 1997). The Groundwater Field Methods classes found water-level declines near Balmorhea Springs of about 20 feet with respect to the 1932 data (White et al. 1938). Recent declines of pumpage for irrigation because of economic conditions have allowed partial recovery of water levels, but it seems doubtful that predevelopment conditions will be achieved.”

Each of the aquatic habitats in the project area is briefly characterized below.

San Solomon Spring

San Solomon Spring is by far the largest spring in the Balmorhea area (N30°56’40”, W103°47’08”). It provides the water for the swimming pool at Balmorhea State Park and most of the irrigation water for the

District. The artesian spring issues from the Lower Cretaceous limestones at an elevation of 3,346 feet (1,020 meters). Although long-term data are scarce, San Solomon Spring flows have declined somewhat over the history of record, but not as much as Phantom Lake Spring (Schuster 1997, Sharp et al. 1999). Some recent declines in overall flow have likely occurred due to drought conditions and declining aquifer levels. San Solomon Spring discharges are usually in the 20 to 30 cubic-feet/second (0.57 to 0.85 cubic-meters/second) range (Ashworth et al. 1997, Schuster 1997) and are consistent with the theory that the water bypassing Phantom Lake Spring discharges at the San Solomon Spring.

Pupfish Refugium

The Pupfish Refugium in the Park was constructed by TPWD in 1975 to provide a managed habitat for both endangered species of fish. The construction of this refugium allowed for a controlled ecosystem where the composition of the fauna could be monitored and controlled, as well as being isolated from the irrigation canals. This allowed for the protection of the genetic integrity of a population of Comanche Springs pupfish since there were concerns about possible contact and hybridization with the sheepshead minnow (*Cyprinodon variegatus*). As detailed in subsequent sections, a portion of the pupfish refugium was converted into the Hubbs Ciénega, which was intended to improve the quality of habitat.

San Solomon Ciénega

San Solomon Ciénega was constructed in 1994 to provide a larger, more nearly natural wetland habitat for the protection of the two endangered fish. TPWD initiated plans to restore a facsimile of the original San Solomon Ciénega (Garrett 2003). The main purpose of this restoration project was to recreate vital habitat, not only for the two endangered fishes, but for other aquatic, terrestrial, and wetland-adapted organisms as well. An observation deck provides an unobstructed view of most of the above-water portion of the ciénega, and a window wall yields an underwater view of life in the ciénega. The restored San Solomon Ciénega was dedicated in 1996. A number of partners worked together in support of the project, and include the following (TPWD 1996):

Educational Foundation of America;

National Fish & Wildlife Foundation;

Reeves County Water Improvement District No.;1

Texas Department of Transportation;

Texas Department of Agriculture;

U.S.D.A. Natural Resource Conservation Service;

Texas Agricultural Extension Service;

U.S. Fish & Wildlife Service;

U.S. Environmental Protection Agency;

Texas Department of Criminal Justice;

Sul Ross State University;

Texas Organization for Endangered Species; and

Community Leaders of Balmorhea.

The goal of vegetative restoration at San Solomon Ciénega is to replace elements of the plant communities presumably associated with the original, naturally occurring ciénega. Consequently, plant species used in the restoration process were carefully selected, with all individuals being of local genetic

stock, whether transplanted directly or propagated. Native plants have colonized the site as well, apart from human intervention, in addition to weedy alien species, which have been removed.

The ciénega is 3 acres in size and is isolated from fish entering the refuge from the surrounding irrigation canals. Water in the ciénega reaches a maximum depth of about 5-½ feet (1.67 meters). In this deep channel, three islands have been constructed and now support a few Rio Grande cottonwoods (*Populus deltoides var. wislizenii*). Common cattail (*Typha latifolia*) was introduced in the ciénega to produce fast-growing vegetative cover and now fills all but the deepest portions. Along the water's edge, olney bulrush (*Scirpus olneyi*), alkali bulrush (*S. maritimus*), hardstem bulrush (*S. acutus*), sand spikerush (*Eleocharis montevidensis*), common reed (*Phragmites australis*), and buttonbush (*Cephalanthus occidentalis*) are becoming established. Upland areas have been re-vegetated primarily with grasses and a limited number of shrubs. Here, alkali sacaton (*Sporobolos airoides*), big sacaton (*S. wrightii*), and fourwing saltbush (*Atriplex canescens*) have been introduced as dominants. Additional plantings include several grasses: tobosa (*Hilaria mutica*); Texas salt (*Allolepis texana*); green sprangletop (*Leptochloa dubia*); and sideoats grama (*Bouteloua curtipendula*); as well as a few shrubs, primarily granjeno (*Celtis pallida*) and western soapberry (*Sapindus saponaria* var. *drummondii*).

Hubbs Ciénega

The Pupfish Refugium in Balmorhea State Park was constructed by TPWD in 1975 to provide a managed habitat for the Comanche Springs pupfish (*Cyprinodon elegans*) and the Pecos gambusia (*Gambusia nobilis*). Similarly, The San Solomon Ciénega (as described in HCP, p 11-12) was constructed in 1994 to provide a larger, more natural wetland habitat for the protection of the two endangered fish species.

The TPWD in conjunction with the Texas Department of Transportation and USFWS through a cooperative agreement supported by Section 6 grants constructed additional wetlands designed to provide habitat for the two listed fishes and to monitor the population of those and other fishes in the constructed wetlands within the park. These wetlands are known as the Hubbs Ciénega and were completed in April 2009 when the first Balmorhea State Park HCP was under review. The Hubbs Ciénega is similar in nature to the San Solomon Ciénega, but on a smaller scale. It was essentially created within the pupfish refugium canal as a portion was rerouted, so there is inflow and outflow through the wetland. Construction plans for the Hubbs Ciénega (Attachment 1) as well as reports related to section 6 construction (Attachment 2) and biological monitoring (Attachment 3) grants are included.

Irrigation Canals

The Reeves County Water Improvement District #1 (District) maintains the outflow canal from the swimming pool that provides some aquatic habitat for the native species. The primary canal is concrete-lined with high velocities and little natural substrate available. A Biological Opinion concerning the endangered fishes has been in place with the District since 2004 (Service 2004).

The Comanche Springs Pupfish Recovery Plan addressed the canal system and its relative unimportance to the recovery of the species (Service 1981, pp. 6-7):

> "Much of the present Balmorhea canal system is unsuitable for the Comanche Springs pupfish. ...These manipulations of water flow cause some variations in numbers and in the extent of pupfish living space but are considered minor impediments to the survival and recovery of the pupfish when compared to habitat loss and the other major threats facing the species (see Major Threats)."

A Biological Opinion was written in 2004 between the District and the Service to cover actions that might include incidental take of federally-listed species, as well.

3.1.3 Vegetation

The plant life of the area, and particularly the Park as it exists today, is a mixture of woodland, wetland, grassland, and desert scrub components, although much of the area has been modified for agricultural use. In former times, the drainage of San Solomon Spring and its attendant ciénega presumably supported saltgrass (*Distichlis spicata*), Olney bulrush, cattails (*Typha* sp.), sedges (*Cyperus* sp.), rushes or tule (*Juncus* sp.), and common reed. The well-drained soils of the upland areas immediately surrounding San Solomon Ciénega supported a grassland or shrubland dominated by alkali sacaton and four wing saltbush, and included honey mesquite (*Prosopis glandulosa*), big alkali sacaton, and tobosa. As evidenced by historic photographs, riparian trees occurred on higher ground along the periphery of San Solomon Ciénega – presumably Rio Grande cottonwood and willows (*Salix* sp.).
Today, remnants of the wetland flora (mostly cattails, sedges, and alkali sacaton) may be found along some of the canals, although much of the original sacaton grassland has been invaded by native, weedy forbs such as blueweed (*Helianthus ciliaris*), silverleaf nightshade (*Solanum elaeagnifolium*), stinging cevallia (*Cevallia sinuata*), stinking gourd (*Cucurbita foetidissima*), cowpen daisy (*Verbesina encelioides*), and broom snakeweed (*Gutierrezia microcephala*). Rio Grande cottonwood continues to be an important component of the vegetation of the Park, although the vast majority of the extant trees have been planted in developed areas. These cottonwoods provide an island of woodland habitat for wildlife, particularly birds, as evidenced by the many species that have been documented in this small park. The island-like nature of the woodland habitat is especially important to avian migrants and as breeding habitat for certain species. A restored desert wetland ecosystem, including a natural vegetation regime, is being reestablished at the newly created San Solomon Ciénega, where native revegetation efforts were initiated in 1994 and are continuing.

Desert scrub vegetation occurs on the sandy and gravelly soils of dry, upland portions of the Park. Historically desert plains grassland, most of these areas have been encroached upon by invasive shrubby species as a result of human disturbance and various land use practices, as described in the previous section. This shrubland includes honey mesquite, catclaw acacia (*Acacia greggii*), catclaw mimosa (*Mimosa aculeaticarpa* var. *biuncifera*), lotebush (*Ziziphus obtusifolia*), whitebrush (*Aloysia gratissima*), soaptree yucca (*Yucca elata*), Torrey yucca (*Yucca torreyi*), and prickly pear (*Opuntia* sp.) as the dominant woody species. Dominant grasses include black grama (*Bouteloua eriopoda*), blue grama (*B. gracilis*), sideoats grama, and tobosa.

No threatened or endangered plant species have been documented at the Park. Several species, however, that are either candidates for federal listing or that are otherwise considered rare, limited, and/or vulnerable occur within the Park or its vicinity, and are listed below.

- Night-blooming cereus (*Cereus greggii* var. *greggii*): One individual plant of this species has been found along the Park's northwest boundary fence. Considered imperiled in the state because of rarity and thus very vulnerable to extirpation, night-blooming cereus was formerly a Category 2 candidate for Federal listing as endangered or threatened (Poole and Carr 1997). This species typically grows within a thicket, which provides support for its slender, sparingly branched stems. Showy white flowers open strictly nocturnally, typically for only one night (Correll and Johnston 1979). Thus, Night-blooming Cereus is known for its inconspicuous nature.
- *Allolepis texana*: This grass has been used in the San Solomon Ciénega restoration project. It is ranked as critically imperiled in Texas with less than six known occurrences and is considered especially vulnerable to extirpation from the state (Poole and Carr 1997).
- Pecos sunflower (*Helianthus paradoxus*): This composite has recently been found, rather unexpectedly, in Reeves County at the Nature Conservancy Sandia Springs Preserve, only four miles from the Park (John Karges and Jackie Poole, pers. comm.). This species was listed as Threatened on 20 October 1999 (USFWS 2005). Pecos sunflower is the only sunflower in the Southwest that requires permanent wetlands for survival, growing around the outflow of springs, in marshes, or at the edges of lakes or streams. It grows in soils that are saturated and usually somewhat saline. Pecos sunflower may have existed historically in association with San Solomon Spring and San Solomon Ciénega, although it is not currently known from the Park.

