THE STATE OF TEXAS §

THE COUNTY OF TRAVIS §

CONTRACT FOR MITIGATION SERVICES

THIS CONTRACT is made by and between the State of Texas, acting by and through the Texas Department of Transportation, hereinafter called the STATE, and Williamson County Conservation Foundation, hereinafter called the MITIGATOR.

WHEREAS, Transportation Code, Chapter 201, Section 201.617 (a)(3), authorizes the STATE to enter into a contract with any PUBLIC or PRIVATE ENTITY for the management of property owned by the department and used for mitigation purposes; and,

WHEREAS, the MITIGATOR acquired 30 acres of property known as the Chaos Cave Preserve (Preserve) on behalf of the STATE, located in Williamson County, identified as Exhibit B and attached to this contract, for the purpose of mitigating environmental impacts from the construction of TxDOT projects; and,

WHEREAS, the STATE has preserved and managed Big Oak Cave located in Williamson County, identified as Exhibit C and attached to this contract, for the purpose of mitigating environmental impacts from the construction of TxDOT projects; and,

WHEREAS, the primary purpose of the Chaos Cave Preserve and Big Oak Cave is to protect the species *Rhadine persephone* (Tooth Cave Ground Beetle) and *Texella reyesi* (Bone Cave Harvestman) and its habitat under the terms and restrictions outlined in the March 2004 Karst Conservation Summary Report for US 183A, identified as Exhibit D and attached to this contract; and February 2003 SH 45 Karst Conservation Summary Report, identified as Exhibit E, and attached to this contract; and,

WHEREAS, the STATE would like to convey long-term Chaos Cave Preserve and Big Oak Cave management and maintenance responsibility to the MITIGATOR to help achieve the goals of a comprehensive regional habitat conservation plan for Williamson County.

NOW, THEREFORE, in consideration of the promises, mutual covenants and agreements of the parties to be performed as hereinafter set forth, the STATE and the MITIGATOR do mutually agree as follows.

I. **STATEMENT OF SERVICES TO BE PERFORMED:** the MITIGATOR and the STATE will undertake and carry out scope of services described in Exhibit A.

II. **CONTRACT PAYMENT:** No funds are involved.

III. **TERM OF CONTRACT:** This contract begins when fully executed by both parties and shall terminate, when the United States Fish and Wildlife Service states that the recovery goals for the above species are met and they are delisted from the Threatened and Endangered Species list.

VI. **INCORPORATION OF PROVISIONS:** Exhibits A – E are attached and incorporated into this contract as if fully set forth herein.

V. **AUDIT:** The state auditor may conduct an audit or investigation of any entity receiving funds from the state directly under the contract or indirectly through a subcontract under the contract. Acceptance of funds directly under the contract or indirectly through a subcontract under this contract acts as acceptance of the authority of the state auditor, under the direction of the legislative audit committee, to conduct an audit or investigation in connection with those funds. An entity that is the subject of an audit or investigation must provide the state auditor with access to any information the state auditor considers relevant to the investigation or audit. An entity that is the subject of an audit or investigation must provide the state auditor with access to any information the state auditor considers relevant to the investigation or audit.

SIGNATORY WARRANTY: The signatories to this contract warrant that each has the authority to enter into this contract on behalf of the party represented.

THE STATE OF TEXAS	**THE MITAGATOR**
NAME OF AGENCY	NAME OF AGENCY
BY ________ AUTHORIZED SIGNATURE	BY [signature] AUTHORIZED SIGNATURE
DATE ________	DATE 7-9-08
TYPED OR PRINTED NAME AND TITLE	TYPED OR PRINTED NAME AND TITLE

EXHIBIT A

Scope of Services to Be Provided By the MITIGATOR and the STATE

Williamson County Conservation Foundation (WCCF) will be responsible for the long-term management and maintenance of the Chaos Cave Preserve and the Big Oak Cave per the terms and restrictions outlined in the *Karst Conservation Summary Report for US 183A.*

The MITIGATOR shall:

(i) preserve and protect the natural, scenic, open space, and ecological features of the Chaos Cave Preserve and Big Oak Cave.

(ii) beginning in 2008, provide funding and on-going mitigation management consistent with the *SH 45 Karst Conservation Summary Report and Karst Conservation Summary Report for US 183A*, and submit to TxDOT bi-annual reports evidencing compliance with such management responsibilities. Such responsibilities include, but are not limited, to biological surveys, cave cricket and mammal surveys, vegetation monitoring, fire ant and routine maintenance, and adaptive management if needed.

(iii) prevent any use of the Preserve that would significantly impair or interfere with the natural, scenic, open space, and ecological features of the Preserve.

Legal surface control of the 30-acre Chaos Cave Preserve shall remain assigned to Williamson County Conservation Foundation for long-term management and maintenance per the terms and restrictions outlined in the *SH 45 Karst Conservation Summary Report.*

The STATE shall:

(i) have legal surface control of the Big Oak Cave and shall remain assigned to TxDOT; however, the MITIGATOR will be responsible for the long-term management and maintenance of the cave per the terms and restrictions outlined in the *Karst Conservation Summary Report for US 183A.*

The following Exhibits were not included in the background document

Exhibit B – Maps – Chaos Cave Preserve

Exhibit C – Maps – Big Oak Cave

Exhibit D – March 2004 Karst Conservation Summary Report for US 183A

Exhibit E – February 2003 Karst Conservation Summary Report for SH 45

EXHIBIT B

Maps – Chaos Cave Preserve

Karst Features

Preserve Boundary

0 100 200 300 400 FT

0 25 50 75 100 m

PBSJ • Engineering • Environmental Consulting • Surveying

Figure 1

CHAOS CAVE
KARST PRESERVE

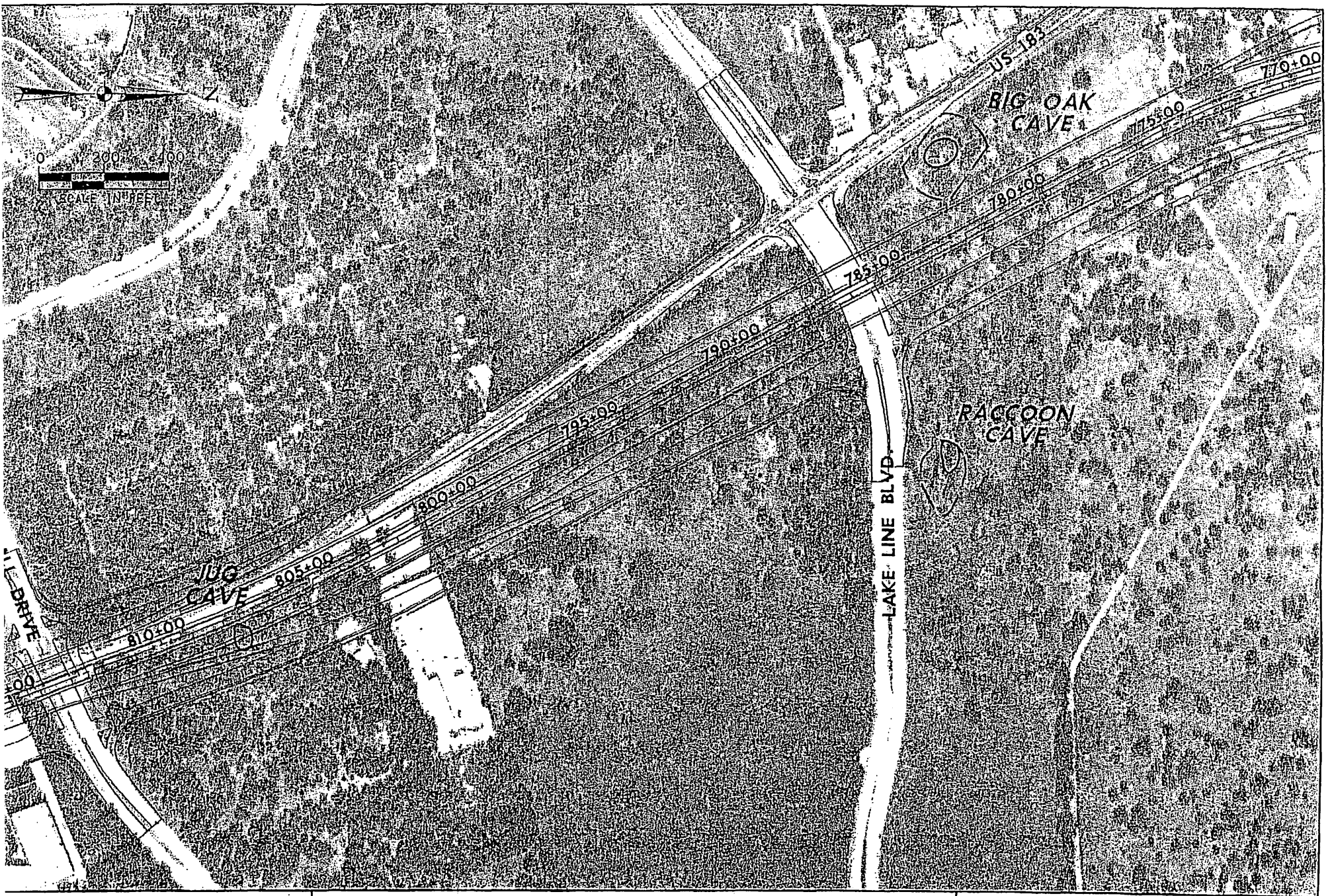
Job No.: 440715.13 | Date: 3/24/05

File: I:\projects\hc1\440715.13\cad\txdot\chaos_cave_karst_preserve_V8_rev.dgn

I:/projects/hc1/txdot/440715.13/chaos cave preserve/cad/figure1.dgn

EXHIBIT C

Maps – Big Oak Cave



Texas Department of Transportation
TEXAS TURNPIKE AUTHORITY DIVISION

Figure 2
Proposed alignment of southern portion of the proposed U.S. 183A project, Williamson County, Texas, showing the locations of the three caves in the project area.

Turner Collie & Braden Inc.
ENGINEERS • PLANNERS • PROJECT MANAGERS

EXHIBIT D

March 2004 Karst Conservation Summary Report for US 183A

Texas Department of Transportation

1421 WELLS BRANCH PARKWAY, BLDG. 1, SUITE 107 PFLUGERVILLE, TX 78660 (512) 225-1300

March 8, 2004

Robert T. Pine
U.S. Fish and Wildlife Service
10711 Burnet Road, Suite 200
Austin, Texas 78758

Reference: US 183A Karst Conservation Summary Report

Dear Mr. Pine:

The Austin District of the Texas Department of Transportation (TxDOT) is pleased to submit the final Karst Conservation Summary Report (attached) in accordance with item 1 under the terms and conditions of the U.S. Fish and Wildlife Service's (the Service's) Biological Opinion dated May 1, 2001. The report has been revised in response to the Service's comments transmitted by letter dated October 20, 2003, and ensuing verbal comments from your office on February 5, 2003.

TxDOT requests the Service's prompt review and approval of the report to ensure effective stewardship of affected endangered species habitats associated with the US 183A project. Please contact me at (512) 225-1346 with any comments or questions regarding the report. We look forward to continuing our partnership with the Service to foster endangered species conservation throughout central Texas.

Sincerely,

Jon Geiselbrecht
Austin District
Turnpike Environmental Coordinator

Attachment

cc: Timothy J. Weight, P.E., Austin District
Jim Travis, Federal Highway Administration
Nader Bokaie, P.E., PBS&J

PBS&J Job No. 440715
CSJ No. 0151-05-081

Karst Conservation Summary Report
U.S. Highway 183 Alternate
From RM 620 to Three Miles North of the City of Leander
Williamson County

Prepared for:
Texas Department of Transportation
Austin District
1421 Wells Branch Parkway, Suite 107
Pflugerville, Texas 78660

Prepared by:
PBS&J
6504 Bridge Point Parkway, Suite 200
Austin, Texas 78730

March 2004

Printed on recycled paper

U.S. Highway 183 Alternate
From RM 620 to Three Miles North of the City of Leander
Williamson County

Karst Conservation Summary Report

1.0 PROJECT SUMMARY

1.1 Background

In May 2001, the Federal Highway Administration (FHWA) and the Texas Turnpike Authority Division of the Texas Department of Transportation (TxDOT) completed work on an environmental impact statement (EIS) for proposed U.S. Highway 183 Alternate (US 183A) in Williamson County, Texas. The limits of the US 183A project presented in the EIS extend from the intersection of existing Ranch-to-Market Road (RM) 620, just west of U.S. Highway 183, to existing US 183 approximately 3 miles north of the city of Leander in Williamson County – a distance of approximately 12 miles. In July 2001, FHWA issued a record of decision completing the environmental study and public involvement phase of project development.

The US 183A project was developed in accordance with the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508), FHWA Environmental Impact and Related Procedures (23 CFR Part 771), Texas Turnpike Authority Environmental Review and Public Involvement Rules (43 TAC Chapter 52), and other related federal and state requirements including Section 7 of the Endangered Species Act (ESA) of 1973, as amended.

1.2 Consultation Summary

In November 2000, FHWA and TxDOT prepared a biological assessment (1) describing the proposed US 183A project; (2) discussing the biology and distribution of federally protected species in the project vicinity that are afforded protection under the ESA; and (3) determining the potential effect of the proposed project on ESA protected species. On November 28, 2000, FHWA transmitted the project's biological assessment to the U.S. Fish and Wildlife Service (the "Service") by letter and requested initiation of formal consultation under Section 7 of the ESA. Formal consultation was initiated on December 22, 2000.

Although Williamson County is home to a number of protected species, only two – the Tooth Cave ground beetle (*Rhadine persephone*) and the golden-cheeked warbler

(*Dendroica chrysoparia*) – were determined to be potentially impacted by the proposed action. Only the karst-dwelling Tooth Cave ground beetle is addressed in this report.

On May 1, 2001, the Service issued a final biological opinion (BO) to FHWA and TxDOT for the proposed US 183A project. A major component of the BO is the Incidental Take Statement (the "Statement") which allows incidental take (i.e., harm, harassment, wounding, killing, etc. incidental to the otherwise lawful implementation of the proposed action) of endangered species under terms of the ESA, provided such taking is in compliance with the terms and conditions of the Statement. The Service modified its BO by letter dated November 6, 2001, to adjust the estimated incidental take and subsequent mitigation measures of golden-cheeked warbler habitat identified in the BO.

In its BO, the Service determined that impacts to the Tooth Cave ground beetle would be in the form of direct take of Jug Cave, a small, poor quality cave within the footprint of the proposed highway, and indirect take of Big Oak Cave and Raccoon Cave. Big Oak Cave is considered a medium quality cave due to its proximity to existing US 183. It lies within 150 feet of the proposed frontage roads of the project and impacts to individuals of the species occupying the cave are expected to be severe. Raccoon Cave, also a medium quality cave, lies approximately 350 feet from the proposed frontage roads of US 183A. Impacts to Raccoon Cave, already impacted by development and relatively distant from the project, were considered to be minor.

1.3 Avoidance Measures

In its biological assessment, TxDOT proposed a plan to avoid direct take of the Tooth Cave ground beetle in Big Oak Cave by splitting the travel laves of US 183A, leaving an undisturbed area in the central median to include Big Oak Cave and most of its probable subsurface hydrologic basin. Due to the likelihood that detrimental effects to this population of Tooth Cave ground beetles may still occur, TxDOT also proposed a plan to biologically monitor Big Oak Cave. The monitoring program is discussed in Section 3.0.

1.4 Reasonable and Prudent Measures

To reduce effects of the take of Jug Cave (direct) and Big Oak Cave (indirect) on the species, the Service required FHWA/TxDOT to establish one or more high quality karst preserves with at least two distinct caves known to contain the Tooth Cave ground beetle. In accordance with Reasonable and Prudent Measure 1 of the BO, the karst preserve(s) should total 70 to 100 acres of land with occupied caves no less than 150 meters (492 feet) from urban areas. The BO further required FHWA/TxDOT to develop a karst preserve plan prior to any construction activities on US 183A. The karst preserve plan should detail those actions associated with preserve acquisition, including responsible parties, time frames and funding mechanisms. The plan should incorporate the best science available on preserve design.

The BO also required FHWA/TxDOT to develop a karst preserve management plan prior to any construction activities on US 183A within karst zones 1 or 2. Karst zones 1 and 2 are geographic areas delineated by George Veni & Associates (1992) that are known to contain or likely to contain endangered cave species. The management plan should describe FHWA/TxDOT's long-term management and monitoring commitments for the duration of operation of the US 183A facility. The karst preserve plan should detail those actions associated with preserve management, including responsible parties, time frames and funding mechanisms. The plan should incorporate the best science available on preserve design.

The Discovery Well Preserve Management Plan (Section 4.0) incorporates both of the above aspects of FHWA/TxDOT's karst preserve commitments, documenting FHWA/TxDOT's compliance with the terms and conditions of the BO relating to the establishment of a karst preserve.

2.0 TOOTH CAVE GROUND BEETLE

2.1 Species Description

The Tooth Cave ground beetle is a reddish-brown moderately robust beetle, approximately 0.3 inch in length at maturity. It is the largest and most active of the Austin-area endangered karst invertebrates, tending to be more active during the winter months unlike most other cave invertebrates. The Tooth Cave ground beetle is considered troglobitic, meaning it completes its entire life cycle underground and has either small or absent eyes. Thus the Tooth Cave ground beetle's continued existence is dependent upon the ecological stability of the karst environment in which it is found.

Like the closely related and sympatric species *Rhadine subterranea*, the Tooth Cave ground beetle is usually found under rocks but can be seen walking on damp rock covered with silt. Because little is known about the Tooth Cave ground beetle's life history, its habits are thought to mirror those of *R. subterranea* which has been observed feeding on cave cricket (and possibly other cave invertebrate) eggs and parts but not other organic materials such as feces, leaf litter or fungi.

The primary threat to the Tooth Cave ground beetle is loss of habitat due to encroaching urban development, as the species' range is restricted to rapidly developing regions of Travis and Williamson Counties. Other factors that threaten karst invertebrate survival include groundwater contamination, damage to the macrohabitat due to human visitation, and fire ant predation.

A more detailed description of the Tooth Cave ground beetle and its habitat requirements can be found in the Biological Opinion for Proposed US 183A (USFWS, 2001) or in the *Recovery Plan for the Endangered Karst Invertebrates in Travis and Williamson Counties, Texas* (USFWS, 1994).

2.2 Endangered Species Recovery Criteria

The recovery plan for seven endangered karst invertebrates, including the Tooth Cave ground beetle, calls for the protection, in perpetuity, of at least three karst fauna areas (KFAs) (if at least three exist) within each karst fauna region (KFR) in the species' range (USFWS, 1994). A KFA is defined as "an area known to support one or more locations with a protected 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." The purpose of protecting at least three KFAs is to provide a margin of safety against any unanticipated catastrophic event(s) which could lead to the extinction of the protected species within one or more KFAs.

A protected KFA is one containing sufficient contiguous karst and surface area to maintain the karst ecosystem's integrity. The size and configuration must adequately maintain moist, humid conditions, air flow, and stable air temperatures. Additionally, it must maintain an adequate nutrient supply, prevent or control the invasion of exotic species (e.g., fire ants), and allow the movement of karst fauna and nutrients through the interstitial space between karst features (USFWS, 1994). It must also offer protection against contamination of the surface and groundwater entering the karst ecosystem.

The Tooth Cave ground beetle is known to occur in two KFRs, Cedar Park and Jollyville Plateau, each with more than three KFAs known to support the species. The Testudo Tube and Buttercup Creek preserves, provide some protection to a portion of the Buttercup Creek KFA in the Cedar Park KFR. The Discovery Well tract may be part of this KFA, but not enough information exists to make such a determination (USFWS, 2001). The other two KFAs in this region are both located on the Lime Creek Preserve. Four preserves within the Jollyville Plateau KFR serve to protect the Tooth Cave ground beetle. Existing preserves in the Jollyville Plateau KFR must be further evaluated to determine the adequacy of protections to achieve downlisting of the species.

3.0 BIG OAK CAVE MONITORING

During investigations for the US 183A project, Big Oak Cave was biologically surveyed and found to support a population of the Tooth Cave ground beetle (Veni, 1997). To avoid direct take of the individuals in the cave, Big Oak Cave will remain within the center median of the travel lanes of US 183A approximately 5000 feet north of the intersection of US 183 and RM 620 (Figure 1). The median will be 0.5 mile long with a maximum width of 225 feet for a total area of 10 acres.

As mentioned above (Section 1.2), the entrance of Big Oak Cave is within 150 feet of the proposed travel lanes of US 183A. The existing US 183 right-of-way at this location will be widened to accommodate the split travel lanes and a wide center median; thus the cave and its surface and subsurface hydrologic basins are entirely within the proposed right-of-way, albeit within the median. Pavement for the proposed southbound travel lanes will


PRELIMINARY AS OF 10/14/02
Turner Collie & Braden Inc.
Texas Department of Transportation
FIGURE 1
US 183A
CAVE LOCATIONS
183A
45

extend to the existing edge of right-of-way. The cave's footprint and surface drainage basin are outside of the existing US 183 right-of-way and will not be directly affected by construction of the proposed US 183A project. Currently, approximately 107 square feet (0.2%) of Big Oak Cave's probable subsurface drainage basin is covered by impervious layers. The proposed project will affect up to approximately 1,728 square feet (4.0%) of the cave's probable subsurface hydrologic basin. The probable subsurface hydrologic basin was roughly mapped by GVA (1997) to include a 1-acre area surrounding the mouth of Big Oak Cave.

Long-term impacts of roadway development and operation on cave species within 150 meters (492 feet) are unknown. Indirect effects on populations of cave species are expected in these situations due to alterations to hydrology and degradation of surface water quality. Thus effects of roadway construction and operation will be monitored at Big Oak Cave over a ten-year period to research the effects of proximal roadway construction and operation on endangered cave species.

Biological monitoring of Big Oak Cave will be performed as described below in Section 4.4.1. Monitoring will be performed annually for the first four years following approval of this plan. This period will cover the construction of the portion of US 183A adjacent to the cave on both the east and west. The remaining survey period will consist of three biological surveys at two-year intervals. This second phase of monitoring will coincide with the first six years of operation of this portion of the highway. If after completing the third annual biological survey, no troglobite biota are observed or collected from Big Oak Cave, the monitoring program may be terminated.

The results of monitoring within Big Oak Cave will be compared to the results of biological monitoring on Discovery Well Preserve, where species caves are further removed from the effects of construction and development. The value of such comparison is to evaluate the effect of proximal construction and roadway operation on the karst ecosystem.

TxDOT will install a data logger to continually monitor temperature and relative humidity within Big Oak Cave. Data from the data logger will be downloaded quarterly.

During construction, the 10-acre median will be surveyed during the spring and fall for fire ants per the methodology presented in Section 4.4.6, below. Upon completion of construction, the cave entrance will be evaluated for fire ants within a 164-foot radius at two-year intervals to coincide with the biological surveys. Red imported fire ant mounds will be treated following each survey according to approved methods outlined in this report.

The entrance to Big Oak Cave will be gated by an experienced professional approved by the Service. The gate will allow for the access of small mammals and other nutrient input, while precluding the unintentional loss of individuals of the species by or injury to unauthorized visitors.

Monitoring results and any management activities performed within the 10-acre Big Oak Cave tract will be included in the Discovery Well annual report.

3.1 Geology and Hydrogeology

The Walnut Limestone Formation outcrops across the entire 106-acre preserve tract. This Cretaceous age formation consists of three separate members that have been observed and documented in area cave studies: Cedar Park, Bee Cave, and Bull Creek. Exposed at ground surface level is the Cedar Park limestone member with an average thickness of 35 to 40 feet. The Cedar Park is underlain by the Bee Cave member (also 35 to 40 feet thick), which is underlain by the Bull Creek member (40 to 45 feet thick). The Walnut formation is underlain by the Upper Glen Rose Limestone.

Miocene age faulting has resulted in a highly fractured and cavernous Walnut Limestone. This faulting, regionally identified as the Cedar Park Fault Series (five faults in series), is the primary structural condition and origin for cave development within the Cedar Park area. This fault series is associated with the Balcones Fault Trend, but occurs in isolation west of the Mount Bonnell Fault and along the margin edge of the Northern Edwards Plateau. The Cedar Park faults extend southward beyond the plateau edge into the deeply eroded and incised Colorado River Drainage Basin and point of Lake Travis.

Past studies have shown that the Buttercup Creek cave system is a network of interconnected caves. Subsurface explorations have yielded physical connections between caves in some cases; however, groundwater movement between caves has been inconclusive. During area cave studies in the late 1990s, the R-Bar-B Ranch Spring along Cypress Creek was suspected to function as a resurgence (discharge) point for the Buttercup Creek cave system. A dye tracing study was conducted in 1997 in an attempt to confirm if ground water moves through the Buttercup Creek cave system. Marigold Cave and Whitewater Cave were selected for this dye-tracing study. Marigold Cave was selected because it has a deeply formed, dynamic flowing stream and is located over a fault. Whitewater Cave, located approximately 4,600 feet to the west, was selected for its distance from a fault and its slowly-moving groundwater conduit. In this study, all potential area springs outside the cave system were monitored for the detection of the dye injected into the system. The study confirmed that the R-Bar-B Ranch spring was the only known point of resurgence (discharge) for the Buttercup Creek cave system. Dye flushes at the R-Bar-B Ranch spring occurred at separate times approximately one week apart. This delay in dye detection illustrates that the flow from Marigold Cave was a direct southward path along the base of the fault, while the flow from Whitewater Cave was a much slower indirect path. The study revealed that the dye flowed along a conduit via Hideaway Cave prior to discharging at the spring. The results of the study implied that ground water does move through the Buttercup Creek cave system.

While the dye tracing study was limited to two caves, these results and previous cave studies suggest that others in the system may also be hydraulically connected. Subsurface explorations indicate that the Discovery Well preserve and the Testudo Tube preserve are

connected to the Buttercup Creek System. The Discovery Well cave complex, which consists of Discovery Well, Hunters Lane, and Uncorked Caves has formed along a structural linament that connects to Buttercup Creek Cave system. Observations of ground water flow at separate locations along the pathway strongly suggests a common groundwater conduit. The Grassy Grove Sink and Hole-in-the-Draw Cave are in this alignment path and may also be connected. Lime Creek Sink, Persimmon Well Cave, Zig Zag Cave, and Jumbled Rocks Cave are likely connected to Testudo Tube Cave via a common groundwater conduit. The caves are considered to be the westernmost entrances to this branch of Buttercup Creek Cave. Testudo Tube cave is directly connected to Buttercup Creek Cave via Buttercup Drain Cave. The connection point within Buttercup Creek Cave would be the Briar Patch passage.

4.0 DISCOVERY WELL PRESERVE MANAGEMENT PLAN

The loss of endangered cave species populations due to filling or collapsing caves for development is permanent. Thus the preservation, in perpetuity, of intact karst systems is essential to the species' survival. To ensure the longevity of a preserved karst system and its inhabitants, a preserve management plan has been developed to monitor the status of endangered species populations and their habitat; to account for and respond to unforeseen, detrimental circumstances; and to maintain the preserve's integrity.

Although this preserve is located approximately 3 miles from the proposed US 183A project, the karst preserve must be acquired and the management plan approved by the Service prior to the commencement of construction related to the US 183A project within karst zones 1 or 2. This section describes the conditions for establishment and management of the Discovery Well Preserve.

4.1 Goals of the Management Plan

This management plan describes in detail all of the necessary actions associated with the acquisition, management (including adaptive management), and monitoring of a karst preserve, in perpetuity, including responsible parties, time frames, and funding mechanisms.

The implementation of the management plan for the Discovery Well Preserve is intended to be a long-term, dynamic undertaking. To provide a foundation for the management measures and to construct a framework for measuring success of the plan, the following goals have been developed.

The goals of the management plan are:

- Provide for the conservation and, if needed, enhancement of the karst ecosystem within the Discovery Well Preserve,
- Implement and integrate management measures (including adaptive management) for the protection of the Tooth Cave ground beetle,

- Monitor the Tooth Cave ground beetle population on the preserve, and
- Establish a maintenance plan for the management of the Discovery Well Preserve in perpetuity.

These goals are intended to fulfill the terms and conditions relating to the karst preserve in the Service's BO for US 183A. A description of the terms and conditions relating to the creation of this karst preserve can be found in the Biological Opinion.

4.2 Plan Administration

Responsible Party: Texas Department of Transportation. Transfer of ownership and/or administration of the Discovery Well Preserve from TxDOT to another entity may be done only with the approval of the Service.

Acquisition: Fee Simple

Time Frames: Acquisition of the Discovery Well Preserve property was completed in July 2003. Approval of the management plan will occur prior to the initiation of construction of US 183A. The management activities of the preserve are outlined in the following discussion. The initial phase (Phase 1) will begin with the approval of this management plan by the Service and will last through delivery of the first annual monitoring report. This phase will include complete baseline studies (except as described below) and the development of recommended management measures. The next phase (Phase 2) will include implementation of management measures. The final phase (Phase 3) will be characterized by less intensive management than earlier phases. Adaptive management may be implemented at any point during Phase 1, 2 or 3 and must be agreed upon by both the Service and FHWA/TxDOT or any future conservator of the preserve. Table 1 shows the timeline for the implementation of management activities.

Reporting: A status report will be prepared by TxDOT annually beginning in March 2005, until the management and/or ownership of the preserve is transferred to a different entity, at which time the new managing entity will prepare the annual reports. A March reporting date will allow for the results of biological surveys (performed in late fall/winter) to be included in the report. Annual reporting will continue for 30 years unless a change is approved by the Service.

