MANAGEMENT PLAN FOR THE LANDS MANAGED BY THE WILLIAMSON COUNTY CONSERVATION FOUNDATION UNDER THE WILLIAMSON COUNTY REGIONAL HABITAT CONSERVATION PLAN

JUNE 2021

PREPARED FOR

Williamson County Conservation Foundation

PREPARED BY

SWCA Environmental Consultants

NOTE: A sentence indicating the WCCF would no longer seek conservation opportunities related to the black-capped vireo was added to the end of the Introduction. No other changes were made to the Williamson County Conservation Foundation's preserve management plan in 2020.

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1 INTRODUCTION

Williamson County (the County) and the Williamson County Conservation Foundation (WCCF) were issued an incidental take permit (ITP) by the U.S. Fish and Wildlife Service (USFWS) in October 2008 to authorize adverse effects to endangered species resulting from public and private development projects. The County began development of the Williamson County Regional Habitat Conservation Plan (RHCP) in 2005 with funding and technical assistance from the USFWS. The RHCP (SWCA Environmental Consultants [SWCA] et al. 2008) authorizes the *take* of the Bone Cave harvestman (*Texella reyesi*), the Inner Space Caverns mold beetle (formerly known as the Coffin Cave mold beetle) (*Batrisodes texanus*), the golden-cheeked warbler (*Setophaga chrysoparia*; GCWA), and the black-capped vireo (*Vireo atricapilla*; BCVI) (collectively, the Covered Species). 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" (16 U.S. Code 1532[19]).

Take of endangered species is mitigated primarily through the establishment and management of multiple preserves, providing habitat for the above-mentioned Covered Species, plus a suite of other species occurring in the same habitats. The WCCF preserve system is intended to sustain high-quality habitat for species already on the endangered species list and to proactively conserve habitat to preclude the need to list other species. Permitted and additional species covered under this plan are included in Tables 1 and 2. This document describes the management activities necessary to maintain and enhance habitat conditions as required by the ITP.

The purpose of this Management Plan for the Lands Managed by the WCCF (management plan) under the RHCP is to establish protocols for the operation, management, and monitoring of preserves consistent with the conservation of the permitted and additional species listed in the RHCP (SWCA et al. 2008: Chapter 3). All monitoring and management will be the responsibility of the WCCF unless otherwise stipulated in the management plan for a specific preserve (SWCA et al. 2008: Appendix B). The USFWS requires monitoring and reporting to ensure compliance with the terms of the ITP and to verify progress toward the RHCP's biological goals and objectives. The biological goals of the RHCP are to support recovery efforts for Covered Species and to proactively conserve the additional species in order to preclude the need for their listing (SWCA et al. 2008: Chapter 5.1.1.1).

For covered karst invertebrate species, measurable objectives to realize these goals include acquiring and managing multiple Karst Fauna Areas (KFAs) in each of three Karst Fauna Regions (KFRs) in perpetuity. The RHCP indicates that nine to 15 KFAs be acquired and managed by year 10 (SWCA et al. 2008: Chapter 2.3). The KFAs will total 700 acres and should comprise a minimum of three KFAs in each KFR (SWCA et al. 2008: Chapters 2.3 and 5.1.1.3). The County has also committed to assuming perpetual management and monitoring responsibilities for 10 of 22 existing conservation areas identified within the RHCP, regardless of KFA status (SWCA et al. 2008: Chapter 2.3). In addition, the County will further enhance recovery efforts by applying for federal and other funding to acquire and manage an additional two KFAs per KFR over the nine to 15 KFAs discussed above, totaling a minimum of 240 acres. The USFWS identified several potential KFAs in Williamson County in the 5-year status review for the Bone Cave harvestman (USFWS 2018a).

For the GCWA, the County will pursue conservation opportunities within Recovery Region 5, and if sufficient high-quality habitat is acquired, the County will establish a conservation bank managed in a manner similar to the existing Hickory Pass conservation bank (SWCA et al. 2008: Chapter 5.1.1.3). For the BCVI, the County will no longer pursue conservation opportunities since this species is now delisted due to recovery (USFWS 2018b).

The Georgetown salamander (*Eurycea naufragia*) is not a covered species and is considered an "additional species" that will receive collateral benefit from the RHCP-derived conservation measures. All preserve lands within the potential drainage areas of occupied springs will be managed in such a manner as to maintain and enhance water quality and to minimize the potential for groundwater contamination. The Georgetown salamander was listed by the USFWS as a threatened species on February 21, 2014. A special 4(d) rule has been created, as part of the listing of the Georgetown salamander. Under the 4(d) rule, incidental take of Georgetown salamanders that results from activities conducted in compliance with City of Georgetown Ordinance 2013-59 (Edwards Aquifer Recharge Zone Water Quality Ordinance) will not be prohibited.