- Gyp locoweed (*Astragalus gypsodes*): Rare and local in gypsum soils in west Texas and New Mexico (Correll and Johnston 1979), this species has been documented in Reeves County, but it is not expected at the Park due to the absence of gypsum soils at the site. Gyp locoweed was formerly a candidate for Federal listing as endangered or threatened but no longer carries any Federal legal status, although it is still considered imperiled in the state due to rarity and very vulnerable to extirpation (Poole and Carr 1997).
- Wright's trumpets (*Acleisanthes wrightii*): The endemic Wright's trumpets is restricted to stony plains and prairies in south and west Texas (Correll and Johnston, 1979). Although documented from Reeves County, it has not been documented at the Park and is not expected due to lack of suitable habitat. Formerly a candidate for Federal listing as endangered or threatened, Wright's trumpets no longer carries any Federal legal status. Nonetheless, the species is considered imperiled in the state because of rarity and very vulnerable to extirpation (Poole and Carr 1997).

A total of 197 plant taxa, including those occurring naturally, those reintroduced as part of the San Solomon Ciénega restoration project, and those used in landscaping, have been recorded within the Park, although there has not been a large-scale, ongoing project to document the complete floral inventory.

3.1.4 Wildlife

Invertebrates

In terrestrial habitats a variety of arthropods, flies, wasps, bees, beetles, millipedes, centipedes, spiders, and scorpions are found. Aquatic habitats, however, undoubtedly contain the greatest diversity of invertebrates within the Park. Beetles, spiders, dragonflies, damselflies, aquatic insects, and crawfish can be found in water-dominated habitats. The restored San Solomon Ciénega has provided additional habitat for these organisms.

Donnelly (1995) has encountered 38 species of Odonates (dragonflies and damselflies) at the park. *Anax amazili*, a tropical species encountered at the park in 1956, is represented in the United States by very few records. Several other species found at the Park are more typically associated with coastal habitats. Ten species recorded in the 1950s were not encountered in 1995; conversely, five species were recorded in 1995 and not previously. Donnelly commented that in the 1950s, the main canal was heavily vegetated, resulting in a higher diversity of damselflies than was noticed in 1995 when the clearing of all canal-related vegetation was the dictated management practice. It remains to be seen exactly what effect the construction of the San Solomon Ciénega will have on dragonfly and damselfly diversity.

More recently, Behrstock, et al. (1997) conducted a thorough one-day census of the area. They encountered 25 species of Odonates in the park and adjacent irrigation canals. Five species found during their census were not included in the 38 species previously reported. Additionally, three of the species encountered were previously recorded only in the 1950s. Most of the taxa encountered by Behrstock's group were photographically documented.

In spite of these efforts, little is known about the exact composition and abundance of the invertebrates of this broad group and other invertebrates in the Park. Basic inventories are also lacking; therefore, further studies are needed to determine baseline data.

Fishes

Native fishes that co-occur with the Comanche Springs pupfish and Pecos gambusia within the Park are: Mexican tetra (*Astyanax mexicanus*), roundnose minnow (*Dionda episcopa*), headwater catfish (*Ictalurus lupus*), green sunfish (*Lepomis cyanellus*), and longear sunfish (*L. megalotis*). In addition, the introduced largespring gambusia (*G. geiseri*) occurs in the Park. There are concerns that sheepshead minnow (*C. variegatus*) has the potential to occur within the irrigation canals and therefore threaten the genetic integrity of the Comanche Springs pupfish through hybridization (Stevenson and Buchanan 1973, Echelle

and Echelle 1994).

Amphibians

Amphibians comprise the least known of all the vertebrate faunal groups. Dixon (1987) delineates the occurrence of 14 species in the two county area surrounding the Park. Baseline information is lacking, so the exact number of species occurring in the Park is unknown.

Of significance is the fact that the barred tiger salamander (*Ambystoma tigrinum mavortium*), an aquatic species in its larval stage that is sometimes neotenic (retains some juvenile characteristics as an adult), has been recorded in both counties. Although this salamander is fairly common in association with aquatic systems in the desert, it requires non-flowing water for breeding which may be a limiting factor for its potential occurrence within the Park. Additionally, the eastern barking frog (*Eleutherodactylus augusti latrans*), a species of limited range centered primarily in the Edwards Plateau, has been recorded in Reeves County. It is doubtful that this species will ever be recorded within the Park due to the lack of habitat, but an outcrop of fractured limestone hills provides ideal habitat at the nearby Phantom Lake Spring.

The canyon treefrog (*Hyla arenicolor*) has a very limited range, occurring only in a four-county area of the central and southern portions of the Trans-Pecos region. It has been recorded in both Jeff Davis and Reeves counties in mesic canyons; however, its status or potential status within the Park is unknown. Finally, the most significant potential amphibian inhabitant of the Park is Blanchard's cricket frog (*Acris crepitans blanchardi*). Historically fairly common in the Pecos River floodplain and its tributaries north into east-central New Mexico, this species has apparently been extirpated from all but the extreme upper portions of the river in New Mexico and the lower portions of the river near Lake Amistad. This has been attributed to the increasing salinity levels in the waters of the river system which have relegated most preferred niches uninhabitable (James Scudday pers. comm., Sul Ross State University). An isolated population still exists in the fresh water streams, canals, and lakes around the town of Balmorhea, including Balmorhea Lake. The potential for occurrence in the Park is high and would represent the westernmost population of the species in the United States, if recorded there.

Reptiles

Typical of many areas within the northern portions of the Chihuahuan Desert, a diverse reptilian fauna exists in the Park and vicinity that includes six species of turtles, 23 species of lizards, and 35 snake species. Among the species of snakes recorded from the area, six are venomous.

The blotched water snake (*Nerodia erythrogaster transversa*) occurs at the far western edge of its range at this location. This species is commonly observed in and around most water habitats in the Park. A terrestrial turtle, the western box turtle (*Terrapene ornata*) is also a species that deserves special attention, primarily due to limited range and lack of information about potentially declining populations. Finally, the list includes the Texas horned lizard (*Phrynosomayou cornutum*), a species listed as threatened at the state level, thereby benefiting from protection. The reasons for the widespread decline of this species over most of its range are not well understood, but over-collection by hobbyists, pesticide use, and predation by the imported red fire ant have been implicated.

Birds

Despite the small size of the Park, a diversity of habitat types and the presence of permanent surface water make it a magnet for a variety of bird life. Approximately 205 of the 328 avian species recorded in the area have been found within the boundaries of the Park. The Park is a popular destination for birders visiting the region, especially during spring migration. Popular spring birds include, but are not limited to flycatchers, swallows, wrens, warblers, tanagers, grosbeaks, buntings, and orioles. During late fall and winter, a variety of sparrows and other seed eaters invade the park and vicinity. Typical species resident to the area include red-tailed hawk (*Buteo jamaicensis*), scaled quail (*Callipepla squamata*), mourning

(*Zenaida macroura*) and Inca doves (*Columbina inca*), greater roadrunner (*Geococcyx californianus*), ladder-backed woodpecker (*Picoides scalaris*), black phoebe (*Sayornis nigricans*) and Say's phoebe (*S. saya*), verdin (*Auriparus flaviceps*), cactus (*Campylorhynchus brunneicapillus*) and Bewick's wrens (*Thryomanes bewickii*), curve-billed thrasher (*Toxostoma curvirostre*), northern mockingbird (*Mimus polyglottos*), pyrrhuloxia (*Cardinalis sinuatus*), and house finch (*Carpodacus mexicanus*).

The San Solomon and Hubbs ciénegas have greatly enhanced the diversity of bird life at the Park. Wetland species such as pied-billed Grebe (*Podilymbus podiceps*), a variety of ducks, common moorhen (*Gallinula chloropus*), American coot (*Fulica americana*), Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothlypis trichas*), swamp sparrow (*Melospiza georgiana*), as well as red-winged (*Agelaius phoeniceus*), and yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) utilize the Ciénegas and associated habitat. A field checklist is available for visitor use (Lockwood 2005); it is the basis for the Park's inventory list that is found in Appendix F, which also includes recent additions reported by TPWD personnel as well as Park visitors.

The precise historical composition of upland vegetation surrounding the complex of Solomon Spring Ciénegas and streams is largely unknown. There is no doubt, however, that it was predominately grassland. It was this type of habitat that the lesser prairie chicken once occupied prior to the complete settlement and eventual development of the area by humans. With the continued use of the land for agriculture and other purposes, former grasslands declined, soils became more alkaline, and thorny shrubs invaded the area. Although grass and other plant species of the former habitats still exist today, not even remnants of the former vegetation communities exist any longer. Therefore, the nearest populations of the lesser prairie chicken are confined to the few remaining pockets of prairie grasslands in the southeastern portions of New Mexico, some 120 miles (193 kilometers) north of the Balmorhea area.

Mammals

Seventy-six species of mammals have been recorded in the vicinity of the Park, generally defined as southern Reeves and northeastern Jeff Davis counties. Prominent mammals of the Park include an occasional mule deer (*Odocoileus hemionus*) or white-tailed deer (*O. virginianus*), common raccoon (*Procyon lotor*), javelina (*Tayassu tajacu*), striped skunk (*Mephitis mephitis*), porcupine (*Erethizon dorsatum*), coyote (*Canis latrans*), bobcat (*Felis rufus*), desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), and several small rodent species. Bat diversity is especially high with fifteen species recorded for the immediate area. The presence of permanent surface water is, in part, responsible for this high diversity (the region as a whole has the highest bat diversity in the U. S.; Schmidly 1991).

Texas Tech University (TTU) has performed a baseline mammal inventory at the Park and Phantom Lake Spring. The most significant finding was a male hoary bat (*Lasiurus cinereus*), netted at Phantom Lake Spring and taken as a specimen. This species is considered a rare migrant in the state and is typically found in wooded habitat versus an open setting like that of Phantom Lake Spring (Clyde Jones, pers. comm., Texas Tech University).

Pecos River muskrat (*Ondatra zibethicus ripensis*) historically occupied portions of the Pecos River and its tributaries, desert springs in the Fort Stockton and Balmorhea areas, and probably extended along the Rio Grande into southwestern New Mexico. Irregular water flow in these watercourses, caused by damming and irrigation demand, has caused a severe degradation of habitat for this mammal. Seepage from oil wells, invasion by salt cedar, the denuding of banks, and trapping have also contributed to the extirpation of the muskrat from nearly all of its former range (Sweptson 1981, Schmidly 1977).

