Final

Williamson County Regional Habitat Conservation Plan

Prepared for:

Williamson County Conservation Foundation

The Honorable Lisa Birkman,
President and Commissioner, Precinct 1

Prepared by:

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Texas Perspectives, Inc.

August 15, 2008

SWCA Project Number 10622-139-AUS

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WILLIAMSON COUNTY
REGIONAL HABITAT CONSERVATION PLAN

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EXECUTIVE SUMMARY

INTRODUCTION

Williamson County, Texas, contains habitat occupied by three karst invertebrates and two bird species that the U.S. Fish and Wildlife Service (Service) has listed as endangered under the Endangered Species Act of 1973, as amended. The County also contains habitat for other rare species, including at least four species of salamanders and 19 species of karst invertebrates that may be in need of conservation efforts to preclude the need for listing in the future. The presence of endangered species habitat has significantly affected both public and private development activities within Williamson County. As the County continues to grow, conflicts with the requirements of the Endangered Species Act will likely increase, and important open space and habitat may be lost. Williamson County has determined that it is in the best interests of the County's natural resources and long-term economic growth to prepare a regional habitat conservation plan (RHCP) that will support an incidental take permit (the Permit) allowing limited impacts to four of the listed species, provided certain conservation and management actions are implemented.

The RHCP will facilitate a regional-scale approach to Endangered Species Act permitting that leads to conservation of less fragmented tracts of habitat that are better for the species and a participatory process that requires less time and money for applicants compared to processing individual permits through the Service. The RHCP is needed to ensure that public and private development goes forward in an orderly, efficient manner consistent with the protection of rare species. Without an RHCP, it is likely that rare species in the County would be negatively impacted by future development projects and the prospects for recovery would be diminished. The urgency for addressing habitat and species protection in an organized and predictable manner is underscored by the high rate of growth projected for Williamson County. In the next 30 years, population in the County is expected to grow from under 400,000 to over 1.5 million, an increase of over 300 percent. An estimated 69 percent of this growth will occur in the Karst Zone,[1] where most of the endangered and rare species and their habitat are found.

The permit area for this RHCP is Williamson County in central Texas, and the County will hold the proposed Permit. The administrative entity that will manage the Permit will be the Williamson County Conservation Foundation (Foundation). While the entire County will be covered by the Permit, potential habitat for the listed and other rare/endemic species in the County occurs primarily on the Edwards Plateau, particularly the Karst Zone, west of Interstate Highway 35 (Figure ES-1). Thus, all anticipated incidental take and most of the specified mitigation will also occur in that portion of the County.

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[1] Veni and Associates (1992) defined four karst zones in Williamson County based on lithology, geologic controls on cave development, and distributions of known caves and cave fauna. In 1992, Zones 3 and 4 were judged to have little or no potential to provide habitat for troglobitic invertebrates, and that remains the case today. Zone 1 was known to contain listed invertebrates, and Zone 2 was thought to have a high potential to do so. Since 1992, listed karst invertebrates have been collected from both Zones 1 and 2; therefore, theses two zones have been combined in this RHCP and are collectively referred to as the "Karst Zone."

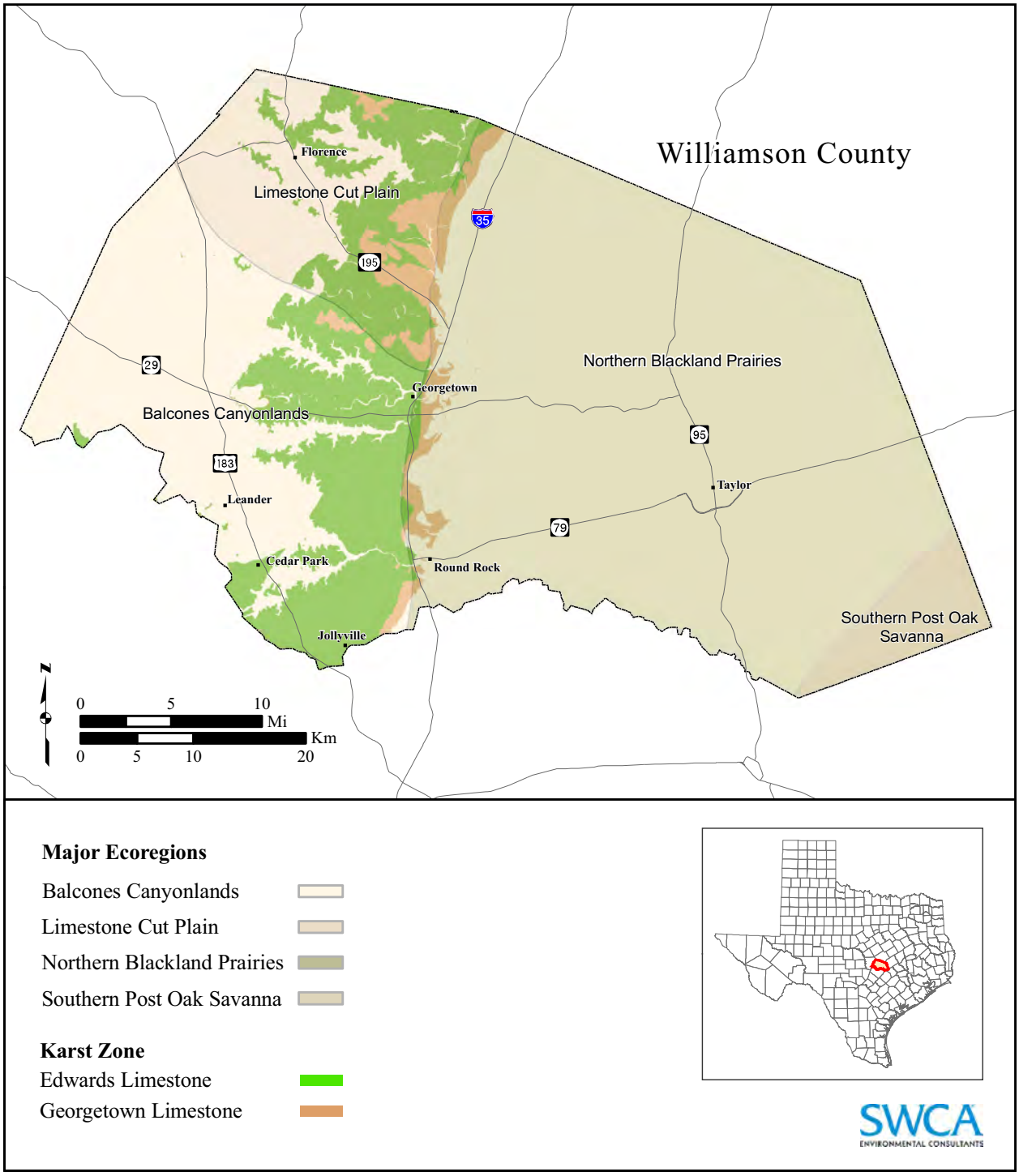

Figure ES-1. The Williamson County permit area including the major ecoregions and Karst Zone, the primary focus of the RHCP.

Two categories of species are addressed in this RHCP: covered species and additional species. "Covered species" are the federally listed species to be included on and covered by the Permit. The covered species in the Williamson County RHCP include two federally listed karst invertebrates: the Bone Cave harvestman (*Texella reyesi*) and Coffin Cave mold beetle (*Batrisodes texanus*). Two federally listed bird species are covered as well: the golden-cheeked warbler (*Dendroica chrysoparia*) and black-capped vireo (*Vireo atricapilla*). Twenty-four "additional species" addressed in the RHCP, including the Tooth Cave ground beetle (*Rhadine persephone*), which is currently listed as endangered, are not covered by the Permit.[2] As the RHCP is being implemented, the Foundation will evaluate on an ongoing basis the degree to which the plan is providing conservation benefits to these additional species and what supplementary measures, if any, the Foundation could implement through the RHCP to contribute to their conservation. If the County determines that coverage of any additional species would benefit both the landowners of Williamson County and the species in question, the County may apply for any appropriate amendments to the RHCP and the Permit.

In addition to providing the affected landowners of Williamson County with an improved process for complying with the Endangered Species Act, the primary purposes of this RHCP are to 1) contribute to and facilitate the recovery of the federally listed endangered Bone Cave harvestman, Coffin Cave mold beetle, golden-cheeked warbler, and black-capped vireo (the covered species); and 2) assist the Service in precluding the need to list the 19 rare, currently *non-listed* karst species and four rare salamander species (all additional species). The conservation actions, as detailed in the RHCP, will facilitate compliance with the Endangered Species Act by implementing a comprehensive, coordinated strategy for future species conservation throughout the County.

The incidental take of covered species associated with the following otherwise lawful activities would be authorized under and in accordance with this RHCP: road construction, maintenance, and improvement projects; utility installation and maintenance, including but not limited to power and cable lines; water, sewer, and natural gas pipelines; construction of plants and other facilities; school development or improvement projects; public or private construction and development; and land clearing. The activities authorized under this RHCP are expected to impact the covered species in the County. Direct impacts to covered species may occur if development and construction results in the disturbance, alteration, or removal of occupied and potentially occupied habitat. Species may also be indirectly impacted by negative changes in habitat quality, which may occur due to removal of existing vegetation, alteration of drainage patterns, increased habitat fragmentation, increased populations of predatory or competitive species, and other indirect effects of proximity to development activities.

ANTICIPATED IMPACTS (TAKE) AND MITIGATION

An objective of the RHCP is to promote the conservation of endangered and rare species in Williamson County by helping plan participants avoid and minimize impacts to suitable habitat for these species. The plan also is designed to help participants minimize disturbance during the

[2] This RHCP does not anticipate the need for permitting take of the Tooth Cave ground beetle because in Williamson County it is restricted to the Cedar Park area, which has little open space left for new development that would potentially affect the species.

nesting season for the endangered golden-cheeked warbler and black-capped vireo. These measures will benefit the species addressed in this RHCP, but incidental take of the covered species will occur nonetheless. A summary of RHCP anticipated take and mitigation/ conservation measures for the covered and additional species is presented in Table ES-1. Allowable take is considered in the context of the entire life of the plan rather than in any plan year. Annual take is likely to vary from year to year; however, an amendment to the incidental take permit will be required only if the 30-year estimate for take is expected to be exceeded.

The RHCP anticipates allowing take for the Bone Cave harvestman prior to full implementation of the mitigation described in Table ES-1; that is, prior to the final acceptance and approval of three karst fauna areas (KFAs)[3] in each of three karst fauna regions (KFRs)[4] (North Williamson County, Georgetown, and McNeil/Round Rock KFRs). Such take will be allowed because this species occurs in at least three known locations in each KFR that have a high probability of qualifying for designation as KFAs. Under this RHCP, no take, except with respect to the Karst Zone,[5] will be authorized for Coffin Cave mold beetle in a specific KFR unless a minimum of three Service-recognized KFAs in that KFR have been identified for that species and remain available for conservation, or, subject to Service approval, authorizing take would not preclude the Foundation from achieving RHCP goals. Take for the golden-cheeked warbler will be authorized as soon as the Foundation has acquired sufficient mitigation credits to cover the take (generally at a 1:1 mitigation ratio[6]). Take for the black-capped vireo will be authorized as soon as the Permit is issued and the appropriate fee is paid by a participant (mitigation for the vireo will be provided on a rolling basis as explained later in this executive summary).

Anticipated Impacts, Participation Fees, and Mitigation for Karst Species. In this RHCP, estimates of relative impact to listed species-occupied karst habitat are based on the limited, but best available scientific information on development-related and quantifiable changes in moisture and nutrient supply to the cave systems. For calculating levels of take, this RHCP provides estimates of 1) the number of acres of potential habitat within the Karst Zone of Williamson County that may be altered or removed and 2) the number of occupied caves and associated surface habitat that may be impacted with implementation of the covered actions (see Table ES-1).

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[3] According to the Recovery Plan for the endangered karst invertebrates of Travis and Williamson Counties a KFA is an area known to support one or more locations of a listed species and is separated from other KFAs by geologic and hydrologic features that create barriers to the movement of water, contaminants, and troglobitic fauna.

[4] Karst fauna regions are large geographic areas delineated based on features related to regional geology and hydrology as well as the distribution of dozens of troglobitic species. Four KFRs are recognized within Williamson County: McNeil/Round Rock KFR, Cedar Park KFR, Georgetown KFR, and North Williamson County KFR.

[5] Incidental take in the Karst Zone refers to potential impacts to karst species habitat in previously undetected voids, and potential impacts to karst species habitat resulting from surface disturbance more than 345 feet from an occupied cave.

[6] The ratio of 1:1 represents what is believed to be an appropriate mitigation ratio that will apply to the overriding majority of participant transactions. In most cases, the habitat impacted will be of lower quality (more fragmented with a lower probability of warbler occupancy) than the conservation bank habitat acquired for mitigation. It is recognized, however, that in rare instances impacted habitat will be of a higher quality than the Williamson County norm, and in these cases a higher mitigation ratio may be justified. The RHCP reserves the right, based on quantification of habitat values, to either deny participation of a land development project, or increase the mitigation ratio from 1:1 to 1.5:1 or up to 2:1.

Table ES-1. Summary of the Williamson County RHCP anticipated take and mitigation for the covered species and conservation measures for the Georgetown salamander and other additional species.

Species	How Level of take Determined	Estimated Covered Take Over Life of RHCP[1]	Participation Fee Structure	Mitigation or Conservation Measures
Bone Cave Harvestman and Coffin Cave Mold Beetle	Impacts to species-occupied caves based on effects to cave moisture regime (surface recharge area) and nutrient input (primarily cave cricket foraging area) measured in distance from cave. Number of species-occupied caves in two zones: Impact Zone A (50–345 ft from cave footprint). Impact Zone B (within 50 ft of cave footprint).	210 species-occupied caves, including: Impact Zone A: 150 caves. Impact Zone B: 60 caves (including one previously undetected species-occupied void per year discovered and destroyed during construction).	Karst Zone (includes impacts to previously undetected species-occupied voids and other direct and indirect incidental take outside of Impact Zones A and B, below): $100/acre Species-occupied caves: Disturbance in Impact Zone A: $10,000/acre Disturbance in Impact Zone B (does not include impacts to previously undetected species-occupied voids): $400,000 flat fee.	By Year 10 acquire and manage 9 to 15, 40- to 90-acre KFAs totaling approximately 700 acres (a minimum of three KFAs in each of the three KFRs occupied by the covered karst species). To qualify as Service-approved, long-term, viable KFAs, the KFAs may be newly established or may be existing karst conservation areas enlarged and/or put under permanent management. To enhance RHCP efforts towards recovery of listed invertebrates preserve up to six additional KFAs acquired with Endangered Species Act section 6 funds or other sources. Assume management/ monitoring of 10 of the 22 existing karst conservation areas.
Golden-cheeked Warbler	Acres of impact to known and potential habitat patches verified with habitat assessments or breeding bird surveys.	Direct and Indirect Impacts: 6,000 acres.	$7,000/acre for impacted habitat beginning in Year 2, increasing by $500/year for 10 years.	Purchase 500 Hickory Pass Ranch mitigation credits each in Years 1 and 4 (1,000 total) and establish a preserve(s)/ conservation bank(s) in the County.[2] Possibly purchase additional mitigation credits outside the County.
Black-capped Vireo	Same as for golden-cheeked warbler	Direct Impacts: 4,267 acres.	$5,000/acre for impacted potential or occupied habitat, with fees increases evaluated on an annual basis.	As accumulated participation fees allow, restore and/or enhance protected vireo habitat on a rolling basis.
Georgetown Salamander	N.A.	N.A.	N.A.	Conduct research and monitoring in Years 2–6, develop a conservation strategy for the species in Year 2, and explore feasibility of a Candidate Conservation Agreement with Assurances.
Additional Species	N.A.	N.A.	N.A.	Mitigation measures for covered species likely to benefit some or all additional species. Fund and manage research and public awareness programs. Periodically evaluate effect of beneficial actions and potential need to convert additional species to covered species.

[1] The estimate of covered take is based on a projected 20% level of participation in the plan, a level that may be exceeded over the life of the RHCP. This reasonable estimate is not intended to establish a maximum amount of authorized take; rather, because the mitigation and conservation measures of the RHCP for the covered karst species amount to satisfaction of recovery criteria, all covered take within the karst will be fully mitigated.

[2] Williamson County has already purchased the first 500 acres of Hickory Pass Ranch Conservation Bank mitigation credits, as well as 115.52 acres of in-county warbler mitigation credits at the Whitney Tract near Lake Georgetown.

Approximately 15.5 percent (112,000 acres; 45,325 hectares) of the County is underlain by geology that is likely to contain caves with endangered karst invertebrates. At the present time, approximately 28.6 percent, or 32,000 acres (12,950 hectares), of the Karst Zone have already been developed or somewhat disturbed. This leaves approximately 80,000 acres (32,375 hectares) of currently undeveloped karst habitat in the County. At least 590 caves have been identified in Williamson County, with over 160 caves known to contain covered or additional species. The RHCP estimates that participation levels under this incidental take permit will range from 10 to 20 percent (i.e., it is anticipated that 10–20 percent of future development on the remaining 80,000 acres of undeveloped karst habitat in the County will be authorized under this RHCP).

To avoid overestimating income from participation, the RHCP assumes 10 percent participation for income estimates. Caves both with and without surface expressions and with and without listed species will be encountered and impacted. To compensate for impacts to these previously undetected voids, the participation fee for any development in the Karst Zone as depicted in Figure ES-1 will be $100/acre.[7]

Over the 30-year life of the RHCP it is estimated that 150 species-occupied caves will be directly and/or indirectly impacted within an area between 50 feet (15 meters) and 345 feet (105 meters) from the cave footprint (Impact Zone A). The participation fee for such impacts to a known species-occupied cave will be $10,000/acre. Based on historical development patterns and related cave discoveries, it is also anticipated that a total of 60 species-occupied caves will be directly and/or indirectly impacted by plan participants within an area 50 feet of the cave footprint (Impact Zone B). This estimate includes previously undetected voids damaged during construction activities. The participation fee for such impacts to a *known* species-occupied cave will be $400,000/cave. Impacts to previously undetected voids occupied by covered karst species are covered by the Karst Zone fee, as are any impacts to a known cave's ecosystem resulting from surface disturbance more than 345 feet from the cave's footprint.

Full mitigation for anticipated impacts to karst species is expected to be realized in the fulfillment of the biological goals of the RHCP, which are focused on ensuring Recovery Plan goals for the karst covered species in Williamson County are reached as quickly as possible by the following actions: 1) contributing to and/or facilitating the establishment and perpetual adaptive management/monitoring of 9 to 15 Service-approved KFAs on 700 acres (202 hectares) of newly acquired (by deed or conservation easement) land; 2) implementing perpetual adaptive management/monitoring plans[8] for 10 karst conservation areas that are already established, but not provided with guaranteed long-term funding; 3) implementing and providing funding for a 30-year research and public awareness program on Williamson County endangered and rare species; and 4) while not required as mitigation, establishing an additional six KFAs as a non-mandatory RHCP recovery enhancement activity with Endangered Species Act section 6 and other sources of external funding.

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[7] All participation fees identified in the RHCP are subject to reassessment and adjustments over the life of plan. For planning purposes, all fees related to impacts to karst habitat are estimated to increase by 10 percent every five years.

[8] The Foundation would prepare and implement the adaptive management/monitoring plans following Service guidance procedures.

Anticipated Impacts, Participation Fees, and Mitigation for Bird Species. This RHCP evaluates acres of potential habitat removed as an indicator of take levels for the two endangered covered bird species.[9] An estimated 34,465 acres (13,947 hectares) of woodland habitat that could potentially support golden-cheeked warbler and 4,267 acres (1,726 hectares) of potential scrubland habitat that could potentially support the black-capped vireo have been mapped within Williamson County.

Take of occupied or potential golden-cheeked warbler habitat is estimated to be 6,000 acres (2,428 hectares) over the 30-year plan period. Mitigation for anticipated impacts to the golden-cheeked warbler is expected to be realized in the fulfillment of the biological goals of the RHCP, which include using up to 1,000 acres (405 hectares) of Hickory Pass Ranch Conservation Bank credits in adjacent Burnet County for 1,000 acres of occupied or potentially occupied woodland within Williamson County. The County has also initiated a program of purchasing high quality habitat within the County for golden-cheeked preserves that will be a source of additional mitigation credits for the RHCP.[10] The participation fee for golden-cheeked warbler will start at $7,000/acre for mitigation credits. Take for occupied or potential vireo habitat is estimated not to exceed 4,267 acres over the life of the plan. Mitigation for this take will start at $5,000/acre of impact, and the accumulated fees will be expended on the restoration, enhancement, or management of vireo habitat on protected lands within or outside the County. Both the warbler and the vireo will also benefit from the implementation and funding of a 30-year prioritized research effort and public awareness program on the County's endangered and rare species.

Anticipated Impacts and Mitigation for Additional Species. Actions authorized under this RHCP may impact additional species, including the Georgetown salamander, a candidate for listing. The three other salamander species included as additional species are either very rare within the permit area or occur in drainages that may be marginally affected by RHCP covered actions. The 20 species of karst invertebrates (19 non-listed, 1 listed) included as additional species could be affected by the covered actions as well as benefit from RHCP karst mitigation.

The Georgetown salamander may be impacted by covered actions through the potential degradation of water quality and quantity in springs and streams in the watersheds where the species occurs. However, sufficient data on the relationship between development and spring water quality/quantity are not available to quantitatively predict levels of impact of the RHCP covered actions on this salamander. The RHCP does not anticipate any *direct* mortality of Georgetown salamanders or measurable impacts to their habitat at the present time; however, it is possible that the covered actions will cause some unquantifiable amount of *indirect* impact to salamander habitat. Primarily as a means of gathering sufficient scientific information on the Georgetown salamander to determine the species status and conservation strategy and actions

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[9] Impacts to golden-cheeked warbler habitat include both direct and indirect impacts; indirect impacts are measured from the edge of development or disturbance to 250 feet (76.2 meters) into adjacent potential or occupied habitat. All impacts to black-capped vireo habitat will be direct. Activities covered under the RHCP are not expected to result in indirect impacts to vireo habitat because the vireo is considered an edge species and occupies early successional habitat. Mitigation will only be required for direct impacts to vireo habitat.

[10] The County recently purchased 115.52 acres of golden-cheeked warbler habitat (in the Whitney Tract) adjacent to U.S. Army Corps of Engineers protected land at Lake Georgetown to use as in-county mitigation for future impacts to warbler habitat resulting from activities covered by the RHCP.

needed to preclude listing, the RHCP includes implementing and funding a five-year species-specific research and monitoring effort. Additional mitigation measures include preparing a conservation strategy for the species within two years of plan implementation, and investigating the feasibility of developing a Candidate Conservation Agreement with Assurances. It is also noted that the Service has expressed the opinion that voluntary compliance with Texas Commission on Environmental Quality's (TCEQ's) optional water quality measures[11] is sufficient to avoid take of the Georgetown salamander.

PARTICIPATION PROCESS

Any party within Williamson County desiring to undertake activities covered by this RHCP within an area that contains potential habitat for the covered endangered karst invertebrates, golden-cheeked warblers, or black-capped vireos may be eligible for participation. The County will, however, reserve the right to decline to allow a participation in the plan where that participation would not be consistent with the biological goals and objectives of the plan or might cause there to be insufficient mitigation available for anticipated County infrastructure needs.

For the karst invertebrates, the RHCP and proposed Permit will authorize incidental take by plan participants for any covered project occurring within the following three karst fauna regions: North Williamson County KFR, Georgetown KFR, and McNeil/Round Rock KFR for the Bone Cave harvestman, and North Williamson County KFR and Georgetown KFR for the Coffin Cave mold beetle. No incidental take coverage will be authorized for karst invertebrates through this RHCP within the Cedar Park KFR. During the Foundation's review of a participant's conceptual development plan, Service-permitted biologists and/or geologists employed or contracted by the Foundation will conduct habitat assessments and presence/absence surveys for the four covered species as needed, and the Foundation will determine the appropriate participation fees based on a published fee schedule (see preceding section for proposed starting participation fees). Costs for the Foundation review will be born by the participant.

Participant land contributions that will contribute to RHCP objectives for acquisition of karst and or bird preserves can be accepted in lieu of participation (mitigation) fees. All such transactions will be negotiated on a case-by-case basis and will be supported by appraisals and other appropriate analyses acceptable to the County.

RHCP COSTS AND FUNDING MECHANISMS[12]

The anticipated costs and income for the 30-year period of the RHCP are presented in Table ES-2. According to the financial plan developed for the RHCP, the plan will operate with

[11] Optional measures adopted by the TCEQ in connection with its Edwards Aquifer water quality program (TCEQ 2005).

[12] All financial projections provided in this document or authorized under the plan are merely estimates intended to demonstrate that the plan is financially feasible. The funding plan is not substantially prescriptive of the timing, size, or nature of actions that may be taken or authorized under the plan. While specific elements of the overall financing plan may change over the 30-year plan period, the permitted take and the mitigation to accommodate that take will not change. Every year during the 30-year life of the RHCP the County will re-evaluate the financial plan to ensure adequate funding and appropriate disposition of excess revenues to meet plan goals.

positive annual cash flow beginning in Year 1. In Year 30, a foundation endowment will be funded with a contribution of $20,025,000 from RHCP-generated funds, resulting in a total endowment at Year 30 of $20,400,000. The financial plan projects a surplus of approximately $20,644,270 by Year 30.

Funding for this RHCP will be generated from five primary sources: 1) participation (mitigation) fees collected from participants; 2) return on endowment investments; 3) County land acquisition funds for parks and open space, provided a public access plan is in place; 4) County advance funding from road improvement mitigation funds;[13] and 5) a Tax Benefit Financing (TBF) program. RHCP initiation costs are expected to be covered with County land acquisition and road improvement mitigation funds in the early years of the plan before participation fees and the TBF program provide sufficient revenues to cover expenses.

The RHCP proposes to accrue funds through a TBF program covering parcels participating in the plan. Under the TBF mechanism, a small portion of the tax on the value of improvements made after plan participation is directed back into the plan. Revenues from the TBF fund are then used to pay for RHCP costs.

Assuming a 15 percent tax revenue diversion to the RHCP, in Year 1, $50,764 will be available from the TBF program, and at Years 10 and 20 this amount will be $764,729 and $2,277,761, respectively. The cumulative 30-year benefit to the RHCP under the TBF program will be $56,990,033.

Table ES-2. RHCP annual income and expenses for Years 1, 10, 20, and 30, and cumulative costs and income over 30-year life of the plan.[1]

	Costs[2]	**Income**
Annual Year 1	$6,639,250	$6,946,864
Annual Year 10	$2,736,378	$2,782,938
Annual Year 20	$2,120,587	$3,172,781
Annual Year 30	$21,067,420[3]	$6,547,936
30-Year Cumulative	**$80,832,669**	**$101,476,939**

[1] All projections for costs and income are estimates and serve to demonstrate the financial feasibility of the plan.
[2] Costs include administrative expenses, land acquisition and management for preserves, and research and public awareness programs.
[3] Year 30 costs include a final contribution of $20,025,000 to the endowment to ensure Foundation operation and preserve management in perpetuity after the 30-year plan period.

[13] These funds would be provided through an interest-earning, advance funding agreement between the County and the Foundation.

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CHAPTER 1 — BACKGROUND, PURPOSE, AND NEED

1.1 BACKGROUND

1.1.1 Introduction

Williamson County, Texas, contains habitat occupied by three karst invertebrate and two bird species that the U.S. Fish and Wildlife Service (Service) has listed as endangered under the Endangered Species Act of 1973, as amended.[14] The County also contains habitat for other rare species, including at least four species of salamanders and several karst invertebrate species that may require conservation efforts to preclude the need for listing in the future.

Section 9 of the Endangered Species Act prohibits "take" of any federally listed endangered wildlife species (16 USC § 1538(a)). Take, as defined by the Endangered Species Act, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC § 1532(19)). "Harm" is defined in the Service's regulations as "an act which actually kills or injures wildlife and may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding or sheltering" (50 CFR § 17.3 (2005)). If it is not possible to design an otherwise lawful land use activity so as to avoid take of a listed species, either directly or through habitat modification, section 10(a)(1)(B) of the Endangered Species Act (16 USC §1539(a)(1)(B)), authorizes the Service to issue a permit allowing take of species providing that the taking is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." Section 10a(2)(A) lays out certain conditions that an applicant must satisfy in order to be issued a permit. These conditions include the preparation of a conservation plan that identifies the impacts that will likely result from the permitted taking, "what steps the applicant will take to minimize and mitigate such impacts" and "the funding that will be available to implement such steps."

Since the late 1980s, a substantial number of private and public projects have been carried out in Williamson County that have had an impact on endangered species. To compensate for these impacts, the agencies and entities responsible for the projects have implemented a variety of individual conservation initiatives. Individual project consultations or habitat conservation plans (HCPs) in Williamson County that have been completed, or are under preparation, include Lake Georgetown, Ronald W. Reagan Boulevard and State Highway 195, O'Connor Road, Silver Oak Property, Brushy Creek Municipal Utility District, Parmer Lane Extension, Shadow Canyon, Lakeline Mall, Buttercup Creek, U.S. 183-A, State Highway 45, Leander Independent School District, Russell Park Estates, Sultan and Kahn, and Sun City Georgetown.[15]

To avoid a continuation of the piecemeal approach to endangered species conservation strategies, Williamson County is committed to applying the lessons learned from permitting and mitigating

[14] A glossary of terms used in this document (e.g., "karst" and "Endangered Species Act") is provided in Chapter 12.

[15] Examples of HCPs and Biological Opinions from Williamson County can be found on-line at http://www.fws.gov/southwest/es/Library.

individual projects to a regional-scale conservation plan that will contribute to the recovery of the listed endangered species and likely benefit the additional species. This regional habitat conservation plan (RHCP) is being prepared in support of an application for a section 10(a)(1)(B) incidental take permit (the Permit). Covering a 30-year period from 2008 to 2038, the RHCP will achieve a significant level of conservation for the County's rare and protected species while streamlining approvals for public and private projects.

The permit area for this RHCP is Williamson County in central Texas (Figure 1-1). While the entire county will be covered by the requested Permit, [16] potential habitat for the listed and other rare/endemic species in the County occurs primarily west of Interstate Highway 35 on the Edwards Plateau, in the Limestone Cut Plain and Balcones Canyonlands Level IV ecoregions[17] and within the Edwards and Georgetown Limestone formations that make up the Karst Zone.[18] Because potential habitat and known locations of the species of interest occur in those areas, the anticipated incidental take and specified mitigation for the karst invertebrate species will also occur in that portion of the County.

Two categories of species are addressed in this RHCP: covered species and additional species. "Covered species" are those covered by the requested Permit. The covered species in the Williamson County RHCP include two karst invertebrates, Bone Cave harvestman (*Texella reyesi*) and Coffin Cave mold beetle (*Batrisodes texanus*), and two listed bird species, the golden-cheeked warbler (*Dendroica chrysoparia*) and black-capped vireo (*Vireo atricapilla*).

The "additional species" are not covered by the requested Permit. Only one of the 24 additional species addressed in this RHCP is listed under the Endangered Species Act, but the remaining 23 species are rare and/or endemic, and without adequate conservation measures they may be listed in the future. Should any of these 23 species become federally listed, they would only be covered by the requested Permit if the County applies for and the Service grants an amendment to the Permit. The single listed species, Tooth Cave ground beetle (*Rhadine persephone*), is an endangered species that, in Williamson County, is restricted to the Cedar Park area, which has little open space left for development. This RHCP does not anticipate the need for allowing take of this ground beetle. Since this Permit would not authorize take of the Tooth Cave ground beetle, any actions that would impact this species would need to be authorized separately by the Service.

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[16] The permit area includes portions of the County that currently are not known to contain federally listed species or their habitat. This was done to facilitate any needed amendments to the RHCP and the requested Permit should such species or their habitat occur in those areas in the future.

[17] Level IV ecoregions are subdivisions of larger Level III ecoregions. Williamson County falls within the Balcones Canyonlands subdivision of the Edwards Plateau Level III ecoregion, and within the Limestone Cut Plain subdivision of the Cross Timbers Level III ecoregion.

[18] Veni and Associates (1992) defined four karst zones in Williamson County based on lithology, geologic controls on cave development, and distributions of known caves and cave fauna. In 1992, Zones 3 and 4 were judged to have little or no potential to provide habitat for troglobitic invertebrates, and that remains the case today. Zone 1 was known to contain listed invertebrates, and Zone 2 was thought to have a high potential to do so. Since 1992, listed karst invertebrates have been collected from both Zones 1 and 2; therefore, theses two zones have been combined in this RHCP and are collectively referred to as the "Karst Zone."

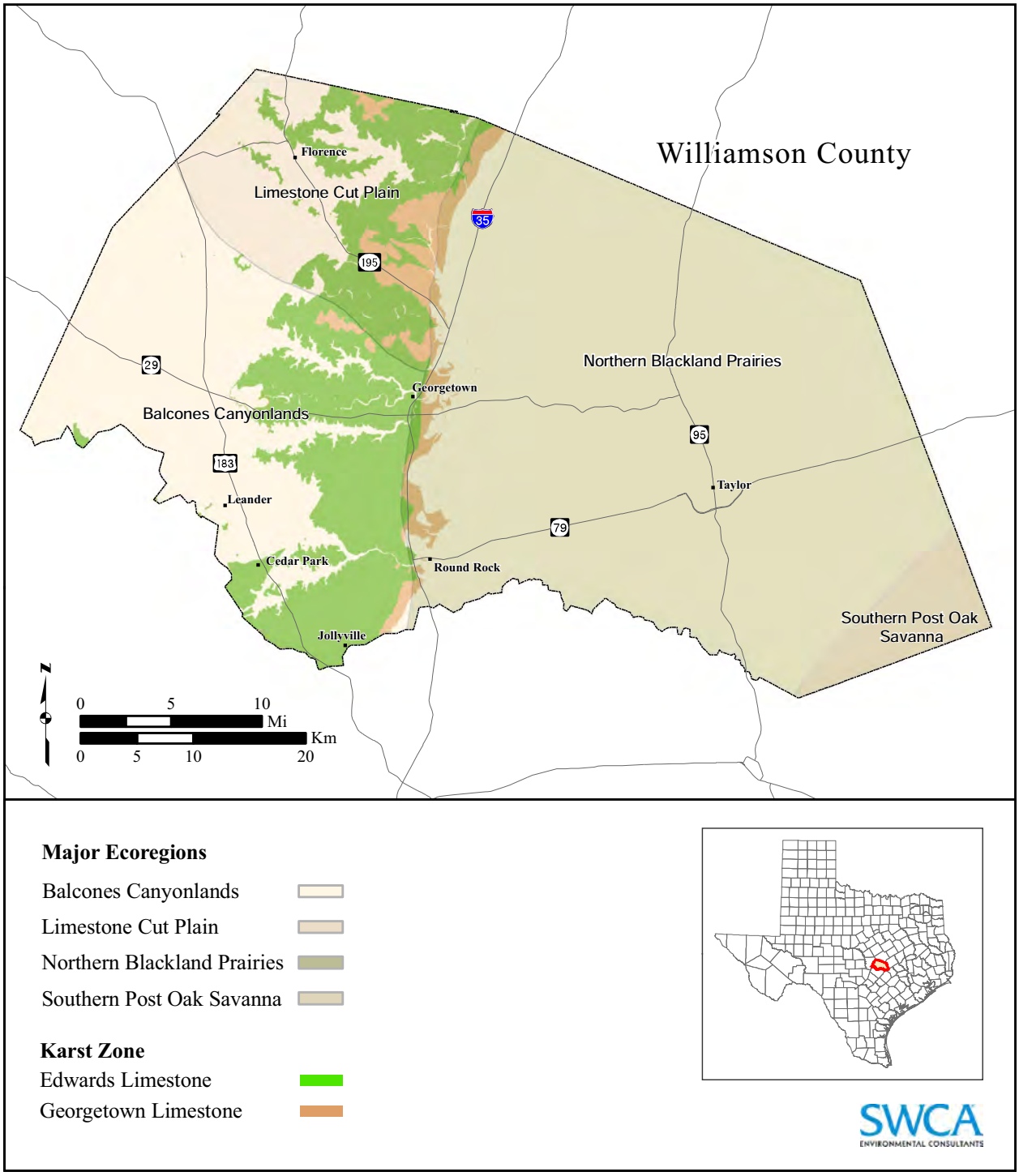

Figure 1-1. The Williamson County permit area including the major ecoregions and Karst Zone, the primary focus of the RHCP.

The additional species addressed in this document include the following 20 karst invertebrates (19 non-listed and 1 listed):

Aphrastochthonius n.sp.1[19]	*Cicurina* n.sp.	*Rhadine persephone* (listed endangered)
Aphrastochthonius n.sp.2	*Cicurina travisae*	*Rhadine russelli*
Arrhopalites texensis	*Cicurina vibora*	*Rhadine subterranea mitchelli*
Batrisodes cryptotexanus	*Neoleptoneta anopica*	*Rhadine subterranea subterranea*
Batrisodes reyesi	*Oncopodura fenestra*	*Speodesmus bicornourus*
Cicurina browni	*Rhadine* n.sp.	*Tartarocreagris infernalis*
Cicurina buwata	*Rhadine noctivaga*	

The additional species addressed in this document also include four rare salamanders, including the Georgetown salamander (*Eurycea naufragia*), Salado Springs salamander (*E. chisholmensis*), and Jollyville Plateau salamander (*E. tonkawae*), all of which are candidate species. The fourth salamander species is the Buttercup Creek salamander (*E.* n.sp.), which has yet to be given a scientific name and is restricted to the Buttercup Creek drainage in Williamson County.

1.1.2 Species Conservation Efforts Conducted by Williamson County

Williamson County has a long history of initiating conservation efforts for listed and rare species. In the late 1980s, the County worked with neighboring Travis County, the Nature Conservancy, the City of Austin, and others on the planning for an RHCP that eventually was approved as the Balcones Canyonlands Conservation Plan (RECON and U.S. Fish and Wildlife Service [USFWS] 1996).

By November 2000, when voters approved major road and parks bond initiatives, Williamson County administrators recognized the need to consider species conservation in the County at a regional scale. The County hired a consultant team to work with the Service and other conservation partners to outline a regional approach to species permitting and conservation, with a special emphasis on the listed cave invertebrates. Thus, on June 20, 2001, the County entered into a letter agreement with the Service outlining actions necessary to move towards a regional approach. The parties agreed to cooperate in identifying key areas of habitat, as well as identifying the recovery status and needs of key species. The letter agreement also contemplated evaluation of the impacts of specific road projects on species and opportunities for avoidance, minimization, and mitigation of such impacts. The parties agreed to cooperate in acquisition of key species habitat and to explore using conservation bank agreements as a mechanism for mitigation.

In 2002, Williamson County purchased "conservation credits" from the Hickory Pass Ranch Conservation Bank in Burnet County in order to minimize and mitigate potential impacts to the golden-cheeked warbler that were anticipated in connection with the partial extension of Ronald W. Reagan Boulevard (formerly known as Parmer Lane). The 3,000-acre (1,215-hectare) Hickory Pass Ranch provides a large, contiguous block of undisturbed golden-cheeked warbler

[19] The designation "n.sp." indicates a "new species" within a genus that has not yet been assigned species name by acknowledged experts. The designations "n.sp.1" and "n.sp.2" refer to two different new species in the genus *Aphrastochthonius*.

habitat that is considered to be important to the recovery of the species. Through an innovative partnership, the Service and the owners of the ranch created the Hickory Pass Ranch Conservation Bank, the goal of which is to ensure the long-term preservation of the ranch for the benefit of the warbler. Under the bank agreement, the ranch owners can sell conservation credits to entities that are required to offset the potential impacts to the warbler that their activities elsewhere may have caused. As the credits are sold, more of the ranch is secured from future development (the entire ranch will be preserved when all the credits are sold).[20]

In December 2002, the County formed the Williamson County Conservation Foundation, Inc. (Foundation) and entered into a Memorandum of Understanding with the Service to establish a more detailed mechanism for conservation and eventual recovery of endangered cave-dwelling invertebrates in Williamson County. The Memorandum of Understanding contemplated that the Foundation would take certain "conservation actions," including acquiring and managing preserve areas associated with endangered cave species. The conservation actions resulting from the Memorandum of Understanding to date are associated with impacts that occurred prior to the initiation of this RHCP. As such, these efforts cannot be used as mitigation for future disturbance; however, any RHCP-initiated efforts to improve conditions for the established conservation areas can be used as mitigation for future impacts. Both pre- and post-RHCP conservation efforts will count toward the species' recovery, the ultimate objective of endangered species management.

The County and the Foundation launched their efforts to conserve endangered cave-dwelling invertebrates by acquiring and dedicating two karst conservation areas totaling approximately 220 acres (89.0 hectares) within the Southwest Regional Park. These conservation areas were funded in part from $3,200,000 contributed from the Texas Department of Transportation to offset their impacts to endangered karst species along the route of State Highway 45 between Round Rock and Cedar Park. The conservation areas, known as the "Wilco" and "Millennium" Preserves, are inhabited by at least one of the endangered karst invertebrate species and several of the additional karst species included in this RHCP. The conservation areas, which are shown on Figure 3-2 in Chapter 3 (Covered Species) of this document, were established pursuant to separate agreements between Williamson County, the Foundation, and the Service.

In September 2004, the Service and the Texas Parks and Wildlife Department (TPWD) awarded the Foundation a $1,353,750 Federal grant under the Service's Habitat Conservation Plan Land Acquisition program. Lands that are clearly identified as important listed or candidate species habitat can qualify for funding through this program, which is authorized by section 6 of the Endangered Species Act and administered by the Service. Habitat Conservation Plan Land Acquisition grants are awarded through state wildlife management agencies. The section 6 money, together with local funds of the Foundation, was used to acquire and conserve a 42-acre (16.2-hectare) Round Rock Independent School District tract. The property, which includes caves that contain the endangered Bone Cave harvestman, is now managed by the Foundation as the Beck Preserve (see Figure 3-2). In 2005, the Foundation also received a section 6 Recovery Land Acquisition grant of $725,000 for the purchase of a 64.4-acre (26.0-hectare) conservation easement on the Lyda tract (Cobbs Cavern). Both tracts contain one

[20] As of April 1, 2007, approximately 2,000 credits (1 credit = 1 acre) were available at Hickory Pass Ranch.

or more caves that are habitat for several karst invertebrate species, including at least one of the listed species. The County also purchased 12 acres (4.9 hectares) of land including Sunless City Cave from the Whitney Partnership due to endangered species impacts from State Highway 45 (see Figure 3-2).

1.1.3 The Williamson County Regional Habitat Conservation Plan

In September 2003, the Foundation embarked on the initial planning process that would lead to the development of a Williamson County RHCP. The Service and the TPWD awarded the Foundation a $200,000 Federal section 6 grant to help defray the costs of planning and pre-permit application activities. With this funding, the Foundation completed a conceptual RHCP, which it delivered to the TPWD and the Service in November 2004.

In September 2004, the Foundation launched the more detailed planning process that led to formulation of this RHCP. The Service and the TPWD awarded the Foundation an approximately $1 million section 6 grant to support the RHCP development. On November 23, 2004, the Commissioners Court approved a Preliminary Work Plan covering items necessary to complete the RHCP.

1.1.4 The Concept and Benefits of a Regional Habitat Conservation Plan

Most HCPs are prepared by entities seeking an incidental take permit to cover the impacts on endangered or threatened species of a single project in a discrete area. The Endangered Species Act requires that the applicant submit a proposed HCP along with the permit application. The HCP must demonstrate that the applicant will minimize and mitigate "to the maximum extent practicable" the impacts of the "taking" of listed species that will be covered by the Permit. Although the Endangered Species Act does not specifically mention RHCPs, the *Endangered Species Habitat Conservation Planning Handbook* issued by the Service initially in 1996 and later supplemented by the Addendum to HCP Handbook (65 FR 35241) discusses the RHCP concept. In contrast to individual HCPs, an RHCP often covers a larger geographic area, numerous landowners, and multiple species. Local or regional governmental entities are often the applicant/permittee, and they commit to implement the mitigation plan contained in the RHCP. The Endangered Species Habitat Conservation Planning Handbook states as one of its "guiding principles" that the Service encourages state and local governments and private landowners to undertake regional and multi-species HCPs.[21]

In addition to providing a participatory process for Endangered Species Act compliance that is less burdensome for individual landowners, several other advantages of RHCPs have been identified by the Service, each of which appears to be applicable to Williamson County's proposed plan:

1. <u>Maximize flexibility and available options in developing mitigation programs</u>. Individual projects often face limited options when developing mitigation proposals because of individual applicants' limited financial resources or the lack of suitable habitat available

[21] In contrast, Texas sate law appears to discourage the development of HCPs (see Texas Parks and Wildlife Code § 83.012(2)).

for mitigation. The RHCP approach facilitates a regional-scale approach to Endangered Species Act permitting that leads to conservation of less fragmented tracts of habitat that are better for the species and applicants. The RHCP administrative entity enjoys improved mitigation "buying power" and can pool participant payments to acquire high quality, contiguous tracts for conservation.

2. Reduce the economic and logistic burden of these programs on individual landowners by distributing their impacts. The RHCP approach introduces an economy of scale in terms of the basic logistical functions by establishing region-wide criteria for participation and consolidating many of the ministerial and other HCP processing steps into one permitting process.
3. Reduce uncoordinated decision making, which can result in incremental habitat loss and inefficient project review. The RHCP approach allows the Service to develop standardized criteria for participants, making it easier to ensure that similarly-situated projects will be treated similarly in terms of mitigation requirements.
4. Provide the permittee with long-term planning assurances and increase the number of species for which such assurances can be given. The regulatory certainty that will result from issuance of the Permit will reduce the legal and financial risks associated with public and private development and infrastructure planning. The Williamson County RHCP will lead to long-term benefits for the covered species and contribute to their recovery.
5. Bring a broad range of activities under the permit's legal protection. Because the requested Permit will cover all public and private development activities in the County, it will contribute substantially to overall efficiency in executing proposed projects and ensure that mitigation requirements for species impacts are determined using consistent criteria.
6. Reduce the regulatory burden of Endangered Species Act compliance for all affected participants. The RHCP will make it possible for each proposed project that voluntarily conforms to the RHCP to obtain Endangered Species Act authorization through a streamlined, efficient process at much less cost than obtaining individual section 10(a)(1)(B) permits and section 7(a)(2) consultations (see Endangered Species Habitat Conservation Planning Handbook [USFWS and NMFS 1996]). While HCPs typically apply to projects without a Federal nexus, RHCP participation will also be available for projects (including those of non-Federal governmental entities) that have other Federal nexi (e.g., a Clean Water Act section 404 permit application, Federal funding, etc.).

In addition to these benefits, the RHCP will also facilitate acquisition of Federal grants to the County through the Service's section 6 Habitat Conservation Plan Land Acquisition Program, a Federal fund with just under $50 million available for each of the past two years. Williamson County has already been the beneficiary of the acquisition program. Land acquired with Habitat Conservation Plan Land Acquisition Program funds cannot be used as mitigation in an HCP but is used to complement or enhance an approved HCP to further assist conservation of a federally listed species.

1.2 TEXAS STATE LAW RELEVANT TO REGIONAL HABITAT CONSERVATION PLANS

Texas state law establishes requirements related to the development of RHCPs by Texas cities and counties (Senate Bill 1272, codified as Subchapter B, Chapter 83 of the Texas Parks and Wildlife Code). Procedural requirements include the following: the governmental entity participating in an RHCP must appoint a citizens advisory committee and a biological advisory team, comply with open records/open meetings laws and public hearing requirements, in certain circumstances provide notice to affected landowners, and acquire preserves by specific deadlines.

In addition, governmental entities participating in an RHCP are prohibited from:

- Imposing any sort of regulation related to endangered species (other than regulations involving groundwater withdrawal) unless that regulation is necessary to implement an HCP or RHCP for which the governmental entity was issued a Federal permit (Texas Parks and Wildlife Code § 83.014(a)).
- Discriminating against a permit application, permit approval, or provision of utility service to land that has been designated habitat preserve for an RHCP (Texas Parks and Wildlife Code § 83.014(b)).
- Limiting water or wastewater service to land that has been designated as habitat preserve or potential habitat preserve, is designated as critical habitat under the Endangered Species Act, or has endangered species or endangered species habitat present (Texas Parks and Wildlife Code § 83.014(c)).
- Requiring a landowner to pay a mitigation fee or set aside, lease, or convey land as habitat preserve as a condition to the issuance of a permit, approval or service (Texas Parks and Wildlife Code § 83.014(d)).
- Accepting a Federal permit in conjunction with an RHCP unless the qualified voters of the plan participant have authorized the issuance of bonds or other debt financing in an amount equal to the estimated cost of acquiring all land for habitat preserves within the time frame required by Chapter 83 (see below) or the plan participant has otherwise demonstrated that adequate sources of funding exist to acquire all land for habitat preserves within the required timeframe.

In addition to the above prohibitions, Chapter 83 stipulates that the mitigation included in an RHCP, including any mitigation fee and the size of proposed habitat preserves, must be based on the amount of harm to each endangered species the plan will protect (Texas Parks and Wildlife Code § 83.015(a)-(b)). However, after notice and hearing by the plan participants, an RHCP, its mitigations fees, and the size of proposed habitat preserves may be based partly on any of the Service's recovery criteria for the species covered by the plan (Texas Parks and Wildlife Code § 83.015(f)).

According to Chapter 83, governmental entities participating in an RHCP must make offers to acquire the land designated as proposed habitat preserve no later than four years after the issuance of the Federal permit or six years after the initial application for the permit, whichever

is later. Acquisition of all habitat preserves in the RHCP must be completed no later than the sixth anniversary of the date the Federal permit was issued (Texas Parks and Wildlife Code § 83.018(c)).

Finally, Chapter 83 imposes a requirement that before adopting an RHCP, plan amendment, ordinance, budget, fee schedule, rule, regulation, or order with respect to an RHCP, the plan participant must hold a public hearing and publish notice of such hearing in the newspaper of largest general circulation in the county in which the participant proposes the action, such notice to include a brief description of the proposed action and the time and place of a public hearing on the proposed action. The plan participant must publish notice in accordance with the foregoing requirements, and must do so not later than the thirtieth day prior to the public hearing (Texas Parks and Wildlife Code § 83.019).

1.3 PURPOSE AND NEED FOR ACTION

The proposed action is issuance by the Service of a section 10(a)(1)(B) permit approving the Williamson County RHCP, under which a variety of land use activities that could adversely affect listed species, and which therefore must comply with the Endangered Species Act, will have a voluntary alternative means of achieving such compliance that is more efficient, effective, and coordinated than would be the case under individual project approvals and which will also contribute to and facilitate the recovery of the covered species. The RHCP and requested Permit are designed to achieve the following general goals:

- *Conservation of natural resources*: The RHCP will promote the recovery of the covered species and long-term conservation of the covered and additional species.
- *Efficient and effective administration of the Endangered Species Act*: The RHCP will reduce the administrative and logistical burden on the Service of processing individual Endangered Species Act permits and monitoring post-issuance performance of multiple individual permit projects within the County.
- *Reduced burden on individual permit applicants*: The RHCP will reduce time and costs for individual permit applicants.
- *Responsible economic activities*: The RHCP will facilitate the coordinated and beneficial use of land within Williamson County to promote the local and regional economy.
- *Maintenance of open space and quality of life in Williamson County*: The RHCP will help to ensure that some of the natural character of the County is maintained despite extensive anticipated development.

The primary ecological purposes of this Williamson County RHCP are to 1) contribute to and facilitate the recovery of the federally listed endangered Bone Cave harvestman, Coffin Cave mold beetle,[22] golden-cheeked warbler, and black-capped vireo (covered species) in Williamson

[22] Chandler and Reddell (2001) have proposed taxonomically splitting the endangered *Batrisodes texanus* (Coffin Cave mold beetle) into two species—*B. texanus* and *B. cryptotexanus*—and renaming *B. texanus* "Inner Space Caverns mold beetle" because they now identify the mold beetles occurring in Coffin Cave as *B. cryptotexanus*. However, the taxonomy and distribution of these mold beetles in Williamson County are not fully understood, are the subject of ongoing research, and may yet again be revised. Because of these uncertainties, the Service has not

County; and 2) assist the Service in precluding the need to list the currently unlisted additional species. The conservation actions, as detailed in the RHCP, will facilitate compliance with the Endangered Species Act by implementing a comprehensive, coordinated strategy for future species conservation throughout the County. The RHCP will contribute to the species' long-term survival while allowing otherwise lawful development to comply with the Endangered Species Act through a voluntary alternative to seeking individual project approvals.

The presence of endangered species habitat has significantly affected both public and private development activities within Williamson County. As the County continues to grow, conflicts with the requirements of the Endangered Species Act will likely increase, and important open space and habitat may be lost. The RHCP is needed to ensure that development goes forward in an orderly, efficient manner consistent with the protection of rare species. The urgency for addressing habitat and species protection in an organized and predictable manner is underscored by the high rate of growth projected for Williamson County. In the next 30 years, population in the County is expected to grow from under 400,000 to over 1.5 million, an increase of over 300 percent (Texas State Data Center Population Forecast, Scenario 1.0). An estimated 69 percent of this growth will occur in the Karst Zone, where most of the endangered and rare species and their habitat are found (see Chapter 4, Section 4.2.2 for more information about projected population growth in the County). As many as 80,000 acres in the Karst Zone may be developed in the next 30 years (see Chapter 4, Section 4.2.2 for an explanation).

As the number of projects requiring Endangered Species Act compliance in Williamson County continues to grow, the RHCP approach will be beneficial to the covered and additional species and much less cumbersome and expensive for public and private entities that intend to carry out development projects. Through this RHCP, the County will approach conservation at the landscape scale. A regional approach will make management, monitoring, and research more efficient. The regional approach will be beneficial to the species and will provide significant cost and time savings to the entities seeking to carry out development projects in the County, but it will also be beneficial to the region as a whole. The RHCP will enhance the County's reputation as an entity that facilitates stable and orderly development, which is an attractive attribute for many who are planning to invest, relocate, or start businesses in Williamson County.

1.4 TERMINATION STATEMENT

The County retains the express right to terminate the RHCP at any time, provided the County will remain obligated to perform any action required by conditions of the RHCP and the Permit to be performed up to the date of termination and will remain obligated for the perpetual operation and maintenance of all preserves acquired under the plan through the date of termination.

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recognized the split and considers all beetles identified as *B. cryptotexanus* to be the endangered *B. texanus* and retains the name "Coffin Cave mold beetle" for this species. The RHCP conforms with U.S. Fish and Wildlife Service practice in this regard.

CHAPTER 2 — ALTERNATIVES CONSIDERED BUT NOT SELECTED

2.1 INTRODUCTION

Section 10(a)(2)(A) of the Endangered Species Act requires that HCPs include a description of the "alternative actions to such taking the applicant considered and the reasons why such alternatives are not being utilized." The Habitat Conservation Planning Handbook (USFWS and NMFS 1996) states that alternatives to the proposed action commonly considered are those that would reduce take below levels anticipated for the proposed action. The handbook also states that economic reasons for rejecting an alternative are permissible, if the applicant provides data to justify the decisions (to the extent that such data are reasonably available and non-proprietary). Further, the decision regarding which alternative is chosen rests with the applicant. However, the Service retains the authority to reject an application for an incidental take permit if it does not satisfy the requirements of the Endangered Species Act. Various approaches contained in other RHCPs were considered in developing the proposed RHCP and the alternatives described below. Provisions contained in the other RHCPs are summarized in Appendix A.

Four potential alternatives to the proposed RHCP have been considered, evaluated, and rejected by the Applicant. They are:

1) No Action
2) Modified (Reduced Take and Mitigation) Williamson County RHCP
3) Williamson County Land Use Zoning-Based RHCP
4) Williamson County RHCP with Upfront Purchase of All Preserves

2.2 ALTERNATIVE 1: NO ACTION

Under the No Action alternative, Williamson County would not seek an incidental take permit for any endangered or threatened species known from the County, nor would it develop an RHCP for any of these species. Williamson County citizens and business interests seeking authorization for incidental take of endangered species would have the responsibility of obtaining individual permits from the Service and developing a separate HCP for each proposed project. The No Action alternative leaves the burden on the landowner of the high costs and unpredictable and lengthy timelines associated with preparing individual HCPs and applying for permits. Consequently, this alternative would not help promote the otherwise lawful and desired economic development in Williamson County.

Several other disadvantages to both Williamson County and the endangered species make this alternative unfavorable. The No Action alternative includes continued regulatory uncertainty for landowners in Williamson County with regard to endangered species. Accurate, consistent, and clear information regarding the biology, habitat, distribution, and management of the karst invertebrates is not generally known and is not easily accessible to the public. As a result, landowners' specific responsibilities under the Endangered Species Act, such as how to

minimize or mitigate for potential impacts, are not well defined or consistent. It is unlikely that clear recommendations based on sound biological research would be developed and distributed to the public in the near future.

Conservation on private lands is necessary for the continued existence and recovery of the endangered karst invertebrates. However, many landowners have difficulty accepting current available options for land uses that are compatible with Service-recommended karst invertebrate conservation. This is due either to decreased economic value of property containing the listed species or to lack of obvious incentives for the landowner. The No Action alternative would not encourage the voluntary management or conservation of karst invertebrates and/or other endangered species known from Williamson County on private lands.

The status of endangered species in Williamson County would not likely significantly improve under the No Action alternative. Because the burden of the lengthy and expensive planning and incidental take permit application process would fall on individual landowners, they might be unwilling or unable to seek a permit for common activities, such as single-family home construction and thereby contribute to the incremental loss of endangered species habitat through unauthorized incidental take. This would potentially lead to a further decline in the available habitat for endangered species in Williamson County.

Individual HCPs are less likely to conserve endangered species than a regional, coordinated effort. An organized research program addressing the status and ecology of the karst invertebrates to aid conservation efforts is currently lacking, and private landowners are not encouraged to partner in such research. Considering the best available scientific information currently available on the karst invertebrates, management and conservation efforts conducted under the No Action alternative could proceed under the unsupported assumptions regarding the biology and habitat of the invertebrates and unknowingly decrease the recovery potential of the species.

Under the No Action alternative, the County would not receive the authorization afforded by an incidental take permit for its own activities, such as construction and maintenance of county roads and parks. Additionally, the County would not receive the revenues generated by the RHCP through participation fees and Tax Benefit Financing (TBF).

Additional discussion regarding the potential benefits and impacts resulting from this alternative is included in the Environmental Impact Statement.

2.3 ALTERNATIVE 2: MODIFIED (REDUCED TAKE AND MITIGATION) WILLIAMSON COUNTY RHCP

This alternative was designed to reduce impacts to the listed species and the short- and long-term financial obligations of the County for the administration and implementation of the RHCP. The alternative would still provide benefits to the County in terms of streamlining the development process relative to compliance with the Endangered Species Act, and it would provide a measure of protection for some of the listed and additional species, but would authorize less take. The

differences between this alternative and the proposed RHCP are summarized below and in Table 2-1.

Alternative 2 would be the same as the proposed RHCP[23] except:

- fewer species would be covered by the incidental take permit;
- the amount of permitted take, the mitigation required for the take, and the costs associated with mitigation would be reduced;
- annual expenditures for administration and implementation of the RHCP would be reduced;
- annual expenditures for research and public education would be reduced;
- the Foundation would not take over the management of any existing karst conservation areas; and
- section 6 funds would not be sought to acquire additional karst fauna areas (KFAs) over and above mitigation efforts.

This alternative assumes that the covered species would be limited to those species for which incidental take needs have historically been the highest in Williamson County: the Bone Cave harvestman and the golden-cheeked warbler. The more rare species, the Coffin Cave mold beetle and the black-capped vireo, would be dropped from consideration, primarily because there have been relatively few applications for incidental take of these species in the County. Compared to the harvestman and the warbler, future demand for incidental take coverage of these species is expected to be low. In addition, due to the mold beetle's rarity, data on its distribution, density, and taxonomy are limited; it is uncertain whether three KFAs in each of the three karst fauna regions (KFRs) in which it occurs could be established to mitigate for future impacts to the species. Similarly, little is known about the distribution and population size of the black-capped vireo in Williamson County and few records exist.

Under this alternative the number of species-occupied caves directly and/or indirectly impacted within 50 feet (15 meters) of the cave footprint would be reduced from 60 to 48. The number of caves directly and/or indirectly impacted in an area between 50 feet and 345 feet (105 meters) of the cave footprint would be reduced from 150 to 120. Mitigation for take would require the establishment of 9 KFAs, instead of up to 15 KFAs as in the proposed RHCP. A total of 560 acres (227 hectares) of karst habitat would be acquired instead of 700 acres (283 hectares). Three KFAs for the harvestman would be established in each of three KFRs: North Williamson County KFR, Georgetown KFR, and McNeil/Round Rock KFR.

This alternative would also differ from the proposed RHCP in that the Foundation would not establish and manage six additional KFAs to enhance the recovery of the harvestman, nor would the Foundation assume the management of 10 of 22 existing karst conservation areas.

[23] The proposed RHCP is described in detail in Chapters 3–11 of this document. See the Executive Summary for a synopsis of the proposed RHCP and Table 2-1, below, for a comparison of Alternative 2 and the proposed RHCP.

Table 2-1. Comparison of Alternative 2 and the proposed RHCP.

Plan Components		Alternative 2 – Modified RHCP	Proposed RHCP
Covered Species		Bone Cave harvestman Golden-cheeked warbler	Bone Cave harvestman Coffin Cave mold beetle Golden-cheeked warbler Black-capped vireo
Estimated Covered Take over Life of RHCP	Bone Cave Harvestman	Total caves impacted: 168	Total caves impacted: 210
	Coffin Cave Mold Beetle	Not covered for take.	
	Golden-cheeked Warbler	Direct and Indirect Impacts: 1,000 acres.	Direct and Indirect Impacts: 6,000 acres.
	Black-capped Vireo	Not covered for take.	Direct Impacts: 4,267 acres.
	Georgetown Salamander	Not covered for take.	Not covered for take.
Mitigation or Conservation Measures	Bone Cave Harvestman	Acquire and manage nine, 40- to 90-acre KFAs totaling approximately 560 acres ((three KFAs in each of the three KFRs occupied by the Bone Cave harvestman).	Acquire and manage 9 to 15, 40- to 90-acre karst fauna areas (KFAs) totaling approximately 700 acres (a minimum of three KFAs in each of the three karst fauna regions [KFRs] occupied by the covered karst species). To enhance RHCP efforts towards recovery of listed invertebrates preserve up to six additional KFAs acquired with Endangered Species Act section 6 funds or other sources. Assume management/ monitoring of 10 of the 22 existing karst conservation areas.
	Coffin Cave Mold Beetle	Not covered for take; no mitigation required.	
	Golden-cheeked Warbler	Purchase 500 Hickory Pass Ranch mitigation credits each in Years 1 and 4 (1,000 credits total). No effort to establish preserves within Williamson County beyond current levels.*	Purchase 500 Hickory Pass Ranch mitigation credits each in Years 1 and 4 (1,000 credits total) and explore further opportunities for establishing preserve/ conservation banks in the County* or purchasing additional mitigation credits outside the County if there is demand for additional take.
	Black-capped Vireo	Not covered for take; no mitigation required.	As accumulated participation fees allow, restore and/or enhance protected vireo habitat on a rolling basis.
	Georgetown Salamander	Conduct research and monitoring in Years 2–6, develop a conservation strategy for the species in Year 2, and explore feasibility of a Candidate Conservation Agreement with Assurances.	Conduct research and monitoring in Years 2–6, develop a conservation strategy for the species in Year 2, and explore feasibility of a Candidate Conservation Agreement with Assurances.
Research		Fund and manage research $20,000/yr.	Fund and manage research $25,000/yr.
Public Awareness		Fund and manage public awareness programs $16,000/yr.	Fund and manage public awareness programs $20,000/yr.
Endowment		Establish a total endowment of $16,320,000 by end of Year 30.	Establish a total endowment of $20,400,000 by end of Year 30.
Finances	30-Year Costs	$64,397,052	$80,832,669
	30-Year Income	$95,073,642	$101,476,939

* The County recently purchased 115.52 acres of golden-cheeked warbler habitat (in the Whitney Tract) to use as in-county mitigation for future impacts to warbler habitat resulting from activities covered by an RHCP.