The results of preserve monitoring will be included under separate cover and submitted to the USFWS on June 1 of each year of the 30-year permit (SWCA et al. 2008: Chapter 7.2 states, January 1 is the due date for annual reports; however, the current deadline for annual report submittal is June 1 of each year). This required information includes the locations of surveys, a description of any deviations from required survey protocols, personnel conducting surveys, and documentation of all survey results as required in the protocols for each listed species (SWCA et al. 2008: Chapter 7.2). Survey results are presented to the AMWG and the WCCF Director; both of which work to prioritize research needs.

Table 1. Permitted Species Identified in the Williamson County Regional Habitat Conservation Plan

Species	Known Karst Fauna Regions of Occurrence	Notes
Bone Cave harvestman (*Texella reyesi*)	McNeil/Round Rock, Georgetown, North Williamson County	The Bone Cave harvestman is an obligate cave-dwelling harvestman restricted to Travis and Williamson Counties (USFWS 1994). Ubick and Briggs (1992) indicate that most Bone Cave harvestmen have been observed in the deep recesses of the cave environment, past the twilight zone in the permanent dark. The total number of known locations for the Bone Cave harvestman has increased from 70 in 1994 (USFWS 1994) to 138 in 2004 (Ubick and Briggs 2004) to 203 in 2018 (USFWS 2018a), primarily due to biological surveys being conducted in new locations. The geographic range of the species covers an area approximately 30 miles (48 kilometers [km]) long and up to 14 km (9 miles) wide between northern Travis County and northern Williamson County.
Inner Space Caverns mold beetle (*Batrisodes texanus*)*	Georgetown, North Williamson County	The Inner Space Caverns mold beetle is 2.60 to 2.88 mm (0.10 to 0.11 inch) in length. Fully developed eyes are lacking, with granules present instead (Chandler 1992). The USFWS states that the Inner Space Caverns mold beetle is predatory, with prey including mites (USFWS 1994). The Inner Space Caverns mold beetle is considered troglobitic because individuals of this species have been observed past the twilight zone in total darkness and are blind. The Inner Space Caverns mold beetle and the Dragonfly Cave mold beetle collectively range across an expanse of the Edwards Aquifer recharge zone measuring approximately 20 km (12.4 miles) long north/south by 10 km (6.2 miles) wide east/west. The total number of blind mold beetle locations has increased from five in 1994 (USFWS 1994) to 24 in 2018 (USFWS 2018c).
Golden-cheeked warbler (*Setophaga chrysoparia*)		Breeds exclusively in oak-juniper woodlands of the Edwards Plateau and the Cross Timbers Level III ecoregions of central Texas. Potential habitat includes woodland patches greater than 11 acres in size. Winters in oak and pine-oak woodlands of southern Mexico and northern Central America.
Black-capped vireo (*Vireo atricapilla*)		Occurs in shrubby habitats in western, central, and north-central Texas with a few localities in Oklahoma; also occurs in northeast Mexico. Minimal potential habitat in Williamson County. Winters on the Pacific slope of western Mexico.

Source: SWCA et al. 2008: Chapter 3

* Chandler and Reddell (2001) described a new species of *Batrisodes* for Williamson County. They named it the Dragonfly Cave mold beetle, based on a specimen that was previously thought to be a Coffin Cave mold beetle. The Dragonfly Cave mold beetle (*Batrisodes cryptotexanus*) is 2.80 to 3.04 mm (0.11 to 0.12 inch) in length, with eyes completely lacking (Chandler and Reddell 2001). The USFWS does not recognize the split between *B. texanus* and *B. cryptotexanus* and considers all the *Batrisodes* with reduced eyes in Williamson County to be the listed form, *B. texanus* (USFWS 2018c). Following this policy, the Williamson County RHCP treats all reduced-eyed *Batrisodes* as *B. texanus*.