Pecos River muskrat was reported at Balmorhea in 1949 but the population was said to be declining. Sweptson (1981) made the first specimen collections from Balmorhea during a study in 1979 and 1980, representing the first Reeves County collections; these specimens are maintained at Sul Ross State University and Texas A&M University. Sweptson's description of the ditch in which he located the muskrat population indicates that it is the overflow ditch from the San Solomon Spring swimming pool at the Park. The current status of the population is unknown, although it is likely completely extirpated from the area. The current status of Pecos River muskrat will be elucidated from the mammal inventory being

conducted by TTU. San Solomon Ciénega provides excellent habitat for the muskrat, whose diet consists primarily of cattails and sedges, but no muskrats have been reported in this newly-restored habitat. Pecos River muskrat presently occurs in El Paso and Hudspeth counties in irrigation canals associated with the Rio Grande.

3.1.5 Existing Land Use

The Park was acquired by the State of Texas in the early 1960s to provide a recreational facility at or near San Solomon Spring. Facilities for public use include: San Solomon Spring Courts (18 units) that were constructed by the CCC in 1936, two bathhouses and a concession building at the entrance to the San Solomon Spring swimming pool, and a developed campground includes 34 units, 28 with electricity. Visitation to the Park exceeded 200,000 in 2004 and is part of a trend of increased visitor usage in each of the past 10 years.

3.2 Covered Species in the HCP Area

When the original Balmorhea State Park HCP was submitted in 2008, three “candidate” invertebrate species were included to be covered by the HCP in the event they were listed as federally endangered. These include the Phantom tryonia (*Tryonia cheatumi*), the Phantom springsnail (*Pyrgulopsis* [=*Cochliopa*] *texana*), and the diminutive amphipod (*Gammarus hyalleloides*), which were listed as federally endangered in 2013. The change in federal status of these species is worth noting.

Another change worth noting concerns the taxonomy of one of the invertebrate species. The Phantom springsnail was first described in 1938 by Pilsbry as *Cochliopa texana*. Hershler et al (2010) reviewed the systematics of the species and transferred Phantom springsnail to the Genus *Pyrgulopsis* based on morphological and mitochondrial DNA analysis. Thus, the Phantom springsnail is now classified as *Pyrgulopsis texana*.

Comanche Springs pupfish (*Cyprinodon elegans)*

a. Species description

Comanche Springs pupfish was federally-listed as endangered in 1967 without critical habitat (32 FR 4001). In 1981, a recovery plan for the species was completed (Service 1981). Several updates of the recovery plan have been drafted, but not yet completed. Comanche Springs pupfish is one of the most distinctive members of the genus *Cyprinodon* (Echelle et al. 2003). Males possess a unique speckled color pattern and all individuals have a relatively streamlined body shape. They lack the vertical bars on the sides of their bodies that are found in most other *Cyprinodon*. Comanche Springs pupfish are small fishes; individuals only attain a maximum size of approximately 2 inches (5.08 cm) standard length (SL) (Itzkowitz 1969, Echelle and Hubbs 1978, Service 1981).

b. Life history

Comanche Springs pupfish can breed in swifter water than all other known *Cyprinodon*. Males orient and maintain position upstream from their territories until a female enters the territory and positions herself near the algal mat substrate (Itzkowitz 1969). These territories are variable in size (averaging approximately 5.4 square feet) and most often over algal mats. The males guard eggs until hatching and they aggressively defend their territories against intruders (Itzkowitz 1969). Courtship behaviors are similar to other species of *Cyprinodon* based upon the direct observations of Itzkowitz (1969) and Brannon et al (2003) as well the existence of natural hybrids between Comanche Springs pupfish and introduced sheepshead minnows as documented by Stevenson and Buchanan (1973). Eggs are apparently laid singly onto the algal mat substrates of the male's territory (Itzkowitz 1969). Aquarium studies suggest females may lay 30 eggs per day and eggs hatch in 5 days at 68° F (Cokendolpher 1978). Comanche Springs pupfish are relatively short-lived fish with most individuals living approximately

1 year. This aspect, coupled with their reproductive biology, causes large fluctuations in population numbers. Gut analysis of 20 specimens by Winemiller and Anderson (1997) revealed Comanche Springs pupfish eat mostly filamentous algae and some snails (*Pyrgulopsis [=Cochliopa] texana*).

Water emanating from the springs is stenothermal (limited range of temperature), approximately 72-79° F (Stevenson and Buchanan 1973, Gehlbach et al. 1978, Brune 1981), however, exposure to ambient temperatures in the Park makes the waters in which Comanche Springs pupfish occur more eurythermal (wide range of temperatures). Temperature preference experiments indicate that habitat temperatures between 68-86° F during August and September are optimal (Gehlbach et al. 1978). Comanche Springs pupfish have a critical thermal maximum of approximately 105° F and there is significant diurnal variation in the critical thermal maximum (higher in afternoon than morning) (Gehlbach et al. 1978).

c. Population dynamics

Estimated adult population size of the pupfish in the 1970s was about 1,000 or more in the vicinity of San Solomon Spring and perhaps several thousand in the irrigation canals (Echelle 1975). Densities are considered sparse in the irrigation canals due to lack of suitable habitat (Echelle 1975). During a two-year sampling study (Garrett and Price 1993), population size in the pupfish canal on the Park was estimated to be as low as 968 (May 1990) and as high as 6,480 (September 1990). Construction of the modified canal at Phantom Lake Spring resulted in an increase in local abundance, with an average of 14.7 individuals per square meter (Winemiller and Anderson 1997). During 1999 to 2001, the population in San Solomon Ciénega in the Park averaged 270,000 in summer to approximately 18,000 in winter (Garrett 2003). The pupfish refugium and San Solomon Ciénega now provide protected refugia where the largest populations of pupfish now reside.

d. Status and distribution

Comanche Springs pupfish originally inhabited two isolated spring systems approximately 56 miles (90 kilometers) apart in the Pecos River drainage of western Texas (Baird and Girard 1853). The type locality, Comanche Springs, inside the city limits of Fort Stockton, Pecos County, Texas, is now dry, and the population at this locality is extinct. The other population is restricted to the springs, their outflows, and a system of irrigation canals historically interconnecting Phantom Lake Spring (located in easternmost Jeff Davis County, Texas), San Solomon Spring, Giffin Spring, and Toyah Creek near Balmorhea, Reeves County, Texas (Echelle et al. 2003). The numbers of fish in the San Solomon Spring outflow have greatly increased in recent years as a result of the increased habitat availability from the San Solomon Ciénega. Comanche Springs pupfish habitat has been markedly altered into an irrigation network of concrete-lined canals with swiftly flowing water and dredged earth-lined laterals. The area has been highly modified repeatedly over the past century for the benefit of irrigation agriculture (Bogener 1993). Waters from Phantom Lake Spring originally emerged from a cave and formed a ciénega that drained back into a cave. Subsequently, water was captured in an irrigation canal as it emanated from the cave, but now there is no outflow from Phantom Lake Spring. Water from San Solomon and Giffin springs flows into additional irrigation systems, some of which is stored for irrigation supply in Balmorhea Lake. The aquatic habitat in the canals is highly impacted, ephemeral, and very dependent upon local irrigation practices and other water-use patterns. For the most part, the irrigation canals provide little suitable habitat for Comanche Springs pupfish (Service 1981). Also, in order to repair or re-dredge canals, flows are sometimes diverted by the District, causing mortalities of Comanche Springs pupfish (Davis 1979, USFWS 2004).

e. Threats

Primary threats to the Comanche Springs pupfish include the loss of aquatic habitat due to declining spring flows, hybridization with the introduced sheepshead minnow, and competition and predation from sheepshead minnow. For example, flows from Phantom Lake Spring have been declining since measurements have been taken in the 1930s (Brune 1981). Also, it was the complete loss of spring habitat from Comanche Springs in Fort Stockton that extirpated the fish from its type locality. Comanche Springs pupfish readily hybridize with sheepshead minnow and are eventually replaced by this nonnative.

A large population of sheepshead minnow occurs in Balmorhea Lake (Stevenson and Buchanan 1973, Echelle and Echelle 1994), and expansion of the nonnative species into upstream areas of the spring outflows is a constant threat to the existence of Comanche Springs pupfish in the wild. Comanche Springs pupfish has relatively generalized ecological needs. Because of similarities in ecological requirements, competition with sheepshead minnow poses a serious threat. The presence of sheepshead minnow in East Sandia Spring and its outflow canal demonstrated that this species can become established in spring flow systems. This greatly increases the chance that major portions of the Comanche Springs pupfish population will be replaced by competition or hybridization with sheepshead minnow.

The Service is maintaining captive stocks of Comanche Springs pupfish at the Dexter National Fish Hatchery and Technology Center, Dexter, New Mexico, and the Uvalde National Fish Hatchery, Uvalde County, Texas. The Uvalde population originated from 73 individuals collected from the distinctive subpopulation at Phantom Lake Spring (Garrett and Price 1993). The Dexter population came from individuals taken from the Uvalde stock in 2003 following a genetic evaluation of the stock (Echelle and Echelle 2002, Garrett 2003).

Much of Far-west Texas has been subjected to petroleum exploration and production over the last half century. Recent innovations in alternative extraction techniques and a new perspective on exploration has resulted in a new large discovery - the Alpine High play - by the Apache Corporation. The footprint of the play in its entirety is estimated at over 400,000 acres and Apache Corporation has secured leases to over 350,000 acres of the footprint, which covers most of southwestern Reeves County (including the hypothesized flowpaths to San Solomon Springs). While the Alpine High play is in its infancy and the full extent of exploration and production are yet to be realized, general concerns exist regarding potential impacts to water quantity and quality, area recreational activities, and critical or restricted habitat for all of the listed species.

Pecos gambusia (*Gambusia nobilis)*

a. Species description

Baird and Girard (1853) described Pecos gambusia based on material from Leon and Comanche springs, Pecos County, Texas. Leon Springs was later designated the type locality (Hubbs and Springer 1957). This fish has been Federally-listed as endangered since 1970. The Pecos gambusia is a relatively robust *Gambusia*, with an arched back and a caudal peduncle depth that is approximately two-thirds of the head length. The margins of the scale pockets are outlined in black and spots are normally absent on the caudal fin, however, sometimes a faint medial row of spots may be present. The dorsal fin has a subbasal row of spots. Females have a prominent black area on the abdomen that surrounds the anus and anal fin. The male gonopodium has a number of unique features including elongated spines on ray 3, small rounded hooks on the tips of rays 4p and 5a, and an elbow on ray 4a consisting of 3 or 4 fused segments located opposite the serrae of ray 4p (Hubbs and Springer 1957, Koster 1957, Bednarz 1975, Echelle and Echelle 1986). Populations in Toyah Creek (Texas) and Blue Springs (New Mexico) were found to be the most diverse morphologically and genetically, and the Toyah Creek population had the greatest genetic heterogeneity (Echelle and Echelle 1986, Echelle et al. 1989).

b. Life history

The Pecos gambusia produce live young. Bednarz (1979) reported that the number of embryos was related to female size and that the mean number of embryos was 38 in the Blue Springs population. Hubbs (1996) found that the birth weight of Pecos gambusia from Texas populations ranged between 0.0012 and 0.0018 ounces (35 and 50 milligrams) and females had an interbrood interval averaging 52 days. Hybrids between Pecos gambusia and western mosquitofish (*G. affinis*) or largespring gambusia are occasionally found, especially in habitats where one of the species is rare (Hubbs and Springer 1957, Service 1983).