Compared to the proposed RHCP, take for the golden-cheeked warbler would be reduced from 6,000 acres (2,428 hectares) to 1,000 acres (405 hectares). The 1,000 acres of take would be mitigated by acquisition of Hickory Pass Ranch Conservation Bank credits, plus existing in-county mitigation credits available due to the purchase of the Whitney Tract. There would be no additional take or mitigation authorized for the golden-cheeked warbler under the plan without an amendment to both the RHCP and the Permit[24]; thus no efforts would be made to establish additional preserves for the warbler in Williamson County.

The five-year salamander research effort as described in the proposed RHCP would remain unchanged. However, under Alternative 2, the annual research program would be would be reduced from an annual expenditure of $25,000 to $20,000, and the public outreach program would be reduced from an annual expenditure of $20,000 to $16,000. Because fewer preserves would be managed in perpetuity, the endowment would be reduced compared to the proposed RHCP, from $20,400,000 at the end of Year 30 to $16,320,000.

Compared to No Action (Alternative 1), the Modified RHCP would provide greater benefits to the Bone Cave harvestman, the golden-cheeked warbler, and the additional species listed in Chapter 1, Section 1.1.1.[25] Compared to the proposed RHCP, it would reduce both take and mitigation, resulting in substantially lower land acquisition and management costs for the County. This alternative, however, offers less protection for the karst invertebrates and fails to fully meet the goals and objectives listed in Chapter 5, Section 5.1. It was rejected for the following specific reasons:

- Because the Coffin Cave mold beetle would not be covered by the incidental take permit, neither the stakeholders in Williamson County nor the beetle would be adequately served by this alternative. Landowners who have the mold beetle on their property would still require individual incidental take permits to legally develop their land if they do not avoid occupied habitat. While the mold beetle would benefit if it occupied KFAs established for the Bone Cave harvestman, there is no assurance that the KFAs would include the mold beetle or that downlisting of the species would occur.
- Similarly, landowners who have the black-capped vireo on their property would still require individual incidental take permits to legally develop their land if they do not avoid occupied habitat. This alternative also does nothing to protect, preserve, or enhance black-capped vireo habitat and thus contribute to the conservation of the species.
- This alternative only allows for impacts to a total of 168 Bone Cave harvestman caves. This may not provide for the maximum amount of take of Bone Cave harvestman that may be needed by the landowners for the 30-year life of the Permit, increasing the likelihood that the RHCP would need to be significantly amended during the life of the plan.
- The reduction in the number of KFAs established under the plan (compared to the proposed RHCP) from a possible 15 for mitigation and another 6 for enhancement,

[24] Service policy requires a permit amendment to consist of the same process as the original permit application, a potentially lengthy and time consuming process (USFWS and NMFS 1996).

[25] The additional species that would benefit from the proposed RHCP would remain unchanged under Alternative 2 with the exception that the Coffin Cave mold beetle would be added.

coupled with the failure to assume the management of 10 existing karst conservation areas, would significantly reduce the efforts in Williamson County to conserve, not only the Bone Cave harvestman, but the Coffin Cave mold beetle and the additional karst species identified in Chapter 1, Section 1.1.1. As a result, the probability of precluding future listing of the currently unlisted species would be significantly reduced.

- This alternative does not provide for the maximum amount of take of golden-cheeked warblers that may be needed by landowners in Williamson County for the 30-year life of the Permit, increasing the likelihood that the RHCP would need to be significantly amended during the life of the plan. And, without an amendment, no efforts would be made under the auspices of the plan to establish additional golden-cheeked warbler conservation banks or preserves in the County.

2.4 ALTERNATIVE 3: WILLIAMSON COUNTY LAND USE ZONING-BASED RHCP

Under this alternative, an RHCP would be developed based on land use zoning. The County would identify areas significant to the conservation of the covered species, and through a land use zoning effort, limit development activities in those areas. Similar to Alternative 2, this alternative was designed to reduce take of the listed species; however, it was considered primarily because precedents exist for this approach, most recently by county-wide habitat conservation planning in Pima County, Arizona (RECON 2006). Alternative 3 would be modeled on the Pima County Multi-species Conservation Plan, which is summarized below.

Pima County has a zoning ordinance in place that regulates land use in all unincorporated areas of the county within its jurisdiction, over 600,000 acres (242,800 hectares). The existing zoning pertains unless a developer submits a request to change the zoning on an area or to increase the density above that for which it is already zoned. In that case, if the area falls within a new county-wide Conservation Land System, new conditions apply. The Conservation Land System, which was developed by the county in collaboration with Federal, state, and municipal land management entities, classifies some 2 million acres (809,000 hectares) within the county into seven categories, each with accompanying conservation guidelines. In the most restrictive categories (Biological Core Management Areas, Special Species Management Areas, and Important Riparian areas), from 80 to 95 percent of the total acreages in those categories must be conserved or enhanced as wildlife habitat, depending on the classification. Development on any given property is restricted to the least sensitive portions of that property.

Under Alternative 3, Williamson County would have to establish a zoning program, including expanded authority for issuing land use-related discretionary permits and a system for monitoring zoning compliance and enforcing sanctions for zoning violations. Adherence to zoning designed to protect conservation values, specifically those pertaining to the covered species, would provide a mitigation framework for take authorized by the requested incidental take permit. Participation in the RHCP would not be voluntary because zoning stipulations would apply to all property within the County's jurisdiction. Compared to the proposed RHCP, the amount of permitted take, the mitigation required for the take, and the costs associated with mitigation would likely be reduced (depending on the outcome of the zoning process); annual expenditures for administration and implementation of the RHCP would likely increase due to

the initial zoning efforts and monitoring of land use compliance; and the anticipated participation rate would be higher as participation in the land use zoning would be required.

Alternative 3 would provide benefits to the County in terms of streamlining the development process relative to compliance with the Endangered Species Act, and it would provide a significant measure of protection for the listed and additional species. However, the alternative was rejected because, at this time, the County does not have the regulatory authority to implement land use zoning, and the County is unlikely to gain that authority from the Texas Legislature given the strong tradition of protecting private property rights in the state. In Texas, a county has only the authority expressly granted it by the state constitution or state statutes. No county in Texas has general ordinance-making authority, although in several cases, the state legislature has authorized a county or counties to enact rules or ordinances in regard to a specific issue. For example, certain counties may adopt zoning ordinances in limited areas around particular features, such as Padre Island beachfront or specific lakes (Texas Local Government Code, Chapter 231). The regulatory authority granted to all counties in the state is limited to automotive wrecking and salvage yards (Texas Transportation Code § 396.041), wild animals (Local Government Code § 240.002), mass gatherings (Health and Safety Code, Chapter 751), and residential subdivision plats[26] in unincorporated areas (Local Government Code, Chapter 232). Specifically, a subdivision plat must be approved by the County Commissioners Court and filed with the county clerk as a permanent real property record, where it may be used for land title research, land sales, or property tax purposes. Before approving a plat, a commissioners court may require rights-of-way on subdivision roads, reasonable specifications on road construction and drainage infrastructure, and purchase contracts to specify the availability of water (Local Government Code § 232.003). Clearly, this limited authority does not include the right to establish land use zoning to protect conservation values.

2.5 ALTERNATIVE 4: WILLIAMSON COUNTY RHCP WITH UPFRONT PURCHASE OF ALL PRESERVES

Alternative 4 would be similar to the proposed RHCP except all the preserve areas described in Chapter 5 (Avoidance, Minimization, and Mitigation Measures) would be identified and acquired within six years of the plan's authorization.[27] Identifying and acquiring all the preserves upfront may expedite the downlisting and/or delisting process for endangered species occurring in Williamson County.

This alternative was rejected as impracticable, however, because 1) at the present time it may not be feasible to identify all KFAs needed to meet the RHCP goals and objectives in the six-year period, and 2) the costs associated with acquiring all the needed land and mitigation credits in such a short timeframe and before the plan generates substantial income to help defray costs would not be economically feasible for the County.

[26] A plat is a legal document that includes a map of the subdivided property and public improvements, such as streets or drainage infrastructure.

[27] According to state law acquisition of all habitat preserves in an RHCP must be completed no later than the sixth anniversary of the date the Federal permit was issued (Texas Parks and Wildlife Code § 83.018(c)).

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CHAPTER 3 – COVERED AND ADDITIONAL SPECIES

3.1 INTRODUCTION

Covered Species: "Covered species" are the four federally listed endangered species covered by the proposed section 10(a)(1)(B) incidental take permit. These include two karst invertebrates, the Bone Cave harvestman and the Coffin Cave mold beetle, and two migratory songbirds, the golden-cheeked warbler and the black-capped vireo. Collectively these four species are considered covered species because the incidental take of these species will be authorized through issuance of the proposed section 10(a)(1)(B) permit to Williamson County by the Service as supported by implementation of the RHCP. The RHCP has been designed to preserve, protect, and manage habitats at a level sufficient to ensure that development activities performed through participation in the RHCP will not jeopardize the continued existence of any of these four species.

A fifth federally endangered species, the Tooth Cave ground beetle, is documented from Williamson County and neighboring Travis County. In Williamson County it is known only from the Cedar Park KFR,[28] which is extensively developed. Relatively little additional development is anticipated in the Cedar Park KFR, and little or no potential exists to establish additional protected KFAs[29] for the Tooth Cave ground beetle in that region. Because further take of this species in the County is unlikely and adequate mitigation would be difficult to arrange, the Tooth Cave ground beetle will not be included in the section 10(a)(1)(B) permit as a covered species. Rather than completely disregarding the Tooth Cave ground beetle in this RHCP, the species has been grouped with the non-listed additional species (see below). Efforts to benefit the covered species may incidentally benefit the Tooth Cave ground beetle as well. Since this species will not be included on the Permit, any projects impacting this species will need to seek separate authorization with the Service.

The Service believes one other federally listed endangered species has the potential to occur in Williamson County, the whooping crane (*Grus americana*). This species is not included in this RHCP, however, because it occurs in the region only as an occasional transient. Development activities in the County are unlikely to have any significant adverse effects on whooping cranes. Similarly, any conservation actions that could be implemented in the County are unlikely to provide any significant benefits to the species.

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[28] KFRs, or "karst fauna regions," are large geographic areas delineated based on features related to regional geology and hydrology as well as the distribution of dozens of troglobitic species. As the concept was originally presented, each of the KFRs was supposed to be bound by geological and hydrological barriers to the distribution of troglobitic species (Veni and Associates 1992). We know today, however, that the boundaries of the KFRs do not in fact define the boundaries of the species and that overlap of troglobitic species is relatively common between KFRs (White et al. 2001; Paquin and Hedin 2004, 2005).

[29] According to the Travis/Williamson County Recovery Plan (USFWS 1994) a KFA, or a "karst fauna area" is an area "known to support one or more locations of a listed species and is distinct in that it acts as a system that is separated from other karst fauna areas by geologic and hydrologic features and/or processes that create barriers to the movement of water, contaminants, and troglobitic fauna."

Additional Species: "Additional species," while considered rare, would not be covered by the proposed Permit, nor, absent a permit amendment, would they be covered by the Permit should they be federally listed in the future. Many non-listed species of karst invertebrates are known from caves in Williamson County. The vulnerability of these species to impacts from development-related activities is difficult to determine because knowledge of their abundance and distribution is extremely limited. Many of the species are known from only a small number of caves, and these species may be as vulnerable to extinction as the listed species, if not more so. The non-listed karst invertebrate species known from comparatively few caves are identified and discussed in Section 3.3, below. Because knowledge of these species is very limited, and they are not currently listed, for the purposes of this RHCP, all are considered to be additional (rather than covered species). However, the ranges of these species overlap with the listed species, thus significant protection of many of these species has occurred and will continue to occur as caves are protected for endangered species management. Because one of the goals of this plan is to assist the Service in precluding the need for future listings of karst invertebrates, potential cave acquisitions will be weighed, at least partially, by the overall diversity of troglobitic fauna contained within the caves, including the covered and additional species identified in this RHCP. As noted above, one listed additional karst invertebrate species, Tooth Cave ground beetle, is included in this category.

Also considered to be additional species are four aquatic salamanders: the Georgetown salamander, Jollyville Plateau salamander, and Salado Springs salamander (all candidates for listing by the Service), and the Buttercup Creek salamander. The Georgetown salamander is known to occur only in Williamson County. The Jollyville Plateau salamander occurs in southwestern Williamson County and western Travis County. The Salado Springs salamander is known to occur only in Bell County, although precipitation on a portion of the Edwards Aquifer Recharge Zone in north-central Williamson County likely contributes to flow at the springs at which the salamander occurs (Senger et al. 1990). The Buttercup Creek salamander is known to occur only in subterranean aquatic habitats in the vicinity of Buttercup Creek Cave in southwestern Williamson County. The Buttercup Creek salamander has not been formally described as a species (Chippindale et al. 2000).

Covered species are discussed in greater detail in Section 3.2.1 (karst invertebrates) and in Section 3.2.2 (golden-cheeked warbler and black-capped vireo). More information on the additional species is provided in Section 3.3. These sections contain figures that depict known locations for the covered species and the salamanders, and, in some cases, distribution of potential habitat for the species. However, the distribution of these species and their habitat in Williamson County is not completely known. Depiction of potential habitat for covered species is to facilitate development and discussion of RHCP participation methodology. These figures do not provide assurance that areas not mapped as potential habitat for federally listed endangered species do not contain habitat for such species, nor do these figures of potential habitat constitute identification of potential preserve acquisition lands. It is the responsibility of individual landowners to ensure that activities occurring on their property are performed in compliance with provisions of the Endangered Species Act.

3.2 COVERED SPECIES

3.2.1 Karst Invertebrates

Due to their restricted range and threats from urban expansion, 16 species of troglobitic karst invertebrates have been added to the endangered species list in central Texas, including 3 that occur in the Williamson County RHCP permit area. At the present time, 22 troglobites (3 currently listed) are thought to be endemic to caves in Williamson County and the surrounding area (Reddell 2004). To date, at least 590 caves are known to exist within Williamson County. Of these caves, approximately two-thirds have natural open entrances at the ground surface, and the remaining one-third were first opened to the surface during excavations associated with construction activities (SWCA 2006a).

Troglobites are obligate cave-dwelling organisms that include more than 1,200 species worldwide (Barr 1968). Centers of troglobitic diversity occur in the U.S. in karst areas in Texas, the southeast (Appalachian Mountains, Cumberland Plateau, Central Basin of Tennessee, and the Bluegrass and Mammoth Cave regions of Kentucky), and the Sierra Nevada foothills of California. Among these areas, Texas ranks highest in total troglobite diversity and second in terrestrial troglobite diversity (Peck 1998, Culver et al. 2000). Troglobites are characterized by a number of anatomical and physiologic adaptations to cave life collectively referred to as troglomorphy. Troglomorphic characters include loss of pigment and loss of sclerotization (hardening of exoskeletons), reduction or loss of eyes, elongation of appendages, lengthened life span, modified fecundity (i.e., decreased number of eggs), and metabolic adaptation to nutrient-poor habitat conditions. As a result of adaptation to low energy environments, the life cycle of many troglobites is characterized by delayed reproduction, increased longevity, lower total egg production, and production of larger eggs (Culver 1982).

What makes the troglobitic fauna of Williamson County vulnerable to impacts from development activities is their absolute dependence on environmental conditions present only in the caves. The cave environment is relatively monotonous compared to surface habitats and is characterized by stable temperatures close to the mean surface temperature, constant near-saturation humidity, low evaporation rates, and the absence of photosynthetic nutrient production (Barr 1968, Culver 1982).

Due to the lack of light for photosynthesis most cave communities lack primary producers. Instead they rely on nutrient input from the surface ecosystem, and as such they are an extension of the surface ecosystem. Nutrients are introduced into the subsurface in the form of plant detritus washed in by surface waters, micro- and macro-organisms that enter caves under their own power, and the eggs and waste of trogloxene species. Trogloxenes are species that have adapted to the cave environment sufficiently that they complete part of their life cycle in a cave, but must return to the surface to feed and thus retain adaptations for surface life. These types of cave communities are essentially decomposer communities (Culver 1982); they break down organic debris into simpler components (i.e., molecules and compounds) that are then available for other functions within the cave ecosystem.

In central Texas, cave crickets (*Ceuthophilus* spp.) are trogloxenes that provide nutrient and energy input into cave systems (USFWS 2003). Cave crickets utilize cave systems for shelter, as a daytime roost, and to complete their reproductive cycle. Cave cricket eggs, feces, and dead bodies provide a source of nutrient input to the cave ecosystem on which troglobitic species depend. At night, cave crickets forage on the surface, ingesting a variety of plant and animal materials. Taylor et al. (2005) studied cave cricket foraging distances from Big Red Cave in Coryell County, Texas, and relocated approximately 51 percent of cave crickets within 131 feet (40 meters) of the cave entrance, and 92 percent of cave crickets within 263 feet (80 meters) of the entrance. The maximum distance a cave cricket was found foraging away from the cave entrance was 345 feet (105 meters). This cricket foraging distance is assumed to be an important factor in determining the amount of aboveground habitat required for maintaining the nutrient base in the belowground cave environment (Taylor et al. 2005, USFWS 2004a).

The origin and geographic distribution of troglobites have important general implications for evolutionary biology (Holsinger 1988). Many troglobitic species are considered to be relicts persisting in subsurface refugia long after their surface ancestors abandoned their geographic range due to climate fluctuations. Most terrestrial troglobites are thought to have evolved from surface ancestors that were pre-adapted for cave life because they were adapted to living in cool, moist soil or leaf-litter (Barr 1968).

Many of the caves in the RHCP area are relicts of groundwater flow systems that were generated during the early development of the modern aquifer but no longer exist. Based on the general understanding of the structure and development of the aquifer (Abbott 1973, Collins 2002, Maclay 1995, Senger et al. 1990, Woodruff and Abbott 1979), rocks of the Edwards Formation in northern Travis and Williamson Counties were gradually exposed both from the southeast to the northwest along ramping fault blocks and from the northwest to the southeast across progressively more downthrown fault blocks. The combination of land surface denudation with the formation of progressively lower aquifer discharge points along the San Gabriel River and Salado Creek valleys has caused the saturated zone of the aquifer to move to progressively lower fault blocks in the coastward direction. The unsaturated zone with its air-filled caves (and terrestrial troglobite habitat) has followed in its wake. Today new caves are forming surface connections to the northeast and along the coastward edge of the recharge zone where certain fault blocks are currently partially covered by overlying strata. To the southwest and along the inland edge of the recharge zone, older caves are gradually being removed by erosion.

In 1991, the Service commissioned a study that attempted to determine the likelihood of various rock types and geologic outcrops in Williamson and Travis Counties to contain karst features with potential habitat for cave-dwelling invertebrates (Veni and Associates 1992).[30] The study resulted in delineation of zones based on lithology, distributions of known caves and cave fauna, and geologic controls on cave development.

The zones were delineated as follows:

Zone 1 - contains endangered cave species.
Zone 2 - high probability of endangered or endemic cave fauna.

[30] These zones are currently being revised.

Zone 3 - low probability of endangered or endemic cave fauna.
Zone 4 - does not contain endangered or endemic cave fauna.

The difference between Zones 1 and 2 is largely an artifact of where endangered species surveys had been conducted. Zones 1 and 2 together reflect the distribution of potentially cavernous rock exposed at the surface. The entire cavernous zone has the potential to contain karst invertebrates; therefore, these two zones are referred to collectively hereafter as the "Karst Zone."

The study also discussed the overall karst geography of the Austin region and potential geologic and geographic barriers to karst invertebrate dispersal and limits to their distribution. Eight KFRs were delineated within Travis and Williamson Counties: South Travis County, Rollingwood, Central Austin, and Jollyville KFRs in Travis County, and McNeil/Round Rock, Cedar Park, Georgetown, and North Williamson County KFRs in Williamson County (Veni and Associates 1992).

3.2.1.1 Bone Cave Harvestman (*Texella reyesi*)

Bone Cave harvestman is an obligate cave-dwelling harvestman restricted to Travis and Williamson Counties (Ubick and Briggs 1992, 2004). Ubick and Briggs (1992) originally described the species when it was separated from Bee Creek Cave harvestman (*T. reddelli*). Bee Creek Cave harvestman was listed as endangered in September 1988 (53 FR 36029–36033), and with the subsequent taxonomic revision, Bone Cave harvestman was considered listed as of August 18, 1993 (58 FR 43818–43820).

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At maturity, Bone Cave harvestman is a pale orange harvestman with a total body length ranging from 0.06 to 0.11 inches (1.41 to 2.67 millimeters). Retinas are absent and corneal development varies from well developed to absent (Ubick and Briggs 1992). Bone Cave harvestman likely feed on microarthropods, such as springtails (*Collembola* spp.) (Rudolph 1979).

Ubick and Briggs (1992) also state that most specimens of Bone Cave harvestman have been observed in the deep cave environment, past the twilight zone. Bone Cave harvestman has a wider distribution than other *Texella* species. As of July 2004, Bone Cave harvestman was known from five KFRs in approximately 154 caves throughout its range, of which 138 caves are in Williamson County (see Figure 3-1; Ubick and Briggs 1992, 2004).

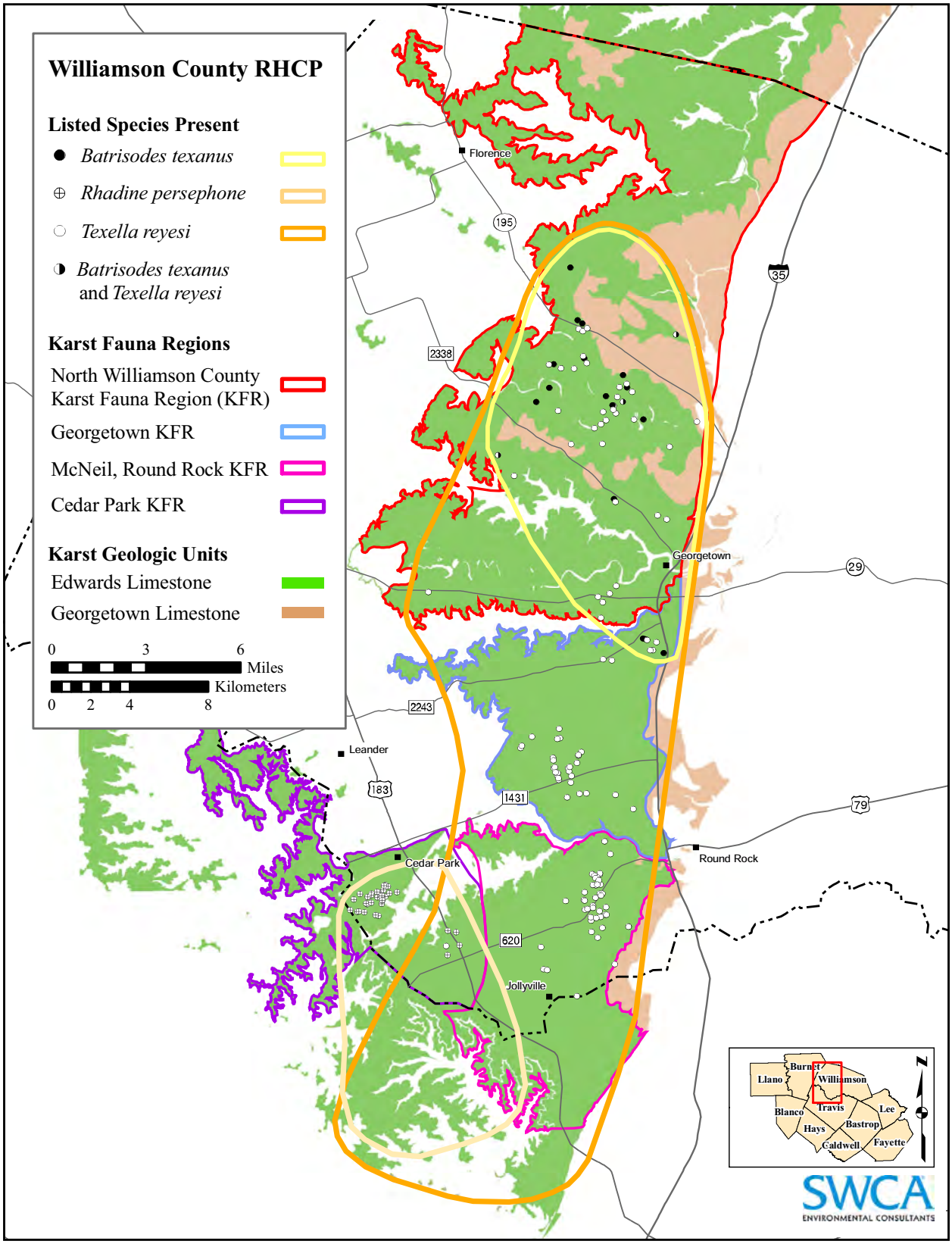

Figure 3-1. Karst Zone, karst fauna regions, and listed invertebrate species ranges in Williamson County, Texas.

3.2.1.2 Coffin Cave Mold Beetle (*Batrisodes texanus*)

Photo by Kemble White

The genus *Batrisodes* lies within the family of mold beetles or ant-like litter beetles. As of 2001, eight other genera of mold beetles were known to occur in Texas, including *Texamaurops* (Chandler and Reddell 2001). The Coffin Cave mold beetle was first described as a new species by Chandler (1992), when it was separated from Kretschmarr Cave mold beetle (*Texamaurops reddelli*).

Kretschmarr Cave mold beetle was placed on the Federal endangered species list on September 16, 1988 (53 FR 36029–36033), and with the subsequent taxonomic revision, Coffin Cave mold beetle was considered a listed species as of August 18, 1993 (58 FR 43818–43820).

Mature Coffin Cave mold beetles are 0.10 to 0.11 inches (2.60 to 2.88 millimeters) in length. Eyes are lacking on individuals of this species, with granules present instead (Chandler 1992). The Coffin Cave mold beetle is considered to be troglobitic because most individuals have been observed past the twilight zone in total darkness and have reduced eyes. This species is predatory, with prey including mites (USFWS 1994).

Coffin Cave mold beetle is known to inhabit at least 18 caves in Williamson County. Sixteen of the caves are in the North Williamson County KFR, and two are within the Georgetown KFR (Chandler and Reddell 2001; D.S. Chandler, e-mail to K. White, 2006). No records for the Coffin Cave mold beetle are confirmed from either Cedar Park KFR or McNeil/Round Rock KFR.[31]

3.2.1.3 Primary Threats to the Karst Invertebrates

One of the primary threats to the listed karst species is loss of habitat due to urban development (USFWS 1988, 1993, 1994). Williamson County is an area that is undergoing continual urban expansion at a rapid rate, and karst features are frequently impacted during land development. In the past, some caves have been filled, collapsed, or otherwise altered during building site preparation, road construction and transmission line placement and construction. Ranching activities have also been known to result in the filling of cave entrances in an attempt to prevent livestock from accidentally falling into caverns and to obliterate hiding places for livestock predators (Vinther and Jackson 1948). Prior to the listing of the karst invertebrates in 1988, it was estimated that at least 10 percent of the caves in adjacent Travis County were destroyed every 10 years (Elliott and Reddell 1989).

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[31] Earlier drafts of this RHCP indicated that the Coffin Cave mold beetle was found in the McNeil/Round Rock KFR. The single distribution record upon which this finding was made has since been determined to be erroneous. In 2001, a collection was made by Veni and Associates (2001) of the Coffin Cave mold beetle in Rattlesnake Inn Cave, near Sun City in the North Williamson County KFR, as part of the biological assessments to determine the impacts of Highway 195. The specimen from Rattlesnake Inn Cave was incorrectly labeled "Becks Rattlesnake Cave," a cave found in the McNeil/Round Rock KFR that is several miles south of the Highway 195 project footprint and the area from which biotic surveys were performed. It was only during the detailed efforts to determine the range of the Coffin Cave mold beetle for this RHCP that the error was discovered by James Reddell in early 2007.

Many impacts to cave ecosystems, however, do not result from destruction of the physical cave structure, but from activities that influence, directly or indirectly, the habitat of karst invertebrates. In an attempt to evaluate cause and effect impacts to cave ecosystems, the Service has assessed habitat requirements and threats to karst invertebrates in central Texas (USFWS 1994, 2003). These species require high humidity, warm, stable temperatures, and nutrient input from surface plant and animal communities (Howarth 1983a, 1983b). Chemical contamination from groundwater and/or surface drainages, including pesticides, fertilizers, sewage, hazardous materials spills, various pipeline leaks, storage tanker leaks, landfills, urban stormwater runoff, and trash dumping directly into caves can adversely affect karst invertebrates (Culver 1986, Elliott and Reddell 1989).

Altering surface drainage patterns through changes in topography, impervious cover, and site grading can lead to drying of karst features and changes in nutrient input (Howarth 1983a). Loss or alteration of surface biological communities can potentially adversely affect karst invertebrates by altering nutrient input, altering the stable physical environment of caves, and introducing potentially harmful organisms. When changes in composition of surface plant communities occur, potential exists to alter the type and quality of nutrient input into cave systems (Culver et al. 2000).

Changes in surface plant communities can in turn alter the local diversity and/or relative abundance of surface animal species (Elliott and Reddell 1989, USFWS 1994). Alterations in surface faunal communities may lead to decreased levels of nutrient input into caves via a decrease in populations of troglophiles and trogloxenes. If the surface plant community is removed (replaced with impervious cover, left as bare ground, etc.) this could lead to fluctuations in cave temperatures and moisture regimes that are outside the normal range of variability for the system. Lastly, disturbance of soils may lead to increased density of red imported fire ants (*Solenopsis invicta*) (Porter et al. 1988) or alter the physical environment of the cave through increased sedimentation.

Imported fire ants, an exotic species in central Texas, may be a threat to karst invertebrates through direct predation and competition with native species for food resources. Imported fire ants have been documented within and near caves and have been observed feeding on dead troglobites, cave crickets, and other species within caves (Elliott 1992, 1994). Taylor et al. (2003) found that foraging by red imported fire ants around caves was inversely correlated with foraging of native ant species, and that cave crickets often arrived at baits placed aboveground at night before fire ants, but departed at the arrival of fire ants, indicating competition for at least some food resources. Reduction in cave cricket foraging and, hence, cave cricket populations would lead to a reduction in overall productivity in the caves (Taylor et al. 2003).

Regarding the above-described potential threats, it is unknown how activities that result only in changes to surface plant and/or animal communities actually affect karst invertebrate species. Caves containing the listed invertebrates are known to occur in a wide variety of landscapes, including relatively dense woodland, semi-open or open woodland, shrubby grassland, grassland, and suburban land, including at least one backyard (USFWS 1994). Therefore, while the "decomposer" communities contained within caves are undoubtedly dependent upon input of nutrients from surface communities, the simple presence of a surface vegetation community and

the animals it supports may be far more important to sustaining a cave ecosystem than the composition of that surface community. Research is needed to clarify the role that composition of surface communities has on distribution and abundance of karst species.

3.2.1.4 Travis/Williamson Counties Karst Invertebrate Recovery Plan

The Recovery Plan for the endangered karst invertebrates of Travis and Williamson Counties (Travis/Williamson County Recovery Plan) was issued in 1994 (USFWS 1994). At that time, the Service believed that the prospect for complete recovery and delisting (removal from the endangered species list) of all these species was uncertain, and it was reluctant to prescribe a plan that included a full delisting of these karst species. Thus, the Travis/Williamson County Recovery Plan includes "recovery criteria" that once met, would allow only for downlisting from endangered to threatened. Once these criteria are met, it is assumed that a revised Recovery Plan would address the conditions needed for full recovery and delisting.

Recovery criteria are only intended to serve as recommendations and are not mandatory steps toward achieving downlisting, or indeed, in the case of the Williamson County karst invertebrates, guidelines for complete recovery. Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect listed species. The basic premise of the Travis/Williamson County Recovery Plan is protection of caves set within discrete KFAs based on distribution of the species within the KFRs as originally defined by Veni and Associates (1992) and modified by the Service (USFWS 1994). The recovery criteria to achieve downlisting for the karst invertebrates include the following:

- Three KFAs within each KFR in each species' range should be protected in perpetuity.
- If fewer than three KFAs exist for a species, that species would still be considered for downlisting if it occurred in two KFAs and those were adequately protected.

While the Recovery Plan indicates that three KFAs should be set aside within each KFR for each listed species, it provides only general guidelines for determining the configuration of these KFAs (see HNTB Corporation 2005). For example, according to the Recovery Plan, KFAs should be spatially separated such that a single catastrophic or stochastic event (e.g., disease, flooding, contamination, etc.) would not be likely to impact multiple KFAs at a time. The Recovery Plan also states that "to be considered "protected," a karst fauna area should contain a large enough expanse of contiguous karst and surface area to maintain the integrity of the karst ecosystem on which each species depends. The size and configuration of each [KFA] should be adequate to maintain moist, humid conditions, air flow, and stable temperatures in the air-filled voids; maintain an adequate nutrient supply; prevent contamination of surface and groundwater entering the ecosystem; prevent or control the invasion of exotic species, such as red imported fire ants; and allow for movement of the karst fauna and nutrients through the interstitial spaces between karst features."

3.2.1.5 Distribution and Status of the Karst Invertebrates in Williamson County

Figure 3-1 shows the KFR boundaries within the Karst Zone as delineated in the Travis/Williamson County Recovery Plan, the better known caves inhabited by listed karst invertebrates, and their ranges. In 1988 and 1993 when the Service listed the karst invertebrates

of Travis and Williamson Counties, and subsequently prepared the Travis/Williamson County Recovery Plan in 1994, the species were considered far more rare than they are today. Benefits that have accrued to these species by the original listing actions include a more focused local and scientific interest in the species such that many additional caves in Williamson County have been found. In 1963, the Texas Speleological Survey reported only 68 caves in their paper *The Caves of Williamson County* (Reddell and Finch 1963). The number of known caves in the area today is 590 (SWCA 2006a). Thus, many more caves supporting the listed species are known now than were known nearly two decades ago, and a significant number of these sites are under protective management.

In 1988, the *Texella* harvestman (then considered a single species, *T. reddelli*) was known from only five caves throughout its range. Due to increased interest and greater intensity of biotic investigations in caves, by 1994, after *Texella* had been split into two species, the new species (*T. reyesi*, or Bone Cave harvestman) had been found in an additional 55 caves. Today the Bone Cave harvestman is known from at least 154 caves, most of which are in Williamson County (Reddell 2004; USFWS unpublished data; SWCA 2006a; Ubick and Briggs 1992, 2004).

The Tooth Cave ground beetle is also known from dozens more caves today than in 1988 and 1994. Known only from two caves at the time of its listing in 1988, this ground beetle is known today from at least 52 caves. While the Coffin Cave mold beetle is known from far fewer caves (approximately 20) than either of the other two species, its relatively widespread range and elusive nature (this mold beetle is extremely small and hard to find even if present) suggests that future intensive surveys will likely reveal additional locations within the boundaries of its known range. Coffin Cave mold beetles may be overlooked now because once surveyors discover the much larger and easier to see Bone Cave harvestman in a cave (and thus establish the presence of an endangered species), they often look no further. More exhaustive searches of caves known to be occupied by the Bone Cave harvestman (whose range overlaps that of the mold beetle and whose habitat requirements are similar) may eventually reveal the presence of the mold beetle as well.

Not only are many more occupied caves known today than in 1988 and 1993, but several more caves occupied by the listed species are now protected and under some type of conservation management than was the case nearly two decades ago (Travis County 2005; SWCA 2006a; USFWS 1994, 2001, 2004a, 2005a). Numerous occupied caves and cave systems have been avoided and set aside in conservation areas of various sizes, some of which have conservation area boundaries that are very small (1–10 acres; 0.4–4.0 hectares) and likely do not meet the definition of a KFA. Other existing conservation areas are, however, of sufficient size that they either currently meet the KFA general guidelines or could meet those guidelines if enlarged or otherwise enhanced (see Table 3-1, Figure 3-2).

Table 3-1. Existing and proposed karst conservation areas in Williamson County and preliminary determination of suitability for KFA status (shaded conservation areas appear to be suitable, with appropriate modifications, for designation as Service-approved KFAs).

Existing Conservation Area	Karst Fauna Region [1]	Listed Species Present [2]	Acreage (ha)	Suitability for KFA Status [3]
1. Cobbs Cavern*	NW	TR and BT	165 (67)	Low
2. Sun City Pricilla's Well	NW	TR and BT	13.4 (5.6)	High
3. Sun City Karankawa	NW	TR and BT	126 (51)	High
4. Sun City Medicine Man	NW	TR and BT	12.6 (5)	Unknown
5. Sun City Woodruff	NW	TR	10.7(4.4)	Unknown
6. Sun City Unearthed	NW	TR and BT	37.6 (15.2)	Medium
7. Sun City Dragonfly	NW	TR and BT	13 (5.3)	Low
8. Sun City Shaman	NW	TR and BT	70.9 (29)	High
9. Russell Park Estates (Whitney Tract) / Sunless City	NW	TR and BT	145 (59)	High
10. Temples of Thor	NW	TR and BT	105 (43)	High
11. Shadow Canyon*	NW	TR	44(18)	Unknown
12. Millennium Preserve	GT	TR	90 (36)	High
13. Wilco Preserve	GT	TR	130 (52)	High
14. Highlands of Mayfield	GT	TR (Probable)	40 (16)	High
15. Zapata	GT	TR	unknown	Unknown
16. Christy Quintana Caves A–D	McRR	TR	>100 (>40)	Medium
17. Beck Preserve	McRR	TR	40 (16)	High
18. Chaos Preserve	McRR	TR	30 (12)	Medium
19. Testudo	Cedar Park	RP	26 (11)	Unknown
20. Buttercup Creek	Cedar Park	RP	163 (66) noncontiguous	Unknown
21. Discovery Well	Cedar Park	RP	106 (43)	Unknown
22. Big Oak Cave	Cedar Park	RP	10 (4)	Unknown

* *Eurycea naufragia* (Georgetown salamander) present.

[1] Karst fauna regions: NW = North Williamson County; GT = Georgetown, McRR = McNeil/Round Rock; CP = Cedar Park.

[2] Listed species: TR = *Texella reyesi* (Bone Cave harvestman); BT = *Batrisodes texanus* (Coffin Cave mold beetle); RP = *Rhadine persephone* (Tooth Cave ground beetle).

[3] The assignment of suitability categories of High, Medium, and Low is based on existing information about the conservation area's potential to meet KFA criteria (see the text in Section 5.3.1.1), including, but not limited to, presence of listed species, size of preserve, portion of the surface and subsurface drainage basins preserved, and the proximity to other preserves. The suitability of the areas listed here as KFAs has not yet been assessed or approved by the Service.

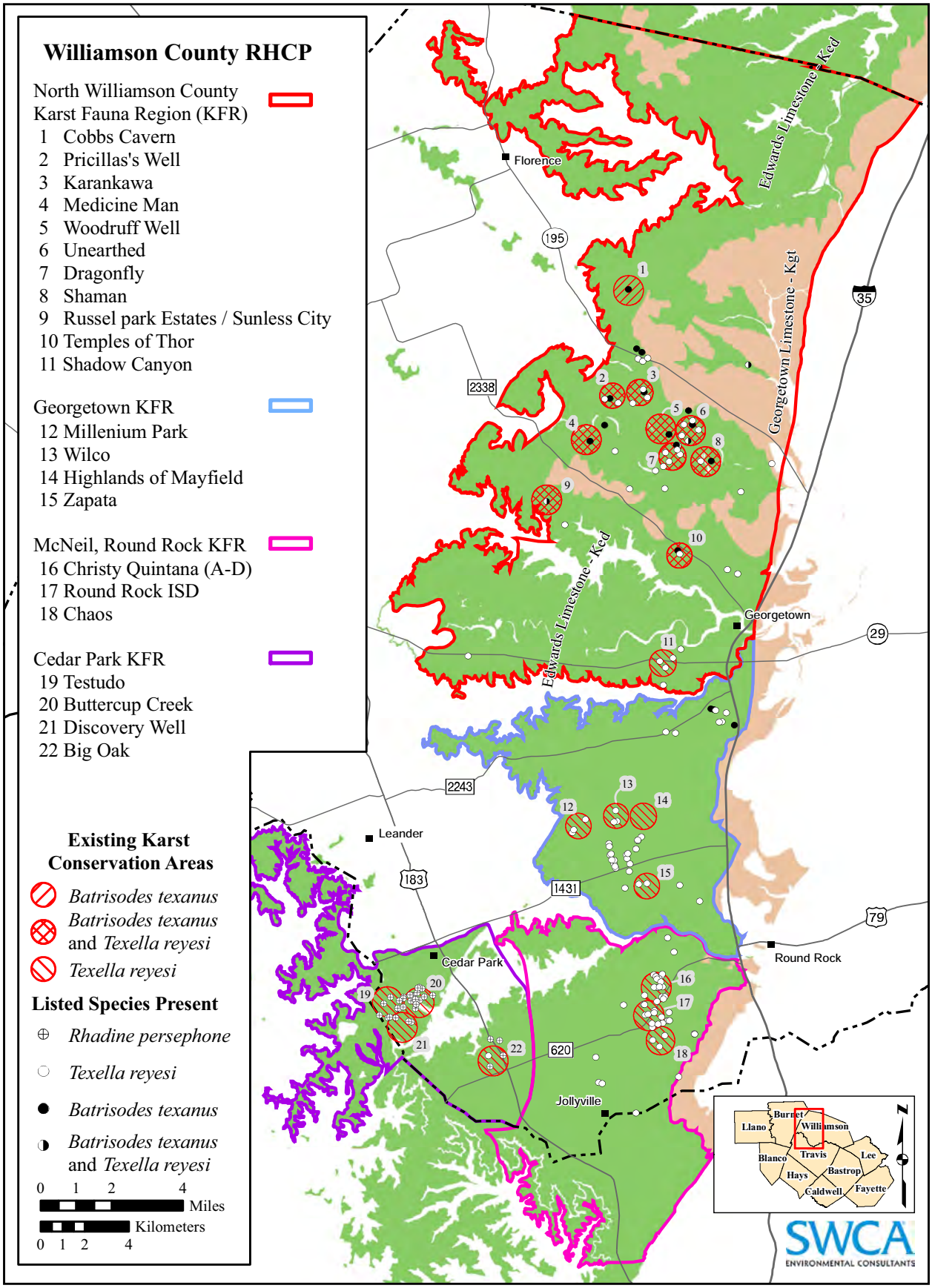

Figure 3-2. Existing karst conservation areas by karst fauna region and species-occupied caves in Williamson County, Texas.

Within most of these existing conservation areas, cave entrances have been gated to prevent unauthorized access, and management actions such as red imported fire ant control have been implemented. Efforts at control of red imported fire ants on a number of cave sites in Williamson County currently under management by the Texas Cave Conservancy indicate that with periodic treatment using boiling water on ant colonies, fire ant proliferation is controlled (M. Walsh, Texas Cave Conservancy, pers. comm. to SWCA, 2006; see also Reddell 2000).

The Travis/Williamson County Recovery Plan notes that, because of the time and expense involved, the recovery objective cannot be met if establishment of KFAs is delayed until the needs of karst invertebrate species for long-term survival are determined through research (USFWS 1994). In implementation of the RHCP, establishment of KFAs will proceed based on existing knowledge and will be informed by new knowledge, but will not be delayed due to incomplete knowledge. KFA status will be evaluated on a case-by-case basis.

While much needs to be done, given the progress in preserving occupied caves since 1988, downlisting[32] for the harvestman and ground beetle is a real possibility and may be imminently achievable through the combined conservation measures set forth in this RHCP, in the Balcones Canyonlands Conservation Plan for Travis County (RECON and USFWS 1996), and in a variety of individual project-related Biological Opinions and incidental take permits.

3.2.2 Migratory Songbirds

Two federally endangered bird species occur in Williamson County, the golden cheeked-warbler and the black-capped vireo. The golden-cheeked warbler was emergency listed May 4, 1990, and gained permanent listing status December 27, 1990 (55 FR 53153–53160). The black-capped vireo was federally listed as endangered October 6, 1987 (52 FR 37420–37423). In June 2007, the Service recommended that the vireo be reclassified as threatened in its 5-Year Review of the species (USFWS 2007a).

3.2.2.1 Golden-cheeked Warbler (*Dendroica chrysoparia*)

3.2.2.1.1 Golden-cheeked Warbler Natural History

Photo by Steve Maslowski

The golden-cheeked warbler winters in southern Mexico and northern Central America and breeds in the Edwards Plateau and Cross Timbers Level III ecoregions of central Texas.[33] Figure 3-3 shows the range of this species in Texas by county. Most golden-cheeked warblers arrive in central Texas in early to mid-March and start returning to their wintering grounds in July.

[32] The Travis/Williamson County Recovery Plan objective provides only for downlisting, not delisting, because at the time that Recovery Plan was written, the Service concluded that the prospects for complete recovery were uncertain (USFWS 1994).

[33] The Level III ecoregions are subdivided into Level IV ecoregions. Williamson County falls within the Balcones Canyonlands subdivision of the Edwards Plateau ecoregion, and within the Limestone Cut Plain subdivision of the Cross Timbers ecoregion.

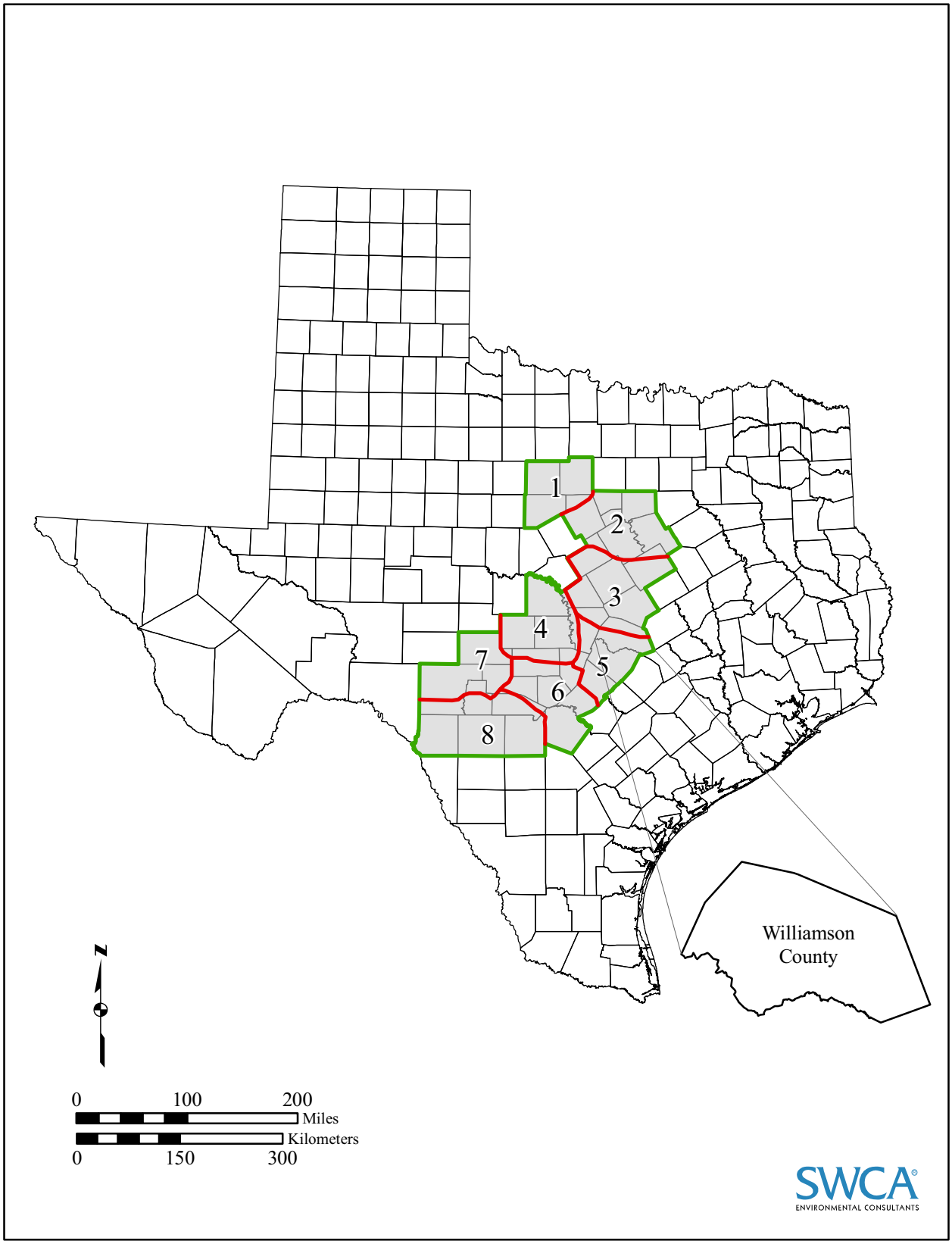

Figure 3-3. The breeding range of the golden-cheeked warbler (exclusive to Texas) (after Pulich 1976), and designated recovery regions (USFWS 1992).

Golden-cheeked warbler breeding habitat typically consists of relatively dense and mature woodland composed of a combination of Ashe juniper (*Juniperus ashei*) and hardwood tree species, especially deciduous oaks. Other hardwood tree species often found in warbler breeding habitat include escarpment black cherry (*Prunus serotina* var. *eximia*), Arizona black walnut (*Juglans major*), cedar elm (*Ulmus crassifolia*), and Texas ash (*Fraxinus texensis*). Ashe juniper can account for 10 to 90 percent of trees present in warbler habitat, and hardwoods can account for 10 to 85 percent of trees present; woodlands utilized regularly by warblers also typically have canopy cover greater than 50 percent and tree height greater than 10 feet (3 meters) (USFWS 1996a, Alldredge et al. 2002).

*Territory Density***.** The density at which golden-cheeked warblers occur in woodlands is known to vary with habitat quality. Typically, the species will defend territories of 4 to 8 acres (1.6–3.2 hectares) in higher quality habitat, but may establish territories of 16 to 20 acres (6.5–8.1 hectares) or larger in lower quality habitat (USFWS 1996a). Pulich (1976) used warbler densities of 19.8 acres (8 hectares)/pair, 49.4 acres (20 hectares)/pair, and 81.5 acres (33 hectares)/pair for good, average, and marginal habitat, respectively, in formulating one of the first population estimates for the species. Subsequent studies have reported a range of territory densities from 50 acres (20 hectares)/pair to 3.3 acres (1.3 hectares)/pair (Kroll 1980, Wahl et al. 1990, USFWS 1996a, Travis County Natural Resources Division 2004).[34]

Habitat Quality and Patch Size. As discussed below, some studies indicate that woodland patch size influences golden-cheeked warbler use of potentially suitable habitat. In general, habitat quality decreases as density of deciduous trees and/or percent canopy closure decreases (Beardmore 1994, DeBoer and Diamond 2006). Recent studies demonstrate that habitat requirements vary depending on landscape-level factors such as patch size, tree species composition and structure, slope, adjacent land use, and distance from larger blocks of regularly occupied habitat (Dearborn and Sanchez 2001, Miller et al. 2001, Magness et al. 2006, DeBoer and Diamond 2006).

Wahl et al. (1990) excluded patches of potentially suitable woodland that were less than approximately 123.5 acres (50 hectares) in size from a habitat-based estimate of range-wide breeding population as they believed this was the lowest patch size of importance to breeding golden-cheeked warblers. They considered prime habitat to be in woodland patches that are at least 247 acres (100 hectares) in size (Wahl et al. 1990). Since 1990, other studies have attempted to identify minimum warbler habitat patch size requirements. DLS Associates and WPTC Consulting Group (1994) found that the smallest of 11 habitat areas supporting one to two warblers in Travis County were 102–325 acres (41.1–131.6 hectares). Arnold et al. (1996) suggested that approximately 56.8 acres (23 hectares) was the minimum threshold patch size required for warbler occupancy and consistent production of young. Based on a study of 100 patches of woodland of varying sizes, Coldren (1998), like Wahl et al. (1990), concluded that golden-cheeked warblers selected against patches of woodland smaller than approximately 247 acres (100 hectares).

[34] Researchers variously represent density as acres or hectares per male, territory, or pair. For consistency and to avoid confusion, the expression "acres/pair" is used throughout in this document.

Coldren (1998) investigated the relationship of occurrence and breeding success of warblers to human use of land directly adjacent to habitat patches but only explored cursorily the relationship of occurrence of warblers to degree of isolation of potential habitat patches and use of lands between patches. In general, the chance for occurrence of golden-cheeked warblers in a smaller patch of woodland that appears suitable for use from a vegetative standpoint generally decreases with increased distance of that patch from a larger block of occupied habitat. It also appears that presence of extensive amounts of human development between a patch of potentially suitable woodland and a larger block of occupied habitat further decreases the probability of that patch being utilized by warblers (Wahl et al. 1990, Coldren 1998).

Magness et al. (2006) developed a method for predicting presence or absence of golden-cheeked warblers in a given landscape and found that the birds occurred in a habitat patch only when landscape composition within a 400-meter radius exceeded 40 percent woodland, and that the likelihood of occupancy was greater than 50 percent only when landscape composition exceeded 80 percent woodland. While they could not rule out a relationship between habitat fragmentation and overall habitat quality as measured by nesting success and recruitment, Magness et al. (2006) did conclude that common measures of habitat fragmentation, including edge density, mean-nearest neighbor, and distance between woodland patches, were poor predictors of species occurrence across all spatial scales. The existing studies on optimum patch size for the golden-cheeked warbler are useful for describing optimum or prime habitat, but they do not provide limits on the smallest patch size within which the species *could* be found nesting. The smallest discrete patch of woodland in which SWCA has observed these warblers successfully fledging young was approximately 11 acres (4.5 hectares) in size (SWCA unpublished data). This patch was set in a rural landscape and was surrounded by open grassland, although larger patches of golden-cheeked warbler habitat occurred commonly in the area. The nearest larger patch was approximately 75 acres (30.4 hectares) in size and occurred approximately 600 to 800 feet (183–244 meters) away from the 11-acre patch.

Breeding Range Population Size. The total golden-cheeked warbler population is not precisely known, but distribution of the species across its breeding range in Texas is thought to be patchy and localized (Ladd and Gass 1999). In 1990, Wahl et al. estimated the population to range from 4,822 to 16,016 breeding pairs. Corrections to the Wahl et al. (1990) estimate were applied in the Golden-cheeked Warbler Recovery Plan to derive a 1990 population estimate of 13,800 pairs (USFWS 1992). No range-wide population estimate has been made since that time, but it is possible that the population has increased since 1990. For example, at Fort Hood Military Reservation (Fort Hood), Coryell and Bell Counties, where golden-cheeked warblers are afforded some protection and management, and where annual population censuses have taken place for over a decade, golden-cheeked warbler detections along point count routes almost doubled from 1992 to 2003 (The Nature Conservancy 2005). Based on extrapolation from warbler densities in established study areas, total warbler population on Fort Hood in 2003 was estimated to be approximately 4,514 pairs on 52,935 acres (21,431 hectares), or 11 acres (4.5 hectares)/pair (Peak 2003, USFWS 2005f). The Service is currently conducting a status review of the golden-cheeked warbler that is likely to result in a revised estimate of the total population number, and SWCA has been contracted by the Texas Department of Transportation to independently assess the species' status. SWCA's preliminary estimates indicate that there

may be up to 20,000–25,000 breeding warbler pairs throughout their range, an increase of at least 10,000 pairs over the 1990 estimate (SWCA 2007).

3.2.2.1.2 Primary Threats to the Golden-cheeked Warbler

The greatest threats to the continued existence of the golden-cheeked warbler are loss of habitat and urban encroachment within its breeding habitat (Wahl et al. 1990, USFWS 1992, Coldren 1998). Other factors include the loss of deciduous oaks (used for foraging) to oak wilt, brood parasitism by brown-headed cowbirds (*Molothrus ater*), and predation and competition by blue jays (*Cyanocitta cristata*) and other urban-tolerant birds (USFWS 1992). Human agricultural activities have also eliminated a considerable amount of warbler habitat within the central and northern parts of the range of the species (USFWS 1992). Habitat loss continues as suburban developments spread into golden-cheeked warbler habitat along the Balcones Escarpment, especially in a growth corridor from Williamson County southward through Bexar County (USFWS 2005b).

A common factor in the decline of neotropical migratory passerines is habitat degradation and/or destruction in core breeding areas. Some studies (Robinson 1992, Donovan et al. 1995) also show that declining populations of neotropical migrants in marginal, outlying habitats may be due to declining productivity in central populations that would normally emigrate to the less productive areas. Research on golden-cheeked warblers has indicated that occupancy and productivity are significantly lower in "small" patches of habitat than in larger ones (Maas-Barleigh 1997, Coldren 1998).

Populations of golden-cheeked warblers appear to be less stable in small habitat patches surrounded by urbanization (Engels 1995, Arnold et al. 1996, Moses 1996). Some studies indicate that abundance of the warbler is reduced within 656 to 1,640 feet (200–500 meters) of an urban edge (Engels 1995, Arnold et al. 1996, Coldren 1998). Coldren (1998) reported that warbler occupancy declined with increasing residential development and roadway width. Moreover, increases in the amount of development typically lead to fragmentation of remaining warbler habitat. Habitat fragmentation can lead to increased predation rates and increased distances for juvenile dispersal, thus decreasing recruitment (Robinson et al. 1995, Coldren 1998, Rappole et al. 2003).

Currently, three large populations of golden-cheeked warblers receive some degree of protection. These populations breed on the Balcones Canyonlands National Wildlife Refuge in Burnet, Travis, and Williamson Counties; on Balcones Canyonlands Conservation Plan lands in Travis County; and on Fort Hood lands. Smaller populations receiving some form of protection occur on U.S. Army Corps of Engineers' (Corps) land at Lake Georgetown in Williamson County; Hickory Pass Ranch in Burnet County; Pedernales Falls State Park in Blanco County; Guadalupe River State Park/Honey Creek State Natural Area in Comal County; at Government Canyon State Natural Area, Camp Bullis Military Reservation, and the Indian Springs/Cibolo Canyon areas in Bexar County; Lost Maples State Natural Area in Bandera County; Garner State Park in Uvalde County; Kerr Wildlife Management Area in Kerr County; and Kickapoo Cavern State Park in Edwards and Kinney Counties. To the north of Williamson County, small populations receive protection at Colorado Bend State Park in Lampasas and San Saba Counties; Meridian

State Park in Bosque County; Dinosaur Valley State Park in Somervell County; and Possum Kingdom State Park in Palo Pinto County.

3.2.2.1.3 Golden-cheeked Warbler Recovery Plan

The Service prepared a Recovery Plan for golden-cheeked warblers in 1992, which divided the breeding range of the warbler into eight regions. Northern Williamson County lies within Recovery Region 3, along with all of Bell and Coryell Counties, and portions of Burnet, Bosque, Hamilton, Lampasas, and McLennan Counties. Southern Williamson County lies within Recovery Region 5, along with all of Travis County and portions of Blanco, Burnet, and Hays Counties (See Figure 3-3).

The Recovery Plan identified preservation and protection of one viable warbler population in each of the eight recovery regions as a primary criterion for delisting of the species. "Viable population" is not defined in the Recovery Plan, although the plan does suggest a viable population of warblers could range from 500 pairs to a few thousand individuals. More recently, the Service has indicated a viable population of golden-cheeked warblers may need to be as large as 3,000 pairs of warblers (USFWS 1996a, Alldredge et al. 2002).

Based on the above, a viable population of warblers appears to be present in Recovery Region 3 on Fort Hood, where the population is thought to comprise over 4,500 singing males (Peak 2003, USFWS 2005f). Protected populations of warblers are also present in Recovery Region 5 on the Balcones Canyonlands National Wildlife Refuge, where the warbler population is estimated to range from 800 to 1,000 (C. Sexton, U.S. Fish and Wildlife Service, pers. comm. to SWCA, 2007) and on Balcones Canyonlands Conservation Plan lands where hundreds more are thought to breed (J. Kuhl, Travis County, pers. comm. to SWCA, 2007). These two areas are relatively close together, being separated by a distance of approximately 5 miles (8 kilometers).

3.2.2.1.4 Current Status of the Golden-cheeked Warbler and its Habitat in Williamson County

Population size of the golden-cheeked warbler in Williamson County is not known. Surveys for the species have been conducted on comparatively few properties, with most of those surveys having been conducted on Corps land around Lake Georgetown and on private lands south of State Highway 29 (USFWS data).[35] Acknowledging the relative paucity of warbler survey data and our inability to predict a county-wide population estimate accurately, this section presents an assessment of golden-cheeked warbler habitat within the County based on 1) an initial delineation of all potential golden-cheeked warbler habitat in the County, and 2) an assessment of the possible acres of varying habitat quality within this delineation using the approach developed by Magness et al. (2006).

Initial Delineation of Potential Golden-cheeked Warbler Habitat. The range of the golden-cheeked warbler in Williamson County is limited to those lands occurring west of the Balcones Escarpment in the Balcones Canyonlands and Limestone Cut Plain Level IV ecoregions (see

[35] The U.S. Fish and Wildlife Service Austin Ecological Services Office compiles all golden-cheeked warbler survey data submitted to it by permitted biologists. These data are not available on-line but are publicly available at the Service office and were reviewed by SWCA in support of preparation of this document.

Figure 1-1). Within this range, distribution of woodlands containing potential golden-cheeked warbler habitat was delineated by SWCA using 2004 color infrared imagery available through the Texas Natural Resource Information System (http://www.tnris.state.tx.us) (Figure 3-4). Factors considered in the delineation of potential warbler habitat included density of woodland, apparent density of Ashe juniper and deciduous trees, size of trees, habitat patch size, and land use at local and landscape scales.

In general, woodlands for which survey data were lacking were classified as potential warbler habitat if they had canopy closure in excess of 50 percent and appeared to be composed of a combination of larger Ashe juniper and broad-leafed hardwood trees. Tree heights were estimated based on crown diameter, which is apparent on the digital imagery, and the assumption that trees are generally as tall as their crown is wide. Woodlands appearing to contain higher densities of smaller trees were also identified as potential habitat if percent canopy closure was greater, generally in excess of 80 percent, and if some larger hardwood trees were also present. Woodlands appearing to be composed almost wholly of Ashe juniper or hardwood trees were excluded from the habitat delineation.

Patches of woodland smaller than 11 acres (4 hectares) were excluded from the delineation because this is the smallest size patch in which SWCA has observed warblers successfully fledging young. It is recognized that it becomes increasingly unlikely that warblers would utilize a small patch of woodland with increasing distance of the patch from larger blocks of habitat, or increasing level of development around the patch (Engels 1995, Arnold et al. 1996, Moses 1996). However, because data are limited to provide a basis for making decisions on how to vary minimum patch size across a landscape, SWCA applied the minimum patch size of 11 acres throughout the potential range of the warbler in Williamson County. This no doubt has resulted in identification of some small patches of woodland as potential habitat in developed or otherwise isolated areas that have a very low likelihood of supporting golden-cheeked warblers.

Through review of aerial photography as described above, SWCA delineated approximately 34,465 acres (13,947 hectares) of woodland in Williamson County as potential golden-cheeked warbler habitat (Figure 3-4). As shown in Figure 3-4, habitat patches in Williamson County are, with a few exceptions, relatively small, fragmented, and isolated.[36] The few exceptions include habitat on Corps-managed lands around Lake Georgetown and on relatively isolated patches of private land in the San Gabriel River and Brushy Creek corridors.

Assessment of Golden-cheeked Warbler Habitat Quality. Figure 3-4 also depicts locations of warbler observations made in Williamson County based on records held by the Service and the TPWD. A comparison of warbler observations and potential habitat on Figure 3-4 shows considerable overlap. Warbler observations tend to coincide with the presence of potential habitat, although this is not always the case.

[36] The relative sparseness of golden-cheeked warbler habitat in Williamson County is evident when compared with the extent and density of warbler habitat patches in counties farther south (see Chapter 4, Figure 4-3).