Funding: TxDOT will be responsible for costs associated with the management of Discovery Well Preserve as long as the preserve is under TxDOT ownership. Any transfer of ownership will be subject to Service approval and be contingent upon the receiving entity assuming responsibility for the requirements of the management plan and providing funds for any outstanding obligations as well as future management.

Table 1

DISCOVERY WELL PRESERVE
MANAGEMENT PLAN IMPLEMENTATION TIMELINE

Activity	Phase 1	Phase 2				Phase 3 (ongoing)				
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Biological Survey	▲*	▲*	▲	▲	▲	▲	▲			▲
Detailed Preserve Map		▲								
Fence Preserve Boundary	▲									
Access Restriction Evaluation	▲									
Access Restriction Implementation	▲	▲								
Cave Cricket Survey	▲**	▲**	▲**	▲			▲			▲
Mammal Survey	▲		▲		▲		▲			▲
Vegetation Survey – Initial Site Assessment	▲									
Vegetation Management – Recommendations	▲									
Vegetation Management – Implementation		▲								
Vegetation Monitoring				▲			▲			▲
Fire Ant Survey	▲**	▲**	▲**	▲**	▲**	▲**	▲**	▲**	▲**	▲**
Fire Ant Management	*As needed*									
Routine Maintenance	▲***	▲***	▲***	▲***	▲***	▲***	▲***	▲***	▲***	▲***
Adaptive Management	*As needed*									
Annual Report	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲

* Biological surveys of potential habitat caves will be performed twice per year for two years following initial discovery.
** These surveys will be performed twice per year as described in the management plan.
*** Routine maintenance will be performed monthly.

4.3 Discovery Well Preserve Description

FHWA/TxDOT purchased the approximately 106-acre Discovery Well Preserve in July 2003 specifically for the purpose of establishing a karst preserve to partially fulfill the reasonable and prudent measures recommended by the Service for impacts to Tooth Cave ground beetles that may be associated with the construction and operation of US 183A. In satisfying the requirements for a preserve as outlined in the Service's BO, the value of the Discovery Well Preserve tract is enhanced by its contiguity with other preserved cave tracts to the north and west.

4.3.1 Preserve Location

Discovery Well Preserve is located adjacent to and east of existing Lime Creek Road in southern Williamson County, Texas. The City of Cedar Park plans to extend Anderson Mill Road along the southern and western boundaries of Discovery Well Preserve (replacing a portion of Lime Creek Road). A section of the Buttercup Creek subdivision bounds the northernmost edge of the preserve, and the Ranch at Cypress Creek subdivision is located along the western boundary.

Discovery Well Preserve will contribute to the comprehensive system of preserves located to its north and west. The Testudo Tube Cave Preserve (owned and managed by the City of Austin as a part of the Balcones Canyonlands Preserve (BCP)) and preserve areas within the Buttercup Creek subdivision lie to the north. Lime Creek Preserve, also owned and managed by the City of Austin as a part of the BCP, is west of Discovery Well Preserve along existing Lime Creek Road. The Baker Preserve, owned and managed by the Travis Audubon Society lies to the south of Lime Creek Preserve. The limits/location of Discovery Well Preserve are shown in Figure 2.

4.3.2 Habitat Description

The 106-acre Discovery Well Preserve is characterized by live oak, post oak, and cedar elm savannah. Previous owners of the tract actively managed the tract to remove all Ashe juniper, presumably for livestock grazing, distinguishing it from adjacent preserve tracts which maintain a juniper-oak woodland composition conducive to golden-cheeked warbler habitation.

Caves found on the Discovery Well Preserve may be part of the Buttercup Creek KFA and, thus, ultimately hydrologically connected to those in the preserves of the Buttercup Creek subdivision and Testudo Tube Preserve to the north (USFWS, 2001). Geologically, the Walnut Limestone Formation, Cedar Park member, is exposed at the surface and is faulted by the Cedar Park Fault Series which is the primary mechanism for karst development in the Buttercup Creek KFA (Mike Warton & Associates, 2001).

Ten caves exist within the preserve's boundaries. Of these, one is known to support the Tooth Cave ground beetle and three others are considered potential habitat for the

GRIMACE CAVE
KARKAR CAVE
BUTTERCUP DRAIN CAVE
NELSON RANCH CAVE
LEGEND
TESTUDO TUBE CAVE
LOT 33
HOLE IN THE DRAW CAVE
GRASSY GROVE CAVE
FERSTMMON WELL CAVE
TUMBLE ROCK CAVE
HUNTER LANE CAVE
UNCORKED CAVE
ZIG ZAG CAVE
DISCOVERY WELL CAVE
UNDER 3 OAKS CAVE
UNDERSTORY CAVE
YAWNING ENTRANCE CAVE
TRACTS 2 CAVE
Turner Collie & Braden Inc
FIGURE 2
DISCOVERY WELL PRESERVE
DATE: AUGUST 4, 2003
SHEET 1 OF 1

endangered beetle. The Tooth Cave ground beetle was confirmed in Discovery Well Cave in January 2002 by James Reddell and Marcelino Reyes (Reddell, 2002). The hydrologically connected, but distinct, caves known as Hunters Lane Cave and Uncorked Cave are considered likely habitat for the beetle and should be considered as important for the species' survival (Reddell, 2002). This cluster of caves is located approximately 570 feet (173 meters) at its closest point from the Ranch at Cypress Creek subdivision to the east. Persimmon Well Cave in the western portion of the preserve is another potential habitat cave located approximately 359 feet (109 meters) at its closest point from the proposed Anderson Mill Road extension. An unconfirmed specimen of the Tooth Cave ground beetle was collected from this cave by Horizon Environmental prior to 2002 (Reddell, 2002). Although only one cave has been verified as endangered species habitat and Persimmon Well Cave, a potential habitat cave, is located less than 150 meters from a roadway, in a letter dated February 21, 2003, the Service confirmed that the Discovery Well Preserve tract meets the intent of the BO's reasonable and prudent measures regarding preserve selection. A detailed assessment of previous investigations of the mitigation property can be found in the attached reports by Mike Warton & Associates (Appendix A).

In addition to the Tooth Cave ground beetle, the preserve supports a relatively diverse assemblage of troglobite fauna. Of special note are a couple of little-known troglobitic species, a salamander (*Eurycea* sp.) and a ground beetle (*Rhadine* sp.). According to Reddell (*pers. comm.*), the salamander was observed to be slightly larger and more cave-adapted than the Jollyville Plateau salamander; however a specimen was not collected. This salamander was found in Hunter's Lane Cave. The ground beetle is a currently undescribed species of the same genus as the Tooth Cave ground beetle. According to Reddell (*pers. comm.*), this species appears to be sympatric with the Tooth Cave ground beetle, although it seems to be restricted to the Cedar Park area. It was found in Discovery Well and Persimmon Well Caves on the preserve.

The original preserve size was reduced from 119.69 acres to the current 105.99 acres to accommodate the construction of Anderson Mill Road. One cave, Yawning Entrance Cave, will be filled in conjunction with Anderson Mill Road construction. This cave is not considered to have potential habitat for the Tooth Cave ground beetle. TxDOT is committed to working with Williamson County, Travis County, and the City of Cedar Park to minimize effects of that project on the preserve's karst system.

4.4 Preserve Management

4.4.1 Karst Investigations

The previous owner of the Discovery Well Preserve tract contracted Mike Warton & Associates from 2001 to 2002 to investigate the property to identify karst features and associated setbacks for potential residential development of the tract. These efforts identified ten caves within the boundaries of the preserve in addition to one cave within the alignment of the Anderson Mill Road Extension. One cave, Discovery Well Cave, was

found to support the Tooth Cave ground beetle, and three others, Hunters Lane, Uncorked and Persimmon Well Caves, were deemed potential habitat, warranting further investigation of the caves. The locations of all karst features identified on the preserve, as well as any newly discovered features, will be verified and/or resurveyed, including GPS coordinates, during Phase 2 as part of the preparation of a detailed map of the preserve tract.

As part of Phase 1 of this management plan, all four caves with known or potential endangered species habitat will be biologically surveyed by a qualified professional holding, to the extent required by current law or policy, a valid Endangered Species Act section 10(a) permit. Biological surveys in caves with potential habitat will be surveyed twice per year for two years. If listed species are not documented, then TxDOT may decide, with Service concurrence, whether additional surveys are needed based on the species found, habitat conditions observed and the environmental conditions occurring during survey efforts. Biological surveys in occupied caves will continue annually through Phase 2 with special attention paid to any effects related to nearby urban development. Annual biological surveys will continue for a minimum of two years into Phase 3, at which time surveys for the protected species will occur every third year unless the Service approves less frequent surveying.

Surveys for protected species will always be performed at the same time of year (within 30 days). Because low oxygen concentrations exist in many of the caves on the preserve during hot weather and the Tooth Cave ground beetle appears to be more active during the late fall and winter months and early spring, biological surveys in occupied caves will be performed between November and January and/or April. A number of set sampling stations for repeated surveying should be established within each cave and delineated on each respective cave's map. To constantly monitor temperature and relative humidity, data loggers will be installed within one cave in the Discovery Well complex and in each additional cave (outside of the complex) found to contain protected species.

Monitoring in all caves with protected species will include, but not be limited to:

1. all vertebrates and invertebrates, alive or dead, including all troglobites, troglophiles, trogloxenes, and accidental species;
2. quantities for each species (approximations may be made for very abundant species);
3. microhabitat descriptions and locations (maps and descriptions) within the cave of each protected species;
4. types (identified as specifically as possible) and approximate quantities of other organic matter including leaf litter, fungus, feces, bones;
5. signs of mammal or other trogloxene or accidental vertebrates (e.g., scratch marks, middens, nesting materials, shed skins); and
6. temperature and humidity within the cave at the time of the survey; and
7. presence of standing or flowing water.

Downloading of data logger data will occur during biological monitoring and cave cricket counts. Sampling of endangered species will be performed visually. No collecting of individuals of listed species should occur unless specifically authorized by the Service. Results will be included in the annual report.

4.4.2 Access Restriction

Vandalism and damage by novice cavers is a common cause of karst habitat degradation in urban settings. Because Discovery Well Preserve is located in a suburban setting, access restriction must be evaluated to reduce the threat of damage or injury to the protected species and their habitat as well as that of unauthorized visitors. Authorized access will be limited to FHWA/TxDOT's or any future conservator's representatives and researchers approved by the Service.

All caves on the preserve will be evaluated by a qualified karst geologist during Phase 1 for the necessity of access restriction measures. Access restriction may be accomplished by gating and locking the cave entrance or by fencing around the cave openings, or clusters of openings. Openings that allow the passage of small to medium-sized vertebrates, while excluding human visitors, will be incorporated into fence or gate design. Recommendations will be discussed with the Service for concurrence prior to installation of any access restriction measures. Installation of the access restriction measures will occur during Phase 2. If access to the cave appears to be a threat to the species or its habitat or a danger to public safety in the future, access restriction measures may be reevaluated at that time. Furthermore, if the Service recommends that additional access restrictions (cave gating or fencing) are necessary, TxDOT will implement access restriction measures within an appropriate timeframe upon which TxDOT and the Service agree.

At this time, caves that are proximal to neighboring residential developments have exhibited some disturbance by unauthorized visitors. TxDOT representatives, in coordination with the Service, have devised an initial plan to restrict access to those caves. Upon approval of this plan, the three caves in the Discovery Well complex and Hole in the Draw Cave will be gated within six months.

Based on previous discussions with the Service, a five-strand barbed wire fence will be installed (or the existing fence mended, as applicable) around the preserve's perimeter. This type of fence will allow for the migration of small to medium-sized mammals within and among the immediate network of preserves. Signs will also be placed at several logical entry points to deter trespassers. The sign's wording is subject to approval by the Service.

4.4.3 Cave Cricket Survey

Cave crickets (*Ceuthophilus* spp.) are known to be an especially important component of karst ecosystems because many cave invertebrates feed on their eggs, nymphs, dead body

parts, and feces. They typically dwell in the darkness of the cave during the day, emerging only at night to feed. Cave crickets are considered scavengers or detritivores, feeding on dead insects, carrion, and some fruits, although they are not known to feed on foliage. They, along with daddy longlegs harvestmen (*Leiobunum townsendi*), also abundant in most caves, are thought to be an important input of nutrients to the karst ecosystem.

Because cave crickets tend to hide within inaccessible areas of caves and may migrate to different areas of a cave during the day or during a single survey event (particularly when disturbed by a surveyor), cave crickets are best counted as they emerge from the cave at dusk. Counts will begin at sunset and continue for two hours. Surveys will occur at all three caves in the Discovery Well complex and at any caves within the preserve found to support protected species. Cricket counts will be conducted at the same time of year (within 30 days) during spring and/or fall (depending on the monitoring phase) and when temperatures are between 40° F and 100° F and relative humidity is greater than 80 percent. Care should be taken to differentiate the number of adults from the number of juveniles during each survey period. Notations will be made regarding current weather, surface temperature and relative humidity; recent weather events in the previous week (e.g., rain or lack thereof, unusual temperatures, tornadoes); and current weather trends (e.g., drought).

Cave cricket surveys will be performed twice per year during the first three years to establish a sufficient baseline to which all future surveys can be compared. Cave crickets will then be counted every third year thereafter to coincide with biological monitoring. All results will be included in the annual report.

4.4.4 Mammal Survey

Some mammals that provide important nutrient input into karst ecosystems are also predators of insects and other fauna and, thus, may potentially become a threat at higher densities. These mammals include raccoons, mice (*Peromyscus* spp.), opossums, and skunks. Domestic and feral cats, dogs, rats and mice associated with residential subdivisions may also adversely impact native animal communities.

A baseline survey for small and medium-sized mammals will be conducted during Phase 1 to establish densities of such mammals on the preserve. During Phase 2, mammal surveys will be performed every other year by a qualified wildlife biologist. During Phase 3, the preserve will be monitored every third year, unless the Service approves less frequent surveying. Phase 3 surveys will be scheduled to coincide with other monitoring on a 3-year rotation to streamline preserve management. Monitoring should occur at the same time each year (within 30 days) and will include current weather, surface temperature and relative humidity; moon phase; recent weather events in the previous week (e.g., rain or lack thereof, unusual temperatures, tornadoes); and current weather trends (e.g., drought). Biologists will also document other field indicators of the presence and load of mammals within the preserve.

On a preserve of this size (106 acres) with a nearly homogenous vegetation composition, small mammal trapping will consist of 90 trap-nights (30 traps x 3 nights) set at 30-foot intervals in linear transects within the preserve. Medium-sized mammal trapping will be conducted using 15 trap-nights (5 traps x 3 nights) set randomly in suitable locations within the preserve, with some traps placed near cave openings. Monitoring during Phases 2 and 3 will be compared to previous years' data to detect population trends and to help determine whether active management of mammal populations may be required.

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 long-term adverse effects on the abundance and distribution of tree seedlings and saplings by increasing browsing pressure and uprooting native vegetation. Such pressure can cause a decrease in the recruitment of oak seedlings through intense herbivory, causing a shift in plant and animal communities within deciduous woodland communities.

If at any time terrestrial mammal populations are responsible for degradation of the preserve system, appropriate management techniques in coordination with the Service may be approved. Corrective actions should be taken promptly and in consultation with the Service. Such management actions may include trapping or other humane mammal population reduction methods. Due to the preserve's proximity to residential neighborhoods, hunting will not be allowed. The preserve will be made available for censussing by Texas Parks and Wildlife Department (TPWD) or other agencies interested in assessing deer and feral hog populations following coordination with TxDOT.

4.4.5 Vegetation Survey

Surface vegetation is important to karst habitats. Nutrient input to the subsurface, such as leaf litter and other organic debris that washes or falls into the cave and tree and other vascular plant roots that extend through the cave ceiling, and associated biological activity are closely related to surface conditions. The surface vegetation also has filtering effects (e.g., contaminants) and buffering effects on subsurface physical conditions (temperature and humidity) of karst habitats. The surface conditions also influence the potential for fire ant infestation.

The open, savannah-like condition of Discovery Well Preserve is attributed to removal of Ashe juniper by the previous landowner to enhance rangeland. The surrounding preserves are more densely wooded, primarily live oak-juniper woodland, and are considered to be indicative of the native condition.

Phase 1 will include a site assessment to characterize the overall vegetation community. A species list will be developed according to structure category (canopy, subcanopy, herbaceous layer). Pilot nested-plot techniques, add-on sample area techniques, or comparable techniques approved by the Service, will be used to construct and examine species-area curves to determine the sampling intensity needed. Data to be collected and

analyzed by stratum (herb, shrub/midstory, overstory) should include species composition, density (for shrub/midstory, overstory), dominance, importance, and percent cover of vegetation canopy, bare ground and rockiness of surface. Non-native species and invasive species associated with disturbance and past livestock grazing and/or current browse pressure will also be assessed. A separate report of the survey results will be prepared following the initial site assessment with recommendations for enhancement and/or management of the vegetation community.

At the beginning of Phase 2, any vegetation management measures recommended in the initial site assessment report will be implemented. Vegetation monitoring will proceed every other year in Phase 2 following implementation of the vegetation management measures described above. Vegetation surveys will continue every third year in Phase 3. During Phases 2 and 3, vegetation monitoring will evaluate the effectiveness of enhancement/management activities and/or changes from the baseline conditions. Any adaptive management measures needed will be assessed at that time. All vegetative assessments and monitoring will be performed by a qualified botanist. Results will be included in the annual report.

4.4.6 Fire Ant Management

Red imported fire ants have been shown to be a key factor in karst habitat degradation. During each phase of this plan, two intensive surveys for the presence of red imported fire ants will be performed annually. Because fire ants do not maintain their mounds during the summer, making them more difficult to see, but begin rebuilding them as soon as rains and cooler temperatures return, fire ant surveys should be done in the spring and fall. During these surveys, mound density within 164 feet of the entrance of caves or cave complexes with protected species will be calculated to determine the level of infestation and the effort needed to treat these mounds. Throughout the remainder of the preserve, mounds will be counted within 20-foot wide belt transects to estimate density and determine effort needed for treatment, described below.

Because chemical fire ant control used near karst areas is known to detrimentally affect non-target species, including protected species or their food sources, pesticide use is prohibited within 164 feet of the footprint of any known karst feature. The most commonly recommended measure for fire ant control is the application of boiling water or steam. One to 4 gallons of boiling or near boiling water, with an optional 1 to 2 teaspoons of detergent added, may be poured directly onto the mounds.

Beyond 164 feet from the footprint of any karst feature, either boiling water, steam, or chemical baits (such as Amdro or Logic) may be used (see restrictions that follow). If chemical baits are used between 164 and 500 ft from a karst feature, the following protocols must be met: (1) baits must be placed in containers appropriate to allow fire ant access but that will allow baits to be removed at the end of the day, (2) the bait must be placed out in mid-morning, (3) the ground must be dry, (4) the ground temperature must be

between 70° F and 95° F, (5) there must be no rain predicted for that day, and (6) all uneaten bait must be removed by sunset.

If chemical baits are used more than 500 ft from any karst feature, the baits may be broadcast, but the following protocols must be met: (1) the bait must be placed out in mid-morning, (2) the ground must be dry, (3) the ground temperature must be between 70° F and 95° F, (4) there must be no rain predicted for that day, (5) no more than 1.5 pounds of bait per acre may be used, and (6) broadcast baits should not be used if the presence of red-imported fire ants has not been verified within the previous year. If there are changes to the Service's guidelines on fire ant control in the future and the Service provides new guidance to TxDOT, those changes will be incorporated by TxDOT. Care should be taken to avoid misidentification of ant species and impacts to native ant species.

Fire ant treatment will be implemented within 30 days, unless fire ant mounds are detected within 33 feet of any karst feature, in which case treatment will occur within 15 days. An increase in the frequency of fire ant control will be required if either of the following conditions are met during any survey: (1) fire ant densities are greater than 40 mounds per acre, or (2) there are greater than 40 mounds within 164 feet (the approximate cave cricket foraging radius) of the entrance of any karst feature that harbors the protected species or cave crickets (Discovery Well Cave, Hole in the Draw Cave, Hunter's Lane Cave, Jumbled Rocks Cave, Persimmon Well Cave, and Uncorked Cave). The frequency of fire ant control must increase until the density of fire ant mounds declines below the previously described indices.

Red imported fire ant surveys and treatments will be conducted by a qualified specialist. During these surveys, particular attention will be paid to the preserve perimeter, especially along road rights-of-way, residential areas, and any observed disturbed areas. Results of these surveys will be included in the annual report.

4.4.7 Maintenance

Due to its proximity to urban development and the current lack of sufficient fencing, the preserve tract has been the site of dumping from the surrounding residential neighborhoods. During Phase 1, following fence construction, trash and construction materials that have been deposited by trespassers will be removed from the preserve and disposed of in an appropriate manner.

Because the preserve is located in an urban setting, routine maintenance of the preserve will be performed monthly starting as soon as possible. Routine maintenance will include checking all fences, gates, and locks within the preserve and along the perimeter of the preserve for signs of damage or trespassing. An example maintenance checklist is found in Appendix B.

4.4.8 Adaptive Management

Adaptive management measures may be implemented at any time throughout the life of the preserve if it is determined that the goals of the management plan are not being met or if management or monitoring activities are determined to be ineffective in conserving the Tooth Cave ground beetle. Adaptive management measures may be recommended by the Service or FHWA/TxDOT, or any future conservator of the preserve, and must be agreed upon by both parties. Conditions which may warrant management adjustments include, but are not limited to, the following:

- destruction or deterioration of subterranean habitat (which could be due to a number of factors including, but not limited to, drying, loss of hydrologic inputs, and point-source and non-point source pollution);
- a single drastic or consistent gradual decline in the number of observed Tooth Cave ground beetles, cave crickets, or other native species that normally inhabit the caves;
- declines in measured relative humidity or increased variation in measured temperature or shifts from suitable temperatures;
- new information on the biology of the Tooth Cave ground beetle; or
- evidence of loss of structural integrity of one or more caves such as collapse or large breakdown in the cave interior or entrance.

Adaptive management options to be considered may include, but are not limited to:

- additional surveys to determine the root cause of degradation of habitat or declines of important faunal communities;
- replacement or modification of the karst preserve perimeter fence and/or installation of interior cave security fencing around specific caves;
- installation, replacement, or repair of cave gates;
- hunting, trapping, or other deer and hog reduction programs;
- vegetation control or plantings to achieve trespass deterrence, runoff control, improved nutrient input, cave cricket forage, re-establishment of native floral species, or cave temperature and moisture regulation;
- modification of drainage patterns within and around the karst preserve;
- vegetation management such as thinning of the canopy, removal of selected individuals, control of exotic species, prescribed fire away from immediate cave areas, replanting native species that are under-represented, oak wilt control, and other suitable restoration activities approved by the Service;
- modifications to fire ant treatments (such as increasing the frequency of treatments);
- actions to reduce the number of mammalian predators;
- physical reinforcement of a cave(s) or cave entrance(s);
- activities that address root causes of poor reproduction of the plant community or survivorship (such as control of seed predators, browsers, disease, etc); and

- installation of a barrier between developed areas and the preserve to prevent, ameliorate, or deter deleterious impacts from the developed area.

4.4.9 Annual Report

An annual report will be prepared and submitted to the Service in March of each year. The report will present the results of monitoring of Discovery Well Preserve throughout the previous year, including fire ant surveys and regular maintenance, and will address the implementation of mitigation measures or management actions. Damage to the preserve and any recommendations for adaptive management, as needs are identified, will be reported as well. Finally, the report will discuss the status of each protected species known to occur on the preserve. Each report will be comprehensive, but will not simply repeat previous years' results. Instead, the report will evaluate current conditions relative to previous years' data, particularly the baseline conditions.

The annual report will also present the results of monitoring at Big Oak Cave in the US 183A median. Results of this effort will be compared to that of prior years, with a focus on conditions relative to the construction and operation of the roadway. A comparison of results at Big Oak Cave will be compared to those at Discovery Well Preserve to evaluate the effects of proximal road development on cave fauna and habitat.

4.5 General Conditions

4.5.1 Unpredictable Circumstances

Any circumstances detected in the preserve as potentially detrimental to the management goals will trigger the need to consult with the Service for advice on adaptive management. In addition, TxDOT will report to the Service within 48 hours of detecting any site conditions or disturbances that pose an immediate risk to the Tooth Cave ground beetle.

The following measures are general procedures for dealing with foreseeable, but unpredictable, circumstances that could occur. With respect to these potential unpredictable circumstances, TxDOT will undertake such corrective actions in consultation with the Service, as necessary, to meet the goals of this management plan:

- Vandalism of Caves. If detected, the Service as well as local law enforcement authorities will be promptly notified. Any effects of vandalism will be documented and then corrected, if possible, in consultation with the Service and within a reasonable time.

- Storm Damage. Within one week of storm damage, the Service will be notified and damage will be assessed and documented. Following consultation with the Service, corrective measures will be implemented promptly and within a reasonable time frame.

- Fire. In the event of a fire, TxDOT will promptly notify the Service. As soon as warranted by safety considerations, TxDOT will assess any impacts and implement appropriate corrective actions in consultation with the Service. If utilizing a controlled burn for vegetation management, the Service will be consulted beforehand.

- Release of Hazardous Materials. In the event of a release of chemicals, gasoline, oil, or other hazardous materials within the karst preserve or on the adjacent road right-of-way, TxDOT will immediately notify the Service. As soon as warranted by safety considerations, TxDOT will assess any impacts and implement appropriate corrective actions in consultation with the Service.

- Activities of Adjacent Landowners or Occupants. In the event that activities on adjacent properties threaten or damage the karst preserve (including, but not limited to, vandalism or trash dumping within the preserve), TxDOT will assess any impacts and develop appropriate corrective actions in consultation with the Service.

4.5.2 Other Conditions

- Cattle, other domestic and/or exotic livestock, and pets will not be allowed in the preserve unless approved by the Service and only as part of the preserve management.

- Contaminants such as fertilizers, herbicides, and pesticides will be prohibited within the karst preserve, except as outlined above (Section 4.4.6).

- No new roads, new utilities, or other development including storm water or wastewater lines, treatment ponds, structures or other facilities are allowed within the karst preserve boundary unless approved by the Service.

- The operation of motor vehicles within the preserve will be limited to that necessary to facilitate operation, monitoring, and maintenance of preserve areas.

- No public access will be allowed on the karst preserve including hiking, biking, and horseback riding unless approved by the Service.

5.0 BIBLIOGRAPHY

George Veni & Associates. 1992. Geologic controls on cave development and the distribution of cave fauna in the Austin, Texas, region. Appendix D: Distribution Maps of Endangered Cavernicole Fauna in the Austin Region. Prepared for U.S. Fish and Wildlife Service.

George Veni & Associates. 1997. Hydrogeologic investigation of Big Oak Cave, Williamson County, Texas. Prepared for Hicks and Company. San Antonio, Texas.

Mike Warton & Associates. 2001. Completion of karst feature investigations (phases no. 2 and 3) per potential endangered invertebrate species habitat(s), and associated point recharge values for tract no. 3 (119.69 acres) of the ranch at Deer Creek/Standard-Morrison No. 2 LLC residential subdivision development prospectus, Cedar Park area south, Williamson and Travis Counties, Texas. Final report of findings. Cedar Park, Texas.

Reddell, J. 2002. Cave biology tract #3, Ranch at Deer Creek, Cedar Park, Williamson County, Texas. Austin, Texas.

U.S. Fish and Wildlife Service. 2001. Biological opinion for U.S. Highway 183 Alternate, Travis and Williamson Counties, Texas. Austin, Texas.

U.S. Fish and Wildlife Service. 1994. Recovery plan for endangered karst invertebrates in Travis and Williamson Counties, Texas. Albuquerque, New Mexico.

APPENDIX A

PREVIOUS INVESTIGATIONS OF THE DISCOVERY WELL PRESERVE TRACT

Mike Warton & Associates

GEOLOGIST / KARST TERRAINS SPECIALIST / NATIONAL CAVE GATE CONSULTANT
P.O. BOX # 1313 CEDAR PARK, TEXAS 78630-1313
(512) 259-0705 FAX (512) 250-0706
SPECIALIST IN TEXAS' ENVIRONMENTAL KARST RESEARCH & SERVICES

COMPLETION OF KARST FEATURE INVESTIGATIONS (PHASES NO. 2 & 3) PER POTENTIAL ENDANGERED INVERTEBRATE SPECIES HABITAT(S), AND ASSOCIATED POINT RECHARGE VALUES FOR " TRACT NO. 3 " (119.69 ACRES) OF THE " RANCH AT DEER CREEK "/ STANDARD-MORRISON NO. 2 LLC RESIDENTIAL SUBDIVISION DEVELOPMENT PROSPECTUS, CEDAR PARK AREA SOUTH, WILLIAMSON & TRAVIS COUNTIES, TEXAS.

" FINAL REPORT OF FINDINGS "

DATE: 07 MAY, 2001

Prepared For:

BLANTON DEVELOPMENT COMPANY
1701 Directors Blvd., Ste. 290
AUSTIN, TEXAS 78744

Mike Warton & Associates

GEOLOGIST / KARST TERRAINS SPECIALIST / NATIONAL CAVE GATE CONSULTANT
P.O. BOX # 1313 CEDAR PARK, TEXAS 78630-1313
(512) 250-0705 FAX (512) 250-0706
SPECIALIST IN TEXAS' ENVIRONMENTAL KARST RESEARCH & SERVICES

BLANTON DEVELOPMENT COMPANY
1701 Directors Blvd., Ste. # 290
AUSTIN, TEXAS 78744
AC (512) 441-1557
Fax: (512) 441-1922
Attn: Mr. Perry O. Blanton, Pres.,
Land Development & Planning Dept.