The Pecos gambusia inhabit stenothermal springs, runs, spring-influenced marshes (ciénegas), and irrigation canals carrying spring waters (Service 1983, Hubbs 2003). Some populations are also known

from areas with little spring influence; these habitats generally have abundant overhead cover, and include sedge-covered marshes and gypsum sinkholes (Echelle and Echelle 1980). One or two other *Gambusia* may also be found in association with Pecos gambusia. Where the western mosquitofish is found, Pecos gambusia inhabits stenothermal waters and western mosquitofish is most often found in eurythermal habitats. Where the largespring gambusia has been introduced, the Pecos gambusia is much more likely to be found associated with vegetation or in deeper waters, while large-spring gambusia tends to be at the surface or in open water over non-vegetated substrates (Hubbs et al. 1995, Hubbs 2001, 2003). Pecos gambusia feed relatively non-selectively, consuming a diversity of food types, including; amphipods, dipterans, cladocerans, filamentous algae, arachnids, and mollusks (Hubbs et al. 1978, Winemiller and Anderson 1997).

c. Population dynamics

Where suitable habitats exist, Pecos gambusia populations can be dense. An estimated 27,000 individuals inhabit the Bitter Lake National Wildlife Refuge area, and 900,000 inhabit Blue Springs (Bednarz 1975, 1979). Approximately 100,000 Pecos gambusia are estimated to inhabit the San Solomon spring complex and more than 100,000 in the Diamond Y spring and draw (Service 1983).

d. Status and distribution

The Pecos gambusia is endemic to the Pecos River basin in southeastern New Mexico and western Texas and originally ranged from near Fort Sumner, New Mexico to the area around Fort Stockton, Texas. At present, the species is restricted to four main areas, two in New Mexico and two in Texas. Populations live in various springs and sinkholes in Bitter Lake National Wildlife Refuge, near Roswell, New Mexico; Blue Springs, east of Carlsbad Caverns National Park, New Mexico; the Diamond Y spring and draw (=Leon Creek), near Fort Stockton, Texas; and the Toyah Basin (San Solomon spring complex) near Balmorhea, Texas. Extirpated populations include the Pecos River near Fort Sumner and North Spring River in New Mexico, and Leon and Comanche springs, which are now dry, in Texas.

e. Threats

The Pecos gambusia faces severe threats from spring flow declines and habitat modification throughout their range. Loss of outflow in Phantom Lake Spring (described earlier) has also affected the local population of Pecos gambusia. Currently, the total number of individuals persisting at Phantom Lake Spring is estimated to be less than 100 (N. Allan, Service, personal observation, 2003). Throughout their historic range, ciénegas presumed to have supported large numbers of Pecos gambusia have been systematically drained and spring flows diverted for irrigation. Additional stresses on the population may occur through competition with the introduced large spring gambusia.

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Phantom tryonia (*Tryonia cheatumi*)

a. Species description

The Phantom tryonia was first described by Pilsbury (1935). It is a very small snail, measuring only 0.11 inches to 0.14 inches long (2.8-3.5 mm) (Taylor 1987). The shell is narrowly conical, with an obtuse apex and a broadly rounded anterior end (Taylor 1987). Whorls number 4.75 to 5.75 in large males and 5

to 6 in large females, regularly convex, and separated by a deeply incised suture (Taylor 1987). Snails of the family Hydrobiidae are sexually dimorphic with females being characteristically larger and longer-lived than males.

b. Life history

Like other hydrobiids, the Phantom tryonia is sexually dimorphic and ovoviviparous. They are presumably fine-particle feeders on detritus and periphyton associated with substrates (mud and vegetation); Dundee and Dundee (1969) found diatoms to be the primary component in the digestive tract.

c. Population dynamics

Within its limited range, Phantom tryonia can occur in very high densities. These snails likely have life spans of 9 to15 months and reproduce several times during the spring to fall breeding season (Taylor 1987, Pennak 1989, Brown 1991).

d. Status and distribution

Dundee and Dundee (1969) described the conditions of Phantom tryonia at Phantom Lake Spring in 1968. Despite the fact that Phantom Lake Spring has been drastically altered from its original state, the native snails (Phantom springsnail and Phantom tryonia) occurred in the irrigation canal in such tremendous numbers that the sides of the canal appeared black from the cover of snails. Today the snails are limited to low densities in the small pool at the mouth of Phantom Cave and cannot be found in the irrigation canal downstream (J. Landye pers. obs., USFWS, Fish Health Center, Pinetop, AZ). A similar situation occurs at San Solomon Spring, where Taylor (1987) reported the snail was abundant and generally distributed in the canals from 1965 to 1981. No recent information is available on the status of the species at San Solomon Spring.

In the summer of 2000, East Sandia Spring was surveyed for aquatic macroinvertebrates for the first time. A healthy abundance and diversity of snails and other macroinvertebrates were present in the spring head and small outflow channel (Lang et al. 2003). The entire available habitat is estimated at less than 492 feet (150 meters) in length, and usually 3 feet (0.9 meter) wide or less.

e. Threats

The most significant threat to the continued existence of this snail is the degradation and eventual loss of spring habitat (flowing water) due to the decline of groundwater levels of the supporting aquifer. Another threat to snail habitat is the potential degradation of water quality due to pollutants. This can occur either directly into surface water or indirectly through contamination of groundwater that discharges into spring run habitats used by the snail. The primary threat for contamination comes from herbicide and pesticide use in nearby agricultural areas. An additional threat of unknown effect is the introduction of exotic snails, *Melanoides tuberculatus* (Red-rimmed melania) and *Tarebia granifera* (Quilted melania), that have become established in Phantom Lake Spring (McDermott 2000). These species have been found at San Solomon Spring for some time longer but have not been found in East Sandia Spring. In many locations at San Solomon Springs, these exotic snails essentially are the substrate in the small stream channel. These exotic snails are likely competing with native snails for space and resources. Other changes to the ecosystem from the dominance of these non-native species are likely to occur and could have detrimental effects to the native invertebrate community.

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impacts to water quantity and quality, area recreational activities, and critical or restricted habitat for all of the listed species.

Diminutive amphipod (*Gammarus hyalleloides*)

a. Species description

The diminutive amphipod (*Gammarus hyalleloides* Cole) was first collected by W.L. Minckley from Phantom Lake Spring in 1967 and was formally described by Cole (1976). The name comes from the species being considered the smallest of the known North American fresh-water *Gammarus*. Adults range in size from 0.2 to 0.3 inches (5-7.6 millimeters). Some diagnostic features include being more elongate and less setaceous than *G. pecos*; lacking setae on the posterior margin of the first peduncular segment of antenna 1; coxal plates 1-4 with fewer anteroventral setae, rarely more than a sum of 10 on one side; epimera 2 and 3 armed with spines, usually lacking anterior, ventral, and facial setae; and females without teeth in palmar concavities of gnathopods 1 and 2 (Cole 1976).

b. Life history

The diminutive amphipod only occurs in desert spring outflow channels. The small amphipods occur on substrates, often within interstitial spaces on and underneath rocks and within gravels (Lang et al. 2003), and are most commonly found in microhabitats with flowing water. They are also commonly found in dense stands of submerged vegetation, primarily *Chara* beds (Cole 1976). 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.

c. Population dynamics

Within its limited range, diminutive amphipod can be very abundant. For example, in May 2001, Lang et al. (2003) estimated mean densities at San Solomon, Giffin, and East Sandia spring of 6,833 amphipods per square meter (standard error ±5,416), 1,167 (±730), and 4,625 (±804), respectively. No data is available for Phantom Lake Spring densities, as the amphipod was not found there at the time of these surveys.

d. Status and distribution

The diminutive amphipod occurs in only four springs in Jeff Davis and Reeves counties, Texas: Phantom Lake, San Solomon, Giffin, and East Sandia spring (collectively referred to here as the San Solomon Spring System) (Gervasio et al. 2004). These springs are all within about 8 miles (13 km) of each other. There is no available information that the species historic distribution was larger than the present distribution. However, other area springs may have contained the same or similar species, but because these springs have been dry for many decades (Brune 1981), there is no opportunity to determine the potential historic occurrence of amphipods.

e. Threats

The primary threats to the diminutive amphipod are essentially the same as that of the Phantom springsnail. The most significant threat is potential degradation and eventual loss of spring habitat. Other potential threats include: the possible degradation of water quality due to pollutants, either through contamination of groundwater or from runoff of herbicide and pesticide from nearby agricultural areas; and the potential resource competition posed by the introduction of the exotic snail, *Melanoides* sp. in Phantom Lake Spring (McDermott 2000).

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over 350,000 acres of the footprint, which covers most of southwestern Reeves County (including the hypothesized flowpaths to San Solomon Springs). While the Alpine High play is in its infancy and the full extent of exploration and production are yet to be realized, general concerns exist regarding potential impacts to water quantity and quality, area recreational activities, and critical or restricted habitat for all of the listed species.

