Balcones Canyonlands Preserve
Karst Monitoring and Management
FY 2023 Annual Report



Red imported fire ant (*Solenopsis invicta*) carrying away troglobitic springtail (*Pseudosinella violenta*) in Sacred Grove Cave, on the Stovepipe Karst Preserve, 8/4/2023, photo by Colin Strickland

Travis County
Department of Transportation and Natural Resources
Natural Resources and Environmental Quality Division
and
City of Austin Balcones Canyonlands Preserve – Austin Water (AW)

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1.0 REGIONAL PERMIT

There are six species of endangered karst invertebrates (ES; Table 1) and 25 karst species of concern (SOC; Table 2) covered by the Balcones Canyonlands Conservation Plan (BCCP), a regional 10(a)1(B) permit issued by the U.S. Fish and Wildlife Service (USFWS) to the City of Austin (COA) and Travis County (TC) in May 1996 (USFWS 1996a). If these 25 species of concern become listed as endangered in the future, no additional mitigation will be necessary to protect them, provided that all karst protection requirements outlined in the BCCP are fully implemented.

The Regional Permit requires protection of 36 endangered species caves and 26 additional caves that support SOC, for a total of 62 karst features (60 caves, one mine and one karst spring). Several of these karst features occur in clusters, identified in the Regional Permit's associated Habitat Conservation Plan/Environmental Impact Statement (HCP/EIS) as the Four Points, McNeil, and Northwood cave clusters (USFWS 1996b). As of Fiscal Year 2023, (FY23), 52 of the 62 BCCP karst features have some form of formal protection on properties owned and managed by COA, TC, and BCCP partners, Texas Cave Management Association (TCMA), as well as private mitigation lands.

Table 1. Federally Listed Karst Species Covered by the BCCP
Footnotes follow table.

Common Name	Scientific Name
Tooth Cave pseudoscorpion	*Tartarocreagris texana*
Tooth Cave spider	*Tayshaneta myopica*[1]
Tooth Cave ground beetle	*Rhadine persephone*
Kretschmarr Cave mold beetle	*Texamaurops reddelli*
Bee Creek Cave harvestman	*Texella reddelli*
Bone Cave harvestman	*Texella reyesi*

[1] *Tayshaneta myopica* is listed in the regional permit as *Neoleptoneta myopica*, but a 2012 study revised the genus *Neoleptoneta,* thus identifying this species in the genus *Tayshaneta* (Campbell et al. 2012).

Table 2. Karst Species of Concern Covered by the BCCP
Footnotes follow table.

Common Name	Scientific Name
Flatworm	*Sphalloplana mohri*
Ostracod	*Candona* sp. nr. *stagnalis*
Isopod	*Caecidotea reddelli*
Isopod	*Trichoniscinae N. S.*
Isopod	*Miktoniscus N. S.*
Spider	*Cicurina bandida*
Spider	*Cicurina cueva*
Spider	*Cicurina ellioti*
Spider	*Cicurina reddelli*
Spider	*Cicurina reyesi*
Spider	*Cicurina travisae*
Spider	*Cicurina wartoni*
Spider	*Tayshaneta concinna*[1]
Spider	*Tayshaneta devia*[1]
Spider	*Eidmannella reclusa*
Pseudoscorpion	*Aphrastochthonius* N. S.
Pseudoscorpion	*Tartarocreagris comanche*[2]
Pseudoscorpion	*Tartarocreagris reddelli*
Pseudoscorpion	*Tartarocreagris intermedia*
Pseudoscorpion	*Tartarocreagris* N. S. 3
Harvestman	*Texella spinoperca*
Millipede	*Speodesmus* N. S
Ground Beetle	*Rhadine s. subterranea*
Ground Beetle	*Rhadine s. mitchelli*
Ground Beetle	*Rhadine austinica*

[1] *Tayshaneta concinna* and *Tayshaneta devia* are listed in the regional permit with the genus *Neoleptoneta*, but a 2012 study revised the genus *Neoleptoneta,* thus identifying these species in the genus *Tayshaneta* (Campbell et al. 2012).
[2] *Tartarocreagris comanche* is improperly listed in the regional permit as the New Comanche Trail Cave harvestman.

2.0 CAVE MANAGEMENT SUMMARY

This annual report covers the fiscal year 10/01/22 - 9/30/23 (FY23). In FY23, the BCCP partners continued efforts to determine and track the status of the 62 karst features covered by the BCCP 10(a) permit. The permit holders continued efforts to acquire, protect, and monitor the karst species in the caves included in the Permit (see Tables 3 and 5 for species localities).

Of the 62 BCCP permit caves, a total of 24 are still in the hands of private landowners and 38 are formally protected on the BCP. Of the 24 that are privately owned, four caves (Cave X, Cold Cave, Pennie's, and Pipeline) have protection agreements that include development setbacks from the cave entrance. TC BCP also conducts species monitoring for the privately owned Cold Cave for the Preston Oaks HOA. As of May 4, 2021, the City of Austin BCP finalized a Cave Management Agreement with TCMA, this agreement spells out the responsibilities of both parties for managing, monitoring and protecting Lost Oasis and Whirlpool Caves. Also, in February 2020, AW BCP purchased the 4.7-acre lot that encompasses most of Whirlpool Cave, including the Travis County Room. This brings the total to 52 caves that are afforded some level of protection or monitoring, and 10 (Armadillo Ranch Cave, Bandit Cave, Bee Creek Cave, Ceiling Slot, Fossil Garden Cave, Hole-In-The-Road Cave, Jacks Joint, McNeil Bat Cave, Lost Gold Cave, and Moss Pit) that are still unprotected, and it is unclear what management activities are conducted, if any at these nine caves. Lost Gold Cave had development setbacks but is considered unprotected and negatively impacted since the owner has removed the buffer fencing, cleared vegetation in the surface catchment area, and installed infrastructure within the surface catchment area years ago and was granted an administrative variance by the City Environmental Officer to allow these negative impacts to remain in place and so therefore, the cave will not be restored.

It should be noted that some of these protected caves only have protected entrances but could be threatened by surrounding development or planned development. The 48 BCCP caves that are formally part of the BCP are currently managed as follows: 22 caves protected and managed to some extent as part of the BCP on COA land; one cave protected on the Texas Nature Conservancy (TNC) land; two caves protected on combined TCMA/COA land; 15 caves protected as part of the BCP on TC land; eight caves protected as part of private Section 10(a) or Section 7 agreements with USFWS. Ownership and protection status of each of the 62 BCCP caves is detailed in Table 7.

The monitoring and management of BCCP permit caves entails annual, biannual, or quarterly faunal surveys for all caves with ES or SOC species. Red-imported fire ant (RIFA) treatments are performed at various times of the year for caves that have RIFA infestations.

In addition to protecting and monitoring caves covered by the BCCP permit, COA and TC also provide protection for other karst features found on the BCP containing ES and SOC (Tables 4 and 6). Some of these additional karst features are incorporated into TC and COA's shared biological monitoring program, as described in Section 6.0. As of FY23, 15 endangered species karst features which were not listed on the BCCP permit are being protected on BCP lands (six features on TC BCP; nine features on COA BCP; Table 4). Additionally, 25 SOC karst features not listed on the Permit are also being protected on BCP lands (eleven features on TC BCP; fourteen features on COA BCP; Table 6).

To assist with analyzing the adequacy of the current preserve design for each karst feature, including the amount of surface and subsurface habitat needed to support these ecosystems, the COA and TC have been working together to maintain a comprehensive database for the 62 features and other features identified within the BCP since the regional permit was issued in 1996. The database also incorporates monitoring data and management issues for each karst feature. The karst database is discussed in more detail in Section 5.0.

Table 3. Endangered Karst Invertebrate Locations within BCCP caves of Travis County, Texas

This table, originally in the BCCP 1996 documents, has been revised to show new species location information. *Key and footnotes follow table.*

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion *Tartarocreagris texana*	Tooth Cave Spider *Tayshaneta myopica*	Tooth Cave Ground Beetle *Rhadine persephone*	Kretschmarr Cave Mold Beetle *Texamaurops reddelli*	Bee Creek Cave Harvestman *Texella reddelli*	Bone Cave Harvestman *Texella reyesi*
Amber Cave	BCP Jollyville/ TC	Jollyville Plateau	X 1996		X 2010 (Reddell)	X 1996		
Bandit Cave	Private	Rollingwood					P 1996 X 2009	
Beard Ranch Cave	BCP Ivanhoe/COA	Jollyville Plateau						X 1996
Bee Creek Cave	Private	Rollingwood					X 1996	
Broken Arrow Cave	BCP Lime Creek Preserve/COA	Cedar Park			X 1996			
Cold Cave	Private	McNeil/Round Rock						X 1996
Cotterell Cave	BCP Spicewood Springs Park/COA	Central Austin						X 1996
Disbelievers Cave	BCP Private 10(a)	Jollyville			X 1996			
Eluvial Cave	BCP Private 10(a)	Jollyville						X 1996
Fossil Cave	BCP Schroeter Park/COA	McNeil/Round Rock						X 1996
Fossil Garden Cave	Private	McNeil/Round Rock						X 1996
Gallifer Cave	BCP Jollyville/TC	Jollyville Plateau		P 1996 X 2010 (Ledford)	P 1996 X 2005	X 2009 (Chandler)		X 1996
Hole-in-the-Road Cave	Private	McNeil/Round Rock						X 1996
Japygid Cave	BCP Private 10(a)	Jollyville			X 1996	P 1996 X 2005		
Jest John Cave	BCP Forest Ridge/COA	Jollyville Plateau					X 1996 Delete X 2017 (Ubick)	X 2017 (Ubick)

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion *Tartarocreagris texana*	Tooth Cave Spider *Tayshaneta myopica*	Tooth Cave Ground Beetle *Rhadine persephone*	Kretschmarr Cave Mold Beetle *Texamaurops reddelli*	Bee Creek Cave Harvestman *Texella reddelli*	Bone Cave Harvestman *Texella reyesi*
Jester Estates Cave	BCP Forest Ridge/COA	Jollyville Plateau	X 2008 (Cokendolpher)	X 2010 (Ledford)			X 1996	
Jollyville Plateau Cave	BCP Private 10(a)	Jollyville			X 1996			X 1996
Kretschmarr Cave	BCP Jollyville/TC	Jollyville Plateau			X 1996	X 1996		
Kretschmarr Double Pit	BCP Jollyville/TC	Jollyville Plateau	P 1996 X 2005		P 1996 X 2005	X 2016 (Reddell)		
Lamm Cave	Private Section 7	Jollyville Plateau			X 1996			
Little Bee Creek Cave	BCP Ullrich WTP/COA	Rollingwood					X 1996	
McDonald Cave	BCP Jollyville/TC	Jollyville Plateau						X 1996
McNeil Bat Cave	Private	McNeil/Round Rock		X 2010 (Ledford)				X 1996
M.W.A. Cave	BCP Private 10(a)	Jollyville	P 1996 X 2005		X 1996	P 1996 X 2005		X 1996
New Comanche Trail Cave	BCP Lake Travis/TC	Jollyville Plateau		X 1996				X 1996
No Rent Cave	BCP McNeil/TC	McNeil/Round Rock						X 1996
North Root Cave	BCP Jollyville/TC	Jollyville Plateau			X 1996			X 2017 (Ubick)
Pickle Pit Cave	Private Section 7	Jollyville Plateau						X 2018 (USFWS)
Rolling Rock Cave	BCP Lime Creek Preserve/ COA Sec.10(a)	Cedar Park			X 1996			
Root Cave	BCP Jollyville/TC	Jollyville Plateau		X 2010 (Ledford)	X 1996			X 1996

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion *Tartarocreagris texana*	Tooth Cave Spider *Tayshaneta myopica*	Tooth Cave Ground Beetle *Rhadine persephone*	Kretschmarr Cave Mold Beetle *Texamaurops reddelli*	Bee Creek Cave Harvestman *Texella reddelli*	Bone Cave Harvestman *Texella reyesi*
Spider Cave	BCP Park West/COA	Jollyville Plateau			X 2004 (Reddell)		X 2004 (Reddell)	
Stark's North Mine Cave	BCP Stark's/TC	Not within a KFR					X 2009 (USFWS)	
Stovepipe Cave	BCP Canyon Creek/ COA	Jollyville Plateau		X 2009 Delete X 2018 (USFWS)	X 1996	X 1996		P 1996 X 2009 (USFWS)
Tardus Hole	BCP Jollyville/TC	Jollyville Plateau			X 1996	X 2009 (Chandler)		
Tooth Cave	BCP Jollyville/TC	Jollyville Plateau	X 1996	X 1996	X 1996	X 1996		X 1996
Weldon Cave	BCP McNeil/TC	McNeil/Round Rock						X 1996

Sources: BCCP Permit 1996; Elliott 1992; Reddell 2004,2005, 2010, 2016; HNTB 2005; USFWS 1994, 2009a, 2009b, 2009c; Ledford 2010, Ubick 2017.

Key and Footnotes

X 1996 = confirmed occurrence based on collected specimen, the designation in the 1996 BCCP permit
P 1996 = probable occurrence based on observation but not confirmed with collected specimen; the designation in 1996 BCCP permit
X 2004 (Reddell) = confirmed by J. Reddell (pers. comm 2004)
X 2005 = was listed as confirmed in the HNTB summary of James Reddell's data, 2005 report for USFWS
X 2008 = Cokendolpher (pers. comm 2008) confirmed that Jester Estates Cave is a new site for *Tartarocreagris texana*, as also reported in USFWS 2009b.
X 2009 = USFWS – according to the 2009 5-year review on *Texella reyesi* the report lists *T. reyesi* as confirmed for Stovepipe Cave (USFWS 2009a); *Texella reddelli* 5-year review confirms *T. reddelli* for Stark's North Mine (USFWS 2009c); *Neoleptoneta myopica* 5-year review confirms this species for Stovepipe Cave (USFWS 2009b).
X 2009 (Chandler) = confirmed by D. Chandler, as reported in USFWS 5-year review (2009b).
X 2010 (Ledford) = confirmed by J. Ledford (pers. comm 2010)
X 2010 (Reddell) = confirmed by J. Reddell (pers. comm 2010)
X 2016 (Reddell) = confirmed by J. Reddell (pers. comm 2016)
Delete X 2017 (Ubick) = *T. reddelli* was accidentally listed as occurring in this cave, the species is actually *T. reyesi* (personal communication Ubick 2017)
X 2017 (Ubick) = confirmed by D. Ubick (pers. comm 2017)
X 2018 (USFWS) = according to the 2018 5-year review on *Texella reyesi* the report list *T. reyesi* as confirmed for Pickle Pit Cave (USFWS 2018)
Delete X 2018 (USFWS) = according to the 2018 5-year review on *Tayshaneta myopica* the report list *T. devia* as confirmed for Stovepipe Cave (USFWS 2018)

Table 4. Non-BCCP listed Caves/Karst Features with Listed Invertebrates Protected on BCP

Key follows table.

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion *Tartarocreagris texana*	Tooth Cave Spider *Tayshaneta myopica*	Tooth Cave Ground Beetle *Rhadine persephone*	Kretschmarr Cave Mold Beetle *Texamaurops reddelli*	Bee Creek Cave Harvestman *Texella reddelli*	Bone Cave Harvestman *Texella reyesi*
Black-cap Cave	COA	Jollyville Plateau		P				X 2021
Cortana Cave	COA	Jollyville Plateau		X 2010				X 2008
Down Dip Sink	COA	Jollyville Plateau			X 2007a			
Garden Hoe Cave	COA	Jollyville Plateau			X 2007b			
Gaping Maw	COA	Jollyville Plateau			P			P
Geode Cave	TC	Jollyville Plateau		X 2008	X 2008			X 2008
Hammett's Cave	Westcave	Pedernales					X 2021	
IV-3	COA	Jollyville Plateau						X 2018a
LU-11	TC	Jollyville Plateau		X 2008				
LU-12	TC	Jollyville Plateau						X 2008
Little Black Hole	COA	Rollingwood					X 2009c	
Persephone Caverns	COA	Jollyville Plateau			P	P		P
Pond Party Pit	COA	Jollyville Plateau			X 2016			X 2010

Cave Name	Current Preserve Status	Karst Fauna Region	Tooth Cave Pseudoscorpion *Tartarocreagris texana*	Tooth Cave Spider *Tayshaneta myopica*	Tooth Cave Ground Beetle *Rhadine persephone*	Kretschmarr Cave Mold Beetle *Texamaurops reddelli*	Bee Creek Cave Harvestman *Texella reddelli*	Bone Cave Harvestman *Texella reyesi*
RI-1	TC	Jollyville Plateau					X 2010	
Tight Pit Cave	TC	Jollyville Plateau		X 2010				
Two Trunks Cave	TC	Jollyville Plateau			X 2008 (USFWS)			

Sources: Reddell 2016; USFWS 2008, 2009c; Zara Environmental 2007a, 2007b, 2008, and 2010 and Ubick 2021.
X 2018 (USFWS) = according to the 2018 5-year review on *Texella reyesi*
Key: X = confirmed occurrence based on collected specimen
P = probable location based on proximity to other known sites and being within the known range of the species.

Table 5. Karst Invertebrate SOC within BCCP Caves, Travis County, Texas[1,2]

Key and footnotes follow table.