Table 2. Additional Karst Species Identified in the Williamson County Regional Habitat Conservation Plan

Species	Known Karst Fauna Regions (KFRs) of Occurrence	Notes
SPIDERS		
Eyeless spiders of the genus *Cicurina* (subgenus *Cicurella*) are the remaining troglobites of the central Texas karst listed in the RHCP. *Cicurina* spiders comprise up to 60 species (Cokendolpher 2004; Mitchell and Reddell 1971).		
Cicurina n. sp.	Cedar Park	Known from Lakeline Cave only. Phylogenetic data from Hedin (2015) indicate this is *C. buwata.*
Cicurina browni	Georgetown	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 Farm-to-Market Road (FM) 1431 northward toward Lake Georgetown.
Cicurina buwata	Cedar Park McNeil/Round Rock Jollyville	Thought to occur in caves (many in Williamson County) along the Williamson/Travis County line (Hedin 2015).
Cicurina travisae	Cedar Park Jollyville	Thought to occur in caves between Brushy Creek and the Colorado River, but is restricted to western Edwards limestone in Travis County (Hedin 2015).
Cicurina vibora	North Williamson County	Thought to occur in 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*.
Tayshaneta (syn. *Neoleptoneta*) *anopica*	North Williamson County	Known only from Cobbs Cavern and represents the only known eyeless *Tayshaneta* in Texas (Gertsch 1974; Reddell 1965).
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.		
Aphrastochthonius n.sp.1	North Williamson County	Known only from 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 USFWS (Reddell 2004).
Tartarocreagris infernalis	Cedar Park McNeil/Round Rock Georgetown North Williamson County Jollyville	Known from many caves in Williamson County (Reddell 2004). Distribution indicates this species 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.
MILLIPEDES		
Speodesmus bicornourus	McNeil/Round Rock Georgetown North Williamson County Central Austin Jollyville	Known from many caves in Williamson County and adjacent counties (Reddell 2004).
COLLEMBOLA (Springtails)		
Oncopodura fenestra	Georgetown North Williamson County Southern Travis County	Known from few caves in Williamson County southern Travis County (Reddell 2004).
Arrhopalites texensis	Cedar Park North Williamson County Southern Travis County	Known from few caves in Williamson County and southern Travis County (Reddell 2004).

Species	Known Karst Fauna Regions (KFRs) of Occurrence	Notes
GROUND BEETLES		
Three species of *Rhadine* ground beetles are on the endangered species list, including Tooth Cave ground beetle (*Rhadine persephone)* 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 mostly from caves 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 toward the Williamson County line, but not beyond (Reddell 2004).
Rhadine persephone	Cedar Park	Federally endangered species mostly known from Williamson County caves near Tooth Cave; though some Travis County locations are known (HNTB Corporation 2005).
Rhadine russelli	N/A	Known from Post Oak Ridge KFR in extreme western Williamson County caves with documented cave inhabitation within Travis and Burnett Counties (Reddell 2004).
Rhadine subterranea subterranea	McNeil/Round Rock	Ranges from Brushy Creek south into Travis County. The species is known mostly from Cedar Park KFR (Reddell 2004).
Rhadine subterranea mitchelli	Georgetown Jollyville	Found only in Williamson County and ranges from Brushy Creek north to the north branch of the San Gabriel River (Reddell 2004).
MOLD BEETLES		
Batrisodes reyesi	Georgetown	Known from Post Oak Ridge and North Williamson County KFRs. Currently known from very few Williamson County caves, with distribution including northern Travis County and 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 USFWS does not recognize the split (USFWS 2018c). Species identified as *B. cryptotexanus* is only known from Williamson County caves near Sun City (Chandler and Reddell 2001; D.S. Chandler, personal communication to K. White, 2006).
Salamanders		
All four salamanders discussed below—Georgetown salamander, Jollyville Plateau salamander, Salado Springs salamander, and Buttercup Creek salamander—are neotenic (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).		
Georgetown Salamander (*Eurycea naufragia*)	N/A	This species was listed as threatened by the USFWS on March 26, 2014. 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 residential development (Chippindale et al. 2000; A. Price, Texas Parks and Wildlife Department, pers. comm. to SWCA Environmental Consultants, 2006).

Species	Known Karst Fauna Regions (KFRs) of Occurrence	Notes
Jollyville Plateau Salamander (*Eurycea tonkawae*)	N/A	This species was listed as threatened (Federal Register 78:51277) on August 20, 2013. It 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 (Chippendale et al. 2000). Devitt et al. (2019) indicate this species may occur as far north as San Gabriel Springs, near Georgetown.
Salado Springs Salamander (*Eurycea chisholmensis*)	N/A	This species was listed as federally threatened on March 26, 2014, and has similar habits and life history to Georgetown and Jollyville Plateau salamanders. This species is known from springs in Bell County and may also occur at springs in the nearby Buttermilk Creek watershed (Chippindale et al. 2000). Hillis et al. (2015) indicates the species may range from Bell County south towards Lake Georgetown.
Buttercup Creek Salamander (Eurycea aff. *tonkawae)*	N/A	The Buttercup Creek salamander is known only from the Buttercup Creek Cave karst system in southwestern Williamson County. 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. Devitt et al. (2019) indicates that this species is likely the Jollyville Plateau salamander.