Phantom springsnail (*Pyrgulopsis [=Cochliopa] texana*)

a. Species description

The Phantom springsnail was first described by Pilsbury (1935). It is a very small snail, measuring only 1 to 1.4 mm in length (Dundee and Dundee 1969). Habitat of the species is found mostly on firm substrates (rocks and vegetation) on the margins of spring outflows (Taylor 1987). These snails likely have life spans of 9 to15 months and reproduce several times during the spring to fall breeding season (Taylor 1987, Pennak 1989, Brown 1991). Snails of the family Hydrobiidae are sexually dimorphic with females being characteristically larger and longer-lived than males. The snails are ovoviviparous, producing live young serially (as opposed to broods). They are presumably fine-particle feeders on detritus and periphyton associated with substrates (mud and vegetation); Dundee and Dundee (1969) found diatoms to be the primary component in the digestive tract.

b. Life history

The Phantom springsnail only occurs in desert spring outflow channels. They are most abundant in the first few hundred meters downstream of spring outlets. Habitat of the species is found on both soft and firm substrates on the margins of spring outflows (Taylor 1987). They are also commonly found attached to plants, particularly in dense stands of submerged *Chara* beds.

c. Population dynamics

Within its limited range, Phantom springsnails can occur in very high densities. These snails likely have life spans of 9 to15 months and reproduce several times during the spring to fall breeding season (Taylor 1987, Pennak 1989, Brown 1991).

d. Status and distribution

The Phantom springsnail is an aquatic snail occurring in only three spring systems and associated outflows (Phantom Lake, San Solomon, and East Sandia Spring) in the Toyah Basin of Jeff Davis County and Reeves County, Texas (Taylor 1987). The snail may also occur at Giffin Spring, in the same area, but information is not available from that site because access is limited by the private landowner. There is no available information that indicates the species historic distribution was larger than the present distribution. However, other area springs may have contained the same species, but because these springs have been dry for many decades, there is no opportunity to determine the potential historic occurrence of the snail fauna.

e. Threats

The primary threats to the Phantom springsnail are essentially the same as that of the Phantom tryonia. The most significant threat is potential degradation and eventual loss of spring habitat. Other potential threats include: the possible degradation of water quality due to pollutants, either through contamination of groundwater or from runoff of herbicide and pesticide from nearby agricultural areas; and the potential resource competition posed by the introduction of the exotic snails, *M. tuberculatus* and *T. granifera* in Phantom Lake and San Solomon springs (McDermott 2000).

Section 4

Potential Biological Impacts/Take Assessment

4.1 Direct and Indirect Impacts

The proposed action, as described in section 2, may have adverse effects to the covered species. Effects of the action include possible take associated with swimming pool maintenance and cleaning, vegetation control and window maintenance in the San Solomon Ciénega, removal of aquatic vegetation to maintain the pupfish refugium, and irrigation of camping areas. The proposed action occurs within the known range of the covered species, but will likely affect the pupfish more than the gambusia and the invertebrates, due to higher numbers of pupfish expected to occur in the irrigation canals.

The effects of the swimming pool and maintenance occur once each year as water is diverted into the northern drainage canal, rather than the main concrete canal. It normally takes from 5-14 days to complete the annual pool maintenance depending on the level of maintenance required.

Impacts to the biological resources to the aquatic systems in the Park are minimal and short term. Each action and it impacts to the covered species are described below.

1) Cleaning and maintenance of the swimming pool. The slow draw down of the pool reduces the water level to the normal spring flow, with substantial flow through the western end of the pool. This provides habitat for individual fish that remain in the pool and any individuals washed down the aqueduct and into the irrigation ditch system where the species is also present. Water is diverted from the primary outflow canal and 531 feet (162 meters) virtually dries up. Water flow is maintained through 177 feet (54 meters) of the outflow canal in order to continue water circulation through the pupfish refugium and the ciénegas. In addition, minimal water flow continues in the outflow canal below the San Solomon ciénega as the dam system used in the canal is not 100% water tight. Local displacement of individual fish occurs within the pool and in the outflow canals (Figure 2).

   Endangered fish possibly lost from the canal system during swimming pool drawdowns are naturally recolonized from upstream populations in the spring outlets. The occurrence of fish in the canals is a result of downstream colonization. Nothing in the proposed action prevents the continued colonization of the canals by fishes migrating, or being displaced, downstream from the spring outlets.

   During swimming pool drawdowns the level of water in the pool is lowered over a several hour period as the water held in the pool and spring flow is diverted through a gate and aqueduct system in the District irrigation canal system. The process transfers some fish from the pool into a portion of the canal system where the San Solomon Ciénega discharge flows.

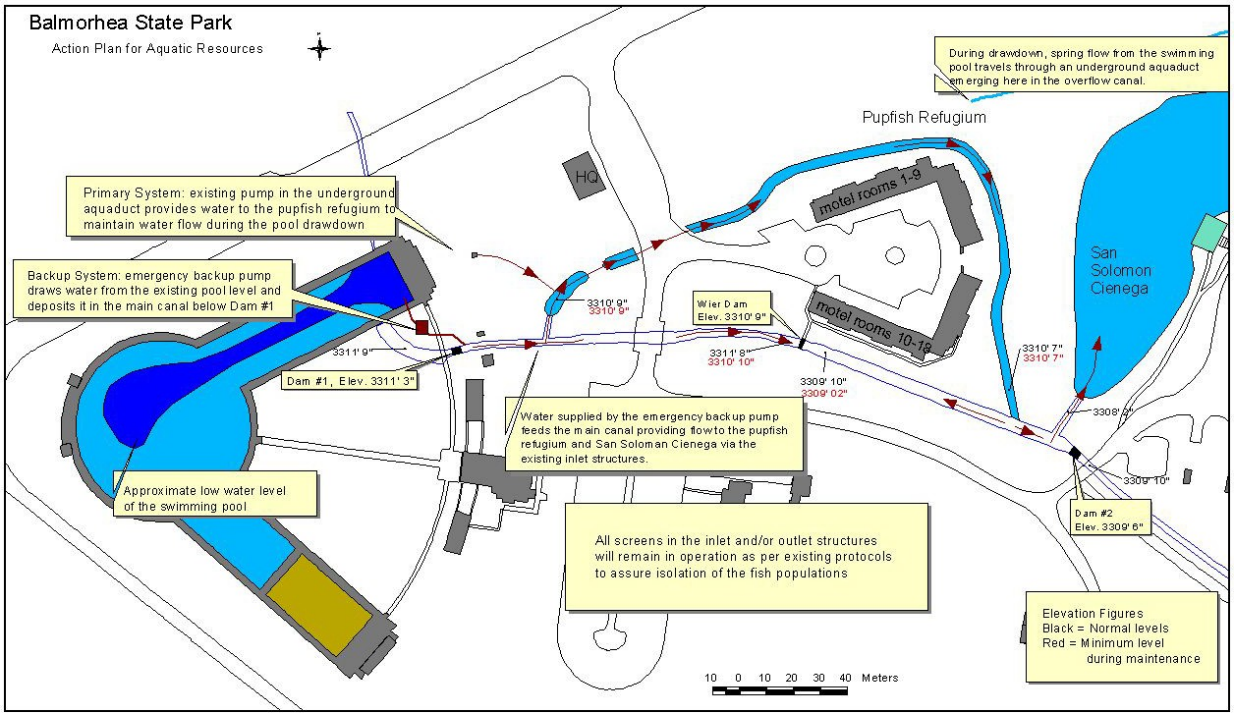

Figure 2. Aquatic action plan used during swimming pool maintenance activities.

2) Maintenance of the pupfish refugium is performed by hand or mechanically and does not require adjustment of the water level, and therefore has very minimal impacts to fish populations. However, local displacement of individual fish may occur.

3) Herbicides and/or fertilizers are to only be used with strict adherence to the manufacturer's product labeling and in any manner where runoff (even if unintentional) into any of the aquatic systems of the Park or downstream from the Park will be avoided. No impacts to the aquatic systems are anticipated.

4) Control of cattails at San Solomon and Hubbs ciénegas will primarily be through prescription burning followed by treatment with the approved herbicide Rodeo. Rodeo application will be through wicking. No impacts to the aquatic systems are anticipated.

5) Any maintenance to the window at San Solomon Ciénega involves sealing off the remainder of the Ciénega and has no impacts to the aquatic resources.

6) Irrigation of the camping area is accomplished by using a small irrigation pump with a screen over the out-take hose. No impacts to the aquatic systems are anticipated.

4.1.1 Anticipated Take of Covered Species

Incidental take of covered species during pool maintenance activities is difficult to quantify. However, these activities will not greatly impact the overall population of any of the covered taxa. Up to 100 percent of the covered species occurring within the first 531 feet of the primary outflow canal from the swimming pool will be affected. Incidental take is expected to be in the form of killing individuals as the outflow

canal dries during maintenance of the swimming pool. This channel contains only marginal habitat and has a very low population of all species, because of the high flow velocity exiting the pool. In addition, individuals occurring in this section comprise an extremely small portion of the overall population and they are rapidly replaced by migration. The canal is 12 feet (3.6 meters) wide and water depth is a maximum of 1.0 foot (0.3 meter). Because of the high flow velocity the fish that inhabit this canal are restricted to microhabitats within the canal that are more protected. The available surface area on the floor and along the sides of the canal is a maximum of 7,552 square feet (701.6 square meters). This can be compared with the higher quality, managed habitat provided in the pupfish refugium and Hubbs and San Solomon ciénegas. The surface area of the floor of the refugium is approximately 0.3 acres (0.12 hectares), while the San Solomon Ciénega is approximately 3 acres (1.21 hectares) in size and the Hubbs Ciénega is approximately 0.2 acres (0.08 hectares) in size. The canal system is considered to be low quality habitat for the endangered fish (Echelle and Echelle 1994) when compared to the high-quality managed habitat of the refugium and Ciénegas (Garret 2003).

The potential numbers of individuals taken during the period of the consultation is impossible to predict or detect for the following reasons:

1. The number of individuals of the covered species occurring in the pool and canal system at the Park is unknown and detection of the species is difficult due to their small size.

2. The number of individuals impacted by the proposed action is unknown. On one occasion, the number of individuals fish impacted from the drying of one section of ditch was documented (Davis 1979), but no other data exists on which to base any estimates of take for any of the covered species.

All covered species are subject to direct take in the form of mortality occurring within the 531 feet of the primary outflow canal from the swimming pool when the canal is allowed to go dry during pool cleaning. Additionally, mortality of covered species due to entrainment is anticipated from vegetation removal to maintain optimum habitat in the pupfish refugium. This is anticipated to affect the invertebrate species more than the fish as the fish are more mobile and should be able to retreat to nearby habitat.

Take in the form of harassment to covered species is anticipated in the swimming pool from the reduction of available habitat during the drawdown of the pool. The level of the pool is reduced by about 8 feet, which confines the covered species to a much smaller pool of water. Take in the form of harassment is also anticipated during vegetation removal in Hubbs and San Solomon ciénegas. This is anticipated to affect the invertebrate species more than the covered fish as they are likely to avoid those areas during the prescribed burning.

These incidental take limits are subject to full implementation of all mitigation measures, as described in Section 5.0. If, during the operation of the park, take of listed species is anticipated to be greater than analyzed in this HCP, the Applicant shall cease all landscaping and construction operations and immediately contact the Service.

4.1.2 Effects of Anticipated Take

Effects of the anticipated take include harassing fish in the swimming pool during the annual drawdown and maintenance of the pool, management of aquatic vegetation in the pupfish refugium, control of cattails within San Solomon Ciénega, and window cleaning and maintenance in the San Solomon Ciénega. The above activities are not anticipated to have a long term detrimental effect to the covered species as a whole. The covered species are not known to breed seasonally, but rather breed throughout their adult stage with reproduction primarily occurring spring through fall. The long term effects to covered species from the management of the Park are considered beneficial as TPWD strives to preserve the ecological value of the Ciénega and promote viable populations of the covered species. Short term effects include the loss of some individuals and a reduction of available habitat for short periods of time on an annual basis.