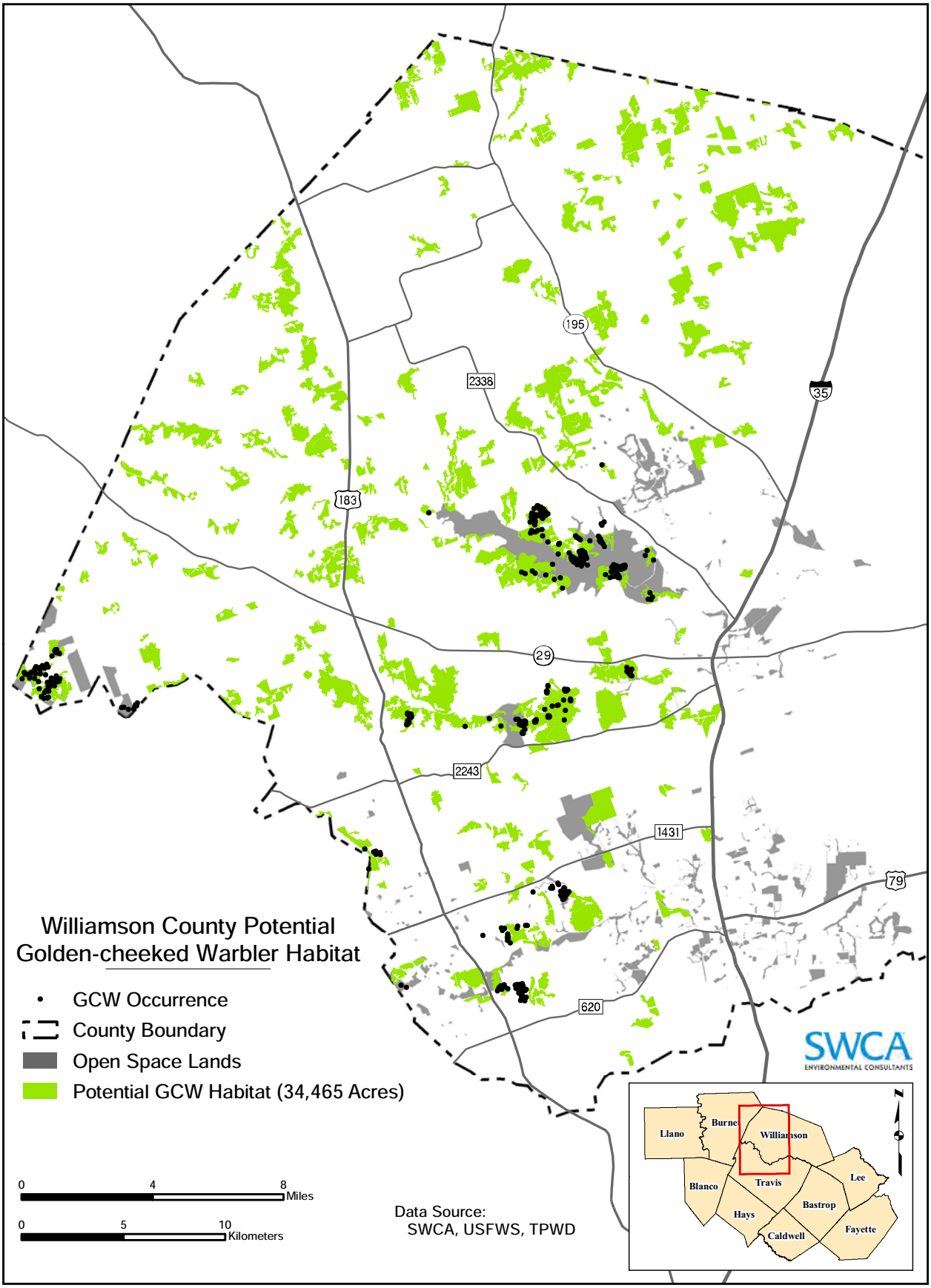

Figure 3-4. Golden-cheeked warbler (GCW) occurrences in Williamson County, Texas, and distribution of potential warbler habitat (at least 50% woodland composition in patches larger than 11 acres).

The apparent absence of habitat at a warbler observation site in Figure 3-4 may indicate a loss of habitat subsequent to the sighting,[37] or possibly an incidental sighting of a migrating bird passing through unsuitable habitat. Conversely, many areas identified as potential habitat do not contain warbler observations. Such areas either may not have been surveyed for warblers or visited by a knowledgeable birder, or sightings did not occur during surveys. The absence of observations may also indicate that the area identified as potential golden-cheeked warbler habitat is not regularly, or ever, occupied by warblers. Occupancy rates of potential habitat may vary annually as a result of natural fluctuations in the golden-cheeked warbler population. It is also true that, while any habitat patch greater than 11 acres (4.5 hectares) of woodland (all the habitat depicted in Figure 3-4) containing junipers and oaks *could* contain golden-cheeked warblers during the breeding season, it has been demonstrated that the probability of occurrence in an area increases with increasing habitat quality (Wahl 1990, Coldren 1998, Magness et al. 2006).

Within the 34,465 acres of woodlands delineated in Figure 3-4, the quality of habitat and the probability that any given part of it will support golden-cheeked warblers is likely to vary greatly. Assessing the relative quality of habitat over such a large area in the absence of data on woodland species composition, canopy cover, etc., is problematic. Still, it is misleading to assume that all delineated 34,465 acres are suitable warbler habitat. In an attempt to rank the delineated acreage by its probability to support golden-cheeked warblers, this RHCP employs methods developed by Magness et al. (2006).

Using remote sensing Geographic Information System (GIS) techniques and logistic regression analysis, Magness et al. (2006) found that that the higher the percent woodland composition of the landscape within a 400-meter radius, and the greater the patch size of the largest woodland (also within a 400-meter radius), the greater the probability of habitat occupancy. At the 60 percent woodland composition (mature oaks and junipers), the probability of warbler occupancy was approximately 20 percent. At 80 percent woodland composition, the probability of warbler occupancy increased to approximately 50 percent.

Following the techniques of Magness et al. (2006), Figure 3-5 depicts portions of the woodlands within a 400-meter radius containing 80 percent or greater woodlands (in red) and at least 60 but less than 80 percent woodlands (in yellow). The remaining habitat (in green) depicts landscape with at least 50 but less than 60 percent woodlands.

Within Williamson County, approximately 5,277 acres have at least 80 percent woodland composition and at least a 50 percent probability of warbler occupancy. Approximately 8,108 acres have 60 to <80 percent woodlands and a 20 to <50 percent probability of warbler occupancy. Approximately 21,080 acres of potential warbler habitat have 50 to <60 percent woodlands and a <20 percent probability of warbler occupancy (Table 3-2).

[37] It should be noted that all historical golden-cheeked observations are depicted, while the habitat delineation reflects only the most current aerial photography (2004). Some observations may have occurred at sites where suitable warbler habitat once existed but has since been lost.

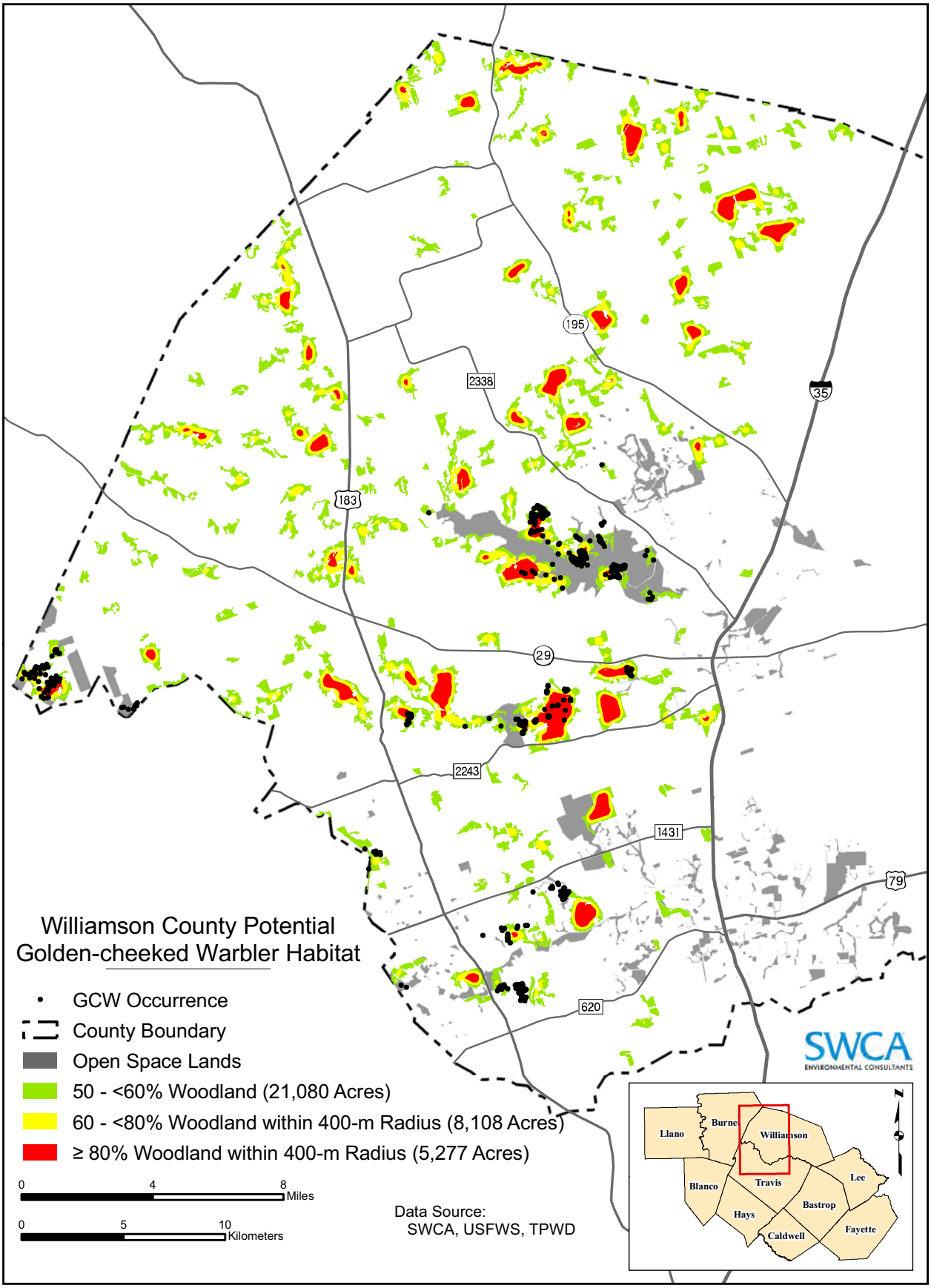

Figure 3-5. Golden-cheeked warbler (GCW) occurrences in Williamson County, Texas, and distribution of potential habitat at 50-<60%, 60-<80%, and ≥ 80% woodlands composition within a 400-meter radius.

Table 3-2. Estimated amount of woodland habitats at varying levels of percent composition and golden-cheeked warbler probability of occupancy in Williamson County.

Percent Woodland Composition (color on Figure 3-5)	Percent Probability of Occupancy by Warblers	Acres of Potential Habitat (% of total) (hectares)
≥80 (red)	≥50	5,277 (15%) (2,136)
60–<80 (yellow)	20–<50	8,108 (24%) (3,281)
50–<60 (green)	<20	21,080 (61%) (8,531)
Total	**-**	**34,465 (100%) (13,947)**

Golden-cheeked Warblers on Managed Lands. Approximately 4,363 acres (1,766 hectares) of the 34,465 acres of woodland in Williamson County identified as potential warbler habitat are contained in various public and private open space lands, parks, or easements. Status of the warbler on these lands is generally unknown, although these totals do include preserved and/or managed lands at Lake Georgetown, Russell Park Estates (Whitney Tract), and portions of the Balcones Canyonlands National Wildlife Refuge where the species is known to occur regularly.

Around Lake Georgetown, the Corps manages 5,330 acres (2,157 hectares), approximately 1,310 acres (530 hectares) of which are covered by the lake conservation pool. Another approximately 2,937 acres (1,189 hectares) support dense to semi-open Ashe juniper/oak woodlands that are known to support golden-cheeked warblers. Lands owned by the Corps at Lake Georgetown are generally preserved but not managed specifically for the benefit of the warbler. These lands have not been comprehensively surveyed for warblers since 1992. At that time, it was estimated that 33 territorial males occurred on Corps-owned lands at Lake Georgetown (DLS Associates 1992). Approximately 139 acres (56 hectares) of dense Ashe juniper/oak woodland occur on preserved land on the Russell Park Estates property (Whitney Tract) directly adjacent to Corps-owned woodlands at Lake Georgetown. This preserve area was established for the benefit of the warbler and was estimated to support all or portions of eight warbler territories in 2004 (SWCA 2004).[38] Managed lands within Balcones Canyonlands National Wildlife Refuge include several hundred acres of potential warbler habitat in Williamson County.

[38] Williamson County recently purchased the Russell Park Estates preserve (Whitney Tract).

3.2.2.2 Black-capped Vireo (*Vireo atricapilla*)

3.2.2.2.1 Black-capped Vireo Natural History

Photo by Texas Parks and Wildlife Dept.

The black-capped vireo occurs in western, central, and north-central Texas, a few localities in central Oklahoma, and in the states of Coahuila, Nuevo Leon, and Tamaulipas, Mexico (USFWS 1991, Farquhar and Gonzalez 2005). In central Texas, distribution of the vireo is restricted to habitats occurring west of the Balcones Escarpment. Black-capped vireos arrive in central Texas from late March to mid-April and generally return to their wintering grounds in September. The species winters primarily on the Pacific slope of western Mexico (Graber 1957, Marshall et al. 1984). Very few sightings of the black-capped vireo have been recorded from Williamson County (see Figure 3-6).

Breeding Habitat. Typical breeding habitat for the black-capped vireo consists of semi-open to relatively dense shrubland with vegetation cover down to ground level (Graber 1961). Grzybowski et al. (1994) characterized vireo habitat as having shrub cover of at least 35 percent and shrubby foliage present from ground level up to 6.6 feet (2 meters) in height.

Maresh (2005) documented a wider range of habitat usage, finding black-capped vireo territories in areas with woody cover ranging from less than 10 percent to greater than 90 percent with canopy height greater than 19.7 feet (6 meters). However, Maresh reaffirmed that areas occupied by vireos consistently contained shrubby vegetation within 2 meters of the ground.

In central Texas, black-capped vireo habitat is usually dominated by shin oak (*Quercus sinuata* var. *breviloba*) or evergreen sumac (*Rhus virens*); other species often occurring in vireo habitat include Texas oak (*Quercus buckleyi*), plateau live oak (*Quercus fusiformis*), fragrant sumac (*Rhus aromatica*), prairie sumac (*Rhus lanceolata*), poison ivy (*Toxicodendron radicans*), Texas persimmon (*Diospyros texana*), agarita (*Mahonia trifoliolata*), redbud (*Cercis canadensis*), and Ashe juniper (Maresh 2005, Travis County 1999).

Vireo breeding habitat in central Texas is typically early to mid-successional. Therefore, vireo habitat currently present in the region has potential to become unsuitable for the species with time as shrubs become taller and are replaced by trees, which usually then create too much shade for understory foliage to be maintained at a level suitable for vireos. Historically, it is believed that wildfires allowed for creation of vireo habitat by damaging Ashe juniper while enhancing growth of fire-adapted oak and sumac species (Travis County 1999).

Breeding habitat for the vireo can be maintained naturally by wildfire, or artificially by mechanical clearing or with prescribed burns. Fire stimulates growth of certain shrubs and causes hardwoods to sprout new growth at the base of trees, thereby providing the low foliage cover required by black-capped vireos (Campbell 1995). Selective thinning of Ashe juniper, as well as mulching shrubs to ground level can be used to create or maintain vegetation of a structure suitable for black-capped vireos.

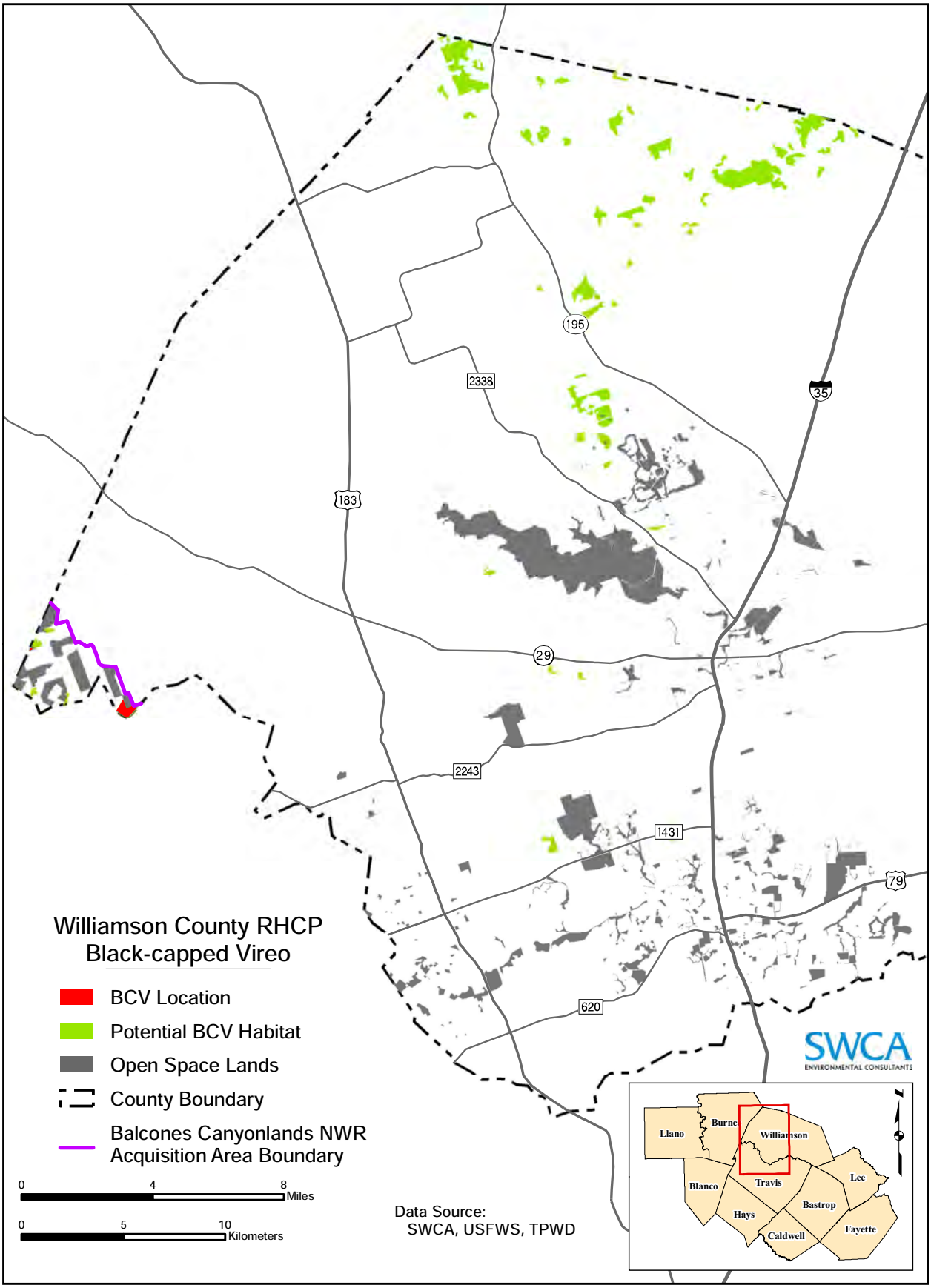

Figure 3-6. Black-capped vireo (BCV) occurrences and distribution of potential black-capped vireo habitat in Williamson County, Texas.

Geology, soils, and slope gradient and aspect can also influence the species composition and structure of woody vegetation communities. In general, thinner soil and rocky substrates allow shrubby communities to persist for longer periods of time. Steeper, south-facing slopes also often support shrubbier communities, sometimes indefinitely, because moisture availability can be too low to support trees. Shrub species preferred by the vireo occur most commonly, but not exclusively, on limestone substrates, with distribution of the vireo in central Texas correlating strongly with outcrop of the Fredericksburg Group of limestones (USFWS 1996b).

Territory Size. Male vireos generally establish territories that range in size from 1 to 10 acres (0.4–4.0 hectares). Average territory size is 2 to 4 acres (0.8–1.6 hectares; Graber 1957, Tazik and Cornelius 1989). Black-capped vireos often occur in clusters within patches of habitat, with the species apparently receiving benefit from increased social interaction as reproductive success is greater in larger groups of birds than in smaller groups (USFWS 1991).

Population Size. The total black-capped vireo population is unknown, owing to much of the range of the species in Mexico and Texas encompassing privately held lands that have not been surveyed. Black-capped vireo habitat can also be difficult to identify from satellite imagery or aerial photography, making it infeasible to first estimate extent of potential habitat and then apply an assumed occupation rate to reach a population estimate. Estimates of population size are based on a limited but growing body of survey data, and those data suggest that populations of the vireo in its breeding range are increasing.

In 1991, the number of male vireos known to occur Oklahoma and Texas was on the order of 1,000 (USFWS 1991). By 1995, that number had increased to around 1,800 (USFWS 1996b). By 2005, the known U.S. population was 5,996 males (Wilkins et al. 2006). In Oklahoma, as of 2005, the combined number of territories on the Wichita Mountains National Wildlife Refuge and Fort Sill was in excess of 1,750 (USFWS 2005d). At least 6–7 territories were present in Cleveland County in 2004 (Shackford 2004), and 11–12 territories were present in Blaine County as of 2006 (J. Grzybowski, University of Central Oklahoma, pers. comm. to SWCA, 2006). The number of male black-capped vireos occurring in Texas was estimated to be approximately 9,200 in 2005 (Maresh 2005, Cimprich 2005). Of these, approximately 8,100 occurred on Fort Hood and another 687 occurred on and west of the southwestern Edwards Plateau in Edwards, Kinney, Real, Terrell, and Val Verde Counties.

In Mexico, the population of black-capped vireos is poorly known and, as of 1995, was believed limited to Coahuila (USFWS 1996b), although the species had been documented in Nuevo Leon, San Luis Potosi, and Tamaulipas (Phillips 1911; Davis in Graber 1961; Marshall et al. 1984, 1985). Benson and Benson (1990) estimated that 3,139 to 9,463 pairs of vireos could be present in Coahuila based on extrapolation from limited surveys. Results of surveys from 2001 through 2005 by Farquhar and Gonzalez (2005) indicated presence of high densities of black-capped vireos in northern Coahuila, consistent with the estimates of Benson and Benson (1990). Farquhar and Gonzalez (2005) also confirmed presence of black-capped vireos in Nuevo Leon and Tamaulipas, and considered it likely that breeding populations of the species are extant in San Luis Potosi. Thus, the Mexican population may be greater and distributed more widely than was thought at the time of listing in 1987.

In June of 2007 the Service completed a "5-Year Review" of the black-capped vireo (USFWS 2005c, 2007a). Findings of this review indicate that the overall breeding population of this species is substantially larger than was known as the time of the listing in 1987. At that time, the only known breeding locations accounted for fewer than 200 pairs, with a total estimated population of between 250 to 525 pairs (Marshall et al. 1985). Today the known population is at 6,269, including limited portions of the Mexico range (USFWS 2007a). From existing data, it is often difficult to determine whether the dramatic difference in numbers in the decade since the bird was listed is due to increased survey efforts or to substantial increases in natural reproduction. In many local situations, it could be that increased search efforts for the species has led to larger known populations. In some locations, however, evidence suggests that breeding populations have increased. For example, in three of the four areas where good population density data were available a decade ago, Fort Hood Military Reservation (Texas), the Wichita Mountain Wildlife Refuge (Oklahoma), and Fort Sill Military Reservation (Oklahoma), the known breeding populations have increased by almost 10 times (USFWS 2007a).

The conclusions of the 5-Year Review indicate that "…the current overall threat to the black-capped vireo is less in magnitude than it was at the time the species was listed. This is based on some threats decreasing in magnitude, the reconsideration of magnitude of certain threats, and the effects of conservation measures on the major threats to the species" (USFWS 2007a:22) The review concludes with the recommendation that the species be reclassified from endangered to threatened status.

3.2.2.2.2 Primary Threats to the Black-capped Vireo

Primary threats to the black-capped vireo include direct destruction of breeding habitat, loss or deterioration of breeding habitat through natural processes, low reproductive success, and indirect effects of land use on breeding grounds (USFWS 1991). Low reproductive success has been attributed to high rates of nest parasitism by brown-headed cowbirds (*Molothrus ater*) and nest predation by red imported fire ants and other species. Habitat loss occurs through clearing of land for ranching or other agricultural practices, and browsing of low-level vegetation by goats and other domestic animals, and clearing for residential developments, road construction, placement of utilities, and other land uses. Suppression of wildfire likely causes potentially suitable black-capped vireo habitat to develop at rates below those of historical times. Potential impacts to wintering habitat are thought to be relatively understudied (Grzybowski et al. 1994). However, a recent study by Powell and Slack (2006) found that clearing of brush for grazing and/or other agricultural purposes was common throughout the Mexico winter range, but did not conclude that such disturbance "could be considered a serious problem for the species." Interestingly, this study also indicated that the species is more of a habitat generalist on the wintering grounds than it is during the breeding season (Powell and Slack 2006).

The striking increases in vireo numbers on Fort Hood and at the Wichita Mountains National Wildlife Refuge and Fort Sill is thought to have resulted from concerted management efforts, including creation of new habitat, management of existing habitat to negate loss through successional processes, and aggressive trapping of brown-headed cowbirds (USFWS 1996b, 2005d). Studies have indicated that female black-capped vireos raise from 0 to 2.25 young per

year in areas where cowbirds are not controlled, but they can raise from 1.7 to 3.8 young per year in areas where cowbirds are controlled (USFWS 1996b).

On Fort Hood, where cowbirds are controlled and vireo nesting success is sampled annually, it was found that in 2005, 75.3 percent (232 of 308) of nests whose fates were known failed to produce fledglings (Cimprich 2005). Depredation was the leading cause of nest failure (186 of 232, or 80.2 percent). For those nests that were successful, the average number of fledglings produced per nest was approximately 1.17 (Cimprich 2005). In 2004, 53 percent of monitored vireo nests (n = 314) failed to produce fledglings, while successful nests produced an average of 3.22 fledglings per nest (Cimprich 2004).

3.2.2.2.3 Black-capped Vireo Recovery Plan

The Service prepared a Recovery Plan for the black-capped vireo in 1991 (USFWS 1991). Because of gaps in knowledge of the biology, ecology, and population status of the black-capped vireo at the time of its preparation, the Recovery Plan does not identify criteria for delisting of the species. Instead, it states that the vireo will be considered for downlisting to threatened when: 1) all existing populations are protected and maintained; 2) at least one viable breeding population exists in Oklahoma, Mexico, and four of the six recovery regions delineated in Texas; 3) sufficient and sustainable area and habitat on the winter range exists to support the breeding populations; and 4) the previous three criteria have been maintained for at least five consecutive years, and available data indicate that they will continue to be maintained.

The Recovery Plan divided the breeding range of the black-capped vireo into six regions and placed Williamson County within Recovery Region 2. In 1996, it was recommended that the six recovery regions for the vireo be revised to four and that Comal County be placed in the newly reconfigured Recovery Region 1 (USFWS 1996b), although this recommendation has not been adopted formally through issuance of a revised or amended Recovery Plan. "Viable population" is defined in the Recovery Plan as 500 to 1,000 breeding pairs of vireos. A population and habitat viability assessment performed for the vireo indicated that the vireo has a very low probability of going extinct even in a population of 200 to 400 breeding pairs if fecundity of $\geq$1.25 female offspring per female is achieved, either naturally or through management (USFWS 1996b). As of 2005, viable populations of black-capped vireos, as defined by the Recovery Plan, were present in Oklahoma and Texas (USFWS 2005d, 2005f, Cimprich 2005).

3.2.2.2.4 Current Status of the Black-capped Vireo in Williamson County

The range of the black-capped vireo in Williamson County is primarily limited to those lands occurring west of the Balcones Escarpment within the Balcones Canyonlands and Limestone Cut Plain Level IV ecoregions (see Figure 1-1). The status of the black-capped vireo in Williamson County is not known. In contrast to the golden-cheeked warbler, potentially suitable habitat for the vireo is very limited in extent in Williamson County. This is despite extensive outcrops of the Fredericksburg Group of limestones, a substrate known to support vireo habitat in other areas (USFWS 1996b). This is likely the result of topography, which is comparatively gentle across much of the region. Because topography is not rugged, soils are deeper and more apt to support

woodland rather than scrub, and land is relatively easy to keep free of woody vegetation where actively cleared for ranching purposes.

Records of the vireo from Williamson County are few. The species is known to occur regularly in Williamson County only within the acquisition area for the Balcones Canyonlands National Wildlife Refuge. A total of 33 male black-capped vireos occurred in this area as of 2005 (Maresh 2005). One second-year male vireo was discovered on April 15, 2006, near Cedar Hollow Camp on the south side of Lake Georgetown and was still present at that location as of May 20, 2006 (T. Fennell and K. McCormack, Audubon Society, pers. comm. to SWCA, 2006). A second vireo was discovered by SWCA on May 15, 2006, on the north edge of Lake Georgetown in scrub formed below the high flood pool elevation of the reservoir, but this bird could not be relocated on May 20, 2006 (P. Sunby, SWCA, pers. obs., 2006; T. Fennell, Audubon Society, pers. comm. to SWCA, 2006). Two male vireos were reported from a private property in the north-central portion of the County on April 3, 2004 (Neiman Environments Inc. 2004). It is not known whether these birds were territorial or transients because the property was visited on only one day and during the vireo migration period. One male vireo was detected on April 15, 2003, in Russell Park at Lake Georgetown, although this bird was believed to be a transient since it occurred in unsuitable habitat (Ashe juniper/oak woodland with negligible shrub development) and was not re-located on a visit to the area the following week (SWCA 2003). Figure 3-6 depicts locations of vireo observations made in Williamson County based on records held by the Service and TPWD.

Distribution of potential black-capped vireo habitat in Williamson County was delineated by SWCA for this RHCP using 2004 color infrared imagery available through the Texas Natural Resource Information System. As stated previously, vireo habitat can be difficult to identify from aerial photography. Prior to the delineation of potential habitat, the photo signature of known vireo habitat in Williamson and Travis Counties was inspected, and portions of western Williamson County were field-visited to compare actual vegetation communities occurring along roadsides with those predicted to occur based on prior review of the aerial photography. In addition, distribution of known vireo habitat in Williamson and Travis County was compared to soils maps for evidence of correlation between soils and distribution of habitat. In most cases, vireo habitat was developed on Eckrant soils in Williamson County, and on essentially identical soils in Travis County, although in that region they are referred to as Tarrant soils.

Factors considered in the delineation of potential vireo habitat included presence of deciduous shrubby vegetation (deciduous shrubs appear gray on the infrared photography; live oak appears pink and Ashe juniper appears maroon), density of shrubby vegetation, extent of shrubby vegetation, underlying geology, and soils. Minimum habitat patch size requirements of the vireo receive little treatment in the scientific literature. While vireos usually occur in groups within patches of suitable habitat, individual vireos, often second-year males, can occur in patches of shrubbery seemingly no larger than what is needed to provide for a single territory (P. Sunby, SWCA, pers. obs.). In general, lone birds in small patches of scrub occur in relatively close proximity to established groups of vireos. For the RHCP, no patches of shrubland smaller than 8 acres (3 hectares) were included in the delineation. This was not purposeful, but likely resulted from small patches of shrubland being difficult to distinguish on the aerial photography.

Through review of aerial photography as described above, approximately 4,267 acres (1,726 hectares) of potential black-capped vireo habitat were delineated in Williamson County (Figure 3-6). It is believed likely that this is an overestimate of the amount of truly suitable vireo habitat present in the County because shrubs occur in much lower densities in much of the delineated potential habitat than in habitat known to be occupied in Williamson and Travis Counties.

It is not believed that a meaningful population estimate can be developed for the vireo in Williamson County based on the acreage of potential habitat delineated therein. It is considered highly probable that black-capped vireos occur in some of the areas delineated as potential habitat, especially to the northwest of the Sun City Development and in the north-central portion of the County. However, it is also considered highly questionable whether vireos occur in the smaller and more isolated patches of delineated potential habitat considering how few vireos are known to occur in the County and how far removed these patches are from known vireo populations in Williamson and Travis Counties and on Fort Hood. It is also believed that the probability is good that some smaller patches of shrubby vegetation with potential to be occupied by vireos were not identified as potential habitat during the delineation process.

Approximately 33 male black-capped vireos occur in approximately 210 acres (85 hectares) of habitat managed for their benefit on the Balcones Canyonlands National Wildlife Refuge and other privately held land within the Refuge acquisition area. These are the only vireos known to occur on protected lands within Williamson County. Management activities occurring on these lands include habitat creation and maintenance and trapping of cowbirds.

3.3 ADDITIONAL SPECIES

3.3.1 Karst Invertebrates

The known status of 20 species or subspecies of karst invertebrates identified as additional species in the RHCP is summarized in Table 3-3, which is organized by species or related group of species. This list of species was developed by the Biological Advisory Team of the RHCP. All these species are known only from a small number of caves and many are known only from Williamson County, although some also are known to occur in Travis County. The process for determining whether any of these species would be integrated for coverage under the RHCP by amendment is identified in Chapter 5, Section 5.7. As noted at the beginning of this chapter, one of these species, the Tooth Cave ground beetle, is a federally listed species. Due to its protected status, it is treated in somewhat greater detail than are the other additional species. As noted in Table 3-3, six of the additional karst invertebrate species were included in a listing petition that was recently submitted to the Service by the Forest Guardians (2007).

Table 3-3. Additional karst species identified in the Williamson County RHCP. Species included on the Forest Guardians' listing petition (Forest Guardians 2007) are marked with an asterisk (*).

SPIDERS		
Eyeless spiders of the genus *Cicurina* (subgenus *Cicurella*) are the outstanding troglobites of the central Texas karst comprising up to 60 species (Mitchell and Reddell 1971, Cokendolpher 2004). Four species of *Cicurina* occurring in Bexar County are on the endangered species list and one species (*C. wartoni*) from the Travis/Williamson County region is considered a candidate species.		
Species	**Known KFRs of Occurrence**	**Notes**
Cicurina n.sp.	Cedar Park	Known from Lakeline Cave only. Phylogenetic data (Paquin and Hedin 2004) indicate that this undescribed population may be *C. wartoni*, which occurs in Travis County.
*Cicurina browni**	Georgetown	Known from Brown's Cave only. Although only confirmed from Brown's Cave in the Brushy Creek area, phylogeographic data (Paquin and Hedin 2004, 2005) indicate that this species may occur in many of the caves from FM 1431 northward toward Lake Georgetown.
Cicurina buwata	Cedar Park McNeil/Round Rock Jollyville	Thought to occur in about 12 caves (9 in Williamson County) between Brushy Creek and the Colorado River (Reddell 2004). Phylogeographic data (Paquin and Hedin 2004, 2005) indicate that it is most closely related to the taxon inhabiting Lakeline Cave.
*Cicurina travisae**	Cedar Park Jollyville	Thought to occur in about 11 caves (one in Williamson County) between Brushy Creek and the Colorado River (Reddell 2004).
*Cicurina vibora**	North Williamson County	Thought to occur in about 12 caves between Lake Georgetown and the northern Williamson County line (Reddell 2004). Phylogeographic data (Paquin and Hedin 2004, 2005) indicate that it is very closely related to *C. browni*.
Two species of troglobitic *Neoleptoneta* spiders are listed as endangered in Bexar and Travis Counties. Due to their extremely small size and cryptic habits they may be overlooked in biological surveys and their very limited known distribution likely is at least partially attributable to this factor. Only one species of this genus is currently known from Williamson County.		
*Neoleptoneta anopica**	North Williamson County	Known only from Cobb's Cavern (Reddell 1965, Gertsch 1974). Whereas the two listed *Neoleptoneta* species have eyes that are reduced in size and function, *N. anopica* is lacking eyes altogether, the only eyeless Neoleptoneta in Texas, indicating that it is in a more advanced state of troglomorphy.

PSEUDOSCORPIONS		
Troglobitic pseudoscorpions are among the least known troglobites because of their tiny size and cryptic habits. Their relative abundance and distribution have been difficult to determine as a result.		
Species	**Known KFRs of Occurrence**	**Notes**
Aphrastochthonius n.sp.1	North Williamson County	Known only from about 6 caves north of Lake Georgetown (Reddell 2004).
Aphrastochthonius n.sp.2	Cedar Park	Known only from Lakeline Cave. Listed species occurring in this cave are considered "taken" by the Service (Reddell 2004).
Tartarocreagris infernalis	Cedar Park McNeil/Round Rock Georgetown North Williamson County Jollyville	Known from about 25 caves, all but 1 of which are in Williamson County (Reddell 2004). Distribution indicates it is a relatively widespread troglobite, suggesting that it may commonly be overlooked in biological surveys as a result of its tiny size and cryptic habits.

Table 3-3, continued

MILLIPEDES		
Species	**Known KFRs of Occurrence**	**Notes**
Speodesmus bicornourus	McNeil/Round Rock Georgetown North Williamson County Central Austin Jollyville	Known from 37 caves, 17 of which occur in Williamson County (Reddell 2004).
COLLEMBOLA (Springtails)		
Oncopodura fenestra	Georgetown North Williamson County Southern Travis County?	Known from 3 caves in Williamson County and 2 caves in southern Travis County (Reddell 2004).
Arrhopalites texensis	Cedar Park North Williamson County Southern Travis County?	Known from two caves in Williamson County and one cave in southern Travis County (Reddell 2004).
GROUND BEETLES		
Three species of *Rhadine* ground beetles are on the endangered species list, including Tooth Cave ground beetle in Travis and Williamson Counties and two species in Bexar County. They are scavengers and predators that have been observed feeding on cricket eggs.		
Rhadine n.sp.	Cedar Park	Known from 27 caves, all but 3 of which are located in Williamson County (Reddell 2004). Nearest relative is believed to be *Rhadine subterranea* (HNTB Corporation 2005). Distribution indicates it is sympatric with Tooth Cave ground beetle.
*Rhadine noctivaga**	North Williamson County	Ranges from the North Branch of the San Gabriel River north towards the County line. It is known from 44 caves, all of which are located in Williamson County (Reddell 2004).
Rhadine persephone	Cedar Park	Federally endangered species. See discussion following this table.
*Rhadine russelli**	n/a	Known from Post Oak Ridge in 3 caves in extreme western Williamson County, a cave in Travis County, and a cave in Burnet County (Reddell 2004).
Rhadine subterranea subterranea	McNeil/Round Rock	Ranges from Brushy Creek south into Travis County. It is known from 40 caves, 31 of which are located in Williamson County in Cedar Park KFR (Reddell 2004).
Rhadine subterranea mitchelli	Georgetown Jollyville	Ranges from Brushy Creek north to the North Branch of the San Gabriel River. It is known from 40 caves, 37 of which are located in Williamson County (Reddell 2004).
MOLD BEETLES		
Batrisodes reyesi	Georgetown	Known from Post Oak Ridge. Currently known from only one cave in Williamson County but its distribution includes 5 caves in northern Travis County and 2 in Burnet County (Reddell 2004).
Batrisodes cryptotexanus	North Williamson County Georgetown	Chandler and Reddell (2001) split the listed *Batrisodes texanus* into two species, *B. texanus* and *B. cryptotexanus*, but the Service does not recognize the split. Species identified as *B. cryptotexanus* are known from 15 caves, all in Williamson County (Chandler and Reddell 2001; D.S. Chandler, e-mail to K. White, 2006).

In addition to the six species identified in Table 3-3, the Forest Guardians' petition identifies eight species that have the potential to occur in Williamson County, but their presence has not been documented in the County. These eight species include a cave obligate decapod (*Palaemonetes holthuisi*) and two cave obligate amphipods (*Seborgia hershleri*) and (*Texiweckelia relicta*), as well as the nymph trumpet (*Phreatoceras taylori*), Hueco cavesnail (*Phreatodrobia conica*), mimic cavesnail (*Phreatodrobia imitate*), beaked cavesnail (*Phreatodrobia rotunda*), and Texas salamander (*Eurycea neotenes*). During its annual assessment of the status of species and their habitat, the Foundation will evaluate whether any of these species should be added to its list of additional species.

3.3.1.1 Tooth Cave Ground Beetle (*Rhadine persephone*)

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The Service listed the Tooth Cave ground beetle as endangered on September 16, 1988 (53 FR 36029–36033). It is an approximately 0.3-inch (8-millimeter) long, reddish-brown, troglobitic ground beetle that feeds, at least in part, on cave cricket eggs (Mitchell 1971, Barr 1974). The Tooth Cave ground beetle is the largest, most visible, and most active of the regional endangered karst species. Although this species is usually found under rocks, it has also been observed walking on damp rocks and silt. This species is found most commonly in areas of deep, uncompacted silt, where it digs holes to feed on cricket eggs (USFWS 1994). The Tooth Cave ground beetle has been at least tentatively confirmed in a total of 52 caves, 48 of which are situated in conservation areas of various sizes.[39] Thirty-one of these caves are in Williamson County in the Cedar Park KFR. Two others are located in Travis County in the Cedar Park KFR adjacent to Williamson County (HNTB Corporation 2005).

3.3.2 Salamanders

All four salamanders discussed below—Georgetown salamander, Jollyville Plateau salamander, Salado Springs salamander, and Buttercup Creek salamander—are neotonic (retain juvenile characteristics as adults) and are ecologically similar to one another. Studies involving genetic analysis have shown all four of these species to be closely related and all more closely related to each other than to any other *Eurycea* salamanders occurring south of the Colorado River (Chippindale et al. 2000). Of these four species, the Georgetown salamander is described most extensively in this section because it is known only from Williamson County and is a candidate for listing as endangered or threatened by the Service.

3.3.2.1 Georgetown Salamander (*Eurycea naufragia*)

The Service classified the Georgetown salamander as a candidate for Federal listing on October 30, 2001 (66 FR 54807). While the Service considers listing of the salamander to be warranted,

[39] While most of these conservation areas have been established—and approved by the Service under section 10(a) and section 7 of the Endangered Species Act—specifically to preserve the Tooth Cave ground beetle, their adequacy for the long-term survival of the species has yet to be determined.

publication of a proposal to list the species has been precluded by other higher priority listing actions (USFWS 2004b).

©Plethodonid Research, Photo by Justyn Miller

Georgetown Salamander Natural History: This salamander is a small (less than 3 inches [7.6 cm] long) salamander that inhabits springs and spring runs within the San Gabriel River watershed. The species is known to occur only in Williamson County, where it has been found at springs in association with the South, Middle, and North Forks of the San Gabriel River; the Cowan and Berry Creek drainages; and in one cave (Bat Well) near the Sun City development (Chippindale et al. 2000; A. Price, TPWD, pers. comm. to SWCA, 2006). Individuals retain external gills throughout their adult lives; consequently, this salamander is an obligate aquatic species.

Several closely related species of salamanders within the genus *Eurycea* occur in central Texas, some of which (e.g., the federally listed endangered Barton Springs salamander [*E. sosorum*], federally listed threatened San Marcos salamander [*E. nana*], and the Jollyville Plateau salamander) have been studied more extensively than the Georgetown salamander. Habitat for *Eurycea* salamanders is generally described as shallow pools of well-oxygenated water that occur in caves and at springs and spring runs (City of Austin 1998, Bowles et al. 2006). Moreover, low siltation rates, adequate cover, and near constant water temperatures are thought to be important components of *Eurycea* habitat (City of Austin 1998, Bowles et al. 2006). *Eurycea* salamanders feed primarily upon small aquatic invertebrates and likely are opportunistic generalists, preying upon whatever animals can fit inside their mouths. Studies have shown these salamanders to prey upon amphipods, chironomid (midge) larvae, mayfly nymphs, and isopods (City of Austin 1998).

Primary Threats to the Georgetown Salamander: The Service identifies the primary threats to the Georgetown salamander as degradation of water quality and quantity due to urbanization (USFWS 2004b). The Georgetown salamander is entirely aquatic and, based on similarities with other *Eurycea* species, it is expected that water quality degradation from various contaminants, decreased dissolved oxygen, increased sediments, and increased nutrients can cause disease and deformities, especially during development, which could then result in population declines (Hutchinson 1995). Urbanization and increases in impervious cover can increase contaminant loads in springs and groundwater, as well as alter local hydrologic regimes by increasing storm runoff and decreasing base flows in drainages (Arnold and Gibbons 1996). Increased storm runoff results in a decrease in aquifer recharge, increased variability in water availability and flow, and decreased water quality. Decreases in base flow result in a decrease in water availability at spring locations, with decreased spring flow especially problematic during periods of drought (Price et al. 1995, USFWS 2004b).

Current Status of the Georgetown Salamander in Williamson County: As stated previously, this species is known to occur only in Williamson County from springs and a cave in the San Gabriel River and Cowan and Berry Creek drainages. A groundwater divide between the South Fork of the San Gabriel River and Brushy Creek likely creates the division between the ranges of the

more southerly occurring Jollyville Plateau salamander and the Georgetown salamander. Similarly, a groundwater divide between Berry Creek and Salado Creek likely creates division between the ranges of the Georgetown salamander and more northerly occurring Salado salamander (*E. chisholmensis*) (see Figure 3-7).

Locations of springs and the cave where Georgetown salamanders are known to occur are depicted on Figure 3-7. A total of 13 salamander localities were identified through literature review, consultation with salamander researchers, and independent field surveys. A list of these sites, status of land on which they are located, and status of salamanders at the sites are summarized in Table 3-4. It is considered likely that salamanders occur at other sites in Williamson County (Chippindale et al. 2000); however, occurrence of potential locations on private land limits the probability these populations will be identified. Potential for salamanders to occur at these springs likely varies greatly, and it is not certain that all the springs are extant. Locations of the springs were identified from Brune (2002) and through review of U.S. Geological Survey topographic maps.

Total population of the species is unknown. In general, salamanders occur at any given location in comparatively low numbers. However, because methods are still under development to make it possible to identify salamanders as individuals, and because of the known ability of salamanders to occur in, or otherwise retreat into, spring outlets, it is not possible to estimate accurately the number of salamanders occurring at any given location (USFWS 2004b). As indicated in Table 3-4, Georgetown salamander populations are presumed extant at all known locations, except possibly for a spring location in San Gabriel Park in the City of Georgetown. Recent searches for salamanders at this location have been met with negative results (A. Price, TPWD, pers. comm. to SWCA, 2006). Salamanders have been observed at Cobb's Spring and Russell Park Estates Spring in both 2006 and 2007 (P. Sunby, SWCA, pers. obs.).

3.3.2.2 Jollyville Plateau Salamander (*Eurycea tonkawae*)

The Jollyville Plateau salamander was added to the Federal candidate species list on December 13, 2007, when the Service issued a 12-month petition finding that listing the species as threatened or endangered is warranted (72 FR 71040). This salamander occurs primarily in springs and spring-fed creeks north of the Colorado River in western Travis County. A portion of its range extends northward into southwestern Williamson County within the Brushy Creek watershed. The Jollyville Plateau salamander is known from five sites in Williamson County (Figure 3-7) and approximately 36 sites in Travis County, with most Travis County locations occurring in the Bull Creek and Cypress Creek watersheds (Chippendale et al. 2000).

Most locations from which this species is known are springs or spring runs, although it has also been observed in underground streams within caves. Springs and cave streams that support this species drain the Edwards Formation. As with the Georgetown salamander, this species typically occurs at springs or spring runs with low to moderately low flow volumes and abundant cover such as rocks and dead leaves.

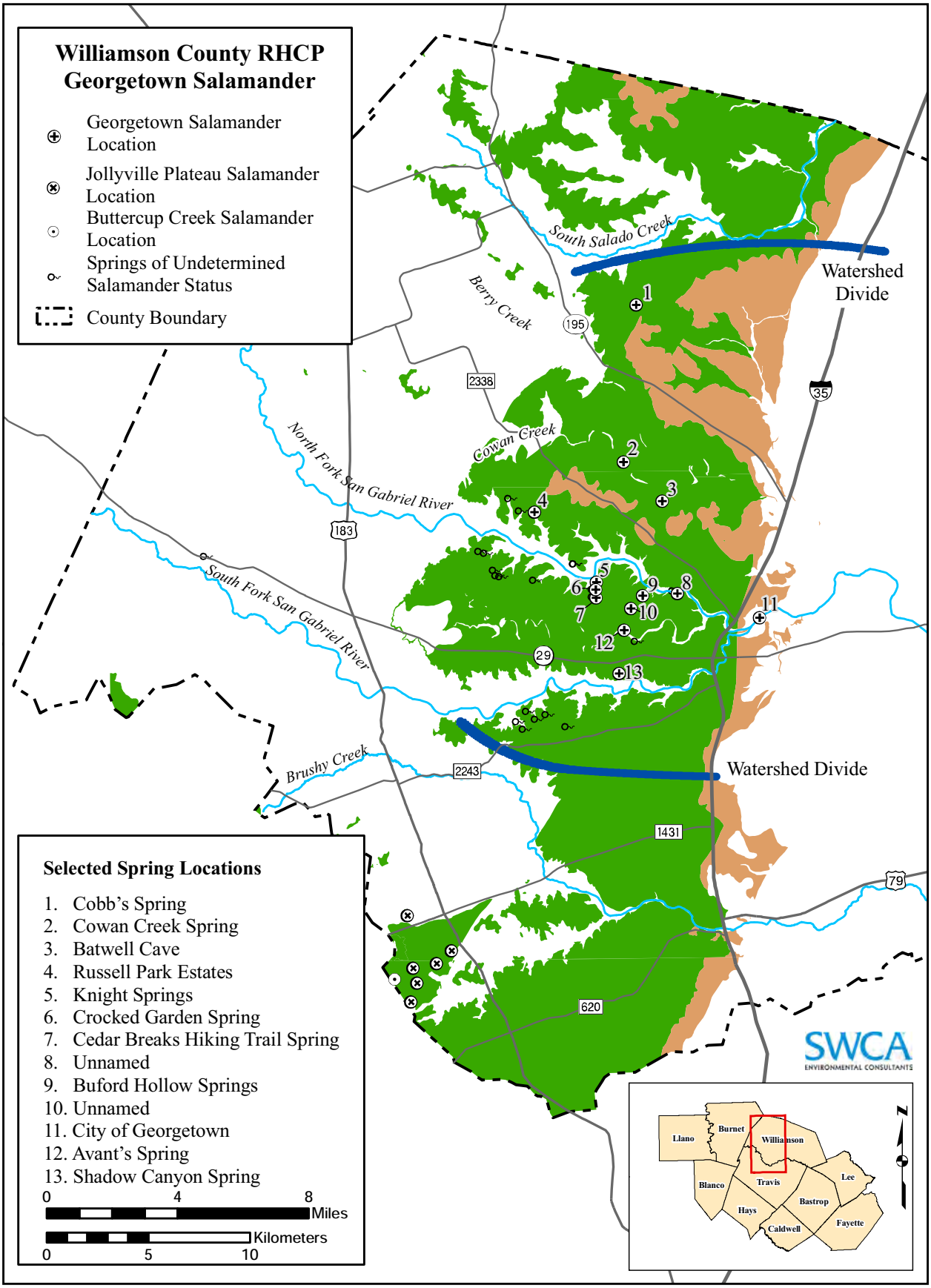

Figure 3-7. Occurrences of the Georgetown salamander, Jollyville Plateau Salamander, and Buttercup Creek salamander and springs of undetermined salamander status in Williamson County, Texas.

Table 3-4. Georgetown salamander locations with land status and population status.

Salamander Site	Location	Land Status	Salamander Status
Avant's Spring	South of Lake Georgetown	Private	Presumed extant
Bat Well Cave	Near Sun City	Private	Presumed extant
Buford Hollow Springs	South of Lake Georgetown	Private	Presumed extant
Cedar Breaks Hiking Trail Spring	South of Lake Georgetown	Private	Presumed extant
Cobb's Spring	North of State Highway 195	Private	Presumed extant
Cowan Creek Spring	Sun City Development	Private	Presumed extant
Knight's Spring	South of Lake Georgetown	Private	Presumed extant
Russell Park Estates Spring	North of Lake Georgetown	Public / Occurs on Preserved Land (145 ac)	Presumed extant
San Gabriel Park Spring	City of Georgetown east of Interstate Highway 35	Public	Possibly extirpated[1]
Shadow Canyon Spring	South of State Highway 29	Private / Occurs on Preserved Land (44 ac)	Presumed extant
Unnamed spring	South of Lake Georgetown	Private	Presumed extant
Unnamed spring	Southwest of Lake Georgetown	Private	Presumed extant
Unnamed spring[2]	Below Lake Georgetown Dam	Private / Spring Run on U.S. Army Corps Land	Presumed extant

[1] A. Price, TPWD, pers. comm. to SWCA, 2006.
[2] Salamanders identified and photographed at this location during field trip by representatives of Williamson County, City of Georgetown, SWCA, and Smith-Robertson on January 13, 2006.

3.3.2.3 Salado Springs Salamander (*Eurycea chisholmensis*)

The Salado Springs salamander is a candidate for listing under the Endangered Species Act (67 FR 40657). It is similar in size and habits to Jollyville Plateau and Georgetown salamanders (Chippindale et al. 2000). This species is known from two springs in Bell County (Salado Springs [= Big Boiling Springs] and Robertson Springs) and may also occur at springs in the nearby Buttermilk Creek watershed (Chippindale et al. 2000). Although the Salado Springs salamander does not occur in Williamson County, that portion of the Edwards Aquifer Recharge Zone in Williamson County that occurs north of a groundwater divide between Berry Creek and the South Fork of Salado Creek likely contributes to flow at springs at which this species occurs.

3.3.2.4 Buttercup Creek Salamander (*Eurycea* n.sp.)

The Buttercup Creek salamander is known only from the Buttercup Creek Cave karst system in southwestern Williamson County (Figure 3-7). Chippindale et al. (2000) assigned this population of salamanders provisionally to *Eurycea tonkawae*, although individuals show traits of troglomorphy, including depigmentation, broadening and flattening of the head, and reduced eyes. Chippindale et al. (2000) suggested this population of salamanders probably deserves consideration as its own species.

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CHAPTER 4 – COVERED ACTIONS

4.1 AUTHORIZED ACTIONS

If the requested section 10(a)(1)(B) permit is issued, take of covered species associated with the following activities would be authorized under and in accordance with this RHCP:

- Public or private construction and development.
- Road construction, maintenance, and improvement projects.
- Utility installation and maintenance, including but not limited to power and cable lines; water, sewer, and natural gas pipelines; and plants and other facilities.
- School development or improvement projects.

As discussed previously, the County is experiencing rapid growth. Infrastructure improvements, public and private development and construction projects, and other development activities are expected to continue as the population grows. The landscape of the County will continue to change as new development activities are carried out. The activities authorized under this RHCP are expected to impact the covered species in the County. Primary impacts will be disturbance, alteration, or removal of occupied and potentially occupied habitat. Direct impacts to covered species may occur if development and construction results in destruction of occupied habitat. Species may also be indirectly impacted by negative changes in habitat quality, which may occur due to removal of existing vegetation, alteration of drainage patterns, increased habitat fragmentation, increased populations of predatory or competitive species, and other indirect effects of proximity to development activities.

In addition to estimating levels of take authorized under this RHCP for the Bone Cave harvestman, Coffin Cave mold beetle, golden-cheeked warbler, and black-capped vireo, this chapter assesses the potential impacts of covered actions on the Georgetown salamander, a Federal candidate species known only from Williamson County. Because nutrient and moisture requirements are likely similar for all karst invertebrates, it is anticipated that potential impacts of covered actions on additional karst species would be similar to those on the covered karst species. Prior to inclusion of any of the additional species on the Permit, a complete analysis (as identified in Chapter 8, Section 8.4) of anticipated impacts will be performed.

Throughout this chapter, estimates of impacts are based on an RHCP participation rate of 20 percent; that is, for planning purposes we have made the assumption that 20 percent of all development impacting covered species in Williamson County over the 30-year life of the plan will be authorized through this RHCP. It should clearly be understood that the 20 percent participation assumption is only that, an assumption. A participation rate of 20 percent should in no way be construed as a measure of take, or a limit on take, once the RHCP is implemented. For example, if the actual level of participation exceeds 20 percent over the life of the plan, and more than the predicted number of acres in the Karst Zone are developed by plan participants, the take authorized by the Permit will not be exceeded for that reason. Incidental take authorized

by the Permit will, instead, be measured by the number of species-occupied caves impacted (see Section 4.2.3) and the number of acres of occupied golden-cheeked warbler and black capped vireo habitat disrupted or removed[40] (see Sections 4.3 and 4.4, respectively). The proposed conservation measures described in Chapter 5 are adequate to mitigate for the level of take eventually authorized under the Permit. Specifically, all covered take within the Karst Zone will be fully mitigated because the mitigation and conservation measures of the RHCP for the covered karst species amount to satisfaction of recovery (downlisting) criteria, and for the bird species, each acre of take in the County will be matched with at least an acre of mitigation.

4.2 IMPACTS OF COVERED ACTIONS ON KARST INVERTEBRATES

Table 4-1 provides examples of existing and proposed projects in Williamson County that have the potential to impact endangered karst invertebrates or their habitat. Chapter 3, Section 3.2.1 provides a summary of the known and presumed impacts of land disturbance on karst invertebrates.

The activities anticipated by this RHCP may impact karst invertebrates if caves are filled, collapsed, or otherwise altered; destruction of occupied caves is likely to result in direct take of listed karst invertebrates. These species may also be indirectly affected—and take may occur—if either subsurface or surface habitat in the proximity of occupied caves is degraded by activities associated with increased urban development.

Table 4-1. Examples of projects occurring in Williamson County with potential to impact endangered karst invertebrates.

Entity	Examples of Existing or Potential Projects in Williamson County
TxDOT	US 183A, SH 45, SH 195
Williamson County Road Bond Program	Ronald W. Reagan Boulevard, O'Connor Drive, RM 620
Independent School Districts	School Construction
Texas Utilities, LCRA, Brazos River Authority, other utility providers	Electric transmission lines, trunk lines, water lines, wastewater lines
Municipality or County	Infrastructure or parkland programs
Private Land Developers	Residential or commercial development
Capital Metro	Transportation Corridors / Railroad Extension and Re-alignment

4.2.1 Estimating Take of Karst Invertebrates

Few scientifically based guidelines exist that provide a basis for estimating levels of the direct and indirect impacts of encroaching land development on a cave system inhabited by listed invertebrates. The amount of surface habitat around a cave entrance or footprint needed to maintain the integrity of a particular karst ecosystem and sufficient to ensure the long-term

[40] As explained in Chapter 6, Sections 6.2.2 and 6.2.3, if a participant elects not to have bird surveys conducted to verify presence or absence of the listed species to ascertain the numbers of pairs or territories impacted by a project, take will be measured in acres of potential warbler or vireo habitat disturbed.

conservation of listed invertebrates has not been definitively described by the scientific community and may vary from cave to cave.

The conditions that result in a reasonable probability of take must be addressed based on the best available science (USFWS and NMFS 1996). Often, incidental take is expressed as the number of organisms likely to be "harmed" by the proposed action(s). This number, in turn, is based on the estimated population of the listed species present in the area of potential impact. In the case of karst invertebrates, basing take on the numbers of organisms affected is not practicable. Simple detection of these invertebrates is problematic because of their often infrequent occurrence within humanly accessible portions of their habitat and their small size. It is difficult, therefore, to determine trends in population size or to establish estimates of overall population numbers in a given habitat. As a result, most inferences relating to the health of karst ecosystems and listed karst species rely on estimates of the density and movements of non-listed trogloxenes (e.g., cave crickets), which are much easier to observe and study (Taylor et al. 2005). In an attempt to determine the minimum size of the surface vegetation community needed to ensure the viability of a cave's subsurface ecosystem, some biologists have used studies on the minimum viable population of surface vegetation species (e.g., Pavlik 1996; Van Auken et al. 1979, 1980, 1981) and literature on habitat fragmentation and edge effects in other types of ecosystems (e.g., Lovejoy and Oren 1981, Lovejoy et al. 1986). While there have actually been no specific studies on surface vegetation requirements for cave preserves, the above-cited studies have been used to reasonably infer minimum preserve sizes for the central Texas karst systems.

Addressing the question "How much land around an occupied cave would have to be left undeveloped to avoid take?" has varied widely in practice. Since the first karst species in central Texas were listed in 1988, consultation efforts with the Service and karst experts have resulted in recommendations for cave setbacks in central Texas ranging from 2 acres (0.8 hectare) (Richardson Verdoorn 1994) to over 100 acres (40 hectares) (USFWS 2000). The inconsistency in cave setback recommendations reflects site-specific considerations that include the quality of the cave habitat, number of listed species present, proximity to adjacent developments and other possible edge effects, habitat fragmentation, drainage considerations, red imported fire ant infestations, and cricket foraging area considerations.

The RHCP uses the best available science to estimate levels of take and the specific conservation efforts that would mitigate that take once the covered actions described above are implemented. For indicators of take levels, this RHCP provides 1) an estimate of the number of acres of potential habitat within the Karst Zone of Williamson County that may be affected, and 2) an estimate of the number of occupied caves and associated surface habitat that may be affected with implementation of the covered actions.

4.2.2 Impacts of Covered Actions on Karst Habitat

Approximately 15.5 percent (112,000 acres; 45,325 hectares) of the County is underlain by geology that is likely to contain caves with endangered karst invertebrates. Approximately 32,000 acres (12,950 hectares), or 28.6 percent, of the Karst Zone have already been developed or somewhat disturbed and can be classified as "urban," "suburban," "central business district," or "central business district fringe" areas (Capital Area Metropolitan Planning Organization

[CAMPO] 2004). This leaves approximately 80,000 acres (32,375 hectares) of undeveloped karst habitat in the County that have the potential for expressing species-occupied caves.

While approximately 28.6 percent of the Karst Zone has been developed to some degree, it does not mean that 32,000 acres of karst habitat have been destroyed or that most of the cave systems in the developed areas are impacted. In most development scenarios when a cave or significant recharge feature is encountered, existing Texas Commission on Environmental Quality (TCEQ) regulations require minimum setbacks away from these features as a water quality protection measure (TCEQ 2004). These minimum setbacks, generally 50 feet (15 meters) from the feature entrance or the local collapse zone around the entrance (Barrett 2005), do not always provide what is thought to be the minimum area needed for long-term maintenance of the troglobitic inhabitants of the caves (USFWS 1994, 2003). In addition, throughout the existing developed area of Williamson County, section 7 consultations and HCPs have resulted in development setbacks from caves that are significantly greater than the minimum area required by the TCEQ. Existing cave conservation areas and their significance to the future recovery of the listed karst invertebrates are discussed in more detail in Chapter 3 (Covered Species; see Table 3-1 and Figure 3-2), and Chapter 5 (Avoidance, Minimization, and Mitigation Measures).

Future development on the County's Karst Zone is expected to dramatically increase during the life of this RHCP. As stated previously, the human population growth in the County is expected to increase by over 300 percent over the next 30 years (Table 4-2, Figure 4-1). Currently, almost 240,000 people, or 65 percent of the total population of Williamson County, live on the Karst Zone. Assuming future growth reflects recent distribution patterns, it is estimated that by 2037 an additional 778,000 persons (over 1,017,000 total) will occupy the Karst Zone (Table 4-2). An estimated 32,000 acres of the 112,000-acre Karst Zone have already been developed (CAMPO 2004), for an average population density of approximately eight persons per acre (240,000/32,000 = 7.5), or 18.5 persons per hectare. If that population density held constant, in 30 years the projected 1,017,000 persons would occupy approximately 141,000 acres (57,061 hectares), significantly more than the total amount of land in the Karst Zone (112,000 acres).

Table 4-2. Population forecast in five-year increments, 2007–2037, for Williamson County, Texas, and Karst Zone within the County.

Year	County Population Forecast	New Population	Karst Zone Population Forecast
2007	369,953	19,690	239,700
2012	476,922	23,949	314,797
2017	607,901	29,566	416,895
2022	769,982	36,692	537,323
2027	969,994	44,968	677,470
2032	1,213,323	54,212	837,673
2037	1,504,810	64,425	1,017,247

Source: Capitol Market Research, market area household forecast (unpublished data). Based on U.S. Census Bureau data and Texas State Data Center Population Forecast, Scenario 1.0.