RE: COMPLETION OF KARST FEATURE INVESTIGATIONS (Phases No. 2,& 3) PER POTENTIAL ENDANGERED INVERTEBRATE SPECIES HABITAT(S), & ASSOCIATED POINT RECHARGE VALUES FOR TRACT NO. 3 (Approx. 120 Acres) per " RANCH AT DEER CREEK "/Standard-Morrison No. 2 LLC Development Prospectus, CEDAR PARK Area South, WILLIAMSON & TRAVIS COUNTIES, TEXAS.

* Geologist's Final Report of Findings.

" REPORT OF FINDINGS "

COMPLETION OF KARST FEATURE INVESTIGATIONS (PHASES NO. 2,& 3) PER POTENTIAL ENDANGERED INVERTEBRATE SPECIES HABITAT(S), & ASSOCIATED POINT RECHARGE VALUES FOR " TRACT NO. 3 " (APPROX. 120 ACRES) PER THE " RANCH AT DEER CREEK "/ STANDARD-MORRISON NO. 2 LLC RESIDENTIAL SUBDIVISION DEVELOPMENT PROSPECTUS, CEDAR PARK AREA SOUTH, WILLIAMSON & TRAVIS COUNTIES, TEXAS.

DATE: MAY 7th, 2001

INTRODUCTION:

Our Office was Authorized by written proposal of MARCH 14,2001 (Approved on 3/29/01) to provide Karst Feature Investigations (Phases No. 2, & 3) Site Study for the " Tract No. 3 " Site referenced above. The Site Project work for these phases of work began on APRIL 2,2001, and continued until the point of Completion on MAY 1st, 2001. In this scope of work, a Total of FOURTEEN (14) Karst Features were Investigated & Documented by Mike Warton & Associates under Federal Permit No. TEO-22329-0. This study is designed to determine the potential " Presence or Absence " of Subgrade Caves associated to surface karst feature expressions, and " Presence or Absence " of Potential Endangered Invertebrate Species Habitat(s) within such features & caves. The study further investigates for the presence of Any Potential " Species of Concern " (SOC'S), and the Potential Point Recharge Values as relative to the " CEDAR PARK WATERSHED "/ or " BUTTERCUP CREEK " CAVE SYSTEM, as has been previously studied within this Regional Area. Presently, the Only Federally Listed Invertebrate Species known, and found within this Area & System, is the " TOOTH CAVE GROUND BEETLE " or " **Rhadine Persephone** " **Species.** Other " Species of Concern " considered rare or unique, and endemic to this " System ", such as " **Rhadine New Species** ", And the " **Jollyville Plateau Cave Salamander** " **(EURYECA)**, are further known to occur from the caves of this Area.(A Study of Cave Habitats,Point Recharge Potential,and associated Karst Lands of the Buttercup Creek Development Properties, CEDAR PARK, WILLIAMSON COUNTY, TEXAS. OCTOBER 18, 1997, By: Mike Warton & Associates.

Our Study & Reporting objectives are to provide reliable scientific study and basis from which a " Sound and Well Suited " Environmental Planning may be

developed and established to provide protection and preservation for Species, and groundwater quality issues, with potential applications of site area development that would Not cause " Harm " to Species, or Degradation of Groundwater Quality within the indicated Cave " System " that constitutes the " Cedar Park Watershed ". This Site Project work was conducted under the direction of Mike Warton/ Karst Terrains Specialist, and James Reddell/ Karst Invertebrate Specialist, with Karst Technician Assistance from Bud Wetuski, and Marcellino Reyes.

SITE DESCRIPTION, GEOLOGY, AND PAST HISTORY:

In 1990, the subject tract was composed of Approx. 150 Acres of densely wooded property, that contained a single residence. With the building of the " Lake-Line " Mall, 28 Acres of this tract were purchased to set aside as a Karst Preserve for the Endangered Tooth Cave Ground Beetle/ " **Rhadine Persephone** ", found within the cave identified as " **Testudo Tube** " (" Testudo Tube " Cave Preserve). The site residence & Preserve were survey subdivided onto seperate land tracts. Within the karst Preserve tract, there are several other sink-hole features present that have Not been studied to this date. Thus, the Site acreage is bounded by this preserve And the Phase # 5 area of the " Buttercup Creek " Property on the Northern side, the " Ranch at Cypress Creek " Subdivision on the East side, Un-developed land along Cypress Creek along the South side, and " LIME CREEK " Road along the West side. From 1995 to 1997, extensive clearing of Ash Juniper (Cedar) was done on the property. Today, the percentage of cedar left on this tract is about 1% of the remaing trees consisting primarily of Live Oak, Post Oak, & Cedar Elms. Virtually, all open ground areas excluding karst bedrock exposures, are now covered by tall native Savannah, and 5% prickly Pear Cactus. Only a few of the karst features of this tract were previously visited by cavers, and No official study conducted for species until this study. Thus, prior data on some caves was present, a very limited level of excavations done, and essentially No documentations preformed on any caves other than a few descriptions. A new trail road was built that follows the boundaries of the tract. An old house and stone water tank use to sit in the eastern side of this tract, but was demolished & removed presumably about the time that the cedar removal began. In May of 1997, we were working on caves of the adjacent Buttercup Creek property, and near this tract's boundary when a tornado struck, leveling a path through many oak trees that is still well visible today. The remains of a 15' foot tall water tank (metal) on the Buttercup property was picked up, shredded, and hurled hundreds of feet South into this tract. These sections of the tank are still present on the tract. The Travis/Williamson County Line, also transects through this tract along a Northwest line, leaving roughly 70% of the tract in Williamson County. In the long term past, the property had been used primarily for cattle & livestock ranching.

Geologically, the subgrade is faulted by the Cedar Park Fault series, in which the **WALNUT LIMESTON FORMATION (kwa), Cedar Park Member** is exposed at the ground surface over a wide area including this tract as well as the Buttercup Creek Property. The Cedar Park Faults are the primary mechanism for karstified and cave development along subgrade fractures & joints of the Walnut, extending into & through the Cedar Park, Whitestone, Bee Cave, & Bull Creek Members at various studied locations. The subgrade of this tract **IS** a continuation of the subgrade area that encloses & contains the Cedar Park Watershed, and Buttercup Creek Cave **System.** The subgrade beddings of this tract are tilted Eastward towards the Fault series, and hydrologically transmit groundwater flow movements along bedding planes and significantly through developed stream passage dip-tubes. Dye tracing studies preformed by MWA in spring of 1997 confirmed initial Eastward down-dip flow movement to base levels along the faults. After reaching the fault(s), flow then

turns South with the declining lineament ends to the point of the systems primary point of resurgence along " Cypress Creek ". The declining subterranean flow from this area, and areas West of the Fault series, is more gently declining than in caves positioned between faults, or East of the Easternmost Fault. The structure of " Testudo Tube " Cave very " Classically " illustrates such pattern of flow. The " Cedar Park Watershed/ Buttercup Creek " Cave System, is further shown to be a " Closed " or " Self-Contained " System, that is Not contributory to the Northern Segment of the Edwards Aquifer.

INVESTIGATION OF KARST FEATURES (PHASES NO. 2, & 3):

The following is a descriptive account of the investigations of the tract's **FIFTEEN (15)** Karst Features. In this process of investigations, variable levels of excavations were preformed in order to attempt to open subgrade caves for study, and at ONE (1) Feature, involved a large scale clean-up & restoration of the " Discovery Well " Cave Site, of which had been used as a major trash & refuse dumping site by old tenants of the property. Each feature that produced a cave, previously known or not, received a thorough documentation in all appropriate areas and aspects.

Karst Feature No. 1: This Feature was previously known, and referred to as the " Hole in the Draw " Sink in the U.S.S. " Buttercup Creek Karst " Publication by William H. Russell, of 1993. In it's original brief description, it is indicated to be located within a shallow draw. Because the term " Draw " was used, it should be mentioned and noted that this is Not a surface drainage draw or tributary arm to the Jamail branch arm of Buttercup Creek, but a low linear depression created by this sink, and a much larger on to the immediate South ("Grassy Grove" Sink), in which the loss of surface soils & clay sediments into filled cave structures has left behind a significant depression of closed drainage between these Two features, but does Not extend beyond the lineament ends in either direction. The feature consisted of a narrow slot-like opening rimmed by stone and dropped vertically for a few feet to clay infilling & loose rocks. Loose rocks had been pulled from it in the past, however, there was No serious attempt at excavating it. It's appearance however, was highly expressive & suggestive of leading into a subgrade cave. Thus, in this study it was excavated by hand to a depth of 6.0' feet. In order to accomplish this, the entrance opening had to become enlarged. This was done by hand, using sledge hammers, and pry bars to break and pull away the constricting surface layer of limestone, to reach the next consecutive solid layer beneath, also solid, but having solutioned portals as well. The entrance was enlarged to approx. 5' feet long by 2.5' feet wide. Two (2) vertical portals were found in the next rock layer, and each was enlarged as much as possible by hand, but was limited as this layer was much thicker. At the 6.0' foot depth level in the main portal, a massively filled layer of clay and rock was encountered. The second portal is smaller, and offset to the entrance's Northeast corner side. We managed to enlarge it just enough to attempt an entry feet first, and were successful. It also drops to the 6.0' foot level to fill, however, the bottom " bells-out " considerably larger, and intersects a low bedding plane extention to the East & Northeast side. Within this bedding plane that extends about 6.0' feet to the East, and 8' feet to the Northeast, is a dome in the flat roof that rises up to create a small room like area about 4' feet tall (not reaching the surface). The flooring of the feature is connective between portals, and of continuous fill having No drainage portals through it at any point. Observing this, We probed as much area of the flooring that could be reached with a long heavy pointed metal pry bar to determine if any other loose areas of fill or other voids could be determined. The bar was sunk to a depth of 2.0' feet through the clay &

rock at several points, however, No voids or loose areas were found, and the bar came to strike a solid bottom at all points. At this point, the excavation was terminated. The feature was intensely searched for invertebrate life forms, and yielded only a few common and soil related species. **No endangered invertebrate species, or any species of concern was found.** Following the collection, the entire feature was surveyed and mapped, and yielded just enough extent to be qualified to list as a small cave. Thus, the feature was officially assigned to retain it's original known name, but is now " **HOLE IN THE DRAW " CAVE** instead of " Hole in the Draw " Sink. This feature was assessed as **NON-HABITAT for Potential Endangered Invertebrate Species, with a " Minor " or " Relic " state of Point Recharge Value (Not a significant contributor of point recharge)**. The magnitude of fill that has over long time invaded this cave has rendered the aspect of further excavation not feasible, and highly probable to be Non-productive in reaching any other cave extent. It was further determined that a re-collection of this small cave would not be necessary or required due to the fact that it's shallowness & flooring material are very unsuited conditions for potential species habitat.

Karst Feature No. 2: This feature is the Large Sink depression immediately South of F-1 above, was previously known from the Buttercup Creek publication as " **Grassy Grove Sink** ". This 60' foot long by 40' wide by 4' deep sink is rimmed by live oaks & cedar elm, and within the linear configuration with F-1 above to give the impression of a shallow draw. At the bottom of the sink's North side, and at the base of a large cedar elm tree is an exposed low headwall of rock where a small drain portal in massive clay infilling is present. From the size of the sink, and degree of surface soils missing at the surface, gives one the impression that a large cave might be present beneath. An excavation by hand was attempted on the drain portal, which proved to be very difficult. The clay was very hard packed, containing a heavy matrix of roots. An area 6' feet across by 3.5' feet wide was dug down for 3.0' feet, exposing some very large tree roots at that level. It was dug in such manner as to attempt to continue down beneath the headwall in hopes of being able to breakthrough to a void space along a roof line that was leveling, however, a point was reached where only massive infilling was verified 6.0' feet outwards in all directions along the roof. There were No other portals or loose areas to follow, as pointed metal bars were used to probe deeper into the filled areas, but yielded only more tight clay infillings of such magnitude that the pursuit by excavation became no longer feasible. It had become clear that this feature had been overtaken and re-claimed by massive infilling for a very long time, and that it's Point Recharge capability has been reduced to a state of " Relic " condition where drainage to the sink essentially temporarily ponds until it slowly and gradually can sink through the clay fill. The aspect of using machinery to continue would cause major damage to the large cedar elm by the portal, and not be able to reach beneath the headwall as well, thus was determined unsuitable. It was noted, that the roof line level beneath the headwall, was essentially at the same level as the roof line of the bedding plane room in F-1, and the likelyhood of being able to find or determine it's structural continuation was remote. At this point, the excavation was terminated, and the feature evaluated as a " **Relic " Point Recharge Feature whose contributory function is no longer significant, and is marginal at best.** Such feature is unsuitable of condition for potential species habitat & assessed as " **Non-Habitat for endangered Invertebrate species.** The feature's structural framework, is such however, that could easily eventually lead into a groundwater conduit at depth. It is massively sealed though and would likely never re-open by natural processes.

Karstt Feature No. 3: This Feature is located in the Southeastern corner area of the tract, and almost due South of the " Discovery Well " Cave Complex. This feature is small at the surface, and unlike many of the feature's of the tract, does Not possess a well defined surface depressional sink. It's very subtle sloped sink is only 10' feet across, and must be observed closely to distinguish it from the surrounding grounds. In it's initial appearance, it gave the impression of a possible rock joint controled sink at a Northeast trend, of which was not the case under excavation. It sits at the base of THREE (3) Oak Trees which are immediately side by side. It measured 3.5' long by 1.0' wide, and was very severely choked with infilling. The excavation by hand began with removing loose rocks and a heavy layer of leaves & twigs down to a claysoil matting thick with small roots at about 2.5' feet down. This was followed by dark gray clay mixed with rocks. The dig did Not appear very promising at this point. It continued to about the 4.5' foot level after using a sledge hammer to enlarge the shaft enough that it could be continued downwards. At 5.0' feet we questioned whether or not we could continue due to the constricting space, and a large tree root also diving down the shaft. Suddenly, a breakthrough occurred after pulling out a rock, and the whole bottom became loose. In attempt to pull more rocks, the bottom fell out, as we listened to rocks of all sizes rattle on down for several feet. At that point, a larger void space was visible at the bottom of the shaft. Over the course of the next couple of hours, many 5 gallon buckets of rocks & soil were hoisted to the surface, as the shaft increased in depth and size, and revealed Two more short drops from the bottom at about 11' feet down. At this point, the excavation had continued down vertically, passing by a small side passage to a small window-like opening in the rock. A Large tree root winds around along the wall, and partially constricts this opening. It was checked closer, and with removing a single large rock just beyond the root, presented us witha view into a parallel open domeshaft that we hadn't realized was there. The shaft appeared well large enough beyond the window, but it took awhile to figure out how to get through the window. It required something of an un-natural act of movement by entering head first, but laying on your back. The constriction was tight, but smooth surfaces allow one to slide through while you have to force yourself into the top of the small dome to get your legs through. It is not any easy manuver both entering & exiting. The bottom of this shaft led into a low bedding plane room, requiring a bit of trenching in the floor to crawl in. The room is low, but about 30' feet long by 15' feet or better across. It is completely floored with dark gray clay, and has only one low point for a possible drain but is massively plugged. No invertebrate lifeforms of any kind were found. Following the exploration and collection attempt, the small cave was surveyed & Mapped. The feature was given the official name of **" UNDER THREE OAKS " CAVE** for identification purposes. It was evaluated as **" Non-Habitat for endangered species, and " Minor " Range in Point Recharge Value (Not a significant contributor of runoff to groundwater flow or storage)**. The air-quality within the low bedding plane room was not good, and was likely oxygen reduced. This feature's entrance was apparently sealed for a very long period of time. It's interior condition did not appear very suitable for cave invertebrates. No air-flow conductivity was detectable at any points during the excavation, or after it was opened. The lowest portal was dug at, but is well sealed, and there is very little room available for placing fill out of the way.

Karst Feature No. 4-A: This feature is One (1) of Four (4) that occur in a " Cluster " arrangement with additional features of F-4, F-5, & F-6. This " Cluster ", here-in will be referred to as the " **Discovery Well/ Hunters Lane " Cave Complex.** This feature within the " Complex ", is located immediately West of F-5 (" Hunters Lane " Cave). It is a sizable sink depression about 20' feet in diameter that was Not mentioned in the Buttercup Creek Karst publication of 1993. This sink, like the sink entrance of F-4 (" Discovery Well " Cave) was used as a trash & refuse dump in the past by ranching operations, however, Not as much refuse was placed into it as was " Discovery Well " Cave. The sink is rimmed by live oak & cedar elms, and distinctively has numerous rough textured limestone rocks & boulders scattered around the perimeter of the sink's Eastern side. A limited hand excavation had been attempted in the past, however was abandoned after encountering only more large boulders in the sink. During this study, a backhoe that would be used to remove massive refuse at " Discovery Well " Cave, was used at this feature in attempt to excavate and open a potential cave. The sink was excavated to a depth of 5.0' feet, at which level a solid rock bottom and closed rock joint was revealed. The bottom was carefully cleaned by hand revealing that the rock joint was completely closed tight, and No drainage portals of any kind were present. A layering of old trash in the form of old cans, bottles, and some wire was also exposed. The trash was gathered up by hand and put into plastic bags to be removed from the site. As this was completed, and inspection of the bottom of the sink completed, No reason remained for leaving the excavation open, so it was back-filled and caringly restored to the condition found initially, which required much hand work after using the machine. The feature did not produce a cave, and was not named. It was assessed as " **Non-Habitat for potential endangered invertebrate species, and of No significant value to point recharge contribution.** Structurally, this feature is likely only a vague surface expression of the same rock joint that nearby " Hunters Lane " Cave is developed along.

Karst Feature No. 4: This Feature was previously known and was described in the Buttercup Creek Karst publication of 1993, as " **DISCOVERY WELL " CAVE.** It consists of a large 40' diameter surface sink depression. This sink depression was used as a trash & refuse dumping site in the past by ranching operations. The amount of refuse placed into this sink was 25' feet in diameter and piled up 6.0' feet high above ground level. Cavers in the past, were able to push some of the refuse aside just enough to be able to enter the cave beneath. During this study, a backhoe was used to remove ALL of the trash & refuse, moving it to an alternate location well away from the cave where it can easily be reached in the future for removal from the property. The bulk of the refuse consisted of massive amounts of wire of all kinds, that was so heavily entangled, that removal by hand was not feasible. Mixed with this material were old metal swamp coolers, feed troughs, water well tanks, metal frames, buckets, cans, old fire extinguishers, poles, and MUCH broken Glass. The backhoe worked extremely well, as was predicted, by hand filling the front bucket, and then turning around and reaching out with the backhoe arm and scooping up massive loads of wire weighing up to 5 to 6 hundred pounds a load. This was done repeatedly until all of the bulk rolls of wire were removed. Gradually, the cave's vertical solid walled entrance became exposed. The excavation continued on for many hours, filling the front bucket by hand, as the surface area became cleaned up of all trash, and the excavation continued down the vertical entrance to approx. the 15' depth level. At the point of finish, the cave's impressive entrance had been completely cleaned & restored. It is probably the most impressive cave entrance of the property, and was most rewarding to see it now clean.

The cave is developed along a Westward trending rock joint that continuously descends to it's present lowest point. From the base of the entrance shaft, old infillings of rocks & clay constrict the passage to little more than

crawling spaces along the joint. In order to follow this passage, loose rocks must be continuously moved aside, and stacked out of the way into any available pockets or spaces below the First drop of about 5' feet. During the removal of some of these rocks, a single specimen of " Rhadine " Beetle was found and collected. The specimens " slender " size, did not appear to be that of the endangered " Tooth Cave Ground Beetle " (" Rhadine Persephone "), and later under microscopic observation at the invertebrate laboratory, proved to be identified as " **Rhadine New Species** " (Not endangered, but a " Species of Concern "/ SOC). This species of Rhadine is endemic to the caves of the " Buttercup Creek " Cave System. The passage continues down to a point where it becomes very small and constricted, and essentially becomes too constricted to continue. A possible pit ahead is only partially visible, and air quality is good, but with little flow movement. The only way to continue ahead, would be to use a low grade explosive to remove a section of wall to reach the point of the pit, however, if such were done, there would be No place availble to stack any spoils out of the way short of hauling them out of the cave, which is Not feasible. Thus, continuing the excavation was determined Not to be feasible, and the excavation was terminated at this point. Following an intensive collection of the cave, the cave was surveyed and mapped. The Cave was assessed as a " **Major** " **Point Recharge Feature**, as it receives a considerable upslope drainage contributory to it from the Southwest, and it's structure is highly suggestive and suspect of interconnection to nearby " Hunters Lane " Cave (F-5), of which contains an active groundwater conduit (Stream Passage).

Karst Feature No. 5: This Feature was previously known and identified as " **HUNTERS LANE** " **CAVE** in the Buttercup Creek Karst publication of 1993. In 1991, the feature was sealed by a heavy layer of Ranch Trash & Refuse, similar to the condition of " Discovery Well " Cave nearby, however, without the massive rolls of wire and large items. At that time, I had taken interest in the feature and excavated a large amount of trash/refuse from it, and removed it from the site. (about 8 pick-up truck loads). The excavation revealed a small vertical shaft at the Northern end of the surface sink. The bottom of the shaft below remained blocked by fill, and the excavation did not continue at that time. The feature has a surface sink depression of about 40' feet in diameter, and funnels to a 12' by 8' foot 5' foot drop containing this portal. Later on, cavers excavated the bottom of the shaft just enough to enter the cave beyond. During this study, all remaining trash & refuse that could be found was gathered up and placed into plastic bags & removed from the site. The bottom of the entrance shaft had become plugged and blocked off again, and had to be re-excavated in order to open and access the cave for study. A small constrictive window at the bottom also had to be slightly enlarged. Beyond the window is a short drop into a small low room. On the Northwest side of this room is another window-like opening that overlooks a large pit along the rock joint and drops vertically for 15' feet. This pit may be down-climbed by First traversing horizontally out over the top, to a point where ledges of the opposing walls offer both easy hand and foot holds. The top of the pit continues on into a narrowing of the rock joint that is too narrow to follow. At the bottom of the pit, the flooring of water washed clean stones slopes down back in the direction of the entrance above, and drops 2.0' feet into a low groundwater conduit that continues in both up-stream & down-stream directions. The up-stream is low with a muddy floor, and essentially too low to follow. The down-stream immediately slopes into a semi-water filled crawl, and low air-space of only 2" inches about 12' feet in. At the edge of the water, a layer of floating organics is present.

while observing this, a large specimen of Troglobitic Cave Salamander (EURYECA) appeared in front of me to feed in the shallow water. I observed it for some time. This specimen was about 5 & 1/2" to 6" inches in length, white in color with very small eyes, and appears very similar to the specimens found in " ILEX " CAVE of the Buttercup Creek Property in the past. It was Not collected at this time, as I did not have the suitable gear needed with me. Beyond the point of the low air-space, is a slight off-set in the passage. It very clearly continues for a long distance, but remains in very low air-space, and appeared to be possibly submerged about 20' feet ahead.

The cave was intensely searched for invertebrates, however, No specimens of Rhadine beetle was found, and **No endangered invertebrate species were found.** The **" Jollyville Cave Salamander " (Euryeca), is a vertebrate " Species of Concern (S.O.C.).** The Cave recieves considerable drainage in it's position in the cave " complex ", and is structurally clearly suggestive & suspect of interconnection with " Discovery Well " Cave nearby. It was assessed as a **" Major " Point Recharge Feature.**

Karst Feature No. 6: This feature is the last feature associated to the " Discovery Well "/ " Hunters Lane " Cave complex. It is a small diameter (15') subtle sloped sink located just West of Feature No. 3, and was Not mentioned in the Buttercup Creek Karst publication of 1993. It consisted of only a small heavily filled drainage portal less than 6" inches in diameter along the edge of an exposed bedrock/ headwall. A large Post Oak Tree grows on the West side of the sink. A backhoe was used for the initial excavation down to the 5.0' foot depth level. At this point, the shape of an old solid rock portal was vaguely taking shape, but still filled with hard packed clay. The backhoe bucket could not go deeper because of the constriction, so excavation by the machine stooped at that point. The excavation, did not appear to look promising, however, it resumed by hand. After about 1 hour of digging by hand, a void space was found, and break through into a semi-open pit occurred. It took a couple more hours before the shaft was enlarged, and cleared enough to enter, dropping about another 10' feet into a small cave. At the bottom, are 2 small drops separated by a small natural bridge of rock. The main drop enters a small room-like area to the East, rising up to a dome in the roof. At the top of the dome, is a low bedding plane passage extending over to the South for about 10' feet, and to a small hole in the floor that connects back into the bottom of the dome room. At the bottom of the dome Rooms East side is a low crawl that extends for 7' feet to an end in fill. The flooring is composed of a massive infilling of dark gray clay. A low spot in the floor was dug at, but revealed only more thick clay, and is Not a semi-open drainage portal. This small cave has been sealed for a very long period of time. In the sealing process, large rocks had become wedged into the constricted part of the entrance shaft, and " Corked " the entrance shaft closed, leaving the larger space below open. As a result, the potential organic input was blocked off, and few invertebrate species were found below the blockage. The cave was surveyed and mapped as a new cave, and given the name of **" UN-CORKED " CAVE** for identification purposes. It was assessed as **Non-Habitat for potential endangered invertebrate species, and of " Relic " condition value to Point Recharge (Not significant of input)**, However, it's structure is very suggestive and suspect of interconnection at depth with the up-stream conduit of nearby " Hunters Lane " Cave.

Karst Feature No. 7: This feature is a small diameter surface sink formed along a rock joint, just North (30') of the tract's South boundary fence & trail

road. It is One of 3 features that would likely be in the projected pathway alignment extension for the continuation of " Anderson Mill " Roadway to " Lime Creek " Road..The feature dropped only 1.5' feet to fill, and a large boulder that had been pushed into it. This feature was further Not mentioned in the Buttercup Creek Karst publication of 1993. It was excavated to a total depth of 15.0' feet, being mostly filled to that level, and requiring various enlargements to reach the bottom. Only a small extension to the North, mid-way down the pit was semi-open, and the last couple of feet at the bottom where the walls of the rock joint become far too narrow too follow.atop a clay bottom. When the excavation was completed, the extent of the feature was enough to qualify in listing as a small cave. Thus, the feature was given the name of **" YAWNING ENTRANCE " CAVE** for identification purposes. A small assemblage of invertebrate species were found and collected, However, **No endangered invertebrate species were found,** and the feature's characteristics are unsuited to such habitat conditions. it was further assessed as **" Minor " Range in Point Recharge value, and Not a significant contributor.** It's surface sink and position is such that it receives only what little water falls directly upon it.

Karst Feature No. 8: This feature is located a short distance West of F-7 above, and is also close to the tract's South boundary line fence & trail road. The presence of this feature appears to have been unknown, and was Not mentioned in the Buttercup Creek Karst publication of 1993. It consists of a very small sink along a rock joint similar to that of F-7,only smaller. It was excavated by hand using sledge hammers to enlarge to a depth of 3.5' feet, at which point a solid rock bottom was encountered, and offsets on the southeast side into a very low bedding plane 3" inches tall and extends back for only 2.5' before closing completely. At this point, the excavation was terminated. The feature did evidence a small degree of nest materials for past usage as a ground mammal burrow. There is no further extent, and there were No drainage portals found at the bottom. The feature was assessed as **" INSIGNIFICANT " to reporting issues, being Non-Habitat for endangered invertebrate species, and of No Value to Point Recharge.**

Karst Feature No. 9: This feature is located on the tract's Northern area side, and only 60' feet East of the " Testudo Tube " Cave Preserve East side fencing. It is a small sink under live oaks that had a small portal at the bottom, and Not mentioned in the Buttercup Creek Karst publication of 1993. It is approx. 3.0' in diameter & funnels to the portal less than 6" inches in diameter. It was excavated by hand to a depth of 3.0' feet, and found to be an old mammal burrow, with a solid rock bottom beneath reddish clay. This feature was assessed as **" INSIGNIFICANT " to reporting issues, and of NO Value to Point Recharge.**

Karst Feature No. 10: This feature is located about 800' feet South of the " Testudo Tube " Preserve tract's South boundary, and beneath the canopies of large mature Cedar Elm trees. It consists of a large diameter sink depression about 75' feet in diameter that funnels drainage to TWO (2) rock lined portals. Additional drainage to this feature comes from the up-slope direction to the Southwest. The main portal is 5.5' feet in diameter dropping 4.5' to a rock bottom, and ledges of rock that protrude into the portal. Beneath the South & West wall sides, are 2 small portals too small to enter but drop 3.0' feet into a solid floored area. The portal to the Southwest issues a detectable air-flow conductivity, and the sink drains considerable runoff. The smaller surface portal to the South

drops only 2.0' feet to a massive infilling, & low bedding plane that connects to the main portal. This feature is Not mentioned in the Buttercup Creek publication of 1993. I made a brief excavation of this feature in 1991, stopping at the point of the small portals. The feature was not named. In this study, it was excavated both by hand, and with the aid of an air-powered jack hammer to a depth of 6.5' feet. The excavation connected both portals in the main sink entrance, and followed a short passage that curved around to the top of a small rock lined pit beneath the Northwest side of the entrance. The floor of the passage leading to this pit was carved by past water flows into a " V " shaped trough. The excavation pushed until the top of the pit was finally accessible for observation. Unfortunately, it dropped vertically only 4' feet into a very narrow rock joint that was entirely too small to follow. This joint turns and runs back beneath the rock bottom of the entrance. The excavation had followed a constant " Zig-Zagging " back & forth of the passage. The rock joint still issues a notable air-flow conductivity of good quality, strongly suggesting that a cave is present at greater depth, however, there is essentially No feasible way to reach it. A minimum of invertebrates were collected during the excavation, however, **No endangered invertebrate species were found.** a low bedding plane extent to the Southeast was also found, but is too low to enter having a solid rock roof & floor only a few inches high. The toatal extent and particularly the characteristics of this feature were determined to warrant listing this feature as a small cave. Thus, the feature was given the assigned name of " **ZIG ZAG " CAVE.** This feature was further assessed to be an " **INTERMEDIATE " Range Point Recharge Feature, and is significant of runoff input to groundwater flow in the subgrade.** The cave was surveyed & mapped.