Cave Name	*Aphrastochithonius N.S.*	*Caecidotea reddelli*	*Candona sp. nr. stagnalis*	*Cicurina bandida*[3]	*Cicurina travisae*[4]	*Cicurina sp.*[5]	*Eidmannella reclusa*	*Miktoniscus N.S.*	*Tayshaneta concinna*	*Tayshaneta devia*	*Rhadine austinica*	*Rhadine s. subterranea*	*Rhadine s. mitchelli*	*Speodesmus N.S.*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Tartarocreagris intermedia*	*Tartarocreagris N.S. 3*	*Texella spinoperca*	*Trichoniscinae N.S.*
Adobe Springs Cave						X														
Airmen's Cave				X							X						X		X	
Amber Cave					X								X							
Armadillo Ranch Sink		X																		
Arrow Cave				X							X									
Bandit Cave				X							X									X
Beard Ranch Cave					X															
Bee Creek Cave				X							X									
Blowing Sink Cave				X							X									
Broken Arrow Cave																				
Buda Boulder Spring		X																		
Cave X		X	X	X				X			X			X						
Cave Y				X							X									
Ceiling Slot Cave						X														
Cold Cave						X						X								

Cave Name	*Aphrastochithonius N.S.*	*Caecidotea reddelli*	*Candona sp. nr. stagnalis*	*Cicurina bandida* [3]	*Cicurina travisae* [4]	*Cicurina sp.* [5]	*Eidmannella reclusa*	*Miktoniscus N.S.*	*Tayshaneta concinna*	*Tayshaneta devia*	*Rhadine austinica*	*Rhadine s. subterranea*	*Rhadine s. mitchelli*	*Speodesmus N.S.*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Tartarocreagris intermedia*	*Tartarocreagris N.S. 3*	*Texella spinoperca*	*Trichoniscinae N.S.*
Cotterell Cave					X							X								
Disbelievers Cave						X														
District Park Cave				X							X									
Eluvial Cave																				
Flint Ridge Cave				X							X									
Fossil Cave												X								
Fossil Garden Cave						X						X								
Gallifer Cave					X															
Get Down Cave				X							X									
Goat Cave				X										X						
Hole-in-the-Road Cave						X														
Ireland's Cave				X							X									
Jack's Joint		X				X														
Japygid Cave																				
Jest John Cave					X															
Jester Estates Cave					X							X								

Cave Name	*Aphrastochithonius N.S.*	*Caecidotea reddelli*	*Candona sp. nr. stagnalis*	*Cicurina bandida* [3]	*Cicurina travisae* [4]	*Cicurina sp.* [5]	*Eidmannella reclusa*	*Miktoniscus N.S.*	*Tayshaneta concinna*	*Tayshaneta devia*	*Rhadine austinica*	*Rhadine s. subterranea*	*Rhadine s. mitchelli*	*Speodesmus N.S.*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Tartarocreagris intermedia*	*Tartarocreagris N.S. 3*	*Texella spinoperca*	*Trichoniscinae N.S.*
Jollyville Plateau Cave																				
Kretschmarr Cave					X								X							
Kretschmarr Double Pit					X															
Lamm Cave																				
Little Bee Creek Cave				X							X									
Lost Gold Cave				X					X		X									
Lost Oasis Cave				X							X									
M.W.A. Cave																		X		
Maple Run Cave				X							X									
McDonald Cave					X					X										
McNeil Bat Cave												X								
Midnight Cave				X							X									
Moss Pit																				
New Comanche Trail Cave					X		X									X				
No Rent Cave	P					X						X								
North Root Cave					X															

Cave Name	*Aphrastochithonius N.S.*	*Caecidotea reddelli*	*Candona sp. nr. stagnalis*	*Cicurina bandida* [3]	*Cicurina travisae* [4]	*Cicurina sp.* [5]	*Eidmannella reclusa*	*Miktoniscus N.S.*	*Tayshaneta concinna*	*Tayshaneta devia*	*Rhadine austinica*	*Rhadine s. subterranea*	*Rhadine s. mitchelli*	*Speodesmus N.S.*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Tartarocreagris intermedia*	*Tartarocreagris N.S. 3*	*Texella spinoperca*	*Trichoniscinae N.S.*
Pennie's Cave				X							X			X						
Pickle Pit					X															
Pipeline Cave				X										X						
Rolling Rock Cave						X								X						
Root Cave					X															
Slaughter Creek Cave				X																
Spanish Wells Cave		X				X									X					
Spider Cave					X		X													
Stark's North Mine									X											
Stovepipe Cave	X				X		X			X										
Talus Springs Cave																				
Tardus Hole																				
Tooth Cave					X		X						X							
Weldon Cave	X					X						X								
Whirlpool Cave				X							X									

Sources: Elliot 1997, Paquin and Hedin 2005, Paquin et al. 2008, TMM 2007, Zara Environmental 2008, 2010, Ledford et al. 2012, Hedin 2015, Reddell 2016, Hedin 2022.

Key and Footnotes

X = confirmed location based on collected specimen.

[1] *Cicurina ellioti* listed as an SOC in the regional permit is not included in this table because this species has now been synonymized with *Cicurina buwata*, a non-SOC (Cokendolpher 2004).

[2] *Tartarocreagris reddelli* listed as a SOC in the regional permit is not included in this table because this species has now been synonymized with *Tartarocreagris infernalis*, a non-SOC (Muchmore 2001).

[3] Occurrences of *Cicurina bandida* include localities formerly listed as *Cicurina cueva* and *Cicurina reyesi*, which have been formally grouped together into the single species *C. bandida* (Paquin et al. 2008).

[4] Occurrences of *Cicurina travisae* include localities formerly listed as *Cicurina reddelli* and *Cicurina wartoni*, which have been formally grouped together into the single species *C. travisae* (Hedin 2015).

[5] Localities of possible SOCs; blind *Cicurina* specimens not yet confirmed to species level.

Table 6. Non-BCCP Caves/Karst Features with Karst SOC Protected on BCP[1,2]

Key and footnotes follow table.

Cave Name	BCP Owner	*Aphrastochithonius N.S.*	*Caecidotea reddelli*	*Candona sp. nr. Stagnalis*	*Cicurina bandida* [3]	*Cicurina travisae* [4]	*Cicurina sp.* [5]	*Eidmannella reclusa*	*Miktoniscus N.S.*	*Tayshaneta concinna*	*Tayshaneta devia*	*Rhadine austinica*	*Rhadine s. l5ubterranean*	*Rhadine s. mitchelli*	*Speodesmus N.S.*	*Sphalloplana mohri*	*Tartarocreagris attenuata*	*Tartarocreagris comanche*	*Tartarocreagris intermedia*	*Tartarocreagris N.S. 3*	*Texella spinoperca*	*Trichoniscinae N.S.*
Artificial Intelligence Cave	TC						X															
Black-cap Cave	COA						X	P														
Brewpot Cave	TC										X											
Caverns of Sweet Nora	COA						X															
Cedar Chopper Cave	TC						X															
Cortana Cave	COA						X															
Devil's Lair Cave	TC						X															
Down Dip Cave	COA						X															
Gaping Maw	COA						X				P		P				P					
Flying Kave	TC						X															
Geode Cave	TC					X		X														
Hammett's Cave	Westcave						X															
Hoskin's Cave	COA				X																	
IV-3	COA					X																

Cave Name	BCP Owner	*Aphrastochithonius N.S.*	*Caecidotea reddelli*	*Candona sp. nr. Stagnalis*	*Cicurina bandida* [3]	*Cicurina travisae* [4]	*Cicurina sp.* [5]	*Eidmannella reclusa*	*Miktoniscus N.S.*	*Tayshaneta concinna*	*Tayshaneta devia*	*Rhadine austinica*	*Rhadine s. 15subterranean*	*Rhadine s. mitchelli*	*Speodesmus N.S.*	*Sphalloplana mohri*	*Tartarocreagris attenuata*	*Tartarocreagris comanche*	*Tartarocreagris intermedia*	*Tartarocreagris N.S. 3*	*Texella spinoperca*	*Trichoniscinae N.S.*
LU-29	TC						X															
McMac Cave	TC						X															
Millennium Cave	COA				X																	
Persephone Caverns	COA					P	X	P					P				P					
Pond Party Pit	COA					X							X									
RI-1	TC						X															
RI-3	TC						X															
Sacred Grove	COA					P																
Siebert Sink	COA				X					X											X	
Two Trunks Cave	TC					X																
Wyoaka Cave	COA				X																	
Y2 Cave	COA				X																	

Sources: Bayless pers. comm 2013, Paquin and Hedin 2005, Sanders pers. comm 2013, TMM 2007, Zara Environmental 2008, 2010, Hedin 2015, Reddell 2016, Hedin 2022.

Key and Footnotes

X = confirmed location based on collected specimen.

P = probable location based on proximity to other known sites and being within the known range of the species.

[1] *Cicurina ellioti* listed as an SOC in the regional permit is not included in this table because this species has now been synonymized with *Cicurina buwata*, a non-SOC (Cokendolpher 2004).

[2] *Tartarocreagris reddelli* listed as a SOC in the regional permit is not included in this table because this species has now been synonymized with *Tartarocreagris infernalis*, a non-SOC (Muchmore 2001).

[3] Occurrences of *Cicurina bandida* include localities formerly listed as *Cicurina cueva* and *Cicurina reyesi*, which have been formally grouped together into the single species *C. bandida* (Paquin et al. 2008).
[4] Occurrences of *Cicurina travisae* include localities formerly listed as *Cicurina reddelli* and *Cicurina wartoni*, which have been formally grouped together into the single species *C. travisae* (Hedin 2015).
[5]Localities of possible SOCs; blind *Cicurina* specimens not yet confirmed to species level.

3.0 OWNERSHIP AND PROTECTION STATUS

Many karst features listed in the BCCP permit have adequate protection, based on the criteria outlined in USFWS's *Karst Preserve Design Recommendations* (USFWS 2012). However, some of the caves listed in Table 7 as protected may not be adequately protected as defined in USFWS (2012). Efforts are being made by the BCCP Permit Holders to contact owners of privately owned caves to assess their protection efforts and to assist them with protection where possible.

Though not specifically required in the BCCP permit, the updated USFWS karst preserve design recommendations direct that the protected area surrounding the cave should be at least 16–40 ha (40-99 acres) in size to capture most of the plant and animal community elements needed to support the karst ecosystem, as well as protect the cave footprint and surface/subsurface drainage basins of the cave (USFWS 2014a). Some caves within the BCP meet or exceed these recommendations, while others do not due to conditions that existed before the Permit was issued, such as pre-existing development in the form of subdivisions, roads, power lines, petroleum lines, and sewer lines that preclude complete protection of the recommended preserve areas. BCCP Permit Holders will continue to do what is reasonable to protect these features from pre-existing development and continue efforts to acquire and protect the karst features listed in the BCCP permit.

Per BCCP Permit Conditions S2 and T2, if new karst features "are discovered with a significant diversity of troglobitic fauna, those karst features may be submitted to the Service for consideration for exchange with karst features identified for protection by the BCCP" (USFWS 1996a). In order to allow the Permit holders to implement these Permit conditions, COA and TC created a Cave Substitution Policy that provides a process that allows caves listed in the BCCP permit to be substituted with other suitable caves in a manner that is transparent, science based, and consistent with the vision and intent established for the BCCP. This policy includes a definition of "significant diversity of troglobitic fauna" as it applies to eligibility of a cave for substitution and determines parameters that quantify preservation of environmental integrity for BCCP-listed caves and candidate substitution caves as it applies to management of caves. These defined criteria will be used in determining both the need to substitute a feature listed on the Permit as well as whether the substitution cave will adequately replace the previously identified BCCP cave or caves. The BCCP Cave Substitution Policy was adopted by the BCCP Coordinating Committee in August 2015.

Karst Preserve Management

Karst preserves, even those pre-existing at the time containing permit caves, were not specified in the HCP/EIS. Karst preserves were directed to be created for the 62 listed karst features in the governing documents that generally include the water sources to the caves (surface and subsurface catchment areas) and other management areas.

Twelve of the 62 caves lie on City of Austin property that is managed by Austin Parks & Recreation Department (PARD). An interdepartmental management agreement between PARD and AW that specifies management activities of BCP land management plans are in progress. The dual management sites include Bull Creek District Park and Greenbelt, St. Edward's Park, Barrow Preserve, Commons Ford Park, Shoal Creek Greenbelt (Buda Boulder Spring); Barton Creek Wilderness Area and Greenbelt (Airmen's Cave and Cave Y), Mt. Bonnell, Blowing Sink Research Management Unit now renamed William H. Russell Karst Preserve (Blowing Sink Cave), Stillhouse Hollow Nature Preserve (Cotterell Cave), Goat Cave Karst Nature Preserve (Goat Cave and Maple Run Cave); Dick Nichols District Park (District Park Cave); Circle C Ranch on Slaughter Creek (Midnight Cave, Arrow Cave, and Slaughter Creek Caves); and Hubert C. Schroeter Neighborhood Park (Fossil Cave). This agreement would allow AW BCP to conduct necessary restoration and cave management, to provide adequate protection for the sites, fence as necessary to protect the preserve, find and restore non-BCCP permit caves for potential substitution of impacted permit caves, and eliminate toxic chemical application in sensitive water source areas.

William H. Russell Karst Preserve

While Blowing Sink Cave is the deepest cave on the BCCP permit, extending 240 ft to the water table, it has been obstructed since October 2013. The entire preserve contains surface and/or subsurface catchment area for Blowing Sink Cave. This preserve is currently managed by Austin Nature Preserves of Austin Parks and Recreation Department. There is no formal interdepartmental agreement yet that would allow dual management and restoration by AW BCP. In February 2020, a Tier III Management Plan was produced for the newly renamed William H. Russell Karst Preserve by AW BCP and Austin Nature Preserves Division of Austin Parks & Recreation Department. While the land management plan specifies the required management work, the interdepartmental agreement specifies which department is responsible for and empowered to accomplish the management tasks.

Village at Western Oaks Karst Preserve and Watershed Management Area

The Village at Western Oaks Karst Preserve and Watershed Management Area (VWO Karst Preserve) contains Get Down Cave, which is a BCCP permit cave, was acquired by the City

of Austin in June 2016 under Watershed Protection Department management. An interdepartmental agreement in July 2018 delegated AW BCP with management of the karst preserve and Watershed Protection responsibility for the water quality ponds and Millennium Cave, a non-permit education cave that underlies one pond.

The preserve has public trails maintained by the Village at Western Oaks Homeowners Association, including trash removal, pet waste bags, and trail maintenance. A formal agreement between VWOHOA and AW BCP was drafted in FY21 and is expected completed in FY24 along with a Tier III management plan.

A Friends of the Preserve group was started by neighbor Stephanie Simmons, which participates in public education of preserve sensitivity through a Facebook page. The Friends educate neighbors on alternatives to pesticides, including the use of boiling water to suppress red imported fire ants, the benefits of increasing our tree canopy, and use of native plants, along with information on endangered songbirds and karst invertebrate ecosystems. They also notify and facilitate events, including neighborhood cave tours, Tree Folks planting, Native Plant Giveaways, Boy Scout projects, and others.

Karst Preserve Friends FY23 Activities

- TREES! Replacing the tree canopy loss with a variety of wildlife habitat focused native tree species is now a top priority for Karst Preserve Friends' activities.
    - Winter storm Mara in February 2023 compounded the amount of tree canopy loss that was caused by winter storm Uri in February 2021.
    - The prolonged drought and extreme heat of 2023 has taken an even greater toll on the remaining trees than the extreme drought of 2011.

- Our 8th Annual **"Texas Most Wanted: Invasive Plant Buy-Back & Native Plant Swap"** event was held the weekend of March 18th-19th, 2023.
    - TreeFolks.org donated many native tree sapling species and several 5-gal cedar elms to the swap and for planting within the Karst Preserve.
    - Author of *Wanted! Mountain Cedars, Dead and Alive* and executive director of Project Bedrock, Elizabeth McGreevy, attended on Saturday to discuss karst soil issues and nature-based solutions with attendees (www.ProjectBedrockTX.org).
    - Sunday, we had terrific weather for Cliff Tyllick, the 'Grim Reaper of Ligustrums' in Austin, to provide a Ligustrum Girdling Workshop.
    - Visitors of ALL ages learned about the Bluebonnet seed cycle and took home a wide variety of central Texas native plants for FREE!

- Our 4th Annual **"Texas Arbor Day"** event was held on November 4th, 2023.

- This year's event was part of the City of Austin's Roots & Wings Festival!
- TreeFolks.org provided 30 5-gallon native Texas trees; 26 were distributed to neighborhood attendees and 4 were planted at the trailhead.
- Visitors were encouraged to walk the trail and see the totality of tree canopy loss in the last decade to highlight how important annual tree planting and quality tree care are to keeping our water supply clean and our neighborhoods cool!

Whirlpool Karst Preserve

Whirlpool Cave is the third largest cave of the 62 permit caves and has historically been used in public education. In FY21, AW BCP and TCMA approved a formal management agreement for Whirlpool, Lost Oasis, and Avery Ranch (non-BCCP permit education) Caves on May 4, 2021.

Whirlpool Cave is managed by Liz Herren on behalf of TCMA. In May 2021, a drip gauge was installed under active drip formations as part of a hydrogeological studies. Continuous measurement of carbon dioxide, temperature and barometric pressure are monitored in the East Cavern passage. Surface measurements of temperature and humidity at 3 ft height were installed on the surface in May 2021 to compare differences between grasslands and forests over the cave.