4.2 Cumulative Impacts

The cumulative impacts from this project are negligible. Cumulative effects include the effects of future State actions that are reasonably certain to occur in the action area considered in this document. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

If future spring flows decline from San Solomon Spring, endangered fish populations will be further stressed. This situation would have the potential to make the proposed action aggravate an already stressed ecosystem. It will be important to review the status of the baseline and the effects of the actions to ensure that the future situation will continue to support aquatic habitats for the listed fishes.

The other significant factor is the prevention of the upstream movement of sheepshead minnow from Balmorhea Lake to spring outflow areas. Expansion of the range of the sheepshead minnow would seriously compromise the existence of the Comanche Springs pupfish. However, nothing in the proposed action adds new opportunities for sheepshead minnow invasion from Balmorhea Lake.

Section 5

Conservation Program/Measures to Minimize and Mitigate for Impacts

5.1 Biological Goals

The biological goals of this proposed HCP are:

1. To minimize and mitigate to the maximum extent practicable the impacts of the proposed project to the covered species; and

2. To contribute to the conservation and recovery of the two endangered fishes and three candidate invertebrates.

5.2 Conservation Actions

Pupfish Refugium

The pupfish refugium at the Park was constructed in 1975 to provide suitable lasting habitat for the Comanche Springs pupfish. TPWD's objective was to maintain this refugium to provide the best available habitat (at the time) for Comanche Springs pupfish, as well as for other native aquatic organisms. As mentioned previously, the Hubbs Ciénega was constructed along a section of the pupfish refugium, which reduced the size of the refugium in favor of more natural ciénega habitat but did not replace or eliminate the refugium in its entirety, Following are procedures that will maintain this habitat in a suitable state for the continued conservation of the two endangered fish species occupying this facility.

Vegetation in the refugium:

When aquatic plants form a continuous mat that is longer than 50 feet, mechanically, or by hand, remove (use no chemicals) ten-foot wide swaths perpendicular to the channel for every 50 feet of aquatic plants throughout the length of the refugium. Rotate placement of swaths so as to remove aquatic plants where they are most dense. Cattails and other emergent vegetation will be mechanically removed.

Water quantity/quality in the refugium:

An Auxiliary pump will be used to maintain water flow through the refugium at no less than 50% of normal flow. Normal flow is one (1) cfs. The present auxiliary pump is not adequate for the long-term provision of water for the refugium. The drilling of a well to a reliable aquifer may be necessary to ensure adequate water flow for the refugium in the event of cessation of San Solomon Spring surface flow. The refugium auxiliary pump will be adequately tested two weeks prior to the periodic draining of the swimming pool for cleaning and maintenance. This is to allow for pump repair or acquisition of a replacement pump if needed.

Chemicals, particularly pesticides, herbicides, and fertilizers, are not to be used in the Park area if they could reasonably affect runoff, affect groundwater, or drift into the refugium.

Other animal species in the refugium:

Predatory, non-native fish, particularly largemouth bass, will immediately be removed from the refugium.

The bullfrog (*Rana catesbeiana*), introduced throughout much of the western United States, will "eat virtually anything that moves and it can swallow" (Conant and Collins 1991). Consequently, any bullfrogs that are found in the refugium will be removed and destroyed immediately. Park personnel will learn and listen for calls during the breeding season and report any positive findings to the Region 1 TPWD Natural Resources coordinator immediately.

No fish species of any kind are to be introduced into the refugium, swimming pool, or nearby canals without a permit from the Natural Resources Program who will coordinate any introductions with the appropriate specialists.

Removal of specimens of endangered fish species from the refugium require Federal, State, and state park permits.

Landscaping changes in the vicinity of the refugium:

Landscaping changes in the vicinity of the refugium are to be avoided: no new shrubs or trees are to be planted where extensive shade may be cast onto the refugium. No more than 50% canopy coverage would be permitted. Landscape modifications require coordination with the Natural Resources coordinator.

No changes in contour that would affect runoff and thus affect sedimentation in the refugium are to be made.

Introduction of live fish into the Park is prohibited. Introduction of non-native fish would increase the dangers of predation, competition, and hybridization. While signs are not recommended, Park personnel will be ever alert to the need to inform the public, particularly those who fish in nearby Balmorhea Lake, of the prohibition of introductions and why.

Stability:

Any changes that could affect the refugium will be made slowly. The refugium is doing well in its present condition regarding stream flow, substrate, and overhead cover.
Any change which could affect the refugium must first be cleared through the Natural Resource Coordinator. This section will then establish review process prior to change being affected.

Long-term objectives:

Long-term maintenance issues with the canal and the need to provide higher quality habitat resulted in the construction of the Hubbs Ciénega as previously described. The primary objective of the new Ciénega was to maintain a population of Comanche Springs pupfish isolated from other protected populations and to enhance the quality and quantity of habitat available for all listed and candidate taxa.

San Solomon Ciénega

Many of the objectives and concerns regarding the management of the Pupfish refugium/canal also apply to the management of the San Solomon Ciénega (and Hubbs Ciénega), but there are a number of differences between these aquatic habitats. The San Solomon Ciénega is a much larger unit than the Hubbs Ciénega or pupfish refugium/canal with a much greater effort applied to the restoration of the total aquatic and upland ecosystem; the canal is a simple unit designed solely for providing habitat for the two endangered fish species. Additional management parameters will be required to operate the Ciénega including, but not limited to the following:

1. The flow of water through the Ciénega is a critical component to the stability of the recreated

ecosystem and requires monitoring/checking on a daily basis.

2. All screens and filters will be checked and cleaned daily.

3. Daily monitoring is required to insure that Park visitors stay within the designated public use facilities (the interpretive shelter/overlook structure and the underwater viewing window) and do not wander all over the unit impacting fragile plantings. Park visitors will not be allowed, under any circumstances, in the waters of the Ciénega, nor will they be allowed to sit at the inflow or outflow structures.

4. Control of cattails will be achieved in accordance with best management practices and according to manufacturer's label instructions/guidelines. Control methods will primarily be centered on prescription burning followed by treatment with the approved herbicide, Rodeo. Structures such as the observation deck and other vegetation (particularly cottonwoods) must be protected during prescription burns and during application of the herbicide Rodeo, which the application will only be by wicking, not spraying.

5. It is imperative that the Ciénega's clay liner be protected. Consequently, it should not be walked-on or otherwise disturbed. Cattails must not be pulled-up or controlled mechanically for this reason.

6. Non-native fish should not be introduced into the Ciénega under any circumstances. If non-native fish such as bass are detected, they will be removed immediately. Similarly, the non-native bullfrog will be removed.

7. Park personnel will coordinate with the Natural Resources Coordinator any plantings which are desired. Any/all plantings can be achieved by any means possible; however, such planting will remain aligned with the basic vegetation parameters created by Park personnel during the early phases of the project. Planting of exotic species of plants or species which are not native to the immediate region is strictly forbidden.

Other Aquatic Systems

Monitoring is the key to determining the suitability of other aquatic habitats within the park with respect to occupation by the pupfish, gambusia, other aquatic vertebrates and invertebrates. The Comanche Springs pupfish thrives in these waters and is doing well; however, the exact distribution of the Pecos gambusia needs to be determined.

Sudden changes in water quality have the potential to harm these and other aquatic inhabitants. Natural events such as heavy rains (flooding) and earthquakes have in the past produced sudden changes in water quality and flow. Continued monitoring of these events in conjunction with sampling is the recommended course of action.

The occurrence of a fish kill of any proportion will be considered an emergency and reported immediately to the resource management personnel, as well as, pertinent Water Resources Branch and Inland Fisheries staff. Such an event may or may not be tied to a natural phenomenon and will be considered a threat to the health of the two endangered fish species located at this Park site.

San Solomon Spring Swimming Pool

The pool elevation in this facility is normally drawn down approximately eight feet on an annual basis. The purpose is to facilitate cleaning (mainly algae) from the sides, steps, and concrete floor in the west end of the pool prior to each summer season. Cleaning is normally accomplished with a pressure sprayer utilizing pure, non-heated water. Because this facility contains a number of sensitive aquatic resources the following procedures will be followed:

1. Complex/site management and/or the complex maintenance supervisor will submit to the Natural Resources Program (and to Water Resources Branch and Inland Fisheries staff) a plan of action to include, but not be limited to the following: the time period for the draw down, areas to be cleaned, methods which will be utilized to clean these selected areas, other maintenance/ or minor repair to be applied (if any), and personnel involved. A copy of the plan must be submitted to the Service as part of the annual reporting requirement.

2. No chemicals, biocides, or disinfectants of any kind are permitted in the pool area, which have potential to run off into its waters. Any use of such or any deviation thereof, must be coordinated with the Complex Manager, the resource staff, and the Service.

3. Drawdowns required for unexpected or other reasons will be coordinated immediately with the Complex Manager and the Natural Resources coordinator. The Service will be informed of any such actions.

Main Irrigation Canal

Under normal conditions the upper portion of this structure receives 100% of the exit flow from the San Solomon Spring Swimming Pool. The main irrigation canal is a concrete lined structure that exits the park at its eastern boundary. It eventually channels spring water to other distribution canals and Balmorhea Lake. The most common fish species in this facility include the Mexican tetra, headwater catfish, and Comanche Springs pupfish. Management recommendations for this unit include:

1. No chemicals, biocides, or disinfectants of any kind which have potential to run off into its waters are permitted in the pool area. Any use of such or any deviation thereof must be coordinated with the Complex Manager, the Park personnel, and the Service.

2. During swimming pool maintenance, some water flow will be provided through the use of pumps and irrigation tubes, in order to prevent the canal from going dry during these actions.

Overflow Canal

The overflow canal, which has historic origins, serves two very important functions. First, it receives all of the diverted outflow water from San Solomon Spring when there is a need to lower the pool level on the swimming pool. Second, it receives the entire outflow from the San Solomon Ciénega project. This is a significant structure because it is lined with natural soils and vegetation rather than concrete. This canal was the last known location from which the now extirpated Pecos River Muskrat was recorded. Surveys previously established the presence of pupfish and gambusia in the canal, even prior to the increased flow provided by the outflow of the ciénega project (Garrett, pers. comm.).

Hubbs Ciénega

In an effort to contribute to the conservation and recovery of the two endangered fish species, TPWD staff constructed the Hubbs Ciénega in 2009 within the pupfish refugium. As described previously, the Hubbs Ciénega was constructed as a managed wetland habitat that more closely resembles natural habitat than the pupfish refugium canal. Much like the San Solomon Springs Ciénega, additional management parameters will be required to operate the Ciénega including, but not limited to the following:

1. The flow of water through the Ciénega is a critical component to the stability of the recreated ecosystem and requires monitoring/checking on a daily basis.