Karst Feature No. 11: This feature is the closest located feature to the South side of the "Testudo Tube " Cave Preserve Tract. It consists of a large diameter sink depression that funnels into a small round hole only 2.0' feet by 1.5' feet rimmed by solid stone. The drop is vertical for 8.0' feet to the floor of a small room. From this room, a low space extends to the Northeast before ending in fill. On the West side of the room, the floor drops 2.0' into a low bedding plane type passage of crawlway size over a flooring massive fill composed of large boulders, clay, and mounds of organics washed in from the surface. The infilling is so massive, that there does not seem to be a specific drain release portal, however, it would appear to drain against the room's North wallas it declines with the fill of the flooring. It was dug at by hand, only to reveal a tightly packed matrix of rocks & clay with No loose spaces. There was No air-flow conductivity detected, however, the air quality was good. The interior condition of this room clearly suggests that it likely fills up and submerges following heavy rainfalls, and slowly drains through the fill. This small cave was Not mentioned in the Buttercup Creek Karst publication of 1993. It does however, have enough extent to qualify as a cave, and was given the name of " **JUMBLED ROCKS " CAVE** for identification purposes. It was intently collected, yielding a few invertebrates, however, **No endangered invertebrate species were found.** The cave was then surveyed and Mapped. This feature was further assessed to be an " **INTERMEDIATE " Range Point Recharge Feature, and is Significant of runoff input to groundwater flow in the subgrade.** It contains a massive interior plugging of rocks & clay that does Not appear feasible to excavate & remove.

Karst Feature No. 12: This feature is a previously known cave identified as " **PERSIMMON WELL " CAVE.** This feature however, is Not mentioned in the Buttercup Creek Karst publication of 1993. The cave was excavated by myself in 1992 to a depth of approx.12.0' feet, and stooped at that level. During this study, the excavation resumed and a lower passage was opened that extends in Two directions.

To the Northwest, it extends for about 20' feet before becomming to low to continue. To the Southeast, it extends about 15' feet to a drain portal in the floor that is solid rimmed and entirely too small to follow. The passage continues sloping upwards to a reddish clay floor in a meandering tunnel that becomes too small to follow after another 20 to 25' feet. The cave recieved a thorough collection, of which yielded only ONE (1) species of concern (" **Rhadine New Species** ") of which is endemic to the caves of this area, but **NO Endangered Invertebrate Species was found.** Following the collection, the cave was surveyed & Mapped.It was further evaluated as an " **INTERMEDIATE** " **Range Point Recharge Feature, and is Significant of runoff input to groundwater flow in the sub-grade.**

Karst Feature No. 13: This is an " Outlying " karst feature to the tract, of which is thought to be the Only feature of this study to be located in TRAVIS County. It is located near " Lime Creek " Road, and about 60' feet South of the Tract's South boundary fenceline & trail road. It is/was an open cave, however, it was Not mentioned in the Buttercup Creek Karst publication of 1993, and has Old excavation piles around the Southeastern side of the entrance. It is located just inside of the dense woods & brush line to the South side of the road. It consists of a 15' foot in diameter sink depression that funnels to a solid stone rimmed entrance dropping vertically for 5.5' feet. A large Hackberry tree grows from the floor of infilling at the bottom of the entrance. The entrance is 7' feet long by 4.0' feet wide. At the bottom, it opens onto a low bedding plane room to the Northwest side, and slopes down to a small pit opening at the back wall. This pit drops for 6.5' feet into a small passage at the bottom to the Northwest before ending. There are No drain portals in the flooring of this passage. This small cave has been given the name of " **UNDERSTORY** " **CAVE** for identification purposes. It was intently collected, but only a few invertebrates were found, and **NO endangered invertebrate species were found.** The cave was then surveyed and Mapped, and evaluated as only a " **Minor** " **Range Point Recharge Feature.** The cave has a very limited surface collection sink, and essentially recieves what little water falls directly upon it. It is Not considered to be a significant contributor to Point Recharge.

Karst Feature No. 14: This feature is located near " Lime Creek " Road, in the far Northern corner of the tract, and within the area between " Lime Creek " Road, and the " Testudo Tube " Preserve Tract. The feature is a prominent sinkhole at the base of a large Cedar Elm tree that is rimmed by very large boulders. This feature is Not mentioned in the Buttercup Creek Karst publication of 1993. A hand excavation was attempted on this feature, but was terminated after about 3.0 Hrs. after starting. Several large rocks had been broken up & removed, and at the 5.0' foot depth level, A massive clay infilling was encountered that contained No drainage portals. A long heavy metal bar was used to probe deeper into the fill, however, No further loose points or void spaces were found. The magnitude of the infilling is such that to pursue it further is Not feasible. It appears to have been well sealed for a very long period of time. It's structure however, is likely to have relationship with " Testudo Tube " Cave (down-slope), in the sense that is likely an old infeeder point that has now been re-claimed by infilling, and become rendered in a " Relic " state or condition to Point Recharge. It's surface area of drainage collection is limited to less than 50' feet around the opening. **NO endangered invertebrate species were found, and it is evaluated as a " Minor " Range Point Recharge Feature.** Because of it's " prominent " or " pronounced " appearance at the surface, this feature was given the name of " **LIME CREEK** " **SINK.** It does Not qualify for listing as a cave, and there-in No Map is necessary or required.

CONCLUSIONS AND RECOMMENDATIONS:

Of the Site's FIFTEEN (15) Karst Features, a Total of TEN (10) Features led into underground extents that qualified for listing & identification as actual CAVES. FIVE of these caves occur within the boundaries of the Tract, and are within WILLIAMSON County, while the other FIVE are in TRAVIS. One Cave lies just South of the South boundary fence ("Gholson" Tract).

ALL of these Caves have recieved a very thorough investigation & documentation. EACH CAVE was collected for invertebrate Biology a Total of THREE (3) Times, with the Last Time preformed by Dr. James Reddell/ Karst Invertebrate Specialist & Assistant Marcelino Reyes. ALL Biological collections have been transported to the " Regional Invertebrate Laboratory " at the TEXAS MEMORIAL MUSEUM/ " PICKLE " RESEARCH CENTER in AUSTIN, for positive species identifications, and Taxonomic listing. Dr Reddell will provide the listing of species found as an Addendum Material to this Report. The Project's summary statement, is that NO ENDANGERED INVERTEBRATE SPECIES WERE FOUND, However, TWO (2) " SPECIES OF CONCERN " (SOC's) WERE FOUND. These Species are identified as " RHADINE NEW SPECIES " of which is endemic to the Caves of this Area, And Specimens of the " JOLLYVILLE " CAVE SALAMANDER, a vertebrate troglobitic species of high concern were found. The Site specific Caves found to contain these species is as follows:

1. " HUNTERS LANE " CAVE - Jollyville Cave Salamander, & potential to contain " Rhadine New Species ".
2. " DISCOVERY WELL " CAVE- " Rhadine New Species "
3. " PERSIMMON WELL " CAVE- " Rhadine New Species "

Many of the Site's Caves have a SIGNIFICANT Point Recharge Value contributory to the CEDAR PARK WATERSHED/ BUTTERCUP CREEK CAVE SYSTEM of which has a direct relationship to the Habitat of the Jollyville Cave Salamander. The Site specific Caves found to possess these Values area as follows:

1. " HOLE IN THE DRAW " CAVE - " Relic " Recharge Condition, but Structurally related to the Cave SYSTEM between the points of the " Discovery Well Cave complex, and " Nelson Ranch/ Ilex/ Buttercup Creek " Caves of the " Buttercup Creek " Property.
2. " GRASSY GROVE " SINK- Relationship is the same as above.
3. " DISCOVERY WELL " CAVE COMPLEX - Includes the following Caves & Sinks: " Discovery Well " Cave, " Hunters Lane " Cave, Uncorked " Cave, & F-3 Sink (Un-named Sink). Relationship to system is confirmed by existing grounwater conduit containg Salamander Habitat, and structural connectiveness with each cave & feature of the Complex.
4. " ZIG ZAG " CAVE- Large surface collection area for runoff, and feature has Good Air-Flow Conductivity, Likely connection to cave system.
5. " JUMBLED ROCKS " CAVE - Large surface collection area for runoff, and likely a structural connectiveness to the Cave System.
6. " PERSIMMON WELL " CAVE- Large surface collection area for runoff, and likey a structural connectiveness to the Cave System.
7. " LIME CREE " SINK- " Relic " Recharge Condition, but Structurally related as old infeeder route to " Testudo Tube " Cave, & the Cave System.

SUMMARY OF SITE KARST FEATURES TO BE PROTECTED BY PRESERVE STATUS:

1. " HOLE IN THE DRAW " CAVE
2. " GRASSY GROVE " SINK ——————Both in Single Preserve

3. " UN-NAMED " SINK (F-3)
4. " DISCOVERY WELL " CAVE
5. " HUNTERS LANE " CAVE ——————ALL FOUR in Single Preserve (" Discovery Well " Cave Complex)
6. " UNCORKED " CAVE

7. " ZIG ZAG " CAVE ——————Single Preserve

8. " JUMBLED ROCKS " CAVE ——————Single Preserve

9. " PERSIMMON WELL " CAVE——————Single Preserve

10." LIME CREEK " SINK——————Single Preserve

SUMMARY OF SITE CAVES THAT WOULD BE WARRANTED FOR PROTECTION BY CAVE GATES:

1. " HOLE IN THE DRAW " CAVE
2. " DISCOVERY WELL " CAVE
3. " HUNTERS LANE " CAVE
4. " UNCORKED " CAVE
5. " ZIG ZAG " CAVE
6. " JUMBLED ROCKS " CAVE
7. " PERSIMMON WELL " CAVE

Non-Sensitive caves
(if protected)

1. " UNDER 3 OAKS " CAVE
2. " YAWNING ENTRANCE " CAVE

It should be noted that the observed depth level of groundwater conduit development observed is at -33' in the subgrade of the site, and is -16' feet at " Testudo Tube " Cave. This clearly illustrates in testament that while the route of subgrade conduits are likely to be of suitable depth beneath the surface of the Eastern half of the tract, and would be a non-issue concern at the surface, such development in the Upper Western (Northwestern) part of the tract may Not be at a sufficient depth to escape the possibility of becoming intersected by buried utility line excavations. Both case examples found in this area, indicate that geologically, the conduits have developed at the base of the Cedar Park Member of the Walnut, and top of the underlying Bee Cave Member. This may further be an indicator that the Bee Cave Member beneath the tract is less fractured than in areas East & Northeast of the tract towards the Faults.

It should be further noted, that the boundary relationship between this tract, and the " Testudo Tube " Preserve Tract, is " **Problematic** " in the sense that there are several remaining sinkhole karst features of the Preserve tract that have never been investigated, and that any of these might have a " Foot-print " capacity to extent outwards of the preserve and beneath this tract. Further, Endangered Invertebrate species (" Rhadine Persephone ") is confirmed in " Testudo Tube " Cave, and might well be found within other presently unknown caves of this Preserve. Presently, based upon the data gathered from the Tract No. 3 Study, we have No scientific factors to support connecting any of the tract's Cave Preserve areas with the " Testudo Tube " Preserve tract with exception of " LIME CREEK " SINK, of which has a very obvious structural relationship as an up-stream

infeeder, that is inaccessible, and in a " Relic " Condition. Thus it would be very unrealistic to assume that No subgrade problems would exist for development in this area, and well risky to develope without additional study data from the " Testudo Tube " Preserve Tract. I am otherwise comfortable with our assessment data relative to Preserve set-back sizes, as is based upon the Tract # 3 Study material.

RECOMMENDED PRESERVE SET-BACK AREAS :

As the Biological Concern of protection in this area has been brought to a focus upon " **Species of Concern** " instead of any confirmed Federally Listed Species, and a very important factor in that Concern becomes that of Point Recharge & Ground water quality to the Watershed/ Cave System supporting the Habitat quality of Cave Salamanders, We have placed the aspect of Point Recharge Values at the top of the priorty concern list, as we feel that by protecting All of the Point Recharge Basins & Collection areas, provides protection for the " Species of Concern ". Thus, We have carefully measured All of the surface basin collection areas for these Caves & Features, and would recommend the following Preserve area sizes:

Preserve No. 1: " Hole in the Draw " Cave & " Grassy Grove " Sink .

From the dug portal in Grassy Grove Sink, a Line at S. 213 Degrees W. extends Up-Slope for 140' Feet. From the same point, a line at NJ 40 degrees E. for 91' feet extends to the Entrance of " Hole in the Draw " Cave. Then to the Downslope of " Hole in the Draw " Cave entrance, a line extends at N. 40 degrees E. for 75' feet.For Preserve width, see Addendum Karst Feature Location Map.

Preserve No. 2: " Discovery Well " Cave Complex.

From the Entrance of " Discovery Well " Cave, a Line at S.220 Degrees W. extends Up-Slope for 200' Feet. From the same point, a line at N. 40 Degrees E. for 112' feet extends to the South side of Entrance at " Hunters Lane " Cave. From the South side of Entrance at " Hunters Lane " Cave, a line to the Down-slope extends at N. 70 Degrees E. for 100' feet. Then from the same point at " Hunters Lane " Cave, a line extends at N.278 Degrees W. for 60' feet to F-3 Sink, and then for 107' feet (same azmuth) to the entrance of " Uncorked " Cave. Last, from the entrance of "Uncorked" Cave, a line extends Up-Slope at N.278 Degrees W. for 100' feet.* see Addendum Karst Feature Location Map.

Preserve No. 3: " Zig-Zag " Cave.

From the Entrance (Main opening) of " Zig-Zag " Cave, a Line at 220 Degrees S.W. extends in the Up-slope direction for 200' feet. Then, from the same point, a Line at 40 Degrees N.E. extends for 100' Feet in the Down-slope direction. See Addendum Karst Feature Location Map.

Preserve No. 4: " Jumbled Rocks " Cave.

From the Entrance of " Jumbled Rocks " Cave, a Line at S. 267 Degrees W. extends in the Up-slope direction of drainage for 190' Feet. Then, from the same point, a Line at N. 80 Degrees E. extends in the Down-slope direction for 80' Feet. See Addendum Karst Feature Location Map.

Preserve No. 5 " Persimmon Well " Cave.

From the Entrance of " Persimmon Well " Cave, a Line extends at S. 227 W.

for 210' Feet in the Up-slope direction of drainage. Then, from the same point, a Line at S.E. 110 Degrees extends for 65' Feet in the down-slope direction. See Addendum Karst Feature Location Map.

Preserve No. 6: " Lime Creek " Sink.

From the Entrance of the Sink, a Line would extend Up-slope directly to the " Lime Creek " Rd. & Property fencing (West). Then, from the Sink, a Line would extend Down-slope directly to the " Testudo Tube " Preserve boundary fence (East). See Addendum Karst Feature Location Map.

" ANDERSON MILL " ROADWAY EXTENTION ALIGNMENT:

Should the " Anderson Mill " Roadway Extention Alignment path, continue it's present projected direction towards " Lime Creek " Road, and essentially following the South boundary fenceline of the Study Site, the following features would likely be encountered:

1. **" UNDER THREE OAKS " CAVE**
2. **" YAWNING ENTRANCE " CAVE**
3. **F-8 Sink**

Additionally, the Roadway would pass very close to **" UNDERSTORY " CAVE** of the adjacent South Tract. **ALL** of these Caves & Features have been found to be **" Non-Habitat " for endangered invertebrate species, No meaningful Point Recharge Values, And there-in, NO PROTECTION of these features is Recommended.**

If, the roadway path should go directly over both **" UNDER 3 OAKS " CAVE, And/or " YAWNING ENTRANCE " CAVE,** there lower sections should become **Permanenty Sealed in Concrete to act as barriers to prevent any potential contaminents or pollutants from migrating into the sub-grade along these feature's routes/avens into the sub-grade.**

CLOSING STATEMENTS & REFLECTION:

The condition of the Site Study Tract Area, has undergone dramatic change of appearance in recent years through the massive clearing of Ash Juniper (Cedar), of which before was very densely present, and now almost entirely absent. Since then, vast areas and particularly around cave entrance have been re-vegetated by tall native grasses, of which is very good for soil and sediment stabilization, and greatly helps to both difuse and filter Ronoff flows to be captured as input to karst features. This helps to insure water quality for the cave system, and aquatic habitat there-in. Great care should be taken to see that such areas within surface collection basins of closed drainage to features remains undisturbed, and under potential development should be prior outlined with filtration & construction fencing.

Habitat for the endangered **" Rhadine Persephone ", has Not been found,** as of this study, and remains " questionable " primarily due to the following aspect observed in the past in other caves of nearby property. Both " Rhadine Persephone, And Rhadine New Species " have been observed to live in co-habitation with each other in the same cave, and apparently with little, if any conflict.

The nature of such relationship is still not known, but may simply indicate that conflict is not apparent due to an abundance of food source typically present within the area caves. Comparative traits between the specis indicate that Rhadine Persephone is typically larger in both size and body structure than the New Species, and in natural selection, would appear the more stronger or predominant of the Two. Both of these species, like conditions where reddish clay floorings are present, and particularly areas where " Pulverite " or chalky leached limestone is present, However, it has been my observation that Rhadine Persephone is More preferential of high quality conditions, than is Rhadine New Species, who is apparently able to settle for less quality.areas. Many caves of this area where only the New Species has been found after many samplings, continue to evidence only their presence. Thus I would support future samplings from these site caves to evidence any co-habitation, however, am of an impression and opinion that habitat in these caves is primarily that of the New Species, and potential habitat for Rhadine Persephone would appear very marginal at best, if present at all.

The Most " Problematic or Troublesome " Aspect of this Tract for application of potential development, is the Northwestern quarter, where the nature of ground-water conduits have developed at considerably shallow depth, as is evidenced with the structure & extent of " TESTUDO TUBE " CAVE, and from the presence of several other features present within that tract in which Nothing is known. Without the benefits of such data, it is essentially impossible to determine how, and to what extent the shared property boundaries around this Preserve And the Tract No. 3 are effected. Such condition well warrants a specific concern to both Habitat, and groundwater issues that would have to be studied before any scientific basis is present for surface and sub-grade delineations between determining Sensitive and Non-Sensitive areas. I am un-aware of any such studies to this effect, since the point that the " Testudo Tube " Preserve Tract was established.

Addendum Reporting Materials:

Site Study CAVE MAPS (10)
Site Karst Feature Photography (7 Pages)
Karst Feature Location Map (1)
Site Taxonomy Report (3 Pages)

*** Report Copies to:**

Blanton Development Company (4)

Respectfully,

MIKE WARTON, Principal Executive

GEOLOGIST/ Karst Terrains Specialist
National Cave Gate Consultant

MIKE WARTON & ASSOCIATES

MIKE WARTON
MIKE WARTON & ASSOCIATES
P.O. BOX #1313
CEDAR PARK, TEXAS 78630-1313

Mike Warton & Associates

GEOLOGIST / KARST TERRAINS SPECIALIST / NATIONAL CAVE GATE CONSULTANT
P.O. BOX # 1313 CEDAR PARK, TEXAS 78630-1313
(512) 250-0705 FAX (512) 250-0706
SPECIALIST IN TEXAS' ENVIRONMENTAL KARST RESEARCH & SERVICES

SITE KARST FEATURE INVENTORY:

TRACT NO. 3 Per The " RANCH AT DEER CREEK " Residential Subdivision Development, CEDAR PARK Area South, TRAVIS & WILLIAMSON Counties, TEXAS

The Following FOURTEEN (14) Karst Feature Locations were taken By GPS on MARCH 13, 2001. These locations need to be plotted onto a tract no. 3 land plat map by computor, using GIS/ WGS-84 Software. Tract No. 3 consists of approx. 300acres.

	GPS – UTM's			
1. Karst Feature No. 1:	North	0610233	East	3373500
2. Karst Feature No. 2:	North	0610200	East	3373467
3. Karst Feature No. 3:	North	0609957	East	3373316
4. Karst Feature No. 4:	North	0610069	East	3373422
5. Karst Feature No. 5:	North	0610095	East	3373439
6. Karst Feature No. 6:	North	0610047	East	3373470
7. Karst Feature No. 7:	North	0609703	East	3373369
8. Karst Feature No. 8:	North	0609673	East	3373390
9. Karst Feature No. 9:	North	0609884	East	3373662
10. Karst Feature No.10:	North	0609678	East	3373537
11. Karst Feature No.11:	North	0609620	East	3373691
12. Karst Feature No.12:	North	0609489	East	3373739
13. Karst Feature No.13:	North	0609358	East	3373518
14. Karst Feature No.14:	North	0609510	East	3373985

* Note: Karst Feature No. 13 is beyond South fencing & likely an Outlying Feature.
* GPS Accuracy should be to within 4.0 Meters/ ALL readings had at least 5 satellites, and many had 6.

If any questions, please contact me at (512) 250-0705. Thank You.

Respectfully,

MIKE WARTON/ Geologist/ KTS

CAVE BIOLOGY OF TRACT #3, RANCH AT DEER CREEK, CEDAR PARK, WILLIAMSON COUNTY, TEXAS

James R. Reddell

3 May 2001

Twelve caves and sinks have been biologically investigated on Tract #3 of the Ranch at Deer Creek subdivision. Mike Warton collected in all of the features during initial excavation and exploration. James Reddell and Marcelino Reyes re-collected in five of the largest caves. No specimens of the endangered Tooth Cave ground beetle, *Rhadine persephone*, were found, but at least three of the caves appear to contain habitat for this species and should probably be re-studied under different conditions. Of special note is the presence of troglobitic salamanders of the genus *Eurycea* in Hunter's Lane Cave. No specimens could be collected but this is probably an undiscovered species.

Discovery Well Cave

The presence of three troglobites in the cave indicates that this may contain habitat for *Rhadine Persephone*. Collections were made in the cave on 19 April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:

Harvestmen: *Latobunum townsendii* (trogloxene)
Millipedes: *Cambala speobia* (troglobite)
Speodesmus sp. (troglobite)
Insects: Insecta larvae undetermined (accidental)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Ceuthophilus*) *secretus* (trogloxene)
Ground beetles: *Rhadine* new species (troglobite)
Cliff frog: *Syrrhophus marnocki* (trogloxene)

F-8 Sink

Mike Warton collected in this small feature on 10 April 2001. The only fauna present were roaches (Blattaria undetermined).

Grassy Grove Sink

This small feature does not appear to have habitat for troglobites. Mike Warton collected in this small feature on 13 April 2001. The following is a fauna list:

Terrestrial isopods: Oniscoidea undetermined
Centipedes: Lithobiomorpha undetermined
Millipedes: Diplopoda undetermined (accidental)

Hole in the Draw Cave

This small cave does not appear to have habitat for troglobites. Mike Warton collected in it on 12 April 2001. The following is a fauna list:

Spiders: Araneae undetermined
Cave crickets: *Ceuthophilus* (*Geotettix*) *cunicularis* (troglophile)

Hunter's Lane Cave

This cave appears to potentially have habitat for *Rhadine persephone*. Two terrestrial and two aquatic troglobites were present. Collections were made in the cave in April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:
Flatworms: ?*Sphallopiana* sp. (troglobite)
Snails: Gastropoda undetermined (empty shell)
Spiders: Araneae undetermined
Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: Diplopoda undetermined
Cambala speobia (troglobite)
Speodesmus sp. (troglobite)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) *secretus* (trogloxene)
Salamanders: *Eurycea* ?new species (troglobite)

Jumbled Rocks Cave

This small cave does not appear to have habitat for troglobites. Collections were made in the cave on 10 April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:
Terrestrial isopods: Oniscoidea undetermined
Spiders: Araneae undetermined
Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: Diplopoda undetermined
Springtails: Collembola undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) *secretus* (trogloxene)
Rove beetles: Staphylinidae genus and species
Flies: Diptera undetermined
Mosquitoes: Culicidae genus and species (trogloxene)

Lime Creek Road Sink

This small feature does not appear to have habitat for troglobites. Mike Warton collected in the sink on 10 April 2001. The following is a fauna list:
Centipedes: Lithobiomorpha undetermined
Scutigeridae genus and species
Millipedes: Diplopoda undetermined

Persimmon Well Cave

This cave contains three troglobites and may be habitat for *Rhadine persephone*. Collections were made in the cave on 11 April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:
Terrestrial isopods: Oniscoidea undetermined

Spiders: Araneae undetermined
Cicurina (*Cicurella*) sp. (troglobite)
Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: *Cambala speobia* (troglobite)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Geotettix*) *cunicularis* (troglophile)
Ground beetles: *Rhadine* new species (troglobite)

Uncorked Cave

The presence of two troglobites in the cave indicates that this could be habitat for *Rhadine persephone*. Mike Warton collected in the cave on 24 April 2001. The following is a fauna list:
Spiders: *Cicurina* (*Cicurella*) sp. (troglobite)
Subterranean silverfish: *Texoreddellia* sp. (troglobite)
Beetles: Coleoptera undetermined (accidental)

Understory Cave

This cave does not appear to contain habitat for *Rhadine Persephone*. Collections were made in the cave on 11 April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:
Terrestrial isopods: Oniscoidea undetermined
Spiders: Araneae undetermined
Cicurina (*Cicurella*) sp. (troglobite)
Harvestmen: *Leiobunum townsendii* (trogloxene)
Springtails: Collembola undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Ceuthophilus*) *secretus* (trogloxene)
Rove beetles: Staphylinidae genus and species
Mosquitoes: Culicidae genus and species (trogloxene)

Yawning Entrance Cave

This small cave does not appear to contain habitat for *Rhadine persephone*. Mike Warton collected in the cave in April 2001. The following is a fauna list:
Spiders: Araneae undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)

Zig-Zag Cave

This small cave does not appear to contain habitat for *Rhadine persephone*. Mike Warton collected in the cave on 19 April 2001. The only fauna found was a centipede of the family Scutigeridae.

CAVE BIOLOGY OF TRACT #3, RANCH AT DEER CREEK, CEDAR PARK, WILLIAMSON COUNTY, TEXAS

James R. Reddell

27 January 2002

Twelve caves and sinks have been biologically investigated on Tract #3 of the Ranch at Deer Creek subdivision. Mike Warton collected in all of the features during initial excavation and exploration. James Reddell and Marcelino Reyes re-collected in five of the largest caves in May 2001. James Reddell, Marcelino Reyes, and Mike Warton returned to the area on 26 January 2002. The endangered Tooth Cave ground beetle, *Rhadine persephone*, was found in Discovery Well Cave on the last date, but two other caves appear to contain habitat for this species and should probably be re-studied under different conditions. Of special note is the presence of troglobitic salamanders of the genus *Eurycea* in Hunter's Lane Cave. No specimens could be collected but this is probably an undescribed species.

The presence of *Rhadine persephone* in Discovery Well Cave provides stronger evidence that this species will also be found in other caves on the property. Discovery Well, Hunter's Lane, and Uncorked Caves are clearly structurally connected even if human connections are not possible and all should be considered habitat for the endangered ground beetle. A record by Horizon Environmental of *Rhadine persephone* in Persimmon Well Cave has not been verified by examination of specimens, but the presence of *Rhadine* new species indicates that it likely occurs there and this cave should probably also be considered habitat for the endangered ground beetle.

Discovery Well Cave

Collections were made in the cave on 19 April 2001 by Mike Warton, on 1 May 2001 by James Reddell and Marcelino Reyes, and on 26 January 2002. On the latter date the endangered Tooth Cave ground beetle, *Rhadine persephone*, was found The following temperature and humidity readings were taken in January. These readings are as follows: surface temperature (57.5° F), surface humidity (41%); end of cave temperature (63° F), end of cave humidity (90%). The following is a fauna list:

Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: *Cambala speobia* (troglobite)
Speodesmus sp. (troglobite)
Insects: Insecta larvae undetermined (accidental)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Ceuthophilus*) *secretus* (trogloxene)
Ground beetles: *Rhadine* new species (troglobite)
Rhadine persephone (troglobite)
Cliff frog: *Syrrhophus marnocki* (trogloxene)

F-8 Sink

Mike Warton collected in this small feature on 10 April 2001. The only fauna present were roaches (Blattaria undetermined).