In February 2020, AW BCP acquired a 4.7-acre private lot that overlies the majority of Whirlpool Cave. Whirlpool Cave Preserve is now a formal BCP karst preserve (Figure 1). A Tier III management plan is expected to be created in FY24. Most of the South Cavern's passage lies outside the preserve in private homeowners' association. A future step will be to seek inclusion of about 200 ft in the preserve through easement, acquisition, or management agreement.

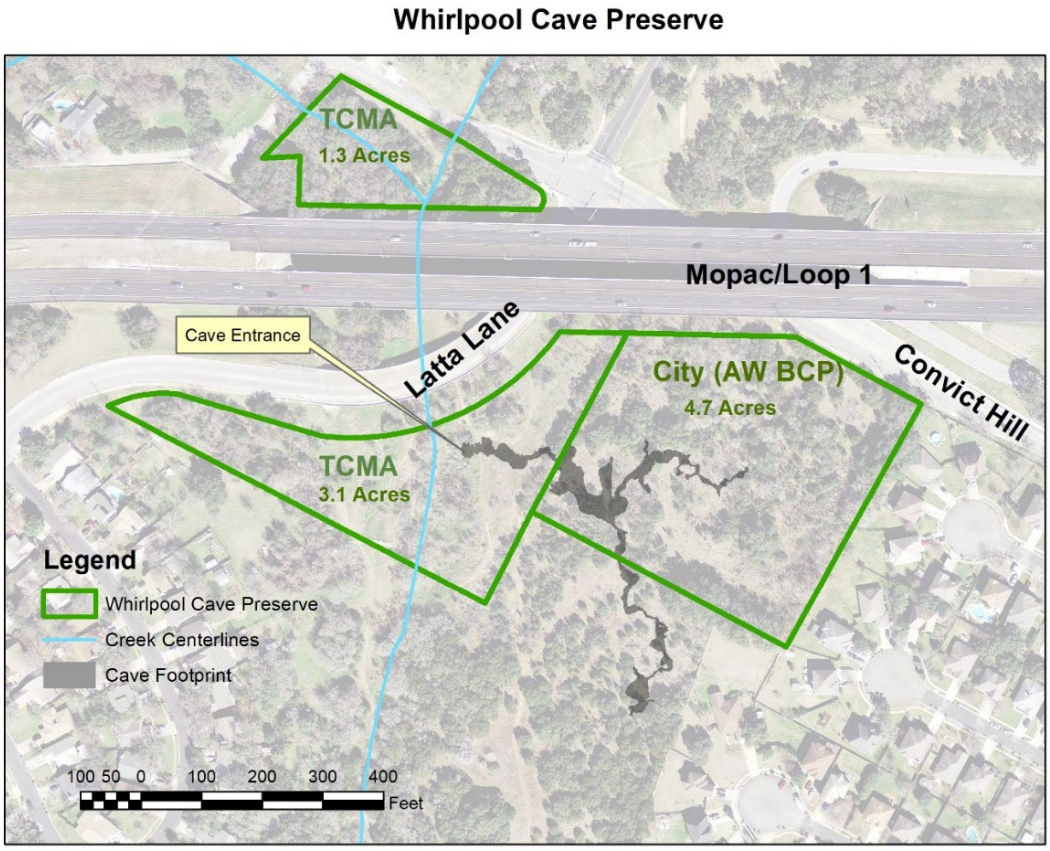


Figure 1. New lot acquired by AW BCP containing a large portion of Whirlpool Cave.

In FY22, AW BCP in collaboration with the Hill Country Conservancy (HCC), COA Public Works, and contract artist Barbara Attwell installed a cave mural along the Violet Crown Trail adjacent to Whirlpool Cave. HCC and COA Public Works installed more educational signs regarding caves in FY23. On April 1, 2023, HCC along with Austin City Council Member Paige Ellis, City of Austin's Public Works, and Austin Water held a Whirlpool Patio Ribbon Cutting Event, it was well received by the public. Whirlpool Patio Education Center

Lost Oasis Karst Preserve

Lost Oasis Cave Preserve is managed by Drew Thompson on behalf of TCMA and is adjacent to Tabor WQPL where Flint Ridge is located. A formal agreement for BCP management was created with TCMA, although the cave is currently being managed per Tier II Karst Land Management Plan with regular fire ant treatments, annual faunal surveys, visitor traffic counts, etc. Significant progress was made on the lead at the bottom of the cave in FY23 expanding the cave 15 ft farther in depth consisting of a proximately 20 ft of new passage with two small rooms. There is still strong airflow so work will continue in FY24. A significant amount of native revegetation was done on the property to encourage canopy regrowth to replace lost trees from the 2023 winter storm and to provide diverse nutrients for cave crickets and wildlife.

Four Points Private Karst Preserve

On February 27, 2019, AW and TC BCP staff met with representatives of the Four Points Preserves that contain four (Disbelievers, Eluvial, Japygid, and MWA Caves) of the 62 permit caves in a private karst preserve (Figure 2). BCP requested ownership and management responsibilities for the preserves. On September 13, 2019, representatives of the owner committed to transferring ownership after buildout of associated development and a certificate of occupancy is issued, which may take approximately 2 years. BCP has no data on what, if any, management has been occurring on this preserve or the status of the four permit caves, as this is reported directly to USFW. The transfer process was initiated in FY22, and the properties will be surveyed and hopefully COA BCP will take over ownership and management in FY24.

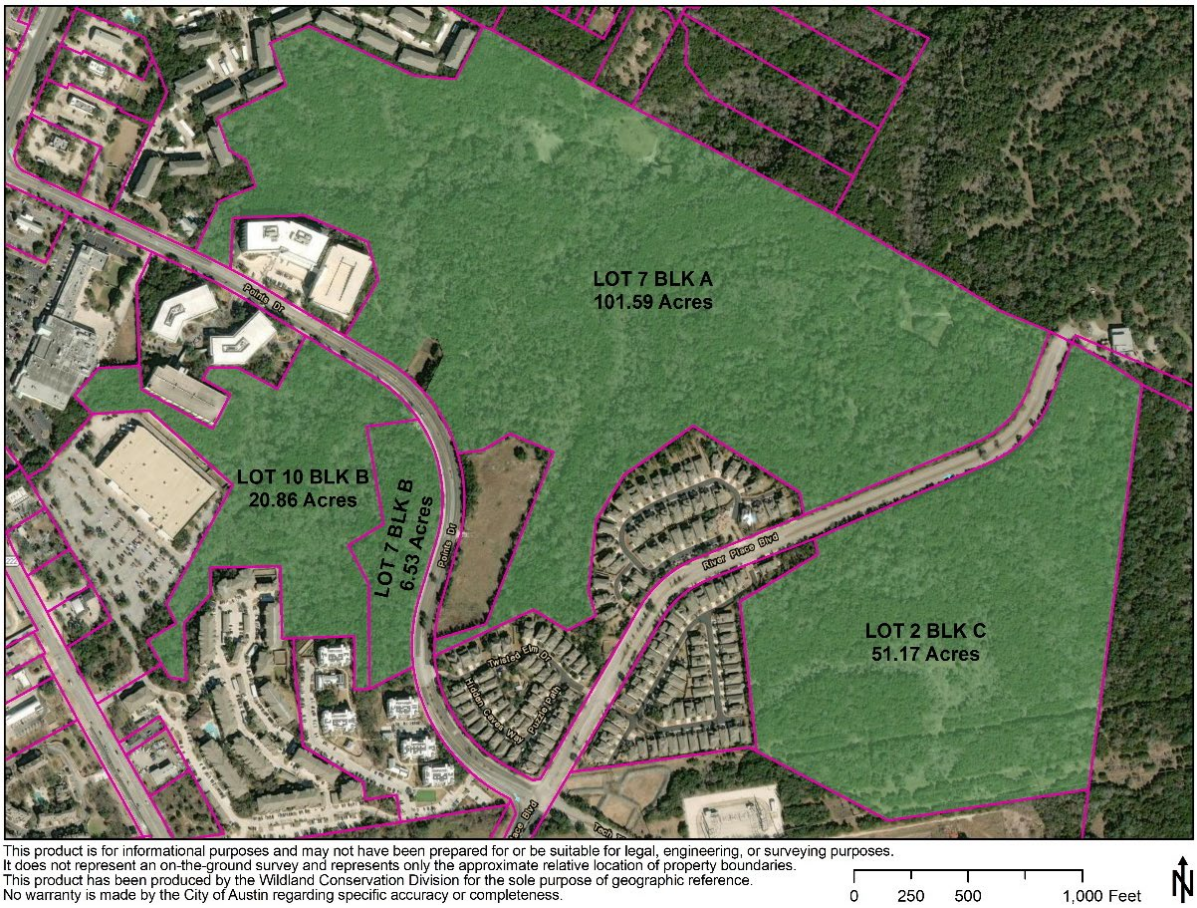


Figure 2. Four Points Preserve Map

In FY21, AW BCP utilized Section 7 conservation measures funding from TxDOT to develop formal karst preserves near FM 2222 and FM 620 by excavating previously unknown caves of ranch fill and extending the few previously known caves on Stovepipe (Canyon Creek), Cortaña, Park West, and Kent Butler preserves, as described in the Hydrological Studies and Cave Restoration section. The caves reveal new cave drip areas and creates habitat to enhance the preserves. Many of these karst areas are associated with springs which are also investigated for fauna and water quality/discharge rate.

Table 7. FY23 Ownership, protection, monitoring and access status of the 62 BCCP caves/karst features (36 caves with ES and 25 caves with SOC) [1, 2].

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Adobe Springs Cave	SOC	BCP/TNC	Fenced	Protected on preserve	TC bi-annual surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Airmen's Cave	SOC	BCP/COA	Gated	Protected on parkland Seeking access easement from overlying Brodie Oaks Mall.	COA quarterly surface monitoring; annual cave cricket exit counts; annual species monitoring Easement was granted from the pri landowner to the BCP for access (Appendices)	access by permit*
Amber Cave	ES	BCP/TC	Gated and fenced	Protected on preserve (very close to road and sewer line)	TC quarterly surface monitoring; red-imported fire ant (RIFA) survey control; annual species monitoring; annual cave cricket exit count	none
Armadillo Ranch Sink	SOC	Private		Private - Unknown		none
Arrow Cave	SOC	BCP/COA	Gated	Protected on parkland (There are nearby homes immediately south of the cave entrance).	COA quarterly surface monitoring; annual species monitoring	none
Bandit Cave	ES	Private	Gated	Private, current status is unknown, however, the cave is owned by an ecological concerned landowner.		none
Beard Ranch Cave	ES	BCP/COA		Protected on preserve	COA quarterly surface monitoring; annual faunal survey	none
Bee Creek Cave	ES	Private		Private- AW BCP inquired about purchasing in April 2021 but not interested i selling at this time.		none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Blowing Sink Cave	SOC	BCP/COA	Gated	Protected on preserve (200 acre preserve, but subsurface catchment extends more than a mile west). Lower half of the cave has been inaccessible since 2013. A Tier III plan was completed February 28, 2020.	COA monthly surface and annual species monitoring; RIFA control as needed	none
Broken Arrow Cave	ES	BCP/COA	Fenced	Protected on preserve	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; bi-annual RIFA control	none
Buda Boulder Spring	SOC	BCP/COA		Protected on parkland (close proximity to a hike and bike trail).	COA bi-annual surface monitoring; annual species monitoring.	none
Cave X	SOC	Private/COA Protection Agreement	Gated and fenced	Protected by landowner with 4.5-acre setbac to protect cave entrance. Protected to some extent (not actively managed and the setbac inadequate). Owner rejected COA offer on Sept. 19, 2017, to assist in cave management and monitoring. Regents built sports field within the Cave X buffer, over th footprint of the cave sometime between January 2018 and November 2019. WP approved Regents restoration plan in March 2023, the plan calls for revegetating the disturbed area with native shrubs and trees.	In the past, occasional species and surface monitoring by COA and SWCA. SWCA completed cave cricket exit counts in October 2015 and one partial cave faunal survey February 2016 as part of an agreement to allow for on site construction of a berm to reduce flooding concerns. It is unknown if further biological monitoring has been performed	none
Cave Y[1]	SOC	BCP/COA	Gated	Protected on parkland. .	COA quarterly surface monitoring, bi-annual species monitoring; bi-annual cave cricket exit counts; RIFA control as needed	none
Ceiling Slot Cave	SOC	Private		Private - Unknown		none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Cold Cave	ES	Private	Gated and fenced	Protected with a COA WPD agreement that includes development setbac from the cave entrance as well as setbacks for nearby caves located on the same property Lacks formal management agreement to ensure compliance.	TC bi-annual surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Cotterell Cave	ES	BCP/COA	Gated and fenced	Protected on parkland. (There are nearby homes immediately east of the cave entranc	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Disbelievers Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, hired Plateau Land & Wildlife Management		none
District Park Cave	SOC	BCP/COA	Gated	Protected on parkland.	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	1st room open past 1st room protected by gate, access by permit*
Eluvial Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, hired Plateau Land & Wildlife Management		none
Flint Ridge Cave	SOC	BCP/COA	Gated	Protected on Water Quality Protection Land (portions of the cave and its catchment area overlain by the newly constructed SH45 SW	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Fossil Cave	ES	BCP/COA	Access protected by large rocks	Protected on parkland. All caves in park are filled in and require restoration.	Exact location of cave is unknown COA quarterly surface monitoring features suspected to be Fossil Cav	none
Fossil Garden Cave	ES	Private		Private – Unknown		none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Gallifer Cave	ES	BCP/TC	Gated and fenced	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; RIFA survey/control; bi-annual species monitoring	none
Get Down Cave	SOC	BCP/COA	Gated and fenced	Protected on preserve	COA monthly surface monitoring; annual cave cricket exit count; annual species monitoring; RIFA control as needed	none
Goat Cave	SOC	BCP/COA	Fenced	Protected on parkland.	COA monthly surface monitoring; annual species monitoring; RIFA control as needed	access by permit*
Hole-in-the-Road	ES	Private		Private –Unknown. (very close to a major roadway)		none
Ireland's Cave	SOC	BCP/ TC	Gated and fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
Jack's Joint	SOC	Private		Private - Unknown		none
Japygid Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, managed by Plateau Land & Wildlife Management		none
Jest John Cave	ES	BCP/COA		Protected on preserve	COA annual cave cricket exit count; bi-annual surface monitoring	none
Jester Estates Cave	ES	BCP/COA	Gated and fenced	Protected on preserve (3.2 acre preserve surrounded by homes).	COA monthly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Jollyville Plateau Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, managed by Plateau Land & Wildlife Management		none
Kretschmarr Cave	ES	BCP/TC	Gated and fenced	Protected on preserve. Close to roadway and in power line ROW.	TC quarterly surface monitoring; RIFA survey/control; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Kretschmarr Double Pit	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
Lamm Cave	ES	BCP/Private Section 7	Gated and fenced	Protected with a COA WPD negotiated setback of approximately 150 ft from the entrance of the cave.	Occasional surface and species monitoring by COA and TC	none
Little Bee Creek Cave	ES	BCP/COA	Gated	Protected on preserve	COA quarterly surface monitoring; -annual cave cricket exit counts; bi-annual species monitoring	none
Lost Gold Cave	SOC	Private	Gated	Private – COA WPD had negotiated a small setback from future development. In FY19, silt-laden runoff from a new water well and playscape structures were found built in the buffer by City inspectors, due to these violations a stop order was in place on the w installation, City staff initially attempted to work with the landowner to remove the illega improvements and restore the site, however, the City Environmental Officer decided to gi property owner a variance which allows all the structures to remain and so therefore, the site will not be restored		none
Lost Oasis Cave	SOC	Private/ TCMA	Gated and fenced	Protected by TCMA. Formal management agreement with AW BCP to ensure permit compliance was signed on May 4, 2021	COA bi-annual cave cricket exit counts; bi-annual species monitorir RIFA control as needed	controlled access**

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
M.W.A. Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, managed by Plateau Land & Wildlife Management		
Maple Run Cave	SOC	BCP/COA	Gated	Protected on parkland.	COA monthly surface monitoring bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	access by permit*
McDonald Cave	ES	BCP /TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
McNeil Bat Cave	ES	Private		Private – Unknown (close proximity to high school)		none
Midnight Cave	SOC	BCP/COA	Fenced	Protected on parkland (close proximity to soccer fields).	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	access by permit*
Moss Pit	SOC	Private		Private – Unknown		none
New Comanche Trail Cave	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual cave cricket exit count; annual species monitoring	none
No Rent Cave	ES	BCP/TC	Gated and fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; quarterly cav cricket exit counts; quarterly specie monitoring	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
North Root Cave	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual specie monitoring	none
Pennie's Cave	SOC	Private		Protected with a COA WPD 300 ft. buffer around the cave entrance. Landowner had filled entrance but Zara re-excavated and gated the entrance in May 2008. Zara's Management report is attached in the Appendix	Zara Environmental annual species monitoring; Zara Environmental bi-annual RIFA surveys/control	none
Pickle Pit[4]	ES	BCP/Private Sec. 7	Gated	Protected by Section 7 permit.	TC/COA occasional species monitoring; sporadic surface inspections by concerned neighbor	none
Pipeline Cave	SOC	Private	Gated	Protected with a COA WPD setback around the cave entrance. A nearby petroleum pipelineexists. Lacks fo management agreement to ensure permit compliance. Permission granted for temporary access to allow for restoration, faunal surveys, and hydrogeological studies.	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Rolling Rock Cave	ES	BCP/COA	Fenced	Protected on preserve	COA quarterly surface and annual species monitoring; RIFA control as needed	none
Root Cave	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Slaughter Creek Cave	SOC	BCP/COA	Gated	Protected on parkland (Nearby homes are immediately south of cave entrance, and Mopac South excavation to cave level 500' east).	COA quarterly surface and annual species monitoring; RIFA control as needed.	none
Spanish Wells Cave	SOC	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; RIFA survey/control; bi-annual species monitoring	none
Spider Cave	ES	BCP/COA	Fenced	Protected on preserve	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Stark's North Mine[2]	ES	BCP/TC	Gated	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; RIFA survey/control; bi-annual species monitoring	none
Stovepipe Cave	ES	BCP/ COA	Fenced	Protected on preserve	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; RIFA control as needed	none
Talus Springs Cave[3]	N/A	BCP/Private Section 10(a)	Gated	Protected by Homeowners Association and TC, only has 50' setback from houses and is probably affected by uphill development.	TC bi-annual surface monitoring; RIFA survey/control; annual specie monitoring	none
Tardus Hole	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual specie monitoring	none
Tooth Cave	ES	BCP/TC	Gated and fenced	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; RIFA survey/control;	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
					bi-annual species monitoring	
Weldon Cave	ES	BCP/TC	Gated and fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; quarterly cav cricket exit counts; quarterly specie monitoring	none
Whirlpool Cave	SOC	Private/ TCMA	Gated	Protected by TCMA. Formal management agreement with AW BCP to ensure permit compliance was finalized a signed by all parties on May 4, 2021. On February 2020, AW BCP acquired a private lot that overlies much of the cave	TCMA routine surface monitoring; COA bi-annual species monitoring and cave cricket exit counts to asse tawny crazy ant impacts	controlled access**

[1]Cave Y was considered an ES cave *(Texella reddelli)* in the 1996 BCCP Permit but has since been determined not to contain *Texella reddelli* (Reddell 2004).
[2]Stark's North Mine was listed as a SOC cave in the 1996 BCCP Permit but has since been determined to contain *Texella reddelli* (USFWS 2009c).
[3] Talus Springs Cave has never been known to contain ES or SOC. This cave was placed on the BCCP permit because it contained the amphipod *Stygobromus birfurcatus*, originally considered as a SOC candidate; however, *S. birfurcatus* was not included in the Permit's final list of 25 SOC karst species to be protected.
[4] Pickle Pit was listed as a SOC cave in the 1996 BCCP Permit but has since been determined to contain *Texella reyesi* (USFWS 2018).