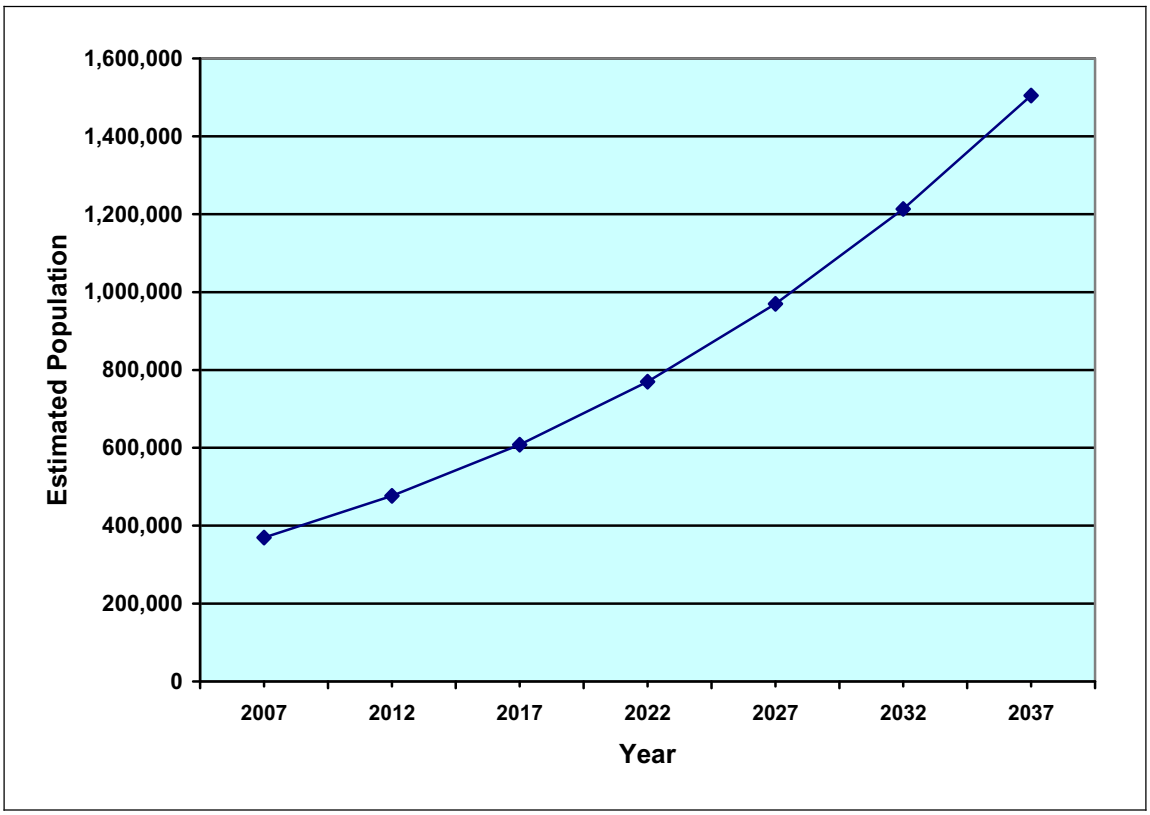

Figure 4-1. Estimated population growth in Williamson County, 2007–2037.

For purposes of establishing RHCP estimates of long-term impact to the Karst Zone, it has been assumed that the Karst Zone will likely be fully developed in the next 30 years (both the 32,000 acres of existing development and the 80,000 acres of currently undeveloped land), and probably at a somewhat higher average population density than seen today. While we are assuming all 80,000 acres of karst habitat will be developed over the next 30 years, this does not mean that all karst habitat will be destroyed or that most of the cave systems in the developed areas will be impacted. Just as with existing development, impacts of future development on the karst ecosystem will be moderated by limitations on the amount of allowable impervious cover for aquifer protection, setbacks from cave entrances or footprints, open space designed into residential and commercial developments, and public parkland.

The amount of impact on karst habitat attributable to development covered by this RHCP (i.e., covered actions) will be less than the total expected impact in the County (i.e., less than 80,000 acres). For example, the RHCP does not anticipate that all persons engaging in development activities that will cause disturbance to karst resources will elect to participate in this plan. Some persons will choose to contact the Service independently and apply for individual incidental take permits, and some persons will not apply for permits at all, assuming that a) their activities will not violate section 9 of the Endangered Species Act; b) that their activities will escape the notice of the regulating agencies; or c) they are simply unaware of their responsibilities under the Endangered Species Act. The level of expected voluntary participation in the RHCP is impossible to accurately predict at this time. Landowner enrollment in an RHCP in adjacent Travis County has averaged less than 10 percent participation, with only a small

fraction of the number of developments actually constructed participating in the plan. We expect the Williamson County RHCP to attract more participants than Travis County's plan for several reasons.

First, Travis County has had a low participation rate in part because prolonged controversy stretched plan development over a very long period; the entire process from initiation to the final authorization took nearly a decade to complete. This was a period of very rapid growth, and many landowners had pursued and acquired individual section 10(a)(1)(B) permits before the regional plan could be finalized. In contrast, the Williamson County RHCP is being started earlier in the population growth curve for the planning region and is generating less controversy. We also have the advantage of learning from the Travis County experience and anticipate a much shorter timeframe from plan initiation to authorization.

Other factors that will encourage more participation from Williamson County landowners in the RHCP than was realized in Travis County is the average time for completion of individual section 10(a) permits today compared to a decade ago. In the early 1990s, individual section 10(a) permits could be processed in a little over a year; similar permits today often take over two years from permit application to actual signing of the Permit. Given this long timeframe, landowners in Williamson County are less likely to pursue individual permits than did their counterparts in Travis County a few years ago. With the RHCP in place, participant applications are likely to be approved in three months or less. Avoiding lengthy project delays is expected to be a strong incentive for landowner participation in the Williamson County RHCP. In addition, the landowner community is far more aware of Endangered Species Act requirements and the need for compliance than was apparent a decade ago, and the Williamson County RHCP effort has been publicized as a positive factor for local economic growth (Williamson County Conservation Foundation 2007). Finally, the costs for participation in this RHCP are expected to be less than fees paid for the Travis County Plan and generally less than costs of individual permits. Given these circumstances, it is not unreasonable to assume that the RHCP participation rate in Williamson County will exceed that seen in Travis County and may equal or surpass 10 percent.

Anticipating the level of participation is an important, but not critical, factor in estimating the amount of impact, or "take," that will be authorized by the proposed incidental take permit and mitigated for by the RHCP conservation measures. As stated earlier in this chapter, to ensure that the proposed measures are adequate to mitigate for the actual level of take eventually authorized under the Permit, this RHCP assumes a participation rate of 20 percent. At this rate, development covered by the RHCP is estimated to affect 20 percent of the 80,000 acres of anticipated development in the Karst Zone, or 16,000 acres (6,475 hectares) of karst habitat. The annual average estimated number of acres of development expected to be evaluated for impacts and mitigated at the 20 percent participation rate over the 30-year life of the RHCP is 533 acres (16,000 acres/30 years = 533), or 216 hectares.[41]

It is not uncommon for development and construction activities to uncover voids, mesocaverns, and sometimes caves when utility and road-trenching occurs on the Karst Zone. Most caves and

[41] It is reiterated here that a participation rate of 20 percent should in no way be construed as a measure of take, or a limit on take, once the RHCP is implemented.

significant karst features on a parcel of land are discovered during the Geologic Assessment required by the TCEQ for aquifer protection, but some features have no or little surface expression and are missed until encountered during excavation activities. Costly delays in time and consultant fees can result. Insufficient data exist to predict the frequency of discovery of previously undetected voids or mesocaverns or to estimate the level of impact that trenching through the Karst Zone will have on the listed species. However, it is expected that impacts to listed invertebrates through the uncovering of previously undetected voids will be low. These voids are generally unanticipated because they have no significant openings to the surface, and for this reason they generally lack the input of moisture and nutrients essential for the support of karst invertebrates. Previously undetected voids discovered during construction activities rarely contain listed species; however, it is reasonably probable some limited take may occur. Some voids that do not have an obvious surface expression may have openings that are not readily detectable during walking feature surveys and may be able to support karst invertebrates. The openings may be adequate for cave cricket ingress and egress, and moisture may still reach a cave in other ways besides the entrance through the subsurface drainage basin. For planning purposes, it is anticipated that one previously undetected *occupied* species cave per year unearthed during development activities will be impacted and require mitigation. The procedures to be followed when RHCP participants encounter previously undetected voids are described in Chapter 6 (Participation Process).

4.2.3 Impacts of Covered Actions on Occupied Karst Habitat

Some as yet unknown number of caves will be encountered during development, and some unknown percentage of those caves will be occupied by the listed species. Impacts may occur if such development encroaches on the surface and subsurface habitat necessary to sustain the listed karst invertebrates. Development activities are likely to result in direct or indirect invertebrate mortality when an occupied cave is collapsed and/or filled. The following sections provide an estimate of the levels and types of impacts that are expected over the life of the plan.

4.2.3.1 Levels of Impact on Occupied Karst Habitat

In this RHCP, estimates of relative impact to occupied karst habitat are based on the limited, but best available, scientific information on moisture and nutrient supply to the cave systems. Troglobite habitat is also affected by the degree to which levels of red imported fire ants, human visitation, contaminants/water quality issues, and surface vegetation are altered as a result of development encroachment. For purposes of this RHCP, however, we focus on how that encroachment affects the cave moisture and nutrient base to evaluate levels of impact. Elliott and Reddell (1989) noted that troglobitic populations are sensitive to many ecological changes to their habitats, but most especially to drying and nutrient loss. A cave's moisture level is often directly dependent on its localized recharge area (the drainage catchment area for the cave). Any diversion or alteration of the surface drainage into an occupied cave could lead to drying or contamination; consequently, development within the surface drainage area of an occupied cave has the potential to adversely impact the karst ecosystem that supports listed species (USFWS 1994).

For nutrients, troglobitic species must rely on input from the surface ecosystem, and in central Texas, cave crickets provide a large component of that nutrient input (USFWS 2003). This RHCP focuses on these two elements, moisture and nutrients, as measures of impact to occupied caves, not only because they are important, but because surface drainage areas and potential cave cricket foraging areas are readily measurable. In this, the RHCP follows well-established precedent. Among the first and most often referenced determinations of appropriate setbacks from caves is Veni and Associates' 1988 report on hydrological investigations of the Jollyville Plateau. This study referred to surface drainage basin of each cave as hydrologically "critical area" (zones of the greatest direct impact), and, for the caves in question, recommended setbacks ranging from less than an acre to a little over 5 acres (2 hectares).

Recently, the consideration commonly used to evaluate the level of development encroachment on occupied caves (and, hence, inferences on take), and the consideration that seems to have the greatest support from the scientific community (including the Service), is concern over providing sufficient forging area for trogloxenes. Documented foraging activities of cave crickets (Taylor et al. 2005) is one of the few metrics available for measuring a demonstrable connection between surface and subsurface biological components of a cave's ecosystem. Taylor et al. (2005) measured the distances traveled each night by crickets leaving a cave to forage before returning to the cave for shelter during the day. As described in Chapter 3, the maximum distance crickets were found to forage away from the cave entrance was approximately 345 feet (105 meters). Crickets occurred during foraging in relatively uniform densities out to 262 feet (80 meters), and slightly over 50 percent of the crickets were found within 131 feet (40 meters).

It is known that use of a cave by cave crickets is important to troglobites because trogloxenes supply nutrients to karst ecosystems (Taylor et al. 2005). What is *not* known is: 1) what minimum number of crickets or other trogloxenes is needed to support a given karst ecosystem; 2) whether increasing the number of crickets in a cave can result in input of nutrients in excess of that which can be utilized by the listed karst invertebrates (i.e., Does or does not an increase in the number of crickets always allow for increases in the populations of listed karst invertebrates?); or 3) whether higher cricket populations could actually be detrimental to listed karst invertebrates because greater abundance of resources may allow other species to utilize the karst habitat at the expense of the listed invertebrates, which generally are thought to be adapted to nutrient-poor systems. These unknowns notwithstanding, the scientific community largely considers protection of trogloxene surface foraging area to be of greatest concern when conserving karst invertebrates. Therefore, this RHCP uses the findings of Taylor et al. (2005), combined with TCEQ practice regarding recharge feature protection, to recognize two levels of impact to known species-occupied caves: "Impact Zone A" and "Impact Zone B." Figure 4-2 illustrates these two levels of impact as concentric bands, or impact zones, around the footprint of a cave.

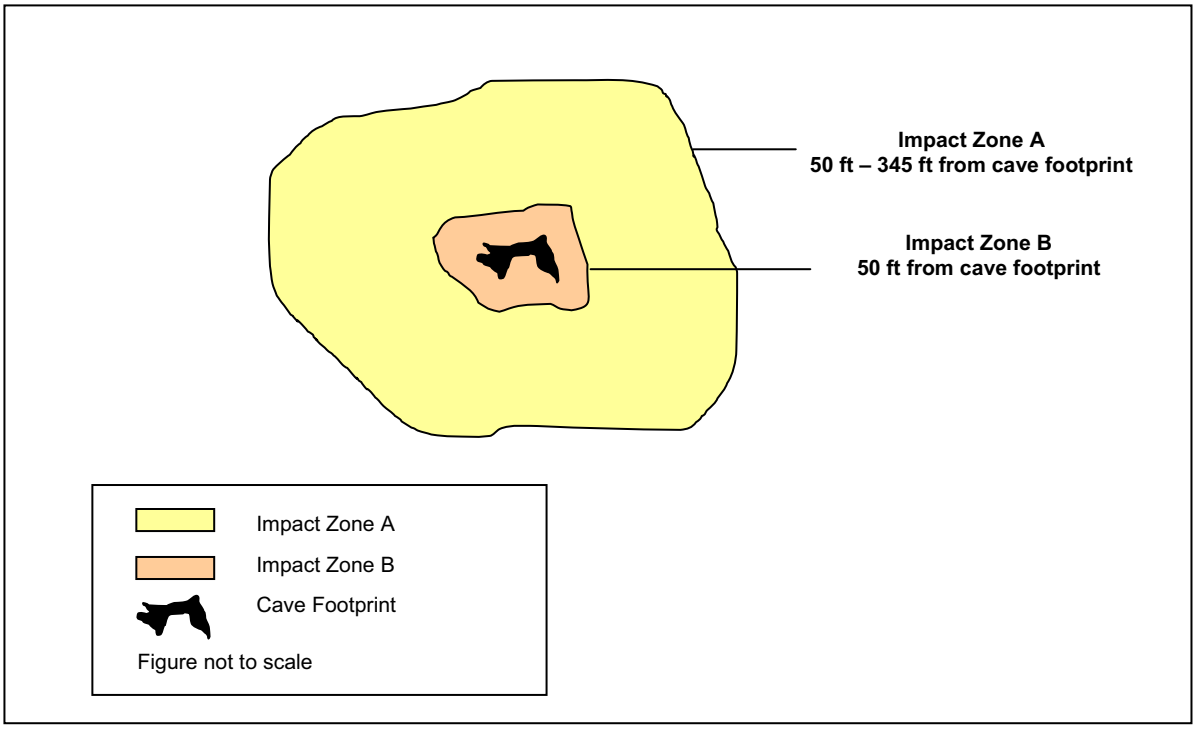

Figure 4-2. Impact zones around the footprint of a species-occupied cave.

Impact Zone A: This category of impact includes those specie-occupied caves with a setback of at least 50 feet but less than 345 feet (105 meters) from the cave footprint. Disturbance in this area may not necessarily impact the moisture regimen of the cave; however, the cricket foraging area may be reduced,[42] and this will likely have some indirect, but long-term consequence to the survival of the listed invertebrates at the same population levels compared with the pre-development situation. Thus, while the future long-term survival of the karst ecosystem is not certain, it is also not certain that such encroachment on the karst ecosystem will preclude the long-term survival of the troglobitic inhabitants.

It is possible in some cases that surface disturbance beyond 345 feet from the cave footprint could impact the cave's subsurface drainage area and therefore result in an indirect impact on listed species within the cave. Based on estimates of the subsurface drainage areas of 64 caves in Bexar County, Texas (Veni 2002), TCEQ determined that 87 percent of the subsurface drainage areas of those caves would be included within a setback with a default radius of 500 feet from the feature(s) (TCEQ 2007b). Because the subsurface drainage areas for caves vary widely and can fall well within 345 feet or well beyond 500 feet of a cave's entrance, and because the subsurface drainage area can only be estimated, this RHCP considers any potential impacts to a species-occupied cave resulting from disturbance more than 345 feet from the cave's foot print to

[42] A 105-meter radial projection around a cave opening has been shown to include 100 percent of the cricket foraging area (Taylor et al. 2005).

be impacts to the Karst Zone (see Section 4.2.2, above), and will be mitigated accordingly (see Chapter 6, Section 6.2.1.1)

Impact Zone B: This category of impact includes all occupied caves where the cave is either filled or collapsed, or where less than a 50-foot (15-meter) radial projection from the cave footprint is left in natural habitat.[43] The 50-foot setback is based on the distance generally required by TCEQ for groundwater protection; however, TCEQ measures this distance from the feature entrance, which may not protect the entire footprint from possible infiltration by contaminants. For purposes of this RHCP, it is assumed that the moisture and nutrient supply to a cave with less than a 50-foot setback from the cave footprint could deteriorate over time, eventually resulting in the demise of the troglobitic inhabitants. Protecting the surface habitat over the entire cave footprint covers the possibility that small fissures exist and allow moisture and nutrient input to the cave.

4.2.3.2 Estimated Number of Affected Caves

To obtain a reasonable estimate of the expected number of occupied caves that will be impacted during the next 30 years of development in the County, we reviewed the amount of karst habitat (both occupied and unoccupied) that has been encountered during land development in the past decade within Williamson County. Table 4-3 presents a review of 10 major development projects undertaken in Williamson County from approximately 1994 to 2006. All of these areas had Geologic Assessments performed to TCEQ guidelines (TCEQ 2004) and had subsequent evaluations of karst features, including biotic surveys of caves on the property. Of the development projects reviewed, the number of significant recharge features (as defined by TCEQ)[44] ranged from 4 to 95 (average of 0.033 features/acre), and the number of caves containing listed species ranged from 0 to 28 (average 0.012 caves/acre).

While the number of significant recharge features and caves varied considerably on a project-by-project basis, throughout the remaining undeveloped portions of the Karst Zone, it can reasonably be expected that average cave density and patterns of impacts to those caves will be similar over the long-term future to those found in the past decade. Therefore, assuming an average of 0.012 occupied caves/acre, and an average development rate of 533 acres/year covered by the RHCP (see Section 4.2.2), it is predicted that a long-term average of six (0.012 x 533 = 6.4) occupied caves per year (both known locations and newly discovered) will be encountered by RHCP participants during future development projects. The RHCP also assumes that over the 30-year life of the plan, RHCP participants will uncover one previously undetected species-occupied cave per year during construction activities. Thus, we are estimating that a total of seven species-occupied caves per year will be encountered during activities covered through the RHCP. Table 4-4 summarizes the expected numbers of species-occupied caves predicted to be encountered by RHCP participating lands over the 30-year plan period.

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[43] In situations where the cave has already been impacted by previous development activities, RHCP impact assessments will be done on a case-by-case basis.

[44] A significant recharge feature is defined as a karst feature with a well-defined surface opening (such as a cave) or a sinkhole (without a surface opening) that has a catchment area greater than 1.6 acres (TCEQ 2004).

Table 4-3. Significant recharge features and cave density from existing survey and land development records.

Project Name	Survey Area Acreage (hectares)	Total No. Features / No. of Species Caves	Significant Recharge Features per Acre/ Species Caves per Acre
Sun City (Richardson Verdoorn 1994)	5,600 (2,267)	95 / 28	0.018 / 0.005
Mayfield Ranch (Mike Warton and Associates 1999a)	470 (190)	27 / 17	0.059 / 0.036
Cornerstone (USFWS 1999)	193 (78)	26 / 13	0.143 / 0.067
Cat Hollow (Mike Warton and Associates 1999b, SWCA 1993, Ubick and Briggs 2004)	326 (132)	24 / 18	0.071 / 0.055
Buttercup Creek (USFWS 1999)	554 (224)	47 / 24	0.091 / 0.043
SH 195 (SWCA 2006b)	292 (118)	27 / 5	0.091 / 0.017
Williamson County RP (Horizon Environmental Services 2002)	550 (223)	30 / 6	0.056 / 0.011
Sendero Springs (Mike Warton and Associates 1994a, 1994b)	272 (110)	24 / 2	0.091 / 0.007
Avery Ranch (Mike Warton and Associates 1999c)	1,044 (423)	12 / 0	0.011 / 0
Casey Ranch ((Mike Warton and Associates 2001a, 2001b)	370 (150)	4 / 0	0.011 / 0
Total	**9,671 (3,915)**	**316 / 113**	**0.033 / 0.012**

Table 4-4. Anticipated cumulative number of listed species-occupied caves on RHCP participating lands potentially encountered over the duration of the plan.[1]

Lapsed Years of Permit	Developed Acres (hectares)	Estimated Total No. of Occupied Caves
1	533 (216)	7
10	5,330 (2,157)	70
20	10,660 (4,314)	140
30	15,990 (6,471)	210

[1] Includes known caves and those expected to be discovered during site evaluation.

Foundation staff will work with RHCP participants to avoid and minimize impacts to these caves, and it is unlikely that all the caves will be affected by the participants' projects. However, to allow for the improbable event that all the caves would be impacted to some degree, the RHCP will seek a permit based on that premise and the following assumptions. The RHCP assumes that of the seven occupied caves (newly discovered caves, known caves, or both) addressed through the RHCP in each year of the plan, two will be impacted within 50 feet of the cave footprint (including one occupied previously undetected void), and five will be impacted in an area between 50 feet and 345 feet of the cave footprint. These estimates of impacted caves are simply that—estimates. They are approximations based on limited historical data. Actual impacts are likely to vary from those predicted as land development occurs. However, the

anticipated mitigation for impacts to species-occupied caves is expected to be sufficient to accommodate impacts that are in excess of those estimated (see Chapter 5). Over the 30-year plan, it is predicted that:

- 60 caves would have impacts within 50 feet of the cave footprint through authorization provided by the RHCP, and
- 150 caves would have impacts in an area between 50 feet and 345 feet of the cave footprint.

Because of the uncertainties inherent in making long-range estimates, the RHCP will seek a permit allowing for up to 60 caves to have impacts within 50 feet of the cave footprint and another approximately 150 caves to have impacts in an area between 50 feet and 345 feet of the cave footprint. All of these caves would be occupied by one or both of the covered karst species (Bone Cave harvestman and Coffin Cave mold beetle) and represent an unquantifiable number of these invertebrates. Should it appear that the limit on take of caves, as specified in the Permit will be reached before the end of the 30-year life of the plan, the RHCP administrators may apply for appropriate amendments to the Permit well in advance of any take exceedance.

Conditions under which take of the Bone Cave Harvestman and the Coffin Cave mold beetle will be allowed under the proposed Permit are described in Chapter 5 (Avoidance, Minimization, and Mitigation Measures) and Chapter 6 (Participation Process). It is important to state here, however, that the RHCP anticipates allowing take of the Bone Cave harvestman and the Coffin Cave mold beetle in the Karst Zone[45] prior to the final acceptance and approval of the required three KFAs each in North Williamson County, Georgetown, and McNeil/Round Rock KFRs. It is also anticipated that take of the Bone Cave harvestman in known occupied caves will be allowed prior to the final acceptance and approval of the KFAs, because this species occurs in at least three known locations in each KFR that have a high probability of qualifying for designation as KFAs (see Chapter 3, Table 3-1). However, no take will be authorized for the Coffin Cave mold beetle in known occupied caves (i.e., no disturbance within 345 feet of the cave footprint) in a specific KFR unless 1) a minimum of three Service-recognized KFAs in that KFR have been identified for that species and remain available for conservation, or 2) subject to Service approval, authorizing take would not preclude the Foundation from achieving RHCP goals and objectives.[46]

[45] Incidental take in the Karst Zone refers to potential impacts to karst species habitat in previously undetected voids, and potential impacts to karst species habitat resulting from surface disturbance more than 345 feet from an occupied cave.

[46] For example, in specific situations where proposed impacts to karst systems containing the Coffin Cave mold beetle are either additional impacts to already damaged cave ecosystems, or the cave in question would not qualify as a component of an approved KFA, the Service may authorize take prior to the identification or acquisition of the three KFAs in each KFR.

4.3 IMPACTS OF THE COVERED ACTIONS ON GOLDEN-CHEEKED WARBLER

4.3.1 Types of Impacts That May Result from Covered Actions

Actions authorized under this RHCP may impact the golden-cheeked warbler through removal and/or additional fragmentation of habitat that is already mostly non-contiguous (see Figure 3-4). Figure 4-3, taken from DeBoer and Diamond (2006), shows the warbler's breeding habitat, county by county, with Williamson County at the far eastern boundary of the range having a relatively low density of habitat. Compared to many other portions of the species' breeding range, habitat patches in Williamson County are, with a few exceptions, relatively small, fragmented, and isolated. The few exceptions include comparatively high quality habitat on Corps-managed lands around Lake Georgetown and on relatively isolated patches of private land in the San Gabriel River and Brushy Creek corridors (see also Figures 3-4 and 3-5). Though the golden-cheeked warbler habitat in Williamson County may be fragmented and of generally lower quality than in many other areas, it may provide movement corridors and a level of connectivity to higher quality habitat in adjacent counties (C. Sexton, U.S. Fish and Wildlife Service, pers. comm. to SWCA, 2007).

The warbler breeding habitat in adjacent Travis County, to the south of Williamson County, is considered to have the least fragmented woodlands of anywhere within the warbler breeding range, and ranks among the highest quality habitat for the species (Austin Regional Habitat Conservation Plan Biological Advisory Team 1990; Kent S. Butler and Associates and Espy, Huston, and Associates 1992).

Large tracts of preserve land in Travis County are said to support 40 percent more breeding habitat than any other Texas county (USFWS 1992, Wahl et al. 1990). Additionally, to the north of Williamson County in Coryell and Bell Counties, the U.S. Army reservation at Fort Hood contains almost 53,000 acres (21,448 hectares) of occupied warbler habitat in the largest known golden-cheeked warbler breeding habitat area under single ownership (USFWS 1992).

Under this RHCP, clearing of areas of golden-cheeked warbler habitat on participating parcels would be allowed to occur only during the non-breeding season (August 1–February 29) when most warblers are on their wintering range, or are in transit to or from these areas in Mexico and Central America.[47] Nevertheless, regardless of the presence or absence of the warbler, the loss of oak-juniper woodlands that constitute the species' nesting habitat would result in loss of carrying capacity and in population reductions.

[47] Unless a breeding season survey performed according to Service protocols by an Endangered Species Act section 10(a)(1)(A)-permitted biologist indicates that no golden-cheeked warblers are present within 300 feet of the desired activity.

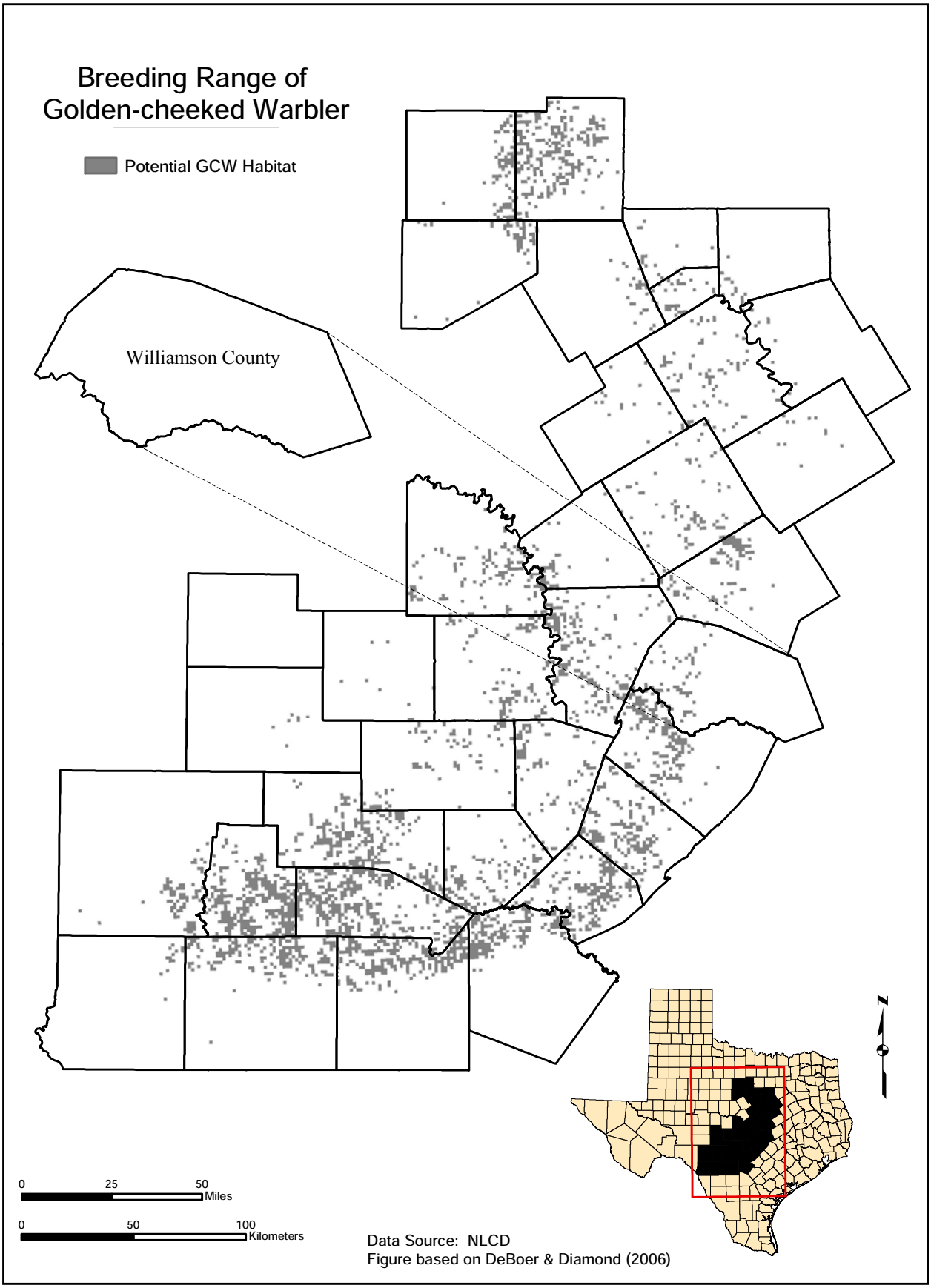

Figure 4-3. The breeding range of the golden-cheeked warbler and relative density of breeding habitat by county.

The additional habitat fragmentation that may occur as a result of actions authorized under this RHCP may also be detrimental to habitat quality. Fragmented habitat results in smaller patch sizes and a greater amount of "edge," which may increase predation and nest parasitism and negatively impact dispersal and reproductive success of birds (Lovejoy et al. 1986, Saunders et al. 1991, Wahl et al. 1990, Wilcove et al. 1986).

The projected human population growth in Williamson County is likely to result in urban development occurring within and in close proximity to warbler habitat. Urban development is often accompanied by increases in generalist species, or species that are successful within a wide range of habitats. Increases in species that are habitat generalists (e.g., grackles [*Quiscalus* spp.], jays [*Cyanocitta* spp.], mice [*Peromyscus* spp.], and fox squirrels [*Sciurus niger*]) often occur at the expense of species with more specialized habitat requirements. Possible introduction and/or increase of predators such as house cats, grackles, and jays and the brood parasite, the brown-headed cowbird, can also have a negative impact on nesting birds (Sexton 1987).

For the reasons stated below, the amount of habitat removal expected to be authorized through this RHCP is not likely to have a major impact on the breeding population as a whole. As may be seen from Figure 4-3, a relatively small amount of the total breeding habitat for the species occurs in Williamson County, and the actions covered by this RHCP will only result in loss of a small portion (estimated at 20 percent; see Section 4.3.2) of that occupied habitat within the County over the life of the plan. Thousands of acres of largely unfragmented warbler preserves to the south (Travis County) and west (Burnet County) currently provide habitat for breeding and movement (Pulich 1976, USFWS 1992).

The impact of the covered actions of the RHCP will also not likely affect the potential for eventual recovery of the golden-cheeked warbler (USFWS 1992). The recovery plan calls for protecting sufficient breeding habitat in each of eight recovery regions such that "at least one self-sustaining population is either viable on its own or through its connection to other populations." In addition to being in Recovery Region 5, portions of Williamson County are also in Recovery Region 3, where the protected habitat of Fort Hood in Coryell and Bell Counties (see Figure 3-3) may already meet the recovery region goals of a healthy and self-sustaining population (USFWS 2005f, see also Peak 2003).

4.3.2 Estimated Acres of Take of Golden-cheeked Warbler Habitat

Because quantifying take of individual golden-cheeked warblers is difficult (clearing of habitat typically results in displacement, not in death or injury of individuals, although the ultimate result is reduced population and habitat carrying capacity), this RHCP will instead evaluate acres of potential habitat removed as an indicator of take levels. This approach has also been used for warbler take evaluation in adjacent Travis County (RECON and USFWS 1996).

It is important to point out that while it is expected that many areas of currently undisturbed woodland containing habitat for the warbler will be subject to some form of development over the life of the RHCP, not all of this habitat will necessarily be irrevocably impacted, or indeed, impacted at all. Three lines of reasoning allow this conclusion. First, one of the primary objectives of this RHCP will be to assist landowners in avoidance of warbler habitat when

possible; second, participation fees will be sufficiently high ($7,000/acre initially, and will rise through time) to encourage avoidance; and third, some of the best of the existing warbler habitat is in steep canyons where development is difficult-to-impossible under the best of conditions.

As has been previously discussed in this chapter (see discussion in Section 4.2), the human population in Williamson County is expected to increase by more than 300 percent over the life of this plan. Some of the development associated with this growth can be expected to occur within potential habitat of the golden-cheeked warbler. An estimated 34,465 acres of woodland habitat (minimum mapped patch size 11 acres) that could potentially support golden-cheeked warblers presently exists within the Williamson County plan area (Figure 3-4). As described in Chapter 3, Section 3.2.2.1.4, this potential habitat can be categorized into three habitat quality levels based on known or perceived probability of habitat occupancy by warblers (see Magness et al. 2006). These levels are termed "relatively high probability of occupancy habitat," "relatively low probability of occupancy habitat," and "marginal habitat." Table 4-5 shows the estimated number of acres in each category, the number of acres in each category in protected (or managed) areas, and the number of acres of remaining habitat that may be lost if 20 percent of the owners of this property participate in the RHCP and fully develop the warbler habitat.

Table 4-5. Estimated acreage of "relatively high probability of occupancy," "relatively low probability of occupancy," and "marginal probability of occupancy" golden-cheeked warbler breeding habitat currently available (see Figure 3-5), currently protected, and anticipated to be lost over the 30-year life of the RHCP.

Golden-cheeked Warbler Breeding Habitat	Existing Potential Habitat (hectares)	Existing Protected Habitat[1] (hectares)	Remaining Acres (hectares)	Acres Lost @ 20% Participation Level (hectares)
"Relatively High Probability of Occupancy"[2] (15%)	5,277 (2,136)	385 (156)	4,892 (1,980)	978 (396)
"Relatively Low Probability of Occupancy"[3] (24%)	8,108 (3,281)	554 (224)	7,554 (3,057)	1,510 (611)
"Marginal Probability of Occupancy"[4] (61%)	21,080 (8,531)	3,424 (1,386)	17,656 (7,145)	3,531 (1,429)
Total (100%)	**34,465 (13,947)**	**4,363 (1,766)**	**30,102 (12,182)**	**6,019 (2,436)**

[1] Existing protected habitats identified in Chapter 3, Section 3.2.2.1.4.

[2] "Relatively high probability of occupancy" habitat is all woodland with 80% or greater juniper/hardwood (usually oak) composition within a 400-meter radius.

[3] "Relatively low probability of occupancy" habitat is all woodland with at least 60% but less than 80% juniper/hardwood (usually oak) composition within a 400-meter radius.

[4] "Marginal probability of occupancy" habitat is all woodland with at least 50% but less than 60% juniper/hardwood (usually oak) composition within a 400-meter radius.

As shown in Table 4-5, of the estimated 34,465 acres of woodland present, the "relatively high probability of occupancy habitat" (i.e., most highly likely to be occupied) constitutes approximately 15 percent (5,277 acres). Another 24 percent (8,108 acres) is "relatively low

probability of occupancy habitat" (i.e., less likely to be occupied). The remaining 61 percent of the potential habitat (21,080 acres) is "marginal probability of occupancy habitat," and while it has a low probability of supporting the golden-cheeked warbler at this time, portions of the habitat *could* be occupied now or in the future.

Of the estimated 34,465 acres of potential warbler habitat currently present in the County, 4,363 acres (1,766 hectares) are already included in public or private dedicated open space that will not be developed (Table 4-5). This leaves approximately 30,102 acres (12,182 hectares) of potential warbler habitat that may be developed. Assuming a 20 percent participation rate in the RHCP, Table 4-5 summarizes the maximum amount of golden-cheeked warbler habitat that may be impacted (both directly and indirectly)[48] by RHCP participant activities over the life of the plan. The maximum amount of "relatively high probability of occupancy," "relatively low probability of occupancy," and "marginal probability of occupancy" habitat expected to be affected is 978, 1,510, and 3,531 acres, respectively. This represents a total 30-year maximum take estimate of 6,019 acres of warbler habitat that could be subject to some level of loss under the plan.

The 3,531 acres of marginal habitat, while not likely to be occupied by warblers, has been included in the overall estimate of 6,019 acres of golden-cheeked warbler habitat take. Although including marginal habitat overestimates the total potential take, it was done for two reasons: 1) over the 30-year life of the plan, some of the habitat that is today considered "marginal" could develop into a higher quality habitat, and 2) at the present time and for the foreseeable future, some of the 3,531 acres of marginal habitat *could* be occupied by the warbler, and only on-site habitat assessments or breeding bird surveys will determine the land status as it relates to warbler occupancy. Surveys conducted according to Service protocols during one-year's breeding season by an Endangered Species Act section 10(a)(1)(A)-permitted biologist would confirm either the presence or absence of golden-cheeked warblers on the subject property.[49]

The combined acreage (2,488) of the "relatively high probability of occupancy" (978 acres) and "relatively low probability of occupancy" (1,510 acres) habitats is also likely an overestimation of the actual amount of occupied habitat that will be taken over the life of the plan. While there is a higher expectation of warbler occupancy than in marginal habitat, actual breeding bird surveys would likely result in a determination of occupancy less than half the time. With a full understanding that the methods used in this RHCP to assess take under the plan have resulted in a likely overestimation, the RHCP will seek a permit allowing for up to 6,000 acres (2,428 hectares) of golden-cheeked warbler habitat to be lost over the 30-year life of the plan.

Attempting to estimate how many golden-cheeked warbler territories are represented by 6,019 acres of variable quality habitat is conjectural at best. One approach is to assume that the

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[48] Direct impacts include those impacts that result in the actual removal or significant modification of occupied or potential golden-cheeked warbler habitat. Direct impacts are assessed at a mitigation ratio of at least 1:1. Indirect impacts are those assumed impacts that occur in occupied or potential habitat adjacent to direct impacts. Indirect impacts are measured up to 250 feet from direct impacts and are assessed at a 1:0.5 mitigation ratio.

[49] If golden-cheeked warblers are detected on the subject property during a survey, all woodlands contiguous to the detection site that have the characteristics of potential habitat will be considered occupied.

2,488 acres of the habitats most likely to be occupied is a reasonable base for estimating number of warbler territories that may be impacted under the RHCP. This number is an overestimation as explained above and probably more than compensates for the few birds likely to occupy the 3,531 acres of marginal habitat. Using 2,488 acres as a base, and assuming that 20 to 80 acres (Pulich 1976) are required for each warbler territory, the range of possibly affected warbler territories may be from 31 to 124. This range may be too low. As noted in Section 3.2.2.1.1, more recent studies have reported a range of territory densities from 50 acres/pair to 3.3 acres/pair in locations other than Williamson County (Kroll 1980, Wahl et al. 1990, USFWS 1996a, Travis County Natural Resources Division 2004). For Williamson County, the low end of that range (50 acres/pair) may be realistic, but given the largely fragmented nature of warbler habitat depicted in Figure 3-5 and the small amount of habitat with a high probability of warbler occupancy, a density of 3.3 acres/territory would be unrealistically high for Williamson County. The survey data (17 acres/territory [6.9 hectares/territory]) collected from the Russell Park Estates warbler preserve[50] (the highest quality warbler habitat currently known in Williamson County) may be more representative of the high end of warbler density in the County. Therefore, assuming that 17 to 50 acres are required for each warbler territory, the range of possibly affected warbler territories on 2,488 acres may be from 50 to 146. Assuming that a constant rate of habitat loss is maintained (which is not likely) over the life of the plan, approximately two to five territories may be impacted per year.

4.4 IMPACTS OF COVERED ACTIONS ON BLACK-CAPPED VIREO

Actions authorized under this RHCP may impact the black-capped vireo through habitat removal, increased nest parasitism, and nest depredation. Within the permit area no reliable data are available on numbers of black-capped vireos. The counties to both the north (Bell and Coryell) and south (Travis) have substantial numbers of vireos (up to several thousand individuals) (The Nature Conservancy 2005, Maresh 2005), but Williamson County has only a few recorded instances of vireo occupation during the breeding season outside of the Balcones Canyonlands National Wildlife Refuge (see Chapter 3). Williamson County has never been considered to have much habitat for the species (see USFWS 1996c). Only 4,267 acres (1,726 hectares) of potential vireo habitat is estimated to occur within Williamson County (see Figure 3-6). Most of this potential habitat is in the far northern portion of the County, where development is not currently focused, and given the few records of the species outside the wildlife refuge, much of the potential habitat is likely unoccupied or occupied at very low densities. Loss of vireo nesting habitat within the County is expected to be small, and the take of vireos and vireo habitat in Williamson County is not likely to be a major issue over the 30-year life of the RHCP. Still, some loss of black-capped vireo is expected to occur, and an estimate of that loss must be made for purposes of this RHCP.

Since so little is currently known about the black-capped vireo status and habitat distribution in Williamson County, it is not practical to assign relative habitat values to the total delineated habitat as was done for the more common and well-studied golden-cheeked warbler. Nor is it reasonable to speculate on how many territories of what size this potential habitat might support. For estimating take under the plan, the full 4,267 acres of potential habitat delineated in

[50] The Russell Park Estates preserve (Whitney Tract) is adjacent to Corps-owned woodlands at Lake Georgetown.

Figure 3-6 is used here as the base value. If we assume that RHCP covered activities will directly impact a maximum of 20 percent of that base, that would be equivalent to 900 acres.[51] However, in the case of the vireo, because so little is known about its density and distribution in Williamson County, and because the RHCP vireo mitigation plan (see Chapter 5, Section 5.5.1.3) provides an acre of habitat restoration or preservation for every acre eventually impacted, the RHCP will seek a permit allowing for up to 4,267 acres of black-capped vireo habitat to be taken over the life of the plan.

4.5 GEORGETOWN SALAMANDER

While the Georgetown salamander is not a covered species under the Proposed Action, and, absent an amendment to the Permit, would not be included on the proposed incidental take permit if it should it be federally listed in the future, this species is being singled out for special consideration in the RHCP because it is a candidate for Federal listing as endangered or threatened and is known to occur only in Williamson County. The Georgetown salamander is an entirely aquatic species that never metamorphoses into a terrestrial adult. As for most amphibians, water quality degradation poses a significant threat to this species (Hillman and Withers 1979). Actions authorized under this RHCP for other species (i.e., the covered species) may impact the Georgetown salamander by degrading water quality and quantity in springs and streams in the watersheds where the species occurs. Development activities that could affect water resources include removal of vegetation and replacement with impervious cover. Impervious cover prevents rainwater from infiltrating the ground, which results in increased surface runoff. Increased impervious cover has been correlated with declines in water quality, increased sediment loadings, and negative impacts to stream hydrology, morphology, habitat and biodiversity (City of Austin 1998, Veenhuis and Slade 1990). One of the most serious consequences of the conversion of rural land to urban land is an increase in sediment derived from soil erosion, which dramatically increases when vegetative cover is removed during development (Wolman and Schick 1967, Nelson and Booth 2002). Soil erosion is known to be a major factor in the pollution of surface water (Menzer and Nelson 1980), and contaminants carried and stored in sediments can include petroleum hydrocarbons, pesticides, and heavy metals (Hoffman et al. 1995).

The actions authorized by this RHCP may cause some impacts to Georgetown salamanders outside of, and, to a limited degree, potentially within the existing protected karst conservation areas (Figure 3-2), as well as within new conservation areas or preserves established through the actions of this RHCP. Sufficient data on the relationship between development and spring water quality/quantity are not available to quantitatively predict levels of impact on the salamander (see USFWS 2005e) of the RHCP covered actions. At the present time, however, Williamson County does not implement water quality protection standards that could benefit salamanders beyond that required by TCEQ for aquifer protection. Because water quality protection standards are not implemented or monitored on a regional level, existing water quality standards

[51] Activities covered under the RHCP are not expected to result in indirect impacts to black-capped vireo habitat because the vireo is considered an edge species and occupies early successional habitat. Mitigation will only be required for direct impacts to vireo habitat.

may not provide the maximum amount of protection for the salamanders given the development expected over the next 30 years.

4.6 CUMULATIVE IMPACTS

Cumulative impacts can be defined as "…the impact on the environment which results from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time" (40 CFR 1508.7). Thus, cumulative impacts on the covered species include not only the impacts of the proposed RHCP, but those impacts that have already occurred and those impacts that are not related to the RHCP, but are likely to occur over the life of the plan.

4.6.1 Cumulative Impacts on Karst Species

Bone Cave harvestman. The range of the Bone Cave harvestman is restricted to Williamson and Travis Counties. Within Travis County, the Balcones Canyonlands Conservation Plan (BCCP) ensures the long-term protection of the species. For example, of the 39 federally listed karst invertebrate localities currently known in the BCCP permit area, 35 localities, many containing the harvestman, will be protected by the BCCP or other permits (RECON and USFWS 1996). Within the BCCP permit area, the harvestman is the most widely distributed endangered arthropod, being known from 19 caves and probable in 2 caves. Of the 21 known or suspected harvestman localities in Travis County, all but 2 are likely to be preserved in perpetuity. In Williamson County, impacts to the harvestman will be limited to some of the 60 caves expected to have impacts within 50 feet of the cave footprint and the 150 caves expected to have impacts in an area between 50 feet and 345 feet of the cave footprint over the 30-year life of the RHCP. At present the harvestman is known from at least 138 caves in Williamson County, many of which are already in some form of conservation management. While some unknown number of harvestman caves will eventually be destroyed or otherwise impacted, the RHCP calls for conserving a sufficient number of caves in each karst region to satisfy the preservation (downlisting) objectives of the Recovery Plan. Thus, it is likely that the long-term cumulative impacts of the covered actions in both Travis and Williamson Counties will include downlisting of the Bone Cave harvestman from endangered to threatened and eventual recovery.

Coffin Cave mold beetle. The Coffin cave mold beetle occurs exclusively in Williamson County and is currently known from relatively few caves. Up to this time, no take has been authorized for this species. As stated above, no take, except with respect to the Karst Zone,[52] will be authorized for the mold beetle under the auspices of this RHCP in a specific KFR unless 1) a minimum of three Service-recognized KFAs in that KFR have been identified for that species and remain available for conservation, or 2) subject to Service approval, authorizing take would not preclude the Foundation from achieving RHCP goals and objectives. These goals and objectives include achieving the recovery (downlisting) criteria (USFWS 1994) for the Coffin

[52] Incidental take in the Karst Zone refers to potential impacts to karst species habitat in previously undetected voids, and potential impacts to karst species habitat resulting from surface disturbance more than 345 feet from an occupied cave.

Cave mold beetle; therefore, the cumulative effect of the proposed RHCP combined with other past and future actions within the range of this species is anticipated to be downlisting from endangered to threatened and eventual recovery.

4.6.2 Cumulative Impacts on Golden-cheeked Warbler

The cumulative impact on golden-cheeked warblers of the RHCP combined with previously authorized incidental take is summarized in Table 4-6. Impact is expressed in acres of warbler breeding habitat modified or lost due to the covered actions.

Table 4-6. Cumulative impact on golden-cheeked warblers and black-capped vireos of the RHCP combined with previously authorized incidental take.

Species	Acres of Breeding Habitat in Texas (hectares)	Acres of Take Requested in RHCP (hectares)	% of Total Habitat	Acres of Previously Authorized Take (hectares)	% of Total Habitat	RHCP & Previously Authorized Take (hectares)	% of Total Habitat
Golden-cheeked Warbler	1,178,051 (476,740)	6,000 (2,428)	0.51	36,804 (14,894)	3.12	42,804 (17,322)	3.63
Black-capped Vireo	1,450,000 (586,794)	4,267 (1,726)	0.29	3,300 (1,335)	0.23	7,567 (3,062)	0.52

The entire breeding range of the golden-cheeked warbler contains 1,178,051 acres (USFWS 2004c) to 1,363,807 acres (SWCA 2007) of breeding habitat. This habitat supports an estimated 13,800 (USFWS 1992) to 27,000 territories (SWCA 2007). The amount of take of this habitat (6,000 acres) and territories (31 to 124) expected to occur as a result of actions that would be authorized under this RHCP will be a maximum of approximately one half of one percent (0.51%) of habitat (6,000 acres/1,178,051 acres), and a maximum of less than one percent (0.89%) of the estimated number of pairs (124/13,800).

Other habitat conservation plans and incidental take permits authorized by the Service throughout the warbler's breeding range account for additional loss of warbler habitat. Most of that authorized take (26,753 acres; 10,826 hectares) is in Travis County; however, the established preserves encompassing almost 30,000 acres of prime habitat in Travis County is assumed to fully mitigate for authorized take in that county. To calculate the total number of estimated acres and territories of the golden-cheeked warbler that have been previously authorized by the Service for take, the Service's Southwest Region on-line electronic library was queried for all HCPs and Biological Opinions posted for this species (USFWS 2007b). As a result of this search, it was determined that in 151 separate Federal actions, a total of 36,804 acres, supporting just over approximately 2,000 territories, have been permitted for incidental take. This represents approximately 3.12 percent of the estimated available habitat for the warbler (36,804 acres/1,178,051 acres). When the additional 0.51 percent of the habitat authorized for take through this RHCP is added to the estimate of take previously authorized, approximately 3.63 percent of the available species known breeding habitat will be authorized for removal. The estimated number of territories cumulatively authorized to be taken through previous actions (a

maximum of 2,000 territories) and the RHCP (a maximum of 124 territories) represent approximately 15.39 percent of the entire known breeding territories (2,124/13,800). These numbers do not include past unauthorized take, which is unknown.

Future actions that are likely to affect golden-cheeked warbler breeding habitat and territories are impossible to predict with any precision. However, within the 35 counties identified as containing warbler breeding habitat (USFWS 1992), human population growth is expected to increase from approximately 4.0 million in 2005 to an estimated 5.7 million by 2035, an increase of 40 percent (Texas State Data Center and Office of the State Demographer 2007). While it is not possible to project how much of this growth will occur in golden-cheeked warbler habitat, a 40 percent increase in population and associated development is expected to result in a cumulative loss of warbler habitat.

4.6.3 Cumulative Impacts on Black-capped Vireo

The breeding range of the black-capped vireo in the United States (four percent of the known breeding population resides in Mexico) comprises almost 34 million acres (13,759,611 hectares) of rangeland, including approximately 1,450,000 acres of potential breeding habitat in 53 counties across the species range in Texas (USFWS 2007a). It has been estimated that approximately 75 percent of the known breeding population is found on 400,000 acres (161,877 hectares) in Oklahoma and Texas (USFWS 2007a). For this vireo the Service has consulted on 12 separate projects, and through section 7, approved the removal of approximately 3,300 acres of occupied or potentially occupied habitat (USFWS 2007b). The impact of past unauthorized take is unknown.

The existing approved take of 3,300 acres plus the 4,267 acres of estimated potential take for which this RHCP seeks approval totals 7,567 acres, or approximately 0.52 percent of the known potential breeding habitat in Texas (Table 4-6). Because each acre of occupied habitat taken will be mitigated by at least an acre of potential vireo habitat restored or enhanced, this RHCP is not expected to contribute to cumulative adverse impacts on the species.

While future expected take is unknown, it is important to note that a recent status review of the vireo (USFWS 2007a) found that the population size and distribution of the species is significantly greater today than was thought at the time of the listing. As a result, the Service has recommended that the vireo be downlisted from endangered to threatened. Even with continued growth in the human population within the range of the vireo over the life of the RHCP, the focus on management of the vireo brought by the original listing, and the habitat restoration that will occur as a requirement of existing HCPs and this RHCP, may assure the long-term viability of the vireo.

CHAPTER 5 – AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

The following sections describe the steps that will be taken to avoid, minimize, and mitigate impacts of the Williamson County RHCP to the four covered species (two invertebrates and two songbirds). These steps may also benefit the additional species.

5.1 GOALS AND OBJECTIVES OF THE WILLIAMSON COUNTY RHCP

The RHCP and proposed section 10(a)(1)(B) permit are designed to achieve the following general goals:

- *Reduced burden on individual permit applicants*: The RHCP will reduce time, costs, and logistical burden for individual permit applicants.
- *Responsible economic activities*: The RHCP will facilitate the coordinated and beneficial use of land within Williamson County to promote the local economy of the region.
- *Maintenance of open space and quality of life in Williamson County*: The RHCP will help to ensure that some of the natural character of the County is maintained despite extensive anticipated development.
- *Conservation of natural resources*: The RHCP will promote the long-term conservation and recovery of the covered species.
- *Efficient and effective administration of the Endangered Species Act*: The RHCP will reduce the administrative and logistical burden on the Service of processing individual Endangered Species Act permits and monitoring post-issuance performance of multiple individual permit projects within the County.

The RHCP is designed to meet these goals through a variety of mechanisms and programs, the core features of which include:

- Meeting the biological goals and objectives described below and applying the associated conservation measures.
- Prescribing the conditions necessary for Williamson County to secure Service authorization for take of covered species during land use and development projects.
- Establishing the standards and procedures for extending the RHCP permit take authorization to land use projects undertaken within the County by other non-Federal entities.

5.1.1 Biological Goals and Objectives of the RHCP

The HCP Handbook 2000 Addendum defines biological goals as the broad, guiding principles that clarify the purpose and direction of the conservation components of an HCP (65 FR 35241). The biological goals and objectives are designed to address the anticipated impacts of the proposed activities while taking into account the overall conservation needs of the listed species

and their habitat. Conservation measures identified in an HCP, including minimization and mitigation strategies, provide the means for achieving these biological goals and objectives.

5.1.1.1 Biological Goals

The biological goals of this RHCP are to:

- Support recovery efforts for the endangered Bone Cave harvestman, Coffin Cave mold beetle, golden-cheeked warbler, and black-capped vireo.
- Help conserve the 20 additional karst species[53] and four additional salamander species listed in Chapter 1, Section 1.1.1, thereby assisting the Service in precluding the need to list those that are not currently listed (all but the Tooth Cave ground beetle).

5.1.1.2 Biological Objectives

In general, the biological goals will be accomplished 1) by minimizing disturbance to endangered and rare species and their habitat occurring in Williamson County, and 2) by mitigating the impacts of take contemplated by this RHCP by preserving and managing certain known endangered and rare species habitat areas. For the covered bird species, due to the paucity of high quality habitat within Williamson County, the RHCP will need to focus mitigation efforts outside of the County, although mitigation opportunities will be actively pursue within the County as well (see Sections 5.4 and 5.5, below). In addition to these general objectives, the biological goals of the Williamson County RHCP will be met by accomplishing the following measurable objectives:

- Ensure Recovery Plan conservation goals for the Bone Cave harvestman and Coffin Cave mold beetle in Williamson County are reached as quickly as possible. The published recovery (downlisting) criteria (USFWS 1994) include the following:
    - Three KFAs within each KFR[54] in each species' range should be protected in perpetuity.
    - If fewer than three KFAs exist for a species, that species would still be considered for downlisting if it occurred in two KFAs and those were adequately protected.
- Provide long-term management (*in perpetuity*) of the KFAs required for covered species recovery.
- For additional karst invertebrate species, acquire and manage KFAs that are rich in invertebrate species diversity.
- For golden-cheeked warbler, contribute to the amount of high quality habitat (at least 1,000 acres [405 hectares] within the first four years of the plan) preserved in perpetuity in Recovery Region 5.

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[53] One of the 20 additional karst invertebrate species, the Tooth Cave ground beetle, is already listed.

[54] With the exception of Cedar Park KFR, which contains the Bone Cave harvestman but is already largely developed and has little potential for additional take and little or no potential for establishment of additional protected KFAs.

- For black-capped vireo, restore and enhance protected vireo habitat either within or outside Williamson County commensurate with vireo habitat taken under the plan.
- For the Georgetown salamander (a candidate species not covered by the proposed Permit), increase knowledge of the species' status, distribution, and conservation needs through research in Years 2–6 of the plan.
- Increase the knowledge and understanding of covered and additional species via research and monitoring throughout the 30 years of the plan.
- Increase public understanding and appreciation of the need to protect the covered and additional species via public education throughout the 30 years of the plan.

5.1.1.3 Conservation Measures for Attaining Biological Objectives

The strategy for attaining the above biological objectives consists of the following conservation measures. Each of these measures is described in detail later in this chapter.

For the covered species:

- For karst species, to discourage impact on species-occupied caves within 50 feet of the cave footprint and to provide sufficient funds to contribute to the purchase of KFAs, levy a high participation fee ($400,000/cave) for impacts within 50 feet of the cave footprint.
- To mitigate for incidental take of the Bone Cave harvestman and Coffin Cave mold beetle, purchase or acquire management control[55] of approximately 700 acres (283 hectares) of KFAs, establishing three KFAs for each species in the KFRs where the two species occur: North Williamson County KFR, Georgetown KFR, and McNeil/Round Rock KFR for the Bone Cave harvestman, and North Williamson County KFR and Georgetown KFR for the Coffin Cave mold beetle.[56]
- Develop and carry out long-term management/monitoring plans for 10 of the 22 existing karst conservation areas (see Table 3-1 and Figure 3-2), the 700 acres in new KFAs, and up to 240 acres of protected karst habitat as identified above.
- For the golden-cheeked warbler and the black-capped vireo, preserve habitat by helping plan participants avoid and minimize impacts to habitat.
- For the golden-cheeked warbler and the black-capped vireo, minimize disturbance during the nesting season through temporal and spatial restrictions on clearing activities.

[55] A service-approved KFA may be established for an existing conservation area that meets all KFA criteria except adequate management, if the Foundation provides the needed management, beginning with the preparation of a karst management and monitoring plan.

[56] No take or mitigation is planned for the fourth KFR in the County, Cedar Park, because that KFR is already built out to the extent that insufficient undeveloped land with occupied caves is available for a KFA. No KFAs are planned for the Tooth Cave ground beetle because, in Williamson County, this species is known only from the Cedar Park KFR, which cannot support a new KFA. Little additional development on undisturbed land will occur in Cedar Park, so no additional take of the Tooth Cave ground beetle in the County is expected in any case.

- For the golden-cheeked warbler, purchase 1,000 acres of Hickory Pass Ranch[57] Conservation Bank credits to mitigate for take on a 1 to 1 ratio[58] (or up to 2:1 ratio in some instances; see Section 5.4.1.3) for direct impacts and a 0.5 to 1[59] ratio for indirect impacts for potential or occupied habitat.
- If, after the 1,000 acres of Hickory Pass Ranch credits are exhausted, additional demand exists for warbler take and mitigation,[60] establish one or more preserves of warbler habitat within the County[61] and establish a conservation bank similar to Hickory Pass Ranch, or utilize an alternate Service-approved out-of-county mitigation bank.
- For the black-capped vireo, establish a rolling mitigation program in which participation fees are collected prior to land disturbance for anticipated impacts to vireo habitat and opportunities are assessed annually to use these accumulated funds to restore, enhance, and manage protected vireo habitat on a 1 to 1 ratio within or outside the County (or up to 2:1 ratio in some instances; see Section 5.5.1.3).
- For the covered species, manage and monitor in perpetuity all preserved habitat areas to maintain or enhance habitat quality.

For the Georgetown salamander (not covered by the Permit):

- Implement research and monitoring of spring habitat quality and salamander presence/abundance in the County. The research and monitoring will be funded by at least $50,000 per year for five years (Years 2–6); however, the most intensive monitoring will be conducted in the first two years of the research program and will be geared toward gathering the data needed to prepare a conservation strategy for the salamander.[62]
- After the first two years of research and monitoring, review the status of the Georgetown salamander in Williamson County and prepare a conservation strategy for the species. At the end of five years, investigate the feasibility of developing a Candidate Conservation Agreement with Assurances.

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[57] Hickory Pass Ranch, currently 3,000 acres in size and expected to grow to 4,400 acres in size in the near future, is a Service-approved conservation bank established for the long-term benefit of the golden-cheeked warbler. Hickory Pass Ranch Conservation Bank is part of the Balcones Canyonlands Preserve system, which includes almost 30,000 acres of warbler habitat

[58] The base 1 to 1 ratio of mitigation credits to impacted acres is based on the assumption that, from a range-wide perspective, the relatively lower quality and fragmented warbler habitat generally found in Williamson County will be mitigated by higher quality and less fragmented warbler habitat available through Service-approved conservation banks that are managed and monitored under Service-approved guidelines (like Hickory Pass Ranch). Intensive habitat management for the benefit of the golden-cheeked warbler will be required.

[59] It is standard practice for the Service to assign indirect impacts at 50 percent of the mitigation requirements of direct take. Per Service guidance, indirect impacts occur for a distance up to 250 feet from the direct impact.

[60] When and if the 1,000 acres of Hickory Pass Ranch mitigation credits are utilized for take authorized by this RHCP, no further take will be permitted until such time additional mitigation credits are available either within or outside the County.

[61] The County recently purchased 115.52 acres of golden-cheeked warbler habitat (in the Whitney Tract) adjacent to U.S. Army Corps of Engineers protected land at Lake Georgetown to use as in-county mitigation for future impacts to warbler habitat resulting from activities covered by the RHCP.

[62] This research project is a focused study for the benefit of the Georgetown salamander that is a separate research effort from the 30-year study described for the benefit of all covered and additional species (see Section 5.8.1).

For all covered and additional species:

- Provide funding of at least $25,000[63] per year for 30 years, totaling $1.1 million for a program of prioritized research on endangered and rare species in the County (independent of the five-year funding for Georgetown salamander research and monitoring).
- Develop and maintain a database on the known locations and general population numbers and/or karst survey specimen collection records, and preserve habitat quality indices collected during monitoring efforts. To the fullest extent allowed by state law, the Foundation will attempt to maintain the confidentiality of the database.
- Develop a public education/outreach conservation program funded annually by at least $20,000,[64] reaching a total expenditure of approximately $878,000 over 30 years.
- Periodically evaluate the degree to which the RHCP, as it is being implemented, is providing conservation benefits to the additional species, and, if data indicate that one of the species is in need of increased management or its status indicates a potentially threatened or endangered existence, identify what additional measures, if any, the Foundation could implement through the RHCP to provide conservation benefits for the species.

5.2 RHCP PROGRAM ADMINISTRATION

The avoidance, minimization, and mitigation of RHCP impacts cannot be actualized without a dedicated, long-term commitment from the Permit holder (Williamson County). Many elements of the RHCP will require consistent and thorough administrative procedures and assurances that the program will be sufficiently funded and staffed to implement the program in all aspects of the commitments detailed in this document. Program implementation includes not just a 30-year commitment over the life of the section 10(a)(1)(B) incidental take permit, but a commitment to manage the endangered species preserves in perpetuity.

Management of the RHCP will be the responsibility of the County through the Williamson County Conservation Foundation (Foundation)[65] with advisement and oversight of the Service. As the Permit holder, Williamson County will sign an Interlocal Agreement specifying the responsibilities of the County and the Foundation, its designated management entity for the RHCP. The Foundation will be responsible for the implementation of the mitigation measures identified in this RHCP.

As an agent for Williamson County, the Foundation will perform the following tasks:

- Establish procedures and staffing structure needed to administer the required programs and ensure success of the plan.
- Administer the RHCP budget and finances, including the development of an annual operating/financial plan.

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[63] Research and public awareness expenditures are calculated to increase annually at a rate of 2.5 percent.

[64] See preceding footnote.

[65] See http://wcportals.wilco.org/wccf/index.html.

- Enter into formal agreements (Participation Agreements leading to Certificates of Inclusion, see Chapter 6, Section 6.2) with the plan participants to ensure compliance with RHCP permit conditions.
- Identify and acquire lands for new karst and bird preserves for the County.
- Identify and acquire lands to enhance existing conservation areas for inclusion in the conservation system as preserves for the County.
- Prepare management and monitoring plans for endangered species preserves when and if they are established in Williamson County.
- Establish and manage a mitigation program for black-capped vireo.
- Manage and monitor preserves (both newly acquired and selected conservation areas established prior to the RHCP).
- Maintain an active and functional Adaptive Management system and implement new management actions or abandon out-of-date procedures when appropriate.
- Report to the Service on a timely basis (to be specified in the terms of the Permit) on the status of acquisition and management of preserve lands and development approvals and participant involvement.
- Assist the County in the management of County parkland identified as preserves in the RHCP.
- Administer a research program, including the creation and maintenance of a computerized database to manage information gathered through the research and monitoring programs.