Grassy Grove Sink

This small feature does not appear to have habitat for troglobites. Mike Warton collected in this small feature on 13 April 2001. The following is a fauna list:
Terrestrial isopods: Oniscoidea undetermined
Centipedes: Lithobiomorpha undetermined
Millipedes: Diplopoda undetermined (accidental)

Hole in the Draw Cave

This small cave does not appear to have habitat for troglobites. Mike Warton collected in it on 12 April 2001. The following is a fauna list:
Spiders: Araneae undetermined
Cave crickets: *Ceuthophilus* (*Geotettix*) *cunicularis* (troglophile)

Hunter's Lane Cave

This cave appears to potentially have habitat for *Rhadine persephone*. Two terrestrial and two aquatic troglobites were present. Collections were made in the cave in April 2001 by Mike Warton, on 1 May 2001 by James Reddell and Marcelino Reyes, and on 26 January 2002 by James Reddell, Marcelino Reyes, and Mike Warton. The cave was too cold and dry in January to have troglobites. The following temperature and humidity readings were taken in January: surface temperature (57.5° F), surface humidity (41%); temperature at end of cave (59° F), humidity at end of cave (82%). The following is a fauna list:
Flatworms: ?*Sphalloplana* sp. (troglobite)
Snails: Gastropoda undetermined (empty shell)
Spiders: Araneae undetermined
Harvestmen: *Letobunum townsendii* (trogloxene)
Millipedes: Diplopoda undetermined
Cambala speobia (troglobite)
Speodesmus sp. (troglobite)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) *secretus* (trogloxene,
Salamanders: *Eurycea* ?new species (troglobite)

Jumbled Rocks Cave

This small cave does not appear to have habitat for troglobites. Collections were made in the cave on 10 April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:
Terrestrial isopods: Oniscoidea undetermined
Spiders: Araneae undetermined
Harvestmen: *Letobunum townsendii* (trogloxene)
Millipedes: Diplopoda undetermined
Springtails: Collembola undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) *secretus* (trogloxene)
Rove beetles: Staphylinidae genus and species
Flies: Diptera undetermined
Mosquitoes: Culicidae genus and species (trogloxene)

Lime Creek Road Sink

This small feature does not appear to have habitat for troglobites. Mike Warton collected in the sink on 10 April 2001. The following is a fauna list:

Centipedes: Lithobiomorpha undetermined
Scutigeridae genus and species
Millipedes: Diplopoda undetermined

Persimmon Well Cave

This cave contains three troglobites and may be habitat for *Rhadine persephone*. Collections were made in the cave on 11 April 2001 by Mike Warton, on 1 May 2001 by James Reddell and Marcelino Reyes, and on 26 January 2002 by James Reddell, Marcelino Reyes, and Mike Warton. The cave was too cold and dry in January to contain troglobites and only cave crickets were found. The following temperature and humidity readings were taken in January: surface temperature (57° F), surface humidity (41%), temperature at end of cave (61° F), humidity at end of cave (84%). The following is a fauna list:

Terrestrial isopods: Oniscoidea undetermined
Spiders: Araneae undetermined
Cicurina (*Cicurella*) sp. (troglobite)
Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: *Cambala speobia* (troglobite)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Geotettix*) *cunicularis* (troglophile)
Ground beetles: *Rhadine* new species (troglobite)

Uncorked Cave

The presence of two troglobites in the cave indicates that this could be habitat for *Rhadine persephone*. Collections were made in the cave on 24 April 2001, and on 26 January 2002 by James Reddell, Marcelino Reyes, and Mike Warton. The cave cold and dry in January and the only fauna found were mosquitoes, cave crickets, and an accidental spider.The following is a fauna list:

Spiders: *Cicurina* (*Cicurella*) sp. (troglobite)
Lycosidae genus and species (accidental)
Subterranean silverfish: *Texoreddellia* sp. (troglobite)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Beetles: Coleoptera undetermined (accidental)
Mosquitoes: Culicidae genus and species (trogloxene)

Understory Cave

This cave does not appear to contain habitat for *Rhadine Persephone*. Collections were made in the cave on 11 April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:

Terrestrial isopods: Oniscoidea undetermined
Spiders: Araneae undetermined
Ciurina (*Ciurella*) sp. (troglobite)
Harvestmen: *Letobunum townsendi* (trogloxene)
Springtails: Collembola undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Ceuthophilus*) *secretus* (trogloxene)
Rove beetles: Staphylinidae genus and species
Mosquitoes: Culicidae genus and species (trogloxene)

Yawning Entrance Cave

This small cave does not appear to contain habitat for *Rhadine persephone*. Mike Warton collected in the cave in April 2001. The following is a fauna list:
Spiders: Araneae undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)

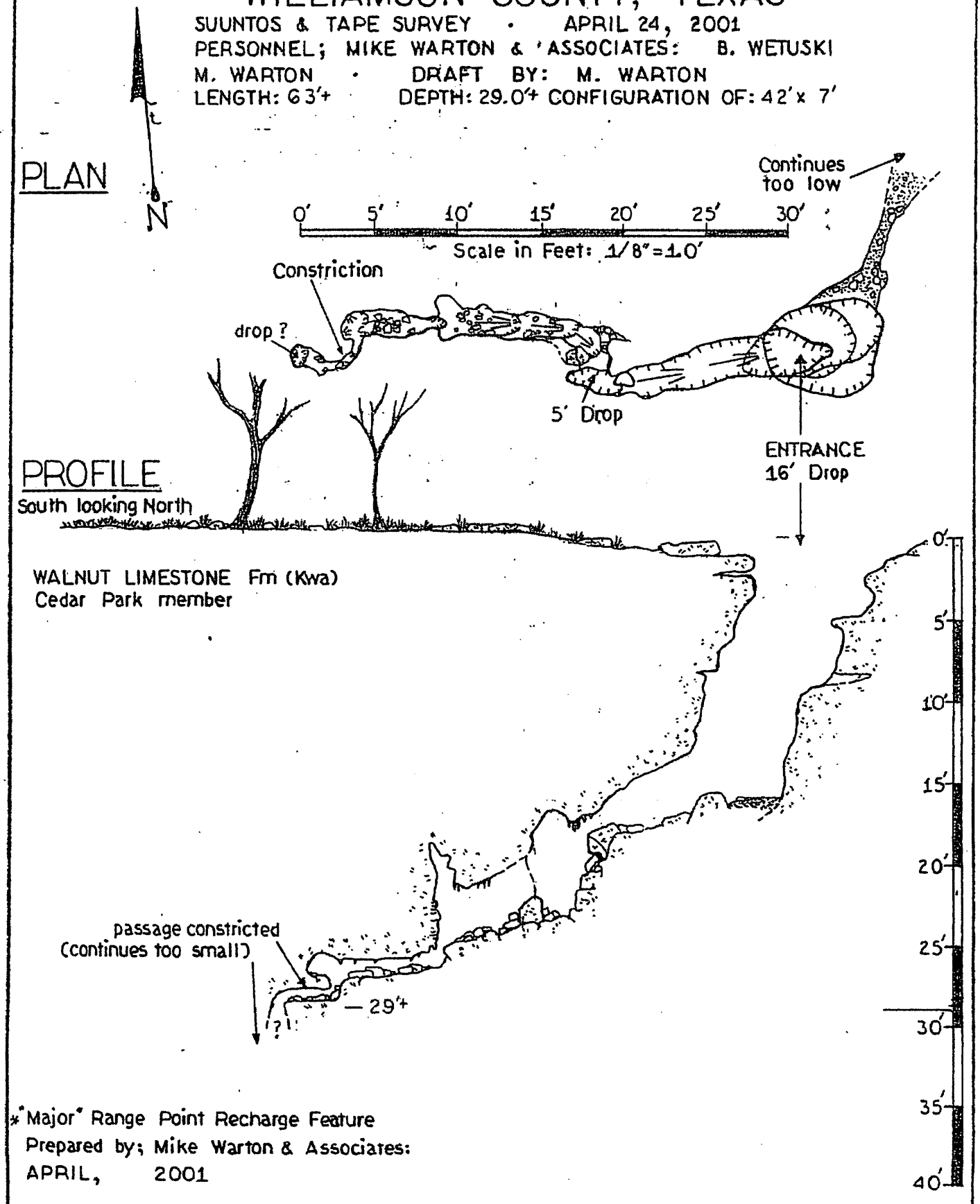
Zig-Zag Cave

This small cave does not appear to contain habitat for *Rhadine persephone*. Mike Warton collected in the cave on 19 April 2001. The only fauna found was a centipede of the family Scutigeridae.

DISCOVERY WELL CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · APRIL 24, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI
M. WARTON · DRAFT BY: M. WARTON
LENGTH: 63'+ DEPTH: 29.0'+ CONFIGURATION OF: 42' x 7'



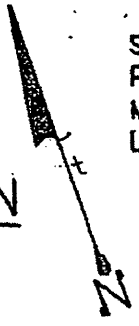
*"Major" Range Point Recharge Feature
Prepared by; Mike Warton & Associates:
APRIL, 2001

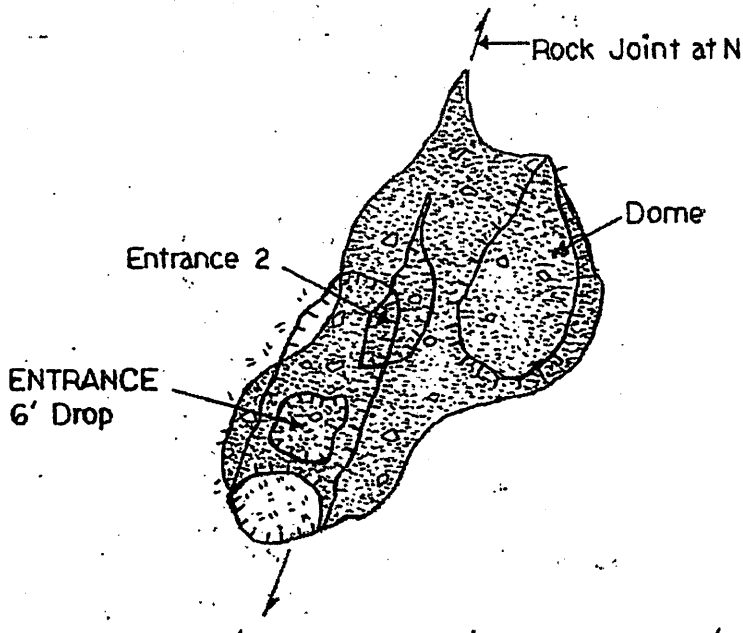
HOLE IN THE DRAW CAVE

WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY • APRIL 12, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI • M. WARTON • DRAFT BY: M. WARTON
LENGTH: 18.4' DEPTH: 6.0' CONFIGURATION OF: 10' x 7'

PLAN

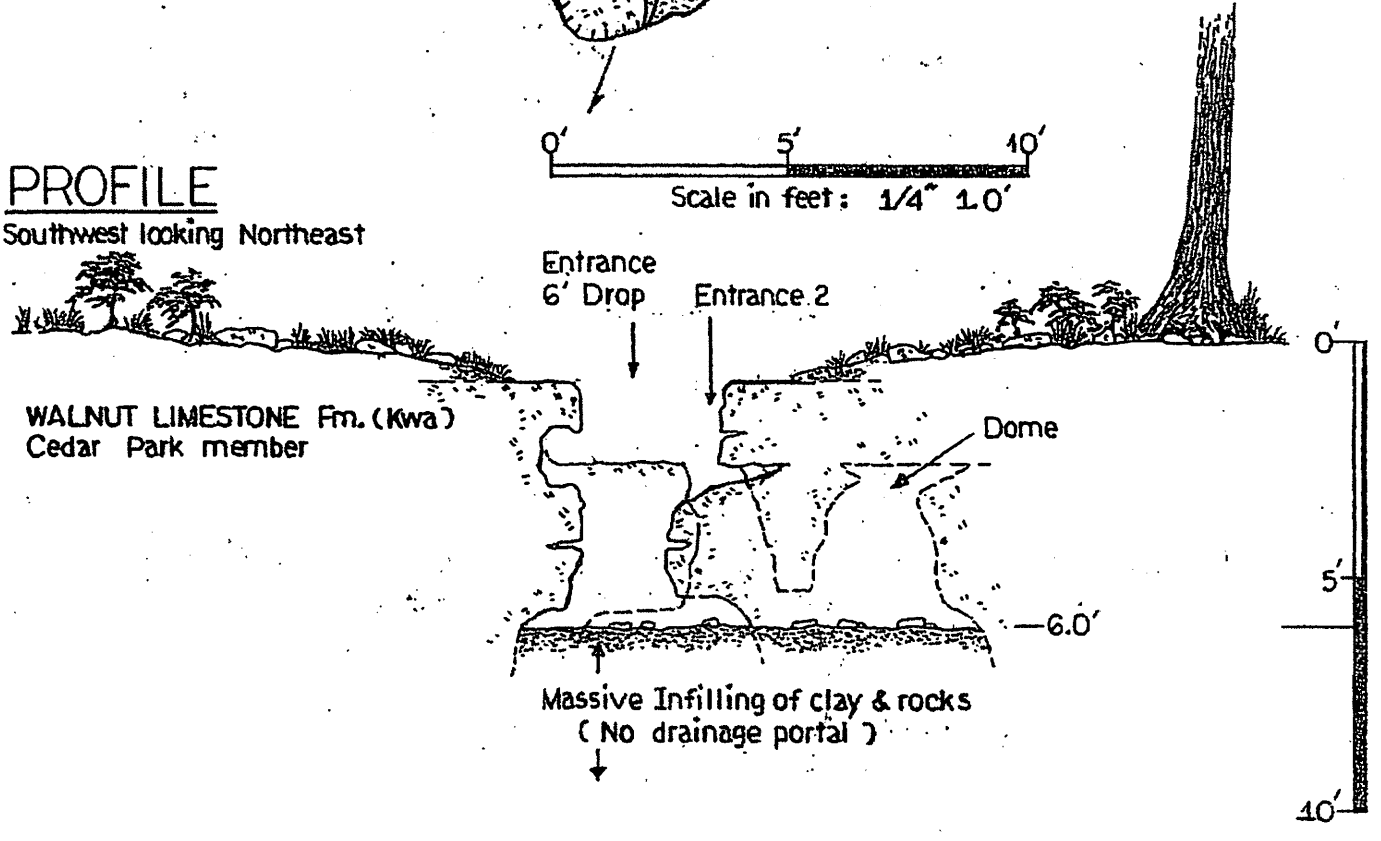




Scale in feet: 1/4" 1.0'

PROFILE

Southwest looking Northeast



Minor Range Point Recharge Feature
"Relic" recharge condition

Prepared by; Mike Warton & Associates:
APRIL, 2001

HUNTERS LANE CAVE

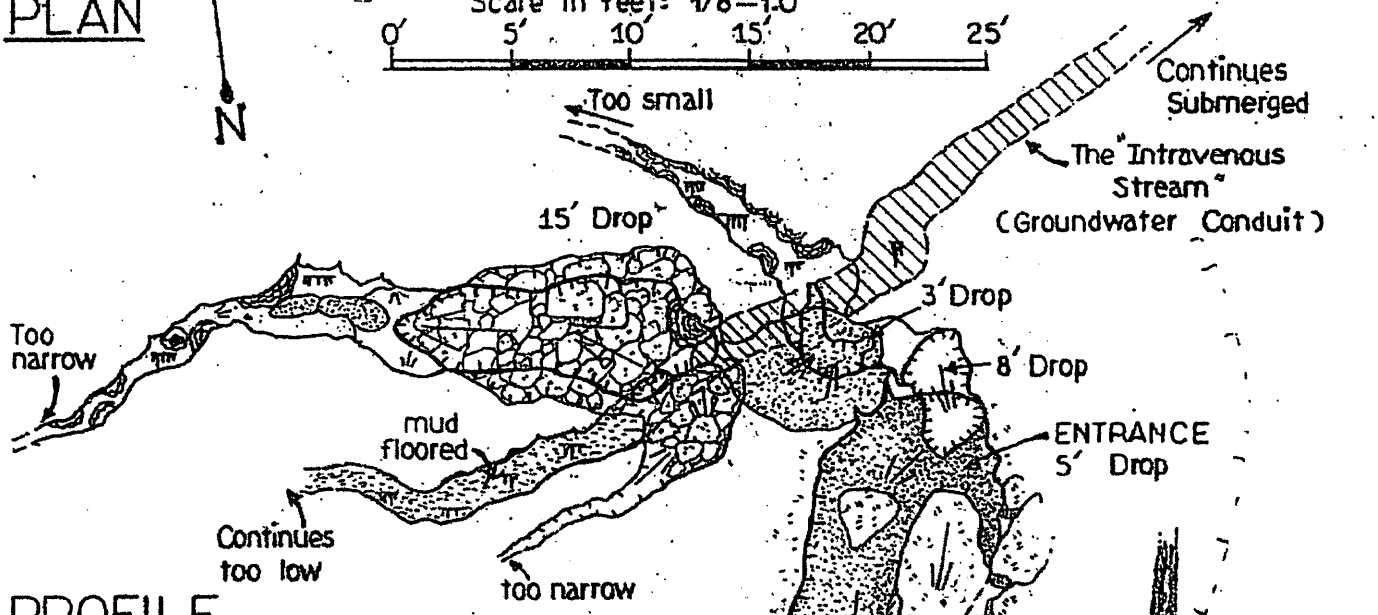
WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · APRIL 14, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · M. WARTON · DRAFT BY: M. WARTON
LENGTH: 128.7′ DEPTH: 36.0′ · CONFIGURATION OF: 52′ x 26′

PLAN

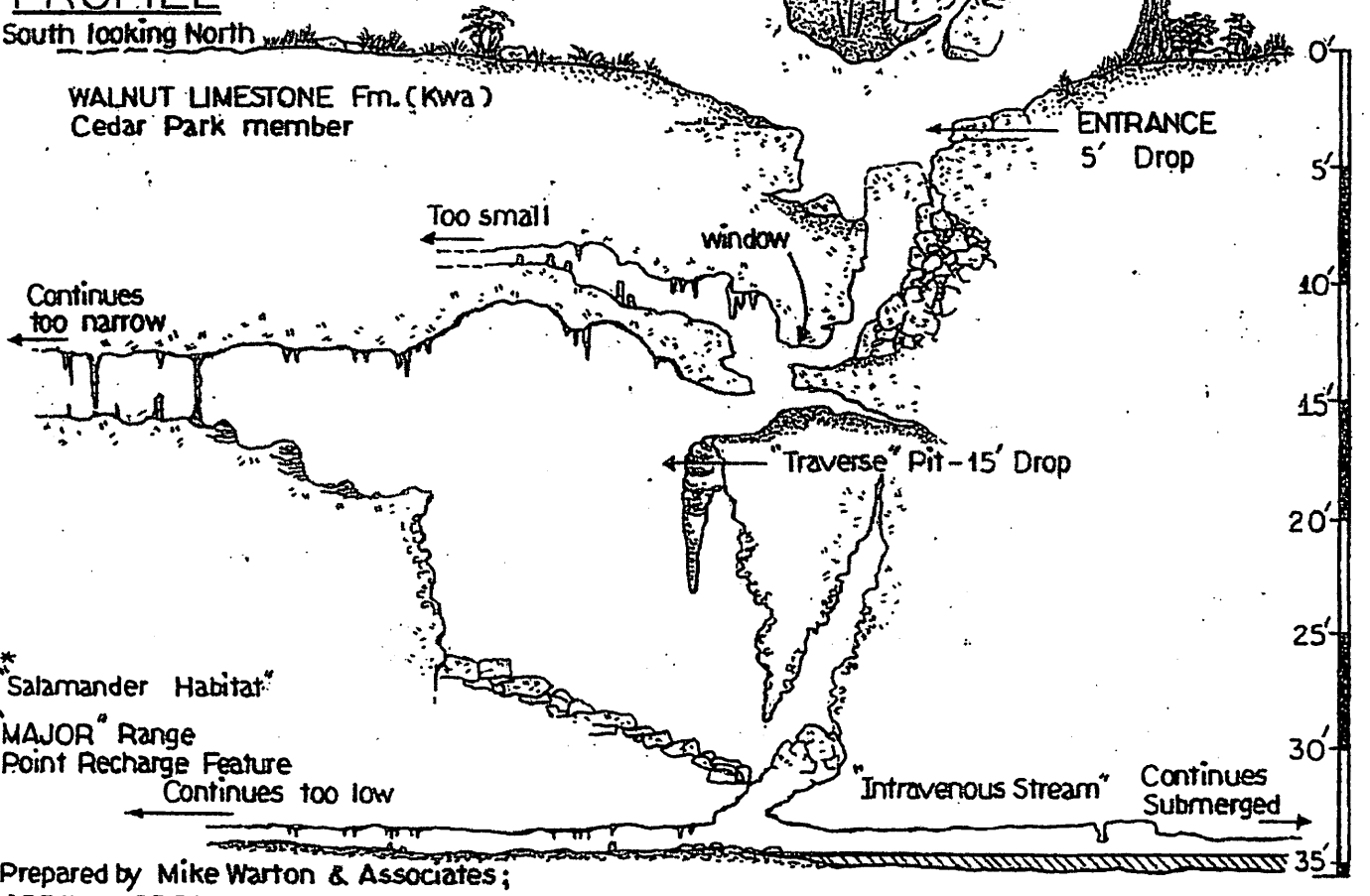
Scale in feet: 1/8"=1.0′
0′ 5′ 10′ 15′ 20′ 25′

N



PROFILE

South looking North



"Salamander Habitat"
"MAJOR" Range Point Recharge Feature
Continues too low
"Intravenous Stream" Continues Submerged

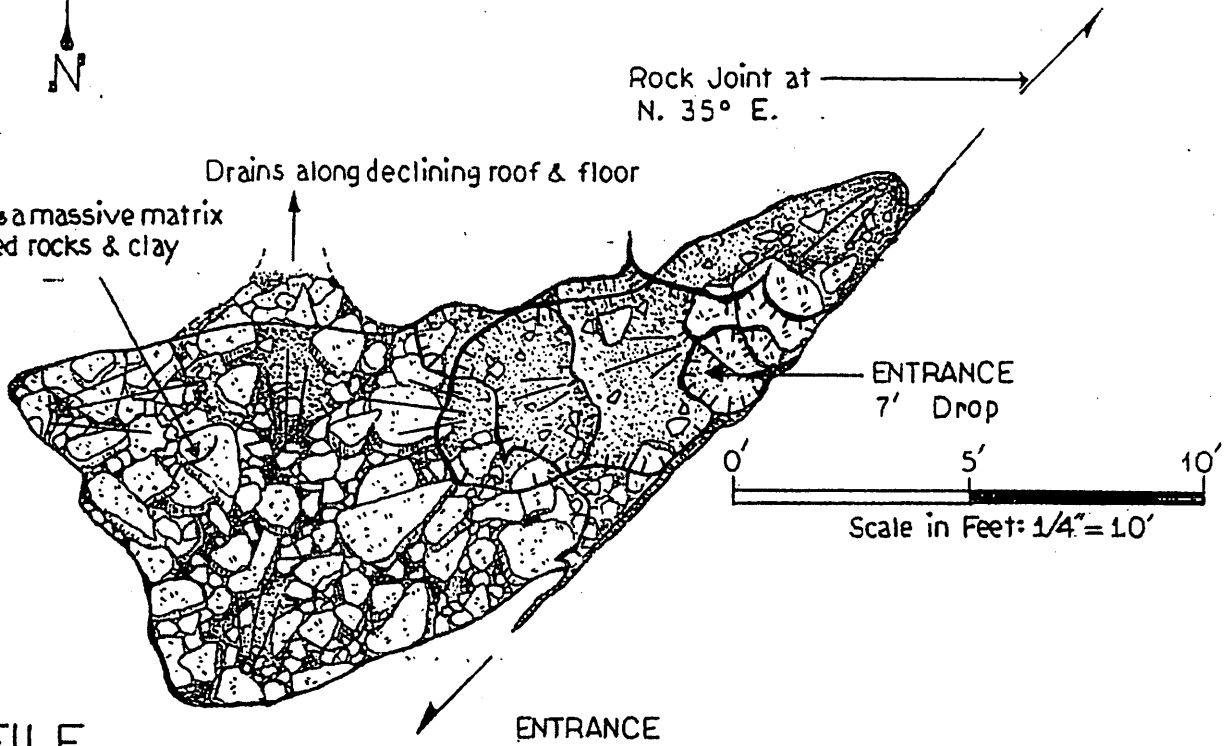
Prepared by Mike Warton & Associates;
APRIL, 2001

JUMBLED ROCKS CAVE

TRAVIS COUNTY, TEXAS

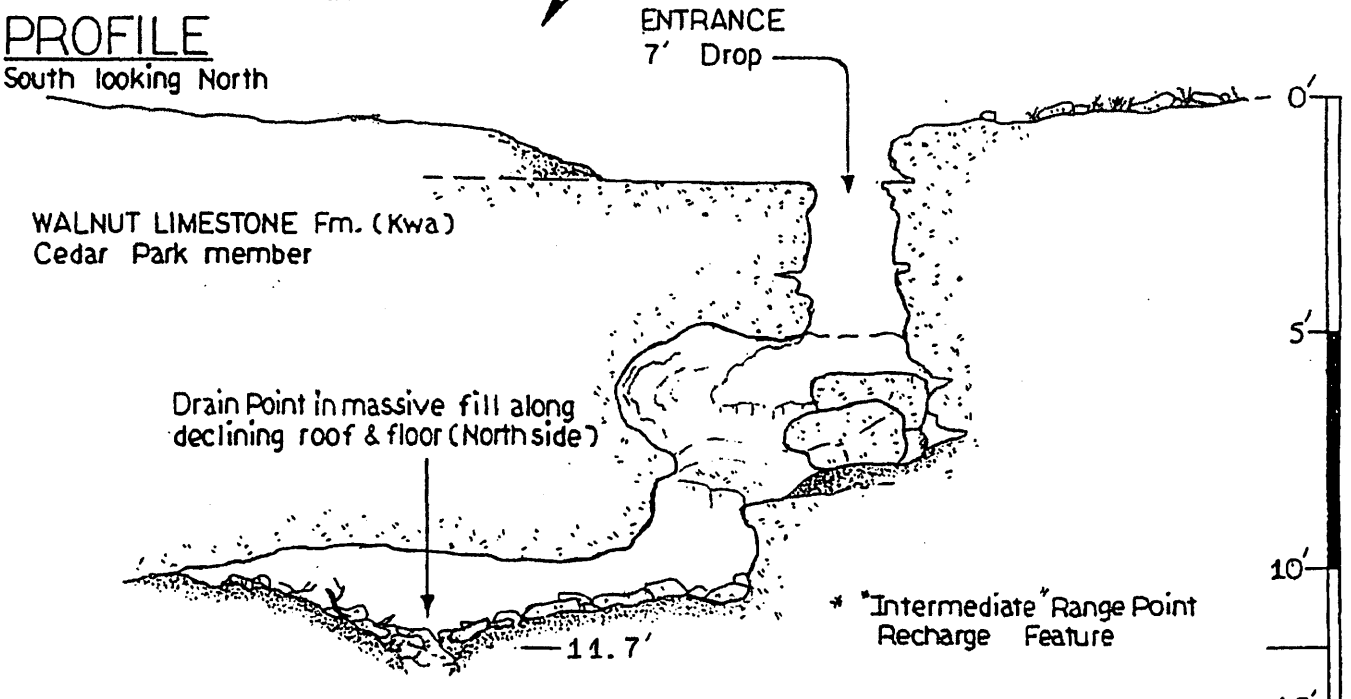
SUUNTOS & TAPE SURVEY • APRIL 16, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI • M. WARTON • DRAFT BY: M. WARTON
LENGTH: 26.0′ DEPTH: 11.7′ CONFIGURATION OF: 19′ x 10′