* Access by Permit - Permit may be issued by COA – Austin Water Utility or Austin Parks and Recreation Department (PARD) staff.
** Controlled Access - Private cave owners control the access.

4.0 ACCESS STATUS AND KARST EDUCATION/RESTORATION ACTIVITIES

Public education on caves and cave ecosystems is recognized as vital for karst species preservation in the BCP Karst Land Management Plan (2016). Currently, most opportunities for children to enter caves and learn about cave ecosystems is through programs provided by COA Watershed Protection Department (WPD), the Balcones Canyonlands Preserve Program of Austin Water (BCP), and Austin Nature and Science Center (ANSC) summer camps. Adult wild cave tours in the Austin area are not widely available, although many tours are conducted through TCMA and the Underground Texas Grotto. Overall, there is more demand for cave education than can be met with existing programs.

One factor limiting cave education is a deficit of caves suitable for immersion, especially when the high demand and its effectiveness as both a teaching tool and management practice to support stewardship for cave ecosystems is considered. Cave education/recreation primarily occurs in 10% of the BCCP caves, which have been used for this purpose prior to the 1996 permit. Whirlpool Cave (owned and managed by TCMA) has the highest traffic of all the BCCP caves, totaling 1,465 person trips in FY23. Although studies on human impacts to cave ecosystems are limited, it is assumed that high human traffic in a cave will negatively impact the cave fauna.

Wildflower and LaCrosse Caves are relatively small non-BCCP caves on the Lady Bird Johnson Wildflower Center that received 1,366 and 109 visitors respectively in FY23. Wildflower Cave has been used for education by COA Earth Camp since 1997 after it was restored by cleaning out trash fill. Wildflower Cave is unsuitable for many cave tours due to its currently limited extent and small size.

Restoring Non-BCCP Caves for Education

By developing non-BCCP caves as a safe and accessible option for adequately trained and responsible groups for guided education/recreation tours, education can be promoted while reducing BCCP cave impacts. Restoration of filled non-BCCP caves for educational purposes is expected to reduce traffic/impact to other publicly accessed BCCP listed caves, namely District Park, Goat, Lost Oasis, Maple Run, and Whirlpool Caves. Caves are a heritage for the Austin area and provide resources for public education and opportunities to connect with local communities.

While obvious, once trash and ranch fill are removed, the cave ecosystem improves. In education caves such as LaCrosse, Wade, and Wildflower it is still assumed that excessive traffic is detrimental to cave ecosystems until more detailed analysis is conducted and reported.

Consequently, it is a goal to restore new education caves to provide more resources for public cave education and to reduce traffic on federal permit caves. A compilation of historic traffic in both BCCP permit and education caves is shown below in Figures 3 & 4. In FY21, an interlocal agreement with the Lady Bird Johnson Wildflower Center will allow AW BCP to restore filled caves there for education and cave ecosystem preservation. In the fall of 2023, work was started on the lead at the bottom of Wildflower Cave. A significant breakthrough was made at the beginning of FY24 which will be covered in next year's report. Cricket Cave discovered at the Wildflower Center is a very significant cave, but the difficulty of entering the cave combined with the extremely delicate formations makes it unsuitable for an education cave. There are other features nearby that will be restored in FY24 or following years that will likely be more suitable for education trips, but this remains unclear until they are opened up.

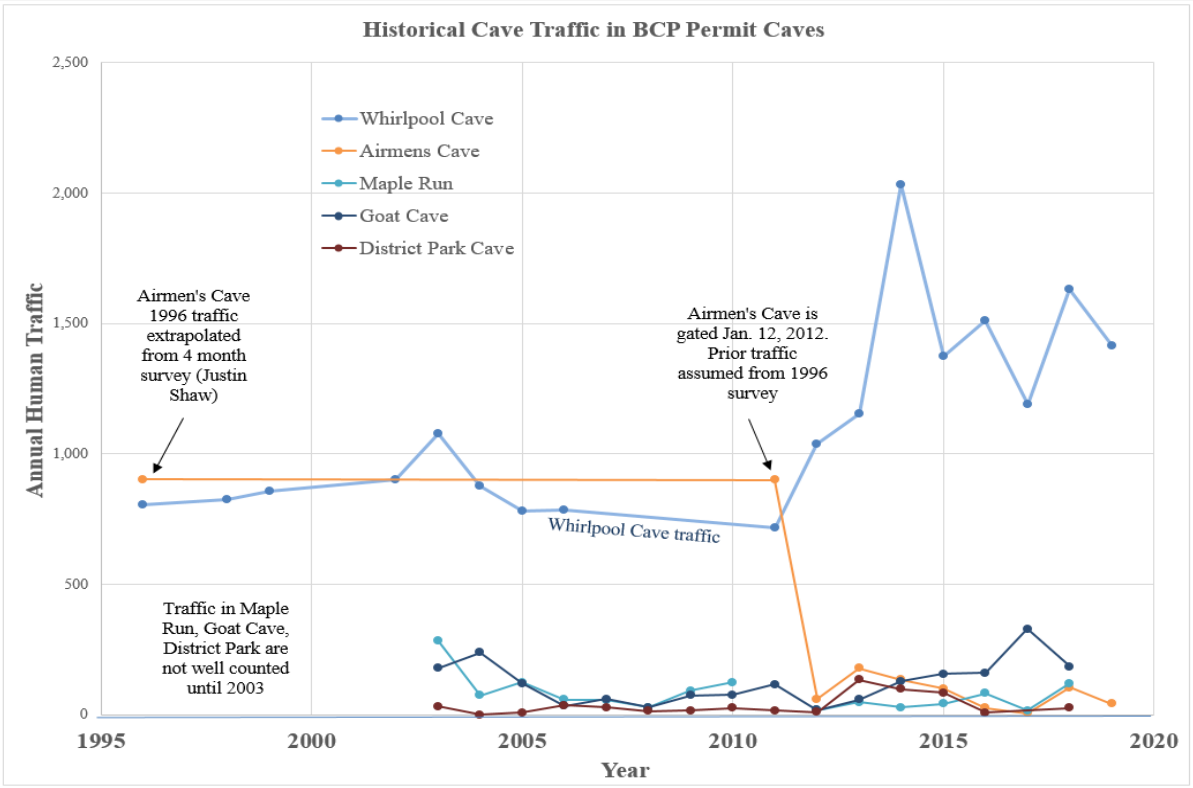


Figure 3. Historical traffic in BCP permit caves.

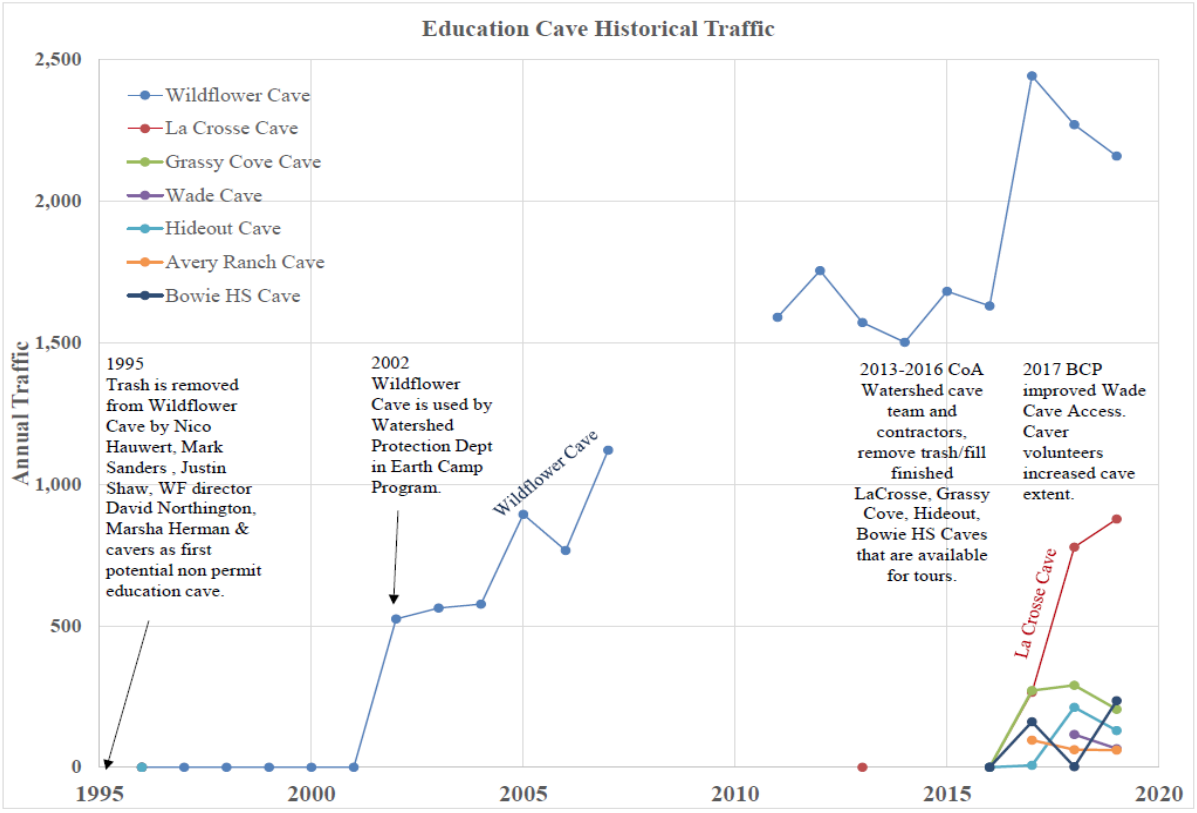


Figure 4. Historical traffic in education caves.

FY23 Cave Education Summary

City of Austin (COA) Education Programs:

During the 2022-2023 school year, the COA Watershed Protection Department (WPD) conducted cave and aquifer education through Earth Camp and Earth School (water quality programs for fifth graders), Watershed Detectives (middle school program), Hydrofiles (high school program), and supporting additional outreach though Clean Creek Camp (a summer parent/child water quality program) and Groundwater to the Gulf Summer Institute for Educators. The 2022-2023 school year updates are detailed below:

Earth Camp and **Earth School**:

Earth Camp is available to Title I (low socio-economic) schools in Austin Independent School District (AISD). The Lady Bird Johnson Wildflower Center is partnered with Earth Camp. During the 2022-2023 school year, students participated in a fieldtrip to Wildflower Cave to learn about cave habitat, how water flows through karstic limestone from the recharge zone of the Edwards Aquifer to Barton Springs, and how actions on the land affect water quality. Throughout the school year, 1,319 fifth-grade students from Title 1 schools participated in

tours of Wildflower Cave through this program. An additional 1,351 fifth graders received Earth School, which included live hands-on experiments with watershed models that feature a recharge zone with sinkholes and a karst aquifer model (Table 8). More details on these programs can be found online at: www.austintexas.gov/EarthCamp and www.austintexas.gov/earthschool.

Watershed Detectives and **Hydrofiles:**
Watershed Detectives and Hydrofiles reach middle and high school classes with hands-on inquiry-based investigations of Austin's water resources. Local field studies involve monitoring local creeks and caving into the Edwards Aquifer. Students learn about hydrogeology and cave biology through "Austin Underground" videos and cave tours led by COA WPD staff. During the 2022-2023 school year, 24 middle school students were given educational tours of LaCrosse Cave and 91 middle school students participated in educational caving tours in Whirlpool Cave. Additionally, 25 high school students were given educational caving tours in LaCrosse Cave and 15 high school students toured Whirlpool Cave (Table 8). More details on these programs can be found online at: www.austintexas.gov/watersheddetectives and www.austintexas.gov/hydrofiles.

Clean Creek Camp and **Groundwater to the Gulf Summer Institute for Educators:**
In summer 2023, families and the general public were given opportunities to receive educational caving tours through Clean Creek Camp and Nature Nights at the Lady Bird Johnson Wildflower Center. Clean Creek Camp is a partnership between COA WPD and Keep Austin Beautiful. Activities focus on watersheds, the Edwards Aquifer, and citizen actions that improve water quality. Clean Creek Camp is offered in summer to parents and their children ages 9-14. Clean Creek Camp brought 15 participants into LaCrosse Cave and Wildflower Cave (Table 8). During the Groundwater to Gulf Summer Institute for Educators at Lady Bird Johnson Wildflower Center, 20 educators participated in tours of LaCrosse Cave and an additional 20 educators toured Wildflower Cave (Table 8). More details on these programs can be found online at: www.austintexas.gov/department/clean-creek-camp and www.coloradoriver.org/groundwater-to-the-gulf/.

Table 8. Summary of school year 2022-2023 COA WPD education programs providing virtual cave field trips and aquifer outreach.

Program	Grade	Total reached
Earth Camp (cave tour)	5th	1,319
Earth School* (*presentation does not include cave immersion, but it does involve demonstrations of watershed model that features a recharge zone with sinkholes and a karst aquifer model)	5th	1,351
Watershed Detectives	6th-8th	115
Hydrofiles	9th-12th	40
Clean Creek Camp	N/A	15
Groundwater to the Gulf Summer Institute for Educators	N/A	40

Austin Water Balcones Canyonlands Preserve Program

AW BCP gave less cave tours during the pandemic but more virtual presentations over Zoom or other software covering Cave Biology, Cave Conservation, and Hydrogeology. In FY22, that changed and AW BCP was the host of the National Cave & Karst Management Symposium (NCKMS) in San Marcos, https://symposium2021.nckms.org. With the wide spread availability of COVID vaccines most BCP outreach activites are now in person. Below is a list of presentions given and other outreach activites.

- **Oct 26, 2022**: Tabled at Reicher Ranch for National Habitat Conservation Plan Coalition field trip.
- **Nov 12, 2022**: Volunteer Appreciation Grassy Cove Cave Tour. Biologists discussed the history, restoration, and biology of the cave.
- **Mar 22-24, 2023**: AFD did cave rescue training at William H Russel Karst Preserve. Drew Thompson helped facilitate and described the sensitivity of the habitat above and below ground.
- **Mar 31, 2023**: Texas Cave Cricket (*Ceuthophilus secretus*) BCP logo designed by Colin Strickland in honor of the genus *Ceuthophilus* being named 2023 USA Cave Animal of the Year (Figure 5). Stickers were printed with the logo for outreach, and it will eventually be on educational signs and likely t-shirts.



Figure 5. Original photo from Cricket Cave at the Wildflower Center (left) and finished Texas Cave Cricket BCP logo (right). Photo and logo by Colin Strickland

- **Sept 2022 to May 2023**: Austin's Underground Frontier paintings by Barbara Attwell were on display at the Barton Springs Sheffield Education Center. Educational cave biology pamphlets describing the species in the paintings were provided for visitors. The Cave Project — At the Well (barbaraattwell.net)
- **Apr 4, 2023**: Whirlpool Cave tour and interview for UT students doing projects on local conservation jobs. Went to Travis County Room then showed them educational kiosks at the Violet Crown Trail.
- **May 17, 2023**: Gave presentation and then took AP Biology students at McNeil Highschool into Millipede Annex Cave.
- **May 25, 2023**: Clay Minerals Society Field Trip to Stovepipe Karst Preserve. George Veni described the geology of the area, Colin Strickland and Mark Sanders described the cave biology and restoration efforts.
- **Jun 6, 2023**: Tabled at the Wildflower Center for National Cave and Karst Day. Drew Thompson, Colin Strickland, and Cait McCann Teran discussed the Wildlands, cave biology and cave restoration with students entering Wildflower Cave and passing WFC visitors.
- **Jun 21, 2023**: Photo shoot with AFSCME in entrance room of Whirlpool Cave. Photographer and interviewer took photos of Colin Strickland (AFSCME union member) doing cave work and were then taken on a short tour halfway to Travis County Room.