2. Screens and filters originally installed were prone to clogging with natural debris and trash, creating the potential for reduced or interrupted flows. As a result their use was discontinued.

3. Daily monitoring is required to insure that Park visitors stay within the designated public use facilities (the interpretive shelter/overlook structure and the underwater viewing window). Park visitors are not allowed, under any circumstances, in the waters of the Ciénega, nor are they allowed to sit at the inflow or outflow structures.

4. Control of cattails is achieved in accordance with best management practices and according to manufacturer's label instructions/guidelines. Control methods primarily consist of treatment with the approved herbicide, Rodeo, consistent with the herbicide label. Structures such as the observation deck and other vegetation (particularly cottonwoods) are protected during application of the herbicide Rodeo.

5. It is imperative that the Ciénega's clay liner be protected. Consequently, it should not be walked on or otherwise disturbed. Cattails must not be pulled-up or controlled mechanically for this reason.

6. Non-native fish are not to be introduced into the Ciénega under any circumstances. If nonnative fish such as bass are detected, they are removed immediately. Similarly, the non-native bullfrog will be removed.

7. Park personnel will coordinate with the Natural Resources Coordinator regarding any plantings which are desired. Any/all plantings can be achieved by any means possible; however, such planting will remain aligned with the basic vegetation parameters created by Park personnel during the early phases of the project. Planting of exotic species of plants or species which are not native to the immediate region is strictly forbidden.

Other Management Actions

Wildfire is defined as any natural or human induced fire that is permitted to burn outside a specified set of conditions or parameters (the prescription). Any fire that does not contribute positive aspects toward resource management goals and objectives will be considered a wildfire and extinguished as quickly as possible, as per the Park's operational procedures. Proper planning is the key to utilization of natural and accidental or visitor-induced fire to the benefit of resource management objectives, as well as in preventing the loss of life, property, and resources.

- Detailed maps that define park facilities, boundaries, public use areas, location of emergency equipment, water sources, hazards, etc., will be on file at the Park and with the local fire department.

- A firebreak will be maintained around the perimeter of the Park, at least in those areas maintained in a natural state. These fire lanes will be approximately 10 feet wide, if practical and can be maintained by mowing, prescribed burning, grazing, or herbicide use where identified and approved.

- Light fuel loads will be maintained in areas adjacent to the public use area and around Park building and facilities.

- Evacuation procedures will be posted at appropriate locations within the Park where it will be visible to all visitors.

- Posted signs informing visitors of current fire conditions will be posted at appropriate locations and during "EXTREME CONDITIONS" a no fire rule will be adopted.

Prescribed fire can potentially be applied to two areas of the Park; all natural areas (undeveloped areas) of the Park and San Solomon Ciénega, in part. The upland restoration area of the San Solomon Ciénega and the cattails within the system will be subjected to prescribed fire as required. An authorization to burn the cattails would normally coincide with: 1) an opportunity to lower the level of the water, thereby exposing the marsh plants to their maximum extent; 2) a timeframe subsequent to a hard freeze that has killed off most of the above water vegetation; and 3) a timeframe that clearly occurs before any of the birds occupying the system begin to nest. Recognizing that wildfire once contributed to natural processes that shaped the area's upland ecology, prescription burning will play an important role in the maintenance and restoration of the natural communities of the site. Within the Park, management objectives utilizing prescribed fire will include, but not be limited to:

1. Maintenance of the "sacaton" grassland of the restored uplands section of the San Solomon Ciénega to revitalize the grass components of the project and control exotic species.

2. Control and elimination of undesirable woody vegetation, especially catclaw (a native, but invasive shrub) and Russian thistle (an invasive exotic), where practical in Management Zone 3. Additional goals are to improve herbaceous composition, enhance wildlife habitat, improve nutrient cycling, and restore natural grassland components. A complete fire management plan will be developed prior to any actions.

Herbicides, Pesticides, and Fertilizers

At present, herbicides are authorized for use in San Solomon Ciénega to control cattail growth and overpopulation. The herbicide, Rodeo, is authorized for use in cattail control and is to be strictly applied within the guidelines of use requirements contained on the label. The only authorized method of application is wicking, not spraying. It is recommended that any application of herbicides be used on aquatic vegetation to: 1) maintain an open channel from the inlet structure to the area of naturally open water in front of the viewing window; 2) to control vegetation growth in and around the outlet structure; and 3) thin out growth in other identified areas to maintain a natural mosaic of marsh, channels, backwater pools, and open water in the deepest portions of the pond.

Otherwise, no herbicides, pesticides, or fertilizers will be used without prior consideration and approval by Park Operations and the Natural Resources Program. Application of any of these substances, if approved, will strictly adhere to policies and procedures defined in the TPWD's Environmental Policy and on manufacturer's product labeling. It is imperative that chemicals not be used in areas and in any manner where runoff (even if unintentional) is likely to enter any of the aquatic systems of the Park or downstream from the Park. Particularly sensitive areas would include the endangered fish refugia, the overflow and swimming pool drainage canal, and the main irrigation canal. The biota of these aquatic and terrestrial systems could be potentially and irreversibly damaged by a single event of misuse of any chemical.

Education

There are several outreach/educational opportunities provided to Park visitors. There are two interpretive wayside panels placed at the observation deck of the San Solomon Ciénega. One describes the initiative that resulted in the development of the ciénega and is titled "rebirth of a desert wetland" and the second depicts a wide variety of organisms that might be expect to be present at the ciénega. At the underwater viewing windows there are interpretive wayside panels describing the Pecos gambusia and Comanche Springs pupfish, as well as one discussing "Why are these fishes endangered?" Interpretive waysides are also placed along the walkway to San Solomon Spring (pool) discussing geology and hydrology. In addition to these exhibits there are three brochures available at the Park headquarters. These are: 1) Fishes of the Refugium; 2) Rebirth of a Desert Wetland; and 3) Interpretive Guide to State Parks of the Davis Mountains. Interactive educational options include guided tours that are provided on request. These are primarily offered to schools for field trips and other youth organizations, but are not restricted to these groups. An Interpretive Master Plan for the Park has been approved for implementation as of 2005

and additional waysides are planned that will discuss the following topics:

Fauna of San Solomon Springs
CCC History
Chronology of human history and water use
Sacaton grassland
Native plant restoration project in the campground loop
Ciénega (definition and ecological function)

In addition, outreach programs are in development as part of this program that will include PowerPoint presentations that can be given on-site or in a classroom setting and a kiosk in the Park.

The TPWD and the Service discussed alternatives to the taking, but the existence of the pool and the historical values of the property mean that the facility cannot be moved and the facility would not remain safe for the public to use and appreciate the Park if maintenance activities were not conducted. Therefore, no viable alternatives to the taking exist.

5.3 Measures to Minimize and Mitigate Impacts

The operational management of the Park is designed with conservation of aquatic resources as a primary objective. All activities that take place in or near the spring system are undertaken in a manner to minimize impacts to the aquatic environment. Natural resource management is a primary activity in the Park, focusing on the spring system and the endangered species covered in this HCP. This management primarily includes maintenance and monitoring of the pupfish refugium and San Solomon Ciénega. These actions directly mitigate for activities that result in take of covered species and benefit all species of conservation concern covered by this HCP. The annual maintenance activities required for the operation of the pool are brief in duration and the impacts to the aquatic systems are minimal.

San Solomon and Hubbs ciénegas

The ciénegas are situated within the boundaries of the original, natural ciénega and are on State park land (McCorkle et al. 1998). They were designed to resemble and function like the original ciénega for the native fish fauna, including Comanche Springs pupfish and Pecos gambusia. The District and the local community it represents agreed to provide the essential water needed to create a secure environment for the endangered species. The main purpose of these restoration projects was to recreate vital habitat, not only for the two endangered fishes, but for other aquatic, terrestrial, and wetland-adapted organisms as well. An observation deck provides an unobstructed view of most of the above-water portion of the San Solomon Ciénega, and a window wall yields an underwater view of life in the ciénega. This location now contains the largest known concentration of Comanche Springs pupfish (summer population averages 270,000) (Garrett 2003, Hargrave et al. 2013). Hubbs Ciénega is small enough that a majority, if not all, of the habitat is visible from ground level. Fish surveys (Hargrave et al, 2013) indicates the habitat contains abundant, healthy populations of the Comanche Springs pupfish and Pecos gambusia.

Park and vicinity

The Texas Department of Agriculture (TDA) is responsible for registering all pesticides distributed in Texas. TDA's Endangered Species Pesticide Protection (ESPP) Program obtains local input about pesticide use and other management practices near endangered species' habitat. TDA works with farmers, ranchers, and others from agriculture, biology, conservation, and the chemical industry to develop recommendations about rates, timing and methods of application, or effective alternatives for pesticide use to minimize impacts on endangered species and be acceptable to agriculture. In cooperation with the TDA, the Rio Grande Fishes Recovery Team, the Service, and the U.S. Environmental Protection Agency, an informal protected area along the spring outflows was established for limiting the agricultural use of chemicals such as trifluralin and emamectin benzoate. The protected area (Figure 2) was designed to minimize impacts on the endangered fishes. The area includes: the

lined outflow canal from Phantom Lake Spring (now dry); the outflow earthen drain canal from Phantom Lake Spring, the main canal from Giffin Spring; the outflow earthen drain canal from San Solomon Spring; and the first earthen lateral canal that connects the drain canal from San Solomon to the main outflow canal from San Solomon. In total, the protected area includes about 6 kilometers (3.7 miles) of ditch.

No chemicals, biocides, or disinfectants of any kind that have potential to run off into its waters are permitted in the pool area. Any use of such, or any deviation thereof, must be coordinated with the Complex Manager, the resource staff, and the Service.

5.4 Monitoring and Reports

5.4.1 Monitoring

Monitoring of the aquatic systems in the Park includes:

1. Park personnel will check daily to ensure adequate water flow of 1 cfs through the refugium and to remove all litter, both organic and of human derivation.

2. Park personnel will check weekly to ensure adequate control of fish predators (i.e. largemouth bass) and to ascertain that fish populations in the refugium are at normal and healthy levels. Introduced fish will be removed using either nets or fishing equipment. Fish populations are assessed through visual inspection.

3. Park personnel will check monthly, during the warm months, to ensure that aquatic plant growth and emergent vegetation are at acceptable levels in the refugium. Park personnel will refer to the series of labeled photographs on file at park headquarters as an aid in determining acceptable vegetation levels.