N/A = Not Applicable

1.1 Management Philosophy

Long-term monitoring of preserve integrity is a necessary component of adaptive management and a required feature of Habitat Conservation Plans. Adaptive management is an iterative process that helps reduce uncertainty in natural resources management by incorporating into flexible management plans new information as it becomes available. The basic foundation of the adaptive management concept is the "*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 (Walters 1986).

Limited scientific information is available on the central Texas karst invertebrate and salamander 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 the Williamson County RHCP. For example, the ongoing focus of RHCP-sponsored research could include the amount of active management needed by cave preserves and the necessary extent and type of red imported fire ant (*Solenopsis invicta;* RIFA) control.

This management plan formalizes the process that ensures the appropriate implementation of adaptive management. The process will be administered by the AMWG as described in the RHCP (SWCA et al. 2008: Chapter 8.2).

The AMWG is composed of seven members, including the RHCP administrator plus one representative each from the USFWS, the Texas Parks and Wildlife Department (TPWD), the Williamson County government, the RHCP citizens advisory committee, the RHCP biological advisory committee, and the scientific community. This group reviews the annual reports and makes recommendations for specific changes in management strategies. 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 and restoration/enhancement efforts), and the effectiveness of WCCF at achieving RHCP goals. The AMWG will meet at least twice a year: once to review WCCF's annual report to the USFWS, and once to review, approve, and/or recommend modifications to the annual operating/financial plan.

The RHCP (SWCA et al. 2008: Chapter 8.3) incorporates the following four-part adaptive management framework for HCPs:

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

   This aspect of adaptive management was originally addressed in the RHCP in the context of determining the size and extent of a KFA given some of the inherent uncertainties of karst systems. In the context of the management needs of both KFA and non-KFA preserves in their existing configuration, the relevant questions consider the specific current and potential threats and the evidence that those threats may have to impacted species of concern. Annually, the AMWG will discuss the uncertainties relative to individual species and preserves, as well as changing perceptions of those uncertainties in light of future research and monitoring data. New information will be utilized to benefit Covered Species in a timely manner.

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

   A key element of the adaptive management process is flexibility for the development of alternative management strategies when research, experimentation, or common sense indicates changes in management are needed. The RHCP has identified several potential threats to the karst invertebrates and salamanders, and it is important that WCCF be capable of precisely identifying what adaptive management actions will occur if any of these threats are realized on specific preserves. For example, trespassing was an issue for the newly acquired Twin Springs KFA, which could have led to harassment of GCWA and impacts to other resources. Coordination with the Williamson County Sheriff's Department led to law enforcement action, and trespassing activity has decreased.

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

   The RHCP calls for regular and consistent monitoring and management activities for both aboveground and belowground habitat. Karst habitat monitoring guidelines are detailed in the RHCP (SWCA et al. 2008: Appendix B) and can be tailored for individual habitats upon the acquisition of novel information. The RHCP (SWCA et al. 2008: Chapter 8.3) indicates the adaptive management process allows for site-specific monitoring plans for each KFA.

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 AMWG. Consistent with the No Surprises Assurances described in the RHCP (SWCA et al. 2008: Chapter 10), if a determination is made by the AMWG 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 USFWS 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 AMWG may recommend to the RHCP administrator (also 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 RHCP amendment(s).

1.2 Plan Organization

Although all of the Williamson County preserves function as part of one habitat bank, each individual preserve contains a different combination of resources and is subject to its own set of potential threats and management issues. While parts of some preserves are generally open to the public for recreation, others are closed or are accessible only on a limited basis. While some preserves are located entirely within a rapidly urbanizing setting with land development on all sides, others are in rural areas of the County with relatively little development pressure. Accordingly, this plan details activities supporting general preserve integrity to be implemented at all preserves. Specific resource sections applying to individual preserves are detailed within the Preserve Description report (Van Kampen-Lewis and White 2020a).

2 GENERAL PRESERVE INTEGRITY

This section covers management activities to be carried out for all preserves regardless of the species present. These activities are intended to maintain and enhance habitat for native wildlife in general. Williamson County is one of the fastest-growing parts of the country and as such, the preserves covered by this management plan are expected to face continued pressure within an urbanizing county. Adaptive management is, therefore, a central tenet of management strategies. Long-term integrity of the preserves will depend upon early detection of potential threats and the ability of managers to allocate management resources to respond to those threats.

Any activities or access not consistent with the stated habitat conservation objectives are prohibited within the preserves.