- **Sept 13, 2023**: Presented Wildflower Center Caves History and Restoration to City of Austin cave educators and Wildflower Center staff. Drew Thompson covered history and cave restoration and Colin Strickland covered cave biology. Tours were then led in Wildflower and LaCrosse caves.
- **Sept 19, 2023:** Barton Springs University. Simulated dye trace hands on activity was run by Colin Strickland and Drew Thompson (Figure 6), while Nico Hauwert discussed cave science with posters. Barton Springs University - Home



Figure 6. Barton Springs University Students taking water quality readings from simulated cave drips, photo by Colin Strickland

Colin Strickland continues to produce short educational videos about karst invertebrates that are shared on the Wildlands Facebook page and used in cave training classes. They can be viewed on his YouTube channel: https://www.youtube.com/@biosubterranea

Austin Parks and Recreation

The Splash! Exhibit in Zilker Park includes a simulated cave and indoor displays, movies, and activities regarding the Edwards Aquifer.
http://www.austintexas.gov/department/austin-nature-science-center

FY23 Access Status

Because of the COVID 19 pandemic many caves were closed after March 2020 for cave tours and fewer of these were offered. Tours have started to pick back up with the wide availability of vaccines. In FY23, access was granted to COA-owned BCCP caves, TCMA-owned BCCP caves and other non-BCCP caves for educational/recreational/rescue training. The increased number of non-BCCP caves available has reduced traffic to BCCP caves. In FY23, 250 people entered COA-owned BCCP caves, with visitors issued access permits by COA staff. COA-owned BCCP caves include Airmen's (2), District Park (28), Goat (202), Maple Run (14), and Midnight Caves (4). A total of 1,489 people were granted access to TCMA-owned BCCP caves including: Lost Oasis (24) and Whirlpool (1465) Caves. An additional 1,571 people visited non-BCCP caves including Avery Ranch (84), Grassy Cove (12), Hideout (0), LaCrosse (109), Wildflower (1,366), and Wade Caves (0) (Table 9). See Table 3 for access and gating status of all the BCCP caves.

Table 9. Summary of FY23 educational and recreational cave trips into non-BCCP Caves compared to BCCP Caves.

Status	Cave	Visitors	Total Visitors
Non-BCCP Caves	Avery Ranch	84	1,571
	Bowie	0	
	Grassy Cove	12	
	Hideout	0	
	LaCrosse	109	
	Wildflower	1366	
	Wade	0	
BCCP Caves	Airmen's	2	1,739
	District Park	28	
	Goat	202	
	Lost Oasis	24	
	Maple Run	14	
	Midnight	4	
	Whirlpool	1,465	
Non-BCCP and BCCP Caves Combined			3,310

5.0 MANAGEMENT COORDINATION AND OVERSIGHT

COA and TC determined that there was a need to create a master database on BCP karst fauna monitoring and management with the ability to analyze these data to determine status and compliance with the regional permit, as well as determine future needs of the listed species. The Karst Database houses all faunal survey data from BCCP caves and provides much of the information needed for these karst analyses. This database is now available for use by BCP partners to enter survey data, and all available data have been entered to date. Though the intent is for this database to be a "shared" information source for all the BCP partners, there are still confidentiality challenges on how to establish this protocol. This database will focus on permit compliance, species status, and contribution to recovery.

Based on recommendations made in Dr. Butch Weckerly's analyses of karst survey efforts on the BCP (Weckerly 2010), COA and TC modified and expanded the BCP's cave monitoring program in FY11. COA and TC identified 25 caves within Travis County managed through BCP partners that provide a more evenly distributed dataset across cave clusters and karst fauna regions (KFRs); this dataset includes both BCCP caves and other ES/SOC caves on the BCP. The number and frequency of karst faunal surveys and cave cricket exit counts are now synchronized among managing partners to better accommodate comparisons and determine species trends. The goal of the cave monitoring program is to provide a clearer understanding of the species distribution and health of karst ecosystems across the BCP.

In FY16, COA/TC BCP staff collaborated on creating guidelines to provide best management practices (BMPs) at construction sites where tawny crazy ants (TCA; *Nylandaria fulva*) have not been confirmed, to supplement BMPs created in FY15 focusing on construction activities within known TCA sites. TCA are a newly discovered non-native ant species which could potentially adversely affect forest and karst ecosystems on the BCP. Implementation of these BMPs will be critical to minimizing the potential of introducing new populations of this destructive species to other parts of Austin and elsewhere. In FY23, these BMPs continue to be disseminated to appropriate TC/COA departments and other agencies.

In FY23, AW BCP staff continued air monitoring in Ireland's, Grassy, and Whirlpool Caves. The intention for this monitoring is to obtain a better understanding about factors influencing airflow and concentrations of carbon dioxide gas, which is a potential hazard. The data collected in FY23 will be compiled and added to the 2022 CO_2 monitoring report. The updated report will be in the appendix of the FY24 annual report. Enough data has been collected at Ireland's and Whirlpool Caves, so monitoring equipment is likely to be removed from those caves in February 2024. The CO_2 meters and temperature/barometric pressure meters will be

moved to other caves with high CO_2. The CO_2 monitoring equipment in Grassy Cove is a mostly permanent setup that runs on solar, and will remain in place if it keeps functioning.

6.0 BIOLOGICAL MONITORING

Caves containing endangered and rare karst invertebrates on BCP properties are monitored to determine long term trends in populations of cave organisms and overall cave conditions. All COA and TC-owned BCP caves with endangered species are surveyed annually. In addition, TC and COA incorporated the newly expanded monitoring plan in FY11, which includes the 25 Travis County caves selected to represent an evenly distributed dataset across cave clusters and KFRs. Caves included in this monitoring plan are surveyed bi-annually, occurring in Spring (May) and Fall (November) or Summer (August) and Winter (mid-January-mid February). Biomonitoring of the caves follow methodology and techniques supported by USFWS to provide results that can be compared between caves throughout the region for better study and analysis (USFWS 2014a).

Beyond USFWS recommendations, survey methodology also follow guidelines described in the *2016 Balcones Canyonlands Preserve Land Management Plan: Tier II-A Chapter IX Karst Species Management*. The protocol for research and monitoring cave fauna involves the use of one to seven (depending on size of cave and logistics) predesignated, permanent survey zones per cave in which all living organisms encountered are identified and enumerated. Survey zones are either transects approximately 5 meters in length that span the width of the cave, or distinct units of the cave such as a small room or an easily discernible section, so that the size and location of the survey area remains constant during the study for trend comparison. For each survey zone, start and end time and the presence of trash or new vandalism are recorded. Relative humidity, temperature, nutrient input, dampness condition, and the presence of red-imported fire ants (RIFA; *Solenopsis invicta*) and TCA are also recorded both outside the cave and at each transect or zone. All data collected during cave surveys are entered into the BCP Karst Database.

Any unknown invertebrates observed during faunal surveys are collected and identified by a karst invertebrate specialist. In caves containing endangered species, collecting only occurs with a special collecting permit obtained by USFWS. All collected specimens are deposited within the Texas Memorial Museum or other reputable facility (USFWS 2014a). The date of deposition and collection number is also recorded (USFWS 2014a).

Land managers also monitor the entrances of caves containing endangered species at least once a year for anything that might harm the rare invertebrates including presence of toxic substances, unauthorized access by recreational cavers, and surface disturbances which might have erosive potential or cause changes in surface drainage patterns.

The overall health of caves is also monitored by performing semi-annual cave cricket exit counts. Cave cricket exit counts are done as crickets emerge from caves during good weather nights (i.e., not raining, warm, etc.). The duration of the counts is timed for two hours starting at sunset, to maintain consistency with all surveys done between managing partners. Current weather conditions, surface temperature, and relative humidity are documented for each survey. Crickets emerging are placed in one of three age classes: nymph (up to 5 mm), sub-adult/juvenile (5-12mm) and adult (>12mm). Number of individuals exiting the cave is counted in ten-minute intervals. Time of first cave cricket exit and any other vertebrates exiting the cave are also recorded. An evaluation of TC/COA's cave cricket exit count survey protocol determined that this methodology meets criteria necessary to assess cave cricket abundance at caves as well as estimate changes over time in the number of cave crickets that emerge from cave entrances, both of which are necessary for determining the state of cave ecosystems and evaluating the effectiveness of the BCP's karst management goals (Weckerly 2012).

FY23 TC/COA Collaborative Monitoring Projects

Since FY12, BCP staff have included monitoring for presence of TCA at all visits to cave sites, using a monitoring and collection protocol and reporting procedures created by TC and COA BCP staff and updated in FY15. In FY13, at least two BCCP caves (Whirlpool and No Rent Caves) were confirmed to be infested by TCAs. COA and TC staff continued to conduct quarterly biological surveys at Whirlpool Cave from FY13 – FY17 to document TCA use of cave environments and assess impacts of this new invasive species on cave fauna (EXHIBIT A). Surveys at Whirlpool Cave were reduced to bi-annually in FY18. For FY23, staff did not observe any TCA activity in Whirlpool Cave. In FY14, TC and COA also expanded monitoring of Weldon and No Rent Caves to document the arrival and impacts of another TCA population in the vicinity of these caves (EXHIBIT A). Subsequently, the TCA population at these caves had disappeared for unknown reasons until February FY22 where they were documented in and around No Rent Cave again. At which time, they were also seen around the entrance of Weldon Cave but were not observed in the cave until May 2022. As a result, quarterly faunal surveys and cricket exit counts were reintroduced to monitor the impacts of TCA on these caves. During FY23, TC continued to collaborate with Dr. Ed LeBrun at BFL to study and inoculate the McNeil population with the microsporidian pathogen to mitigate any

impacts to the karst invertebrates contained within. TCA densities within Weldon and No Rent Caves increased during FY23, but it does appear that previous inoculations have been established within the McNeil population which will be examined throughout FY24.

TC and COA BCP staff began conducting bi-annual cave faunal surveys of Millipede Cave and Millipede Annex Cave in FY13 and continued surveys for FY23 to gather baseline data for the McNeil High School courtyard restoration project, which commenced in FY15. Management activities such as vegetation planting and trash removal were coordinated with McNeil High School staff and students to improve surface conditions of these two non-BCCP ES caves, with the intent of increasing nutrient input while also benefiting cave crickets and fauna. In FY18, staff observed and collected a non-native arachnid, Order Schizomida from Millipede Cave for species identification, it was also confirmed in the adjacent Millipede Annex Cave in December 2021 (Figures 7 and 8). The specimen was determined to be *Stenochrus portoricensis*, likely a native to the Yucatan Peninsula and has been discovered in greenhouses in Europe. It's proposed that this species was inadvertently introduced via plants purchased at local nurseries by school staff, and likely uses parthenogenesis which makes it able to colonize new locations with no males (Monjaraz-Ruedas et al., 2022). This could explain why all specimens collected to date in these caves have been female. Their numbers seem to be increasing in both caves and it was reported by environmental consultants in Dead Dog Cave # 2 which is 5.6 miles away from McNeil High School. BCP staff will continue to monitor this newly introduced predator to see what direct and/or indirect impacts it will have on cave fauna.

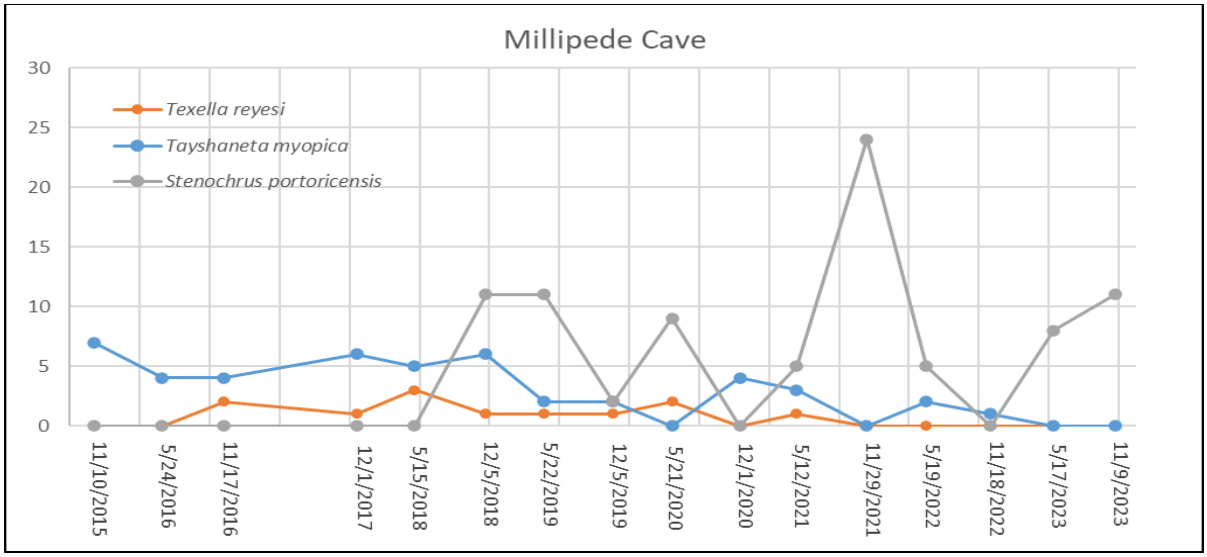


Figure 7. Counts of *Texella reyesi*, *Tayshaneta myopica*, and *Stenochrus portoricensis* during faunal surveys in Millipede Cave (*S. portoricensis* first found 12/5/2018)

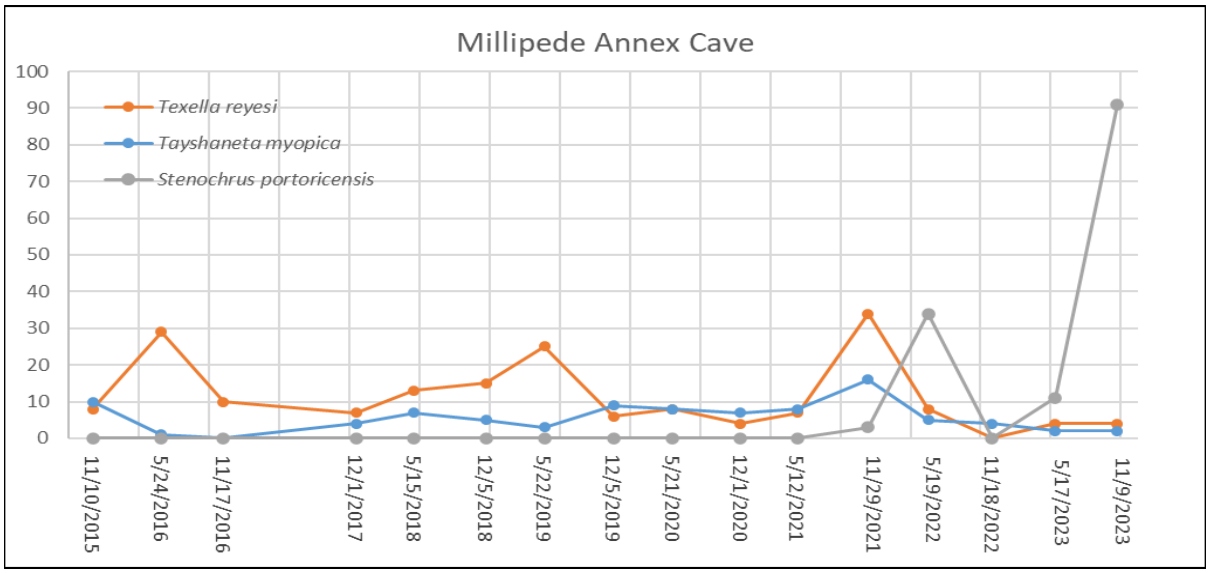


Figure 8. Counts of *Texella reyesi*, *Tayshaneta myopica*, and *Stenochrus portoricensis* during faunal surveys in Millipede Annex Cave (*S. portoricensis* first found 11/29/2021)

Starting in FY20, COA and TC staff assisted with the USFWS to address phylogenetic and species determination questions for the federally listed cave mold beetles of Travis and Williamson Counties. The goal was to collect up to three specimens from a large list of caves that were within the known ranges of *Texamaurops reddelli*, *Batrisodes reyesi*, *Batrisodes texanus*, and *Batrisodes cryptotexanus*. This phylogenomic approach will help answer the species delimitation questions with a robust molecular dataset. Collections for this project were completed in FY21, and staff along with other collaborators were able to successfully collect from many of the selected caves. Preliminary results in FY22 show that *B. reyesi* does not occur in Beck Cave cluster/Round Rock KFR but is apparently a new undescribed species, likely sister to *B. texanus/cryptotexanus*. Also, results still show overlap in range distribution for *B. texanus* and *B. cryptotexanus*. According to USFWS staff, a final report was scheduled to be produced by the end of 2023.