4. The auxiliary pump will be tested bimonthly (every other month) to ensure that it is in good working order. It will be repaired or replaced if necessary.

5. Unscheduled visits will be made by appropriate specialists or cooperators to ascertain any and all of the above.

6. Any changes that could affect the refugium will be made gradually. It is generally doing quite well in its present condition regarding stream flow, substrate, and overhead cover.

7. Any change which could affect the refugium must first be cleared through the Resource Coordinator, who will then establish review process prior to the change being affected.

In addition to the seven listed monitoring activities included in the Balmorhea State Park HCP, TPWD has undertaken additional monitoring related to the species and the habitats that support them. These activities are summarized below as either biological or water resource monitoring.

Biological Monitoring

Since the original Balmorhea State Park HCP was submitted in 2008, TPWD has supported monitoring efforts funded by section 6 grants for the endangered fish species (Attachment 3) and the endangered invertebrate species (Attachment 4). More recently, as the state agency responsible for fish and wildlife resources and as the stewards of Balmorhea State Park, TPWD formed the Trans-Pecos Oil and Gas Workgroup composed of TPWD staff and other identified stakeholders and were intended to begin addressing environmental concerns related to a recently announced major oil and gas discovery in the Delaware Basin of West Texas.The purpose of the meetings was to increase stakeholders understanding of and discuss the Trans-Pecos oil and gas activity, known as the Alpine High Play, and the potential impacts to

area groundwater, springs, surface water, and biological communities, including the endangered species.

Following the meetings of the Trans-Pecos Oil and Gas Workgroup, it was apparent that more details were needed and that several of the recommendations, such as water quality and biological monitoring, were within the capabilities of TPWD staff, while others, such as hydrogeologic analysis and fieldwork, would require third parties. To better define the resources and commitment required to monitor water quantity, water quality and the biological community of San Solomon Springs, a biological monitoring workplan was developed and was used to initiate biological monitoring efforts at San Solomon Springs (Attachment 5). TPWD staff has recently completed 2 years (2016-2018) of quarterly biological monitoring as described in the San Solomon Springs Biomonitoring Workplan and is currently analyzing data and writing a manuscript summarizing the monitoring efforts and outlining recommendations for future monitoring.

Water Resource Monitoring

Water quality and quantity monitoring are an important component of any biomonitoring workplan. In an effort to provide more detail regarding water quality and quantity at San Solomon Springs, TPWD has financed the installation and maintenance of a USGS gaging station and the Texas Commission on Environmental Quality (TCEQ) has installed a Continuous Water Quality Monitoring Program (CWQMP) station to monitor select water quality parameters. The USGS streamflow gage is currently reporting stage or depth data as well as streamflow in real-time and the TCEQ station reports select parameters in near real-time, which constitutes a 15-minute delay.

The USGS gage 08427500 at San Solomon Springs can be viewed at:
https://waterdata.usgs.gov/tx/nwis/uv/?site_no=08427500&PARAmeter_cd=00065,00060

The TCEQ CWQMP station in Balmorhea Pool Discharge Canal (C808) can be viewed at:
https://www.tceq.texas.gov/cgi-bin/compliance/monops/water_site_photo.pl?cams=808

5.4.2 Performance and Success Criteria

Aquatic habitats within the park will be monitored continuously to assess biodiversity and to detect changes in status, abundance, distribution, and general conditions resulting from natural and human induced impacts. Three types of monitoring will be performed within the area: routine monitoring; periodic assessment monitoring; and special monitoring. Ongoing monitoring efforts will focus on endangered species and other species as identified and discussed below.

5.4.3 Reporting

TPWD will be responsible for an annual report documenting the amount of take and all actions taken under this HCP.

Section 6

Funding

6.1 Funding for Minimization and Mitigation Measures

Conservation planning requires sufficient funding be made available to implement the HCP. TPWD will provide such funds as may be necessary to carry out its obligations under the HCP, as needed. TPWD has committed to provide funding adequate to cover expected operation and management costs of the Park.

Section 7

Plan Implementation, Changed and Unforeseen Circumstances

7.1 Plan Implementation

This proposed HCP will be implemented when a section 10(a)(1)(B) incidental take permit is issued to the Applicant.

7.2 Changed/Unforeseen Circumstances

Section 10 regulations [50 CFR 17.22 (b)(2)(iii)] require that an HCP specify the procedures to be used for dealing with unforeseen circumstances that may arise during implementation of the HCP. In addition, the Habitat Conservation Plan Assurances ("No Surprises") Rule [50 CFR 17.21(b)(5)-(6) and 17.22(b)(5)-(6); 63 F.R. 8859] defines "unforeseen circumstances" and "changed circumstances" and describes the obligations of the Permittee and the Service.

The Service provides economic and regulatory assurances under the No Surprises policy (63 FR 8859, Section 1.7.1) to incidental take Permittees who incorporate provisions for changed or unforeseen circumstances in their HCP and fully and completely implement the terms and conditions of the HCP and incidental take permit. These assurances give Permittees certainty regarding the costs of mitigation and conservation of protected species. Changed circumstances means changes in circumstances affecting a species or geographic area covered by the HCP that can reasonably be anticipated by plan developers and the Service and that can be planned for (e.g., the listing of a new species, fire or other natural catastrophic events in areas prone to such events). The policy defines unforeseen circumstances as changes in circumstances that affect a species or geographic area covered by the HCP that could not reasonably be anticipated by plan developers and the Service at the time of the plan's negotiation and development and that result in a substantial and adverse change in the status of the covered species.

The management of the Park and the short duration of the permit (10 years) make the occurrence of any changed circumstances unlikely. Therefore, no changed circumstances are addressed. Unforeseen circumstances would be brought to the attention of the Service and the appropriate course of action would be negotiated within the guidelines of 50 CFR 17.21(b)(5)-(6) and 17.22(b)(5)-(6).

7.3 Other Measures as Required by Director

There are no other measures required by the Director for this HCP. An Implementing Agreement is not required for this HCP because it has been determined by the Service to meet the criteria of low-effect.

7.4 Revisions and Amendments

Revisions and amendments shall be processed in accordance with all applicable legal requirements, including, but not limited to the Act, NEPA, and any applicable Federal regulations.

7.4.1 Revisions (Changes to the HCP Not Requiring Amendment of the Plan or Incidental Take Permit

Revisions to this HCP are changes to the Plan provided for under the Operating Conservation Program, including Adaptive Management changes, and responses to changed circumstances. Revisions do not modify the scope or nature of activities or actions covered by the section 10(a)(1)(B) permit or result in operations under the HCP that are significantly different from those contemplated or analyzed in connection with the Plan as approved, adverse impacts on the environment that are new or significantly different from those analyzed in connection with the Plan as approved, or additional take not analyzed in connection with the HCP as approved.

Revisions to the HCP may include, but are not limited to:

(1) Correction of any maps or exhibits to correct errors in mapping or to reflect previously approved changes in the section 10(a)(1)(B) permit or HCP.

(2) Minor changes to monitoring or reporting protocols.

(3) Any other modifications to the HCP that are consistent with the biological goals and objectives of the HCP that the Service has analyzed and agreed to, and that will not result in operations under the HCP that are significantly different from those analyzed in connection with the HCP as approved.

(4) Adverse impacts on the environment that are new or significantly different from those analyzed in connection with the HCP as approved or take not analyzed in connection with the HCP as approved including but not limited to: the approval or execution of agreements to facilitate execution and implementation of the HCP; and action by the applicant to delegate any of its duties specified by the HCP to a third party under its direct control.

The adaptive management process TPWD will use to address revisions consists of internal communication and coordination within TPWD among Water Resources Branch, State Parks (Balmorhea and HQ), Inland Fisheries, and when appropriate, Executive Office to identify any revisions that may be required. For example, when the Alpine High Play was announced in 2016, TPWD staff formed a Trans Pecos Oil and Gas Workgroup consisting of staff from local, state, and federal agencies as well as non-profits, academia, and private consulting firms with relevant knowledge. A primary recommendation from the workgroup was to establish baseline biological data for the San Solomon Springs system. As a result, TPWD staff developed a biomonitoring program and completed a 2-year baseline biological assessment in 2019. A report summarizing the findings of this baseline assessment is currently being prepared and will be available in 2020.

7.4.2 Amendments to the HCP

Amendments to this HCP will require amendment of the section 10(a)(1)(B) permit. The following summarizes the types of changes which may require an amendment and the procedures for approval.

Major amendments may include any of the following types of changes to this HCP:

(1) Significant changes to this HCP which were not addressed, including, but not limited to the following:

a. Changes to the method for calculating compensation for Incidental Take, which would increase the levels of incidental take permitted under the HCP.

b. Changes to funding, except as otherwise provided for in the HCP, to count for all adjustments for inflation, adaptive management (including recovery plan), and changed circumstances.

(2) Changes to the covered activities which were not addressed in the HCP as originally adopted, and which otherwise do not meet the revision provisions above.

7.4.3 Amendments to the section 10(a)(1)(B) Permits

Following receipt of a complete application package for a proposed amendment to the section 10(a)(1)(B) permit, the Service shall publish a notice of the proposed amendment to the section 10 (a) permit in the Federal Register. The Service shall use its reasonable efforts to process the proposed amendment within one hundred eighty (180) calendar days of publication, except where longer periods are required by law. The amendment of a section 10(a) permit shall be treated as an original permit application. Such applications typically will require submittal of a revised HCP, a completed permit application form with appropriate fees, and preparation of an environmental review document prepared in accordance with NEPA. However, the Parties acknowledge that specific document requirements may vary based on the nature of the amendment.

7.4.4 Suspension/Revocation

The Service may suspend or revoke their respective permit if the Permittee fails to implement this HCP in accordance with the terms and conditions of the permit, if suspension or revocation is otherwise required by law. Suspension or revocation of the section 10(a)(1)(B) permit by the Service, in whole or in part, shall be in accordance with 50 CFR 13.27-29, 17.32 (b)(8).

7.4.5 Permit Renewal

Prior to expiration, the section 10(a)(1)(B) permit may be renewed without the submission of a new HCP, provided that the permit is renewable, and that biological circumstances and other pertinent factors affecting the covered species are not significantly different than those described in the original HCP. To renew the permit, the Applicant shall submit to the Service, in writing:

- a request to renew the permit;
- reference to the original permit number;
- certification that all statements and information provided in the original HCP and permit application, together with any approved HCP amendments, are still true and correct, and inclusion of a list of changes;
- a description of any take that has occurred under the existing permit; and
- a description of any portions of the project still to be completed, if applicable, or what activities under the original permit the renewal is intended to cover.

If the Service concurs with the information provided in the request, it shall renew the permit consistent with permit renewal procedures required by Federal regulation (50 CFR 13.22).

Section 8

Citations

9.1 Literature

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