2.1 Routine Inspections

Routine inspections will be conducted on a monthly basis and may cover the preserve perimeter and the areas near cave entrances and spring runs (SWCA et al. 2008: Appendix B). These regular inspections will include, but may not be limited to, checking for signs of vandalism and unauthorized entry; damage to cave gates, fencing, and/or preserve signs; damage to vegetation; presence of invasive species; trash dumping; and any other existing or emerging conditions that could impact the listed species or the karst ecosystem.

Routine inspections will include counting all visible RIFA mounds within a 10-meter (m) (33-foot) and 50-m (164-foot) radii of the cave entrance. All RIFA mounds within 50 m (164 feet) of cave entrance will be treated with boiling water (biological soap may be used in conjunction with boiling water) twice per year (spring and fall), regardless of infestation level. Additional control efforts will occur on mounds found within 10 m (33 feet) of cave entrance or if 80 mounds are found within 50 m (164 feet) of cave entrance. Should RIFA 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 practical, hot water treatments will be conducted during early to mid-morning during moderate weather when the queen(s) and larvae are likely to be near the top of the mound, per 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. Additionally, consideration will be made for changing the treatment regime as determined appropriate by other scientists and to incorporate new research.

Crazy ants (*Nylanderia fulva*) are also becoming more common in the area and nest removal may become necessary as more information becomes available regarding this species and its effects on species of concern in Williamson County. Qualified professionals will continue these programs in perpetuity. The annual report will document both the need for corrective action and the actions taken or not taken.

Other types of routine inspections include:

- Evidence of trespassing will be reported to the Williamson County Sheriff's office.
- The preserve areas will be inspected regularly for the establishment of exotic plants.
- The Williamson County Preserve and Trail Steward completes site inspection forms to be maintained as supporting documentation for the annual report.

2.2 Vegetation Management and Monitoring

Native vegetation will be maintained or improved within the preserves. No significant clearing, mowing, cutting, thinning, or other activity that removes native vegetation will occur within the karst preserves unless approved by the USFWS. This prohibition does not include routine maintenance around the preserve boundary or other areas required for preserve access. The RHCP (SWCA et al. 2008: Chapter 5.3.1.1) indicates a baseline vegetation survey will be conducted for KFAs within a 152-m (500-foot) buffer area around caves and Appendix B of the RHCP (SWCA et al. 2008) indicates karst preserves should receive a "description of the vegetative association in the aboveground preserved area."

If during surveys/site inspections or during AMWG review of reports, any of the following conditions are determined to be present, then adjustments to the management program may be warranted:

- Destruction or deterioration of surface vegetation and deleterious shifts in community composition regardless of cause.
- A significant imbalance in the community structure of the native plant community as evaluated against literature examining the typical mature vegetation composition for these community types.
- An increase in non-native flora or an abnormal constituent of the dominant plant community within the karst preserves.

Such impacts could result from excessive drying of the plant community along the edges of the preserve, fire, storm damage, invasion of exotics, oak wilt, or other diseases or perturbations. Adjustments will be made within a reasonable time by the County in consultation with the USFWS.

Oak wilt is a disease of the family Fagaceae (*Quercus* sp.) caused by the fungus, *Ceratocystis fagacearum* (Jones and Phelps 1972). Oak wilt represents a significant threat to the GCWA due to the potential to significantly impact key components of nesting and rearing habitat. There is currently no cure for oak wilt, though several measures to manage the disease are available. If oak wilt is detected within or adjacent to preserve areas, WCCF will solicit recommendations by the Texas Forest Service and address the threat as part of the adaptive management process.

2.2.1 Fire Management

Prolonged drought occurrence is possible and greatly increases the potential for a catastrophic wildfire event. In such a case, the security provided by the creation of fire breaks within preserve areas may outweigh the loss of a small amount of vegetation but could increase exotics and non-native species, including RIFA. The County will seek prior USFWS approval of any fire breaks to be created within preserve areas. In the event of a drought, signs will be placed at prominent locations around the preserve warning of the fire hazard conditions. Additionally, WCCF will coordinate annually with the local fire department to keep them informed of preserve access points, existing roads, fire threat conditions, and any other relevant information.

Future adaptive management may include prescribed burns as a management tool for vegetation and bird habitat. Prescribed burns will be considered carefully on a case-by-case basis by the AMWG in coordination with the USFWS and other appropriate entities.

2.3 Fencing, Signage, and Access Point Maintenance

Access to preserves will be generally restricted to authorized personnel and researchers approved by WCCF. Limited public access will be available to all preserves under conditions consistent with the conservation of the species. Note that some preserves are located within public parks (e.g., Millennium, Wilco, Twin Springs, and Shaman Cave Preserves) and access is limited via signage, fencing, cave gates, or by access pass distribution.