As an advisor to and overseer of Williamson County's 10(a)(1)(B) incidental take permit, and as the agency responsible for monitoring compliance with the conditions of the Permit, the Service will:

- Advise, in a timely fashion, the Foundation on requests for review of KFAs, conservation areas, and bird preserves as to their suitability for inclusion in the County's preserve system and the assignment of mitigation credits when applicable.
- Provide timely information on listings, delistings, and other conservation and recovery activities that could influence the management of the RHCP.

To accomplish the RHCP goals it is anticipated that the Foundation will hire plan administrators and appropriate staff, and ensure that these positions will be funded and equipped to a level that is sufficient to meet plan needs. It is currently anticipated that the County will outsource biological and any other science-related services needed for plan administration on an as-needed basis. The Foundation may choose to subcontract much of the initial RHCP monitoring and database management, but ultimately the Foundation may be sufficiently staffed to handle these functions in-house.

5.3 KARST INVERTEBRATES (COVERED SPECIES)

5.3.1 Conservation Plan Components

The impacts on karst invertebrates will be minimized, and current recovery goals will be realized and/or exceeded by meeting the goals and objectives of this RHCP. The strategy for meeting these goals and objectives includes 1) acquiring new karst invertebrate preserve areas (i.e., KFAs) and enhancing the size of existing karst conservation areas (see Figure 3-2) to mitigate take of Bone Cave harvestman and the Coffin Cave mold beetle; 2) acquiring additional KFAs to enhance recovery of these two species; 3) assuming management of selected existing cave conservation areas in the County; 4) funding karst invertebrate research and monitoring (see Section 5.8.1); and 5) increasing public awareness through a public education/outreach program (see Section 5.8.2).

Subject to Service approval, if there is no practicable alternative the County reserves the right to allow limited public infrastructure crossings of RHCP preserves, so long as the proposed infrastructure does not materially diminish the value of the preserve for its intended conservation purpose, and any related impacts are appropriately mitigated. Unless variations are approved by the Service, conditions imposed on any construction of public infrastructure crossing an RHCP preserve include but are not limited to the following: subsurface excavation should be limited to a depth of four feet, the surface and subsurface drainage basins of species-occupied caves will remain undisturbed, and the entire cave cricket foraging area around species-occupied caves (assumed to be an area within 345 feet of the cave footprint) will be protected." If these measures cannot be met and an impact is expected to result, subject to Service approval, additional mitigation may be required to compensate for the loss of values within the existing preserve and to replace any diminishment of mitigation credit previously achieved within the preserve.

5.3.1.1 Land Acquisition and Management for Mitigation

In Chapter 4 it is estimated that, over the 30-year life of the RHCP, up to 60 caves occupied by one or both covered karst invertebrate species will have impacts within 50 feet of the cave footprint, and another approximately 150 caves will have impacts in an area between 50 feet and 345 feet of the cave footprint. The RHCP proposes to mitigate for this take by purchasing and/or acquiring 700 acres of KFAs and managing this land and other existing conservation areas in perpetuity, an effort aimed at achieving the recovery (downlisting) goals for the covered karst species in Williamson County. Thus, the biological goals and objectives of the RHCP are designed to fully mitigate the anticipated impacts of the proposed activities while taking into account the overall conservation needs of the covered karst species and their habitat.

Land Acquisition: The County will acquire, manage, and monitor, in perpetuity, approximately 700 acres of KFAs within the Karst Zone as mitigation for the anticipated take of the Bone Cave harvestman and Coffin Cave mold beetle. The County will acquire (in fee simple or by easement) all 700 acres of new cave preserves by Year 17 of the plan.

The objective is to establish three KFAs for each of the two covered karst species in each of the KFRs in which the species occur (with the exception of Cedar Park KFR, which contains the Bone Cave harvestman but is not included in the RHCP[66]). The Bone Cave harvestman occurs in North Williamson County, Georgetown, and McNeil/Round Rock KFRs, while the Coffin Cave mold beetle occurs only in North Williamson County and Georgetown KFRs. If both species occur in the same KFA, that KFA would be credited as mitigation for both species. The total number of KFAs acquired would range from 9 (if each KFA contained both species) to 15 (if each KFA contained only one of the species).[67] North Williamson County and Georgetown KFRs would each have from three KFAs (if each KFA contained both species) to six KFAs (if each KFA contained only one of the species). McNeil/Round Rock KFR would have three KFAs. Identification of potential KFAs is well advanced as of this writing (see Table 3-1).

Each KFA will be designed to meet or exceed the criteria outlined in the Travis/Williamson County Recovery Plan (USFWS 1994). Those criteria include 1) determining the presence of at least one listed karst species; 2) determining the presence of sufficient aboveground and belowground habitat to ensure KFA long-term conservation; 3) giving priority to areas that exhibit high species diversity and contain other rare or listed species; and 4) ensuring that the protected KFAs are located far enough apart to protect against catastrophic loss and preserve the genetic diversity of each species. Each KFA will comprise at least 40–90 acres, with the minimum size based on rationale included in the Service's 2003 designation of critical habitat for seven listed karst invertebrate species in Bexar County, Texas (68 FR 17156–17231). Included in their criteria for identifying and delineating lands for designation as critical habitat, the Service recommended that, where possible, a minimum of approximately 40 acres (16.2 hectares) of natural habitat be left around each species-occupied cave or cave cluster. An area of this size was considered necessary to maintain the natural surface vegetation communities needed to support a species-occupied cave's ecosystem over the long term. While this RHCP recognizes that designating critical habitat for a listed species is a different process from establishing a KFA, it appears reasonable to assume that if a minimum of 40 acres of natural vegetation is considered necessary to ensure the long-term viability of a species-occupied cave as critical habitat, it would also be considered necessary to ensure the long-term viability of a species-occupied cave within a KFA. The KFAs also will be designed to be consistent with the Service's current criteria for protecting karst features with listed species (USFWS 2005a), while allowing some level of public access within the KFA. All proposed KFA acquisitions, research and monitoring plans, and opportunities for and constraints on public access will be approved through consultation with the Service.

The KFAs acquired will either be newly established preserves or enlarged existing conservation areas that are now possibly too small (less than 40 acres in size) to be considered adequate preserves. The Williamson County karst database currently contains 590 known caves within the County, 165 of which are known to contain one or more of the covered karst invertebrate species (SWCA 2006a). Many of these caves have been deliberately avoided during

[66] Relatively little additional development is anticipated in the Cedar Park KFR, and little or no potential exists to establish additional protected KFAs there.

[67] Because known caves occupied by the Coffin Cave mold beetle also frequently contain the more common Bone Cave harvestman (see Figure 3-1 and K. White, SWCA, pers. comm., 2006), it is anticipated that the number of KFAs eventually acquired will likely be closer to 9 than to 15.

construction and protected from direct development-related impacts through a variety of means. Some of the larger[68] existing karst conservation areas have been set aside (see Table 3-1 and Figure 3-2) as mitigation for project-related impacts during Endangered Species Act section 7 and section 10 consultations with the Service and, in most cases, have limited, short-term management in place. While some of these conservation areas have been referred to as KFAs in the past (USFWS 1994, HNTB Corporation 2005), it has not been adequately demonstrated that any of these areas meet the full requirements of KFAs as described in the Travis/Williamson County Recovery Plan (USFWS 1994). As such, some of these karst conservation areas may not have a high probability of ensuring long-term survival of the resident troglobites. Some of these conservation areas are adjacent to as yet undeveloped parcels and, through land purchase and/or conservation easement, are subject to expansion. Whether any of these areas are capable of being expanded to meet KFA standards will be determined through detailed study of each proposed KFA during the initial stages of RHCP implementation. The study will include topographic and cave mapping (if not previously done), presence/absence surveys, and a surface vegetation assessment to determine whether the area:

1) contains a cave occupied by one or more of the covered karst invertebrate species and, preferably, other rare or candidate species;
2) encompasses the entire cave footprint;
3) includes, to the extent possible, the surface and subsurface drainage areas associated with the cave;
4) includes a 500-foot (152-meter) buffer area around the cave that supports a healthy native vegetative community to preserve nutrient input, and comprises a total minimum of 40 acres; and
5) represents a distinct system, separated from other KFAs by geologic and hydrologic features and/or processes that create barriers to the movement of water, contaminants, and troglobitic fauna.

Results of the study, along with a long-term monitoring and management plan and a commitment from the County that the area will be protected and managed in perpetuity, will be submitted to the Service for review. Because a KFA must meet Recovery Plan criteria, the designation of a KFA is subject to Service approval.

Property acquired to increase the size of existing conservation areas to the minimum KFA standard of 40 acres will be included in the 700 acres of land acquisition mitigation provided under this RHCP. Acreage currently within the boundaries of the existing conservation areas selected for augmentation will not be included in the mitigation total for the RHCP.

Land Management: The County commits, through the Foundation, to preparing management and monitoring plans for all KFAs established under the RHCP, and commits to managing and monitoring these KFAs in perpetuity. The management and monitoring plans will be prepared within one year of land acquisition for a KFA.

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[68] While hundreds of caves exist within developments or near transportation corridors, most are not protected with more than a few acres of aboveground natural habitat. A minimum of 10 acres is the smallest of the karst conservation areas included in Table 3-1.

The RHCP will also provide long-term (perpetual) management and monitoring for existing conservation areas that currently lack adequate management to be considered KFAs (10 of the 22 existing conservation areas). Selection of the 10 areas will be based on the quality of the area as measured by the amount and quality of surface habitat preserved, amount of subsurface habitat available, diversity of the cave fauna present, and other variables. Whether any existing karst conservation areas are capable of becoming KFAs with proper management will be determined through detailed study as described above. If such conservation areas are identified, one or more KFAs may be established without the need to acquire land. All management and monitoring plans for KFAs and conservation areas managed under the aegis of the RHCP will be approved by the Service.

Management and maintenance activities provided by the terms of this RHCP for KFAs will include site-specific, routine biological and physical monitoring; coordination of public access; and control of exotic species. These management and maintenance activities, which are designed to meet Service standards and approval, are described in the RHCP Adaptive Management and Monitoring Plan Guidelines (see Appendix B). Monitoring activities are described in Chapter 7 of this document.

Adequacy of KFAs for Mitigating Take: Establishing three KFAs for each covered karst species[69] in each of three KFRs will be sufficient to mitigate for the anticipated levels of take that may occur for the life of this RHCP because the recovery (downlisting) criteria for these species in Williamson County will have been met. Each KFA will be a minimum of approximately 40 acres and will encompass sufficient surface and subsurface habitat and topography to protect the nutrient and moisture requirements of the cave ecosystem. Each KFA will also be managed by the Foundation in perpetuity for the benefit of the covered species. In addition, take will not be authorized by the requested Permit for a specific cave site if that site, in the judgment of the Foundation and the Service, constitutes one of the KFAs necessary to achieve the recovery (downlisting) criteria for the covered species (i.e., achieve the RHCP goals). No take, except with respect to the Karst Zone,[70] will be authorized for Coffin Cave mold beetle in a specific KFR unless a minimum of three Service-recognized KFAs in that KFR have been identified for that species and remain available for conservation, or, subject to Service approval, authorizing take would not preclude the Foundation from achieving RHCP goals.

5.3.1.2 Land Acquisition and Management for Recovery Enhancement

To enhance recovery efforts for the Bone Cave harvestman and the Coffin Cave mold beetle, the County will apply for grants under Endangered Species Act section 6 (Land Conservation Funds) and other private, state, and Federal sources to support the acquisition, management, and monitoring, in perpetuity, of an additional six KFAs totaling 240 acres. Assuming funds are

[69] A single KFA may count as one of the three required for each species if that KFA contains both species.

[70] Incidental take in the Karst Zone refers to potential impacts to karst species habitat in previously undetected voids, and potential impacts to karst species habitat resulting from surface disturbance more than 345 feet from an occupied cave.

available,[71] two KFAs will be established within each of the three aforementioned KFRs where take of occupied karst invertebrate habitat is anticipated. The purpose of the additional preserves will be to enhance the likelihood of recovery of the covered karst species.

5.4 GOLDEN-CHEEKED WARBLER (COVERED SPECIES)

5.4.1 Conservation Plan Components

The impacts on the golden-cheeked warbler will be minimized, and contributions will be made to current recovery goals, by meeting the goals and objectives of this RHCP. The strategy for meeting these goals and objectives includes identifying, avoiding, and minimizing impact to potential warbler habitat; minimizing disturbance during the nesting season; and mitigating unavoidable impacts to warblers and their habitat.

5.4.1.1 Identifying, Avoiding, and Minimizing Impact to Warbler Habitat

Figures 3-4 and 3-5 provide a preliminary assessment of where in the County potentially occupied habitat is most likely to be found; however, not all woodland areas that may be significant to the golden-cheeked warbler will be found on the maps, and a final determination of presence or absence of habitat must be made at the site. The specific vegetative community parameters characterizing potential warbler nesting habitat and the details on how the habitat maps were prepared are provided in Chapter 3, Section 3.2.1.4 of this RHCP. Once the RHCP is implemented, the RHCP administrator will maintain the digital orthoquads from which the vegetation/habitat maps were made (these may also be available for sale through the RHCP administrator) and will be able to overlay property boundary delineations on the aerial photographs and orthoquads to determine the portion of a property that contains the woodlands typically utilized by the warblers.[72] RHCP participants may use this information as a first level of habitat review during their due diligence and follow this with habitat assessments or presence/absence surveys[73] for a final determination of potential or occupied habitat potentially affected by proposed development. Other RHCP participants may approach the Foundation with habitat assessments (and possibly warbler presence/absence surveys) in-hand, and the final determination of potential or occupied habitat potentially affected by the proposed development would be based on that documentation.

Avoidance and minimization of impact to golden-cheeked warbler habitat will also be encouraged through a public education/outreach program managed by the Foundation.

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[71] The recovery (downlisting) goals for the karst invertebrates will be ensured with the purchase and/or acquisition of the 700 acres of land that will be utilized to establish new KFAs and enhance existing conservation areas. The section 6 funds would be used to purchase land that would exceed the recovery criteria.

[72] While golden-cheeked warblers are more likely to occupy habitat with woodlands composition greater than 50 percent composition as shown in Figures 3-4 and 3-5, warblers are also found in less dense woodlands; to be conservative, and to follow TPWD (2006) standards, RHCP participants will be advised to conduct habitat assessments on all vegetation with woodlands composition greater than 30 percent composition. Participants will also be provided with TPWD information on what constitutes potential warbler habitat.

[73] Habitat assessments would be performed by a Service-permitted biologist according to TPWD (2006) standards, and presence/absence warbler surveys would be performed according to Service protocols.

5.4.1.2 Minimizing Disturbance during the Nesting Season

Clearing activities within, or within 300 feet (91.4 meters) of, golden-cheeked warbler habitat, as determined by the landowner and the RHCP administrator from on-ground assessments, will be conducted only during the time of year when the warbler is not present (August 1 through February 29), unless a breeding season survey performed according to Service protocols by an Endangered Species Act section 10(a)(1)(A)-permitted biologist indicates that no golden-cheeked warblers are present within 300 feet of the desired activity. Construction activities within, or within 300 feet of, golden-cheeked warbler habitat may be conducted during the time of year when golden-cheeked warblers are present as long as such construction follows permitted clearing, as referenced above, in a reasonably prompt and expeditious manner indicating a continuous activity.

5.4.1.3 Mitigating Impacts to Warbler Habitat through Conservation Bank Credits

Currently, significant warbler populations in the vicinity of Williamson County are protected in three preserve areas: Balcones Canyonlands Preserve in Travis County; Balcones Canyonlands National Wildlife Refuge in Travis, Burnet, and Williamson Counties; and Fort Hood Military Reservation in Coryell and Bell Counties. In addition, the Hickory Pass Ranch Conservation Bank exists in Burnet County. The bank was established when the owners of Hickory Pass Ranch entered into a conservation bank agreement for their 3,000–acre (1,215–hectare) property for the perpetual preservation and management of the golden-cheeked warbler and, in exchange, received conservation credits from the Service that can be sold to businesses, private landowners, and local governments to mitigate impacts to the species. The Hickory Pass Ranch Conservation Bank is located within the Balcones Canyonlands National Wildlife Refuge acquisition boundaries.

At the present time there are approximately 34,465 acres of potential golden-cheeked warbler habitat in Williamson County (Figure 3-4). This is approximately the same amount of habitat that the Service estimated to be in the County in 1988 when the bird was listed (USFWS 1992). It is an objective of this RHCP to sponsor efforts that avoid and minimize future development-related reductions of warbler habitat; however, where impacts are anticipated, suitable habitat would be subject to take under the proposed plan. To mitigate for take of warbler habitat, the RHCP administrator will review the participant's land use plans, habitat assessments, and/or presence/absence surveys and evaluate the amount of take and mitigation requirements (acres of warbler habitat to be purchased) for each proposed project. If the RHCP participant chooses not to conduct a presence/absence survey, the level of take and mitigation will be based on the amount and quality of *potential* warbler habitat affected by development activities. If a presence/absence survey is conducted (one year) and no warblers are detected, no mitigation will be required. If warblers are detected during the presence/absence survey, mitigation for the affected *occupied* habitat will be required.[74]

During the first several years of the RHCP, the County intends to mitigate for impacts primarily by purchasing mitigation credits through Hickory Pass Ranch Conservation Bank. The County

[74] Generally, all contiguous woodlands having the characteristics of potential habitat will be considered occupied if any portion of such woodlands are found to be occupied by warbler during a survey.

recently initiated this program with the purchase of 500 Hickory Pass Ranch credits. In addition, Williamson County has acquired the 145-acre Whitney Tract to be incorporated into the RHCP as a preserve for the golden-cheeked warbler and other species. Of the 145 acres, 115.52 acres will be available as warbler mitigation credits. As a result, a total of 615.52 acres of both outside-of-county and within-county conservation credits are now available to mitigate for impact to the warbler under the RHCP. The County also has an option to purchase another 500 Hickory Pass Ranch credits by 2010.

The RHCP proposes a base mitigation ratio of 1 acre (0.4 hectare) preserved and purchased at Hickory Pass Ranch for every 1 acre of impact to golden-cheeked warbler occupied or potential habitat within Williamson County. This ratio of 1:1 represents what is believed to be an appropriate mitigation ratio that will apply to the overriding majority of participant transactions. In most cases, the habitat impacted will be of lower quality (more fragmented with a lower probability of warbler occupancy; see Figure 3-5) than conservation bank habitat, which has the potential to support more warblers per unit area. It is recognized, however, that in rare instances impacted habitat will be of a higher quality than the Williamson County norm, and in these cases a higher mitigation ratio may be justified. The RHCP reserves the right, based on quantification of habitat values, to either deny participation of a land development project or increase the mitigation ratio. When a potential participant's property is found to contain high quality habitat or supports an unusually high density of golden-cheeked warblers (e.g., <17 acres/pair), the mitigation ratio may be adjusted from 1:1 to 1.5:1 or 2:1, or the RHCP administrator may deny participation in the plan. On properties where presence/absence surveys or territory mapping surveys have not been performed, high quality habitat that may require an increased mitigation ratio may be defined as a block of mature woodland greater than 200 acres in size, or contiguous to a block of woodland 200 acres or greater in size, that supports an overstory canopy of Ashe juniper and mixed hardwoods with average tree heights in excess of 20 feet and with greater than 90 percent canopy closure. Assuming the base 1:1 ratio, and assuming the County purchases the additional 500 Hickory Pass Ranch mitigation credits, sufficient credits will be available for purchase by RHCP participants to mitigate for up to 1,115 acres of take under aegis of the plan. After the second 500 mitigation credits are exhausted, no additional take of golden-cheeked warbler habitat will be permitted through this RHCP until such time additional mitigation credits are purchased from a Service-approved conservation bank outside the County, or the County has established additional Service-approved, in-county golden-cheeked warbler preserves as conservation banks (see below).

5.4.1.4 Purchasing and Preserving Warbler Habitat within Williamson County

As noted above, in addition to using Hickory Pass Ranch credits to mitigate for take of golden-cheeked warbler habitat, the County may establish additional warbler conservation banks in Williamson County, or, through land purchase or conservation easement, add warbler habitat adjacent to existing conservation areas (e.g., Federal land around Lake Georgetown). The County would coordinate this process with the Service to ensure that potential acquisitions meet applicable Service guidelines and to assess potential mitigation credits to be assigned to the property. Once acquisition areas have been approved by the Service, the Service would grant mitigation credits to the County that can then be sold to RHCP participants.

5.5 BLACK-CAPPED VIREO (COVERED SPECIES)

5.5.1 Conservation Plan Components

The strategy for meeting the goals and objectives for the black-capped vireo includes preserving vireo habitat by avoidance; minimizing disturbance during the nesting season; restoring vireo habitat in Service-approved habitat restoration programs and/or establishing a vireo habitat restoration program within Williamson County; and increasing public awareness through a public education/outreach program (see Section 5.8.2).

5.5.1.1 Preserving Black-capped Vireo Habitat through Avoidance

To the extent possible, the RHCP participants will be encouraged to preserve black-capped vireo habitat within the County. Figure 3-6 provides a preliminary assessment of where in the County vireo habitat may be found; however, suitable vireo habitat is less easily identified from aerial photography than is golden-cheeked warbler habitat, and the map is admittedly a rough approximation. To assess the likelihood of the presence of black-capped vireos on an RHCP participant's land Service–approved habitat assessments and/or breeding bird surveys will be required.[75] Based on the results of the on-site assessment, Foundation personnel will work with the participant to avoid impacts to vireo habitat to the extent practicable. Avoidance and minimization of impact to black-capped vireo habitat will also be encouraged through a public education/outreach program managed by the Foundation.

5.5.1.2 Minimizing Disturbance during the Nesting Season

On participating parcels, clearing activities within, or within 300 feet (91.4 meters) of, black-capped vireo habitat will be conducted only during the time of year when the black-capped vireo is not present (September 1 through March 15), unless a breeding season survey performed by a Endangered Species Act section 10(a)(1)(A)-permitted biologist indicates that no black-capped vireos are present within 300 feet of the desired activity. Construction activities within, or within 300 feet of black-capped vireo habitat, may be conducted during the time of year when black-capped vireos are present as long as such construction follows permitted clearing, as referenced above, in a reasonably prompt and expeditious manner indicating a continuous activity.

5.5.1.3 Vireo Habitat Management and Restoration Program in Williamson County

Because a limited number of viable vireo habitat patches exist within Williamson County, the focus of this RHCP is on the improvement and expansion of existing or future protected vireo habitat within or outside the County. Any take authorized under this plan would be mitigated primarily through habitat restoration, habitat management, enhancement of existing protected black-capped vireo habitat, or an alternate Service-approved mitigation program. Vireo numbers in Williamson County appear to be low (see Chapter 3, Section 3.2.2.2.4), and the need for incidental take has not been clearly established. However, if and when impacts to black-capped

[75] Habitat assessments will be conducted by a Service-permitted biologist according to TPWD (2006) guidelines.

vireo may result from a proposed participant project, the RHCP administrator will review the participant's land use plans, habitat assessments, and/or results of breeding bird surveys (see Section 5.5.1.1) and evaluate the amount of take and participation fee requirements. The participant will be assessed a fee of $5,000 per acre of vireo habitat impacted (*occupied* habitat if presence/absence surveys confirm the presence of vireos; *potential* habitat if surveys are not conducted).

Black-capped vireo participation fees will be collected by the Foundation prior to land disturbance. The funds will then be banked and distributed for the benefit of vireo habitat restoration and management on the basis of highest and best use of the collected funds. The RHCP Adaptive Management Work Group will work with the Service to determine the appropriate use of the banked vireo mitigation funds on an annual basis. The norm will be to restore and enhance one acre of vireo habitat for every acre of vireo habitat impacted. The base 1:1 mitigation ratio is justified for the following reasons: 1) the impacted vireo habitat is likely to be highly fragmented (see Figure 3-6), while the mitigation habitat will primarily be in large-acre preserves (e.g., Balcones Canyonlands Preserve), will be restored to optimal conditions for vireo breeding, and is expected to support more territories per unit of habitat; 2) the mitigation habitat, once restored, will be protected and maintained over time as vireo habitat, while the impacted habitat, if not disturbed, would have become unsuitable for vireos through natural plant succession; and 3) Williamson County does not appear to have significant populations of black-capped vireos, with the exception of regular occurrences of breeding birds in the extreme southwestern portion of the County near the boundary with Burnet County on Balcones Canyonlands Preserve lands. This suggests that the potential vireo habitat that does exist in the County is largely of poor quality. It is recognized, however, that in rare instances impacted habitat will be of a higher quality than the Williamson County norm, and in these cases a higher mitigation ratio may be justified. The RHCP reserves the right, based on quantification of habitat values,[76] to either deny participation of a land development project, or increase the mitigation ratio from 1:1 to 1.5:1 or up to 2:1.

5.6 ADDITIONAL SPECIES

The additional species that share habitat with the covered species are expected to receive collateral benefit from the mitigation measures in this RHCP designed to conserve and aid in the recovery of the covered species. For example, when practicable, karst preserves would be established where as many as possible covered and additional species occur together. Consequently, any species (karst invertebrates and salamanders) other than the covered species, including very rare species present in protected areas, would also benefit from implementation of the RHCP. Similarly, the setbacks from caves occupied by listed species that will be encouraged by the proposed fee structure will benefit any non-listed species that also occupy those caves.

All additional species will benefit from the research, data collection, and database programs described in Section 5.8.1, below, and Chapter 8, Section 8.3. The Georgetown salamander, because it is a Federal candidate species known only from Williamson County, will be the

[76] Habitat values will be judged by a Service-permitted biologist according to TPWD vireo habitat assessment criteria and proximity to established conservation areas. When presence/absence surveys have been performed, numbers of pairs or singing males/unit area will be taken into consideration.

subject of targeted efforts to conserve the species and preclude Federal listing as threatened or endangered (see Section 5.6.1, below).

5.6.1 Georgetown Salamander

The RHCP does not at this time anticipate that covered activities will have direct impacts on the Georgetown Salamander. However, contributions will be made to the species' conservation by meeting the goals and objectives of this RHCP. The strategy for meeting these goals and objectives includes funding a research and monitoring program, preparing a conservation strategy for the species, and increasing public awareness through a public education/outreach program (see Section 5.8.2). The RHCP will also consider the presence of salamanders in karst acquisition efforts when establishing KFAs and when evaluating acquisition lands for the warbler and vireo.

5.6.1.1 Georgetown Salamander Research and Monitoring

As part of the RHCP annual operation, a review of the status of the Georgetown salamander in Williamson County will be conducted. To complete this review, a five-year research and monitoring project will be funded by the County that focuses on better delineating the range of the salamander, gathering baseline data on water quality and quantity at salamander spring sites, and monitoring salamander presence/abundance at selected spring sites. The research and monitoring will be funded by at least $50,000 per year for five years (Years 2–6); however, the most intensive monitoring will be conducted in the first two years of the program. After completion of the first two years of the program, a status review will be prepared describing an appropriate conservation strategy for the species. Water quality monitoring and salamander presence/abundance monitoring will continue through Year 6 of the plan to continue collecting baseline data. At the end of the five-year research and monitoring program, if the Georgetown salamander is still a candidate species, the Foundation will investigate the feasibility of developing a Candidate Conservation Agreement with Assurances.

5.7 DETERMINING THE STATUS OF THE RHCP COVERED AND ADDITIONAL SPECIES

The RHCP has established a process for determining the status of the RHCP covered and additional species (see Chapter 8, Section 8.3 for a detailed description of the species and habitat tracking process that will be implemented). This process will provide an evaluation on how well the RHCP is working and will identify other species that may be of concern in the future. If it is apparent that a covered species is improving in status, the RHCP administrator will make recommendations in the annual report on the existence of data that would be relevant to downlisting, delisting, or listing efforts. Should data indicate that one of the additional species is in need of increased management or its status indicates a potentially threatened or endangered existence, the Foundation will evaluate the degree to which the RHCP, as it is being implemented, is providing conservation benefits to the species and what additional measures, if any, the Foundation could implement through the RHCP to provide conservation benefits for the species. Depending on this evaluation, the County will decide whether to seek coverage of the species under the RHCP. If it is determined that coverage would benefit both Williamson

County and the species in question, the County would apply for any appropriate amendments to the RHCP, the Permit, and the Biological Opinion.

5.8 RESEARCH AND PUBLIC AWARENESS

5.8.1 Research

The RHCP will fund research on the covered and additional rare species of Williamson County, with primary focus on karst invertebrate and salamander species. Examples of research projects that could lead to improved management practices and thus promote the conservation of both covered and additional karst species include the following prioritized topics:

- Conduct studies to determine KFA status for existing karst conservation areas.
- Determine through DNA analysis and other taxonomic techniques the relationships and species affinities for the area's mold beetles (*Batrisode*s spp.).
- Determine the efficacy of red imported fire ant control efforts.
- Review the status of the listed invertebrate species and the status of the additional non-listed 19 invertebrate species included in this RHCP.
- Review the need for additional karst preserve acquisition and or management modifications: where, why, and when.

Research related to the Salado Springs, Jollyville Plateau, and Buttercup Creek salamanders would be similar to the research program proposed for the Georgetown salamander (see Section 5.6.1.1 above). Information resulting from RHCP-funded research and gathered in the process of managing and monitoring KFAs will be assembled in a computerized database. The database will include information on species presence/absence, numbers of species encountered on each site visit, habitat quantity/quality, water quantity/quality, vitality of surface vegetative communities, and other ecological and physiochemical parameters. The Foundation may initially choose to subcontract much of the initial database management, but ultimately it is possible that the Foundation will be sufficiently staffed to handle this function in-house.

Funding for research activities will start at $25,000 in Year 1 of the plan and, with a 2.5 percent annual increase in funding, reach a total expenditure of $1,046,407 over 30 years.

5.8.2 Increasing Public Awareness

The RHCP will develop a public education/outreach program designed to educate Williamson County residents as to the value and appropriateness of conserving the RHCP covered species and additional rare species. Funding will start at $20,000 in Year 1 of the plan and, with a 2.5 percent increase in annual funding, reach a total expenditure of approximately $878,054 over 30 years. The products resulting from this effort will take a variety of forms including, but not limited to: 1) a 4–6 page brochure describing the approved RHCP; 2) PowerPoint presentations describing the approved RHCP for presentation to real estate interests and developers, community groups, and middle and high school students; and 3) a 10-minute video describing the approved RHCP. The brochure and PowerPoint presentations will be produced during the

first year of the approved RHCP, and the video will be released in Year 3. Educational products for Years 4–30 are not known at this time; however, the County makes the commitment to spend at least $20,000 per year on relevant and Service-approved education and outreach products.

5.9 RHCP ENDOWMENT AND CONTINGENCY FUND

5.9.1 RHCP Endowment

The RHCP commits to managing all karst invertebrate, salamander, and bird preserves established under the authority of the RHCP long after the 30-year life of the Permit has expired. To provide the long-term costs required to ensure preserve management is accomplished, the County will provide to the Foundation $25,000 per year in Years 15–30 to start an endowment. An additional contribution of $20,000,000 will be made in Year 30 from accumulated Foundation general funds (participation fees), for a total of $20,400,000. Additional endowments, grants, and contributions will be solicited by the Foundation over the 30-year permit period. In addition, Foundation expenses may decrease through time, as the adaptive management process focuses on minimizing disturbance to the protected species and their habitat.

5.9.2 Contingency Fund

The RHCP annual operating budget will be augmented each year by $10,000 as a hedge against unexpected periodic RHCP amendments and any unanticipated or otherwise unforeseen costs associated with program and permit operations.

CHAPTER 6 – PARTICIPATION PROCESS

6.1 ELIGIBILITY STANDARDS

Any party within Williamson County desiring to undertake activities covered by this RHCP within an area that contains potential habitat for endangered karst invertebrates, golden-cheeked warblers, or black-capped vireos may be eligible for participation.[77] Potential habitat areas are defined as follows:[78]

- Karst invertebrates: Karst Zone designated in Figure 3-1.
- Golden-cheeked warbler: Woodlands determined to be potential warbler habitat by a Service-permitted biologist during an on-site habitat assessment per TPWD (2006) standards.
- Black-capped vireo: Early successional mixed forest-shrub land determined to be potential vireo habitat by a Service-permitted biologist during an on-site habitat assessment per TPWD (1987) standards.

Participation in the RHCP will be voluntary. Those choosing not to participate can either seek individual permits from the Service or develop independent strategies for compliance that may or may not adhere to the methodologies developed in this plan. The purpose of this RHCP is to offer landowners and the regulated community an option for compliance with the Endangered Species Act that requires less time and money and provides greater certainty for both landowners and species recovery than obtaining Service approval or compliance on an individual basis. While participation in the plan will be encouraged as a rule, the County reserves the right to decline to allow participation in the plan when that participation, in the judgment of the County, would not be consistent with the biological goals and objectives of the plan or might cause there to be insufficient mitigation available for anticipated County infrastructure needs.

Participation in the RHCP does not alleviate the need for applicants to secure other local, State, or Federal approvals and authorizations. For instance, applicants with projects occurring over the Edwards Aquifer Recharge Zone, Transition Zone, or Contributing Zone, must obtain approval for their activities from the TCEQ under 30 TAC 213 in addition to complying with the terms and conditions of the RHCP.

6.2 PARTICIPATION PROCEDURES

All entities, whether public or private, desiring to participate in the RHCP for take coverage will be subject to participation procedures detailed in this section. Those wishing to participate in the

[77] While HCPs typically apply to projects that lack a Federal nexus, RHCP participation will be available for projects (including those of non-federal governmental entities) that have other federal nexi (e.g., Clean Water Act section 404 permit application).

[78] Unlike most karst habitat, songbird habitat is likely to undergo successional changes over the 30-year life of the RHCP. Every five years, the woodland habitats having the potential to support golden-cheeked warblers and/or black-capped vireos will be recalculated on the basis of updated aerial photographs.

RHCP must submit a completed participation application[79] to the Foundation, along with an application fee,[80] and any additional materials required by Sections 6.2.1–6.2.3 below. Once the required form, materials, and fee have been submitted to the Foundation, and the Foundation has completed any necessary assessments and evaluations,[81] the Foundation will issue a "Determination Letter" that describes the amount of authorized take. In addition, the Determination Letter will state the applicant's cost of participation in the RHCP and the period within which the Determination Letter will remain effective.

Applicants who elect to participate in the RHCP will enter into a Participation Agreement with Williamson County (the Permittee). By entering into the Participation Agreement, the applicant agrees to be bound by and comply with the applicable terms of the Permit, and in return, benefits from the authorizations granted by the Permit. In each Participation Agreement, the Service shall be named as a third-party beneficiary with the right to enforce all terms of the Participation Agreement. Once the applicant has signed the Participation Agreement, the applicant must return it to the appropriate Foundation personnel for the Foundation's signature. The Permittee will submit a copy of each fully executed Participation Agreement to the Service promptly after all signatures have been obtained.

Once all required signatures have been obtained, the Foundation will issue to the applicant, now a "participant," a Certificate of Inclusion. Certificates of Inclusion will only cover take of species covered by the RHCP, and no mitigation credit for development or Certificates of Inclusion may be provided for property located outside the jurisdictional boundaries of Williamson County; provided, however, that the County will be entitled, at its discretion, to resell any Hickory Pass Ranch conservation credits it may own to third parties for use under separate Service authorizations outside of Williamson County. As a condition of participating in the RHCP, each participant will be required to record its Certificate of Inclusion in the Real Property Records of Williamson County and to designate the specific tracts of land to which they apply. A copy of the recorded Certificate of Inclusion must be posted at the relevant property site during any activities affecting the habitat of species addressed in the Certificate of Inclusion. For example, for a participant whose Certificate of Inclusion covers impacts to golden-cheeked warbler or black-capped vireo habitat, the Certificate of Inclusion must be posted from the time vegetation clearing begins until the construction is completed. For residential development, "completed construction" means that all roads and utilities are completed to the extent they meet all applicable legal or other requirements and have obtained all requisite approval—governmental or otherwise. For commercial, industrial, and multi-family developments, completed construction means that buildings are suitable for occupancy. It is not anticipated that Certificates of Inclusion are transferable except to subsequent owners of the property to which the Certificates of Inclusion apply.

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[79] The participation application form will be available on the Foundation's Web site, and hard copies will be available at the RHCP office.

[80] The application fee may be adjusted from time to time and will take into consideration the cost of any assessments or evaluations necessary for participation.

[81] Appendix C provides an example of the an analysis of impacts and mitigation that was completed for a 5-mile-long extension of Ronald Reagan Boulevard between FM 2338 and State Highway 195 in the North Williamson County KFR.

So long as the Permit remains in effect and a participant is in compliance with its Participation Agreement, that participant shall be deemed to have with respect to the participant's property covered by the Participation Agreement, the full benefits and authorities of this Permit. In the event that the Service may seek to suspend, terminate, or revoke the Permit for reasons not the fault of a participant, and that participant is in compliance with the terms of its Participation Agreement, the Service shall seek to craft a remedy that does not affect that participant's rights, benefits, and responsibilities under the Permit prior to suspending, terminating, or revoking the Permit. If it is not practicable to craft such a remedy and the Service suspends, terminates, or revokes the Permit, the Service will process for issuance to any such participant a permit conferring the same rights, benefits, and responsibilities with respect to the participant's property as provided under the Permit, without additional requirements or conditions beyond those applicable to the participant under its Participation Agreement. Additionally, the Service agrees that a breach by a participant of its obligations under a Participation Agreement will not be considered a violation by the Permittee or any other participant of this Permit. In the event a participant has materially breached its Participation Agreement and, after reasonable notice and opportunity to cure, such participant fails to cure, remedy, rectify, or adequately mitigate the effects of such breach, then the County, Foundation, or Service may terminate that participant's Participation Agreement.

The Foundation will provide to the Service the Participation Agreement form and the Certificate of Inclusion form for its review and approval prior to issuance of any participation.

The following sections summarizing participation procedures present separate scenarios for potential take of the covered karst invertebrates (Bone Cave harvestman and Coffin Cave mold beetle), golden-cheeked warbler, and black-capped vireo. It is possible that during the development of certain properties more than one of the covered species could be involved.

6.2.1 Karst Invertebrates

The RHCP will provide coverage for incidental take by plan participants of two of the covered karst invertebrate species (Bone Cave harvestman and Coffin Cave mold beetle) for any project occurring within the following three KFRs: North Williamson County, Georgetown, and McNeil Round Rock. As stated earlier, no take is anticipated for Tooth Cave ground beetle, nor will take be permitted through this RHCP within the Cedar Park KFR, the only KFR in Williamson County where the Tooth Cave ground beetle is currently known to occur. Any person or persons planning to engage in activities that will lead to land disturbances within the three aforementioned KFRs may elect to enroll in the RHCP and will participate by paying a per-acre fee for the amount of Karst Zone habitat disturbed and additional fees for potential impacts to caves occupied by covered species (or, in special cases, land in lieu of cash payments; see below).

Pursuant to this RHCP, an individual or entity planning an activity that may potentially disturb karst habitat in the North Williamson, Georgetown, or McNeil/Round Rock KFRs can mitigate for take of Bone Cave harvestman and Coffin Cave mold beetle that could result from the activity as follows. First, the plan participant will have a Geologic Assessment prepared in accordance with TCEQ standards (TCEQ 2004). If that assessment discloses the presence of

caves with potential habitat for listed species, a presence/absence karst survey must also be prepared to Service standards (USFWS 2006; see also Appendix D, or as subsequently amended). At least three cave surveys must be conducted, each separated by one week. Unless otherwise authorized by the Service, surveys may not occur during February and August because these months are typically low-activity periods for the cave fauna (USFWS 2006). If either the Bone Cave harvestman or the Coffin Cave mold beetle is detected during the surveys, the cave will be mapped to the extent possible to delineate its footprint. Knowledge of the cave's footprint is needed for project planning purposes and for determining potential project impacts to the cave.

The plan participant will then submit a conceptual development plan,[82] along with the results of the Geologic Assessment and presence/absence karst survey, to the Foundation for review, verification of findings,[83] and assessment of potential take. The Foundation review will be performed by a Service-permitted karst invertebrate scientist at the expense of the participant, costs of which will be determined in advance based on the number of caves found on the property. After a timely review (30 days) of the participant's proposal and supporting documents, the Foundation will provide the participant with an assessment of the participation (mitigation) fee required to be covered by the terms of the Permit. The fee will be based on the total number of acres of karst present and the assessed project potential to impact listed karst species.

In some cases a participant may satisfy mitigation requirements by providing land in lieu of cash payments, but only if acquisition of that land by the County contributes to fulfillment of RHCP objectives. In such cases, land values will be verified by appraisals acceptable to the County.

6.2.1.1 Mitigation Fees for Impacts to Karst Habitat

A $100/acre participation fee will be charged for all land disturbed by participants in the Williamson County Karst Zone as delineated in Figure 3-1,[84] and verified with each participant's conceptual development plan. The $100/acre fee provides mitigation for any and all incidental impacts to the Bone Cave Harvestman and Coffin Cave mold beetle that may occur on a participant's property other than those in the immediate vicinity of a known species-occupied cave as described below in Section 6.2.1.2.

One of the fundamental principles of Endangered Species Act section 10(a)(1)(B) is that the incidental take permit is supposed to allow a landowner *certainty* about the kinds of activities that can be legally conducted on his or her land now and in the future. The primary reason for the RHCP fee assessment of $100/acre for impacts to karst habitat is to provide compensation for

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[82] The conceptual development plan will at a minimum include property boundary, spine infrastructure and development envelope, and recharge features identified during the Geologic Assessment. The plan submittal will be in Auto CADD or Microstation format.

[83] Due to the technical nature of karst presence/absence surveys, the Foundation will have on-staff or under contract Service-approved and -permitted karst biologists to implement and/or verify the presence/absence surveys. Verification of findings may require cave site visits.

[84] The $100/acre Karst Zone fee will not be charged in addition to the higher cave-specific fees described in Section 6.2.1.2 for the specific impacts covered by those fees.

the previously undetected voids containing the listed species that are discovered and impacted during construction and to provide participants with certainty on how to proceed in the event previously undetected voids and/or mesocaverns are encountered during the land disturbance/construction process. Many karst features, such as solution cavities and caves, are not identified during the Geologic Assessment because they exhibit little or no surface expression, but are discovered by excavation during the construction phase of a project. This plan anticipates that up to one species-occupied cave per year will be discovered by an RHCP participant and impacted during the construction phase of development. The RHCP participation fee provides certainty that if and when listed karst species are found in the previously undetected void, under most circumstances[85] that void may be closed according to TCEQ guidelines (see following paragraph) and development may proceed, with listed species take if any, being covered by the RHCP. No additional fees would be assessed.

Discovering previously undetected voids is especially common during utility trenching (TCEQ 2004). TCEQ guidelines provide instructions as to how the various types of features must be treated (TCEQ 2004) to ensure that water quality and the stability of the utility installation are protected. The guidelines describe two strategies for dealing with unanticipated features, depending on the feature's extent and significance. Small, isolated solution cavities may be filled with concrete according to the guidelines. If more extensive voids are exposed, TCEQ must be contacted. Currently, such voids are usually isolated from construction while certain precautions are taken, such as double wrapping electrical conduit or hanging pipes from the void's ceiling, before the feature is covered over and construction at the feature's location proceeds.

In addition to providing mitigation for impacts to previously undetected voids that may be occupied by listed species, the Karst Zone fee will mitigate for potential impacts to known species-occupied caves resulting from disturbance more than 345 feet from the cave's footprint.

6.2.1.2 Participation Fees for Impacts to Species-Occupied Caves

Additional fees will be paid based on two levels of disturbance to caves containing listed karst species as presented in Figure 4-2 and explained in Chapter 4, Section 4.2.3.1. For those projects with unusually low impervious cover, or for caves that have especially large and extensive footprints, or caves that have suffered previous encroachment,[86] impacts and fees will be assessed on a case-by-case basis. If the cave or caves do not contain listed species as determined by the karst survey, the additional fees will not apply. Participation fees for impacts to listed species are based on a charge for assumed impact and/or take that increases with increased proximity of disturbance to the cave. The two levels of disturbance and associated fee structure are summarized below.

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[85] The possibility exists that a previously undetected void discovered during project construction could be of sufficient size and extent that it is impossible to effectively close per TCEQ standards such that the planned development would no longer be possible.

[86]For example, Inner Space Caverns, an important cave for the Coffin Cave mold beetle as well as other troglobites,, already has Interstate 35 over the cave footprint. Additional impacts to the cave by encroaching development may not be held to the same standards as would be applied to a cave that had no previous impacts, but would be assessed based on the level of additional disturbance to the cave ecosystem.

Impact Zone A. Take is assessed for any disturbance that occurs within a band of surface habitat extending from a radial projection 50–345 feet[87] from the cave footprint based on the cave map (see Section 4.2.3.1 in Chapter 4 and Section 6.2.1, above). This band is identified as "Impact Zone A" on Figure 6-1. Proposed disturbance within this impact zone will be assessed a participation fee of $10,000/disturbed acre. This fee does not apply when impacts also occur within Impact Zone B; i.e., within 50 feet of a species-occupied cave footprint (see below).

Impact Zone B. Disturbance within 50 feet of the cave footprint is assumed to have destroyed the long-term viability of the cave ecosystem (see Chapter 4, Section 4.2.3.1). This area is identified as "Impact Zone B" on Figure 6-1. Because the potential for loss of endangered species is highest in this zone, impacts in the zone are assessed the highest participation fee. A flat fee of $400,000 will be assessed for any incursion within 50 feet of a species-occupied cave footprint. This fee covers all impacts within 345 feet of the cave footprint; no additional fees are charged to mitigate for impacts to that area.

Figure 6-1 illustrates the total participant fee levies for a representative situation. The landowner in this example is developing property that includes 179 acres of Karst Zone and two species-occupied caves. The landowner will be assessed a fee of $100/acre to mitigate for potential impacts to covered species in the Karst Zone. Because landowners will not be charged both the Karst Zone mitigation fee and a cave-specific fee for the same affected area, the landowner in this example will be assessed a Karst Zone fee for approximately 155 acres, or $15,500 (155 acres equals the 179 acres in the Karst Zone minus approximately 24 acres for impacts associated with Impact Zones A and B around Caves #1 and #2). For impacts to Cave #1, the landowner will be assessed a flat fee of $400,000 because residential lots and a road will encroach into Impact Zone B. For impacts to Cave #2, a portion of Impact Zone A will be developed but Impact Zone B will be avoided. Assessed fees for impacts to Cave #2 will be $10,000/acre for the 2.3 acres disturbed in Impact Zone A, or $23,000. All mitigation fees together will total $438,500.

Note that a portion of Impact Zone A of Cave #1 is located on adjacent property. In this example, Cave #1 is now considered destroyed; thus, the adjacent landowner would not be responsible for any future impacts to the portions of Impact Zone A on his property. Assume, however, an alternative scenario in which the depicted development plan called for some encroachment into Impact Zone A of Cave #1, but no impacts within 50 feet of the cave footprint (i.e., no effects to Impact Zone B). If that were the case, and the adjacent property were to be developed by a participant in the RHCP, that participant would be required to mitigate for any impacts to the cave as stipulated in the plan. To assist with identification of cases where impact zones cross property boundaries, the Foundation will maintain a GIS database of compliance projects covered by the RHCP that will be made available to the Service.

[87] The distance of 345 feet represents 100 percent of the cricket foraging area per findings of Taylor et al. (2005).

Zone	Area Proposed for Development	
Karst Zone	155 acres* @ $100/ac	= $15,500
Cave #1		
Impact Zone B-	$400,000	= $400,000
Cave #2		
Impact Zone A-	2.3 acres @ $10,000/ac	= $23,000
Impact Zone B-	No impact	= $0
	Total Assessment	= $438,500

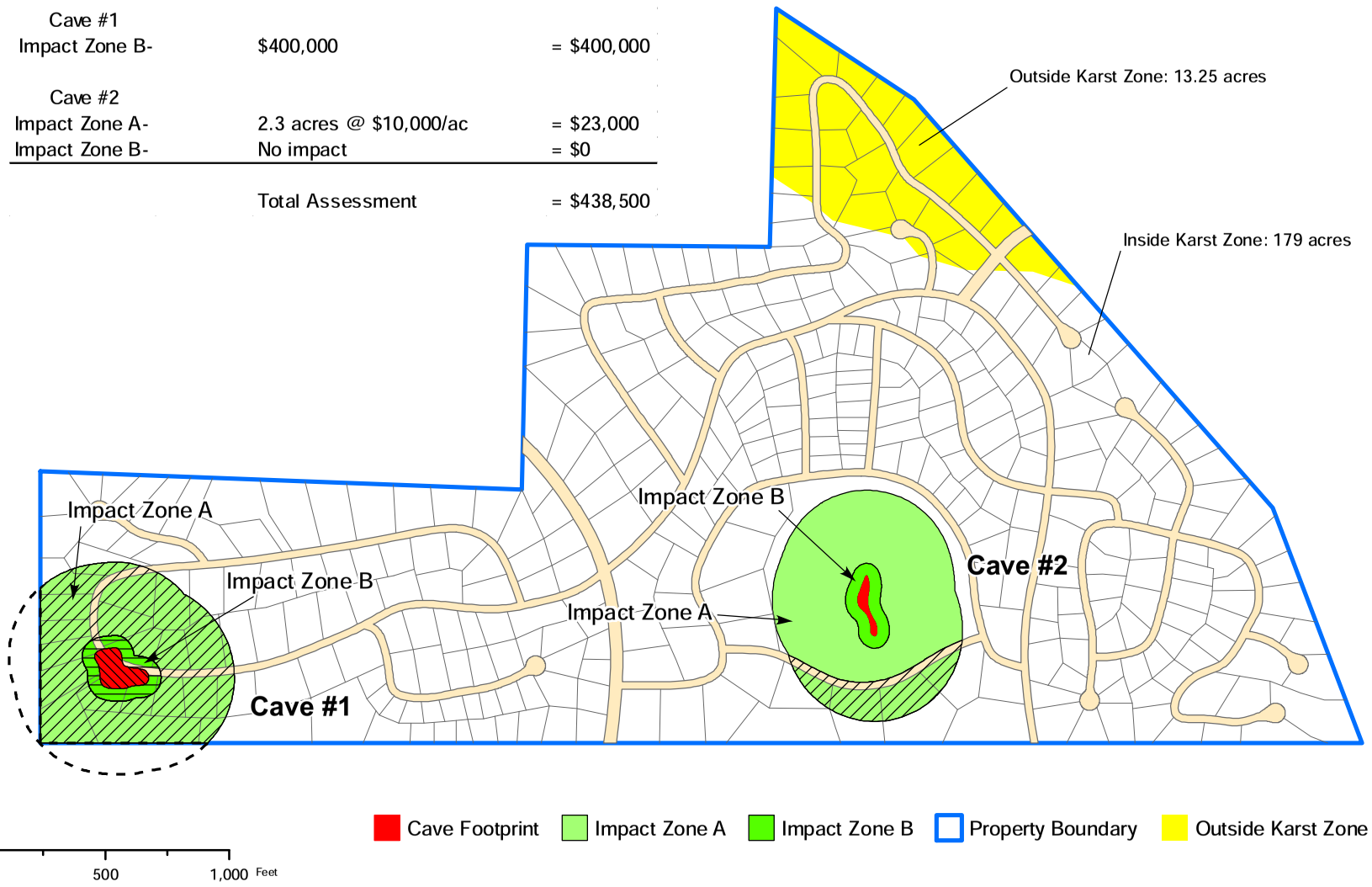

Figure 6-1. Kasrt participation diagram scenario.

*155 acres = 179 acres less 24 acres of impact around Caves #1 and #2.

6.2.2 Golden-cheeked Warbler

Pursuant to this RHCP, an individual or entity planning an activity that may potentially disturb golden-cheeked warbler habitat in Williamson County can mitigate for take of this species. The Foundation will establish the level of expected take after a review of the proposed development activities and the habitat assessment, or the presence/absence survey if one has been performed. If the RHCP participant chooses not to conduct a presence/absence survey, the level of take and mitigation will be based on the amount and quality of potential warbler habitat affected by development activities. If a presence/absence survey is conducted (one year) and no warblers are detected, no mitigation will be required. If warblers are detected during the presence/absence survey, mitigation for the affected occupied habitat[88] will be required, normally at a 1:1 ratio (see Section 5.4.1.3 for an explanation of exceptions). Costs for the habitat assessment will be at the participant's expense and will normally not exceed one person per day for each 40 acres (16 hectares) of habitat. This assessment will be done in a timely (30 days) fashion.

Plan participants whose activities will affect potential golden-cheeked warbler habitat will pay a per-acre fee based on the amount of potential golden-cheeked warbler habitat present and impacted by development. The RHCP defines direct impacts as those areas where potential or occupied habitat is actually destroyed or significantly modified. For this RHCP, mitigation for direct impacts will normally be valued on a 1 to 1 ratio, where for every acre of habitat destroyed one acre of mitigation will be required (see Section 5.4.1.3 for an explanation of exceptions). Indirect impacts are those impacts that occur in warbler habitat adjacent to destroyed or modified habitat; these impacts will be assessed at 50 percent of the value of direct impacts for a distance of 250 feet (76.2 meters) from the edge of the direct impacts. As with karst impacts, on a case-by-case basis, the Foundation may allow a participant to set aside potential or occupied warbler habitat in lieu of mitigation fees when the set-aside habitat contributes to RHCP objectives. All land-in-lieu-of-fee transactions will be at the discretion of the Foundation. The Foundation will provide the plan participant an assessment of the participation fee required in order for the participant to be covered by the terms of the Permit. The participation fee[89] for take of golden-cheeked warbler habitat is $7,000/acre in the first year fees are charged and increasing by an estimated $500/acre each year for as long as the mitigation credits last (see Figure 6-2 for an example from Year 2 of the plan).[90]

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[88] Generally, all contiguous woodlands having the characteristics of potential habitat will be considered occupied if any portion of such woodlands are found to be occupied by warblers during a survey.

[89] These fees are based on the current going rate of Hickory Pass Ranch Conservation Bank credits and a small handling fee to accommodate Foundation costs.

[90] For specific County projects requiring golden-cheeked warbler mitigation, the County will reserve the right to utilize Hickory Pass Ranch credits already purchased from the Hickory Pass Ranch Conservation Bank on a first come, first served basis until such credits are exhausted.

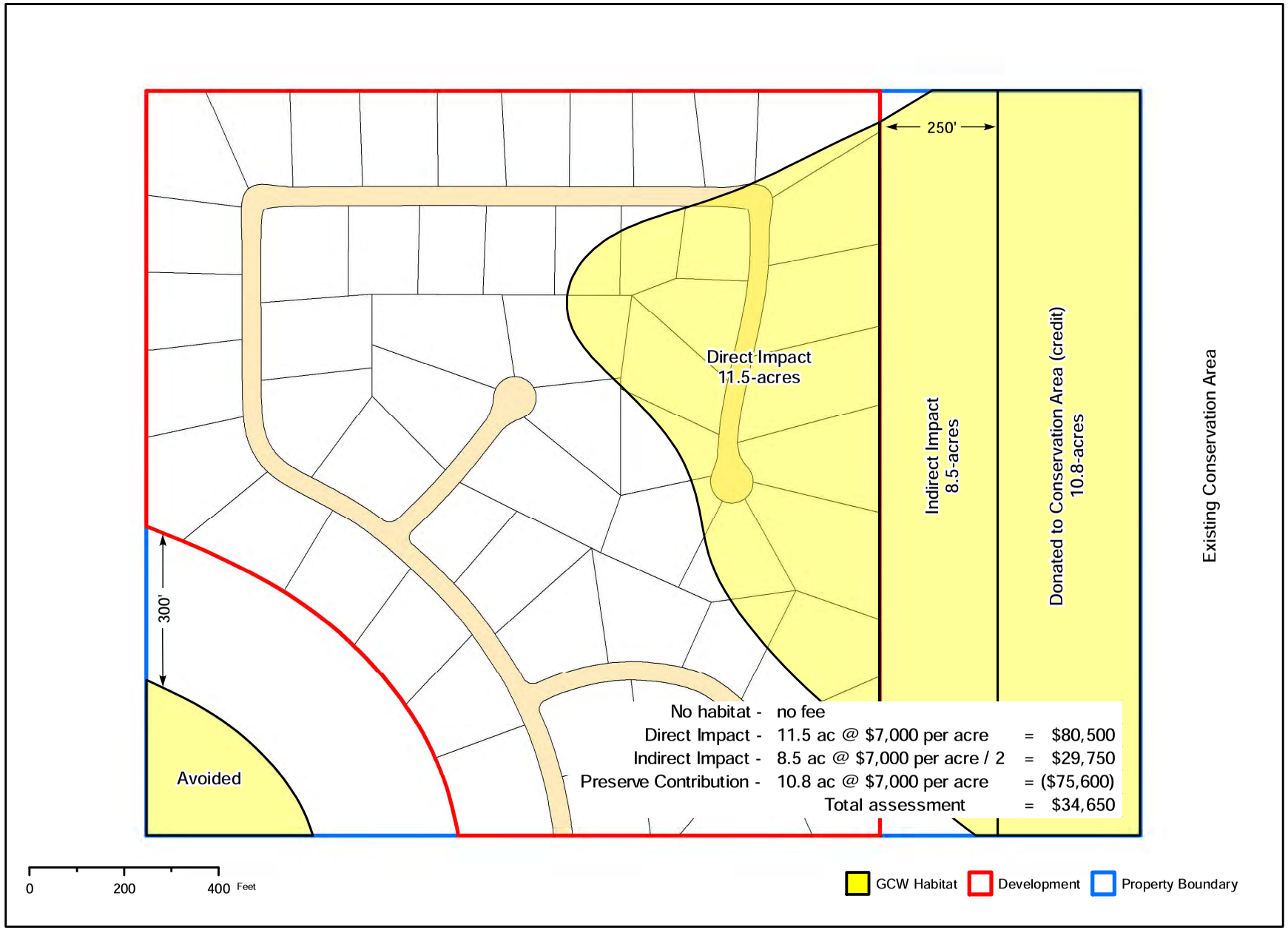

Figure 6-2. Example of golden-cheeked warbler RHCP participation fees.

In the example illustrated in Figure 6-2, the participant's property contains golden-cheeked warbler habitat and abuts an established conservation area[91] for the warbler. As shown in the figure, the participant has decided to develop a portion of the habitat on his property, avoid a portion of the habitat, and dedicate a portion of the habitat to the neighboring conservation area.

Also in this example, the participant opted not to have bird surveys done (bird surveys may result in lower participation fees but may also significantly delay project construction). A fee was assessed for the warbler habitat to be destroyed (direct impact) and for the habitat to be left intact within 250 feet of the destroyed habitat (indirect impact). No fee was assessed for the avoided habitat because no development will take place within 300 feet of that habitat. For the habitat dedicated to the conservation area, the participant received a per-acre credit equal to the per-acre participation fee.

As discussed previously in Chapter 5, Section 5.4.1.3, during the first several years of the RHCP, the mitigation for the disturbance of warbler habitat in Williamson County will occur by the Foundation's purchase of mitigation credits from the Service-approved Hickory Pass Ranch Conservation Bank in adjacent Burnet County, as well as credits available due to the acquisition of in-county preserves such as the Whitney Tract. The RHCP proposes a mitigation ratio normally of 1 acre preserved for every 1 acre of impact to occupied and/or suitable golden-cheeked warbler habitat throughout the Williamson County RHCP plan area (see Section 5.4.1.3 for an explanation of exceptions to the 1:1 ratio).

6.2.3 Black-capped Vireo

Pursuant to this RHCP, an individual or entity planning an activity that may potentially disturb black-capped vireo habitat in Williamson County as delineated in Chapter 3, Figure 3-6 can mitigate for take of this species by paying a per acre fee for direct impacts to vireo habitat. The Foundation will establish the level of expected take on a project-by-project basis after a review of the development activities proposed and the status of the vireo habitat on the subject property. The Foundation biologists will review the preliminary plat or conceptual development plan, compare this with the habitat maps, and visit the site for verification of the amount of habitat expected to be impacted. Costs for this assessment will be at each participant's expense and will normally not exceed one person per day for each 40 acres (16 hectares) of habitat. This assessment will be done in a timely (30 days) fashion.

Plan participants whose activities will affect black-capped vireo habitat will pay a per-acre fee based on the amount of black-capped vireo habitat potentially impacted (*occupied* habitat if presence/absence surveys confirm the presence of vireos; *potential* habitat if surveys are not conducted). The Foundation will provide the RHCP participant an assessment of the participation fee required in order for the participant to be covered by the terms of the Permit. The participation fee for take of black-capped vireo habitat will normally be calculated on a

[91] For the purposes of this RHCP a golden-cheeked warbler conservation area is defined as a block of protected potential or occupied warbler habitat at least 250 acres (101 hectares) in size that is under Service-approved, long-term management for the benefit of the warbler. This minimum size is based on findings of Coldren (1998) (see the discussion of habitat quality and patch size in Section 3.2.2.1.1).

1:1 ratio and will start at $5,000/acre, subject to change as costs change (see Section 5.5.1.3 for an explanation of exceptions to the 1:1 ratio).

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CHAPTER 7 – MONITORING AND REPORTING

7.1 INTRODUCTION

Monitoring and reporting are required by the Service to ensure compliance with the terms of the incidental take permit and to verify progress toward the RHCP's biological goals and objectives. The reported information will include an evaluation of the implementation and effectiveness of the terms of the RHCP (including financial responsibilities and management obligation), an accounting of the amount of incidental take of habitat that has occurred under the RHCP, an assessment of the status of the species and their habitat, and any data necessary for adaptive management purposes. The County, through its implementing agent (the Williamson County Conservation Foundation), will use the results of the monitoring efforts to assess management strategies and develop more effective alternatives, as necessary, through the adaptive management procedures.

7.2 BIOLOGICAL AND COMPLIANCE MONITORING

Biological monitoring will primarily focus on the covered karst invertebrate species in up to 15 separate KFAs (both enhanced existing karst conservation areas and new KFAs established under the RHCP) and on the Georgetown salamander (see Chapter 5, Sections 5.6.1.1 and 5.7). Since take for golden-cheeked warblers will be initially mitigated with Hickory Pass Ranch mitigation credits, monitoring of that site is the responsibility of the mitigation bank and included in the mitigation credit fees. Until such time the need for mitigation above that provided by the Hickory Pass Ranch mitigation credits has been demonstrated and the County establishes one or more within-county mitigation banks for golden-cheeked warblers, no endangered bird monitoring will be done through the RHCP. If such a mitigation bank (or banks) is established a management and monitoring plan will be prepared by the Foundation and approved by the Service.[92] All management and monitoring plans will be completed within one year from when the mitigation land is purchased and the bank established.

The karst invertebrate and salamander monitoring efforts are designed to provide data on the relative abundance, distribution, and habitat condition of these endangered and rare species, as well as to provide annual information that can be used in the Adaptive Management process (see Appendix B and Chapter 8). Multiple years of data will provide further information on abundance, species distribution, response to changing habitat conditions, and appropriate management activities, particularly for species that have been the subject of limited scientific research, such as the endangered karst invertebrates and Georgetown salamander. All biological monitoring data collected by this RHCP will be available to the public for review and further analysis.

[92] The County recently purchased the 145-acre Whitney Tract to be incorporated into the RHCP as a preserve for the golden-cheeked warbler and other species. Of the 145 acres, 115.52 acres will be available as warbler mitigation credits. The County has agreed to assume the monitoring responsibilities required for that property by a previous HCP (the Russell Park Estates HCP; see USFWS 2002).

An annual report summarizing the results of the biological monitoring and adaptive management process and findings will be prepared and submitted to the Service on January 1 of each calendar year. This required information includes the locations of surveys, a description of any deviations from required survey protocols, personnel used, and documentation of all survey results as required in the protocols for the particular endangered species. In addition, the annual report will review existing management and highlight areas where change in management approach may be needed and where prioritized research needs are reviewed.

In addition to those biological elements described in Chapter 8 (see Section 8.4), the annual report will also include a summary of the participation and funding status of the RHCP. Information provided will include the number of participants, number of acres of impacts to potential habitat, number of acres of potential habitat preserved, annual income and expenses of the Foundation, and any other information relevant to the implementation of the RHCP.