In FY22, USFWS staff requested COA and TC staff collect more *Texella* specimens in selected caves to allow for a more thorough analysis of the species range and if some of these sites have undescribed species. In FY23, COA and Travis County staff have continued efforts to collect specimens from the selected caves.

TC and COA BCP continued to assist James Reddell with his project of updating the cave faunal lists and accurate locations of area caves for the Texas Speleological Society (TSS) database.

City of Austin FY23 Biological Monitoring

During FY23, COA BCP staff conducted bi-annual monitoring on the following 15 pre-selected caves: Broken Arrow Cave, Cave Y, Cortana Cave (non-BCCP cave), Cotterell Cave, District Park Cave, Flint Ridge Cave, Jester Estates Cave, Little Bee Creek Cave, Maple Run Cave, Midnight Cave, Pond Party Pit (non-BCCP cave), Seibert Sink (non-BCCP cave), Spider Cave, Stovepipe Cave, and Testudo Tube (non-BCCP cave). Airmen's Cave survey frequency was dropped to once a year to limit staff exposure to Tick-Borne Relapsing Fever (TBRF), (EXHIBIT A). To get a better handle on baseline data, in FY18 COA BCP staff completed one year of quarterly faunal surveys at Get Down Cave, Lost Oasis Cave, and Pipeline Cave. Survey frequency for these caves has been reduced to bi-annual surveys for Pipeline Cave and Lost Oasis and annually for Get Down Cave. The reduction in survey frequency for Get Down Cave was also to limit staff exposure to soft ticks/TBRF. Staff completed quarterly surveys for one year for the newly restored Black Cap Cave, and Persephone Caverns and will now drop surveys to twice yearly. Staff also completed twice yearly surveys for the recently restored Gaping Maw Cave and Sacred Grove Cave and will continue twice yearly surveys for these caves (EXHIBIT A). Faunal surveys in these caves were conducted by permitted COA biologists in either Fall 2022/Spring 2023 or Winter 2023/Summer 2023. As part of a long-term site restoration project, COA BCP staff continued to conduct bi-annual surveys at Millipede and Millipede Annex Caves (EXHIBIT A). Annual faunal surveys were also conducted in Airmen's Cave, Arrow Cave, Beard Ranch Cave, Blowing Sink, Cricket Cave, Goat Cave, LaCrosse Cave, Rolling Rock Cave, Slaughter Creek Cave, and Wildflower Cave (EXHIBIT A).

In FY23, COA BCP staff, with the help of volunteers, conducted bi-annual cave cricket exit counts at the same 14 caves pre-selected for faunal surveys (EXHIBIT B). The Airmen's Cave cricket count was dropped due to safety concerns with soft ticks/TBRF. Also, the Little Bee Creek Cave cricket exit count was dropped due to low numbers observed, more crickets are counted during the in-cave survey. Staff completed quarterly cricket exit counts for the newly restored Persephone Caverns and will now drop surveys to twice yearly. Staff also completed twice yearly surveys for the recently restored Black Cap Cave, Gaping Maw Cave and will continue twice yearly surveys for these caves (EXHIBIT B). COA BCP staff also conducted one cave cricket exit count at Jest John Cave (EXHIBIT B).

Travis County FY23 Biological Monitoring

TC's BCP staff conducted bi-annual monitoring on the following eight pre-selected caves: Adobe Springs, Cold Cave, Gallifer Cave, Geode Cave (non-BCCP cave), Kretschmarr Cave, Spanish Wells Cave, Stark's North Mine, and Tooth Cave. Faunal surveys in these caves, with permitted TC biologists, were conducted in Fall 2022/Spring 2023 or Winter 2023/Summer 2023 (EXHIBIT A). In response to a recent resurgence of TCA, TC staff started performing quarter faunal surveys at two TC-owned BCCP caves: No Rent and Weldon Caves. Annual faunal surveys were also conducted in four other TC-owned BCCP caves with federally listed species: Kretschmarr Double Pit, McDonald Cave, New Comanche Trail Cave, and Tardus Hole (EXHIBIT A). TC staff also conducted annual faunal surveys at two additional BCCP listed cave: Ireland's Cave and Talus Springs Cave (EXHIBIT A).

TC BCP staff conducted bi-annual cave cricket exit counts in FY23 at all the caves pre-selected for faunal surveys: Adobe Springs Cave, Cold Cave, Gallifer Cave, Geode Cave, Kretschmarr Cave, Spanish Wells Cave, Stark's North Mine, and Tooth Cave. Exit counts were conducted in Fall 2022/Spring 2023 or Winter 2023/Summer 2023. TC staff started performing quarterly cricket exit counts at No Rent and Weldon Caves in response to TCA reintroduction (EXHIBIT B).

RIFA surveys were only performed in Spring 2023 on eleven of fifteen TC-owned BCCP caves and two additional ES cave with federally listed species. RIFA mounds were surveyed within an 80 m radius around cave entrances, and all active mounds found during surveys were treated with boiling water as recommended by USFWS (2014b). In Spring of 2023, a total of 130 RIFA mounds were treated within these 80 m cave survey areas, with an additional 11 RIFA mounds treated in the vicinity of caves but outside of survey areas. Survey results and treatments for individual caves are documented in Table 10.

In addition to managing the karst features required in the BCCP permit, TC voluntarily managed other karst features located on BCP land in FY23 including Cactus Pit, Brew Pot Cave, Kretschmarr Sink, and karst features RI-1, LU-11, and LU-12.

TC BCP staff along with its contractor, Zara Environmental, continue to make significant gains in locating, restoring, and monitoring various caves on the Kotrla Unit (Endres, Flying K, Kotrla, and Scott & White tracts) for potential substitution of Ceiling Slot and Moss Pit Caves. In FY17, the Unit was only composed of the Kotrla and Scott & White tracts (~950 acres) where several karst features were found, including seven significant caves (refer to FY17 Annual Report). In FY19, with the permission of the landowner of the adjacent Flying K

Ranch, TC BCP investigated the property to see if other caves could be discovered. Like the Kotrla and Scott & White tracts, the Flying K contained numerous features of varying degree. Most of these required some excavation, which was conducted by Zara in FY20, to see if they harbored karst invertebrate habitat. Twenty-one features were evaluated, of which, five were found to be significant caves. In FY22, due to high karst potential, TC BCP was able to acquire an additional 620 acres of the Flying K Ranch bringing the Kotrla Unit to a total to 1,576 acres.

For the last two years, TC and Zara have continued to build on the previous work conducted on the Kotrla Unit. Utilizing a variety of on ground searches and LiDAR analyses, TC BCP and Zara were able to locate 16 previously unknown karst features. Of which, 10 qualify as caves and six are recommended for additional excavation. A handful of these caves contain significant troglobitic diversity but there are still ongoing efforts to get a full inventory. One cave in particular, Devil's Lair Cave, is currently the most extensive cave found on the property to date. Its surveyed length is approximately 140 m and has a maximum depth of 15 m. It also harbors a wide variety of fauna, but most notable of the invertebrates collected were: *Stygobromus reddelli*, *Batrisodes reyesi*, *Cicurina buwata*, and *Apochthonius* "n. sp.7" an undescribed pseudoscorpion. In two caves nearby, McMac and Artificial Intelligence Caves, an additional undescribed pseudoscorpion, *Aphrastochthonius* "n. sp. 2" was also discovered.

The full report for all FY23 activities and taxonomic verifications can be found in the Balcones Canyonlands Conservation Plan Annual Report Appendices.

Other Biological Monitoring Efforts

Zara Environmental conducted biological monitoring at Pennie's Cave in FY23 as part of an adaptive cave management plan for a development project that began with the reopening of the cave's entrance in 2012. Due to high CO_2 levels, in FY18 Zara installed a semi-permanent in-cave air ventilation system that greatly improved air quality, thus allowing for in-cave faunal monitoring, staff was also able to complete the interior cave mapping. A written report of their work in FY23 was also provided (Zara Environmental 2023a; Appendix T10 of BCCP FY23 Annual Report).

COA BCP staff have continued conducting bat monitoring activities in FY 2023. Acoustic bat monitoring equipment (SM4BAT-FS Ultrasonic Bat Detector) were deployed in the entrances of Goat and County Line Bat Caves. Bat meters will be deployed at Hays Ranch Bat Cave and Barker Bat Cave in early 2024 utilizing external batteries for longer recording durations. Once more data is collected, it will be analyzed with Kaleidoscope Pro to determine what species of bats are present during different times of the year.

In FY24, COA BCP staff will continue to assist James Reddell and the Texas Speleological Survey (TSS) in surveying, excavating, and mapping the karst of the USFWS Balcones Canyonlands National Wildlife Refuge (BCNWR). One cave of interest that may be a suitable substitution for another BCP permit cave that has inadequate protections is Collaboration Cave. Collaboration Cave was initially a 25.5 ft deep shaft plugged with rocks and soil. After 14 days of excavation the shaft is approximately 35 ft deep and there is about 40 ft of horizontal passage with a small stream flowing through it. The stream is inhabited by stygobitic isopods *Caecidotea* sp. and amphipods *Stygobromus* sp. Colin Strickland produced a video of this cave stream and its inhabitants which can be viewed here: https://www.youtube.com/watch?v=XbFbXYWo16c.

Excavation activities at Collaboration Cave have concluded, so it will be mapped and thorough faunal surveys will be conducted in FY24. These efforts continue to expand the knowledge of cave fauna in the karst fauna region shared by two BCCP caves: Jack's Joint and Armadillo Ranch Sink. Once the map and faunal surveys are completed, COA BCP staff will provide a written report of their efforts.

In FY23, COA BCP continued efforts to determine what Trichoniscid species are in the Austin area. Once enough material is collected the DNA will be analyzed by Bold Systems (https://www.boldsystems.org). Though DNA analysis alone will not properly describe them, it can provide insight into diversity, and maybe encourage a taxonomist to take on the project. DNA analysis could be expanded to other species if this project is successful; especially pertaining to species where a taxonomist is lacking that can make species level determinations. *Rhadine* beetles as well as stygobitic isopods and amphipods are good candidates. Also, *Speodemus* millipedes, since there are likely cryptic species that DNA analysis will reveal.

COA BCP has continued to collaborate with Texas State University, Baylor School of Medicine, and the Centers for Disease Control (CDC) on a study to further understand and document the recent increased occurrence of Tick-borne Relapsing Fever (TBRF) in Central Texas. TBRF is a bacterial infection that can cause recurring bouts of fever, headache, muscle and joint aches, and nausea. *Borrelia* bacteria that cause TBRF are transmitted to humans through the bite of infected soft ticks of the genus *Ornithodoros*. All recently confirmed cases of TBRF in the Austin area have been attributed to *Borrelia turicatae*, and the ticks have all been confirmed as *Ornithodoros turicata*. Soft ticks (Family: Argasidae) differ from the more familiar hard ticks (Family: Ixodidae) in two main ways. They have a short feeding duration, usually less than half an hour, and they do not search for hosts in grass or brush but instead reside in animal burrows (CDC TBRF, 2015).

COA BCP continues to monitor soft tick populations to better understand the level of risk that may be associated with caves accessed by the public. Priority has been given to the education caves due to the large number of children visiting them, followed by caves in the Barton Creek Greenbelt that are well known hangouts for hikers seeking relief from the Texas heat.

Pit fall traps using dry ice were deployed in caves in the Austin area to survey soft tick populations. Specimens were collected live and stored in ventilated plastic vials for transport to Texas State University's Professor Dr. Ivan Castro and his students. Some ticks were then sent to Job Lopez at Baylor College of Medicine for *Borrelia* identification and further TBRF research. The information gathered is being shared with Jeff Taylor of the Epidemiology and Disease Surveillance Unit of the Austin Public Health Department, and the CDC.

The number of ticks has dropped in Live Oak Cave; but has risen in Airman's Cave. Environmental researcher Ethan Perrine has stepped forward to help continue our efforts in the study of the rise and fall of tick numbers within our caves. Researcher Job Lopez collected soft ticks from voids adjacent to Live Oak Cave and collected large numbers of soft ticks in small voids at the base of Barton Creek's Seismic Wall. It is unclear what causes some caves to have such high numbers. It is likely due to the presence of favorable cave environments (soft, dry soil that is easy to burrow in) and ample access for specific host species such as mice, racoons, and rock squirrels. Reddell (1988) noted that relapsing fever is typically associated with dry, shelter-like cave entrances with specific mammals such as goats and that infections of a cave by *O. turicata* with *Borrelia turicatae* could possibly by cyclic. Some birds and mammals, particularly predators, are associated with reductions in ticks, either by reducing/intimidating host species such as rodents or by directly preying on ticks (Hofmeester et al., 2017; Ostfeld et al., 2018). COA BCP will continue to monitor education and public access caves, such as Airman's and Bullet Caves. The detection of a single tick does not make a cave high risk for relapsing fever; however, cave guides should be informed about the risk of TBRF should later symptoms arise. There is concern that fear-driven over reaction to TBRF could lead to impairment or destruction of cave ecosystems, as was historically the case in earlier planned bat extermination efforts because of irrational fear of rabies. Furthermore, the soft ticks must be infected with *Borrelia turicatae* to transmit TBRF.

In FY23, caves where people have contracted TBRF and are identified as a high risk for TBRF include Live Oak Cave and Get Down Cave at Village at Western Oaks Karst Preserve; Airmen's Cave, Spider Wire Cave, and Bullet Cave along the Barton Creek greenbelt; and Little Black Hole and Under the Road Cave near the Ullrich water treatment plant. Drew Thompson was bitten by soft ticks in Get Down Cave so the bi-annual cricket count and faunal

surveys were reduced to annually, in the month January, when cold temperatures make the ticks less active. With the rise in the number of ticks in the entrance to Airman's Cave, the cricket counts for that cave will be postponed until a safe way to do so is conceived.

7.0 HYDROGEOLOGIC STUDIES & CAVE RESTORATION

The understanding and protection of water sources to caves is vital for preserving cave life that relies on it. Water sources include surface catchment areas that direct runoff to the cave entrance and subsurface catchment areas where overlying water infiltration from either rainfall or runoff supports cave drips. Surface catchment area delineation generally involves examination of a combination of field GPS delineation of catchment divides and drainages as well as surface topographic contour coverages. Subsurface catchment studies may involve direct tracing, water-quality characterization, drip rate monitoring, geological mapping, cave survey mapping, and cave radio surveying.

Cave restoration is an extremely slow and labor-intensive part of cave preserve management that is a prerequisite for conducting hydrogeological studies, vital for re-establishing necessary nutrient input, and habitat for cave ecosystems. Historical land use practices over karst areas across the Austin area involved plugging caves and sinkholes to keep water at the surface for livestock ponds, mills, and access to shallow sources. Caves were also historically used for trash disposal. Open caves also created hazards for people and livestock, and filling caves with trash seemed like a practical solution to ranchers, particularly given that, prior to local dye tracing studies, many scientists erroneously believed groundwater flowed slowly through tiny pores and that ground water was completely filtered before reaching the water table. Many caves were also covered by urbanization and many local caves that could have been preserved were filled in under the assumption that this measure protected the underlying aquifer from contamination. Efforts to remove trash and fill from caves is slow and regulated to a small group of cave-trained women and men. Once trash and fill are removed from a cave, utilization of the cave by cave-adapted organisms follow, including cave crickets, bats, and other mammals that bring nutrients from the surface. Many of the 62 federal permit caves required excavation of fill or trash, and some such as in the case of Pipeline Cave, still require it. An article on cave restoration by AW BCP was published in the Wildflower Center magazine in November 2019 (Hauwert and Sanders 2019). In addition to restoring cave habitat, cave restoration can also serve to restore recharge and reduce flooding where the cave catchment area is large, improve water-quality in caves filled with trash, and provide educational resources necessary to allow the public to make connections with natural ecosystems. To support cave restoration efforts, AW BCP produced a Guidelines for Cave Restoration in

February 2020. In November 2018, AW BCP released version 3 of Austin Cave Activity Hazards and Safety Report that describes unique cave hazards, protocols for addressing them, and relevant safety regulations.

In addition to the large challenges of widespread historical cave filling, the highly specialized skill and dedicated physical effort required to restore them, and limited resources available for cave restoration, in January 2018, while attempting to unplug BCCP permit Blowing Sink Cave, it was observed that regulation of cave restoration was unclear. In order to clarify the regulatory status of cave restoration and provide distinction of cave restoration from other development activities that could harm caves, Austin Water, Watershed Protection Department, Parks and Recreation Department, and the Development Services Department finalized an MOA which took effect on April 1, 2020, that clarifies that cave restoration using hand-held tools is not a development activity requiring a permit. However, for cave restoration, the use of backhoes and similar heavy machinery, laying of impervious cover and even cave gating requires prior discussion with WPD staff. The Texas Commission on Environmental Quality Edwards Rules similarly requires approval prior to the use of heavy machinery for cave restoration.

Some Central Texas caves are known to have high levels of CO_2 during certain times of the year, with generally higher levels in the hotter months and lower levels in the cooler months. Some of these caves are utilized for public tours, and some are inhabited by rare karst invertebrates and require faunal surveys, so knowing when CO^2 levels are lower is important. To better understand how CO_2 levels vary and how the caves ventilate, CO_2 meters, temperature/barometric pressure data loggers and anemometers were set up in Grassy Cove Cave, Ireland's Cave and Whirlpool Cave by Zara Environmental LLC. The pulling of data and maintenance of this equipment was transferred to The City of Austin Balcones Canyonlands Preserve (COA BCP) in late 2021. The full CO_2 Monitoring Report FY22 can be found in the Balcones Canyonlands Conservation Plan Annual Report Appendices. Figure 9 from the report shows the variations in cave temperatures in Grassy Cove, Ireland's, and Whirlpool Caves. Figure 10 shows the significant negative relationship between CO_2 and barometric pressure in Ireland's Cave, with higher CO_2 levels at lower pressures and lower CO_2 levels at higher pressures. This is also shown in Figure 11 where dropping barometric pressure is correlated with CO_2 levels rising and rising pressure is correlated with falling CO_2 levels.