PLAN



PROFILE

South looking North



Prepared by: Mike Warton & Associates
APRIL, 2001

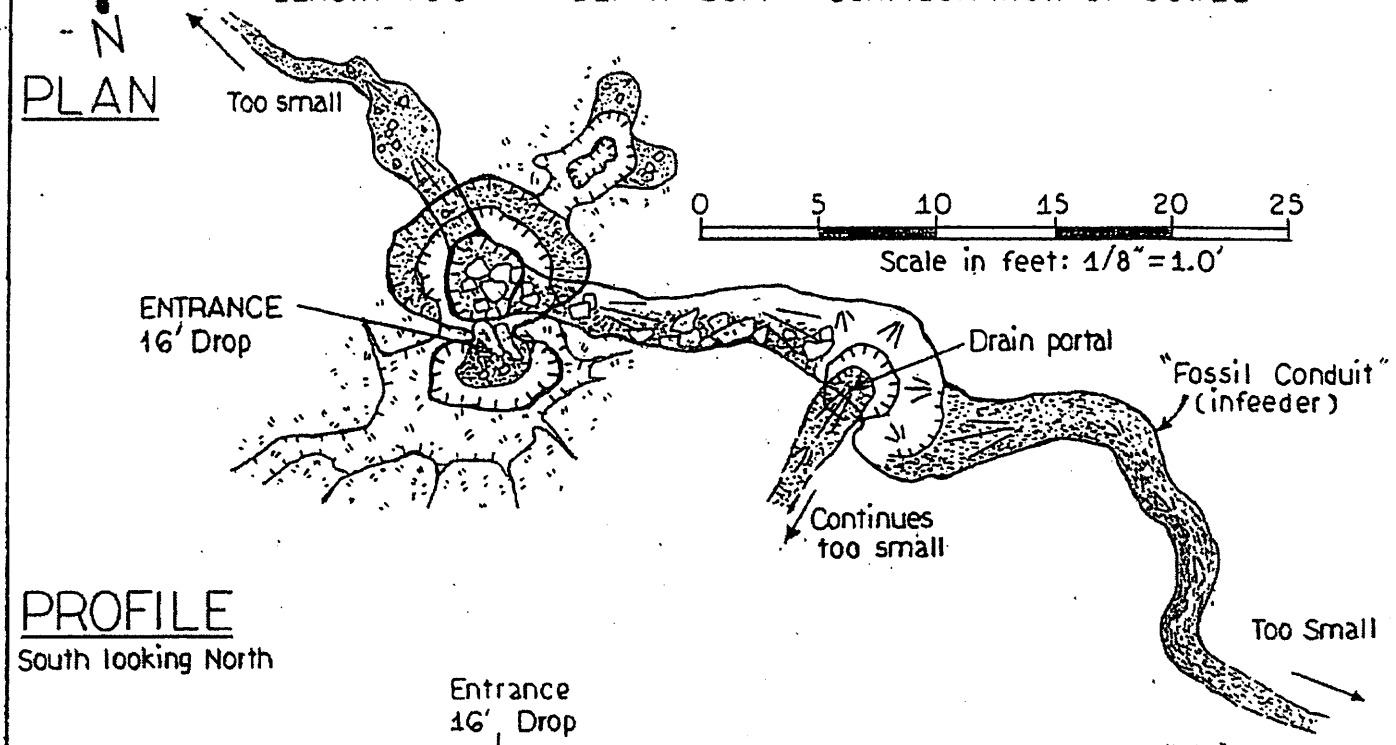
PERSIMMON WELL CAVE

TRAVIS COUNTY, TEXAS

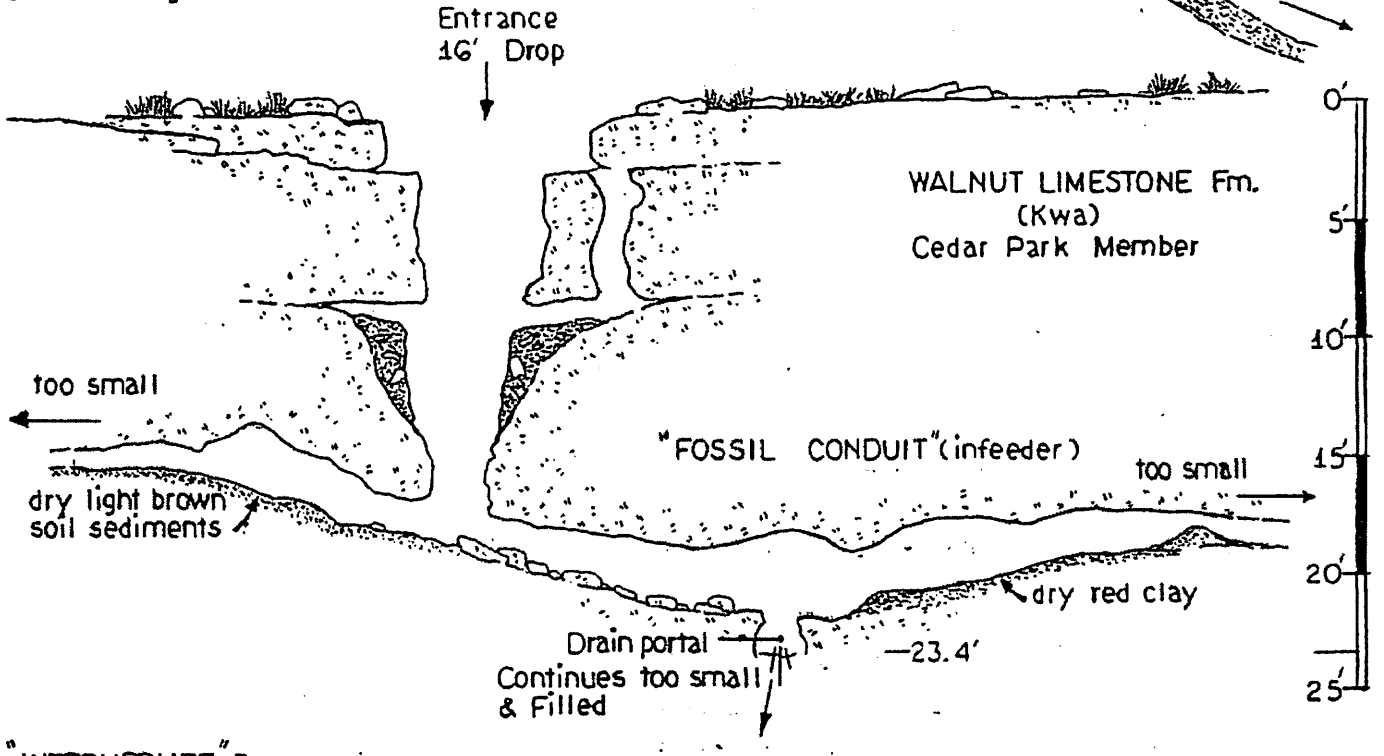
SUUNTOS & TAPE SURVEY · APRIL11, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES; B. WETUSKI·
M. WARTON · DRAFT BY: M. WARTON
LENGTH: 76.5' DEPTH: 23.4' CONFIGURATION OF: 56'x22'

N

PLAN



PROFILE
South looking North



"INTERMEDIATE" Range
Point Recharge Feature

Prepared by; Mike Warton & Associates:
APRIL, 2001

UNCORKED CAVE

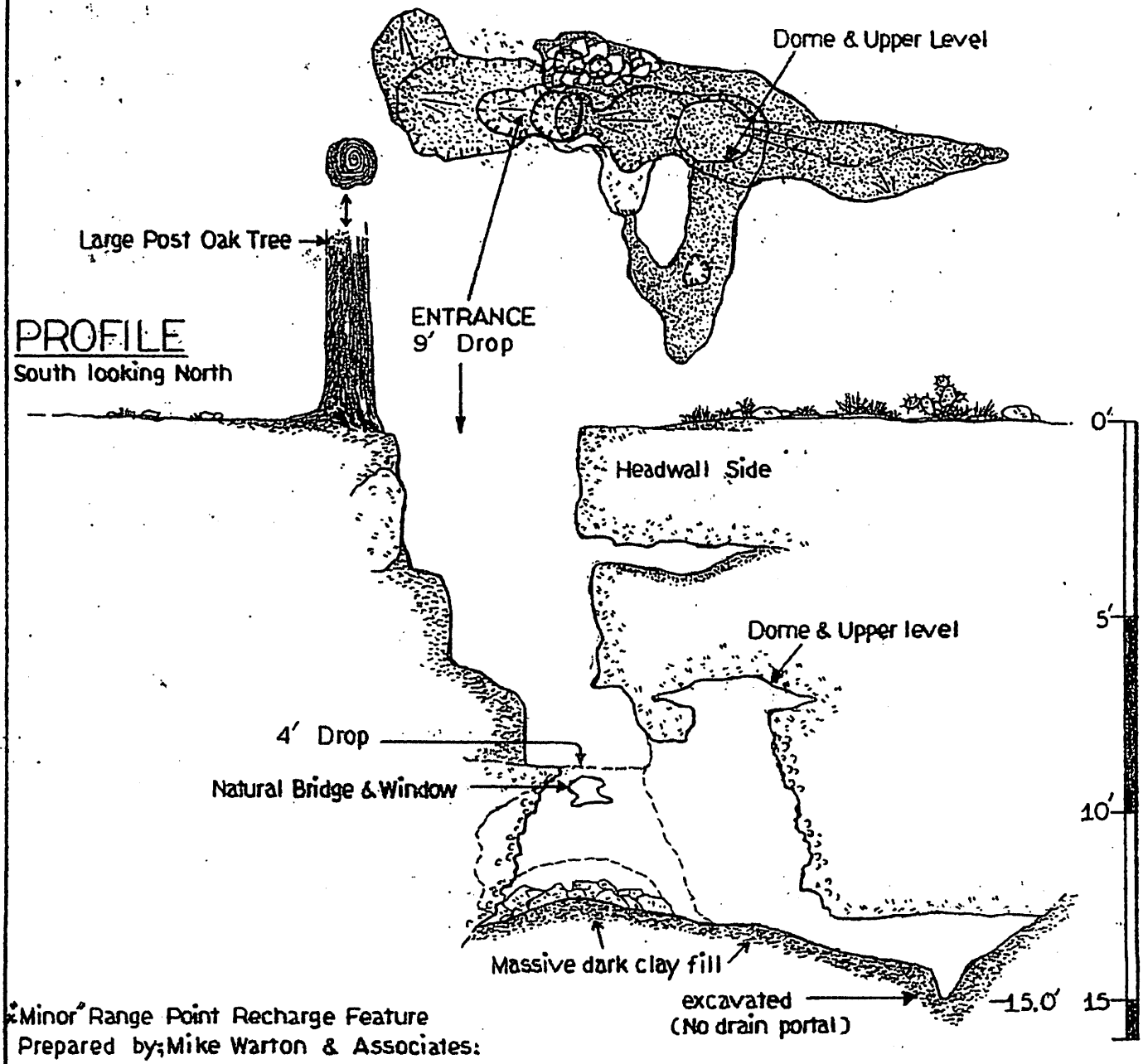
WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY • APRIL 24, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI • M. WARTON • DRAFT BY: M. WARTON
LENGTH=29.5′ DEPTH: 15.0′ CONFIGURATION OF: 16′x 8′

PLAN

N

0′ 5′ 10′
Scale in Feet: 1/4"=1.0′



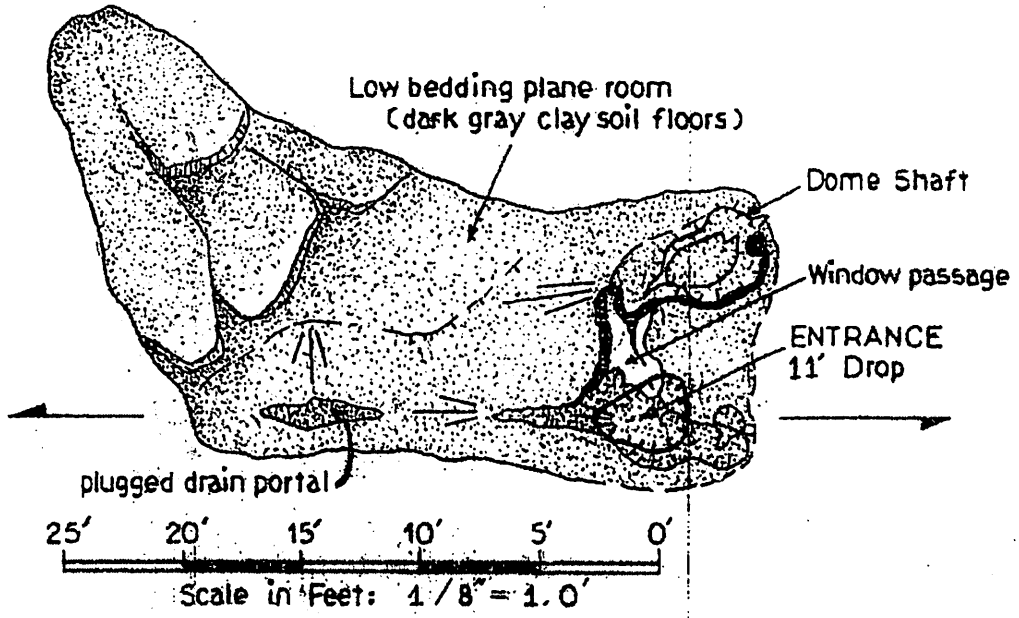
*Minor Range Point Recharge Feature
Prepared by; Mike Warton & Associates:
APRIL, 2001

UNDER THREE OAKS CAVE

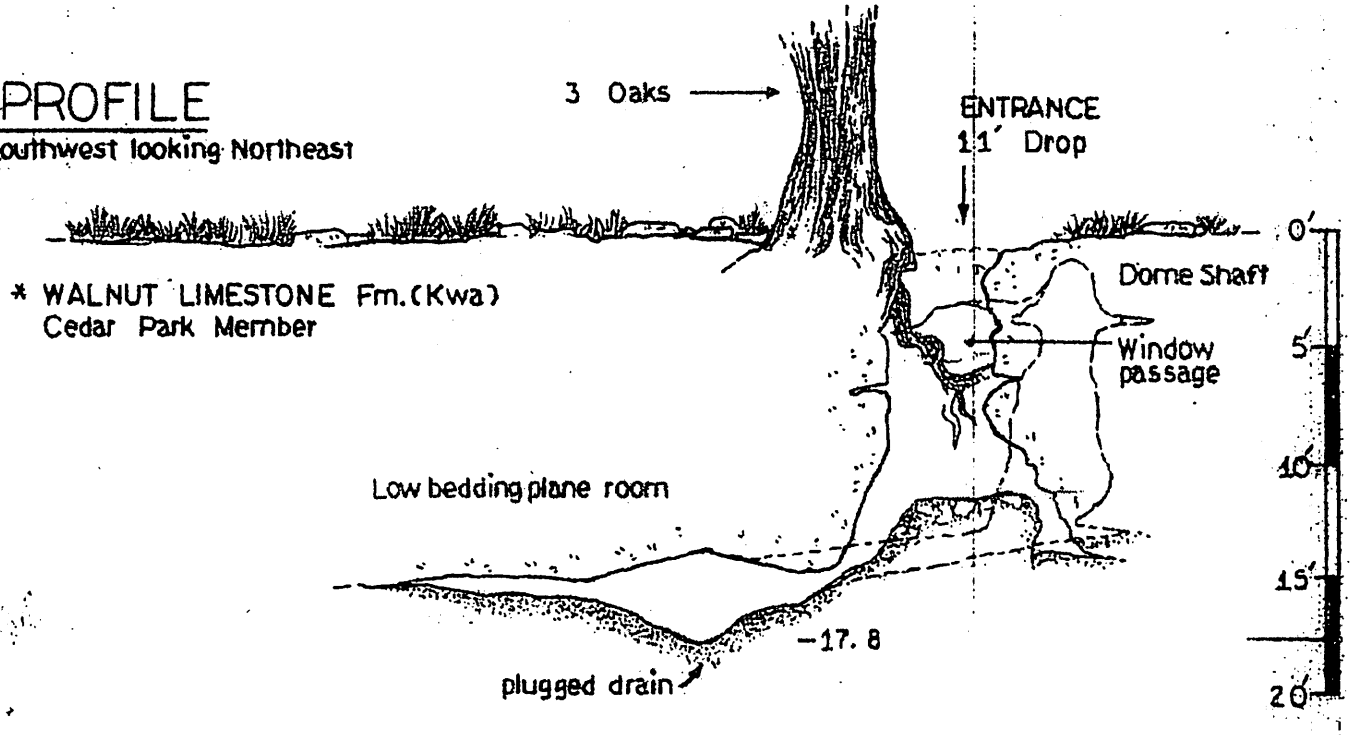
WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · APRIL 14, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI · M. WARTON - DRAFT BY: M. WARTON
LENGTH: 45.7' DEPTH: 17.8' CONFIGURATION OF: 35' x 18'

PLAN



PROFILE
Southwest looking Northeast



"Minor" Range Point Recharge Feature

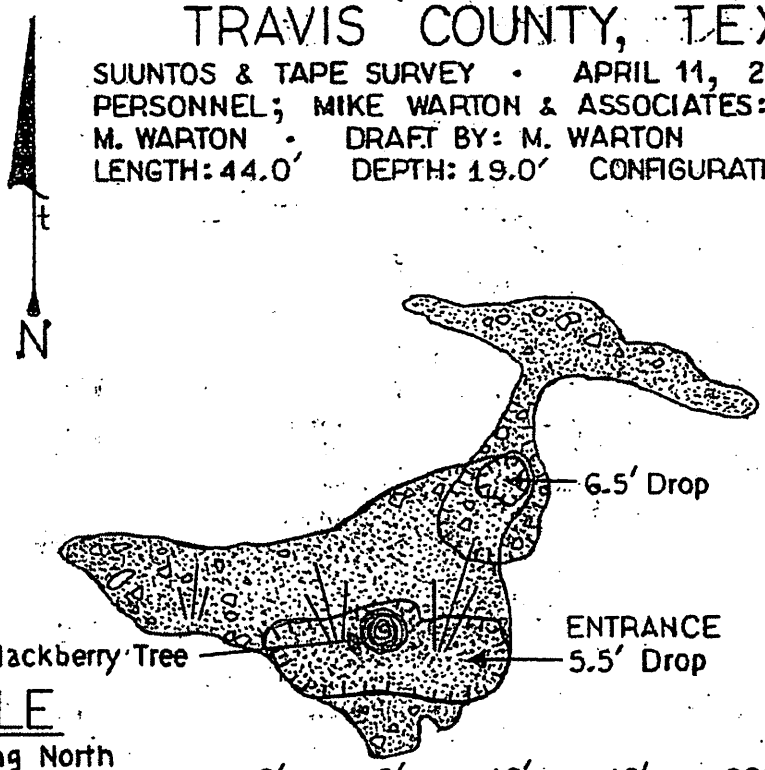
Prepared by; Mike Warton & Associates:
APRIL, 2001

UNDERSTORY CAVE

TRAVIS COUNTY, TEXAS

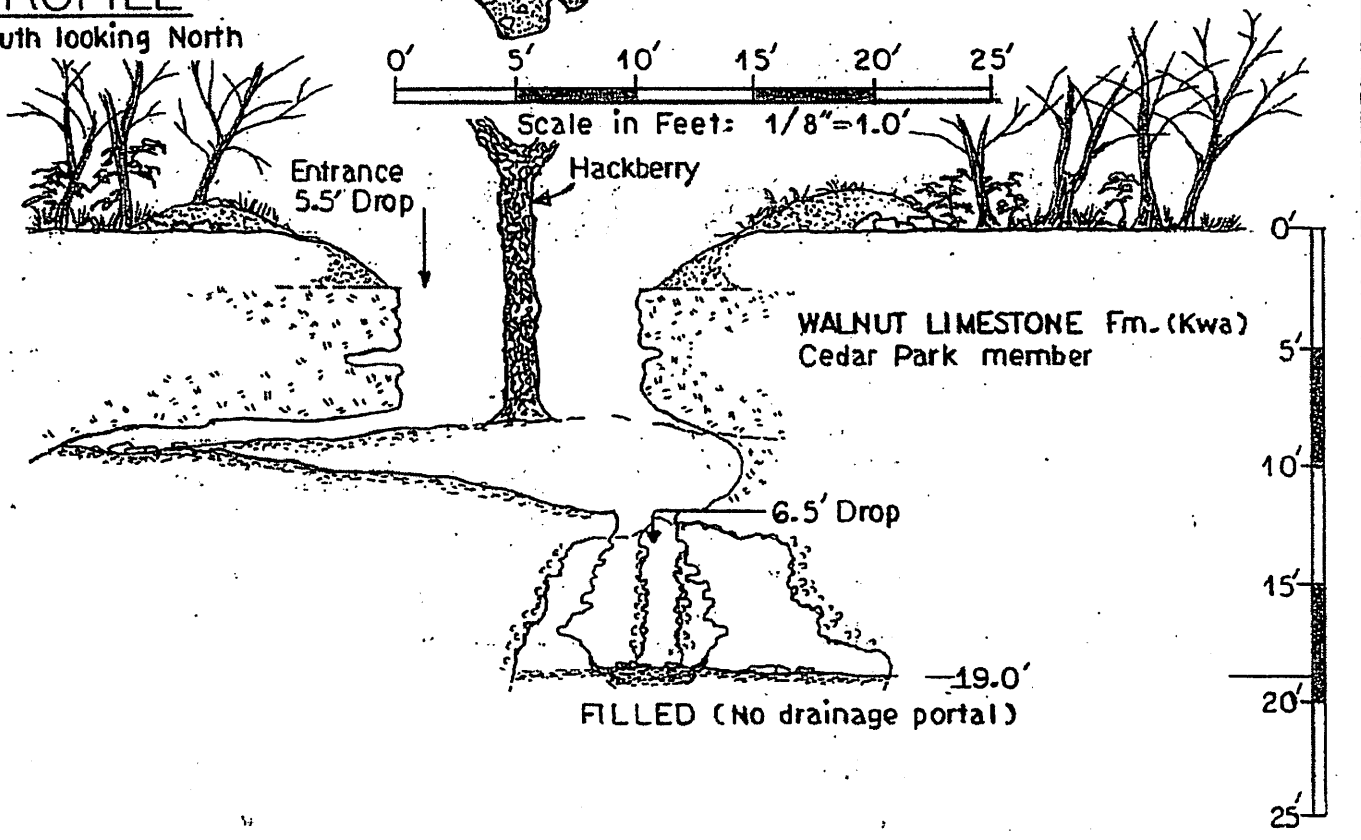
SUUNTOS & TAPE SURVEY • APRIL 11, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI • M. WARTON • DRAFT BY: M. WARTON
LENGTH: 44.0′ DEPTH: 19.0′ CONFIGURATION OF: 21′x 18′

PLAN



PROFILE

South looking North



"MINOR" Range Point Recharge

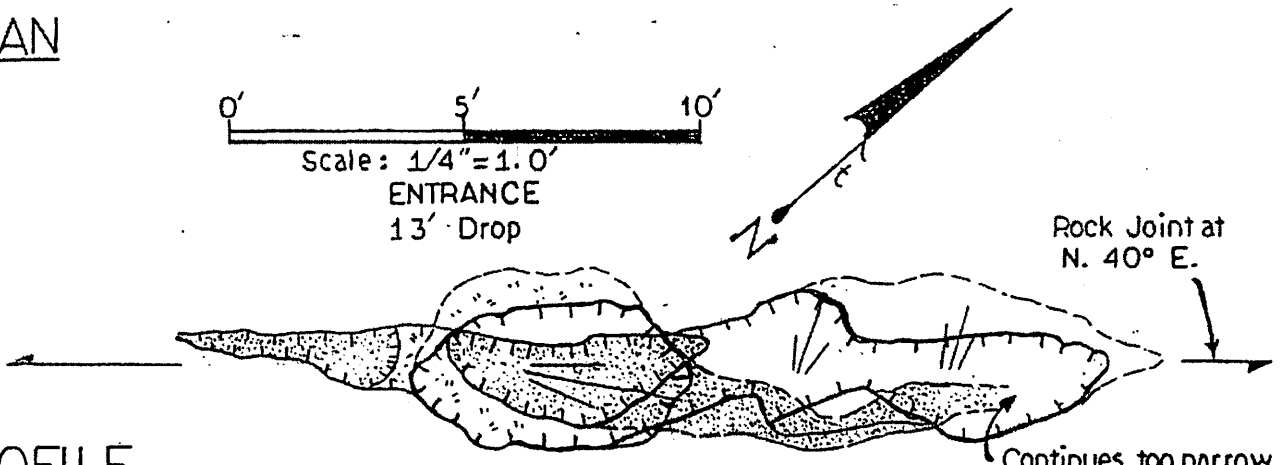
Prepared by; Mike Warton & Associates;
APRIL 11, 2001

YAWNING ENTRANCE CAVE

TRAVIS COUNTY, TEXAS

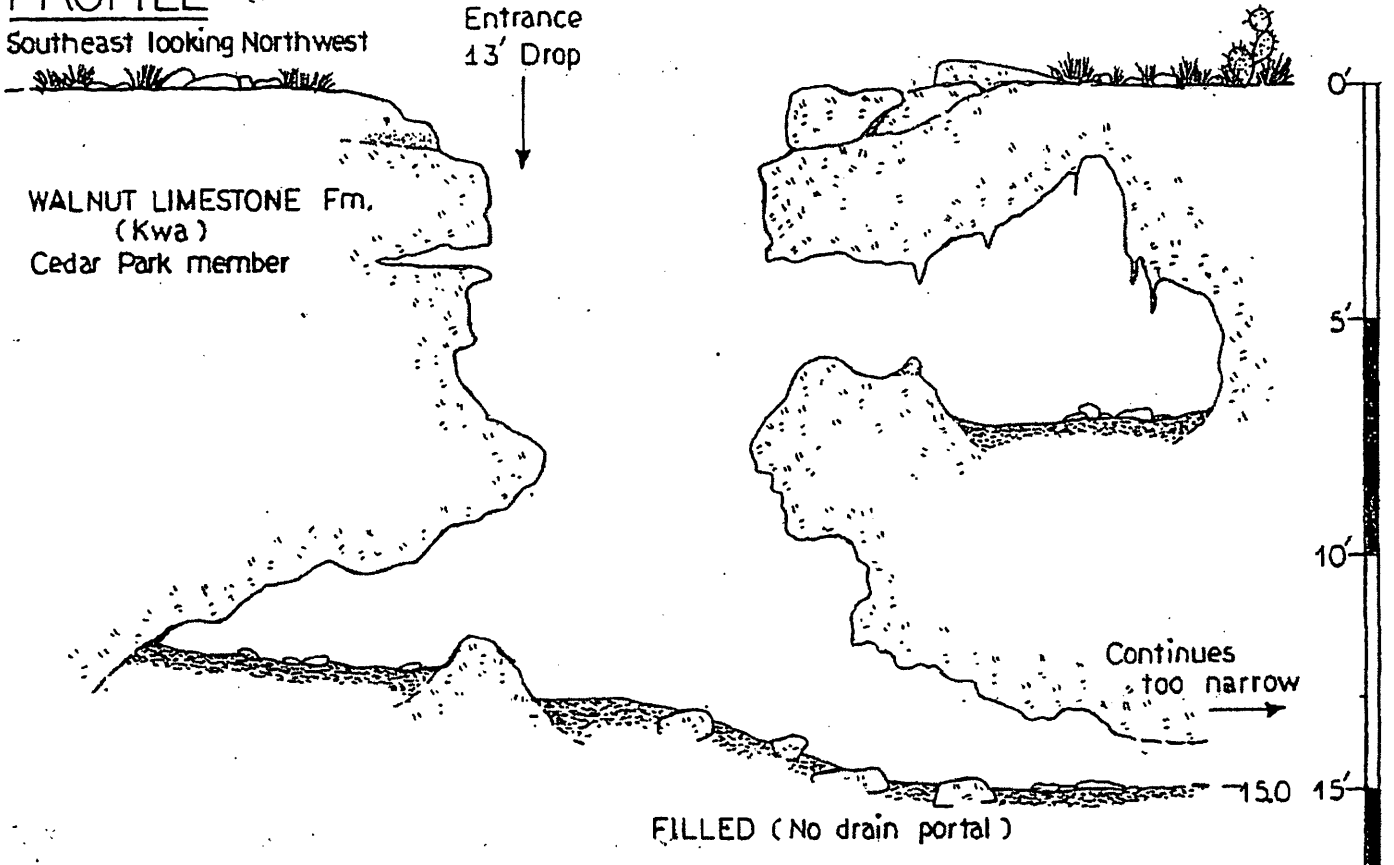
SUUNTOS & TAPE SURVEY • APRIL 9, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI·
M. WARTON · DRAFT BY: M. WARTON
LENGTH: 26.8′ DEPTH: 15.0′ CONFIGURATION OF: 19′x 4′

PLAN



PROFILE

Southeast looking Northwest



"MINOR" Range Point Recharge
(Not Significant)

Prepared by; Mike Warton & Associates:

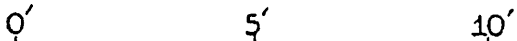
APRIL, 2001

ZIG ZAG CAVE

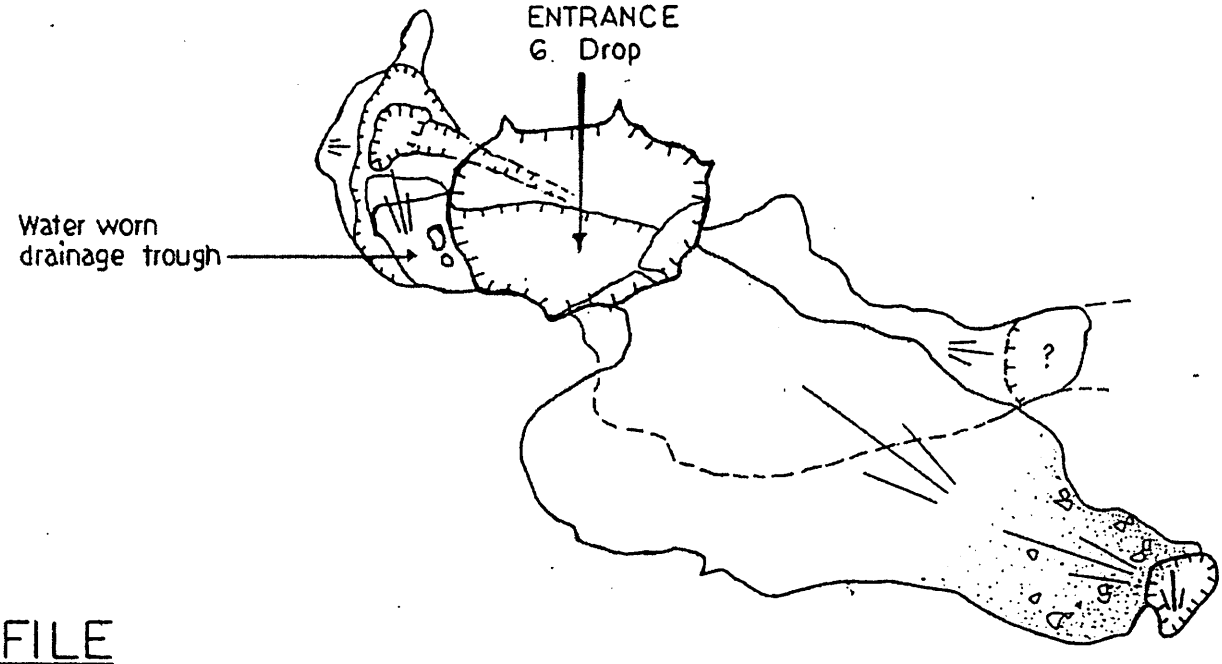
TRAVIS COUNTY, TEXAS

SUUNTOS & TAPE SURVEY · APRIL 20, 2001
PERSONNEL; MIKE WARTON & ASSOCIATES: B. WETUSKI·
M. WARTON · DRAFT BY: M. WARTON
LENGTH: 32.5′ DEPTH: 10.0′ CONFIGURATION OF: 21′x 9′

PLAN

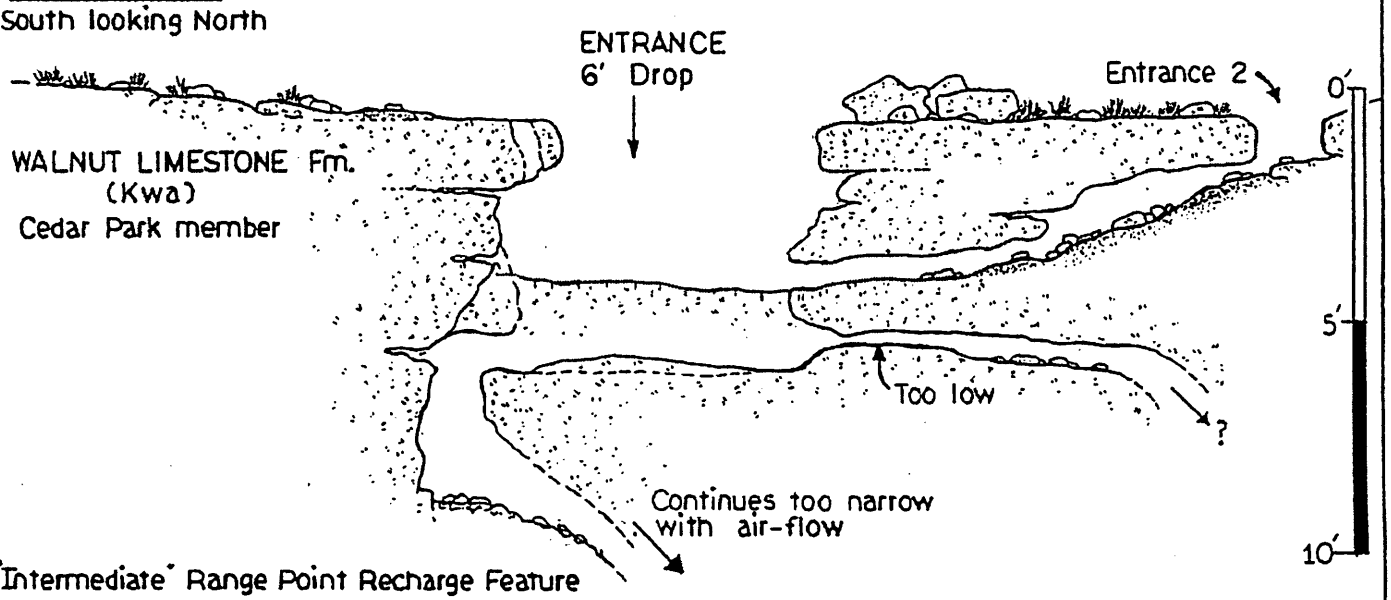


Scale: 1/4″ = 1.0′



PROFILE

South looking North



"Intermediate" Range Point Recharge Feature
Prepared by; Mike Warton & Associates:
APRIL, 2001

COPY

Mike Warton & Associates

GEOLOGIST / KARST TERRAINS SPECIALIST / NATIONAL CAVE GATE CONSULTANT
P.O. BOX # 1313 CEDAR PARK, TEXAS 78630-1313
(512) 250-0705 FAX (512) 250-0706
SPECIALIST IN TEXAS' ENVIRONMENTAL KARST RESEARCH & SERVICES

BLANTON DEVELOPMENT COMPANY
1701 Directors Blvd., Ste. 290
AUSTIN, TEXAS 78744
AC (512) 441-1557
Fax: (512) 441-1922
Attn: Mr. Perry O. Blanton, President,
Land Development & Planning Dept.