CHAPTER 8 – ADAPTIVE MANAGEMENT

8.1 INTRODUCTION

Evaluating the effectiveness of mitigation will be closely tied to the adaptive management and monitoring components of the RHCP. Adaptive management is an iterative process that helps reduce uncertainty in natural resource management by incorporating into flexible management plans new information as it becomes available. The basic foundation of the adaptive management concept is a "learn by doing" experimentation process that allows natural resource managers to learn more about the complex environmental systems they are charged to protect. Walters (1986) described an approach to the adaptive management process as beginning "with the central tenet that management involves a continual learning process that cannot conveniently be separated into functions like 'research' and 'ongoing regulatory activities', and probably never converges to a state of blissful equilibrium involving full knowledge and optimum productivity." He further characterized adaptive management as the process of:

- bounding management problems and recognizing constraints;
- representing knowledge in models of dynamic behavior that identify assumptions and predictions so experience can further learning;
- representing uncertainty and identify alternate hypotheses; and
- designing policies to provide continued resource productivity and opportunities for learning.

Little scientific information is available on the central Texas karst invertebrate species, their management needs, and especially the relationship between land use and take as defined in the Endangered Species Act; thus, adaptive management has immediate relevance for this RHCP. For example, questions that could be the ongoing focus of RHCP-sponsored research include the following: "How much active management do cave preserves need?" and "How much and what kind of red imported fire ant control is necessary?"

To ensure that the adaptive management process is appropriately implemented throughout the RHCP permit period, the process needs to be formalized within the RHCP management and reporting framework. To this end the RHCP recognizes the need to establish an Adaptive Management Work Group.

8.2 ADAPTIVE MANAGEMENT WORK GROUP

To effect an efficient and effective adaptive management process for the RHCP, the Foundation will establish a several-member Adaptive Management Work Group that could include the RHCP administrator and, for example, representatives from the Service, the TPWD, the Williamson County government, the RHCP citizens advisory committee, the RHCP biological advisory committee, and the scientific community. This group will review the annual report and make recommendations for specific changes in management directions. Issues that the group will address include thoroughness of the annual report, implications of the monitoring efforts

relating to the need for management changes, assessment of research priorities, disbursement of mitigation funds (e.g., land acquisition purchases, black-capped vireo restoration/enhancement efforts, etc.), and the effectiveness of the Foundation at achieving RHCP goals. The Adaptive Management Work Group will meet at least twice a year, once to review the Foundation's annual report to the Service, and once to review, approve and/or recommend modifications to the annual operating/financial plan.

8.3 ADAPTIVE MANAGEMENT FRAMEWORK

The Service developed a framework for addressing adaptive management in HCPs that includes 1) identifying areas of uncertainty and questions that need to be addressed to resolve this uncertainty; 2) developing alternative management strategies and determining which experimental strategies to implement; 3) integrating a monitoring program that is able to acquire the necessary information for effective strategy evaluation; and 4) incorporating feedback loops that link implementation and monitoring to the decision-making process that result in appropriate changes in management. The actions that will be taken through implementation of the RHCP to specifically address each of these framework issues are presented below.

1. *Identifying areas of uncertainty and questions that need to be addressed to resolve this uncertainty.*

   One of the greatest existing uncertainties relating to the long-term conservation of the karst invertebrates is the question of exactly how much of an area in acres and what topographic parameters should the aboveground preserve (KFA) include. General guidelines for karst preserve size and configuration are summarized in Chapters 3 and 4, but the specifics of each KFA established must be done on a case-by-case basis. Scientific data on the efficacy of existing conservation areas and the relationship between preserve size and adequacy of species protection will improve through time, and it is essential that new information be incorporated into RHCP management on a timely basis. The adaptive management process is a method to ensure that timely management responses to new data are implemented.

2. *Developing alternative management strategies and determining which experimental strategies to implement.*

   Flexibility for the development of alternative management strategies when research, experimentation, or common sense indicate changes in management are needed is a key element of the adaptive management process. Several potential threats to the karst invertebrates and salamanders have been identified in Chapter 3, and it is important that the Foundation be capable of precisely identifying what adaptive management actions will occur if any of these threats increase. For example, if there is an increase in red imported fire ants, then control and treatment efforts would increase a specific number of times per year. Any changes in treatment for fire ants would then be linked back to the monitoring program to ensure fire ant densities do not exceed a certain threshold level. If thresholds are exceeded, or if through additional research it is determined a lower density is needed, additional adaptive management actions would occur and treatments would change accordingly (see Appendix B for monitoring plan details).

3. *Integrating a monitoring program that is able to acquire the necessary information for effective strategy evaluation.*

   A monitoring program where both aboveground and belowground preserve habitats are regularly and consistently monitored is an important element to the management of preserve resources. Guidelines for an RHCP karst monitoring program are presented in Appendix B; site-specific monitoring plans will be developed and implemented for each KFA, for the Georgetown salamander, and for the golden-cheeked warbler if and when an in-county conservation bank for that species is established. Foundation-supported monitoring may also be appropriate as part of habitat restoration/enhancement activities for the black-capped vireo.

4. *Incorporating feedback loops that link implementation and monitoring to the decision-making process that result in appropriate changes in management.*

   Linking monitoring and research data to changes in management is the primary responsibility of the Adaptive Management Work Group. Consistent with the No Surprises Assurances described in Chapter 10, if a determination is made by the Adaptive Management Work Group that the goals or management objectives of this RHCP are not being met, or management and/or monitoring activity is determined to be ineffective in conserving the endangered species covered in this RHCP, then adjustments to the management program may be warranted. The annual report submitted to the Service will directly address the adaptive management issue, and a statement will be made and supported by research and monitoring findings that management should or should not change each year. Based on research and monitoring findings, the Adaptive Management Work Group may recommend to the RHCP administrator (a member of the group) that the RHCP be changed. The appropriate County officials will then decide whether to act on this recommendation and apply for an amendment(s) to the RHCP.

8.4 SPECIES AND HABITAT TRACKING PROCESS

The RHCP has established the following species and habitat tracking process for determining the status of the RHCP covered and additional species.

- Because all karst species participants will be required to conduct full Geological Assessments and presence/absence surveys of detected features with potential habitat for listed karst species, the participation process is anticipated to generate knowledge of new locations of both covered and additional species. This new information will be included in a database that will be developed and maintained by the Foundation for all covered and additional species included in this RHCP. The database will include the known locations and general population numbers and/or karst survey specimen collection records, and preserve (karst, warbler, vireo) habitat quality indices (e.g., cave humidity and temperature, vandalism) collected during monitoring efforts. To the fullest extent allowed by state law, the Foundation will attempt to maintain the confidentiality of the database.

- Every year as a component of the RHCP annual report, the RHCP administrator will evaluate the increase or decrease in known locations of all species as well as preserve habitat quality improvement or deterioration. This effort will be the basis of an early warning system for the decline in species and or habitat, or, alternatively, will signal improvements in species status.
- Every five years the County will initiate a literature and research update on each of the species to determine whether any new scientific information is available to improve the assessment of their status, threats to their continued survival, and their conservation needs.
- If new information is available on a species, the County will coordinate a species status assessment, with input from the Service, TPWD, and other qualified experts.
- Following the assessment, the County will evaluate the degree to which the RHCP, as it is being implemented, is providing conservation benefits to the species and what additional measures, if any, the County could implement through the RHCP to provide conservation benefits for the species.
- Depending on the evaluation of RHCP benefits, the County will determine the levels of expected impact and existing protected areas for the additional species and decide whether to seek coverage of the species under the RHCP, in which case it will apply for any appropriate amendments to the RHCP.
- As not enough information on the additional species is currently available to adequately determine impacts or benefits, it is not possible or appropriate for the Service to determine if implementation of this RHCP would jeopardize the continued existence of one of these species. As the information identified above becomes available, or one or more of the additional species becomes listed and coverage is desired, at a minimum the Service and the County will need to amend the RHCP, the Permit, and the Biological Opinion to allow for inclusion on the Permit.

CHAPTER 9 – FUNDING

9.1 OVERVIEW

The Endangered Species Act requires that an applicant for a section 10(a)(1)(B) permit ensure adequate funding will be available to implement the HCP. In addition, Texas state law requires that when applicants for RHCPs are governmental entities they must demonstrate that adequate sources of funding will exist to acquire all land for habitat preserves within required state law timeframes. To meet these requirements, Williamson County authorities have approved the financial plan presented in this chapter. Every year during the 30-year life of the RHCP the County will re-evaluate the financial plan to ensure adequate funding and appropriate disposition of excess revenues to meet plan goals.

Funding for this RHCP will be generated from five primary sources: 1) participation (mitigation) fees collected from participants; 2) return on endowment investments; 3) County land acquisition funds for parks and open space, provided a public access plan is in place; 4) County advance funding[93] from road improvement mitigation funds; and 5) a Tax Benefit Financing (TBF) program. To help meet long-term needs after 30 years, an endowment will be funded from plan income. In addition, over the 30-year life of the plan, some additional funds not currently calculated in RHCP income may be derived from a variety of other sources, including estate planning and charitable contributions; endowments, land, and/or contribution of easements; and state, Federal and other grants or donations.

This Chapter, after a brief overview of RHCP financial structure and responsibilities, consists of two primary sections: estimation of RHCP costs, and identification of specific anticipated funding sources. RHCP costs and income have been estimated for the 30-year permit period. It should be noted that the estimates for take of habitat upon which many financial plan elements are based are themselves based on the overall 30-year timeframe, and that take estimates for any one year may or may not be met or exceeded in that year once the plan is underway. The take estimates used for financial planning purposes are not intended to function as annual take limits, the exceedance of which would trigger re-initiation of consultation. Allowable take is framed in the context of the entire life of the plan rather than in any plan year. It is important to emphasize that all funding projections provided in this section or authorized under the plan are merely estimates intended to demonstrate that the plan is financially feasible. The funding plan is not substantially prescriptive of the timing, size, or nature of actions that may be taken or authorized under the plan. While specific elements of the overall financing plan may change over the 30-year plan period, the permitted take and the mitigation to accommodate that take will not change.

[93] These funds would be provided through an interest-earning, advance funding agreement between the County and the Foundation.

9.2 PLAN FINANCIAL STRUCTURE AND RESPONSIBILITIES

Williamson County will hold the requested section 10(a)(1)(B) permit, and the Foundation, as its agent, will implement the RHCP. The County and the Foundation will bear the financial responsibilities described in this RHCP for the conservation and mitigation measures to be implemented, the monitoring and research procedures, and any other permit conditions. Other than the County contributions and advance funding detailed below, the only County funds specifically segregated for the plan will be those of the endowment (see Section 9.3.7 below), and the County is not required to establish separate accounts for the plan. Williamson County's obligations with respect to funding of this RHCP are, of course, limited in accordance with applicable law and to the mechanisms and means described herein, and nothing in this RHCP is to be construed as a commitment of the general fund of the County nor as an unlawful commitment of resources otherwise under the direction and at the discretion of future Commissioners Courts. Nevertheless, the funding plan described herein lays out a reasonable and well-assured plan of finance in accordance with custom and practice for similar endeavors and meeting applicable Federal and state standards for the assurance of funding of RHCPs.

9.3 ESTIMATION OF RHCP COSTS

Table 9-1 provides a summary of the total estimated costs,[94] or funding needs, for Years 1–30 of the plan. An explanation of the origins and assumptions made for the cost estimates are summarized below.

9.3.1 RHCP Operation

Depending on participation and funding levels, the Foundation is expected to hire one qualified, full-time administrator for the RHCP in Year 1 of plan implementation. Prior to the hiring of the administrator, the County will assume the responsibilities and costs of RHCP implementation. Two part-time positions are anticipated as well. For planning purposes, it is assumed that costs for operations (salary, vehicle, rent, preparation of management and monitoring plans, review of applications for participation, and other direct and indirect costs) will be $125,000 per year beginning in Year 1. From Year 1 on, costs are assumed to rise at 2.5 percent per year.

9.3.2 Karst Preserves

The County will acquire through direct purchase or acquisition of perpetual conservation easements approximately 700 acres (283 hectares) of cave preserves.[95] These preserves will include several covered and additional species-occupied caves in each of three KFRs as described in Chapter 5 of this document.

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[94] **COSTS DISCLAIMER.** All estimated costs/income presented in this document are provided only as a general indicator of potential levels and origins of short- and long-term RHCP expenses and income. It should also be noted that all participation fees identified in the RHCP are subject to reassessment and adjustments over the life of plan.

[95] The 700 acres acquired will be newly established preserves or enhanced existing conservation areas that have not been included as mitigation in previous section 10(a) or section 7 Endangered Species Act consultations.

Table 9-1 RHCP Anticipated Costs Years 1 – 30

RHCP OPERATION

1		**Foundation**															
				Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Annual Increase		**Foundation Annual Costs[1]**	**Per Year**	$125,000	$128,125	$131,328	$134,611	$137,977	$141,426	$144,962	$148,586	$152,300	$156,108	$160,011	$164,011	$168,111
	2.5%			**Cumulative**	$125,000	$253,125	$384,453	$519,064	$857,041	$798,467	$943,429	$1,092,014	$1,244,315	$1,400,423	$1,560,433	$1,724,444	$1,892,555

KARST

2		**Karst Land Acquisition**															
				Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
		Acquisition	700 Acres Total	Conservation easement costs estimated at 40% of purchase costs.													
	Annual Increase	**Purchase[2] 500 Acres**	Variable land purchases Years 1-17 @ $30,000 per acre	**Per Year**	$2,400,000	$0	$0	$0	$827,860	$1,018,267	$1,217,678	$1,426,423	$1,644,844	$1,873,294	$2,112,139	$787,252	$806,933
	2.5%			**Cumulative**	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$3,227,860	$4,246,127	$5,463,805	$6,890,228	$8,535,072	$10,408,366	$12,520,506	$13,307,758	$14,114,691
		Easement 200 Acres	50 acres in Years 1-4 @ $12,000 per acre	**Per Year**	$600,000	$615,000	$630,375	$646,134	$0	$0	$0	$0	$0	$0	$0	$0	$0
				Cumulative	$600,000	$1,215,000	$1,845,375	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509
				Total Per Year	$3,000,000	$615,000	$630,375	$646,134	$827,860	$1,018,267	$1,217,678	$1,426,423	$1,644,844	$1,873,294	$2,112,139	$787,252	$806,933
				Total Cumulative	$3,000,000	$3,615,000	$4,245,375	$4,891,509	$5,719,369	$6,737,636	$7,955,315	$9,381,737	$11,026,581	$12,899,876	$15,012,015	$15,799,267	$16,606,201

3		**Karst Management (O&M) of Acquired Land[3]**															
				Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
		Acquisition	700 acres total	130 acres established in Year 1 (by purchase and easement). Future years variable until 700 acres established in Year 27 (See Cost No. 2 for yearly acquisitions). Preserve lands will require initial establishment costs for cave gates, fencing, etc. Annual maintenance begins in year following establishment.													
	Annual Increase	**Initial Establish.**	Initial management costs = $600/ac	**Per Year**	$78,000	$30,750	$31,519	$32,307	$16,557	$20,365	$24,354	$28,528	$32,897	$37,466	$42,243	$15,745	$16,139
	2.5%			**Cumulative**	$78,000	$108,750	$140,269	$172,575	$189,133	$209,498	$233,852	$262,380	$295,277	$332,743	$374,986	$390,731	$406,869
		Annual Mgt.	Annual $300/acre	**Per Year**	$0	$39,975	$56,734	$74,305	$92,720	$103,524	$116,549	$131,944	$149,864	$170,470	$193,933	$220,431	$234,011
				Cumulative	$0	$39,975	$96,709	$171,014	$263,734	$367,258	$483,808	$615,752	$765,615	$936,085	$1,130,018	$1,350,448	$1,584,459
				Total Per Year	$78,000	$70,725	$88,253	$106,612	$109,277	$123,889	$140,903	$160,473	$182,760	$207,936	$236,176	$236,176	$250,149
				Total Cumulative	$78,000	$148,725	$236,978	$343,590	$452,867	$576,756	$717,659	$878,132	$1,060,892	$1,268,828	$1,505,003	$1,741,179	$1,991,328

4		**Karst Management (O&M) of 10 Caves in Existing Conservation Areas[3]**															
				Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
			10 caves	Management of two existing conservation areas assumed each year in Years 6-10. Annual maintenance begins in year following establishment. Preserve sizes are expected to range from 25 to 90 acres, with average size assumed to be 40 acres.													
	Annual Increase	**Initial Establish.**	10 caves @ $5,000/cave	**Per Year**	$10,000	$10,250	$10,506	$10,769	$11,038	$0	$0	$0	$0	$0	$0	$0	$0
	2.5%	**Annual Mgt.**	$300/acre; 40 acres/cave	**Per Year**	$0	$24,600	$50,430	$77,536	$105,966	$135,769	$139,163	$142,642	$146,208	$149,864	$153,610	$157,450	$161,387
				Total Per Year	$10,000	$34,850	$60,936	$88,305	$117,004	$135,769	$139,163	$142,642	$146,208	$149,864	$153,610	$157,450	$161,387
				Total Cumulative	$10,000	$44,850	$105,786	$194,091	$311,095	$446,864	$586,028	$728,670	$874,878	$1,024,742	$1,178,352	$1,335,802	$1,497,189

GOLDEN-CHEEKED WARBLER[4]

5				**Year**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Annual Increase	**Hickory Pass GCW Credits**	500 credits at $6,500 per credit in Year 1; 500 credits at $6,000 per credit in Year 4	**Per Year**	$3,250,000	$0	$0	$3,000,000		0	$0	$0	$0	$0	$0	$0	$0
				Total per Year	$3,250,000	$0	$0	$3,000,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
				Total Cumulative	$3,250,000	$3,250,000	$3,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000

GEORGETOWN SALAMANDER

6		**Salamander Research**															
				Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Annual Increase	**Salamander Research**	$50,000/year Years 2-6	**Per Year**	$0	$50,000	$51,250	$52,531	$53,845	$55,191	$0	$0	$0	$0	$0	$0	$0
	2.5%			**Total Cumulative**	$0	$50,000	$101,250	$153,781	$207,626	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816

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Table 9-1 RHCP Anticipated Costs Years 1 – 30

OTHER RHCP EXPENSES

7		**Research**														
			Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Annual Increase	$25,000/year starting Year 2	**Per Year**	$0	$25,000	$25,625	$26,266	$26,922	$27,595	$28,285	$28,992	$29,717	$30,460	$31,222	$32,002	$32,802
	2.5%		**Total Cumulative**	$0	$25,000	$50,625	$76,891	$103,813	$131,408	$159,693	$188,686	$218,403	$248,863	$280,085	$312,087	$344,889
8		**Public Awareness**														
			Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Annual Increase	$20,000/year	**Per Year**	$20,000	$20,500	$21,013	$21,538	$22,076	$22,628	$23,194	$23,774	$24,368	$24,977	$25,602	$26,242	$26,898
	2.5%		**Cumulative**	$20,000	$40,500	$61,513	$83,050	$105,127	$127,755	$150,949	$174,722	$199,090	$224,068	$249,669	$275,911	$302,809
9		**Williamson County Conservation Foundation Endowment[5]**														
			Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Annual Increase	$25,000/year beginning in Year 15	**Per Year**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	0.0%		**Cumulative**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10		**Contingency Fund[6]**														
			Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Annual Increase	$10,000/year beginning in Year 1	**Per Year**	$10,000	$10,250	$10,506	$10,769	$11,038	$11,314	$11,597	$11,887	$12,184	$12,489	$12,801	$13,121	$13,449
	2.5%		**Cumulative**	$10,000	$20,250	$30,756	$41,525	$52,563	$63,877	$75,474	$87,361	$99,545	$112,034	$124,835	$137,956	$151,404
11		**County Investment Financing Cost[7]**														
			Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Annual Increase	Principal		$3,250,000	$3,250,000	$3,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000
		Interest Payment	**Per Year**	$146,250	$146,250	$146,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250
			Cumulative	$146,250	$292,500	$438,750	$720,000	$1,001,250	$1,282,500	$1,563,750	$1,845,000	$2,126,250	$2,407,500	$2,688,750	$2,970,000	$3,251,250
		Principal Repayment	**Pear Year**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	4.5%		**Cumulative**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		Total Payments	**Per Year**	$146,250	$146,250	$146,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250
			Cumulative	$146,250	$292,500	$438,750	$720,000	$1,001,250	$1,282,500	$1,563,750	$1,845,000	$2,126,250	$2,407,500	$2,688,750	$2,970,000	$3,251,250

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Grand Total Per Year	$6,639,250	$1,100,700	$1,165,536	$4,368,017	$1,587,249	$1,817,330	$1,987,032	$2,224,026	$2,473,632	$2,736,378	$3,012,810	$1,697,504	$1,740,979
Grand Total Cumulative	$6,639,250	$7,739,950	$8,905,486	$13,273,502	$14,860,751	$16,678,081	$18,665,113	$20,889,139	$23,362,771	$26,099,149	$29,111,959	$30,809,462	$32,550,442

Per-year Balance	$307,614	$214,845	$283,148	$224,204	$159,656	$161,154	$170,972	$127,227	$85,582	$46,560	$12,423	$85,843	$166,227
Cumulative Balance	$307,614	$522,460	$805,608	$1,029,812	$1,189,468	$1,350,622	$1,521,594	$1,648,821	$1,734,403	$1,780,963	$1,793,386	$1,879,229	$2,045,456

Footnotes:

[1] The Foundation anticipates funding one full-time and two part-time positions to help administer the plan. Foundation/Service-approved Karst and biological technical expertise will be paid for by the participant.

[2] Current land purchase costs range from $5,000 to $30,000/acre depending upon location. Financial plan based on $30,000/acre in Year 1, increasing by 2.5% /year. The Foundation will purchase land for karst preserves on the basis of highest and best use and number of species conserved.

[3] O & M costs beyond Year 30 will be funded by interest generated by the Williamson County Conservation Foundation endowment.

[4] The initial 500 Hickory Pass Ranch GCW credits were purchased in 2007. Another 115.52 acres of GCW mitigation credits are available as a result of the County's acquisition of the Whitney Tract near Lake Georgetown, although that transaction is not reflected in this table. The County has an optional to purchase another 500 Hickory Pass Ranch credits in Year 4.

[5] To ensure the Foundation will operate in perpetuity $25,000/year beginning in Year 15 and one-time $20,000,000 investment in Year 30 will be dedicated to the endowment to cover operations after 30 years. Interest from this fund is considered as income in Table 9-2.

[6] This fund will be used to pay for expected periodic RHCP amendments and any unanticipated or otherwise unforeseen costs associated with RHCP maintenance.

[7] Interest payment and principal repayment only on County investment advance funding in Year 1 ($3.25 million) and Year 4 ($3.0 million) for costs associated with purchase of GCW Hickory Pass credits ($6.25 million total); Repayment of principal begins Year 20. County investment for costs associated with karst land acquisition ($3.0 million in Year 1) funded from County l
acquisition funds for open space and parks.

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Table 9-1 RHCP Anticipated Costs Years 1 – 30

		Foundation																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	Annual Increase	$172,314	$176,622	$181,037	$185,563	$190,202	$194,957	$199,831	$204,827	$209,948	$215,196	$220,576	$226,091	$231,743	$237,537	$243,475	$249,562	$255,801
	2.5%	$2,064,869	$2,241,491	$2,422,528	$2,608,091	$2,798,294	$2,993,251	$3,193,082	$3,397,909	$3,607,857	$3,823,053	$4,043,630	$4,269,720	$4,501,464	$4,739,000	$4,982,475	$5,232,037	$5,487,838

KARST

		Karst Land Acquisition																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		Conservation easement costs estimated at 40% of purchase costs.																
	Annual Increase	$1,033,883	$1,059,730	$1,303,468	$890,703	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2	2.5%	$15,148,574	$16,208,305	$17,511,773	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477	$18,402,477
		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509	$2,491,509
		$1,033,883	$1,059,730	$1,303,468	$890,703	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		$17,640,084	$18,699,814	$20,003,283	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986	$20,893,986

		Karst Management (O&M) of Acquired Land[3]																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
3	Annual Increase	$20,678	$21,195	$26,069	$17,814	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	2.5%	$427,547	$448,742	$474,811	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625	$492,625
		$248,132	$264,933	$282,418	$302,839	$319,540	$327,528	$335,717	$344,109	$352,712	$361,530	$370,568	$379,832	$389,328	$399,061	$409,038	$419,264	$429,746
		$1,832,591	$2,097,524	$2,379,942	$2,682,781	$3,002,321	$3,329,849	$3,665,566	$4,009,675	$4,362,387	$4,723,917	$5,094,485	$5,474,318	$5,863,646	$6,262,708	$6,671,746	$7,091,010	$7,520,755
		$268,810	$286,127	$308,488	$320,653	$319,540	$327,528	$335,717	$344,109	$352,712	$361,530	$370,568	$379,832	$389,328	$399,061	$409,038	$419,264	$429,746
		$2,260,138	$2,546,265	$2,854,753	$3,175,406	$3,494,946	$3,822,474	$4,158,191	$4,502,300	$4,855,012	$5,216,542	$5,587,110	$5,966,943	$6,356,271	$6,755,333	$7,164,371	$7,583,635	$8,013,380

		Karst Management (O&M) of 10 Caves in Existing Conservation Areas3																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
		Management of two existing conservation areas assumed each year in Years 6-10. Annual maintenance begins in year following establishment. Preserve sizes are expected to range from 25 to 90 acres, with average size assumed to be 40 acres.																
4	Annual Increase	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	2.5%	$165,421	$169,557	$173,796	$178,141	$182,594	$187,159	$191,838	$196,634	$201,550	$206,589	$211,753	$217,047	$222,473	$228,035	$233,736	$239,579	$245,569
		$165,421	$169,557	$173,796	$178,141	$182,594	$187,159	$191,838	$196,634	$201,550	$206,589	$211,753	$217,047	$222,473	$228,035	$233,736	$239,579	$245,569
		$1,662,610	$1,832,167	$2,005,963	$2,184,104	$2,366,698	$2,553,857	$2,745,695	$2,942,329	$3,143,879	$3,350,467	$3,562,221	$3,779,268	$4,001,741	$4,229,776	$4,463,512	$4,703,092	$4,948,660

GOLDEN-CHEEKED WARBLER[4]

		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
5	Annual Increase	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000

GEORGETOWN SALAMANDER

		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6	Annual Increase	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	2.5%	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816	$262,816

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Table 9-1 RHCP Anticipated Costs Years 1 – 30

OTHER RHCP EXPENSES

		Research																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
7	Annual Increase	$33,622	$34,463	$35,324	$36,207	$37,113	$38,040	$38,991	$39,966	$40,965	$41,990	$43,039	$44,115	$45,218	$46,349	$47,507	$48,695	$49,912
	2.5%	$378,511	$412,974	$448,298	$484,506	$521,618	$559,659	$598,650	$638,616	$679,582	$721,571	$764,611	$808,726	$853,944	$900,293	$947,800	$996,495	$1,046,407

		Public Awareness																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
8	Annual Increase	$27,570	$28,259	$28,966	$29,690	$30,432	$31,193	$31,973	$32,772	$33,592	$34,431	$35,292	$36,175	$37,079	$38,006	$38,956	$39,930	$40,928
	2.5%	$330,379	$358,639	$387,604	$417,295	$447,727	$478,920	$510,893	$543,665	$577,257	$611,689	$646,981	$683,155	$720,234	$758,240	$797,196	$837,126	$878,054

		Williamson County Conservation Foundation Endowment[5]																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
9	Annual Increase	$0	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$20,025,000
	0.0%	$0	$25,000	$50,000	$75,000	$100,000	$125,000	$150,000	$175,000	$200,000	$225,000	$250,000	$275,000	$300,000	$325,000	$350,000	$375,000	$20,400,000

		Contingency Fund[6]																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
10	Annual Increase	$13,785	$14,130	$14,483	$14,845	$15,216	$15,597	$15,987	$16,386	$16,796	$17,216	$17,646	$18,087	$18,539	$19,003	$19,478	$19,965	$20,464
	2.5%	$165,190	$179,319	$193,802	$208,647	$223,863	$239,460	$255,447	$271,833	$288,629	$305,844	$323,490	$341,578	$360,117	$379,120	$398,598	$418,563	$439,027

		County Investment Financing Cost[7]																
		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
11	Annual Increase	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$5,250,000	$4,250,000	$3,250,000	$2,250,000	$1,250,000	$250,000	$0	$0	$0	$0
		$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$236,250	$191,250	$146,250	$101,250	$56,250	$11,250	$0	$0	$0	$0
		$3,532,500	$3,813,750	$4,095,000	$4,376,250	$4,657,500	$4,938,750	$5,220,000	$5,456,250	$5,647,500	$5,793,750	$5,895,000	$5,951,250	$5,962,500	$5,962,500	$5,962,500	$5,962,500	$5,962,500
	4.5%	$0	$0	$0	$0	$0	$0	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$250,000	$0	$0	$0	$0
		$0	$0	$0	$0	$0	$0	$1,000,000	$2,000,000	$3,000,000	$4,000,000	$5,000,000	$6,000,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000
		$281,250	$281,250	$281,250	$281,250	$281,250	$281,250	$1,281,250	$1,236,250	$1,191,250	$1,146,250	$1,101,250	$1,056,250	$261,250	$0	$0	$0	$0
		$3,532,500	$3,813,750	$4,095,000	$4,376,250	$4,657,500	$4,938,750	$6,220,000	$7,456,250	$8,647,500	$9,793,750	$10,895,000	$11,951,250	$12,212,500	$12,212,500	$12,212,500	$12,212,500	$12,212,500

Year	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Grand Total Per Year	$1,996,656	$2,075,138	$2,351,812	$1,962,053	$1,081,347	$1,100,725	$2,120,587	$2,095,945	$2,071,813	$2,048,202	$2,025,125	$2,002,597	$1,230,631	$992,991	$1,017,190	$1,041,995	$21,067,420
Grand Total Cumulative	$34,547,097	$36,622,235	$38,974,048	$40,936,101	$42,017,448	$43,118,173	$45,238,760	$47,334,705	$49,406,518	$51,454,720	$53,479,845	$55,482,442	$56,713,073	$57,706,064	$58,723,254	$59,765,249	$80,832,669

Per-year Balance	$43,822	$110,488	$69,619	$627,277	$1,688,534	$1,863,296	$1,052,194	$1,389,985	$1,655,756	$1,939,235	$2,241,797	$2,564,919	$3,759,014	$4,344,708	$4,694,881	$5,072,770	-$14,519,484
Cumulative Balance	$2,089,278	$2,199,767	$2,269,386	$2,896,663	$4,585,197	$6,448,493	$7,500,688	$8,890,673	$10,546,429	$12,485,665	$14,727,462	$17,292,381	$21,051,394	$25,396,102	$30,090,983	$35,163,753	$20,644,270

Footnotes:

[1] The Foundation anticipates funding one full-time and two part-time positions to help administer the plan. Foundation/Service-approved Karst and biological technical expertise will be paid for by the participant.

[2] Current land purchase costs range from $5,000 to $30,000/acre depending upon location. Financial plan based on $30,000/acre in Year 1, increasing by 2.5% /year. The Foundation will purchase land for karst preserves on the basis of highest and best use and number of species conserved.

[3] O & M costs beyond Year 30 will be funded by interest generated by the Williamson County Conservation Foundation endowment.

[4] The initial 500 Hickory Pass Ranch GCW credits were purchased in 2007. Another 115.52 acres of GCW mitigation credits are available as a result of the County's acquisition of the Whitney Tract near Lake Georgetown, although that transaction is not reflected in this table. The County has an optional to purchase another 500 Hickory Pass Ranch credits in Year 4.

[5] To ensure the Foundation will operate in perpetuity $25,000/year beginning in Year 15 and one-time $20,000,000 investment in Year 30 will be dedicated to the endowment to cover operations after 30 years. Interest from this fund is considered as income in Table 9-2.

[6] This fund will be used to pay for expected periodic RHCP amendments and any unanticipated or otherwise unforeseen costs associated with RHCP maintenance.

[7] Interest payment and principal repayment only on County investment advance funding in Year 1 ($3.25 million) and Year 4 ($3.0 million) for costs associated with purchase of GCW Hickory Pass credits ($6.25 million total); Repayment of principal begins Year 20. County investment for costs associated with karst land acquisition ($3.0 million in Year 1) funded from County land acquisition funds for open space and parks.

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The County plans to purchase 500 acres (202 hectares) of preserve lands at $30,000/acre[96] and to acquire through conservation easement an additional 200 acres (81 hectares).[97] Easement costs are anticipated to be 40 percent of purchase price, or $12,000/acre. These estimates include transaction costs.

The rate of accumulation of these preserve lands will be as follows: Purchased Land: 80 acres in Year 1 and additional purchases as funds permit in Years 5–17 (or until all 500 acres are acquired); Conservation Easement Land – 50 acres/year in Years 1–4. All 700 acres of karst mitigation land are expected to be under Foundation management by Year 17 of the plan. From Year 1 on, costs are assumed to rise at 2.5 percent per year.

In addition to acquisition costs, the RHCP participants are required to demonstrate adequate funding for the establishment, operation, maintenance, and monitoring of the karst preserves in accordance with the RHCP. Utilizing existing data on the establishment and annual operation and maintenance costs for the 45-acre (18-hectare) Williamson County Millennium Preserve, as well as additional funds anticipated to be necessary to increase the intensity of red imported fire ant control and biospeleological surveys, the RHCP anticipates that costs will include an initial preserve establishment expense of $600/acre, and annual management costs of $300/acre. It is understood that many of the management requirements (e.g., fences and gates) will eventually need to be replaced beyond the timeframe (30 years) of the RHCP. All future costs for these replacements will be adequately funded by income generated by the endowment.

The Foundation will consolidate the management of up to 10 existing cave conservation areas to enhance their viability as KFAs, control their availability for scientific research, and ensure their long-term contribution to recovery. Estimated costs associated with the consolidation and management of these conservation areas is $5,000 per cave for initial preserve validation (biotic surveys, cave gate maintenance or replacement, RHCP database management, etc.), and $300/acre per year for long-term maintenance. The 10 existing conservation areas will be added to the County's cave management inventory at a rate of two caves per year beginning Year 1 of the plan, with management of all 10 areas assumed by Year 5 of the plan. It is anticipated that over the 30-year period of the plan all management costs will rise by an average of 2.5 percent per year.

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[96] Over the past five years, land values in Williamson County have continued to increase, particularly in the Karst Zone area. Large tracts of land in and around Cedar Park and along Reagan Boulevard. with good transportation access and available utilities are selling for $65,000 to $120,000/acre. Farther north, in the Leander market, similar tracts of land have been selling for $30,000 to $50,000/acre. In the western part of the County, near Liberty Hill, and farther north and west of Georgetown (FM 2338 corridor), 200- to 800-acre tracts of land are averaging $18,000 to $25,000/acre (Prime Strategies data). Williamson County has purchased over 800 parcels of land since 2001 for the County's Road Bond Program. A number of these parcels have been acquired in the market area. Because of that activity, the County has a good knowledge of both landowners and property values. Karst preserve land in the area can be purchased with the proposed budget of $30,000/acre.

[97] At this time the County does not anticipate simple donations of preserve land as part of a development project. Donation of land by developers, including caves occupied by covered species and/or salamanders, is a distinct possibility, but as a conservation measure is not accounted for in the RHCP analysis of long-term preserve acquisition costs.

9.3.3 Golden-cheeked Warbler/Black-capped Vireo

The County has purchased 500 acres of Hickory Pass Ranch warbler mitigation credits and has an option to purchase another 500 credits in Year 4.[98] The County has been offered an option by the owner of Hickory Pass Ranch to purchase 500 credits in 2007 at $6,500/acre and another 500 credits by the end of 2010 at $6,000/acre. Based on this offer, $3,250,000 has been budgeted for this effort in Year 1 and another $3,000,000 in Year 4. The price of warbler credits will cover the conservation bank's management costs, so no additional management costs need be considered. Since these mitigation bank costs are one-time expenditures, no annual increase has been built into the costs.

Because mitigation for the black-capped vireo will be handled on a rolling basis, with costs for restoration, enhancement, and management of vireo habitat directly contingent upon take, any cost and income associated with the vireo is expected to balance in short timeframes (i.e., a money-in/money-out scenario). As a result, actions related to black-capped vireo are not included in the RHCP budget.

9.3.4 Georgetown Salamander

Due primarily to lack of sufficient information on the status and distribution of the Georgetown salamander, the RHCP does not anticipate permitting direct impacts to the species, nor does it anticipate establishing specific preserve areas solely for the salamander species at this time. However, some of the karst preserve areas that will be established as KFAs may also contain the salamander and will be managed to benefit both karst and salamander species as well as terrestrial species. The RHCP will fund a status review of the salamander in Williamson County, dispersing the research funds at $50,000 per year for five years, beginning in Year 2 of the plan. Research funds will be increased by 2.5 percent per year.

9.3.5 RHCP-Funded Research

The RHCP also proposes to implement and fund a research program for Williamson County covered and additional species that is anticipated to be funded annually, beginning with $25,000 in Year 2 and increasing by 2.5 percent per year over the 30 years of the plan.

9.3.6 Public Awareness

An important component of mitigation under this RHCP is an ongoing public education effort. This effort will raise awareness of the importance of species conservation and sustainable use of the region's natural resources by a variety of means (brochure, computer presentations, video, etc.). It will provide the public with information on how to minimize potential harm to endangered and rare species and how to become directly involved in species conservation. The

[98] The County also recently purchased 115.52 acres of golden-cheeked warbler habitat (in the Whitney Tract) to use as in-county mitigation for future impacts to warbler habitat resulting from activities covered by the RHCP. That purchase with parks and open space funds may or may not affect future purchases of Hickory Pass Ranch credits depending on the demand for take over the 30-year life of the plan.

RHCP will annually fund the public awareness program beginning with approximately $20,000 in Year 1 and increasing by 2.5 percent per year over the 30 years of the plan.

9.3.7 Foundation Endowment

To ensure that the Foundation will operate in perpetuity, an endowment will be funded with contributions of $25,000 per year in Years 15–30, and an additional contribution of $20,000,000 in Year 30, for a total of $20,400,000. Income from the endowment will be used after Year 30 to cover, in perpetuity, costs of operating the Foundation and operating, maintaining, and monitoring preserves established under the RHCP.

9.3.8 Contingency Fund

Unexpected costs for Foundation operation are very likely to occur, especially during the first few years of RHCP implementation. In anticipation of unexpected costs, an annual contingency fund of $10,000 per year will be established beginning in Year 1 of the plan. Contingency fund contributions will rise by an average of 2.5 percent per year.

9.3.9 County Investment Financing

Annual interest of 4.5 percent on the $3,250,000 advanced from the County in Year 1 and the $3,000,000 advanced from the County in Year 4 will be paid in full each year beginning in Year 1. Annual interest costs in Year 1 are anticipated to be $146,250, and the annual costs in Years 10, 20, and 26 (year of final payment) are anticipated to be $281,250, $281,250, and $11,250, respectively. Repayment of principal will begin in Year 20, with annual payments of $1,000,000 in Years 20–25, and a final payment of $250,000 in Year 26.

9.3.10 Summary of Estimated Costs

Table 9-1 shows that total RHCP annual costs in Year 1 are anticipated to be $6,639,250, and the annual costs in Years 10, 20, and 30 are anticipated to be $2,736,378, $2,120,587, and $21,067,420, respectively. The total cumulative cost of the RHCP for the 30-year period is $80,832,669.

9.4 FUNDING SOURCES

This section describes expected funding sources, including the income from plan participants' participation fees, return on endowment investments, County land acquisition funds for parks and open space, County advance funds from road improvement mitigation funds, and TBF. Table 9-2 shows the total estimated expected sources and amounts of funding for Years 1–30 of the plan. It is important to emphasize that participation fees are calculated under the assumption that only 10 percent of the development impacting the Karst Zone and the endangered bird habitat will occur under a permit from the RHCP. Should participation rates become higher through time, income from participation will be greater than that presented at the 10 percent level.

9.4.1 Participation (Mitigation) fees

9.4.1.1 Karst Participation fees

The anticipated RHCP income from participation fees for impacts to the Karst Zone (potential karst invertebrate habitat) is estimated to be $12,100 in Year 1, and $1,101,297 over the 30-year life of the plan. This income assumes that 121 acres of the Karst Zone will be developed by RHCP participants in Year 1, and that developed acreage will increase by approximately 5 percent annually to reflect the anticipated growth rate in Williamson County (see Table 4-2). The income stream also assumes a 10 percent increase in fees every five years (Table 9-2). Participation fee income for Impact Zone A caves (3–5 per year) is estimated to be $234,000 in the first year, and $9,027,264 over the 30-year life of the plan. Participation fee income for Impact Zone B caves is estimated to be $400,000 in the first year, and $15,431,220 over the 30-year life of the plan**.**

9.4.1.2 Golden-cheeked Warbler Participation fees

Again, assuming 10 percent participation rate, RHCP anticipated income for impacts to golden-cheeked warbler habitat is estimated to be $560,000 in the second year (no income in Year 1) and $9,439,125 over the 30-year life of the plan, assuming no additional take/mitigation will take place after Year 11 of the plan. Income is based on the sale of 80[99] mitigation credits in Year 2, priced at $7,000/credit, with a $500/credit increase per year through the 10-year lifespan of the golden-cheeked warbler participation fee program.

9.4.1.3 Black-capped Vireo

No income is shown in Table 9-2 related to the black-capped vireo for reasons explained in Section 9.3.3 above.

9.4.2 RHCP Endowment Investment Income

After 30 years of plan operation, the endowment will contain a total of $20,400,000 from direct endowment contributions. At 7 percent return per year, the direct endowment contributions will generate an estimated $238,000 of investment income.

[99] Increasing by 5 percent per year, reflecting the estimated 5 percent per year population growth in the County.

Table 9-2. RHCP Anticipated Income Years 1 – 30

KARST MITIGATION FEES

Mitigation Fees for Impacts to Karst Zone[1]

				Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Annual Increase 0%	(10% increase every 5 years)	Karst Zone Fee (121 Acres in Year 1 Increasing 5% annually @ $100/Acre)	Acres	121	127	133	140	147	154	162	170	179	188	197	207	217	228
				Per Year	$12,100	$12,705	$13,340	$14,007	$14,708	$16,987	$17,837	$18,729	$19,665	$20,648	$23,849	$25,041	$26,293	$27,608
				Cumulative	$12,100	$24,805	$38,145	$52,153	$66,860	$83,847	$101,684	$120,413	$140,078	$160,726	$184,574	$209,615	$235,909	$263,516

Mitigation Fees for Species Caves

				Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	Annual Increase 0%	(10% increase every 5 years)	Impact Zone A Cave (3/yr @ $78,000/Cave [fully impacted Zone] or 5/yr @ $46,800/Cave [partially impacted Zone])[2]	Per Year	$234,000	$234,000	$234,000	$234,000	$234,000	$257,400	$257,400	$257,400	$257,400	$257,400	$283,140	$283,140	$283,140	$283,140
				Cumulative	$234,000	$468,000	$702,000	$936,000	$1,170,000	$1,427,400	$1,684,800	$1,942,200	$2,199,600	$2,457,000	$2,740,140	$3,023,280	$3,306,420	$3,589,560

				Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Annual Increase 0%	(10% increase every 5 years)	Impact Zone B Cave (1/yr @ $400,000/Cave)[3]	Per Year	$400,000	$400,000	$400,000	$400,000	$400,000	$440,000	$440,000	$440,000	$440,000	$440,000	$484,000	$484,000	$484,000	$484,000
				Cumulative	$400,000	$800,000	$1,200,000	$1,600,000	$2,000,000	$2,440,000	$2,880,000	$3,320,000	$3,760,000	$4,200,000	$4,684,000	$5,168,000	$5,652,000	$6,136,000

GOLDEN-CHEEKED WARBLER MITIGATION FEES

Mitigation Fees for Impacts to Golden-Cheeked Warbler[4]

			Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
3	Annual Increase $500	Hickory Pass Credit Sales (Start at $7,000/Credit in Year 2)	Credits	0	80	84	88	93	97	102	107	113	118	118			
			Per Year	$0	$560,000	$630,000	$705,600	$787,185	$875,165	$969,974	$1,072,077	$1,181,964	$1,300,161	$1,357,000	$0	$0	$0
			Cumulative	$0	$560,000	$1,190,000	$1,895,600	$2,682,785	$3,557,950	$4,527,923	$5,600,000	$6,781,964	$8,082,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125

WILLIAMSON COUNTY CONSERVATION FOUNDATION ENDOWMENT INVESTMENT RETURN

			Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
4	Annual Return 7%	Endowment Investment	Per Year	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		Total Investment	Cumulative	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		Annual Return on Endowment	Per Year	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Cumulative Return	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Total Per Year	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Total Cumulative	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

WILLIAMSON COUNTY RHCP INVESTMENT[5]

		Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
5	Land Acquisition Funds		$3,000,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Advance for Purchase of Hickory Pass Credits		$3,250,000			$3,000,000										
		Per Year	$6,250,000	$0	$0	$3,000,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		Cumulative	$6,250,000	$6,250,000	$6,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000

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Table 9-2. RHCP Anticipated Income Years 1 – 30

1			**Mitigation Fees for Impacts to Karst Zone[1]**																	
				Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
				Acres	240	252	264	277	291	306	321	337	354	372	390	410	430	452	474	498
	Annual Increase		**Karst Zone Fee (121 Acres in Year 1 Increasing 5% annually @ $100/Acre)**	**Per Year**	$28,988	$33,481	$35,129	$36,885	$38,730	$40,666	$46,969	$49,318	$51,784	$54,373	$57,092	$65,941	$69,238	$72,700	$76,335	$80,152
	0%	**(10% increase every 5 years)**		**Cumulative**	$292,505	$325,986	$361,115	$398,000	$436,730	$477,396	$524,366	$573,684	$625,468	$679,841	$736,932	$802,873	$872,111	$944,811	$1,021,146	$1,101,297
2			**Mitigation Fees for Species Caves**																	
				Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
	Annual Increase		**Impact Zone A Cave (3/yr @ $78,000/Cave [fully impacted Zone] or 5/yr @ $46,800/Cave [partially impacted Zone])[2]**	**Per Year**	$283,140	$311,454	$311,454	$311,454	$311,454	$311,454	$342,599	$342,599	$342,599	$342,599	$342,599	$376,859	$376,859	$376,859	$376,859	$376,859
	0%	**(10% increase every 5 years)**		**Cumulative**	$3,872,700	$4,184,154	$4,495,608	$4,807,062	$5,118,516	$5,429,970	$5,772,569	$6,115,169	$6,457,768	$6,800,368	$7,142,967	$7,519,826	$7,896,686	$8,273,545	$8,650,404	$9,027,264
				Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
	Annual Increase		**Iimpact Zone B Cave (1/yr @ $400,000/Cave)[3]**	**Per Year**	$484,000	$532,400	$532,400	$532,400	$532,400	$532,400	$585,640	$585,640	$585,640	$585,640	$585,640	$644,204	$644,204	$644,204	$644,204	$644,204
	0%	**(10% increase every 5 years)**		**Cumulative**	$6,620,000	$7,152,400	$7,684,800	$8,217,200	$8,749,600	$9,282,000	$9,867,640	$10,453,280	$11,038,920	$11,624,560	$12,210,200	$12,854,404	$13,498,608	$14,142,812	$14,787,016	$15,431,220

GOLDEN-CHEEKED WARBLER MITIGATION FEES

3			**Mitigation Fees for Impacts to Golden-Cheeked Warbler[4]**																	
				Year	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
				Credits																
	Annual Increase		**Hickory Pass Credit Sales (Start at $7,000/Credit in Year 2)**	**Per Year**	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	$500			**Cumulative**	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125	$9,439,125

WILLIAMSON COUNTY CONSERVATION FOUNDATION ENDOWMENT INVESTMENT RETURN

4				**Year**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
	Annual Return		**Endowment Investment**	**Per Year**	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
	7%		**Total Investment**	**Cumulative**	$25,000	$50,000	$75,000	$100,000	$125,000	$150,000	$175,000	$200,000	$225,000	$250,000	$275,000	$300,000	$325,000	$350,000	$375,000	$400,000
			Annual Return on Endowment	**Per Year**	$1,750	$3,500	$5,250	$7,000	$8,750	$10,500	$12,250	$14,000	$15,750	$17,500	$19,250	$21,000	$22,750	$24,500	$26,250	$28,000
				Cumulative Return	$1,750	$5,250	$10,500	$17,500	$26,250	$36,750	$49,000	$63,000	$78,750	$96,250	$115,500	$136,500	$159,250	$183,750	$210,000	$238,000
				Total Per Year	$1,750	$3,500	$5,250	$7,000	$8,750	$10,500	$12,250	$14,000	$15,750	$17,500	$19,250	$21,000	$22,750	$24,500	$26,250	$28,000
				Total Cumulative	$1,750	$5,250	$10,500	$17,500	$26,250	$36,750	$49,000	$63,000	$78,750	$96,250	$115,500	$136,500	$159,250	$183,750	$210,000	$238,000

WILLIAMSON COUNTY RHCP INVESTMENT[5]

5				**Year**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
			Land Acquisition Funds		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Advance for Purchase of Hickory Pass Credits																	
				Per Year	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
				Cumulative	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000	$9,250,000

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Table 9-2. RHCP Anticipated Income Years 1 – 30

TAX BENEFIT FINANCE FUNDING[7]

			Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
6	Annual Increase	Tax Revenue on Added Improvements at 10% Participation	Per Year	$338,430	$725,600	$1,142,292	$1,590,757	$2,073,417	$2,592,880	$3,151,952	$3,753,653	$4,401,234	$5,098,193	$5,848,295	$6,607,770	$7,425,156	$8,304,867
	2.5%		Cumulative	$338,430	$1,064,030	$2,206,322	$3,797,079	$5,870,496	$8,463,376	$11,615,328	$15,368,981	$19,770,215	$24,868,408	$30,716,703	$37,324,473	$44,749,629	$53,054,495
		15% Tax Revenue Dedicated to Plan	Per Year	$50,764	$108,840	$171,344	$238,614	$311,013	$388,932	$472,793	$563,048	$660,185	$764,729	$877,244	$991,166	$1,113,773	$1,245,730
			Cumulative	$50,764	$159,605	$330,948	$569,562	$880,574	$1,269,506	$1,742,299	$2,305,347	$2,965,532	$3,730,261	$4,607,505	$5,598,671	$6,712,444	$7,958,174

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Grand Total Per Year	$6,946,864	$1,315,545	$1,448,684	$4,592,221	$1,746,905	$1,978,484	$2,158,003	$2,351,253	$2,559,214	$2,782,938	$3,025,233	$1,783,347	$1,907,206	$2,040,478
Grand Total Cumulative	$6,946,864	$8,262,410	$9,711,094	$14,303,314	$16,050,220	$18,028,703	$20,186,707	$22,537,960	$25,097,174	$27,880,112	$30,905,345	$32,688,692	$34,595,898	$36,636,376
Per-year Balance	$307,614	$214,845	$283,148	$224,204	$159,656	$161,154	$170,972	$127,227	$85,582	$46,560	$12,423	$85,843	$166,227	$43,822
Cumulative Balance	$307,614	$522,460	$805,608	$1,029,812	$1,189,468	$1,350,622	$1,521,594	$1,648,821	$1,734,403	$1,780,963	$1,793,386	$1,879,229	$2,045,456	$2,089,278

Footnotes:

[1] A total of approximately 8,000 acres of development in the Karst Zone anticipated over 30 years (80,000 acres undeveloped Karst Zone @ 10% participation rate = 8,000 acres). Rate of impact to Karst Zone reflects the approximately 5%/year anticipated population growth in the Karst Zone (see Table 4-2); 121 acres increasing by 5% annually = 8,039 acres over 30 years.

[2] Impact Zone A cave: 7.8 acres of impact @ $10,000/acre = $78,000/cave mitigation fee for three caves if Impact Zone A is fully developed, or 4.68 acres @ $10,000/acre = $46,800/cave for five caves if Impact Zone iA s partially developed.

[3] Impact Zone B cave: $400,000/cave. It is estimated that one cave per year will incur impacts to Impact Zone B..

[4] It is assumed that 10% of woodland will be developed through participation in the RHCP; assumed that 80 Hickory Pass credits would be sold in Year 1. Rate of credits sold reflects the approximately 5%/year anticipated population growth in the Karst Zone (see Table 4-2); 80 acres increasing by 5% annually = 1,000 credits sold in Years 10. 100% of net revenue will be transferred to the general operating fund.

[5] 80 credits beginning in Year 2 with 5% increase per year through Year 11 for total 1,000 credits sold.

[6] County Investment of $3.0 million for Karst land acquisition in Year 1 from land acquisition funds; $3.25 million investment advance funding for 500 GCW Hickory Pass credits in Year 1; $3.0 million investment advance funding for 500 GCW Hickory Pass credits in Year 4.

[7] It is assumed 10% participation starting in Year 1 with 121 acres in Karst Zone and 8 acres per year of GCW habitat outside Karst Zone starting in Year 2 (for ten years) @ 4 units per acre (starting value $150,000 per unit); added value taxed at current County tax rate (0.00466157) with 15% of added value tax revenue dedicated to Plan.

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Table 9-2. RHCP Anticipated Income Years 1 – 30

TAX BENEFIT FINANCE FUNDING[7]

			Year	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6	Annual Increase 2.5%	Tax Revenue on Added Improvements at 10% Participation	Per Year	$9,251,655	$10,270,637	$11,367,316	$12,547,616	$13,817,915	$15,185,074	$16,656,478	$18,240,078	$19,944,426	$21,778,731	$23,752,903	$25,877,604	$28,164,314	$30,625,386	$33,274,114	$36,124,808
			Cumulative	$62,306,151	$72,576,788	$83,944,103	$96,491,720	$110,309,635	$125,494,708	$142,151,186	$160,391,264	$180,335,690	$202,114,422	$225,867,324	$251,744,928	$279,909,242	$310,534,628	$343,808,743	$379,933,551
		15% Tax Revenue Dedicated to Plan	Per Year	$1,387,748	$1,540,596	$1,705,097	$1,882,142	$2,072,687	$2,277,761	$2,498,472	$2,736,012	$2,991,664	$3,266,810	$3,562,935	$3,881,641	$4,224,647	$4,593,808	$4,991,117	$5,418,721
			Cumulative	$9,345,923	$10,886,518	$12,591,616	$14,473,758	$16,546,445	$18,824,206	$21,322,678	$24,058,690	$27,050,354	$30,317,163	$33,880,099	$37,761,739	$41,986,386	$46,580,194	$51,571,311	$56,990,033

														TOTALS
Year	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Grand Total Per Year	$2,185,626	$2,421,431	$2,589,330	$2,769,882	$2,964,021	$3,172,781	$3,495,931	$3,727,569	$3,987,437	$4,266,922	$4,567,516	$4,989,645	$5,337,698	$5,712,071	$6,114,765	$6,547,936	
Grand Total Cumulative	$38,822,002	$41,243,433	$43,832,764	$46,602,645	$49,566,666	$52,739,448	$56,225,378	$59,952,947	$63,940,384	$68,207,307	$72,774,823	$77,764,468	$83,102,166	$88,814,237	$94,929,003	$101,476,939	
Per-year Balance	$110,488	$69,619	$627,277	$1,688,534	$1,863,296	$1,052,194	$1,389,985	$1,655,756	$1,939,235	$2,241,797	$2,564,919	$3,759,014	$4,344,708	$4,694,881	$5,072,770	-$14,519,484	
Cumulative Balance	$2,199,767	$2,269,386	$2,896,663	$4,585,197	$6,448,493	$7,500,688	$8,890,673	$10,546,429	$12,485,665	$14,727,462	$17,292,381	$21,051,394	$25,396,102	$30,090,983	$35,163,753	$20,644,270	

Footnotes:

[1] A total of approximately 8,000 acres of development in the Karst Zone anticipated over 30 years (80,000 acres undeveloped Karst Zone @ 10% participation rate = 8,000 acres). Rate of impact to Karst Zone reflects the approximately 5%/year anticipated population growth in the Karst Zone (see Table 4-2); 121 acres increasing by 5% annually = 8..039 acres over 30 years.

[2] Impact Zone A cave: 7.8 acres of impact @ $10,000/acre = $78,000/cave mitigation fee for three caves if Impact Zone A is fully developed, or 4.68 acres @ $10,000/acre = $46,800/cave for five caves if Impact Zone iA s partially developed.

[3] Impact Zone B cave: $400,000/cave. It is estimated that one cave per year will incur impacts to Impact Zone B..

[4] It is assumed that 10% of woodland will be developed through participation in the RHCP; assumed that 80 Hickory Pass credits would be sold in Year 1. Rate of credits sold reflects the approximately 5%/year anticipated population growth in the Karst Zone (see Table 4-2); 80 acres increasing by 5% annually = 1,000 credits sold in Years 1-10

100% of net revenue will be transferred to the general operating fund.

[5] 80 credits beginning in Year 2 with 5% increase per year through Year 11 for total 1,000 credits sold.

[6] County Investment of $3.0 million for Karst land acquisition in Year 1 from land acquisition funds; $3.25 million investment advance funding for 500 GCW Hickory Pass credits in Year 1; $3.0 million investment advance funding for 500 GCW Hickory Pass credits in Year 4.

[7] It is assumed 10% participation starting in Year 1 with 121 acres in Karst Zone and 8 acres per year of GCW habitat outside Karst Zone starting in Year 2 (for ten years) @ 4 units per acre (starting value $150,000 per unit); added value taxed at current County tax rate (0.00466157) with 15% of added value tax revenue dedicated to Plan.

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9.4.3 Land Acquisition Funds and County Advance Funding to RHCP from Road Improvement Mitigation Funds

In Year 1 of the plan, County land acquisition funds for parks and open space $3,000,000 will be used to acquire karst preserves.[100] Also in Year 1, $3,250,000 will be advanced by the County to the RHCP. An additional $3,000,000 will be advanced by the County to the RHCP in Year 4. These advances will be made from road improvement mitigation funds, and will be repaid by the RHCP to the County at an interest rate of 4.5 percent. Full repayment is anticipated by Year 26 of the plan.

9.4.4 Tax Benefit Financing

The RHCP proposes to accrue funds through a Tax Benefit Financing (TBF) in the portion of the County within which impacts to listed species occur. Under the TBF mechanism, the value of improvements to a property enrolled in the TBF plan serves as a baseline for identifying and calculating increased property values that result from development activities. Businesses or developers with property enrolled as part of the TBF program continue to pay property taxes on the market value of their property, but the tax revenues (or a portion thereof) derived from improvements made since the property was enrolled in the TBF are deposited into a special account called a TBF fund rather than into a general fund. Revenues from the TBF fund are then used to pay for RHCP and other costs. Should the assumed participation rate of 10 percent be exceeded, and the TBF fund surpass the level needed to fully support implementation of the plan as described in this document, then the excess funds would revert to the County's general fund.

For the RHCP, it is envisioned that participating projects would automatically be enrolled in a TBF program at the time participation is elected. Fifteen percent of the County tax revenues deriving from the increased improvement values within the TBF boundaries would be dedicated as a funding source for the RHCP. It is estimated that a substantial percentage of the Karst Zone will fall within corporate municipal limits within a short time; therefore, fiscal impacts to the County's ability to fund services within the Karst Zone are anticipated to be minimal.

The County recognizes that the TBF income assumptions made in this plan do not account for non-taxable participants such as school districts, but for the purposes of financial projections, any reduction in income due to tax exemptions is off-set by the fiscal conservatism in other assumptions, primarily the low projected participation rate. In general, it is assumed that governmental entities are more likely than private entities to seek a compliance option like the RHCP; however, it is reasonable and conservative to assume that private participation equal to 10 percent of total future development will occur.

Assuming a 15 percent tax revenue diversion to the RHCP, in Year 1 $50,764 will be available from the TBF plan, and at Years 10 and 20 this amount will be $764,729 and $2,277,761,

[100] County land acquisition funds will constitute a credit to be billed against in lieu of participation fees for specific County projects. Until such time as the $3,000,000 credit balance is exhausted for the purchase of karst preserves, the County will not be required to pay participation fees for County projects. The County will have either a similar credit arrangement against the $6,200,000 advanced road mitigation fund principal or have priority use of available Hickory Pass Conservation Bank credits.

respectively. The cumulative 30-year benefit to the RHCP under the TBF plan will be $56,990,033.

9.4.5 Summary of Estimated Income

A review of Table 9-2 shows that total RHCP annual income in Year 1 is anticipated to be $6,946,864, and the 10-, 20-, and 30-year annual income is approximately $2,782,938, $3,172,781, and $6,547,936, respectively. The total cumulative income for the 30-year period is an estimated $101,476,939.

9.5 SUMMARY OF COSTS AND INCOME

Estimated annual costs and income for Years 10, 20, and 30, and the estimated cumulative costs over the 30-year life of the plan are shown in Table 9-3. The RHCP costs $80,832,669 are projected to be lower over the 30-Year period than the projected income $101,476,939. Initial estimates of participation fees and other funding sources indicate a surplus of approximately $20,644,270.

Table 9-3. RHCP annual income and expenses for Years 1, 10, 20, and 30, and cumulative income and expenses over 30-year life of the plan.

	Costs	Income
Annual Year 1	$6,639,250	$6,946,864
Annual Year 10	$2,736,378	$2,782,938
Annual Year 20	$2,120,587	$3,172,781
Annual Year 30	$21,067,420[1]	$6,547,936
30-Year Cumulative	**$80,832,669**	**$101,476,939**

[1] Includes a $20,025,000 contribution to the endowment in Year 30.

CHAPTER 10 – NO SURPRISES ASSURANCES

10.1 INTRODUCTION

An important incentive to encourage participation in the RHCP is the assurance provided by the Service's regulation known as the "No Surprises" rule (63 FR 8859, codified at 50 CFR §§ 17.22, 17.32, 222.2). Under No Surprises, the Service provides participants in an approved HCP that is being properly implemented the assurance that the Service will not impose additional mitigation requirements in the event that unforeseen circumstances occur over time that negatively impact the species. Unforeseen circumstances means changes in circumstances affecting a species or geographic area covered by an HCP that could not reasonably have been 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.

On the other hand, the No Surprises rule recognizes that plan developers and the Service can reasonably anticipate and plan for some changes in circumstances affecting a species or geographic area covered by an HCP (e.g., the listing of new species or a natural catastrophic event in areas prone to such events). To the extent such changed circumstances are provided for in the HCP's operating conservation program, the permittee must implement the appropriate measures in response to the changed circumstances.

This chapter specifies the changed circumstances anticipated by and provided for in the RHCP and explains the assurances provided to the permittee with respect to unforeseen circumstances.

10.2 CHANGED CIRCUMSTANCES PROVIDED FOR IN THE PLAN

It is recognized by the Service and the County that many changes in human conditions and attitudes, development pressures, environmental conditions, and scientific understanding of ecological systems, among many other circumstances, could and will occur over a 30-year permit period. To address this situation, a long-term incidental take permit should contain a procedure by which the parties will deal with changes in circumstances affecting a species or geographic area covered by the Permit that can reasonably be anticipated by the HCP developers and the Service.

The changed circumstances that can reasonably be anticipated by the Service and the County and that can be planned for are: 1) levels of funding anticipated to cover RHCP costs thought to be sufficient today become inadequate to meet future needs; 2) property values of preserve land needed to meet RHCP goals increase more than predicted; 3) an additional species becomes listed; 4) one or more of the listed and protected species is taxonomically split into two or more species; 5) the size of the KFAs are determined through monitoring and research to be inadequate to provide long-term protection; 6) the Hickory Pass Ranch Conservation Bank and other mitigation banks run out of credits; 7) mitigation bank costs increase; 8) sufficient suitable preserve sites are not available; 9) public use of KFAs and or/other RHCP preserves is determined to impact species; and 10) global climate change. The procedures this RHCP has

established to provide for these anticipated changed circumstances begins with implementation of an adaptive management process that allows a flexible and adaptive plan, and the detailed monitoring of preserves that will be effected throughout the life of the plan. This flexibility is reflected in the responses to changed circumstances as presented below:

1. *Levels of funding anticipated to cover RHCP costs thought to be sufficient today become inadequate to meet future needs*

   Chapter 9, Tables 9-1 and 9-2, provide the estimated expense and income related to RHCP management. The summary of these costs demonstrate that estimated income exceeds costs in every year of the plan and that cumulative income ultimately exceeds expenses by over $21,000,000. The income has been calculated to err conservatively by pricing mitigation for take high to overestimate income as a contingency for RHCP costs to exceed today's expectations.

   As the RHCP is implemented, the annual adaptive management review will thoroughly analyze the previous year's costs, as well as cumulative costs, and adjust expenses to meet income expectations, including increasing or decreasing participation fees and seeking alternative funding mechanisms.

2. *Property values of preserve land needed to meet RHCP goals increase more than predicted*

   To control for the inflation of property values, the RHCP anticipates purchasing and acquiring over 40 percent of the land needed for karst mitigation required for the 30-year plan within the first five years of the plan. The mitigation credits for impacts to the golden-cheeked warbler will be purchased or optioned within the first four years of the plan.