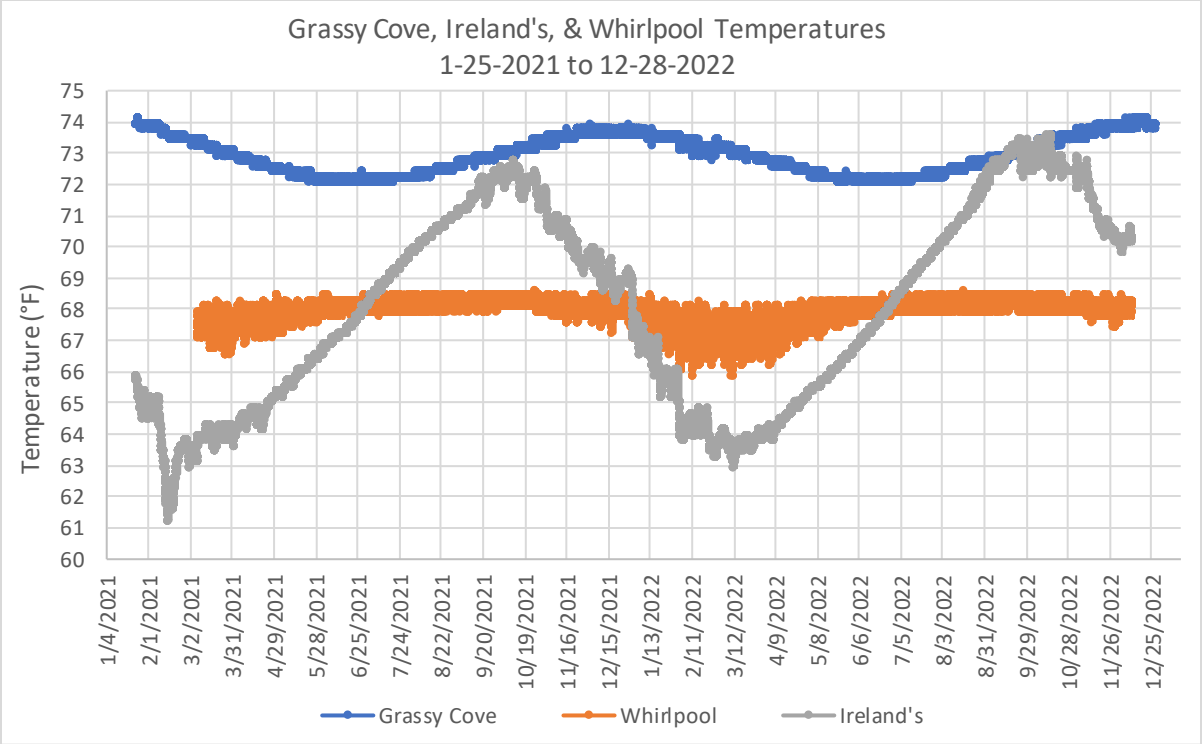


Figure 9. Grassy Cove, Ireland's, & Whirlpool Temperatures, 1-25-2021 to 12-28-2022

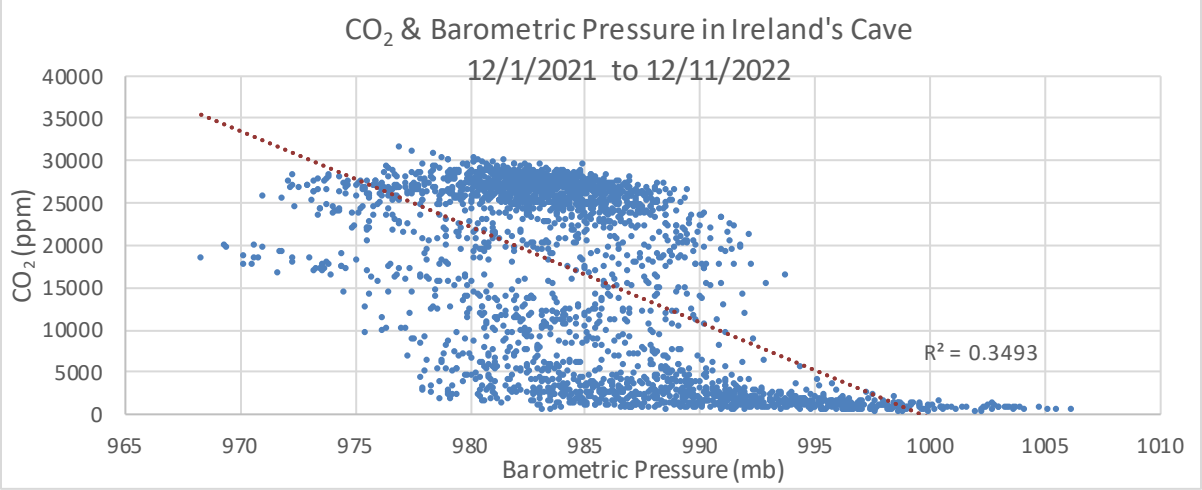


Figure 10. CO_2 & Barometric Pressure in Ireland's Cave, 8/23/2021 to 12/10/2022, (R2 = 0.3493, F (1,2649) = 1421.70, p<.0001)

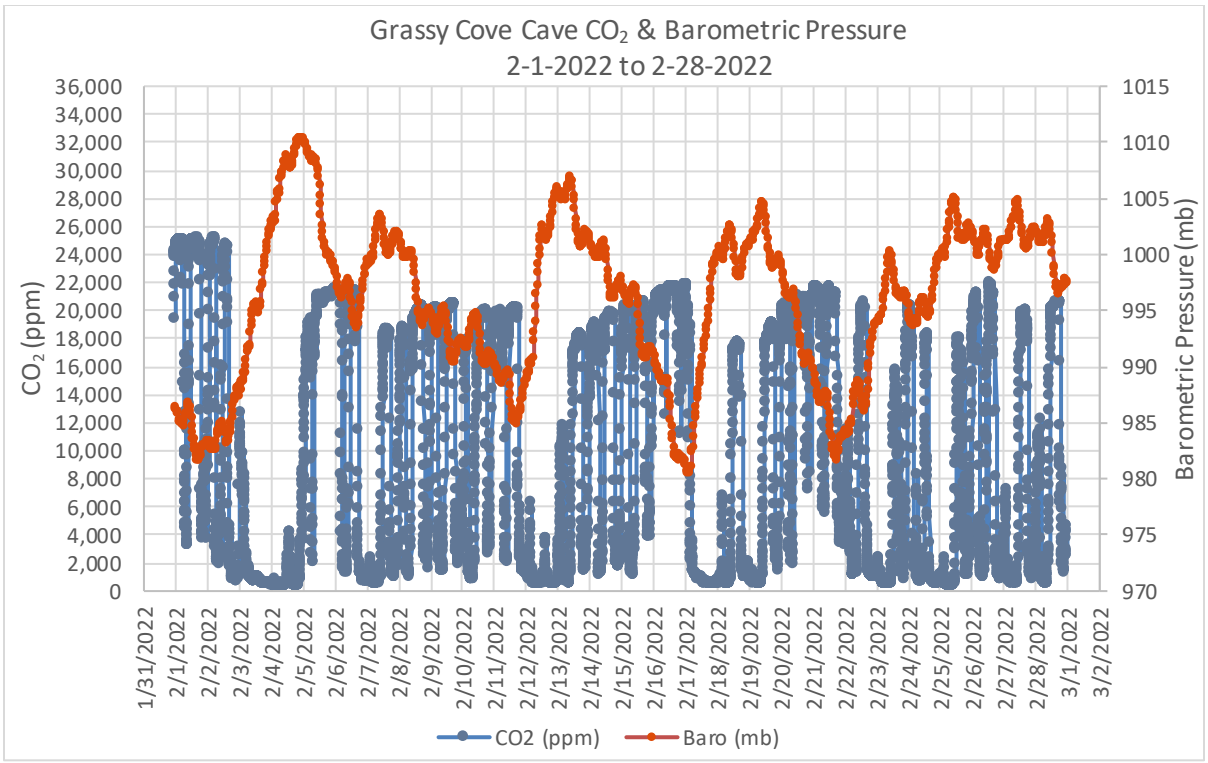


Figure 11. Grassy Cove Cave CO_2 & Barometric Pressure, 2-1-2022 to 2-28-2022

The CO_2 meters and temperature/barometric pressure data loggers were maintained with data pulled every 40 days or so (CO_2 meter battery life with about 20% charge remaining) during FY23. Monitoring in Whirlpool and Ireland's Caves will end in February 2024. The setup in Grassy Cove which is run on solar and fairly permanent will continue to operate until it is too hard to maintain. The data collected in FY23 will be graphed and added to a FY24 CO_2 report in the appendix.

Drip monitoring within Flint Ridge Cave continued in FY23. A data-logging Hydrolab sonde has been continually recording water quality metrics every hour since July 31st, 2019. It measures water temperature, specific conductivity, pH, dissolved oxygen, and turbidity. In May 2019, State Highway 45 SW began operation as a toll road over the cave and subsurface catchment area.

Using Section 7 conservation measure funds provided by TxDOT in 2018, cave restoration and spring evaluations are being conducted in the FM 2222 and FM 620 area as part of a hydrogeological study expected to be completed in FY24, but also to restore cave habitat and establish formal karst preserves based on improved scientific information.

The cave restoration portion of hydrogeological studies is the slowest, most labor and funding intensive portion. There are limited resources for cave restoration, and it requires specialized cave expertise which is not common. FY23 cave restoration efforts are described below.

City of Austin FY23 Cave Restoration Projects

Stovepipe Karst Preserve Cave Restoration

In preparation for an upcoming hydrological study of Stovepipe Cave multiple features on Stovepipe Karst Preserve are being restored including Coffee Mug Cave, Persephone Caverns, Gaping Maw Cave, Gaping Jaw Cave and Sacred Grove Cave. Prior to restoration efforts Stovepipe was the only known cave on the property. Now there are seven caves on Stovepipe Karst Preserve with likely more to come.

Persephone Caverns

Faunal surveys were initially performed quarterly to document the changes after restoration and were then dropped to bi-annually in FY23. With its proximity to Stovepipe Cave, it is likely other rare species such as *Tayshaneta devia* will eventually be found. Tricolored bats have been found in the far northern and southern sections of the cave. They tend to hibernate in the entrance room in the winter (Figure 12), so bi-annual surveys will be switched to spring and fall so they are not disturbed during hibernation. However, a quick check in the month of January will be done to see how many bats are present.



Figure 12. Hibernating tricolored bats, Persephone Caverns, January 25th, 2023, photo by Colin Strickland

Gaping Maw Cave

In December of 2021, Zarria Environmental was awarded the bid for the expansion of Gaping Maw Cave. The goal was to push the boulder filled pit at the back of the cave, taking it down at least 6 ft. The Zarria team made their way down the pit that was chalked with large breakdown blocks and heavily glued together with calcification. Once they made it down 8 ft, they hit a room approximately 3 ft wide by 6 ft long and 2 ft tall. The new room has a mud floor, and at the end, airflow can be felt coming out of a shallow bedding plane. The team had also made their way into another room above the pit that is approximately 3 ft wide and 4 ft long by 2 ft tall (Figure 13). Both new rooms have great potential to become very good species habitat. A drip gauge was placed under Dragon Egg Drip approximately where the column is shown in the profile view below. *Tashaneta devia*, *Rhadine persephone*, and *Rhadine subterranea* have all been observed in the cave. and *Texella reyesi* was finally seen in FY23 on the fourth and fifth surveys during both spring and fall surveys (Figure 14).

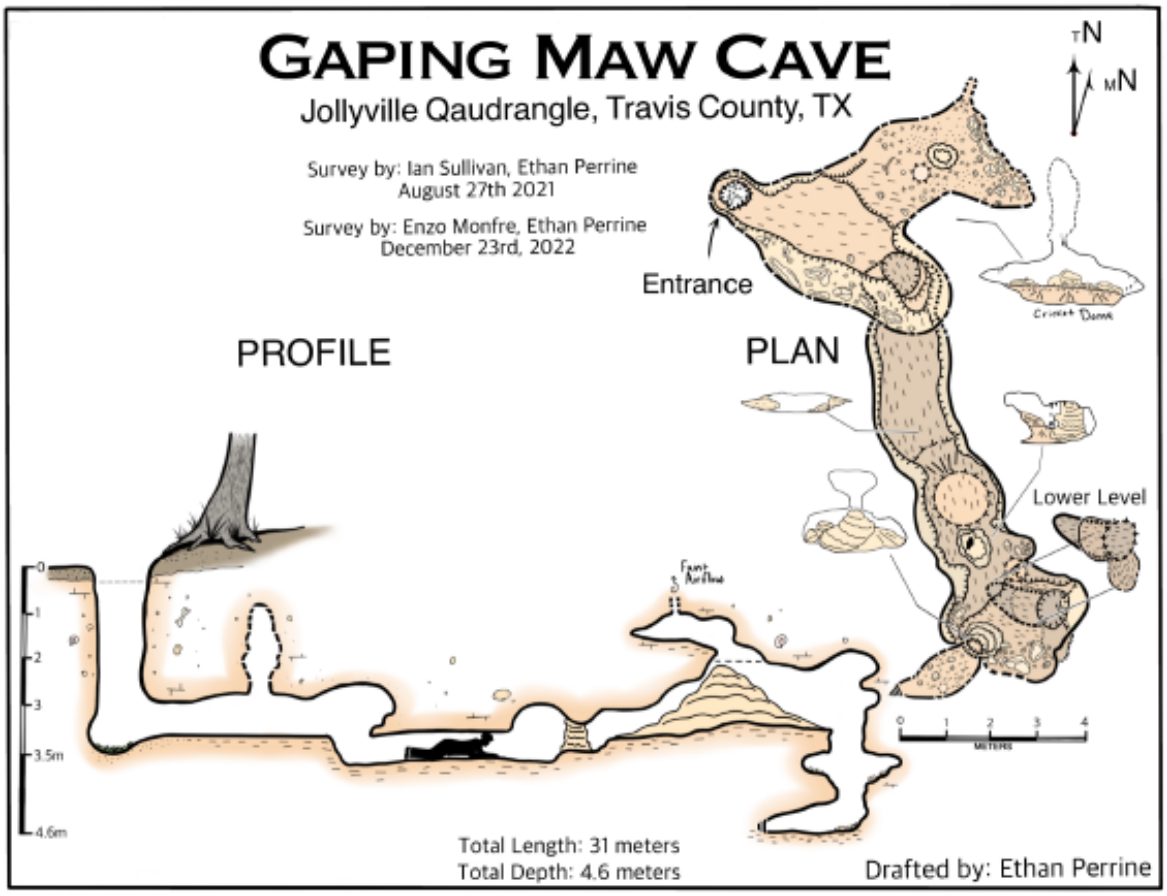


Figure 13. Gaping Maw Cave map, drafted by Ethan Perrine



Figure 14. *Texella reyesi*, Gaping Maw Cave, 5-15-2023, photo by Colin Strickland

Sacred Grove Cave

Sacred Grove was initially found by Colin Strickland in 2019 (Figure 15), and he made it about 6 ft deep when restoration work started in 2020. Zarria Environmental worked on it during August and September 2022, restoring the feature around 15 ft deep where it opened into a room with about 1 ft of space between the dirt floor and solid rock ceiling (Figure 16). Colin Strickland did a faunal survey on September 17th, 2022, and found one *Cicurina travisae*, two *Cambala speobia*, and about a dozen *Ceuthophilus secretus*.



Figure 15. Scared Grove Sink, March 10th, 2020, photo by Colin Strickland



Figure 16. Scared Grove Cave, September 17th, 2022, photo by Colin Strickland

In FY23, Zarria Environmental enlarged the passage and hit a small room. Colin Strickland, Mark Sanders, Drew Thompson, and Guin McDaid worked for a few hours on May 9, 2023 to enlarge some areas to make performing a faunal survey easier, and added habitat rocks along the passage. Colin started mapping the cave on June 7, 2023 and only partially finished (Figure 17). He returned on August 4, 2023 to find both good and bad news. The good news is there was a proliferation of *Pseudosinella violenta* springtails. Colin estimated over 3,000 in the cave and took this video under a cricket dome with large numbers below it. *Pseudosinella violenta* under cricket dome, Sacred Grove Cave, 8-4-2023 The bad news was the cave was overrun with red imported fire ants. The cover photo of this report shows a springtail being carried away, but it is unclear if it was alive when captured or if it was one Colin unintentionally crushed. Colin did not attempt to continue mapping since there were too many fire ants. Thankfully when he returned for a faunal survey in the fall the fire ants were gone. There is currently about 40 ft of passage, but there is airflow at a lead to the northwest and the passage to the northeast is going but filled with soil. Mapping, faunal surveys and perhaps pushing leads will continue in FY24.