Re: Re-Collection of Invertebrates from Tract No. 3 (119.69 Acres of the " Ranch at Deer Creek "/ " Standard-Morrison No. 2 " LLC) Residential Subdivision Development Prospectus, CEDAR PARK Area South, WILLIAMSON & TRAVIS Counties, TEXAS.
* " Addendum Report of Findings "

" ADDENDUM REPORT OF FINDINGS "

RE-COLLECTION OF KARST INVERTEBRATES FROM TRACT NO. 3 CAVES (119.69 ACRES OF THE " RANCH AT DEER CREEK "/ " STANDARD-MORRISON NO. 2 LLC ") RESIDENTIAL SUBDIVISION DEVELOPMENT PROSPECTUS, CEDAR PARK AREA SOUTH, WILLIAMSON & TRAVIS COUNTIES, TEXAS.

DATE: FEBRUARY 7, 2002

Introduction:

Pursuant to our meeting with the U.S.Fish & Wildlife Service on 10/17/2001, and approved written proposal for the re-collection of karst invertebrates 10/29/2001, a re-collection of karst invertebrates was performed at the site's " Key ", or primary caves remaining of potential to produced Habitat for the Endangered " TOOTH CAVE " Ground Beetle, or " **Rhadine Persephone** " **Species.** The basis and contention of this re-collection effort, is based on our past field observances that this species is apparently more active in foraging, becoming more easily found during the late fall and winter months of the seasonal year, than during spring conditions that would be indicated as preferential for other invertebrate species. Thus, a re-collection effort of site specific caves potential for this species was performed on JANUARY 26, 2002.

Site Specific Caves of Potential Habitat:

As indicated from previous studies, and taxonomy listings from caves, the following caves were marked for the purpose of this re-collection effort:

1. " **Persimmon Well** " Cave
2. " **Discovery Well** " Cave
3. " **Hunters Lane** " Cave
4. " **Un-Corked** " Cave

All of the above listed site caves have exibited characteristics of

greater physical & hydrogeological extents than what has been possible to explore, survey, and confirm in the field. Further, the presence of **" Rhadine New Species "** was confirmed from both " Persimmon Well ", and " Discovery Well " Caves. Of an additional note of importance, Troglobitic Salamanders (" Eurycea ") have been observed at the bottom of " Hunters' Lane " Cave, however, have not yet been collected for study. The " Hunters' Lane " Complex of caves (" Cluster ") consists of " Hunters Lane ","Discovery Well", and "Un-corked" Caves, and from all indications, this complex is the initial point of input for the " Buttercup Creek " Cave System, as it is thought of along it's main cave trend of known interconnecting entrances.

Re-Collection of Caves on JANUARY 26 ,2002:

The FOUR (4) Subject Caves were re-collected on JANUARY 26, 2002, under the direction of Karst Geologist/ Specialist Mike Warton (Federal Permit No. TEO-22329-0), and assisted by James Reddell (Regional Invertebrate Specialist), and Karst Assistant Marcelino Reyes. **A single specimen of the Endangered " Tooth Cave Ground Beetle "/ " Rhadine Persephone " was finally found within " DISCOVERY WELL " CAVE.** This specimen was found on a wall within the First small dome area of the descending passage at about 30' feet down into the cave. Additionally, a single specimen of **" Rhadine New Species " was also collected from the cave** (floor of the passage strewn with washed in clay sediments & rocks just beyond the First dome). The presence of Rhadine New Species was already known from this cave, however, the finding of " Rhadine Persephone " evidences to a co-habitation of the Two species within this cave. As the cave is interconnective with " Hunters' Lane " and " Un-Corked " Caves within a " Cluster " arrangement of close proximity, **ALL THREE (3) Caves of this Complex, are to be considered and Confirmed as Endangered Invertebrate Species Habitat.** Cave interior measurements of atmospheric conditions at the time of collections are recorded within enclosed James Reddell's taxonomic listings of the caves (enlclosed Addendum Report).

Re-Collection of Caves on FEBRUARY 1,2002:

An Additional re-collection attempt of the 4 Caves occurred on February 1, 2002. The First cave attempted was " Hunters Lane " Cave of the " Discovery Well " Cave Complex, as we were hopeful of finding Rhadine Persephone present here, as had recently been the case at " Discovery Well " Cave. The cave was scoured intensely for it's presence, however, we well noted that the cave was well colder than the previous trip, the water in the lower conduit was like ice, and air-flow coming from the conduit was very cold. On this inspection of the cave, No invertebrates were found or observed (Not even cave crickets were found). In the conduit passage, No usual flatworms or salamanders were to be seen in the clear water of the stream. Over-all conditions in all of the caves were essentially too cold for finding any invertebrates present.

Conclusions And Recommendations:

With the recent finding of the Endangered " Tooth " Cave Ground Beetle

or " Rhadine Persephone " within " Discovery Well " Cave, this cave complex of the property consisting of " Discovery Well ", " Hunters Lane " , and " Uncorked " Caves should be considered Habitat for Endangered Cave Invertebrate Species. It's protective area should also include " Grassy Grove " Sink, and " Hole in the Draw " Cave, as all of these caves are interconnective to the " BUTTERCUP CREEK " Cave System Proper, and this protective area should be interconnective at the surface with the established Preserve area of the adjacent Buttercup Creek Property that contains " Nelson Ranch ", Ilex ", and " Buttercup Creek " (Main entrance) Caves.

Although the Rhadine Persephone species has still Not been found at " Persimmon Well " Cave, our opinion, as well as James Reddell's, is that it ultimately likely will be, and this cave as well as " Lime Creek " Sink, and " Jumbled Rocks " Cave should be considered as Habitat area for the species, and their protective areas at the surface should be interconnective with the existing " Testudo Tube " Cave Preserve Tract.

In assessment of " Zig Zag " Cave, No habitat is ever likely to be found due to the constrictive extent of the cave, however, it does possess a significance of Point Recharge contribution to the Cave System. It's surface protection area should encircle it's runoff basin, however, we find no scientific basis that it should have to be connective to the " Testudo " Cave Preseve area at the surface, and could be in a seperate preserve. Several of the Tract 3 caves may further require access control by means of gating with growth of the area.

In summation of the tracts habitat areas, a habitat line & boundary will have to be drawn and established to incorporate these areas. Perspect of that, it is clear by both extent and surface topography that such habitat line need Not extend at any point to the tract's South boundary line & fencing. It would further be interpreted that the potential continued alignment path for Anderson Mill Road to a juncture point with Lime Creek Road would look well feasible with No impacts perceived to the Karst Habitat Area. Please contact our office with any questions or if further assistance is needed.

Addendum Report Materials:
Site Taxonomic Report of February 7, 2002/ James Reddell (4 pages)

Copies of Report to:

BLANTON DEVELOPMENT COMPANY (6)

Respectfully,

MIKE WARTON/ Principal Executive
GEOLOGIST/ Karst Terrains Specialist
National Cave Gate Consultant/ Provider
MIKE WARTON & ASSOCIATES

MIKE WARTON
MIKE WARTON & ASSOCIATES
P.O. BOX #1313
CEDAR PARK, TEXAS 78630-1313

DISCOVERY WELL CAVE

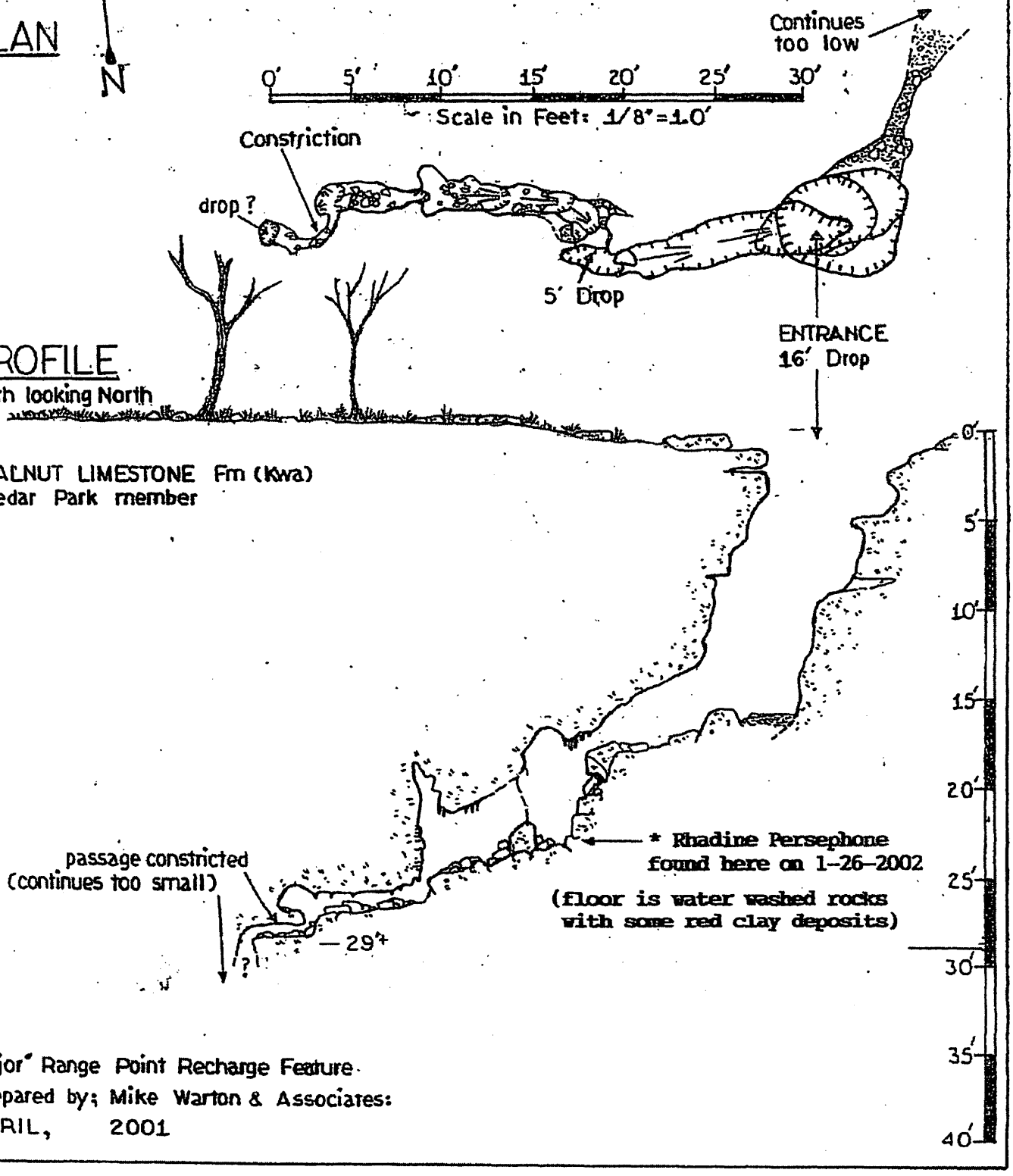
WILLIAMSON COUNTY, TEXAS

SUUNTOS & TAPE SURVEY • APRIL 24, 2001
PERSONNEL; MIKE WARTON & 'ASSOCIATES: B. WETUSKI
M. WARTON • DRAFT BY: M. WARTON
LENGTH: 63'+ DEPTH: 29.0'+ CONFIGURATION OF: 42'x 7'

PLAN

N

0' 5' 10' 15' 20' 25' 30'
Scale in Feet: 1/8"=1.0'



*"Major" Range Point Recharge Feature

Prepared by; Mike Warton & Associates:
APRIL, 2001

Mike Warton & Associates

GEOLOGIST / KARST TERRAINS SPECIALIST / NATIONAL CAVE GATE CONSULTANT
P.O. BOX # 1313 CEDAR PARK, TEXAS 78630-1313
(512) 250-0705 FAX (512) 250-0706
SPECIALIST IN TEXAS' ENVIRONMENTAL KARST RESEARCH & SERVICES

Addendum to Taxonomic Report 2/07/2002

Biological Collections & Atmospheric Data per 13 Karst Features of the " Ranch at Deer Creek ", Tract No. 3, Cedar Park Area South, Williamson & Travis Counties, Texas.

Karst Feature Name/ID:	Collection Dates:	Data: Surface	Data: in-Cave
1."Hole in the Draw" Cave	April 12/01-11am	73F + 68H	76F + 89H
	April 24/01-2pm	80F + 71H	78F + 93H
2."Grassy Grove" Sink	April 13/01-12noon	74F = 70H	73F + 72H
3."Under 3 Oaks" Cave	April 19/01-1pm	82F + 76H	71F + 88H
	April 24/01-10am	75F + 75H	70F + 87H
4."Discovery Well" Cave	April 19/01-2pm	86F + 76H	69F + 98H
	May 1/01-10:45am	84F + 74H	68F + 97H
	Jan.26/02-1pm	57F + 41H	63F + 90H
5."Hunters Lane" Cave	April 12/01-12noon	74F + 68H	66F + 94H
	May 1/01-10:30am	76F + 74H	65F + 96H
	Jan.26/02-2:15pm	57F + 41H	59F + 82H
6."Un-corked" Cave	April 24/01-11:35am	78F + 76H	72F + 93H
	Jan.26/02-4pm	53F + 39H	63F + 89H
7."Yawning Entrance" Cave	April 12/01-9:30am	71F + 64H	73F + 88H
	April 24/01-10:30am	75F + 70H	72F + 89H
8."Zig-Zag" Cave	April 19/01-3:30pm	87F + 74H	77F + 87H
	April 24/01-5:15pm	85F + 73H	79F + 88H
9."Jumbled Rocks" Cave	April 10/01-10am	69F + 62H	76F + 97H
	May 1/01-9:10am	76F + 68H	74F + 98H
10."Persimmon Well" Cave	April 11/01-10:20am	72F + 67H	70F + 96H
	May 1/01-8:20am	69F + 58H	71F + 97H
	Jan.26/02-10:10am	57F + 41H	61F + 84H
11."F-8" Sink	April 10/01-11:30am	70F + 63H	71F + 65H
12."Lime Creek Rd." Sink	April 10/01-8:30am	68F + 62H	67F + 77H
13."Understory" Cave	April 11/01-8:45am	69F + 64H	73F + 84H
	May 1/01-12:45am	79F + 76H	74F + 88H
	Jan.26/02-9:30am	57F + 41H	60F + 78H

* Collection time spent in each feature varied from 30minutes to 2.0hrs. according to feature size & extent.

CAVE BIOLOGY OF TRACT #3, RANCH AT DEER CREEK, CEDAR PARK, WILLIAMSON COUNTY, TEXAS

James R. Reddell

7 February 2002

Twelve caves and sinks have been biologically investigated on Tract #3 of the Ranch at Deer Creek subdivision. Mike Warton collected in all of the features during initial excavation and exploration. James Reddell and Marcelino Reyes re-collected in five of the largest caves in May 2001. James Reddell, Marcelino Reyes, and Mike Warton returned to the area on 26 January 2002. The endangered Tooth Cave ground beetle, *Rhadine persephone*, was found in Discovery Well Cave on the last date, but two other caves appear to contain habitat for this species and should probably be re-studied under different conditions. Of special note is the presence of troglobitic salamanders of the genus *Eurycea* in Hunter's Lane Cave. No specimens could be collected but this is probably an undescribed species.

The presence of *Rhadine persephone* in Discovery Well Cave provides stronger evidence that this species will also be found in other caves on the property. Discovery Well, Hunter's Lane, and Uncorked Caves are clearly structurally connected even if human connections are not possible and all should be considered habitat for the endangered ground beetle. A record by Horizon Environmental of *Rhadine persephone* in Persimmon Well Cave has not been verified by examination of specimens, but the presence of *Rhadine* new species indicates that it likely occurs there and this cave should probably also be considered habitat for the endangered ground beetle.

Discovery Well Cave

Collections were made in the cave on 19 April 2001 by Mike Warton, on 1 May 2001 by James Reddell and Marcelino Reyes, and on 26 January 2002. On the latter date the endangered Tooth Cave ground beetle, *Rhadine persephone*, was found The following temperature and humidity readings were taken in January. These readings are as follows: surface temperature (57.5° F), surface humidity (41%); end of cave temperature (63° F), end of cave humidity (90%). The following is a fauna list:

Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: *Cambala speobia* (troglobite)
Speodesmus sp. (troglobite)
Insects: Insecta larvae undetermined (accidental)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Ceuthophilus*) *secretus* (trogloxene)
Ground beetles: *Rhadine* new species (troglobite)
Rhadine persephone (troglobite)
Cliff frog: *Syrrhophus marnocki* (trogloxene)

F-8 Sink

Mike Warton collected in this small feature on 10 April 2001. The only fauna present were roaches (Blattaria undetermined).

Grassy Grove Sink

This small feature does not appear to have habitat for troglobites. Mike Warton collected in this small feature on 13 April 2001. The following is a fauna list:

Terrestrial isopods: Oniscoidea undetermined
Centipedes: Lithobiomorpha undetermined
Millipedes: Diplopoda undetermined (accidental)

Hole in the Draw Cave

This small cave does not appear to have habitat for troglobites. Mike Warton collected in it on 12 April 2001. The following is a fauna list:

Spiders: Araneae undetermined
Cave crickets: *Ceuthophilus* (*Geotettix*) *cunicularis* (troglophile)

Hunter's Lane Cave

This cave appears to potentially have habitat for *Rhadine persephone*. Two terrestrial and two aquatic troglobites were present. Collections were made in the cave in April 2001 by Mike Warton, on 1 May 2001 by James Reddell and Marcelino Reyes, on 26 January 2002 by James Reddell, Marcelino Reyes, and Mike Warton, and on 1 February 2002 by James Reddell and Marcelino Reyes. The cave was too cold and dry in January and February to have troglobites. The following temperature and humidity readings were taken in January: surface temperature (57.5° F), surface humidity (41%); temperature at end of cave (59° F), humidity at end of cave (82%). A *Eurycea* salamander was seen in January, but none were noted in February. A very hard cold front had passed through a few days earlier and the water was extremely cold. It is assumed that the salamanders had retreated away from the cave entrance. The following is a fauna list:

Flatworms: ?*Sphalloplana* sp. (troglobite)
Snails: Gastropoda undetermined (empty shell)
Spiders: Araneae undetermined
Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: Diplopoda undetermined
Cambala speobia (troglobite)
Speodesmus sp. (troglobite)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) *secretus* (trogloxene)
Salamanders: *Eurycea* ?new species (troglobite)

Jumbled Rocks Cave

This small cave does not appear to have habitat for troglobites. Collections were made in the cave on 10 April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:

Terrestrial isopods: Oniscoidea undetermined
Spiders: Araneae undetermined
Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: Diplopoda undetermined
Springtails: Collembola undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) *secretus* (trogloxene)

Rove beetles: Staphylinidae genus and species
Flies: Diptera undetermined
Mosquitoes: Culicidae genus and species (trogloxene)

Lime Creek Road Sink

This small feature does not appear to have habitat for troglobites. Mike Warton collected in the sink on 10 April 2001. The following is a fauna list:

Centipedes: Lithobiomorpha undetermined
Scutigeridae genus and species
Millipedes: Diplopoda undetermined

Persimmon Well Cave

This cave contains three troglobites and may be habitat for *Rhadine persephone*. Collections were made in the cave on 11 April 2001 by Mike Warton, on 1 May 2001 by James Reddell and Marcelino Reyes, and on 26 January 2002 by James Reddell, Marcelino Reyes, and Mike Warton. The cave was too cold and dry in January to contain troglobites and only cave crickets were found. The following temperature and humidity readings were taken in January: surface temperature (57° F), surface humidity (41%), temperature at end of cave (61° F), humidity at end of cave (84%). The following is a fauna list:

Terrestrial isopods: Oniscoidea undetermined
Spiders: Araneae undetermined
Cicurina (*Cicurella*) sp. (troglobite)
Harvestmen: *Leiobunum townsendii* (trogloxene)
Millipedes: *Cambala speobia* (troglobite)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Geotettix*) *cunicularis* (troglophile)
Ground beetles: *Rhadine* new species (troglobite)

Uncorked Cave

The presence of two troglobites in the cave indicates that this could be habitat for *Rhadine persephone*. Collections were made in the cave on 24 April 2001, and on 26 January 2002 by James Reddell, Marcelino Reyes, and Mike Warton. The cave cold and dry in January and the only fauna found were mosquitoes, cave crickets, and an accidental spider.The following is a fauna list:

Spiders: *Cicurina* (*Cicurella*) sp. (troglobite)
Lycosidae genus and species (accidental)
Subterranean silverfish: *Texoreddellia* sp. (troglobite)
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Beetles: Coleoptera undetermined (accidental)
Mosquitoes: Culicidae genus and species (trogloxene)

Understory Cave

This cave does not appear to contain habitat for *Rhadine Persephone*. Collections were made in the cave on 11 April 2001 by Mike Warton and on 1 May 2001 by James Reddell and Marcelino Reyes. The following is a fauna list:

Terrestrial isopods: Oniscoidea undetermined
Spiders: Araneae undetermined
Cicurina (*Cicurella*) sp. (troglobite)
Harvestmen: *Leiobunum townsendii* (trogloxene)
Springtails: Collembola undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)
Ceuthophilus (*Ceuthophilus*) *secretus* (trogloxene)
Rove beetles: Staphylinidae genus and species
Mosquitoes: Culicidae genus and species (trogloxene)

Yawning Entrance Cave

This small cave does not appear to contain habitat for *Rhadine persephone*. Mike Warton collected in the cave in April 2001. The following is a fauna list:

Spiders: Araneae undetermined
Cave crickets: *Ceuthophilus* (*Ceuthophilus*) new species B (trogloxene)

Zig-Zag Cave

This small cave does not appear to contain habitat for *Rhadine persephone*. Mike Warton collected in the cave on 19 April 2001. The only fauna found was a centipede of the family Scutigeridae.

APPENDIX B

EXAMPLE MAINTENANCE CHECKLIST

Date: _____

Discovery Well Preserve
Maintenance Checklist

1. Check integrity of exterior fencing.
    a. Indicate damage to exterior fence/gate/lock.

    b. Describe evidence of unauthorized entry into preserve.

2. Check each cave for signs of unauthorized entry.
    a. Check cave gates for evidence of tampering (if applicable).

    b. Describe evidence of unauthorized entry into caves.

3. Observe the area for evidence of destructive animal use.
    a. Record presence of fire ant mounds in preserve, especially near caves.

    b. Note damage from wild hogs or other large mammals.

4. Note maintenance performed (including removal of trash).

5. Note additional maintenance (including refuse removal) recommended.

Don't forget to lock up!

EXHIBIT E

February 2003 Karst Conservation Summary Report for SH 45

Texas Department of Transportation
DEWITT C. GREER STATE HIGHWAY BLDG. • 125 E. 11TH STREET • AUSTIN, TEXAS 78701-2483 • (512) 463-8585

February 18, 2003

Robert T. Pine
U.S. Fish and Wildlife Service
10711 Burnet Road, Suite 200
Austin, Texas 78758

Reference: SH 45 Karst Conservation Summary Report

Dear Mr. Pine:

The Texas Turnpike Authority Division (TTA) of the Texas Department of Transportation is pleased to submit the attached Karst Conservation Summary Report in accordance with item 1 under the terms and conditions of the U.S. Fish and Wildlife Service's (the Service's) Biological Opinion dated February 21, 2001, and subsequent correspondence dated August 2, 2002. TTA requests the Service's prompt review and approval of the report to ensure effective stewardship of affected endangered species habitats associated with the SH 45 project.

Please contact me at (512) 225-1351 with any comments or questions regarding the report. We look forward to continuing our partnership with the Service to foster endangered species conservation throughout central Texas.

Sincerely,

(original signed by Stacey Benningfield)

Stacey Benningfield
Environmental Program Manager
Texas Turnpike Authority Division

Attachment

cc: Robert Daigh, Texas Turnpike Authority
Brett Jackson, Federal Highway Administration

State Highway 45
From Anderson Mill Road to FM 685
Travis and Williamson Counties

Karst Conservation Summary Report

1.0 PROJECT AND CONSULTATION SUMMARY

Background

In June 2000, the Federal Highway Administration (FHWA) and the Texas Turnpike Authority Division (TTA) of the Texas Department of Transportation completed work on an environmental impact statement (EIS) for proposed State Highway (SH) 45 in Travis and Williamson Counties, Texas. The limits of the SH 45 project presented in the EIS extend from Anderson Mill Road, just west of U.S. Highway 183 in Williamson County, to Farm-to-Market Road (FM) 685 in northeast Travis County – a distance of approximately 15 miles. In February 2001, FHWA issued a record of decision completing the environmental study and public involvement phase of project development.

The SH 45 project was developed in accordance with the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508), FHWA Environmental Impact and Related Procedures (23 CFR Part 771), TTA Environmental Review and Public Involvement Rules (43 TAC Chapter 52), and other related federal and state requirements including Section 7 of the Endangered Species Act (ESA) of 1973, as amended.

Consultation Summary

In December 2000, FHWA and TTA prepared a biological assessment (1) describing the proposed SH 45 project; (2) discussing the biology and distribution of federally listed species in the project vicinity that are afforded protection under the ESA; and (3) determining the potential effect of the proposed project on ESA protected species. On December 14, 2000, the biological assessment was transmitted to the U.S. Fish and Wildlife Service (the "Service") by letter requesting initiation of formal consultation under Section 7 of the ESA. Formal consultation was initiated on December 22, 2000.

Although Travis and Williamson Counties are home to a number of listed species, only one – the Bone Cave Harvestman (*Texella reyesi)* – was determined to be impacted by the proposed action.

On February 21, 2001, the Service issued a final biological opinion (BO) to FHWA and TTA for the proposed SH 45 project. A major component of the BO is the Incidental Take Statement (the "Statement") which allows the incidental take (i.e. harm, harassment,

wounding, killing, etc. incidental to the otherwise lawful implementation of the proposed action) of the endangered species under terms of the ESA, provided such taking is in compliance with the terms and conditions of the Statement. By letter dated August 2, 2002, the Service modified its BO to allow FHWA and TTA greater flexibility in satisfying the reasonable and prudent measures identified in the BO.