3. *An additional species becomes listed*

   In the event that one or more of the additional species addressed in this RHCP is listed pursuant to the Endangered Species Act, the Foundation will evaluate the degree to which the RHCP, as it is being implemented, is providing conservation benefits to the species and what additional measures, if any, the Foundation could implement through the RHCP to provide conservation benefits for the species. Depending on this evaluation, the County will decide whether to seek coverage of the species under an amendment to the RHCP. If it is determined that coverage would benefit both Williamson County and the species in question, the County may apply for any appropriate amendments to the RHCP, the Permit, and the Biological Opinion.

4. *One or more of the listed and protected species is taxonomically split into two or more species*

   This situation may already exist. Mold beetle experts have proposed taxonomically splitting the endangered *Batrisodes texanus* (Coffin Cave mold beetle) into two species:

B. texanus (renamed Inner Space Caverns mold beetle) and *B. cryptotexanus* (Dragonfly Cave mold beetle) (Chandler and Reddell 2001). At the time of the writing of the RHCP the Service does not recognize the taxonomic split because 1) it was based on a very small number of specimens, and 2) insufficient taxonomic data exist to validate the apparent difference upon which the split was proposed.

Chandler and Reddell (2001) described the new species of *Batrisodes*, the Dragonfly Cave mold beetle, based on a single specimen that was previously thought to be *B. texanus*. This new mold beetle is described as 0.11 to 0.12 inches in length, with eyes completely lacking (Chandler and Reddell 2001). The distinction between these two sibling species has not entirely been resolved because only a small number of specimens are known from a small number of geographically discordant caves (fewer than 30 specimens from only 20 of more than 590 caves known in Williamson County). Once a larger sample set is available for analysis, what currently appears to be significant morphological variation between distinct but closely related sibling species may turn out to be a morphological gradient within a single species. Future research may determine that both taxa should be considered part of a single species complex or that even further taxonomic splitting is appropriate (D.S. Chandler, University of New Hampshire, e-mail to SWCA, 2006). Collections of Dragonfly Cave mold beetle have primarily been made from the underside of rocks, with silt or clay underlying them in total darkness. The species is considered troglobitic (Chandler and Reddell 2001) and is thought to occur in 15 caves (current *B. texanus* locations). It has been collected primarily north of the North Branch of the San Gabriel River in the North Williamson County KFR, although recent surveys have also documented it in the McNeil/Round Rock KFR (Chandler and Reddell 2001, D.S. Chandler, University of New Hampshire, e-mail to SWCA, 2006). The species is predatory like the Coffin Cave mold beetle.

Once additional data become available and the Service then concurs with the taxonomic split as proposed, a possible listing of *B. cryptotexanus* as endangered may occur. Alternatively, it is possible that the RHCP will have already established a sufficient number of KFAs in each of the KFRs where the new taxon occurs, thus precluding the need to list. While the RHCP objectives are to establish at least three KFAs in each of the KFRs where each listed species occurs, it is possible that listing would not be justified if three KFAs in each KFR (recovery plan goals) were protected for the new species. Therefore the RHCP will make a commitment, should additional research indicate that *B. texanus* should be split into one or more species, to establish three KFAs in each KFR within which the new species occur.

A similar taxonomic split of the other covered karst species (*Texella reyesi*) has not been suggested, nor is it likely to occur.

5. *The size of the KFAs are determined through monitoring and research to be inadequate to provide long term protection*

   As presented in Chapter 4, the adequacy of preserve size for karst invertebrates remains under scientific study. The RHCP has set a goal of 40 acres for the establishment of new KFAs and will only assume management of those existing preserves that are 25 acres or more in size. Given that the difficulties in actually establishing levels of take are so problematic, it is not likely that the scientific establishment will demonstrate in the next 30 years that 40 acres of surface habitat is insufficient to meet long-term karst preserve needs. If, however, it is scientifically established that the sizes of the KFAs are inadequate to provide long term protection, RHCP resources will be reallocated *as available* to increase the size of the KFAs.

6. *The Hickory Pass Ranch Conservation Bank and other mitigation banks run out of credits*

   After the Hickory Pass Ranch Conservation Bank and other currently available credits are fully used (estimated at approximately 11–12 years), additional take of golden-cheeked warbler will not be authorized under the RHCP until additional mitigation credits are available either inside or outside of the County. If and when there is demand for more take, the Foundation will explore additional mitigation options.

7. *Mitigation bank costs increase*

   Should mitigation costs be increased, participation costs will be increased to meet those increased costs, or further take will not be authorized.

8. *Sufficient suitable preserve sites are not available*

   As presented in Chapter 3, Figure 3-2, almost two dozen existing karst conservation areas have already been established in Williamson County. Some of these conservation areas can be expanded with RHCP mitigation funds to meet RHCP standards (sufficient aboveground habitat available, listed species present, sufficient subsurface habitat available, etc., see Chapter 4) for suitable preserves. Given that approximately 80,000 acres of undeveloped land currently exists within the karst Zone of Williamson County and that many suitable acres of karst habitat are currently available, finding suitable preserve areas is only a matter of time and money, both of which the RHCP has committed to meeting RHCP goals. However, in the event sufficient suitable preserve sites are not available, take will not be authorized beyond that covered by existing mitigation.

9. *Public use of KFAs and other RHCP preserves is determined to impact species*

   Only a limited amount of public use is anticipated within the boundaries of the KFAs and other preserves established under the RHCP, and only then under highly managed

circumstances. Should this use prove to be inimical to the covered species it will be more strictly limited or discontinued.

10. *Global climate change significantly and negatively alters status of the covered species*

Global climate change has potential to alter current regional distribution of biotic communities in the RHCP area through regional changes in average temperature, levels and frequency of precipitation, groundwater regimes, karst conditions, and fire regimes. It is possible, therefore, that climate change will cause areas containing habitat currently suitable for the covered species to increase or decrease in value to the continued survival of the species. It is also possible that climate change would cause areas containing habitat not currently suitable for the covered species, including areas not currently within the ranges of the species, to increase or decrease in value to the continued survival of the species and that the species would adapt to use such habitat. In any scenario, however, because all of the covered species currently have either relatively or significantly limited ranges within the United States, any changes in climate affecting the RHCP region are likely to result in near uniform effects across the current ranges of these species.

There is at present insufficient knowledge upon which to base a projection of the potential for the KFAs and other habitat preserves established or managed under this RHCP to increase or decrease in value to the relevant species over the next 30 years as a result of climate change. Nor is there sufficient knowledge at present upon which to design alternative or additional mitigation measures within the RHCP that would compensate for any adverse effects of climate change on such KFAs and other habitat preserves. It is expected, however, that any changes will be the same as changes experienced in other areas containing habitat that is currently similar in attributes.

Accordingly, if global climate change causes any KFAs or other habitat preserves directly established or managed by the permittee under this RHCP to increase or decrease significantly in relative value with regard to continued survival of one or more of the covered species, the permittee or its assigns will consult with the Service to determine whether any changes in operation and management of those preserves are warranted. Any changes in operation and management prompted by global climate change would be performed under the established operation and management budget, and no acquisition or management of areas outside of the KFAs or other habitat preserves directly established or managed by the permittee under this RHCP will be provided for or required under this RHCP as a part of any response to climate change effects on such KFAs or preserves.

To the extent that knowledge about the effects of climate change on the covered species is gained over the course of the RHCP term through adaptive management implemented under Chapter 8 of this RHCP or through research endorsed by the Service, the permittee will seek advice from the Service about the implications of such knowledge and will take such knowledge into account in any subsequent identification, establishment, and management of new KFAs and other habitat preserves intended thereafter to serve as mitigation in satisfaction of this RHCP.

To the extent any mitigation required for impacts to covered species is satisfied through purchase or transfer of mitigation credits from a Service-approved third-party conservation bank not owned or operated by the permittee, or is implemented with Service approval through a conservation entity not owned or operated by the permittee, it shall be the sole responsibility of that third-party conservation bank or conservation entity to respond to effects of climate change, and any failure adequately to do so will in no way diminish or rescind the mitigation credits or benefits assigned to the permittee under this RHCP at the time of the purchase, transfer, or acknowledgement of such credits or benefits. The permittee will cooperate with the Service and the conservation bank or conservation entity by sharing information the permittee has obtained through its adaptive management program provided for in Chapter 8 of this RHCP, and will encourage the conservation bank or conservation entity to seek advice from the Service about how to implement such knowledge.

10.3 CHANGED CIRCUMSTANCES NOT PROVIDED FOR IN THE PLAN

If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances and such measures were not provided for in the RHCP operating conservation program as specified in Section 10.1, the Service will not require any conservation and mitigation measures in addition to those provided for in the RHCP without the consent of the County, provided the RHCP is being properly implemented.

10.4 UNFORESEEN CIRCUMSTANCES

Unforeseen circumstances are changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the Service at the time of the conservation plan's negotiation and development, and that result in a substantial and adverse change in the status of the covered species. Under the No Surprises rule, with respect to a properly implemented HCP the permittee will not be required to commit additional land, water, money, or financial compensation, or additional restrictions on land, water, or other natural resources to respond to such unforeseen circumstances beyond the level otherwise agreed upon for the species covered by the HCP without the consent of the permittee. Changes in circumstances not provided for in Section 10.1 are considered unforeseen circumstances for purposes of this RHCP.

No Surprises assurances apply to the species (listed and future listed) that are "adequately covered" under this RHCP. Species are considered to be "adequately covered" if the RHCP satisfied the permit issuance criteria contained in Endangered Species Act section 10(a)(2)(B) with respect to that species. The species considered adequately covered under this RHCP are termed "covered species" and described in Chapter 3.

The covered species listed in this RHCP are adequately addressed by the RHCP and are, therefore, covered by the Service's No Surprises policy assurances. In the event that unforeseen circumstances occur during the term of the Permit and the Service concludes that the species are being harmed as a result, the Service may require additional measures of the County where the operating conservation plan is being properly implemented only if such measures are limited to

modifications within conserved habitat areas, if any, or to the conservation plan's operating conservation program for the affected species, and maintain the original terms of the RHCP to the maximum extent possible. Additional conservation and mitigation measures will not involve the commitment additional land, water, money, or financial compensation, or additional restrictions on land, water, or other natural resources otherwise available for development or use under the original terms of the RHCP without the consent of the County.

The Service will have the burden of demonstrating that unforeseen circumstances exist, using the best scientific and commercial data available. The Service shall notify the County in writing of any unforeseen circumstances the Service believes to exist.

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CHAPTER 11 – COMPLIANCE WITH SECTION 10(a)(1)(B) PERMIT ISSUANCE CRITERIA

11.1 INTRODUCTION

This RHCP includes all measures the Service considers necessary "for purposes of the plan." The RHCP details the process and timeline by which this plan will be implemented and how Williamson County will exercise its existing authorities to control implementation of the plan through its RHCP managing agent, the Williamson County Conservation Foundation. Williamson County will continue to exercise its duly constituted planning and permitting powers and through these responsibilities ensure full compliance with the terms of the RHCP.

Statutory issuance criteria for section 10(a)(1)(B) of the Endangered Species Act require that the permittee, in this case, Williamson County, demonstrate that take of listed species be clearly incidental; that all impacts are avoided, minimized, and mitigated to the maximum extent practicable; that the take will not appreciably reduce the survival and recovery of the species; and that adequate funding sources are available and committed to long-term implementation of the plan (USFWS and NMFS 1996). The following section provides a summary of how the RHCP meets those issuance criteria.

11.2 INCIDENTAL NATURE OF THE TAKING

All taking of federally listed and candidate species detailed in this RHCP will be incidental to otherwise lawful activities, and with the exception of limited scientific collecting,[101] not the purpose of such activities. For example, take associated with residential developments, commercial developments, roadway construction and improvements, utilities and other infrastructure projects, and other land use activities generally is incidental and could be authorized by the Permit.

11.3 AVOIDANCE, MINIMIZATION, AND MITIGATION OF IMPACTS

As detailed in Chapters 5 and 6, Williamson County will, to the maximum extent practicable, minimize and mitigate the impacts of taking the listed species.

11.3.1 Avoidance and Minimization of Impacts

The primary goal of the RHCP is to promote the long-term conservation and recovery of the covered species, and to this extent the actual take of listed species will be minimized. One of the

[101] Limited scientific collecting and preservation of karst invertebrates, both listed and non-listed species, will occur as a regular feature of the monitoring of preserves (KFAs) as well as during presence/absence surveys where features with troglobite habitat occur (see Appendices B and D). This scientific collecting will be done by biologists holding a section 10(a)(1)(A) scientific collecting permit issued by the Service and the sole purpose of the collecting will be done to verify presence of the species in a location, as well as contribute specimens for DNA and other taxonomic analysis for positive identification. This collecting is necessary (and incidental) for identifying suitable KFAs and for establishing levels of take for land disturbance activities.

guiding principles of the RHCP and the Foundation administrators will be to provide assistance to landowners to first identify, then avoid listed species habitat. Chapter 6 details the participation procedures for landowners and describes the methods by which the Foundation biologists will work with the participants to first assess their land for potential habitat and/or species prior to establishing a development plan, then avoid species and habitat to the maximum extent practicable as development plans are prepared. The availability of Foundation biologists to plan participants is expected to substantially reduce impacts to species and their habitats, because development feasibility studies rarely include beforehand knowledge of endangered species habitat.

The RHCP also includes provisions for minimizing disturbance to the golden-cheeked warbler and the black-capped vireo during their nesting seasons by means of temporal and spatial restrictions on clearing activities undertaken by plan participants.

11.3.2 Mitigation of Impacts to Listed Species

The mitigation measures described in Chapter 5 of this RHCP are demonstrably adequate to offset the impacts of the activities covered by the requested incidental take permit. They are also beneficial to the covered species. For the Bone Cave harvestman and Coffin Cave mold beetle, the mitigation program is designed to ensure that Recovery Plan recovery (downlisting) criteria in Williamson County are reached as quickly as possible. The recovery (downlisting) criteria include the following:

- Three KFAs within each KFR in each species' range should be protected in perpetuity.
- If fewer than three KFAs exist for a species, that species would still be considered for downlisting if it occurred in two KFAs and those were adequately protected.

To meet these criteria, the RHCP will contribute to and facilitate the establishment of a minimum of three KFAs for each species in the North Williamson County KFR, Georgetown KFR, and McNeil/Round Rock KFR. To exceed these goals, the Foundation will also apply for Endangered Species Act section 6 funds and other state and Federal grants to establish six additional KFAs, two in each KFR. The Foundation will provide the long-term management (*in perpetuity*) of the KFAs required for covered species recovery. Thus, provisions for the establishment and management of KFAs are specifically designed to ensure that recovery (downlisting) criteria for the karst covered species in Williamson County are reached as quickly as possible.

The golden-cheeked warbler will benefit from the purchase and preservation of breeding habitat, habitat monitoring and management on mitigation bank lands, and public awareness programs—all conservation elements consistent with the Golden-Cheeked Warbler Recovery Plan. The black-capped vireo will benefit from preservation of breeding habitat, habitat restoration and/or enhancement, and the public awareness program. The mitigation efforts that will occur with implementation of the plan include:

- Balance take of fragmented habitat in Williamson County with habitat in a Service-approved conservation bank on at least a 1:1, acre-for-acre basis to support recovery

efforts for the golden-cheeked warbler. The Foundation will also explore additional opportunities for establishing preserves for the warbler within Williamson County.

- Balance take of fragmented habitat in Williamson County by restoring and/or enhancing black-capped vireo habitat on at least a 1:1, acre-for-acre basis.

All covered species included in the RHCP will benefit from the research and public education efforts that will occur with implementation of the plan. Over the life of the plan more than $1.3 million will be invested by the RHCP in prioritized research designed to answer specific management questions, and education efforts (lectures, videos, brochures) intended to increase public awareness. The covered species will also benefit from the establishment of an endowment totaling $20,400,000 by the end of the Year-30 of the plan that will be used to manage, in perpetuity, preserves established under the proposed RHCP.

The mitigation measures summarized above are not only adequate to offset the impacts of the covered activities and beneficial to the covered species, they are the maximum that can practicably be implemented by Williamson County, the Permit applicant. As shown by Tables 9-1 and 9-2 in Chapter 9, the County is committing substantial financial resources to implement the proposed RHCP, primarily for the establishment and perpetual management of protected habitat for the covered species. This commitment of resources is the maximum amount economically and politically feasible for the County.

11.4 SURVIVAL AND RECOVERY OF THE SPECIES

The incidental take authorized by this Permit will not reduce the likelihood of survival and recovery of the covered species in the wild. Instead, the implementation of this RHCP will substantially benefit the covered species through directly meeting Recovery Plan objectives (especially for karst species), including preserve acquisition, preserve management, scientific research, and public awareness, or contributing to species conservation as detailed in the recovery plans for the two covered bird species. The recovery of the karst species is a primary goal of the RHCP and establishment and management and monitoring of 700 acres of new karst preserve areas within the first 17 years of RHCP implementation will benefit the species and speed recovery (see Chapter 5). The mitigation (purchase of up to 1,000 acres of Hickory Pass Ranch Conservation Bank mitigation credits or equivalent, plus in-county preserves as need and opportunity determine) for impacts to the golden-cheeked warbler will contribute to that species' recovery. For the black-capped vireo, the mitigation of habitat removed by restoring and/or enhancing additional habitat elsewhere will ensure a no net loss of vireo habitat. The loss of what is considered to be relatively low quality and generally fragmented habitat for the golden-cheeked warbler and black-capped vireo in Williamson County will not appreciably influence either species' potential for recovery (see Chapter 4).

11.5 ADEQUACY OF FUNDING

Williamson County will ensure that adequate funding for the RHCP and procedures to deal with changed and unforeseen circumstances are provided. The expected costs and income of the RHCP for the 30-year period of the Permit are presented in Chapter 9, Tables 9-1 and 9-2. A summary of the 1-, 10-, 20-, and 30-year annual costs and the cumulative costs are presented

in Table 9-3 and inserted here again (Table 11-1). The proposed funding sources are reliable, will meet the purposes of this RHCP, and include measures to deal with changed and unforeseen circumstances. Initial estimates of participation fees and other funding sources indicate a surplus of approximately $20,644,270 for the 30-year permit period.

Table 11-1. RHCP annual expenses and income for Years 1, 10, 20, and 30, and cumulative income and expenses over 30-year life of the plan.

	Expenses	Income
Annual Year 1	$6,639,250	$6,946,864
Annual Year 10	$2,736,378	$2,782,938
Annual Year 20	$2,120,587	$3,172,781
Annual Year 30	$21,067,420[1]	$6,547,936
30-Year Cumulative	**$80,832,669**	**$101,476,939**

[1] Includes a $20,025,000 contribution to the endowment in Year 30.

11.6 COMPLIANCE WITH TEXAS STATE LAW

The Williamson County RHCP complies with all Texas state laws relevant to RHCPs (see Chapter 1). Summaries of the relevant law from Chapter 1 are restated here.

Texas state law includes requirements for a local government's role in developing, adopting, approving, or participating in a regional HCP (Senate Bill 1272, codified as Subchapter B, Chapter 83 of the Texas Parks and Wildlife Code). Procedural requirements placed on the governmental entity by this law include the following: Chapter 83 requires the governmental entity participating in an RHCP to establish a citizens advisory committee, appoint a biological advisory team, comply with open records/open meetings laws, comply with public hearing requirements, provide a grievance process to citizens advisory committee members, and acquire preserves by specific deadlines.

The Williamson County RHCP has complied with all Chapter 83 procedural requirements. A citizen's advisory committee with 18 members was established on March 15, 2005; a biological advisory team with 8 members was established on June 15, 2005, and both groups have met several times, contributing to the development of the RHCP and reviewing two major drafts, one in February and another in August of 2006. All meetings of the citizen's advisory committee and biological advisory team have complied with open/records open meeting laws. Citizen grievances have been heard and responded to, and a biological peer review process through Texas A&M University has been established. No preserves have been established at this time through the RHCP, but a schedule for acquisitions has been proposed.

Under Chapter 83, governmental entities participating in an RHCP are prohibited from taking any of the actions cited below. The Williamson County RHCP has not violated and will not violate any of these prohibitions.

- Imposing any sort of regulation related to endangered species (other than regulations involving groundwater withdrawal) unless that regulation is necessary to implement an

RHCP for which the governmental entity was issued a Federal permit (Texas Parks and Wildlife Code § 83.014(a)).

- Discriminating against a permit application, permit approval, or request for utility service to land that has been designated a habitat preserve for an RHCP (Texas Parks and Wildlife Code § 83.014(b)).
- Limiting water or wastewater service to land that has been designated as habitat preserve (Texas Parks and Wildlife Code § 83.014(c)).
- Requiring a landowner to pay a mitigation fee or set aside, lease, or convey land as habitat preserve as a condition to the issuance of a permit, approval, or service (Texas Parks and Wildlife Code § 83.014(d)).

In addition to the above prohibitions, Chapter 83 stipulates that the mitigation included in an RHCP, including any participant participation fee and the size of the habitat preserve, must be based on the amount of harm to each endangered species the plan will protect. However, after notice and hearing, an RHCP may include such measures if they are based on the Service's recovery criteria for the species covered by the plan (Texas Parks and Wildlife Code § 83.105).

Chapter 83 also stipulates that governmental entities participating in an RHCP must demonstrate that adequate sources of funding exist to acquire the land for designated habitat preserves within four years, or the voters must have authorized bonds or other financing in an amount equal to the estimated cost of acquiring all of the land needed for habitat preserves within four years (Texas Parks and Wildlife Code § 83.018). The four-year deadline is calculated from the time that a particular parcel is designated as proposed habitat preserve, a provision that gives governmental entities flexibility to acquire preserves on a rolling basis as the plan is implemented.

No land has been designated in the RHCP as a proposed habitat preserve; therefore, the RHCP need not demonstrate that adequate sources of funding exist to acquire any specific parcel within any specific time frame.

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GLOSSARY AND ABBREVIATIONS

Aquifer: Rocks or sediments, such as cavernous limestone and unconsolidated sand, that store, conduct, and yield water in significant quantities for human use.

Balcones Canyonlands National Wildlife Refuge: Located in Travis and Burnet Counties north of Lake Travis. The primary purpose of the refuge is to conserve the nesting habitat of the endangered golden-cheeked warbler and black-capped vireo. The Balcones Canyonlands National Wildlife Refuge is planned to include 46,000 acres within an 80,000-acre "acquisition boundary." Current holdings total approximately 21,400 acres.

Balcones Canyonlands Conservation Plan (BCCP): The regional habitat conservation plan covering western Travis County. The Balcones Canyonlands Conservation Plan calls for the creation of a preserve system to protect eight endangered species as well as 27 other species believed to be at risk. The Balcones Canyonlands Conservation Plan was approved by the Service in 1996 and has a 30-year term. It allows for incidental take outside of proposed preserve lands, and provides mitigation for new public schools, roads and infrastructure projects of the participating agencies (Travis County, the City of Austin, and the Lower Colorado River Authority). Landowners and developers may elect to participate in the Balcones Canyonlands Conservation Plan to obtain Endangered Species Act take authorization rather than by seeking authorization directly from the Service.

BCCP: *See Balcones Canyonlands Conservation Plan*

Biological Advisory Team: Three or more professional biologists retained to provide guidance for the RHCP, especially with respect to the calculation of harm to the endangered species and the size and configuration of the habitat preserves. The Texas Parks and Wildlife Code § 83.015(c) requires a Biological Advisory Team for RHCPs and specifies that at least one member shall be appointed by the Texas Parks and Wildlife Commission and one by landowner members of the citizens advisory committee. The members of the Biological Advisory Team for this RHCP are experts on the species covered by the RHCP.

Biological Opinion: The Service document issued at the conclusion of formal consultation pursuant to section 7(a)(2) of the Endangered Species Act that generally includes: (1) the opinion of the Fish and Wildlife Service as to whether or not a Federal action is likely to jeopardize the continued existence of listed species, or result in the destruction or adverse modification of designated critical habitat; (2) a summary of the information on which the opinion is based; and (3) a detailed discussion of the effects of the action on listed species or designated critical habitat (50 CFR §§ 402.02, 402.14(h)).

Candidate species: Under U.S. Fish and Wildlife's Endangered Species Act regulations, "…those species for which the Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species. Proposal rules have not yet been issued because this action is precluded…" (see 61 FR 7598).

Carrying capacity: The maximum number of individuals of a species that a particular area of habitat is able to support.

Cave: A naturally occurring, humanly enterable cavity in the earth, at least 5 meters in length and/or depth, in which no dimension of the entrance exceeds the length of depth of the cavity (definition of the Texas Speleological Society).

Certificate of Inclusion: A document used with a programmatic or "umbrella" Safe Harbor Agreement, Candidate Conservation Agreement with Assurances, or Habitat Conservation Plan certifying that property enrolled by an individual landowner is included within the scope of a programmatic enhancement of survival permit that authorizes incidental take of a species.

CFR: *See Code of Federal Regulations*

Citizens Advisory Committee: Texas Parks and Wildlife Code § 83.016 requires that the plan participants appoint a citizens advisory committee to assist in preparing the RHCP and application for the Federal permit. The state law requires that at least 4 members, or 33 percent, of the Citizens Advisory Committee, whichever is greater, must own undeveloped land or land in agricultural use in the RHCP area. The law also specifies that a landowner member may not be an employee or elected official of a plan participant or any other governmental entity and that the Texas Parks and Wildlife Commission shall appoint one voting representative to the Citizens Advisory Committee.

Code of Federal Regulations (CFR): A compilation of the general and permanent rules of the executive departments and agencies of the Federal Government as published in the Federal Register. The code is divided into 50 titles that represent broad areas subject to Federal regulation.

Conservation plan: *See habitat conservation plan*

Consultation: A process that: (1) determines whether a proposed Federal action is likely to jeopardize the continued existence of a listed species or destroy or adversely modify designated critical habitat; (2) begins with a Federal agency's written request and submittal of a complete initiation packet; and (3) concludes with the issuance of a Biological Opinion and incidental take statement by the Service. If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required (except when the Service concurs, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat). In the context of an HCP, the consultation is an "intra-service" consultation within the pertinent Service departments (50 CFR §§ 402.02, 402.14).

Covered Species: The federally listed species to be included on and covered by a section 10(a)(1)(B) incidental take permit.

Delist: To remove a species from the Federal list of endangered and threatened species (50 CFR 17.11 and 17.12) because the species no longer meets any of the five listing factors provided

under section 4(a)(1) of the Endangered Species Act and under which the species was originally listed (i.e., because the species has become extinct or is recovered).

Development or land use area: Those portions of the conservation plan area that are proposed for development or land use or are anticipated to be developed or utilized.

Downlist: To reclassify an endangered species to a threatened species based on alleviation of any of the five listing factors provided under section 4(a)(1) of the Endangered Species Act (16 USC § 1533(a)(1)).

Endangered species: "any species [including subspecies or qualifying distinct population segment] which is in danger of extinction throughout all or a significant portion of its range" (section 3(6) of Endangered Species Act, 16 USC § 1532(6)).

Endangered Species Act of 1973, as amended: 16 USC §§ 1513–1543; Federal legislation that provides means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, and provides a program for the conservation of such endangered and threatened species.

Endemic: Being native and restricted to a particular geographic region.

Environmental Impact Statement: A detailed written statement required by section 102(2)(C) of the National Environmental Policy Act containing, among other things, an analyses of environmental impacts of a proposed action and alternatives considered, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR §§ 1508.11, 1502).

Fault: Fracture in bedrock along which one side has moved with respect to the other.

Federally listed: Included in the list of endangered or threatened species maintained by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service under section 4 of the Endangered Species Act of 1973, as amended, and therefore protected by the Act.

Foundation: The Williamson County Conservation Foundation, Inc. (formerly known as the Williamson County Karst Foundation) was formed in December 2002 for the purpose of providing for conservation and perhaps the eventual recovery of endangered and threatened species in Williamson County. The Foundation will be responsible for implementing the RHCP.

Habitat: The location where a particular taxon of plant or animal lives and its surroundings, both living and non-living; the term includes the presence of a group of particular environmental conditions surrounding an organism including air, water, soil, mineral elements, moisture, temperature, and topography.

Habitat conservation plan (HCP): Under section 10(a)(2)(A) of the Endangered Species Act, a planning document that is a mandatory component of an incidental take permit application, also known as a "section 10(a)" or "HCP."

Habitat conservation plan area: Lands and other areas encompassed by specific boundaries which are affected by the conservation plan and incidental take permit.

Harm: Defined in regulations promulgated by the Department of the Interior to implement the Endangered Species Act as an act "which actually kills or injures" listed wildlife. Harm may include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering" (50 CFR § 17.3 (2005)).

Harass: An intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, and sheltering (50 CFR § 17.3).

Impervious cover: Land cover that prevents rain from infiltrating into soil, including roofs and pavement.

Incidental take: Take of any federally listed wildlife species that is incidental to, but not the purpose of, otherwise lawful activities (see definition for "take") (Endangered Species Act section 10(a)(1)(B)).

Incidental take permit: A permit that exempts a permittee from the take prohibition of section 9 of the Endangered Species Act issued by the Service pursuant to section 10(a)(1)(B) of the Endangered Species Act. Also sometimes referred to as a "section 10(a)(1)(B)," "section 10 permit," or "ITP."

Interstitial spaces: Conduits of an aquifer and/or cave which are too small for human access; can be located both above and below the water table. Generally used to describe a type of habitat for cave-dwelling fauna. May include inferred conduits of probable humanly passable dimensions, but which are inaccessible for study.

Karst: A terrain characterized by landforms and subsurface features, such as sinkholes and caves, that are produced by solution of bedrock. Karst areas commonly have few surface streams; most water moves through cavities underground.

Karst feature: Generally, a geologic feature formed directly or indirectly by solution, including caves; often used to describe features that are not large enough to be considered caves, but have some probable relation to subsurface drainage or groundwater movement. These features typically include but are not limited to sinkholes, enlarged fractures, noncavernous springs and seeps, soil pipes, and solution cavities in the epikarst (the highly solutioned zone in karst areas between the land surface and the predominantly unweathered bedrock).

Karst fauna area (KFA): Defined in the Recovery Plan for Endangered Karst Invertebrates (Travis and Williamson Counties) as an area known to support one or more locations of a listed species and is distinct in that it acts as a system that is separated from other KFAs by geologic and hydrologic features and/or processes that create barriers to the movement of water, contaminants, and troglobitic fauna.

Karst fauna region (KFR): Defined in the Travis/Williamson Counties Recovery Plan as a region delineated based on geologic continuity, hydrology, and the distribution of 38 rare troglobitic species. The KFRs delineated in the Travis/Williamson Counties Recovery Plan were modified from those identified by Veni and Association (1992).

Karst Zone: Veni and Associates (1992) defined four karst zones in Williamson County based on lithology, geologic controls on cave development, and distributions of known caves and cave fauna. In 1992, Zones 3 and 4 were judged to have little or no potential to provide habitat for troglobitic invertebrates, and that remains the case today. Zone 1 was known to contain listed invertebrates, and Zone 2 was thought to have a high potential to do so. Since 1992, listed karst invertebrates have been collected from both Zones 1 and 2; therefore, theses two zones have been combined in this RHCP and are collectively referred to as the "Karst Zone."

KFA: *See karst fauna area*

KFR: *See karst fauna region*

Listed species: Species listed as either endangered or threatened under section 4 of the Endangered Species Act (16 USC § 1533).

Mitigation: Under National Environmental Quality Act regulations, to moderate, reduce or alleviate the impacts of a proposed activity, including: (1) avoiding the impact by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of the action; (3) rectifying the impact by repairing, rehabilitating or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or (5) compensating for the impact by replacing or providing substitute resources or environments (40 CFR § 1508.20). Under the Endangered Species Act, the applicant must demonstrate that the applicant will, to the maximum extent practicable, undertake to minimize and mitigate the impacts of take of species. According to the HCP Handbook, typical mitigation actions under HCP and incidental take permits include the following: (1) avoiding the impact (to the extent practicable); (2) minimizing the impact; (3) rectifying the impact; (4) reducing or eliminating the impact over time; or (5) compensating for the impact.

National Environmental Policy Act (NEPA): Federal legislation establishing national policy that environmental impacts will be evaluated as an integral part of any major Federal action. Requires the preparation of an Environmental Impact Statement for all major Federal actions significantly affecting the quality of the human environment (42 USC §§ 4321–4327).

Neotonic: The maintenance of larval characteristics such as gills into adulthood.

NEPA: *See National Environmental Policy Act*

NMFS: National Marine Fisheries Service

No Surprises rule: The regulation entitled "Habitat Conservation Plan Assurances 'No Surprises' Rule" that provides participants in an approved HCP the assurance that the Service will not impose additional mitigation requirements, even if environmental conditions change over time and negatively impact the species (63 FR 8859, codified at 50 CFR §§ 17.22, 17.32, 222.2).

Plan participant: Any non-Federal party desiring to undertake activities covered by the RHCP, who agrees to comply with the terms and conditions of the RHCP.

Proposed action: Under National Environmental Policy Act regulations, a plan that has a goal which contains sufficient details about the intended actions to be taken or that will result, to allow alternatives to be developed and its environmental impacts to be analyzed (40 CFR §1508.23).

Recharge: Natural or artificially-induced flow of surface water to an aquifer.

Recovery plan: Section 4(f) of the Endangered Species Act, 16 USC § 1533(f), requires that the Service develop and implement recovery plans for the conservation and survival of listed species, unless the Service finds that such a plan will not promote the conservation of the species. Recovery plans are required to include (1) a description of site-specific management actions necessary to achieve the plan's goal for conservation and survival of the species, (2) objective, measurable criteria which, when met, would result in the species' removal from the list, and (3) estimates of the time and cost required to achieve the recovery goals. The Service has developed recovery plans for the karst species, golden-cheeked warbler, and black-capped vireo (USFWS 1994, USFWS 1992, and USFWS 1991, respectively).

Regional habitat conservation plan (RHCP): An RHCP typically covers a large geographic area, numerous landowners, and multiple species. Local or regional authorities or entities are often the applicant and permittee, and may be relied upon to implement the mitigation plan under an RHCP (see HCP).

RHCP: *See regional habitat conservation plan*

Section 7: The section of the Endangered Species Act that describes the responsibilities of Federal agencies in conserving threatened and endangered species. Section 7(a)(1) requires all Federal agencies "in consultation with and with the assistance of the Secretary [to] utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species." Section 7(a)(2) requires Federal agencies to "ensure that any action authorized, funded, or carried out by such agency...is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of..." designated critical habitat.

Section 9: The section of the Endangered Species Act dealing with prohibited acts, including the take of any listed species without specific authorization of the Service.

Section 10: The section of the Endangered Species Act dealing with exceptions to the prohibitions of section 9 of the Endangered Species Act.

Section 10(a)(1)(A): That portion of section 10 of the Endangered Species Act that allows for permits for the taking of threatened or endangered species for scientific purposes or for purposes of enhancement of propagation or survival.

Section 10(a)(1)(B): That portion of section 10 of the Endangered Species Act that authorizes the Service to issue permits for the incidental take of threatened or endangered species.

Sinkhole: A natural depression in the ground's surface related to dissolutional processes, including features formed by concave dissolution of the bedrock, and/or by collapse or subsidence of bedrock or soil into underlying dissolutionally formed cavities.

Service: United States Fish and Wildlife Service.

SWCA: SWCA Environmental Consultants

Take: Under section 3(18) of the Endangered Species Act, "…to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" with respect to federally listed endangered species of wildlife. Federal regulations provide the same taking prohibitions for threatened wildlife species (50 CFR 17.31(a)).

Tax Benefit Financing (TBF): Method of public financing whereby the value of a property enrolled in the TBF plan is "frozen," and this value serves as a baseline for identifying and calculating increased property values that result from development activities. Property owners enrolled as part of the TBF program continue to pay property taxes on the market value of their property, but the tax revenues (or a portion thereof) derived from improvements made since the property was enrolled in the TBF are deposited into a special account called a TBF fund rather than into a general fund.

TBF: *See Tax Benefit Financing*

TCEQ: Texas Commission on Environmental Quality

Threatened species: "Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (Endangered Species Act § 3 (20), 16 USC § 1532(20)].

Troglobite: Obligate subterranean species that are unable to survive on the surface; only found in caves and associated karst.

USC: United States Code

USFWS: United States Fish and Wildlife Service

Void: A space within karstic rock formations that may or may not have a surface opening.

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APPENDIX A

Summary of Provisions Contained in Other Regional Habitat Conservation Plans

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APPENDIX A

Summary of Provisions Contained in Other Regional Habitat Conservation Plans

	Plan Participation	How Level of Take Determined	Participation Fee Structure	Form of Mitigation	Financing Mechanism
Metro Bakersfield HCP - 1994 **Covers Four Species**	Not voluntary. All developers with projects proposing urban development in the HCP area pay mitigation fee.	Based on acreage of habitat lost through development in plan area. "Windshield" surveys were performed to determine habitat quality and type on all parcels of undeveloped lands of greater than 10 acres.	$1,250/acre mitigation fee on all new building on previously undeveloped land payable to either city or county at time of grading permit approval, grading plan approval, or issuance of building permit, whichever is first. Fee rate based on the per-acre average land acquisition cost, plus cost of improvements, management, and administrative cost.	Preserve acquisition to take place in pre-approved general acquisition areas. In addition, some specific sites are identified in the HCP for preserve acquisition. Developer mitigation fees.	Developer mitigation fees. State and Federal conservation funds sought to augment local funds for preserve acquisition.
Coachella Valley HCP - 1986 **Covers Coachella Valley Fringe-toed Lizard**	Not voluntary for land developed within a mitigation fee zone, the boundaries of which were drawn to roughly correspond to the lizard's historic range.	Unknown.	$600/acre development mitigation fee paid within mitigation fee zone roughly corresponding to lizard's historic range. Exemption for conversion of land to agricultural use, or existing farmland converted to development.	Fee-simple acquisition of three lizard habitat preserves (16,729 acres) identified in HCP managed by The Nature Conservancy guided by management agreement. Certain additional public land managed so as to protect lizard habitat. Habitat restoration and management and a research program. Developer mitigation fees.	Developer mitigation fees $18.2 million from The Nature Conservancy to purchase 12,087 acres for preserves. Approximately $10 million in LWCF funding for purchase of preserves. $6 million in BLM land exchanges. State Wildlife Conservation Board.

	Plan Participation	How Level of Take Determined	Participation Fee Structure	Form of Mitigation	Financing Mechanism
Coachella Valley Multi-Species HCP - 2006 **Covers 27 Species, Including 10 Federally Listed Species**	Not voluntary. Fee collected for grading permit on all new development within the plan area that impacts vacant land containing habitat.	Based on acres affected by covered activities both outside and in 21 designated "conservation areas." Acres of take/habitat loss were determined by overlaying habitat maps with the plan area map, and calculating the habitat areas outside the designated conservation areas. In addition, a small amount of take can occur within conservation areas.	$1,975/acre mitigation fee on new development within the plan area that impacts vacant land containing habitat. Fee derived by separate mitigation fee "nexus" study not specifically described in the HCP.	Establishment, monitoring, and management of a predetermined approximately 726,000-acre habitat reserve system. 21 "Conservation Areas" are designated. Habitat reserve system is evolving and consists of 538,00 acres of existing conservation lands, complementary conservation lands (unrelated to permit, but complementary), and additional conservation land (to be acquired or otherwise conserved). Habitat reserve system is operated to achieve certain conservation objectives using pre-determined measures to be implemented to achieve conservation goals. Conservation measures include breeding season construction restrictions, and land use restrictions such as pesticide, lighting, and noise restrictions as well as prohibition of non-native invasive plants for land adjacent to conservation areas. Developer mitigation fees.	Developer mitigation fees. $1/ton fee on importation of waste into county landfills. ½ cent sales tax to be used to mitigate for transportation projects. Regional infrastructure mitigation payments by Caltrans and others. Separate agreement providing for dedicating $1/ton of waste at a specific landfill to be used for environmental mitigation. State and Federal grants, and state bonds.

	Plan Participation	How Level of Take Determined	Participation Fee Structure	Form of Mitigation	Financing Mechanism
SW San Diego County Multi-Species Conservation Plan, City of San Diego Sub-area Plan – 1997 **Covers 85 Species, Including 20 Federally Listed Species**	All development within the plan area must comply with the requirements.	Unknown.	Mitigation based on habitat type in project area. Habitat types are classified into tiers, each requiring different mitigation levels. For development outside the 172,000-acre Multi-Habitat Planning Area (MHPA) preserve, the mitigation requirement is determined through a complex analysis of the biological value on the site through field surveys of the site and the location and value of land offered as mitigation (or fee in lieu of land). The land to be disturbed is categorized in four "tiers" based on vegetation communities and requiring differential ratios of compensation. The ratio for land acquired in the MHPA is lower than if the land is outside the MHPA.	A 172,000-acre Multi-Habitat Planning Area (MHPA) preserve. The MHPA defined in some areas by mapped boundaries and in others by quantitative targets for conservation of vegetation communities and by goals and criteria for preserve designs. Local jurisdictions adopt "sub-area plans" implementing the MSCP provisions, and amend their land use plans, development regulations, codes, and also adopt preserve management plan guidelines to incorporate the MSCP provisions. Land use regulations are imposed (e.g., developer mitigation fee based on formula; within MHPA, development is generally restricted to 25% of parcel).	Developer mitigation fees based on formula. General obligation bonds approved by voters. State and Federal funds used for preserve acquisition.

	Plan Participation	How Level of Take Determined	Participation Fee Structure	Form of Mitigation	Financing Mechanism
Balcones Canyonlands Conservation Plan – 1996 Covers eight Listed Species, 27 Other Species	Voluntary. Landowners may chose to participate in plan rather than mitigate directly through the Service for section 10(a) permit.	For most species, take is quantified based on acres of species' habitats not included within the preserve. For karst invertebrates, loss of three known sites of Bone cave harvestman; loss of one known site for Tooth cave ground beetle; loss of up to 38,349 acres of potential karst habitat.	Cost of participation certificate changes based on total acreage in each habitat zone within tract. Warbler habitat: Based on maps/ aerial photos on file with Travis County. Zone 1 (habitat known to support warblers) and Zone 2 (undetermined) pay fee. No participation needed in Zone 3 (does not support warblers). Vireo habitat: Based on most recent survey information provided by the Service. Karst habitat: Based on George Veni maps. Zone 1 (areas known to contain listed cave species) and Zone 2 (probably contain endangered cave species) pay fee. Zone 3 and 4 (areas that do not or probably do not contain endangered cave species), no participation necessary.	Preserve a minimum 30,428 acres of golden-cheeked warbler and black-capped vireo habitat. Developers purchase participation certificates. Current certificate costs: • GCW habitat (zone 1) $3,500/acre • GCW habitat (zone 2) $1,750/acre • BCV habitat $3,500/acre • Karst habitat $750/acre *Special Categories*: Small landowners: Single-family homes on up to 100-acre tract in existence before 5/4/90, or one home/15 acres or more: $1,500 per lot. Agricultural construction: Clearing for new structures (barns, paddocks, etc.) associated with current ranching or farming operations $1,500/acre. Land in lieu of fees: Land that qualifies for transfer to the preserve and is adjacent to or inside the preserve acquisition area may receive mitigation credit to apply to land developed outside the preserve. Conservation Easements: May be donated on lands with appropriate habitat in lieu of fees.	Mitigation fees via Participation Certificates. Tax Benefit Funding for properties with Participation Certificates, the taxable value increase on the improvements by development in habitat are redirected to fund new preserve acquisition. Land in Lieu of Fees and Conservation Easement in Lieu of Fees. $42 million voter-approved bonds. Travis County, private landowners, LCRA, The Nature Conservancy, Travis Audubon own and manage lands dedicated to preserve.

	Plan Participation	How Level of Take Determined	Participation Fee Structure	Form of Mitigation	Financing Mechanism
Clark County, Nevada, Multi-Species HCP **Covers 79 Species**	Not voluntary. Mitigation fee applies to all land disturbed that requires development permit by plan participants (land disturbance not requiring development permit, e.g., grubbing, is exempt).	Acres of species habitat disturbed, a total of 145,000 acres of total take allowed. MSHCP covers Phase I, designed to address only the covered species. Subsequent phases may provide for additional management actions that allow including species for which less information is currently known or available. Impacts were evaluated based on distribution within Intensive Management Areas, Less-Intensive Management Areas, and Unmanaged Areas.	Level of $550/acre mitigation fee carried forward from prior HCP covering only the desert tortoise.	Evolving. Conservation measures for various species are identified, and may be funded, as approved by applicable implementing committee, commissioners, and the Service, using approximately $2 million annually. Conservation actions include construction of species barriers along linear features, translocation of desert tortoises, habitat restoration and enhancement measures, use restrictions, regulatory prescriptions, public information and education, and adaptive management (research, monitoring for trends, and habitat/species inventories). Clark County and other governmental entities impose $550/acre development fee on disturbance of all non-Federal property involving a permit issued by the county/city. NDOT pays development fee for all lands it disturbs outside of Reserve Area in certain range below 5,000 feet. Mitigation requirements imposed on other governmental landowners (BLM, USFS).	Development mitigation fees imposed by Clark County and other municipalities. Development fee paid by NDOT for land it disturbs outside IMAs/LIMAs. Plan to expend $ 2 million annually on MSHCP actions, to increase by up to $1 million annually subsequent to Phase 1 as species are added. Proceeds from $25 million endowment fund resulting from prior HCP for desert tortoise. Dedicated portion of proceeds from the sale of Federal land in the plan area. Foundation grants.

	Plan Participation	How Level of Take Determined	Participation Fee Structure	Form of Mitigation	Financing Mechanism
Washington County, Utah, HCP - 1995 **Covers the Mojave Desert Tortoise**	Voluntary in reserve area. Landowners in the proposed reserve do not have to exchange their property for property outside the reserve. However, if they do not, they do not receive authorization for take and are subject to section 9 enforcement. Not voluntary outside reserve area. All landowners outside reserve area pay mitigation fee. Land only released for take when other lands are acquired for the reserve, and mitigation monies are expended. For habitat acquisition, an acre of take is released for every 2.3 acres acquired within the reserve. Permit administrators determine who is authorized for take within each zone.	Acres of species habitat disturbed and actual individual species taken, based on projected development.	County-wide fee assessed on building permit of 0.2% of construction costs. County-wide fee of $250/acre for platted subdivisions, condos, town homes, or PUDs.	Establish a 61,000-acre habitat reserve (38,800-acre habitat reserve, plus 22,200-acre buffer and other species habitat) assembled through land exchange and acquisition. Reserve is divided into 5 zones, each with zone-specific management guidelines to protect species and species habitat, including by eliminating competing/consumptive uses. Fencing reserve boundaries. Local governments must enact ordinances to require tortoise survey and removal prior to development in certain areas to receive take authorization. Education/outreach. Tortoise translocation program. Acquire grazing permits. Monitor, survey, gather information.	Requested $7 million in Land & Water Conservation Fund for land acquisition. Endangered Species Trust Fund. • County-wide fee assessed on building permit of 0.2% of construction costs. • County-wide fee of $250/acre for platted subdivisions, condos, town homes, or PUDs. • Compensation fees pursuant to separate Biological Opinion. Payment of funds to support conservation actions benefiting tortoise. $1,000 paid to directly benefit tortoise (fencing, habitat acquisition) or $10,000 paid for HCP administration releases 1 acre of land for take authorization.

APPENDIX B

Williamson County Regional Habitat Conservation Plan
Adaptive Management and Monitoring Plan Guidelines

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APPENDIX B

Williamson County Regional Habitat Conservation Plan
Adaptive Management and Monitoring Plan Guidelines

INTRODUCTION

The purpose of management plans prepared under the auspices of the Williamson County Regional Habitat Conservation Plan (RHCP) is to establish programs for the operation, management, and monitoring of preserves consistent with the conservation of the species included in the RHCP as "permitted species" and "additional species" (see Chapter 3 of the RHCP). All monitoring and management will be the responsibility of the Williamson County Conservation Foundation (Foundation) unless otherwise stipulated in the management plan for a specific preserve.

KARST PRESERVES

All karst preserves[1] to be managed under the auspices of the RHCP will have detailed management plans that will include the following:

1. A legal description of the property to be managed.
2. The name and address of the entity responsible for the management and monitoring of the cave(s).
3. The species known to occur or possibly may occur within the cave(s).
4. A description of the aboveground and belowground hydrologic regime.
5. Where appropriate, a water quality and quantity assessment (including quantitative evaluation of water quality).
6. A description of the vegetative association in the aboveground preserved area.
7. The history of the discovery and biological collections of the cave(s) and immediate surroundings.
8. The relative importance of the cave(s) to the permitted and additional species.
9. A description of the planned and authorized land use.
10. An adaptive management plan, including an annual assessment of preserve objectives and progress on meeting those objectives (see Chapter 8 of the RHCP).

Specific management details will be established for each preserve on a case-by-case basis and approved by the Service; however, general management practices for all preserves will likely include the following general provisions.

[1] The term "karst preserves" refers both to existing karst conservation areas, some of which are future protected karst fauna areas (KFAs), and to newly protected KFAs that will be managed under the auspices of the RHCP.

Perimeter Fencing and Cave Gating. Unless otherwise approved and stipulated by the Service and/or landowner, all karst preserves will include perimeter fencing to deter trespass, trash dumping, and other forms of vandalism. Perimeter fences must control non-authorized access. It is anticipated this will be low-security (i.e., 5-strand, 4-foot-tall barbwire fence) and designed to be inconspicuous or aesthetically pleasing to fit with an adjacent land use. No back of lot gates will be allowed. In most cases, the cave entrance(s) will be secured with either a cave gate or high-security fence to further prevent unauthorized entry to the cave. The high-security fence will be at least 2 meters (6.5 feet) high and of such a design that neither adults nor children can easily climb over or crawl under the fence. The fence will also be designed so as not to prevent or deter small to medium-sized vertebrates that are important components of the karst ecosystem from passing through the fence. This can easily be accomplished by leaving animals access holes, similar to those used in cave gates, at ground level for at least every 5 meters (16 feet) of fence. In evaluating whether to gate a cave discharge point, the potential benefits of gating will be weighed against the potential negative effects. All gates and fences will be regularly inspected and maintained, and will be upgraded as necessary to control unauthorized access.

Routine Monitoring/Preservation of Karst Preserve Integrity. Long-term monitoring of preserve integrity is a necessary component of adaptive management and a required feature of Habitat Conservation Plans. The results of preserve monitoring will be included in the annual RHCP report submitted to the Service on October 1 of each year of the 30-year permit.

Fence and gate maintenance and surface monitoring for trash will be conducted monthly. Ecological monitoring will be conducted annually. Long-term monitoring data will be used to track the following preserve attributes:

1. Biodiversity – Annual ecological surveys (one biotic survey per year for each cave in each preserve)[2] will monitor for the presence of listed species and the equally important non-listed species that constitute a healthy troglobitic ecosystem. Surveys will follow Service protocols. Since many cave preservation areas are established following the discovery of only a single endangered taxon, and since many troglobites are very cryptic in their habits, continued biological monitoring of established preserves will likely lead to the discovery of additional species. The true biodiversity of any cave may not be comprehended until many years of survey data can be gathered and compared.
2. Abundance levels – To the extent practical the numbers of each member of the troglobitic community will be recorded. Since the listed species are typically observed in very low numbers within humanly accessible cave passages, most of the population probably occurs in non-accessible voids. In the long term, in-cave abundance data may allow for population modeling. Cricket exit counts will include numbers and lifestage of individuals exiting per ten minute increments in order to track demographics and activity peaks. Observations will be made of predation, mating, foraging, or other behaviors for both in cave and exit counts.

[2] The effort expended for annual biological surveys of each preserve will be described in detail in the management plan for that preserve. Some KFAs will have multiple caves; some will only have a single cave. The amount of biological monitoring required to systematically track cricket exit counts and evaluate numbers of individuals of permitted and additional species will be specific to each system and cannot be estimated herein.

3. Habitat integrity – Abiotic conditions of the ecosystem such as relative humidity and air temperatures, substrate composition, recharge dynamics, erosion, and sedimentation will be recorded.
4. Nutrient input – Any significant changes in surface vegetation (exotics, fire) and quantity of nutrient sources in the cave (trogloxene guano, leaf litter, flood debris) will be recorded.
5. Existing and emerging threats – Threats to cave systems, including unauthorized visitation, exotic or invasive species, or threats unforeseen at this time will be tracked and evaluated annually. Should any individual event or collection of events rise to the level of threat or appear to have the potential to rise to the level of a threat in the future, the Foundation will comment on the events in the annual report and determine appropriate actions to remedy the potential threat in consultation with the Service.

Adaptive Management. Adaptive management is an integrated methodology for addressing uncertainty. An adaptive management approach, "or learning by doing," will be an integral feature of the management of the preserves. The adaptive management process for the RHCP is discussed in more detail in Chapter 8 of the RHCP).

Control of the Red Imported Fire Ant. Red imported fire ants (*Solenopsis invicta*) have been shown to adversely affect surface arthropod diversity and abundance (Porter and Savignano 1990) and as such may pose a threat to listed karst species (USFWS 1994). More recent studies in central and east Texas have shown that the effect of fire ant invasion varies considerably over time, and that within a decade of invasion general arthropod abundance and diversity can return to pre-invasion levels (Morrison 2002, Helms and Vinson 2001). Arthropod communities may therefore be more resilient to fire ant impacts than previously believed (Morrison and Porter 2003). Additionally, recent research on the use of phorid flies as a biological control have yielded encouraging results (Gilbert 1996). Until additional research clarifies the relationship between red imported fire ants and the endangered taxa, control efforts around caves with endangered invertebrates will consist of regular monitoring of fire ant activity and treatment by appropriate methods. Control programs will involve monthly inspections of the area around caves, biennial treatments of mounds during the spring and fall, baiting during summer and winter, and interim treatments when fire ant density exceeds an acceptable threshold. Additionally, consideration will be made for changing the treatment regime as determined appropriate by other scientists and to incorporate new research.

The number of mounds found within 10 meters and 50 meters (33 feet and 164 feet) of cave entrances will be recorded on a monthly basis. Inspections will consist of walking the entire site while visually scanning for mounds and marking them with wire flags, paying particular attention to likely places for colonies such as clearings, stumps, cracks in rocks, road edges, and rotting logs. Per guidance provided by the Texas Cave Management Association, boiling water drenching of all fire ant mounds within 50 meters of a cave entrance will be conducted twice per year, during the spring and fall, regardless of infestation level. Infestation threshold levels for the areas within 10 meters and 50 meters of an entrance will trigger additional control efforts when reached. The threshold for the area within 10 meters of an entrance is one mound, and the threshold for the area within 50 meters of an entrance is 80 mounds. If threshold levels are reached all mounds are to be treated within 15 days. Technicians conducting fire ant surveys as

well as those conducting routine maintenance and other biological surveys will be trained to distinguish red imported fire ants and their mounds from native ants and their mounds. Red imported fire ant mound counts and treatment frequency will be reviewed on an annual basis. Should fire ant levels remain within threshold limits consistently across an annual monitoring period, mound counts may be reduced in frequency. However, upon the first count exceeding threshold limits mound counts will default to a monthly interval.

When treatment is indicated either by mound count data or regular schedule, all mounds within the treatment will be drenched or infused by pressure washer with boiling water. Biodegradable soap may be employed in some instances to increase the effectiveness of the hot water in penetrating subterranean chambers and in clinging to the ants themselves.

When practical, hot water treatments will be done during early to mid-morning during moderate weather when the queen(s) and larvae are likely to be near the top of the mound (Vinson 1991). Mounds will not be disturbed before treatment as this causes the ants to move the queen(s) and larvae to deeper locations within the mound or to a remote location.

Limited use of baits, such as Amdro®**,** will be employed outside of 50 meters from the cave entrance but within 75 meters (246 feet). To avoid effects on non-target species, bait will be placed in containers with perforated lids such that red imported fire ants can remove bait but cave crickets cannot enter. Baits will be left out for no more than one week before being retrieved. The number and density of bait containers used within the bait application area will be determined by the density of mounds within the boiling water treatment area as determined by the previous mound count. Bait containers will be distributed in such a manner as to replicate the measured density of mounds.

ENDANGERED BIRD PRESERVES

Until such time that Williamson County establishes preserves for the golden-cheeked warbler and black-capped vireo within the County and begins to permit take above and beyond that authorized in this RHCP through the Hickory Pass Ranch mitigation bank, annual permitting requirements for take of listed birds will only include number of acres of warbler or vireo habitat affected by development, the relative quality of that habitat, and the number of acres of Hickory Pass Ranch credits utilized. If bird preserves are established in Williamson County, operation and maintenance plans would be similar to the plan in place for Hickory Pass Ranch Conservation Bank.

REFERENCES CITED (APPENDIX B)

Gilbert, L.E. 1996. Prospects of controlling fire ants with parasitoid flies: the perspective from research based at Brackenridge Field Laboratory. *In* Proceedings of the Second Conference on Quail Management, March 1996, Texas A&M University-Kingsville, Kingsville, Texas.

Helms, K.R., and S.B. Vinson. 2001. Coexistence of native ants with the red imported fire ant, *Soleopsis invicta*. Southwestern Naturalist 46:396–400.

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Morrison, L.W., and S.D. Porter. 2003. Positive association between densities of the red imported fire ant *Solenopsis invicta* (Hymenoptera: Formicidae), and generalized ant and arthropod density. Environmental Entomology 32(3):548–554.

Porter, S.D., and D.A. Savignano. 1990. Invasion of polygyne fire ants decimates native ants and disrupts arthropod community. Ecology 71:2095–2106.

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WILLIAMSON COUNTY REGIONAL HABITAT CONSERVATION PLAN

APPENDIX C

Ronald W. Reagan Boulevard Phase III
Endangered Species Take and Mitigation Calculations

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APPENDIX C

Ronald W. Reagan Boulevard Phase III
Endangered Species Take and Mitigation Calculations

INTRODUCTION

This appendix presents an example of how provisions of the proposed Williamson County Regional Habitat Conservation Plan (RHCP) are being applied to an actual project: the 5-mile-long Ronald W. Reagan Boulevard Phase III Project from Farm-to-Market (FM) 2338 to State Highway (SH) 195.[1] Construction of the road extension will potentially impact three of the "permitted species" included in the proposed RHCP: the Bone Cave Harvestman (*Texella reyesi*), the Coffin Cave mold beetle (*Batrisodes texanus*), and the golden-cheeked warbler (*Dendroica chrysoparia*). The preliminary impact and mitigation assessments were completed for this project by SWCA Environmental Consultants (SWCA) in consultation with the U.S. Fish and Wildlife Service (Service or USFWS). Results of the assessments are presented below.

ASSESSMENT PROCEDURE

The project proponent commissioned a Geologic Assessment, which was prepared in accordance with the Texas Commission on Environmental Quality (TCEQ) standards (TCEQ 2004). The Geologic Assessment disclosed the presence of caves with listed species potential habitat (SWCA 2007a)[2]; therefore, a presence/absence karst survey was conducted by a Service-approved and -permitted karst biologist in accordance with Service standards (USFWS 2006). The presence/absence karst survey confirmed the presence or likely presence of the two endangered karst invertebrates in two karst features (SWCA 2007b). Because woodlands are present within the project area, the project proponent also commissioned a Habitat Assessment (Loomis Austin, Inc. 2005) and a presence/absence bird survey (SWCA 2007c), which confirmed the presence of suitable habitat for the golden-cheeked warbler and presence of the bird. Based on the project proponent's conceptual development plan, and the results of the Geologic Assessment, the presence/absence karst survey, the Habitat Assessment, and the presence/absence bird survey, a preliminary assessment of potential take and mitigation fees was made using the fee schedule developed for the Williamson County RHCP. The impacts and mitigation fees presented below are based on the following: 1) total number of acres of karst present; 2) the assessed project potential to impact listed karst species; and 3) the acres of occupied golden-cheeked warbler habitat that will be directly and indirectly impacted as a result of project development.

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[1] No incidental take has yet been authorized for this project, and no take will occur until such take is authorized by the Service through the requested RHCP section 10(a)(1)(B) incidental take permit or by other means.

[2] See also Richardson Verdoorn (1994) for additional information on area karst features and caves containing the listed karst invertebrate species.

RESULTS

The following calculations present estimates of take of endangered species habitat on Ronald W. Reagan Boulevard Phase III based on field investigations conducted by SWCA in 2007. All calculations are based on a right-of-way (ROW) width of 260 feet and project length of 5.27 miles. Mitigation calculations are based on the participation process described in Chapter 6 of the RHCP. The total project area within the Ronald W. Reagan Boulevard Phase III ROW is 166 acres.

KARST INVERTEBRATES

The project area falls within the Karst Zone and includes two karst features (Feature F-1 and Feature F-29) that are either known to be or are likely to be occupied by endangered invertebrates (permitted species) (Figure 1). Several other geophysical anomalies were identified to the north and west of Feature F-29 (Figure 1). These features exhibited no surface expression and are not thought to contain habitat for endangered karst invertebrates.

Karst Zone**.** The road alignment will cross 128.6 acres of the Karst Zone. Mitigation fees are calculated at $100/acre for impacts in the Karst Zone[3].

Karst Zone Fee = $12,860.00

Feature F-1. This feature is an endangered species cave occupied by the Bone Cave harvestman. This cave can not be avoided by the road way alignment, as the road will pass through the Irrevocable Impact Zone; that is, within 50-feet of the cave footprint. The mitigation fee for take of this cave is a flat fee of $400,000.00.

Feature F-1 Fee (Irrevocable Impact) = $400,000.00

Feature F-29. This feature is a sinkhole measuring approximately 10 feet by 15 feet by 8 feet deep. The feature had been partially excavated in 1993–1994 in conjunction with the Sun City Georgetown karst invertebrate avoidance plan and was apparently considered a non-habitat feature.[4] In 2007 SWCA continued excavation on the feature in an attempt to meet current due diligence protocols for determining presence or absence of listed karst invertebrates. SWCA enlarged the feature from 8 ft deep to 15 ft deep without encountering troglobite habitat. Further excavation of the feature was impractical due to cramped working conditions. Electrical resistivity investigations in the vicinity of Feature F-29 detected multiple subsurface geophysical anomalies of indeterminate dimensions and unknown degree of connectivity with F-29 (Figure 2). Feature F-29 is assumed to be a species cave based on its proximity to two species caves to the south, Priscilla's Well Cave (R-49) and Priscilla's Cave (F-26), both known to contain the Bone Cave harvestman.

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[3] Karst Zone impact fees are assessed for impacts to previously undetected voids containing listed karst invertebrates that are occasionally uncovered during project construction.

[4] This feature appears to be "Pit No. 6" in an unnumbered figure from the original Richardson Verdoorn (1994) karst report. All features within which troglobite habitat was found during the 1993–1994 survey were highlighted as caves and the other features without habitat were generally designated as "Sinks and Pits."

The Coffin Cave mold beetle is also known from Priscilla's Well Cave. Because the actual footprint of Feature F-29 is unknown at this time, it is assumed that if a cave were present, the footprint would be similar to the two features to the south, or approximately 20–30 ft in diameter. Assuming a 30-foot radius around the feature opening, the ROW for Ronald W. Reagan Boulevard Phase III will impact 2.0 acres of the Moderate Impact Zone. Fees for intrusion into the Moderate Impact Zone of Feature F-29 are calculated at $10,000/acre.

Feature F-29 Fee (Moderate Impact) = $20,000.00

Total mitigation fees for impacts to karst habitat and species = $432,860.00

GOLDEN-CHEEKED WARBLER

Habitat for the golden-cheeked warbler as mapped in the RHCP is shown on Figure 3. This habitat mapping was then refined through a field habitat delineation and presence/absence survey. The field investigations verified that golden-cheeked warbler habitat occurs in two patches along the western and central portions of the Ronald W. Reagan Boulevard Phase III alignment (Figure 4). The western patch contains 26.0 acres of habitat, and the eastern patch contains 24.7 acres of habitat. Direct impacts to golden-cheeked warbler habitat include those areas where habitat would be directly removed by road construction.

Direct Impacts to Golden-cheeked Warbler Habitat = 50.7 acres

The project will also result in indirect impacts to golden-cheeked warblers (Figure 4). The Service typically measures indirect effects out to a distance of 250 feet from the edge of areas that are directly affected. They also assume that habitat believed to be indirectly affected will lose half of its viability, thus indirect impacts are calculated based on half the acreage.

Indirect Impacts to Golden-cheeked Warbler Habitat = 47.4 acres

Total impact to warbler habitat is then calculated as direct impacts plus half the acreage indirectly impacted.