Unless otherwise approved and stipulated by the USFWS and/or landowner, all preserves will include perimeter fencing to deter trespassing, trash dumping, and other forms of vandalism. Perimeter fences must control non-authorized access, and are anticipated to be low-security (e.g., five-strand, 4-foot-tall barbed wire fence) and designed to be inconspicuous or aesthetically pleasing to fit in with adjacent land use. No back-of-lot gates will be allowed. Signs, to be approved by the USFWS, will be placed along all fences to further minimize the potential for vandalism and unauthorized access to the karst preserves. In most cases, 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 2.0 m (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, which are important components of the karst ecosystem, from passing through the fence. This can easily be accomplished by leaving animal access holes, similar to those used in cave gates, at ground level at least every 5 m (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. Consideration will be given, subject to USFWS approval, to areas that may not require perimeter fencing due to adjacent open space. Adjustments will be made within 30 days of the USFWS's determination.

All preserves will have officially designated points of access or entry. Entry gates will remain locked at all times when unattended. Necessary repairs to fencing, gates, and signs will be initiated promptly if any of these are found to have incurred damage. If vandalism or trespassing occurs, the USFWS may determine that increased monitoring or security may be warranted, which may include, but is not limited to, more frequent surveys of the fences, installing or improving cave gates, increased barbwire strands, and/or installing cave security fences. Adjustments will be made within a reasonable time in consultation with the USFWS.

2.4 Community Outreach and Landowner Relations

Preserve integrity depends to an extent on the activities of adjacent landowners and careful visitation by community members where appropriate. In the interest of maintaining good relations with neighbors and building community support for the preserve system, the County will implement such outreach and educational actions as called for in the RHCP (SWCA et al. 2008: Chapter 5.8). Preserve-specific outreach activities will enhance public awareness of the preserves and may include a variety of in-situ and ex-situ educational programs. Materials produced by the County to enhance public awareness of the preserves will include species-related multi-media educational materials.

2.5 Mammal Monitoring and Management

Deer and feral hogs often occur in greater densities adjacent to suburban areas than in undeveloped areas due to greater availability of food. High densities of deer and feral hogs are known to have a long-term adverse effect on the abundance and distribution of deciduous trees, seedlings, and saplings by increasing browsing pressure (deer) and uprooting vegetation (hogs). The subsequent decrease in the deciduous tree component of the wooded areas could lead to shifts in both plant and animal communities.

During annual inspections of entire preserve areas, surveyors will note any excessive browsing pressure, lack of oak seedling recruitment, and vegetation damage. If vegetation impacts are observed, they will be reported for consideration and remedied by the AMWG. Remedies may include hunting, trapping, or other deer and hog population reduction programs. Deer and/or hog populations will be controlled as allowed by state game regulations and local ordinances.

3 KARST INVERTEBRATE MANAGEMENT AND MONITORING

Due to the nature of karst invertebrate habitat, this plan contains an underground component, a feature not usually found in wildlife management plans. Although karst invertebrate species depend upon nutrient input derived from the surface, and although most management activities will take place on the surface, the best measures of troglobitic ecosystem health are observed directly from the subsurface. Management and monitoring for karst invertebrates is therefore composed of regular monitoring of the surface area, followed by periodic monitoring of biotic and abiotic conditions within the caves. Goals for the karst preserves include maintaining high-quality habitat conditions for karst species by maintaining stable temperature and humidity conditions, maintaining or restoring native vegetation, preventing the introduction of exogenous contaminants, and controlling the effects of invasive species.

In addition to preserves that are directly related to the RHCP impact/mitigation formula, the County has also taken responsibility for management and monitoring of mitigation preserves associated with local transportation projects and other non-traditional means. For the sake of efficiency, consistency of

methods, and comparability of results, this document consolidates management activities for all preserves under one plan.

3.1 Biological Monitoring

Long-term monitoring of preserve integrity is a necessary component of adaptive management and a required feature of HCPs. Monitoring is particularly important for terrestrial karst invertebrates due to the relatively poor scientific understanding of their habitat dynamics. Monitoring data are the best and only available measure of preserve performance. Ecological monitoring of karst preserves will be conducted annually by personnel holding a valid Section 10(a)(1)(A) scientific permit issued by the USFWS. Long-term monitoring data will be used to track the following preserve attributes and will follow guidelines from Appendix B of the RHCP (SWCA et al. 2008).