2.0 REASONABLE AND PRUDENT MEASURES

The BO, as originally issued, included as a reasonable and prudent measure, the establishment of an approximately 160-acre karst preserve (the specific location and configuration of which was depicted in the BA). The BO further provided that the karst preserve is to be established and dedicated for karst conservation before any construction or land clearing activities occur on SH 45 within karst zones 1 or 2. Karst zones 1 and 2 are geographic areas delineated by George Veni & Associates (1992) that are known to contain or likely to contain endangered cave species. The August 2, 2002, letter from the Service modified this reasonable and prudent measure to allow FHWA and TTA a menu of options to satisfy their conservation obligations. Three options were identified – any of which could be employed to satisfy this reasonable and prudent measure. These options are (1) acquire, establish and dedicate the 160-acre preserve identified in the BA; (2) acquire, establish and dedicate an approximately 160-acre preserve at a "biologically equivalent site, approved by the Service", or (3) establish an approximately 30-acre preserve (being that portion of the originally proposed preserve already acquired for this purpose) plus purchase credits equivalent to 4 high quality caves containing Bone Cave harvestmen and about 129 acres, from a Service-approved karst conservation bank.

After reviewing their options, FHWA and TTA elected to pursue the third option. Under the two-pronged approach FHWA and TTA will establish an approximately 30-acre preserve (hereinafter referred to as Chaos Cave Karst Preserve) and will purchase karst conservation credits from a karst conservation bank approved by the Service. This Karst Mitigation Summary Report, serves to document FHWA's and TTA's actions toward satisfying the terms and conditions of the BO (relating to the above described reasonable and prudent measure) and it also contains a management plan (see Section 4.0) for the approximately 30-acre Chaos Cave Karst Preserve.

3.0 PURCHASE OF CONSERVATION CREDITS

On December 14, 2002, the Service and the Williamson County Karst Conservation Foundation (the Foundation) entered into a Memorandum of Understanding (MOU) establishing a conservation bank for Williamson County and other entities needing to offset impacts of their projects. Under the umbrella of the newly-created karst conservation bank, Williamson County has purchased property containing 4 high quality caves (harboring Bone Cave harvestmen) including about 129 acres, and has offered to sell to FHWA and TTA credits that may be applied toward the SH 45 project. According to

their letter dated August 2, 2002, the Service has reviewed the site (located near the future Williamson County Regional Park in the Georgetown KFR) and has determined that purchase of these credits would satisfy the reasonable and prudent measure established in the BO, as amended.

Although the MOU between the Service and the Foundation has been executed, as of the date of this report, the Williamson County Karst Conservation Bank is not yet fully operational. Since purchase of the necessary credits is required prior to any construction or land clearing activities for SH 45 in karst zones 1 or 2, TTA and the Service signed an agreement dated December 18, 2002, to jointly establish an escrow account to serve as a repository of the funds until such time as the bank is fully operational. On January 6, 2003, $3.8 million was deposited into the escrow account where it will be held until such time as the Foundation is prepared to receive the payment.

4.0 CHAOS CAVE KARST PRESERVE MANAGEMENT PLAN

Chaos Cave Karst Preserve

Chaos Cave Karst Preserve is located adjacent to (future) SH 45 in southern Williamson County, Texas. The approximately 30-acre preserve was purchased in 2002 specifically for the purpose of establishing a karst preserve to partially fulfill the reasonable and prudent measures recommended by the Service for impacts to Bone Cave harvestmen that may be associated with SH 45.

The limits/location of Chaos Cave Karst Preserve are shown in Figure 1 of this document. A detailed assessment of the preliminary karst investigations associated with the SH 45 project, including those features located within the boundaries of the Chaos Cave Karst Preserve, can be found in the report *Search and Preliminary Hydrogeologic and Biological Assessment of Caves and Karst Features Along the Proposed State Highway 45, Williamson County, Texas* (Veni 2000) attached as Appendix A to the BA.

Endangered Species Recovery Criteria

The recovery plan for the Bone Cave harvestman calls for the protection of at least three karst fauna areas (KFAs) (if at least three exist) within each karst fauna region (KFR) in the species' range in order to downlist the species (USFWS 1994). Geologic continuity, hydrology and distribution of rare obligate cave-dwelling species are assessed to delineate KFRs. A KFA is defined as "an area known to support one or more locations with 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." The purpose of protecting at least three KFAs is to provide a margin of safety against any unanticipated catastrophic event(s) which could lead to the extinction of the protected species within one or more KFAs.

Of the six KFRs in which Bone Cave harvestmen occurs, only four have more than three KFAs that are known to be occupied by the species. These KFR's are the Jollyville Plateau, McNeil/Round Rock, Georgetown, and North Williamson County KFRs. Therefore, the recovery objectives for these KFRs are to protect at least three of the KFAs within each of these KFRs. The other two KFRs in which the species occurs are Cedar Park and Central Austin, each with only one KFA occupied; therefore, to meet recovery objectives, all KFAs within these two KFRs must be protected (USFWS 1994).

A protected KFA is one containing sufficient contiguous karst and surface area to maintain the karst ecosystem's integrity. The size and configuration must adequately maintain moist, humid conditions, air flow, and stable air temperatures. Additionally, it must maintain an adequate nutrient supply, prevent or control the invasion of exotic species (e.g. fire ants), and allow the movement of karst fauna and nutrients through the interstitial space between karst features (USFWS 1994). It must also offer protection against contamination of the surface and ground water entering the karst ecosystem. The Chaos Cave Karst Preserve would be the first karst preserve in the McNeil/Round Rock KFR.

Management Plan Goals

The implementation of the management plan for the Chaos Cave Karst Preserve is intended to be a long-term, dynamic undertaking. To provide a foundation for the management measures and to construct a framework for measuring success of the plan, the following goals have been developed.

The goals of the management plan are:

- Provide for the conservation and, if needed, enhancement of the karst ecosystem within the Chaos Cave Karst Preserve,
- Implement and integrate management measures (including adaptive management) for the protection of the Bone Cave harvestman,
- Monitor the Bone Cave harvestman population on the preserve, and
- Establish a maintenance plan for the management of the Chaos Cave Karst Preserve in perpetuity.

These goals are intended to fulfill the terms and conditions relating to the karst preserve in the Service's Biological Opinion, as amended, for SH 45. A description of the terms and conditions relating to the creation of this karst preserve can be found in the Biological Opinion, as amended.

4.1 Biological Overview

The following is a brief description of the karst habitat and the biology of the Bone Cave Harvestman. A more detailed discussion can be found in the Biological Opinion for SH 45 issued February 21, 2001, or in the *Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas* (USFWS 1994).

Habitat Description

The surface geology of the Chaos Cave Karst Preserve has been identified as Edwards Limestone (Veni 2000). The area is relatively level and is drained by Lake Creek. The vegetation is characterized as juniper/oak woodland with a few very small areas of open grassland.

The karst investigations for SH 45 identified eight karst features that occur within the Chaos Cave Karst Preserve. The locations of these features are shown in Figure 1. Two of these features were identified as caves containing the endangered Bone Cave harvestman. These caves are Chaos Cave and Under the Fence Sink (note: Under the Fence Sink occurs along the eastern property line but the cave entrance is primarily on the preserve side of the fence). According to Veni (2000), Chaos Cave is the most biologically significant cave in the preserve area and contains a very large population of Bone Cave Harvestmen. One other cave, Poison Ivy Cave, was identified as likely to contain the species and will be further investigated as part of the implementation of the preserve management plan. Feature 74K has potential to open up to a cave and will also be investigated as part of the development and management of the preserve. Veni described Feature 75K as being a point of potential recharge to the aquifer but otherwise had no known biological significance. Rather Gaping Pit was described by Veni as having minor hydrologic significance and little potential to contain habitat for endangered invertebrate species. The other two features (78K and 79K) are fractures that may be important to Chaos Cave and Poison Ivy Cave.

Bone Cave Harvestman

Biology

The Bone Cave harvestman is a pale orange, blind, long-legged harvestman with a body length ranging from 1.41 to 2.67 millimeters (mm), and leg lengths of 6.10 to 11.79 mm. The body is finely wrinkled, the eye mound conical and retina is absent. Although adults are pale orange, juveniles appear white to yellowish-white. This species is similar in appearance to its closest relative, the Bee Creek Cave harvestman (*Texella reddelli*), but is distinguished by its lack of retinas and its color. Some of these features can be observed in the field, but species confirmation requires microscopic evaluation of a preserved adult by a qualified systematist (USFWS 1994).

Bone Cave harvestmen are troglobitic, meaning they spend their entire lives underground. Troglobites have, among other subterranean adaptations, small or absent eyes and elongated appendages. Although their life cycles are completed underground, troglobites are dependent upon the surface for moisture and nutrient input. Like other troglobites, Bone Cave harvestmen prey upon microarthropods. This species is particularly sensitive to drying, requiring very moist, humid conditions. Individuals are generally found beneath large rocks within caves, but are occasionally seen walking about moist cave floors. As smaller caves warm up and become drier during the hottest part of the summer, individuals may retreat to only the coolest, dampest areas in the caves or interstitial spaces in the karst extending beyond the cave.

Distribution

Bone Cave harvestmen are found in six KFRs in the Austin area. These KFRs are the Jollyville Plateau, McNeil/Round Rock, Georgetown, North Williamson County, Cedar Park and Central Austin KFRs. The limited distributions and low reproductive rates of troglobites, combined with ecological specialization, contribute to the vulnerability of these invertebrates to habitat destruction, fire ant infestation, and other threats.

Protection

No karst preserves have yet been established within the McNeil/Round Rock KFR. Chaos Cave Karst Preserve will be the first karst preserve, to date, in Williamson County. Only four caves containing the Bone Cave harvestman have been preserved, all of which are in Travis County (USFWS 2001b).

4.2 Management Plan

A management plan should describe in detail all of the necessary actions associated with the acquisition, management (including adaptive management), and monitoring of a karst preserve, in perpetuity, including responsible parties, time frames, and funding mechanisms. Prior to any construction activities related to the proposed SH 45 project within karst zones 1 and 2, the karst preserve must be acquired and the management plan approved by the Service. This document describes the conditions for establishment and management of the Chaos Cave Karst Preserve.

Administration

Responsible Party: Texas Turnpike Authority Division (TTA) of the Texas Department of Transportation. Transfer of ownership and/or administration of the Chaos Cave Karst Preserve from TTA to another entity may be done only with the approval of the Service.

Acquisition: Fee Simple

Time Frames: Acquisition of the two tracts that constitute the Chaos Cave Karst Preserve was completed in June 2002. Implementation of the management plan will begin prior to the initiation of construction of SH 45 west of Rattan Creek. The management activities of the preserve are outlined in the following discussion. The initial phase (Phase 1) will begin with the approval of this management plan by the Service. This phase will include additional studies and the development of recommended management measures. The next phase (Phase 2) will include implementation of management measures and monitoring during construction of SH 45. Some overlap between Phase 1 and Phase 2 is anticipated. The last phase (Phase 3) is the long-term management of the preserve. Adaptive management may be implemented at any point during Phase 1, 2, or 3 and must be agreed upon by both the Service and TTA/FHWA or any future conservator of the preserve. Table 1 shows the timeline for the implementation of management activities.

Reporting:
A status report will be prepared by TTA annually, unless otherwise approved by the Service, until the management and/or ownership of the preserve is transferred to a different entity, at which time the new managing entity will prepare the annual reports. At a minimum, annual reporting will continue at least two years after completion of construction. Reporting requirements may then be reduced if adjacent properties remain undeveloped (resulting in stable baseline conditions) and if approved by the Service.

Funding:
TTA will be responsible for costs associated with the management of the Chaos Cave Karst Preserve as long as the preserve is under TTA/TxDOT ownership. Any transfer of ownership will be subject to Service approval and be contingent upon the receiving entity assuming responsibility for the requirements of the management plan and providing funds for any outstanding obligations as well as future management.

Karst Investigations

Previous investigations on the Chaos Cave Karst Preserve tract were performed as part of the SH 45 project planning. These efforts focused primarily on the proposed SH 45 alternative alignments and immediately adjacent areas (generally within 500 feet). Consequently, some karst features on the tract were identified but not fully investigated.

During the previous investigations, two caves on the preserve tract were identified as containing the endangered Bone Cave harvestman (Chaos Cave and Under the Fence Sink). One other cave, Poison Ivy Cave, was identified as likely to contain the species but has not been adequately surveyed during the previous work. Karst feature 74K was identified as potentially opening up to a cave. As part of Phase 1 of this management plan, all three caves will be biologically surveyed (again). During Phase 1, feature 74K will be investigated and will be biologically surveyed if it is determined to contain suitable habitat. The locations of all karst features identified on the preserve, including GPS coordinates, will be verified and/or resurveyed during Phase 2 as part of the preparation of a detailed map of the preserve tract. Phase 2 will also include annual biological surveys of all three

Table 1
CHAOS CAVE KARST PRESERVE
MANAGEMENT PLAN IMPLEMENTATION TIMELINE

Activity	Phase 1 (SH45 Const begins)	Phase 2				Phase 3
	2003	2004	2005	2006	2007	Post Const (freq)
Annual Report (ongoing)	▲	▲	▲	▲	▲	1 yr
Biological Survey – All Three Caves*	▲	▲	▲	▲	▲	▲**
Karst Feature 74K Investigation	▲					
Detailed Preserve Map		▲				
Cave Cricket Survey	▲***	▲***		▲		3 yr
Mammal Survey	▲		▲		▲	3 yr
Fence Preserve Boundary Adjacent to SH 45 ROW	▲					
Access Restriction Evaluation – All Three Caves*	▲					
Access Restriction Implementation – All Three Caves*		▲				
Vegetation Survey – Initial Site Assessment	▲					
Vegetation Management – Recommendations	▲					
Vegetation Management – Implementation	*as recommended and/or as needed*					
Vegetation Monitoring			▲		▲	3 yr
Fire Ant Survey	▲†	▲†	▲†	▲†	▲†	▲†
Fire Ant Management	*as recommended and/or as needed*					
Routine Maintenance	▲††	▲††	▲††	▲††	▲††	▲††
Adaptive Management	*as recommended and/or as needed*					

* Chaos Cave, Under the Fence Sink, and Poison Ivy Cave (if Poison Ivy Cave contains listed species). This may also include 74K if it is found to harbor Bone Cave harvestmen.

** Annual biological surveys will continue for two years following construction. After two years, surveys will be conducted every three years unless otherwise approved by the Service.

***Cave cricket surveys will occur twice per year during the first two years.

† Fire ant surveys will occur twice per year or more often if warranted.

†† Routine maintenance will be performed quarterly.

caves (and karst feature 74K if found to contain listed species) to monitor any effects of the roadway construction. Annual surveys will extend a minimum of two years into Phase 3. At this point, biological surveys for the listed species will occur every three years unless the Service approves less frequent surveying.

Surveys for listed species should always be done at the same time of year (within 30 days) during the spring (March through June) or fall (September through December). A number of set sampling stations for repeated surveying should be established within each cave and delineated on each respective cave's map.

Monitoring in all caves with listed species will include, but not be limited to:

1. all vertebrates and invertebrates, alive or dead, including all troglobites, troglophiles, trogloxenes, and accidental species;
2. quantities for each species (approximations may be made for very abundant species);
3. microhabitat descriptions and locations (maps and descriptions) within the cave of each listed species;
4. types (identified as specifically as possible) and approximate quantities of other organic matter including leaf litter, fungus, feces, bones;
5. signs of mammal or other trogloxene or accidental vertebrates (for example, scratch marks, middens, nesting materials, shed skins); and
6. temperature and humidity within the cave at the time of the survey.

Results will be included in the annual report.

Access Restriction/Cave Gating

Vandalism and damage by novice cavers is a common cause of karst habitat degradation in urban settings. A common response to this problem is to gate and lock the cave entrance. However, since the Chaos Cave Karst Preserve is in a semi-undeveloped area and since cave gating may have unintended adverse effects, the need for access restriction measures will be evaluated. Subsequently, gating will be utilized only as a last resort.

The caves identified in Section 4.1 (Chaos Cave, Under the Fence Sink, Poison Ivy Cave, and 74K if it opens up to a cave) will be evaluated during Phase 1 for the application/construction of access restriction measures by a qualified karst geologist and recommendations will be made to the Service for concurrence. Fencing around the cave openings, or clusters of openings, will be the preferred method of access restriction. If fencing is not feasible or advisable, another form of access restriction will be recommended (e.g., gating). Measures to allow movement of small animals in and around each opening will also be included. Installation of the access restriction measures will occur in conjunction with the roadway construction activities (Phase 2). If access to the cave appears to be a threat to the species or its habitat in the future (Phase 3), access restriction measures may be reevaluated at that time.

During Phase 1, prior to roadway construction (or staging) west of Rattan Creek, TTA will install a chain-link fence along the preserve boundary adjacent to the SH 45 right-of-way. Gated access will be provided from the SH 45 right-of-way. During construction, the remainder of the perimeter will be fenced, where necessary. Interior fencing specifications, if needed for access restriction, will be developed by TTA.

Cave Cricket Survey

Cave cricket surveys will occur twice during Phase 1 in the spring and fall. The initial survey will be completed prior to construction or other ground disturbing activity adjacent to the main body (heavily wooded portion) of the preserve. During Phase 2, cave cricket surveys will be performed twice (in spring and fall) in 2004 and once in 2006. In Phase 3, biological surveys for cave crickets will occur once every three years, unless the Service approves less frequent surveying.

Because cave crickets tend to hide within inaccessible areas of caves and may migrate to different areas of a cave during the day or during a single survey event (particularly when disturbed by a surveyor), cave crickets will be counted as they emerge from the cave at night. Counts will begin at sunset and continue for two hours. Surveys will be conducted in the vicinity of caves with listed species (Chaos Cave, Under-the-fence Cave, and possibly Poison Ivy Cave) at the same time of year (within 30 days) during the spring and/or fall when temperatures are between 40°F and 100°F and relative humidity is greater than 80 percent at the time the counts are conducted. Notations will be made regarding current weather, surface temperature and relative humidity; recent weather events in the previous week (e.g., rain or lack thereof, unusual temperatures, tornadoes); and current weather trends (e.g., drought). Cave cricket surveys performed during Phase 2 and Phase 3 will be compared to the baseline (Phase 1) data. Results of these surveys will be included in the annual report.

Mammal Survey

Some mammals that provide nutrient input into karst ecosystems are also predators of insects and other fauna and thus may potentially become a threat at higher densities. These include raccoons, mice (*Peromyscus* spp.), opossums, and skunks. Domestic and feral cats and dogs and rats and mice associated with human habitation may also impact native animal communities. Monitoring prior to construction or other ground-disturbing activity west of Rattan Creek is needed to establish baseline densities of mammals in the preserve.

During Phase 1 and Phase 2, mammal surveys will be performed every two years by a qualified wildlife biologist for small to medium-sized mammals. In Phase 3, the preserve will be monitored every three years unless the Service approves less frequent surveying.

Monitoring should occur at the same time each year (within 30 days) and will include current weather, surface temperature and relative humidity; moon phase; recent weather

events in the previous week (e.g., rain or lack thereof, unusual temperatures, tornadoes); and current weather trends (e.g., drought). Biologists will also document other field indicators of the presence of mammals within the preserve. Small mammal trapping will be conducted and will consist of approximately 90 trap-nights set at 30-foot intervals in linear transects within the preserve. Monitoring during Phase 2 and Phase 3 will be compared to Phase 1 results to detect population trends. TTA may adjust mammal survey protocols at any time, if the results are deemed inadequate or as necessary as a part of adaptive management. Results will be included in the annual report.

Vegetation Survey

Surface vegetation is important to karst habitats because biological activity and nutrient input to the subsurface are closely associated with surface conditions. The surface conditions can also affect water quality and indicate the potential for fire ant infestation. Phase 1 will include a site assessment to characterize the overall vegetation community in April 2003. A species list will be developed according to structure category (canopy, subcanopy, herbaceous layer). Pilot nested-plot techniques or comparable techniques approved by the Service will be used to construct and examine species-area curves to determine sampling intensity needed. Data collected in this mostly wooded preserve will include density, dominance, importance, reproductive profile (size classes), and degree of openness of canopy. In addition to non-native species, invasive species associated with disturbance and livestock grazing/browse pressure will also be assessed. Perimeters of woodland and grassland patches will be delineated using aerial photography, ground-truthing, and GIS software to produce a vegetation map for subsequent monitoring. A separate report of the survey results will be prepared within 6 months following the initial assessment with recommendations for enhancement and/or management of the vegetation community.

During Phase 2, vegetation monitoring will be conducted in 2005 and 2007 to monitor the effectiveness of enhancement/management activities and/or changes from the baseline conditions. In Phase 3, vegetation monitoring will occur every three years unless the Service approves less frequent surveying. Vegetation monitoring will include monitoring of canopy, sub-canopy, and herbaceous species as described above. Future vegetative conditions will be compared to the baseline vegetation survey to appraise the current condition of the karst preserve, and any adaptive management measures needed will be assessed at that time. All vegetative assessments and monitoring will be performed by a qualified botanist. Results will be included in the annual report.

Fire Ant Management

Red imported fire ants (RIFA) have been shown to be a key factor in karst habitat degradation. The main concern in fire ant control in karst areas is the effect on non-target species. For this reason, pesticide use is not recommended within 164 feet of the footprint of any known karst feature. The most commonly recommended measure for RIFA control is the application of boiling water or steam. One to 4 gallons of boiling or near boiling

water, with an optional 1-2 teaspoons of detergent added, may be poured directly onto the mounds. If use of bait is determined necessary, protocols will be recommended and approved by the Service. Since the existence and/or extent of RIFA infestation on the Chaos Cave Karst Preserve is not known, an investigation of the presence of RIFA mounds will be made.

During Phase 1 of this plan, two intensive surveys for the presence of RIFA will be performed, one of which will occur prior to construction or other ground disturbing activity adjacent to the preserve boundary. Because fire ants do not maintain their mounds during the summer, making them more difficult to see, but begin rebuilding them as soon as rains and cooler temperatures return, monitoring surveys should be done in the spring and fall. During these surveys, mound density within 164 feet of the entrance of Chaos Cave, Under-the-fence Cave, Poison Ivy Cave, and Rather Gaping Pit will be calculated to determine the level of infestation and the effort needed to treat these mounds with boiling water. Throughout the remainder of the preserve, mounds will be counted within 20-foot wide belt transects to estimate density and determine effort needed for application of boiling water or small amounts of fire ant bait.

Fire ant treatment will be implemented within 30 days, unless RIFA mounds are detected within 33 feet of any karst feature, in which case treatment will occur within 15 days. An increase in the frequency of fire ant control will be required if either of the following conditions are met during any survey: (1) fire ant densities are greater than 40 mounds per acre, or (2) there are greater than 40 mounds within 164 feet (the approximate cricket foraging radius) of the entrance of any karst feature that harbors the Bone Cave harvestman or cave crickets (Chaos Cave, Under-the-fence Cave, Poison Ivy Cave, and Rather Gaping Pit). The frequency of fire ant control must increase until the density of fire ant mounds declines below the previously described indices.

During Phase 2 and Phase 3, the preserve will be surveyed twice per year for the presence of RIFA and appropriate treatments will be applied. During these surveys, particular attention will be paid to the preserve perimeter, especially along SH 45, and any observed disturbed areas. Results of these surveys will be included in the annual report.

Construction Management

Within karst zones 1 and 2, the roadway has been designed to divert drainage away from all known karst features and through the best available storm water runoff sedimentation and filtration basins and hazardous materials traps to provide for nondegradation of water quality runoff from SH 45. During construction in Phase 1 and Phase 2, a karst geologist will monitor all construction activities in karst zones 1 and 2 to ensure any unknown caves that may be encountered during construction are identified and it is determined whether listed species may be present. These measures will ensure that impacts to the Bone Cave harvestman or other listed species do not surpass the levels authorized by the incidental take statement issued in the Service's BO.

Routine Maintenance

Routine maintenance of the preserve will be done at least quarterly. Routine maintenance will include checking all fences, gates, and locks within the preserve and along the perimeter of the preserve for signs of damage or trespassing.

Adaptive Management

Adaptive management measures may be implemented at any time throughout the life of the preserve if it is determined that the goals of the management plan are not being met or management or monitoring activities are determined to be ineffective in conserving the Bone Cave harvestman. Adaptive management measures may be recommended by the Service or TTA/FHWA, or any future conservator of the preserve, and must be agreed upon by both parties. Conditions which may warrant management adjustments include, but are not limited to, the following:

- destruction or deterioration of subterranean habitat (which could be due to a number of factors including, but not limited to, drying, loss of water inputs, and point-source and non-point source pollution);
- a single drastic or consistent gradual decline in the number of observed Bone Cave harvestmen, cave crickets, or other native species that normally inhabit the caves;
- declines in measured relative humidity or increased variation in measured temperature or shifts from suitable temperatures;
- new information on the biology of the Bone Cave harvestman; or
- evidence of loss of structural integrity of one or more caves such as collapse or large breakdown in the cave interior or entrance.

Adaptive management options to be considered may include, but are not limited to:

- additional surveys to determine the root cause of degradation of habitat or declines of important faunal communities;
- replacement or modification of the karst preserve perimeter fence and/or installation of interior cave security fencing around specific caves;
- installation, replacement, or repair of cave gates;
- hunting, trapping, or other deer and hog reduction programs;
- vegetation control or plantings to achieve trespass deterrence, runoff control, improved nutrient input, cave cricket forage, re-establishment of native floral species, or cave temperature and moisture regulation;
- modification of drainage patterns within and around the karst preserve;
- vegetation management such as thinning of the canopy, removal of selected individuals, control of exotic species, prescribed fire away from immediate cave areas, replanting native species that are under-represented, oak wilt control, and other suitable restoration activities approved by the Service;

- modifications to fire ant treatments (such as increasing the frequency of treatments);
- actions to reduce the number of mammalian predators;
- physical reinforcement of a cave(s) or cave entrance(s);
- activities that address root causes of poor reproduction of the plant community or survivorship (such as control of seed predators, browsers, disease, etc); and
- installation of a barrier between developed areas and the preserve to prevent, ameliorate, or deter deleterious impacts from the developed area.

General Conditions

Unpredictable Circumstances

Any circumstances detected in the preserve as potentially detrimental to the management goals will trigger the need to consult with the Service for advice on adaptive management. In addition, TTA will report to the Service within 48 hours of detecting any site conditions or disturbances that pose an immediate risk to the Bone Cave harvestman.

The following measures are general procedures for dealing with foreseeable, but unpredictable, circumstances that could occur. With respect to these potential unpredictable circumstances, TTA will undertake such corrective actions in consultation with the Service, as necessary, to meet the goals of this management plan:

- Vandalism of Caves. If detected, the Service as well as local law enforcement authorities will be promptly notified. Any effects of vandalism will be documented and then corrected, if possible, in consultation with the Service and within a reasonable time.

- Storm Damage. Within one week of storm damage, the Service will be notified and damage will be assessed and documented. Following consultation with the Service, corrective measures will be implemented promptly and within a reasonable time frame.

- Fire. In the event of a fire, TTA will promptly notify the Service. As soon as warranted by safety considerations, TTA will assess any impacts and implement appropriate corrective actions in consultation with the Service. If utilizing a controlled burn for vegetation management, the Service will be consulted beforehand.

- Release of Hazardous Materials. In the event of a release of chemicals, gasoline, oil, or other hazardous materials within the karst preserve or on the adjacent SH 45 right-of-way, TTA will immediately notify the Service. As soon as warranted by safety considerations, TTA will assess any impacts and implement appropriate corrective actions in consultation with the Service.

- Activities of Adjacent Landowners or Occupants. In the event that activities on adjacent properties threaten or damage the karst preserve (including, but not limited to, vandalism or trash dumping within the preserve), TTA will assess any impacts and develop appropriate corrective actions in consultation with the Service.

Other Conditions

- Cattle, other domestic and/or exotic livestock, and pets will not be allowed in the preserve unless approved by the Service and only as part of the preserve management.

- Contaminants such as fertilizers, herbicides, and pesticides will be avoided within the karst preserve and within 656 feet of the preserve in roadway rights-of-way.

- No new roads, new utilities, or other development including storm water or wastewater lines, treatment ponds, structures or other facilities are allowed within the karst preserve boundary unless approved by the Service.

- The operation of motor vehicles within the preserve will be limited to that necessary to facilitate operation, monitoring, and maintenance of preserve areas.

- No public access will be allowed on the karst preserve including hiking, biking, and horseback riding unless approved by the Service.

BIBLIOGRAPHY

George Veni & Associates. 1992. Geologic Controls on Cave Development and the Distribution of Cave Fauna in the Austin, Texas, Region. Appendix D: Distribution Maps of Endangered Cavernicole Fauna in the Austin Region. Prepared for U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. 2001a. Draft Biological Opinion for TTA/FHWA Proposed SH 45.

U.S. Fish and Wildlife Service. 2001b. Draft Environmental Assessment/Habitat Conservation Plan for Issuance of an Endangered Species Act Section 10(a)(1)(B) Permit for the Incidental Take of the Bone Cave Harvestman (*Texella reyesi*) During Construction and Operation of Commercial Developments On Portions of 5.94 acres (Lots 1, 2, 3, 4, and 5) at RR 620 and Great Oaks Drive – Round Rock, Williamson County, Texas.

U.S. Fish and Wildlife Service. 1994. Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas. Albuquerque, New Mexico.

Veni, George. 2000. Hydrologic and Biological Assessment of Caves and Karst Features Along Proposed State Highway 45, Williamson County, Texas. Prepared for Hicks and Company. May 2000.