Total Impacts to Golden-cheeked Warbler Habitat = 98.1 acres

Mitigation for impacts to golden-cheeked warble habitat will be achieved by purchasing Hickory Pass Ranch Conservation Bank credits from Williamson County. The mitigation ratio will be a 1:1 ratio, or one credit purchased from the County for each acre of occupied warbler habitat impacted. The purchase price of the credits will be $7,000 per credit.

Golden-cheeked Warbler mitigation fee = $686,700.00

TOTAL MITIGATION FEE

Karst	***$432,860.00***
Warbler	***$686,700.00***
Total	***$1,119,560.00***

DEDICATION OF LAND IN LIEU OF FEE PAYMENT

A provision of the RHCP is the option for a participant to dedicate, sell or donate preserve land to the County in lieu of mitigation fee payments. For the Ronald W. Reagan Boulevard project, the opportunity exists for an approximately 40-acre karst fauna area (KFA-also on the project proponent's property but outside the Ronald W. Reagan Boulevard project area) to be established around the cave cluster including Feature F-29 and nearby Priscilla's Well Cave and Priscilla's Cave as well as several additional caves and karst features (see Figure 2). An appraisal of the land would be required to determine the value of the property to be dedicated. At this time it is estimated that the proposed KFA property value ranges from $30,000 to $60,000 per acre.

REFERENCES CITED (APPENDIX C)

Loomis Austin, Inc. 2005. Proposed Ronald Reagan Boulevard Phase III Endangered Species Habitat Assessment. Austin, Texas. LAI Project No. 040206-13

Richardson Verdoorn. 1994. Documentation and compilation of supporting reports for the endangered species assessment, design guidelines, and management plan for the Sun City Georgetown property. Submitted to USFWS, Austin Field Office, December 20, 1994.

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SWCA Environmental Consultants. 2007c. Results of 2007 field surveys for the golden-cheeked warbler and black-capped vireo along the proposed alignment for an approximately 5-mile extension of Ronald Reagan Boulevard, Williamson County, Texas. Submitted to Waterstone Development, Austin, Texas. SWCA Environmental Consultants, Austin, Texas.

[TCEQ] Texas Commission on Environmental Quality. 2004. Instructions to geologists for Geologic Assessments on the Edwards Aquifer Recharge/Transition Zones, Application Form 0585, Texas Commission on Environmental Quality, October, 2004.

[USFWS] U.S. Fish and Wildlife. 2006. United States Fish and Wildlife Service, Section 10(a)(1)(A) Scientific permit requirements for conducting presence/absence surveys for endangered karst invertebrates in central Texas. U.S. Fish and Wildlife Service, Austin Ecological Services Field Office, Austin, Texas.

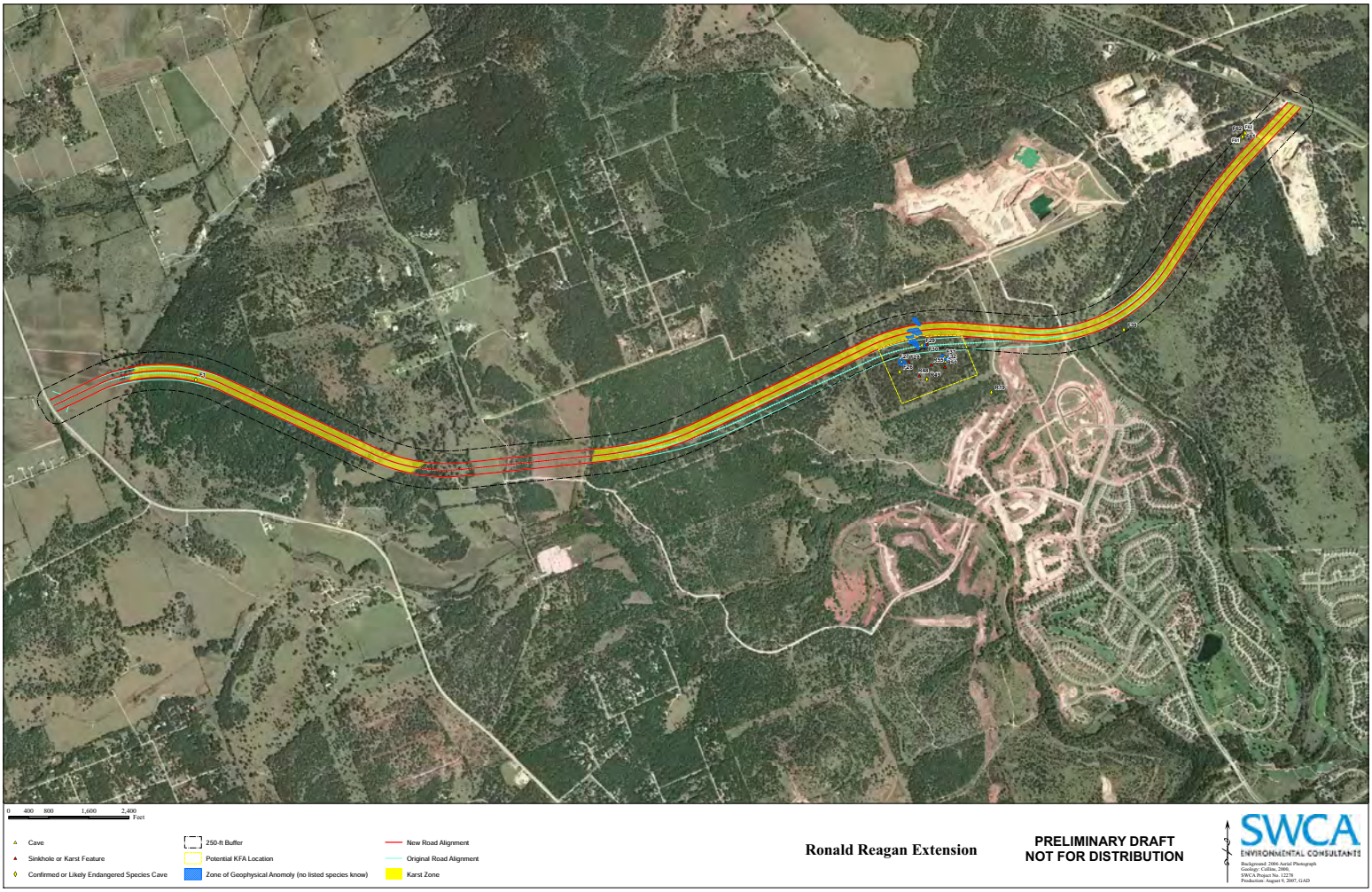

Figure 1. Karst zone and karst feature locations.

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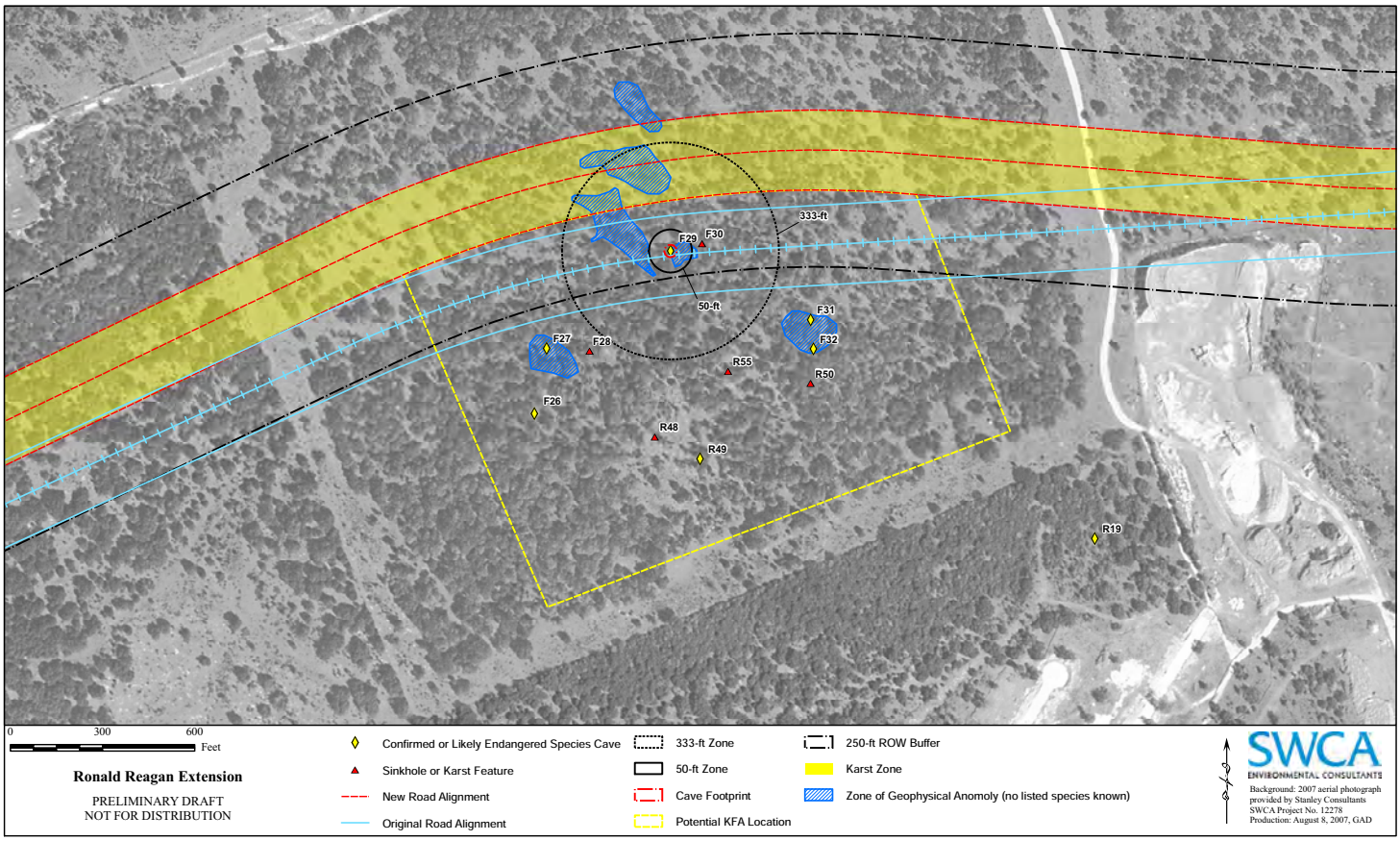

Figure 2. Impact zones for Feature F-29 and potential KFA location.

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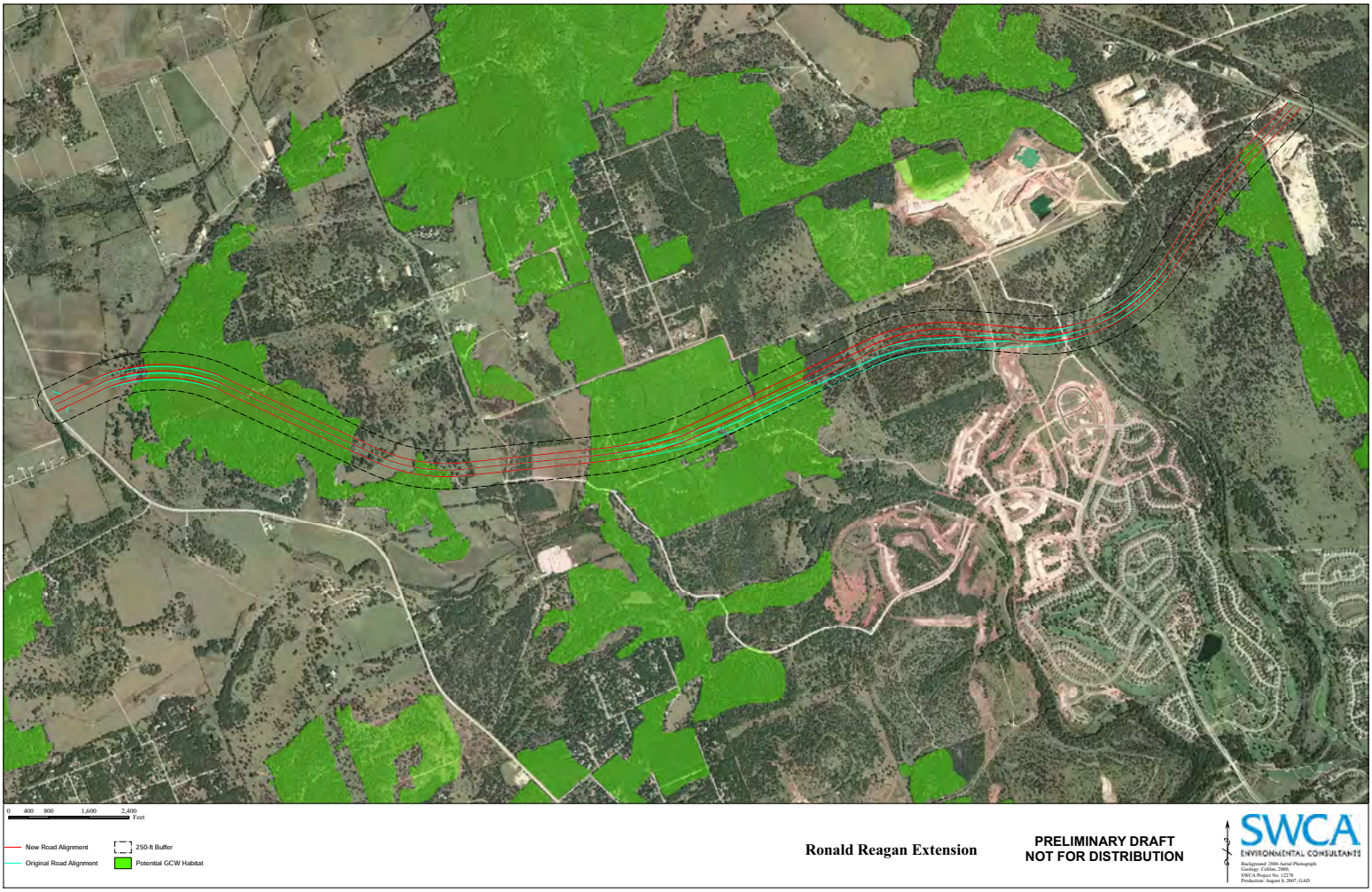

Figure 3. Golden-cheeked warbler habitat designated by the Williamson County RHCP.

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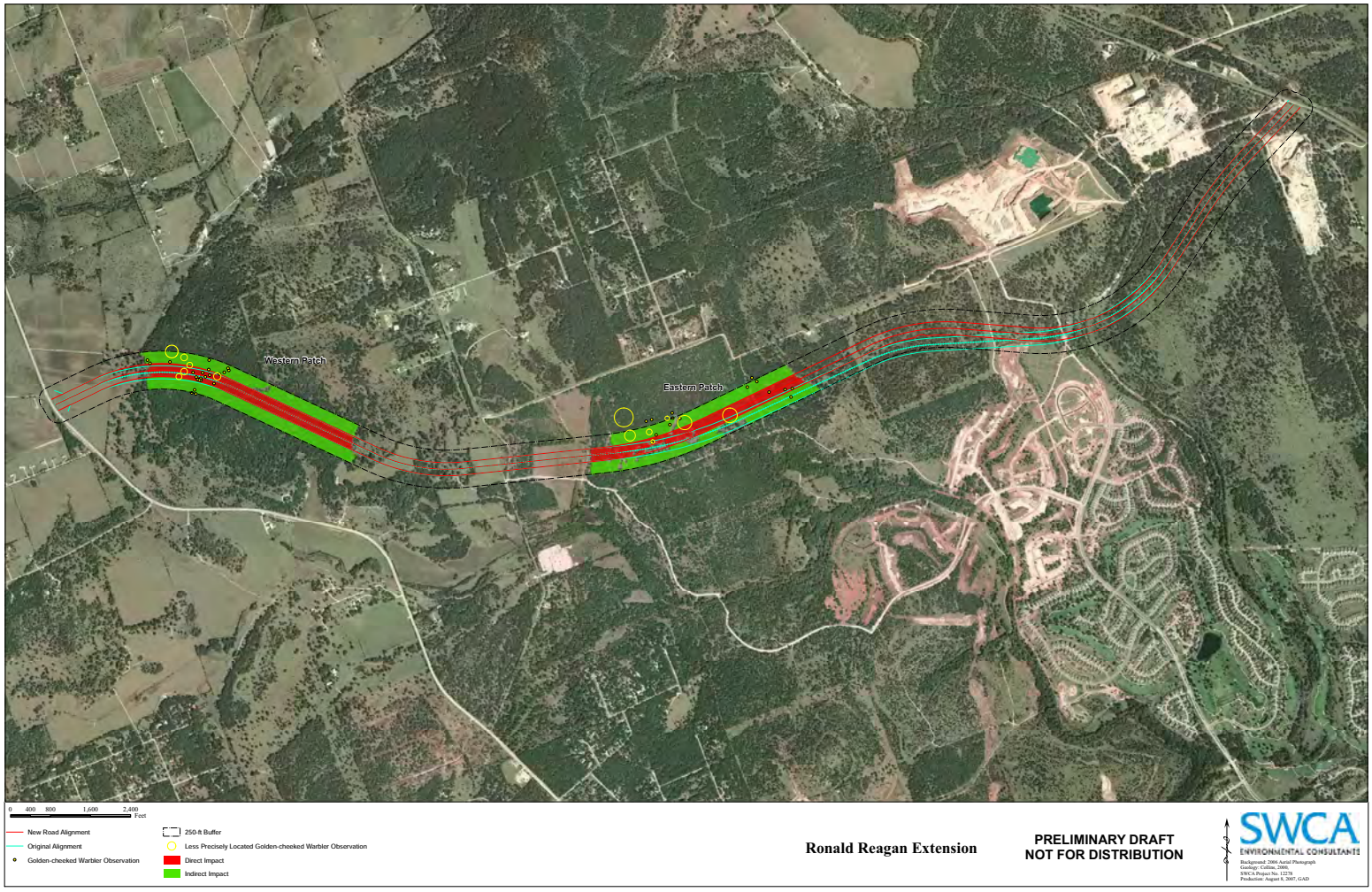

Figure 4. Golden-cheeked warbler impacts.

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APPENDIX D

United States Fish and Wildlife Service, Section 10(a)(1)(A) Scientific Permit Requirements for Conducting Presence/Absence Surveys for Endangered Karst Invertebrates in Central Texas

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United States Fish and Wildlife Service, Section 10(a)(1)(A) Scientific Permit Requirements for Conducting Presence/Absence Surveys for Endangered Karst Invertebrates in Central Texas

U.S. Fish and Wildlife Service, Austin Ecological Services Field Office,
10711 Burnet Road, Suite 200, Austin, Texas
(512) 490-0057

This document provides guidance on when you might be at risk of "taking" a species while conducting karst invertebrate surveys and when it is advisable to have a Section 10(a)(1)(A) permit issued by the Service under the Endangered Species Act of 1973, as amended (Act) to be covered for "take." The ultimate decision to apply for a permit is yours. Individuals engaged in activities that have the potential to "take" listed species are responsible for determining whether the likelihood of "take" is great enough to need a section 10(a)(1)(A) permit (see "*When a Section 10(a)(1)(A) Scientific Permit is needed*" below for the definition of "take").

If you choose to apply for a permit, this document outlines the U.S. Fish and Wildlife Service's (Service) process and requirements for conducting presence/absence surveys for federally-listed endangered, terrestrial karst invertebrate species (herein referred to as "karst invertebrates") in Travis, Williamson, and Bexar counties, Texas, as conditions of holding a section 10(a)(1)(A) permit. See Table 1 for a list of endangered karst invertebrates (53 FR 36029-36033; 65 FR 81419-81433) in these three counties. Section 10(a)(1)(A) permits, also referred to as recovery, enhancement of survival, or scientific permits, allow for "take" of listed species that may or will occur while conducting research to further the recovery of a listed species (see *When a Section 10(a)(1)(A) Scientific Permit is Needed* below). This document outlines methods to be used, information to be included in final reports, and minimum qualifications for personnel conducting presence/absence surveys for endangered karst invertebrates under a section 10(a)(1)(A) permit.

The objective of this document is to identify survey methods that will produce sound scientific information upon which to base decisions and actions for the conservation of these endangered species. Using consistent survey methodology will also allow for greater comparison and analysis of results, and thereby increase our understanding of these species and their habitat requirements. Please note, this document supersedes any previous guidance from the Austin Ecological Services Office on conducting presence/absence surveys for federally endangered karst invertebrates. Information that relates to the effectiveness of these survey guidelines in conserving endangered karst species is welcome. We will consider modifications of, or alternatives to, these methods and qualifications on a case-by-case basis.

Since one of the first steps in determining presence/absence of endangered karst invertebrates is to survey for karst features that may have suitable habitat, this document also outlines the Service's recommendations for conducting surveys for karst features that may contain suitable habitat for endangered karst invertebrates. Since no "take" of listed species is anticipated while conducting initial surface walking karst feature surveys, this activity does not necessitate a section 10(a)(1)(A) permit. However, the potential for "take" exists with entry into a void or cave where endangered karst invertebrates may occur. Therefore, the Service recommends that all personnel excavating, entering,

and/or collecting in a void or cave that may contain suitable habitat for endangered karst invertebrates to conduct conservation work hold a valid 10(a)(1)(A) permit for the endangered karst invertebrates in the county being surveyed.

When a Section 10(a)(1)(A) Scientific Permit is Needed

Collecting endangered species is a form of "take" and therefore, is prohibited under section 9 of the Endangered Species Act of 1973, as amended, unless the "take" is covered under a Section 10(a)(1)(A) scientific permit. "Take" is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." In addition to collecting, forms of "take" that could occur in the process of conducting karst invertebrate surveys and related tasks, such as mapping or excavating a cave, include crushing individuals; compaction of habitat and oviposition sites; destruction of webs; disturbance of cover objects; harm or harassment that may occur with the introduction into the environment of noise, light, chemicals, and biological substances, such as microbes normally found on the surface or in other caves, and possibly other actions that would cause individuals to flee, seek shelter, or alter or cease normal foraging, anti-predation, or reproductive behavior. For information on how to apply for a 10(a)(1)(A) permit contact Stephanie Weagley and Melissa Castiano at Stephanie_Weagley@fws.gov and Melissa_Castino@fws.gov.

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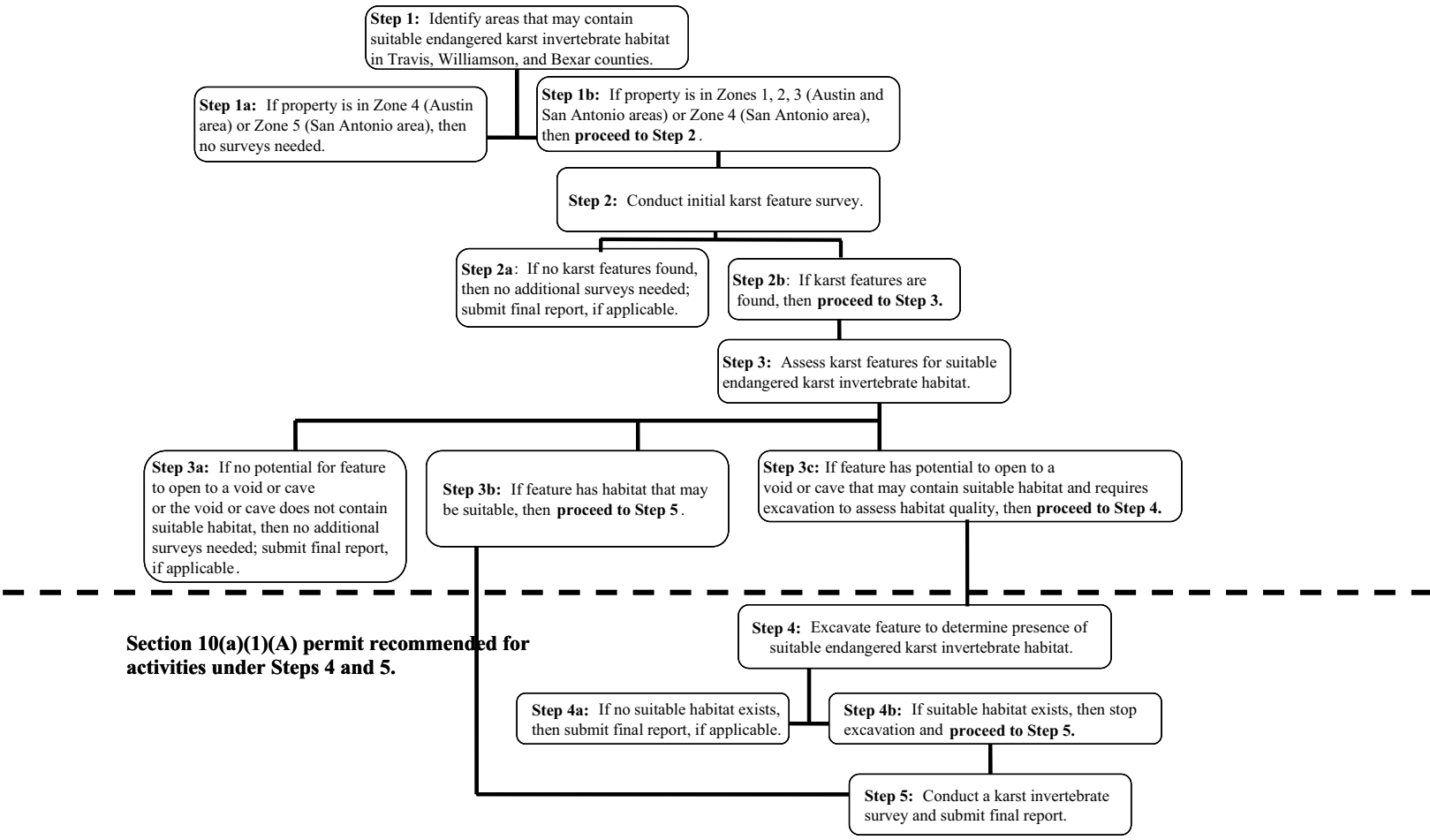
Table 1. Federally endangered terrestrial karst invertebrates from Central Texas (Final Rule for Travis and Williamson Counties - 53 FR 36029-36033; Bexar County - 65 FR 81419-81433; technical corrections – 58 FR 43818-43820).

Common Name	Species	County of Occurrence
Madla Cave meshweaver	*Cicurina madla*	Bexar
Robber Baron Cave meshweaver	*Cicurina baronia*	Bexar
Braken Bat Cave meshweaver	*Cicurina venii*	Bexar
Government Canyon Bat Cave meshweaver	*Cicurina vespera*	Bexar
Government Canyon Bat Cave spider	*Neoleptoneta microps*	Bexar
Cokendolpher cave harvestmen	*Texella cokendolpheri*	Bexar
Ground Beetle (no common name)	*Rhadine exilis*	Bexar
Ground Beetle (no common name)	*Rhadine infernalis*	Bexar
Helotes mold beetle	*Batrisodes venyivi*	Bexar
Bee Creek Cave harvestmen	*Texella reddelli*	Travis
Kretschmarr Cave mold beetle	*Texamaurops reddelli*	Travis
Tooth Cave pseudoscorpion	*Tartarocreagris texana*	Travis
Tooth Cave spider	*Leptoneta myopica*	Travis
Tooth Cave ground beetle	*Rhadine persephone*	Travis and Williamson
Bone Cave harvestmen	*Texella reyesi*	Travis and Williamson
Coffin Cave mold beetle	*Batrisodes texanus*	Williamson

How to Determine if Karst Invertebrates May be Present

Figure 1 outlines a five-step approach for determining presence/absence of endangered karst invertebrates and karst features that may contain suitable habitat for endangered karst invertebrates in central Texas. See text following the figure for a more complete description of each step.

Figure 1: Five-step approach for determining presence/absence of endangered karst invertebrates and karst features that may contain suitable habitat for endangered karst invertebrates in central Texas.



Step 1[1]. Identify areas that may contain suitable habitat for endangered karst invertebrates in Travis, Williamson, and Bexar counties. Four karst zones have been delineated in the Austin area (Travis and Williamson counties) (Veni 1992) and five karst zones have been delineated in the San Antonio area (Bexar County) in Texas (Veni 1994). The karst zones in the San Antonio area were updated and revised in Veni (2002). These karst zones are a useful first step in determining if karst features containing endangered invertebrates are likely to occur on a particular property. The karst zone maps are available online at www.fws.gov/ifw2es/AustinTexas/ or upon request from the Austin Ecological Service Field Office.

Table 2. Definitions of Karst Zones (modified from Veni 1992; 1994; 2002)

In both the San Antonio and Austin areas:	**Zone 1** is defined as areas known to contain endangered karst invertebrate species.
	Zone 2 is defined as areas having a high probability of containing suitable habitat for endangered karst invertebrate species.
	Zone 3 is defined as areas that probably do not contain endangered karst invertebrate species.
In the San Antonio area:	**Zone 4** is defined as areas that require further research but are generally equivalent to Zone 3, although they may include sections that could be classified as Zone 2 or Zone 5 as more information becomes available.
	Zone 5 is defined as areas, both cavernous and non-cavernous, that do not contain endangered karst invertebrate species.
In the Austin area:	**Zone 4** is defined as areas, both cavernous and non-cavernous, that do not contain endangered karst invertebrate species.

Step 1a. If the subject property is in Zone 4 (Austin area) or Zone 5 (San Antonio area), then it lies within an area, either cavernous or non-cavernous, that does not contain the endangered karst invertebrates and no surveys are needed.

Step 1b. When conducting a karst invertebrate survey under a Section 10(a)(1)(A) permit, the surface survey for karst features is not expected to result in "take." However, while not required, certain procedures for surface surveys are recommended as part of the scientifically sound process for assessing the presence/absence of karst invertebrates. In karst zones 1, 2, 3 (Austin and San Antonio areas) and 4 (San Antonio area), we recommend an initial karst feature survey be conducted on the entire property within these zones; **proceed to Step 2** for more on conducting these surveys.

[1] Since "take" is unlikely to occur during activities conducted under Steps 1 and 2, a section 10(a)(1)(A) permit is not needed.

Step 2[1]. Conduct an initial karst feature[2] survey. If you are in zones 1 or 2, we recommend that a survey be conducted by a qualified individual, as defined by Texas Commission on Environmental Quality (TCEQ),[3] with demonstrated experience in karst geology. In zone 3 (in Austin and San Antonio areas) where the presence of endangered karst invertebrates is possible but unlikely, we recommend that, at a minimum, the landowner or their designated representative visually inspect their property for karst features. In zone 4 (in San Antonio area) where sections of Zone 2 may occur, we recommend a survey be conducted by a qualified individual, as defined by TCEQ,[3] with demonstrated experience in karst geology.

To conduct karst feature surveys, follow methods outlined in section II-A of *Procedure For Conducting a Geologic Assessment* in TCEQ's *Instructions to Geologists for Geologic Assessments (GA)* as revised October 1, 2004. Applicable portions of those procedures are included here in Appendix III. Note, we intend for you to use the GA to locate features only and not to assess whether a feature has the potential to lead to karst invertebrate habitat. Guidance on assessing a features potential to contain suitable karst invertebrate habitat is discussed in Step 3 below. If you have questions regarding the GA you may contact the TCEQ Austin Regional Office (512-339-2929), the San Antonio Regional Office (210-490-3096) or on the internet at http://www.tceq.state.tx.us

- If a GA has previously been conducted on the subject site following TCEQ's October 1, 2004, guidelines, then it may serve as an initial karst feature survey.
- If a GA is not required on the subject site by TCEQ (for example, the site is not located on the Edwards Aquifer recharge or transition zones) then we recommend that the initial karst feature survey be conducted following the methods outlined in those portions of section II-A of *Procedure For Conducting a Geologic Assessment* in TCEQ's GA (October 1, 2004) that are contained in Appendix III herein.
- All surveys should be conducted such that the likelihood of overlooking any karst feature is very low.

Step 2a. If no karst features are found during the initial karst feature survey, no additional survey work is needed. While no permit report is required on this part of the survey, we do encourage surveyors to report these results (including negative results) to the Service to increase understanding about these species and to increase the database upon which to make conservation and management decisions.

Step 2b. If karst features are found during the initial survey, **proceed to Step 3**.

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[2] Karst Feature – geomorphic, topographic, and hydrological feature formed by solution of limestone by water. Caves, solution cavities, sinkholes, swallow holes, solution enlarged fractures are common types of karst features; many more can be found in a textbook or glossary of karst terms. (Texas Commission for Environmental Quality (TCEQ), Instructions to Geologists for Geologic Assessments (GA) as revised May 1, 2002, Section IV).

[3] Geologist - a person who has received a baccalaureate or graduate degree in the natural science of geology from an accredited university and has training and experience in groundwater hydrology and related fields, or has demonstrated such qualifications by registration or licensing by a state, professional certification, or completion of accredited university programs that enable that individual to make sound professional judgments regarding the identification of sensitive features located in the recharge zone or transition zone. Since September 1, 2003 geologists conducting assessments are expected to be licensed according to the Texas Geoscience Practice Act (TCEQ, GA as revised Ocotber 1, 2004, Section IV).

Step 3[4]. Assess karst features for suitable endangered karst invertebrate habitat. The potential for each identified karst feature to provide or lead to suitable habitat for endangered karst invertebrates should be assessed by a qualified individual, as defined by TCEQ,[3] with demonstrated experience in karst geology and the ability to identify certain cave - adapted species. To accomplish this assessment, some features may require a reconnaissance excavation.[5] If reconnaissance excavations are conducted as described below they are not expected to result in take. See Step 4 for more on excavating features. Once a feature is located using the TCEQ's GA, the following factors outlined in Veni and Reddell (2002) should be considered when determining if a feature has potential to lead to a void or cave[6] with suitable karst invertebrate habitat:

- If a feature is filled, or partly filled, by leaf litter, loose, modern soils, and a few rocks, it should be subjected to a reconnaissance excavation, prior to its evaluation for its potential to lead to a cave. A rod at least 30 centimeters (1 foot) long should be used to probe into the soils of a feature in search of shallow voids and to quickly and further estimate the feature's origin and permeability. If a site seems likely to contain culturally or paleontologically significant materials, action related to the feature should first be coordinated with the Texas Historical Commission (THC), before determining if excavation is appropriate (http://www.thc.state.tx.us).

- If a feature exhibits airflow, channelized recharge of water, development by soil or bedrock collapse, loose soil or rock fill to a depth of at least 30 centimeters (1 foot), or clean-washed rocks at its base, then it may lead to a void. The presence of *Ceuthophilus cunicularis* cave crickets, *Cicurina varians* spiders, or cave-adapted species found during the reconnaissance excavation also indicates the presence of a void. Therefore, we recommend that the surveyor conducting the karst feature assessment be able to recognize such cave-adapted species.

If none of the above factors are present, then any combination of at least two of the following factors should be considered justification for further excavation of a feature (Veni and Reddell 2002):

- There is development along a fracture related to the karst feature.
- The feature is more than 2 meters (6.6 feet) in length or diameter.
- The feature is more than 1 meter (3.3 feet) deep.
- Morphology of the feature is similar to the pre-excavation appearance of a nearby known cave in the same geologic setting.
- A humanly or potentially humanly enterable void is visible.

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[4] Since the potential for "take" exists for activities outlined in Steps 4 and 5, we recommend that all personnel entering, excavating, and/or collecting in features with potential to contain endangered karst invertebrates to conduct conservation activities for the species hold a valid section 10(a)(1)(A) permit for the listed karst invertebrates in the county being surveyed (see *Appendix II* for surveyor qualifications.) For information on how to apply for a 10(a)(1)(A) permit contact Stephanie Weagley and Melissa Castiano at Stephanie_Weagley@fws.gov and Melissa_Castino@fws.gov.

[5] Reconnaissance Excavation – hand removal of loose soil, rocks, and leaf litter not exceeding 1 foot in depth and 1 foot in diameter and is for the purpose of distinguishing actual karst features from non-karst depressions such as old weathered stump holes, animal burrows, and latrine pits (Veni and Reddell 2002).

[6] Cave - a naturally occurring, humanly enterable cavity in the earth, at least 5 m in length and/or depth, and where no dimension of the entrance exceeds the length or depth of the cavity (www.texasspeleologicalsurvey.org)

Other factors that should be considered justification for further excavation of a feature (Veni and Reddell 2002):

- The feature is close to caves known to contain endangered species.
- The feature is in karst zone 1 or 2.
- The physical characteristics, for example, size, appearance, catchment basin, conduits, air flow, and mammal etchings suggest the presence of a cave.
- The appearance of fill does not match surrounding area, which may indicate the presence of artificial material in a feature.
- The feature is located near structural features that may promote cave and karst features to develop, such as a fault, photolineament (possible bedrock feature indicated by aerial photographs), or an area of relatively high fracture density.
- Vegetation in the area includes certain plants, especially trees, that may preferentially grow in cave entrances and other karst features.
- Past land use activities (for example, agricultural) may indicate the presence of false features.

Characteristics of karst features not likely to contain suitable habitat for endangered karst invertebrates:

The following guidance is based on Veni and Reddell (2002) and is provided as guidance for determining when karst features are not likely to contain habitat for endangered karst invertebrates. Each of the factors listed below indicates conditions unfavorable to the listed species, but individually, none of these factors rule out their occurrence. A "no further action" determination requires that all of these factors occur together, making habitat for the listed species unlikely.

- Features that have all, or nearly all, floors, walls, and ceilings covered with calcite speleothems and lacking black sediment, are highly unlikely to provide habitat for listed species. The calcite speleothems may block the species and nutrients for the species from entering the feature.
- Features with floors that occur less than 1.5 meter (4.9 feet) below the surface are unlikely to contain suitable habitat for the listed invertebrate species (Veni and Reddell 2002). Such features occur in a zone where they will become significantly warmer and drier during the summer, and cooler and drier during the winter than features at greater depths. The listed species usually live in deeper voids where temperatures and humidity are more stable. Also, these shallow depths are more prone to invasion by non-native species, particularly red-imported fire ants that may compete with or prey upon the listed species.
- The absence of non-listed troglobites[7] or troglophiles[8] suggests conditions are unsuitable for the listed troglobites. To determine if this criterion is met, the evaluation must be conducted or directly supervised by someone with experience recognizing these species.

[7] Troglobites - a species of animal that is restricted to the subterranean environment and typically exhibits morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment (Veni 2002).

[8] Troglophiles - a species of animal that may complete its life cycle in the subterranean environment but may also be found on the surface (Veni 2002).

- Features must be "dry," meaning that the apparently normal condition of the feature has no pools, water flow, notable moisture or discernible dampness on the walls, floors, ceilings, or sediments. Since it may not be possible to observe the feature after periods of rainfall, it should be examined for water-formed features that would indicate at least episodic occurrence of significant moisture. Such features include, but are not limited to: recently formed scallops and pitting of sediments and bedrock, sediment depositional patterns exhibiting flow and/or ponding, and recent speleothem resolution and growth.
- Fewer than 10 cave crickets have been found in the feature. These animals are often important components of ecosystems containing the listed species, and their absence or minimal presence suggest conditions unsuitable for the listed species.
- Absence of discernible airflow suggests that the feature does not connect to a cave or significant voids that might contain the listed species. The presence of airflow usually indicates the existence of such voids, but its absence does not indicate the opposite. Several factors may prevent airflow when significant voids are present.
- The feature is not collapse-formed or related to a collapse. If a feature is part of a collapsed area of bedrock, it is part of a deeper, more extensive cave or series of voids that produced the collapse and are more likely to contain suitable habitat for the listed species.

Step 3a. If, after a thorough assessment, you determine there is no potential for the feature to open to a void or cave or the void or cave does not contain suitable habitat, then no additional surveys are needed.

Step 3b. If the karst feature is a cave or has habitat that may be suitable for endangered karst invertebrates, then **proceed to Step 5**.

Step 3c. If the karst feature has potential to open to a void or cave that may contain suitable habitat for endangered karst invertebrates and requires excavation to assess habitat quality, then **proceed to Step 4**.

Step 4.[4] Excavating features: Considering that excavation of features could result in "take," we recommend surveyors conducting excavations beyond the scope of a reconnaissance excavation should hold a 10(a)(1)(A) permit. Excavation may be performed by a technician under the supervision of a qualified geologist who takes responsibility for work and receives daily reports (geologist does not have to be present at time of excavation). The geologist should determine if the feature leads to a cave or other void and will require removal of fine sediments, collapsed rocks, calcite deposits, and/or bedrock. Excavation with hand tools should be used whenever possible to minimize disturbance of a feature's environment. Explosives may be needed to excavate collapsed rocks, calcite deposits, and/or bedrock but should be used strategically under the supervision of experienced personnel and in small amounts to selectively remove obstructions. Backhoes or related heavy machinery may be needed where large rocks or volumes of sediments are impractical and/or unsafe for removal by hand.[9] The

[9] [**NOTE:** Excavation or any other activity that alters or disturbs the topographic, geologic, or existing recharge characteristics of a site, is regulated under the TCEQ's Edwards Aquifer Program and may require a Water Pollution Abatement Plan (WPAP). TCEQ's regional office should be consulted prior to either blasting or using a backhoe to excavate any feature occurring in the Edwards Aquifer recharge and transition zones. For more information, contact TCEQ at 512-239-1000 or access the Internet at http://www.tceq.state.tx.us/EAPP]

size of excavations should be kept as small as possible while allowing space for efficient excavation efforts and creating an area safe for entry. Multiple entrances dry out caves and unneeded excavated entrances should be sealed with natural fill equivalent in permeability to what was excavated. (Also see *Restoring Excavated Features* below). To minimize promotion of fire ant activity and siltation of streams, excavated material from all features should be evenly distributed downslope of, and at least 5 meters (16 feet) from, the features. Sediments should be distributed in thicknesses of no more than 1-2 centimeters (0.39-0.78 inches) to allow rapid integration into the existing soils and stabilization by vegetation.

Excavation should cease upon encountering (1) a cave (caves may require further excavation during biological surveys, see Step 5), (2) solid bedrock with no conduits, (3) packed clay with no airflow present (the passage should be checked several times under different surface temperature conditions (for example, cool mornings, warm evenings) before determining there is no airflow), (4) potential archaeological or paleontological materials, or (5) where continued excavation would be dangerous (for example, due to a large, overhanging rock or high levels of CO_2). If the CO_2 level is high, consider having fresh air blown in or re-surveying during more favorable weather conditions (such as during the winter months, especially after strong cold fronts, which pushes O_2 deeper into the cave displacing CO_2).

If a significant void or cave that may contain suitable habitat for endangered karst invertebrates is encountered during excavation, excavation should stop and a qualified individual (see *Appendix II*) holding a valid section 10(a)(1)(A) scientific permit issued by the Service should survey for endangered karst invertebrates and conduct further excavations within the cave, if needed. However, we recommend immediate collection, by an individual holding a section 10(a)(1)(A) permit, of any karst invertebrates observed within the entrance area during the initial excavation (see *Appendix II*).

Other techniques to assess the presence of karst features and endangered species:
Remote sensing techniques, such as video cameras or geophysical techniques such as electrical resistivity, microgravity, ground penetrating radar, or natural potential, may be helpful in assessing the presence of a void or the extent of a known feature that may contain suitable habitat. It should be noted that use of such techniques cannot determine the presence of endangered invertebrates. If using these techniques detects inaccessible voids that have potential to lead to a cave, coreholes or boreholes should be drilled in and near the voids to allow for baiting (see *Baiting* under Step 5 below). Please note that some karst invertebrate species, such as spiders and harvestmen, are less likely to be captured by baiting (George Veni, George Veni & Associates, in litt. 2003). Therefore, coreholes should be large enough to allow for human-access to conduct surveys. The results of such samples will assist in determining whether endangered karst invertebrates are likely to be present. However, finding only non-endangered invertebrates in borehole samples does not necessarily imply there are no listed species present. After all necessary biological surveys have been conducted, coreholes should be returned to a state most beneficial for the cave ecosystem (see *Restoring excavated features* below).

Restoring excavated features: Features that are excavated into caves should be left open enough that human access for biological surveys is possible. However, openings larger than 1 meter (3.28 feet) to relatively small caves may be detrimental to the karst ecosystem by increasing drying and temperature fluctuation. Excavation sites that may contain suitable habitat should be covered with material to

prevent drying of the habitat in between times when the feature is being actively evaluated. A plastic tarp covered with a light colored blanket would likely meet this need. After all necessary biological surveys have been conducted, features, caves, or boreholes should not necessarily be refilled but should remain in, or be returned to, a state most beneficial for the karst ecosystem, which may include but is not limited to (1) returning the entrance to its pre-excavated condition (for example to reduce air flow if the original entrance was small) or (2) installing a cave gate to prevent large mammal access (for example, feral hogs).

Step 4a. If no suitable habitat for endangered karst invertebrates exists, then no further excavation is necessary. A final karst feature survey report should be provided to the Service if excavation is conducted under a 10(a)(1)(A) permit (see *Appendix I* for reporting requirements). The requirement to report both positive and negative findings is a condition of obtaining a section 10(a)(1)(A) permit for these species. These data are important, even if findings are negative, for the conservation and recovery of the species. We would also appreciate receiving copies of karst feature survey reports, even if not conducted under a 10(a)(1)(A) scientific permit, to further our understanding of these species and their habitat requirements.

Step 4b. If suitable habitat for endangered karst invertebrates exists, then stop excavation and **proceed to Step 5**.

Step 5[4]. Conduct a Karst Invertebrate Survey. Since collection of federally-listed endangered species constitutes "take" and is a violation of section 9 of the Act without a permit, species surveys should be conducted by persons holding a valid 10(a)(1)(A) permit. The following section outlines the required survey methodology for conducting presence/absence surveys for endangered karst invertebrates in central Texas under a section 10(a)(1)(A) permit. Once the survey(s) are complete, a comprehensive report should be submitted whether endangered karst invertebrates were encountered or not (See *Appendix I* for reporting requirements). The requirement to report both positive and negative findings is a condition of obtaining a section 10(a)(1)(A) permit for these species. These data are important, even if findings are negative, for the conservation and recovery of the species.

NOTE: Any work in a cave is inherently dangerous. The presence of pits and ledges; large, unstable, overhanging rocks; and high levels of CO_2 present danger to researchers. Surveyors should use their best judgment to determine when conditions are safe to proceed. If invertebrate surveys are limited or discontinued due to safety concerns, this should be made clear in the report. Baiting (see *Baiting* below) may be recommended as an alternative under these conditions, if it can be done safely by the biologist.

<u>Number of sampling occasions</u>: To determine the presence/absence of listed karst invertebrates, survey all caves and significant features at least three times. Each survey should occur no sooner than one week apart during suitable sampling conditions (see *Suitable sampling conditions* below).

Sampling events should be separated by sufficient time to account for changes in life cycles, trends in seasonal nutrient input, and/or changes in weather conditions that may cause the species to be more or less available to collectors. However, notable differences in species abundance have been observed within as little as a week within caves that cannot be accounted for by rainfall or other surface

condition (George Veni, George Veni & Associates, in litt. 2003). Veni suggests that observed differences in species abundance may be due to life cycle changes or some other factors that we don't yet understand.

Suitable sampling conditions: The entire cave should be searched when conditions in the cave are appropriate for finding the listed karst invertebrates, generally avoiding temperature extremes and low humidity.

- The recommended time of year is spring (March through June) or fall (September through January). Ideally at least one sample should be conducted in each of the two seasons to observe species that may be more active or visible in one season or the other. *Rhadine* beetles appear to be more abundant in the spring, indicating that fall surveys may not be as useful for these species (James Reddell, Texas Memorial Museum, pers. comm. 2002).

- Recommended weather conditions include:
  - Average weather (temperature and rainfall) for time of year.
  - Surface air temperatures during the previous week should not have been greater than 37.8°C (100°F) or less than 4.4°C (40°F).
  - Lack of drought conditions.
  - Recent rainfall.
  - Absence of recent, extensive, local flooding.

Surveys conducted outside of times defined as suitable sampling conditions during which no listed species are found may not count as one of the three recommended surveys. Please contact the Service if surveys cannot be conducted during the appropriate time of year or during appropriate weather conditions.

Sampling diligence and thoroughness:
- The void/cave should be searched thoroughly.
- Search times should be proportional to the size of the void/cave.
- For caves that have large volume rooms, it may be necessary to search using a system of transects or other method to ensure the entire cave is thoroughly searched.

Thoroughness: Because karst invertebrates are small, have low population sizes, and may have behaviors that make them difficult to find, such as retreating under rocks or into passages too small for humans, it is necessary to ensure that sufficient time and effort have been spent surveying before any listed species are judged as being absent. Where applicable, the following should be done:
- Check under all loose and easily moveable rocks; rocks should be moved with care to ensure species are not injured. All rocks should be returned to their original position immediately after examination.
- Check under clumps of dried, cracked sediment; these should also be moved with care and returned to their original position after examination.
- Look in crevices, on ceilings, and walls as much as logistically possible.
- Hand-sift samples of loose sediment and look on, and in, scat and dead animals.
- To the extent practicable, search all habitat types, not only those that are believed to be the

preferred habitat of the listed species, because habitat profiles are incomplete, and this will also provide information on habitat selection by the listed species.

Specimen collection and preservation: Because the endangered karst invertebrates may not be possible to distinguish in the field from closely related species, specimens should be collected for identification by a qualified taxonomist.

- No more than ten specimens of any one species should be collected in any one cave. We also encourage the collection of up to ten specimens of any non-listed invertebrate species that cannot be identified to species in the cave. **NOTE**: Entry and collection in caves known to contain endangered karst invertebrates is not authorized, even under a section 10(a)(1)(A) permit, unless a monitoring or research plan has been approved by Austin Ecological Services Field Office.
- These collections should be identified as specifically as possible and sent to the Texas Memorial Museum, in Austin, Texas (or other appropriate museum or university) for taxonomic determination and curation (see *Appendix I, Specimen Deposition* for address).
- Adult specimens should be preserved in 70-80 percent ethanol to allow for taxonomic study. Because blind *Cicurina* and *Texella* species require adult specimens of a specific gender for positive identification (using morphological techniques), immature specimens of these species, along with any other specimens being collected solely for molecular study, should be preserved in 100 percent non-denatured ethanol.
- Specimens collected should be immediately placed in a cooler and kept there until transferred to a freezer. Before transfer to a freezer, the preservative should be discarded and replaced with new ethanol. All preserved specimens should be stored in, at a minimum, a standard freezer (-11ºC (12ºF) to -22ºC (-8ºF)) until shipped for taxonomic or molecular analysis.
- All specimens should be stored in separate vials to prevent misidentification in the event that appendages become separated from the body.
- Immature specimens collected alive with the intent of rearing them to adulthood for positive identification (for example, blind *Cicurina* and *Texella* species) should be sent to a taxonomist immediately. To promote specimen viability, surveyors should coordinate shipments with taxonomists so they will know when to expect them and can prepare accordingly.

Baiting: Baits may attract fire ants into the cave and, therefore, should be used with caution when using as an invertebrate survey technique. If baiting is used:

- Baits should be used in leads that are inaccessible for visual examination and more than 2 meters (6.5 feet) deep. Baits should be set for three to seven days and only checked at the end of that period. However, the area around the baited void should be checked daily. Any fire ant mounds found prior to, or during, baiting should be treated immediately with boiling water.
- Baits may also be used when suitable habitat is present yet multiple active searches (at least three) have not resulted in species occurrence.
- Please note that some karst invertebrate species, such as spiders and harvestmen, are less likely to be captured by baiting (George Veni, George Veni & Associates, in litt. 2003).

Reporting: Reports documenting activities under a section 10(a)(1)(A) scientific permit are to be provided to the Service annually. Reporting requirements are outlined in *Appendix I*.

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Appendix I:
United States Fish and Wildlife Service, Section 10(a)(1)(A) Karst Feature and Endangered Karst Invertebrate Surveys:
Report Requirements

An annual permit report is required for 10(a)(1)(A) permit holders. For information that should be included in these reports see Karst Invertebrate Survey Report below.

A section 10(a)(1)(A) scientific permit is not required to conduct surface walking surveys to determine the presence/absence of karst features, as no "take" of listed species is likely to occur. However, we would appreciate receiving karst feature reports. These data are important, even if findings are negative, for the conservation and recovery of the species. See Karst Feature Survey Report below for information that we would find helpful in these reports.

KARST INVERTEBRATE SURVEY REPORT: This report is **required** by 10(a)(1)(A) permittees and should include, but is not limited to, the information described below. This information will benefit the conservation of these species by furthering our knowledge of the biology and ecology of these species.

Personnel

- Names of all persons involved in the surveys and their duties.
- Each person's section 10(a)(1)(A) scientific permit number, if applicable.
- A brief summary of experience, education, and certification for each person **NOT** holding a section 10(a)(1)(A) scientific permit.
- Person(s) directly responsible for writing the report.

Location

- Location of caves and features surveyed and the property boundaries on either a USGS topographic map (7.5 minute or larger scale) or, if possible, in a GIS (Geographic Information System) layer with georeferenced location data (using global positioning system (GPS)), including references such as roads and political boundaries.
- If GPS is used, then include GPS location information for each cave or feature surveyed. Also, report the GPS unit model and its accuracy, and if any real time correction or post processing was done.
- Georeferenced data should be collected in lat-long (decimal degrees). North American Horizontal Datum 1983 (NAD 83) is preferred. If collected in an alternate coordinate system, please report the coordinate system and datum the information was collected in.

Methods

- Describe survey methodology using standards consistent with a scientific, peer-reviewed publication.
- Report whether the entire cave was surveyed or surveys were conducted along transects or following another statistical sampling method and describe that methodology.
- Report use of baiting. Include a description of the methodology used including the type(s) of bait

used, the location of bait, and the amount of time baits were left out.
- Report total time spent searching (in person-hours) specifically for karst invertebrates.
- Report date and time of day each survey was conducted.
- Report temperature and humidity on the surface and at locations inside the feature as indicated below in the section titled "Caves and Karst Features." Indicate the brand and model of the equipment used and the equipment's accuracy (degree of accuracy).
- Report weather conditions on the survey day and previous week.

Caves and Karst Features
- Describe each cave or feature surveyed and include a detailed, scaled cave map with plan and profile views.
  - Description or map should include:
    - The approximate passable length of the cave or feature.
    - Possible leads or breakdown areas that could be invertebrate habitat, but are not humanly passable.
    - The approximate heights and widths of passages
    - Locations of any standing or flowing water.
  - Describe the interior of each cave or feature surveyed including:
    - Principle formations and whether they are active.
    - Make-up of the cave floor in each section (for example, mud, breakdown with approximate sizes, powder).
    - Approximate area and depth for standing water and approximate width, length, depth, and flow rate.
    - Temperature (to the nearest 0.1°F) and relative humidity (to the nearest 1 percent). Indicate the brand and model of the equipment used and the equipment's accuracy (degree of accuracy). Temperature and relative humidity should be taken at a minimum just inside the entrance and at the deepest/farthest humanly accessible part of the cave or feature. Several locations are preferred, particularly for large caves or those with multiple rooms, and should be referenced to labeled locations on the cave map.
    - Report any indications of "bad air," (for example, high CO_2 levels or any noxious gas) and reference to labeled locations on the cave map.
- Report the result of any excavation, including reasons for discontinuing excavation.
- Describe the methodology used for restoring excavated features, if applicable.

Species and Biotic Karst Community
Report the presence of all species, listed and unlisted, observed or collected during surveys or any other activity such as during the initial karst feature survey following the TCEQ GA, including:
- Identify species (vertebrate and invertebrate) as specifically as possible, preferably to species level, including:
  - Troglobites - a species of animal that is restricted to the subterranean environment and typically exhibits morphological adaptations to that environment, such as elongated appendages and loss or reduction of eyes and pigment (Veni 2002).
  - Troglophiles - a species of animal that may complete its life cycle in the subterranean environment but may also be found on the surface (Veni 2002).

  - Trogloxenes – a species of animal that inhabits caves but must return to the surface for food and other necessities (Veni 2002).
  - Accidentals – species that may wander into caves but cannot survive there.
- Report listed species behavior when observed (for example, feeding, sedentary, moving, etc.).
- Report the presence of dead specimens (vertebrate and invertebrate) and identify them to the lowest taxonomic level possible.
- Report numbers of each species (listed and unlisted) encountered on each survey date. For highly abundant species, approximations are acceptable.
- Describe the microhabitat where species (listed and unlisted) were found, including:
  - Type of substrate the specimen was found on (for example, large breakdown; dry, fine silt; under a fist-sized rock; on the ceiling).
  - Type of rock/soil the specimen was found on.
  - Organic material found in the cave (for example, scat, bat or cricket guano, dead animals, plant material, fungus) with a reference on the cave map to where the organic material was found.
  - Proximity to water.
  - For listed species, indicate location(s) found on the cave map.
- Report any previous collections in the cave, regardless of the listing status of those species.
- Provide a description and sketch of the area immediately around the cave entrance (approximately 10 meters (32.8 feet)), including approximate percent cover by bedrock versus soil, approximate percent cover by trees or shrubs versus herbaceous plants, and approximate percent cover by deciduous versus coniferous trees.
- Also, report locations where caves/features were searched but no listed species were found and any additional information above that is available.

Species Identification

If specimens are only tentatively identified as listed species in the field and are sent to a taxonomist for verification, the final report should include the results of the taxonomist's identification. If taxonomic results are not back at the time your report is due, identify where the specimens were sent, the date they were sent, and how many specimens were included. The report should include a list of species collected (listed and unlisted species to the Genus level) and/or encountered during collections, name of collector(s), date of collection, and method of preservation/storage.

Specimen Deposition

- All specimens should be deposited with the Texas Memorial Museum at the following address or in other appropriate curated museum collections for the specimens in question:

Texas Memorial Museum
Curator of Entomology
J.J. Pickle Research Center
10100 Burnet Rd, Building 176
Austin, Texas 78758
Phone 512-471-1075

- Include date of deposition and collection number, if available, in final report.

KARST FEATURE SURVEY REPORT: While a report on the surface survey for features is not required, we would appreciate if you prepared and submitted a comprehensive written report following the completion of karst feature surveys. This information will increase our understanding of these species and will assist in making decisions on management and conservation and in evaluating and refining scientific survey procedures for determining presence/absence. In addition to the information required by the TCEQ's GA, the following information would be helpful to include:

Personnel
- Names of all persons involved in the surveys and their duties in the karst feature survey report.
- Each person's section 10(a)(1)(A) scientific permit number, if applicable.
- Person(s) directly responsible for writing the report.

Feature Survey Methodology
Describe survey methodology using standards consistent with a scientific, peer-reviewed publication. Please include in the report:
- Total time spent searching for karst features and spacing and direction of all transects.
- A map of the survey location with transects and features identified.
- Results of reconnaissance excavations and methodology used for restoring excavated features, if applicable. (Note: for excavations that go below 30 centimeters (1 foot) deep, we recommend the surveyor have a 10(a)(1)(A) permit because take is more likely to occur below this depth.)

Supporting information
- Citations for all references used or consulted in the final report.
- Definitions of any terminology that would not be common knowledge to persons with general scientific, non-geology specific backgrounds including terminology specifically used by or for agencies other than the Service, for example, the Texas Commission on Environmental Quality (TCEQ).
- Results of any additional studies related to the karst investigations, for example, biological observations, remote sensing for subsurface voids, hydrological studies, etc.

Appendix II:
United States Fish and Wildlife Service, Section 10(a)(1)(A) Endangered Karst Invertebrate Surveys: Surveyor Qualifications

The following levels of expertise are required for issuance of a section 10(a)(1)(A) scientific permit to conduct presence/absence surveys for endangered karst invertebrates in central Texas. The Service will consider, on a case-by-case basis, granting a section 10(a)(1)(A) scientific permit to individuals who do not meet these qualifications but who have demonstrated adequate/appropriate experience to conduct this work.

1. To be considered qualified by the Service to conduct unsupervised presence/absence surveys for listed karst invertebrates and to supervise others in the field, conditions described below should be met:

- The person has extensive experience collecting and identifying both endangered and non-endangered karst invertebrates in Texas, with at least one year of experience collecting and accurately identifying, at least to genus, the endangered karst invertebrates in the county being surveyed, where all collections were properly documented, verified by an expert taxonomist, and deposited in a museum or university collection, for example, the Texas Memorial Museum. Also, the person can provide at least one letter of recommendation from a taxonomist or collection curator to whom their collected specimens were regularly sent. Equivalent collection experience in caves outside of Texas may be acceptable; the Service will review these on a case-by-case basis.

2. To be considered qualified by the Service to conduct presence/absence surveys for endangered karst invertebrates under the on-site supervision of an individual with a permit to conduct unsupervised presence/absence surveys, the following condition should be met:

- The person has completed adequate field training to be able to collect and identify, at least to genus, the endangered karst invertebrates in the county being surveyed under the supervision of an individual with a permit to conduct unsupervised presence/absence surveys and can provide at least one letter of recommendation from these individuals.

The individual supervising is responsible for ensuring that the assistant is capable of not only identifying, to genus, endangered karst invertebrates, but also of the assistant's ability to spot the karst invertebrates in the field (particularly those less than 0.5 mm (0.019 inch)).

NOTE: Other individuals may be permitted to accompany permittees into caves to gain experience or for the reasons of caving safety. These individuals are **not** permitted to collect endangered karst invertebrates. Also, a section 10(a)(1)(A) permit may be issued to a qualified geologist with demonstrated experience in karst geology covering "take" of endangered karst invertebrates that may occur during a habitat assessment and/or excavation and for the collection of endangered karst invertebrates encountered while conducting these activities. However, the above surveyor qualifications must be met for issuance of a permit to conduct presence/absence surveys for endangered karst invertebrates.

Appendix III:
Section II-A of the TCEQ Procedure For Conducting a Geologic Assessment TNRCC-0585-Instructions (Rev. 5-1-02) to Geologists for Geologic Assessments on the Edwards Aquifer Recharge/Transition Zones

[Note: we have appended applicable portions of Section II-A that we recommend you use to locate karst features. In some places, the text here may be modified slightly from that in the TCEC document. For TCEQ purposes, please see their original and most current document.]

A. Procedure For Conducting A Geologic Assessment

The general procedure for conducting a geologic assessment is to perform the following steps: research information, perform a field survey, evaluate data, return to the site if necessary, make conclusions, and make a report with your feature assessments and recommendations. A geologic map, notes, photographs and/or sketches should be made while in the field. These data may be used and included in your final report.

Research information

Published reports and maps of area geology should be studied prior to performing the field survey. A literature or database search should be conducted for the presence of documented caves or other *karst features* on the property or in proximity to the property boundary. Information may be found about known *caves*, such as mapped extent, depth or elevation or orientation, on the subject property or on adjacent tracts. Some commonly used data sources for geologic maps and cave location and interpretation are included in the "Citations for Sources of Further information" in these Instructions [See TCEQ, GA for these citations.]

Evaluate former land use practices and modifications. Interview persons knowledgeable about historical activities such as well drilling, irrigation or water control ditches or trenches, pit or structure construction, episodes of brush clearing and tree pulling, and cave filling or excavation. In ranches that have been occupied for a long time, manmade features can be degraded and overgrown and be confused with natural features. Human activities also may obscure indicators of natural processes that otherwise could be used to determine the sensitivity of a feature.

Aerial photos may be examined for the presence of structural features that should be field checked and plotted on the map.

Perform a field survey

The entire subject site must be walked to survey the ground surface for the presence of geologic and manmade *features*. It is recommended that the site be walked systematically in spaced transects 50 feet apart or smaller, paying close attention to streambeds and structural features observed on aerial photographs. The transect pattern should be adapted to insure that the geologist is able to see features and will vary with topography and vegetation on the site. Streambeds, including dry drainages, are significant because runoff is focused to them. Not only are features in streambeds likely to receive large volumes of recharge, but they are likely to be part of hydrologically integrated flowpaths because

past flow has preferentially enlarged and maintained conduits. Features in streambeds are likely to be obscured by transported soil or gravel (swallets or swallow hole). Structural features such as faults and fracture zones have influenced karst processes in the Edwards recharge zone, and awareness of these structures may be helpful in completing a high-quality assessment. The assessment must include the path of any proposed sewer line that extends outside of the WPAP assessed area, plus 50 feet on either side. Any features identified should be marked where possible with flagging or stakes, accurately located, preferably using a GPS, assigned a unique number, the location accurately plotted on the geologic map.

[Note: After all karst features are located and mapped, please return to Step 3 of the "United States Fish and Wildlife Service, Section 10(a)(1)(A) Scientific Permit Requirements for Conducting Presence/Absence Surveys for Endangered Karst Invertebrates in Central Texas" to determine if potential karst invertebrate habitat may be present.]