1. **Biodiversity:** Annual ecological surveys (one biotic survey per year for each cave in each preserve) will survey for the presence of listed species and non-listed species that constitute a healthy troglobitic ecosystem, typically in the second half of each year. Surveyors will use methods generally consistent with USFWS protocols. Many cave preservation areas are established following the discovery of only a single endangered taxon, and because 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 known 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 during in-cave ecological surveys. Because 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-cave abundance data may allow for population modeling in the long term. Another measure of ecosystem function is the abundance of trogloxene species as they emerge from the cave to forage. Cricket (*Ceuthophilus* sp.) exit counts will include numbers and life stages of individuals exiting per 10-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.

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. Tabulated summaries of the relative humidity and air temperature data collected for each survey are provided in the Yearly Activities Report (Van Kampen-Lewis and White 2020b).

4. **Nutrient input:** Any significant changes in surface vegetation (e.g., exotics, fire) and quantity of nutrient sources in the cave (e.g., trogloxene guano, leaf litter, and 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 the time that the RHCP was accepted/approved, will be tracked and evaluated throughout the year. 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, WCCF will comment on the events in the annual report and determine appropriate actions to remedy the potential threat in consultation with the USFWS. The AMWG meets twice per year, the WCCF Board meets twice per year (independently of the AMWG), and the WCCF Director is continually apprised of threats to the various preserves managed by the WCCF. All three entities have the ability to implement adaptive management decisions to deal with existing and emerging threats.

The WCCF-designated karst preserve caretaker will complete monitoring forms during each monitoring event.

The field of biospeleology is relatively young, and new management and monitoring techniques are likely to be developed during the 30-year duration of the RHCP. The AMWG will periodically consider new methods and their applicability to the RHCP preserves. Any proposed change to the type or frequency of the above-mentioned activities will be coordinated with the USFWS.

3.2 Cave Gating

Installation of metal cave gates is a generally accepted management practice for protecting cave animals and habitats from unauthorized access and associated impacts, which can cause significant ecological disruption. In most partially urbanized settings and for existing preserves, it is anticipated that all caves will be gated. However, managers may decide not to install cave gates on future preserves if access is sufficiently controlled and if it is determined that installing a gate could reduce habitat quality. Some caves, for example, may house both endangered invertebrates and a bat colony that could be disrupted by gate installation. The AMWG will consider caves and gates on a case-by-case basis and make such decisions in coordination with the USFWS.

4 MIGRATORY SONGBIRD MANAGEMENT AND MONITORING

This section applies to current and future WCCF preserve lands that are either known to contain or have the potential to become viable breeding habitat for the GCWA or the BCVI. Breeding pairs of GCWA are currently known to occur on the Twin Springs Preserve and, according to the Williamson County RHCP, potential habitat occurs on Southwest Williamson County Regional Park, the Chaos Preserve, and the Cobbs Cavern KFA. BCVI are not currently known to occur on any County preserve land, but patches of potential habitat occur near the Southwest Williamson County Regional Park and the Cobbs Cavern KFA.

The RHCP mitigates for impacts to the GCWA through a combination of purchase of Hickory Pass Ranch conservation bank credits and habitat acquisition within the County. Accordingly, the RHCP stipulates that operation and maintenance plans for Williamson County GCWA preserves will be similar to the plan in place for the Hickory Pass Ranch Conservation Bank.

The biological goals of the RHCP will be met on lands managed by WCCF by monitoring changes to GCWA habitat, managing/manipulating habitat to maintain its suitability for GCWA habitat, and monitoring access. Vegetation monitoring will include monitoring levels of browsing pressure, oak seedling recruitment, and construction impacts. In addition, populations of potential problem species (e.g., deer, feral hogs, and brown-headed cowbirds [*Molothrus ater*]) will be monitored and controlled, if necessary, to minimize impacts to GCWA and their habitat. For BCVI, the RHCP will use participation fees in a rolling mitigation program to restore, enhance, and manage BCVI habitat. Any known or potential BCVI habitat brought under management of WCCF will be managed in a manner consistent with applicable USFWS and TPWD guidance.

4.1 Vegetation Management

Vegetation data will be collected for preserves that may contain BCVI or GCWA habitat, per footnote 78 in the RHCP (SWCA et al. 2008: Chapter 6.1). These data will be collected using updated aerial photography and used to quantitatively compare changes in vegetation through time.

Habitat may be enhanced by promoting regeneration of oak-juniper woodlands in areas that have been previously cleared, thinned, or burned (e.g., trails, roads, or pastures). In areas where larger Ashe junipers (*Juniperus ashei*) are dominant, several small openings per acre may be created. These openings should be protected from browsing. Native hardwood seedlings may be planted to speed the process of hardwood regeneration. Slash (i.e., coarse, woody debris) may provide protection for hardwood seedlings (TPWD n.d.).

Campbell (1995:4) indicates that managers may improve GCWA habitat by removing selected young, bushy junipers, less than 3 m (10 feet) in height as long as the tree canopy is not disturbed. Likewise, thin, straight junipers may be removed from areas within habitat with a high density of juniper compared with hardwoods. The trees that are removed must have a relatively small individual canopy, and the tree selections must be scattered over the area. Such removal is predicated on basic forestry techniques, to encourage growth in the remaining trees by thinning competitors and reducing competition for water and light.

Vegetation management will also incorporate considerations for karst invertebrates prior to implementation. Areas in which efforts have been made to enhance or create habitat should be monitored for increases in densities or re-colonization by GCWA (Campbell 1995; USFWS 1992).

Clearing activities within 91 m (300 feet) of GCWA habitat will be conducted only when GCWA are not present (August 1 through March 1), unless a breeding season survey performed by a USFWS-permitted biologist indicates that no GCWA are present within 91 m (300 feet) of the desired activity.

4.2 Golden-Cheeked Warbler Monitoring

Presence/absence surveys for the GCWA will be conducted in accordance with USFWS protocols. Surveys will be conducted every other year for the first 10 years following preserve acquisition, then every third year for the duration of the permit.

A GCWA habitat evaluation will occur if the species is thought to occur within a WCCF-administered karst preserve outside of known GCWA breeding habitat. General habitat evaluations may occur during any season and should occur within one calendar year from notification to the WCCF that a karst preserve may host the species. Additional presence/absence surveys should be conducted the following breeding season after positive GCWA habitat identification is determined. Preserve management may require modification to prevent adverse effects to GCWA if the species is confirmed to breed or otherwise occupy any particular tract under WCCF administration. The WCCF should consider following the most current USFWS land management guidelines for properties with documented GCWA inhabitation. Properties over 500 acres may also be eligible for GCWA credits.

Upon locating a dead, injured, or sick GCWA, or any other endangered or threatened species, WCCF is required to contact the USFWS's Law Enforcement Office, in Austin, Texas, at (512) 490-0948 for care and disposition instructions. Extreme care should be taken in handling sick or injured individuals to ensure effective and proper treatment. Care should also be taken in handling dead specimens to preserve biological material in the best possible state for analysis of cause of death.

5 GEORGETOWN SALAMANDER MANAGEMENT AND MONITORING

The RHCP (SWCA et al. 2008: Chapter 5.6.1.1) indicates commitments to implementing a 5-year research and monitoring program for the Georgetown salamander during years 2 through 6 of the permit; with the first 2 years being focused on developing a conservation strategy.

5.1 Georgetown Salamander Management

Management actions for aquatic species such as salamanders typically focus on water quality protections. Within WCCF-managed lands, any modifications to access points, installation or maintenance of trails, and any activities that may include ground disturbance will be conducted in a manner consistent with the Texas Commission on Environmental Quality's Edwards Aquifer Protection Program guidelines and regulations. Applications of pesticides or fertilizers are generally restricted within preserve lands except where called for during invasive species management. Application of RIFA baits within the potential springshed of a Georgetown salamander habitat will be considered on a case-by-case basis by the AMWG. Community outreach efforts will be focused on landowners within the potential springshed of Georgetown salamander habitat.

5.2 Georgetown Salamander Monitoring

Georgetown salamander monitoring methods are continually refined as knowledge about the species is accumulated and recommended best management practices may change as methods are refined and new data are considered. The AMWG will evaluate monitoring methods annually and develop alternatives as needed.

6 RESEARCH ACTIVITIES

The RHCP (SWCA et al. 2008: Chapter 5.1.1.3) indicates the following research activities will occur as a function of the RHCP.

- Funding of at least $25,000 per year must be made available for research on endangered and rare species in Williamson County. These expenditures will increase by 2.5% each year, so that total funding amounts to $1.1 million over 30 years.
- The WCCF will develop and maintain a database detailing data collected within preserves.
- Funding of at least $20,000 per year will be made available for public outreach and education programs related to Williamson County conservation programs. These expenditures will increase by 2.5% each year, so that total funding amounts to $878,000 over 30 years.
- The WCCF will periodically evaluate RHCP implementation with regard to additional species and determine what, if any, of these species need additional management or conservation actions that can be addressed within the scope of the RHCP.

7 RHCP PROGRAM ADMINISTRATION

The RHCP (SWCA et al. 2008: Chapter 5.2) details the following administrative tasks to be completed by the WCCF as part of its mitigation strategy:

- 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.
- Enter into formal agreements (Participation Agreements leading to Certificates of Inclusion) 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 BCVI.
- Manage and monitor preserves.
- 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 [USFWS] on a timely basis 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.

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