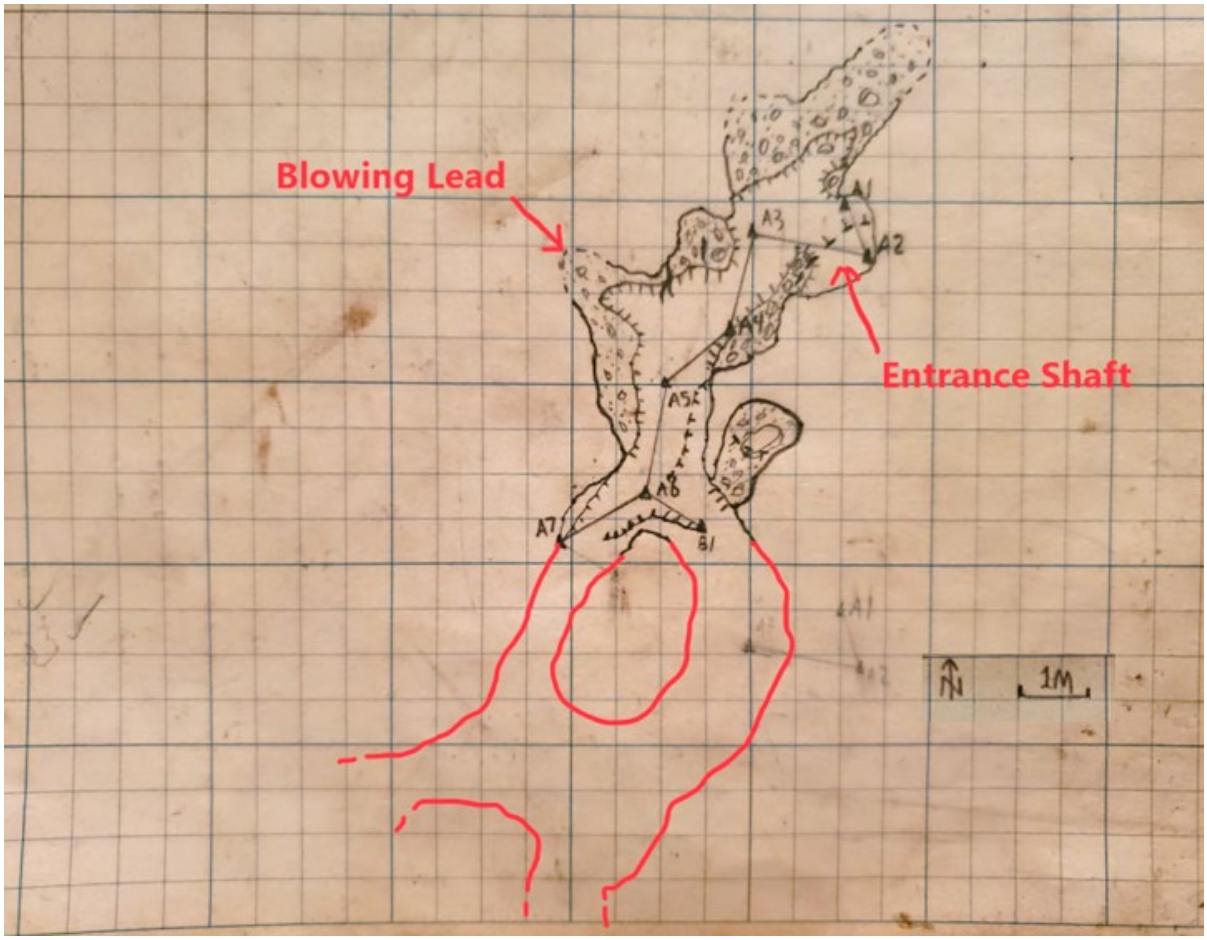


Figure 17. Incomplete sketch of Sacred Grove Cave by Colin Strickland

Kent Butler Preserve Cave Restoration

Zarria Environmental Consulting (ZEC) worked in the fall of 2023 and into FY24 to investigate and attempt to open several features on the Kent Butler tract. Work was performed at Shatter Sink, Jolly Villain Pit, Plethodon Parlor Pit, and Sleipnir Cave. Since most work happened in FY24 this will be covered in next year's report.

Park West Preserve Cave Restoration

Wooden Derrick Cave

In April of 2023, Charley Savvas and his crew were contracted through the master cave contract to continue excavations on Wooden Derrick Cave. Prior to this round of excavations, the cave only had a depth of 30 ft and no side passages. Savvas's crew was able to expand the cave 5 ft deeper and 25 ft horizontally east. This horizontal passage is approximately 2 to 3 ft tall and 3 to 4 ft wide with a length of 25 ft ending in a mud bank with 1 inch of opening across the top between the ceiling. Airflow and signs of water movement were noted in the back moving past the mud hump. A final draft of the map will be attached in the BCCP 2024 annual report. Further excavations on Wooden Derrick Cave would be advised due to the biological and hydrological significance of the feature and obvious signs that the passage continues.

South Austin Cave Restoration

Cricket Cave

Cricket Cave was discovered by Lady Bird Johnson Wildflower Center (WFC) staff in 2018. It was found due by observing a large vapor plume early on a cold morning. The entrance was approximately 4 inches in diameter, but a depth of over 6 ft could be seen. At this point, work was still ongoing to create a formal agreement between the Wildflower Center and the Wildland Conservation Division to open and manage caves and features on their property. Once the agreement was approved, a restoration plan and scope of work that included methods of excavation, spoil containment and disposal, impact reduction, revegetation, stabilization, and allotted time to complete the excavation was submitted.

The initial excavation was conducted in November of 2021 by Drew Thompson, Mark Sanders, Colin Strickland, and Patty Calabrese. The entrance was enlarged to allow access resulting in a 2 ft by 3 ft entrance that led into a 16 ft vertical squeeze into a large room. The first member down into the cave was Patty Calabrese who reported a heavily decorated room, spanning 15

ft by 30 ft with ceiling a height of 10 ft (Figure 18). At this point, we had named the cave Lady Bird Lounge, but the agreement with the WFC said they had the right to name the caves. They voted to name it Cricket Cave in honor of the ecologically important cave crickets that inhabit the cave. The first large room was eventually named Lady Bird Lounge.

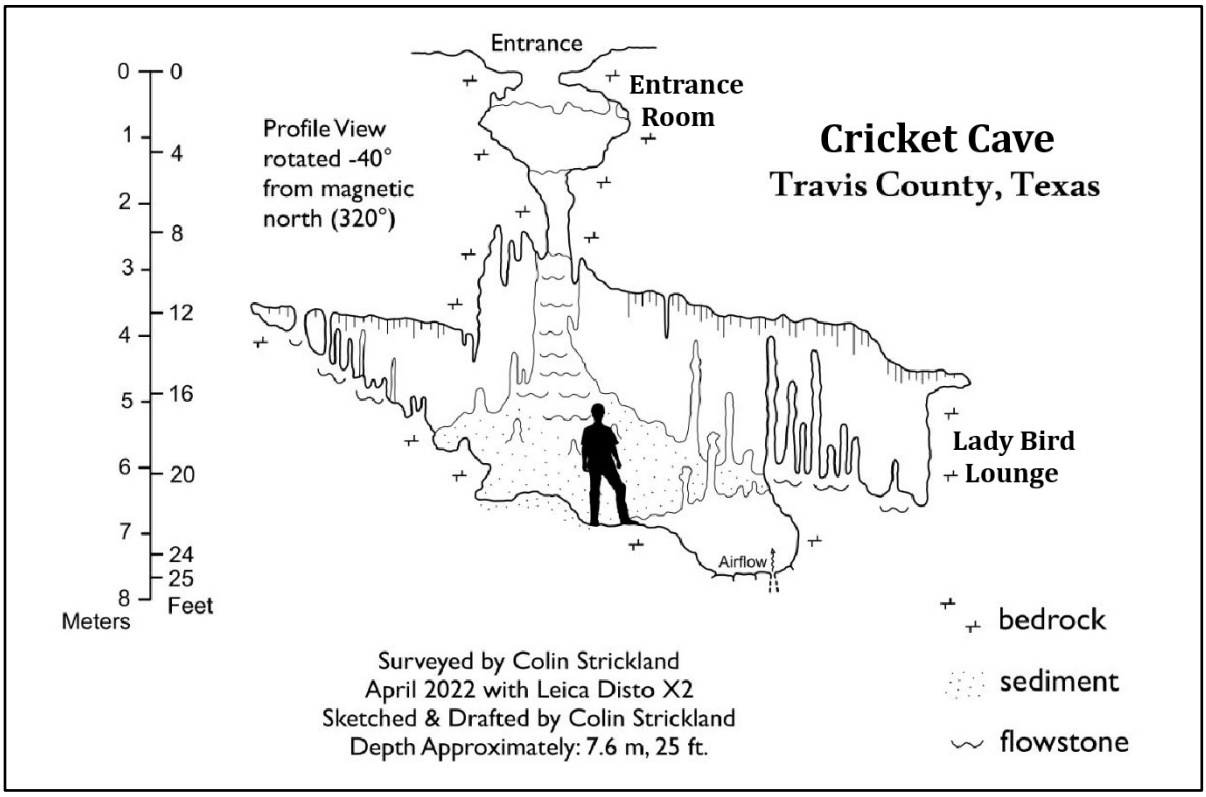


Figure 18. Initial extent of Cricket Cave

The southeast corner of the large room was the lowest part of the cave and airflow was noted coming up through large breakdown blocks. Drew Thompson, Ethan Perrine, Eléonore Le Corvaisier, and Mila Yegorova, proceeded to break up and remove the material from the cave. After 10 ft of excavating down through the breakdown blocks the team discovered two smaller rooms that were covered in popcorn calcite formations (Figure 19).

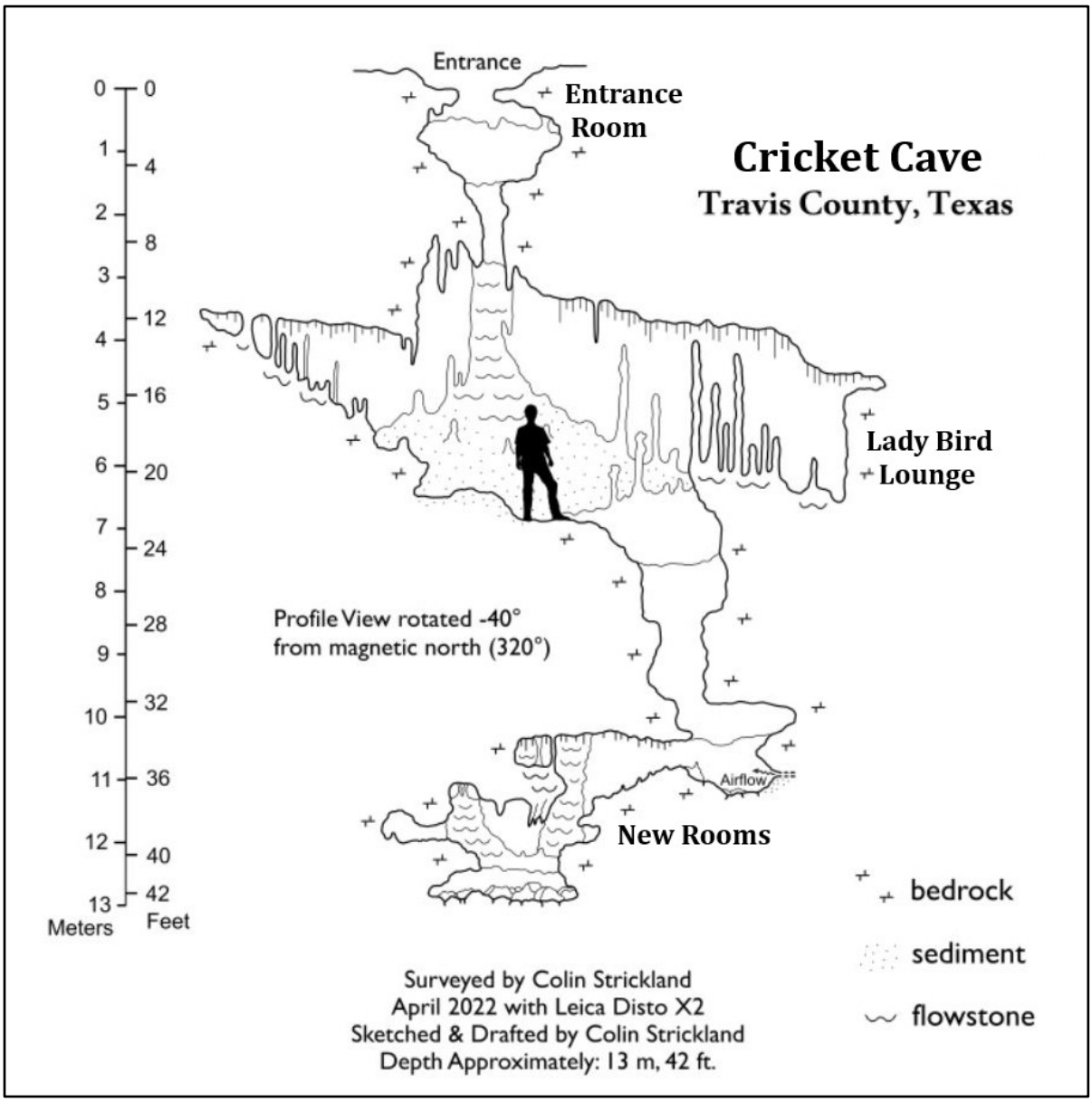


Figure 19. Two small rooms discovered in Cricket Cave

To the east was a shallow bedding plane with a very large amount of airflow. The team excavated horizontally removing chalk like limestone material (pulveriolite). At the end of the 15-ft crawl the team discovered a larger even more heavily decorated room approximately 50 ft by 30 ft with a ceiling of around 20 ft at the highest point. It was named the Omelet (Figure 20).

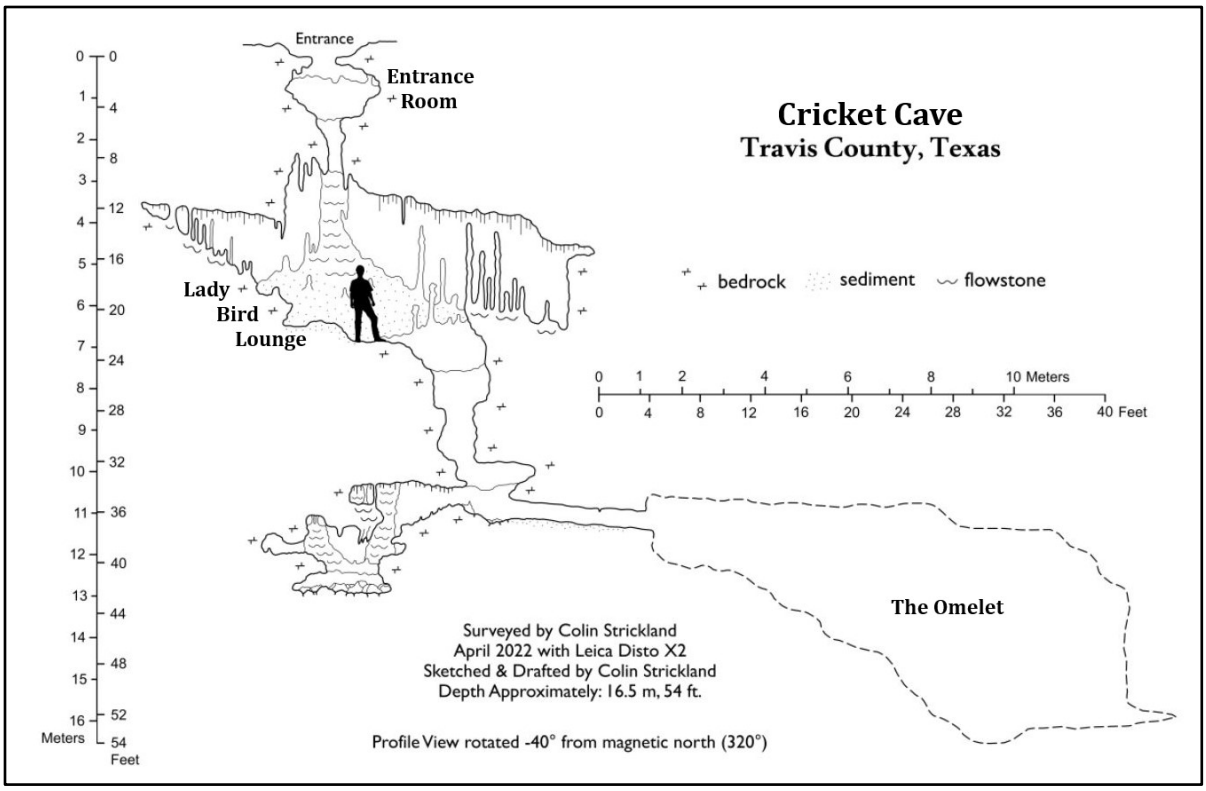


Figure 20. Discovery of the Omelet in Cricket Cave

Many of the formations are extremely beautiful with totems taller than people and a couple of soda straws over 4 ft long (Figure 21). The excavation portion of the project had come to completion and Colin Strickland continued his work on mapping the cave. While mapping, two leads were found going from the main room. The first being a corkscrew climb down through breakdown into a stair stepped room of pulverized limestone with dimensions of 20 ft by 5 ft by 4 ft tall dubbed the Pulveriolite Staircase. The other lead on the far side of The Omelet consisted of a squeeze through a bedding plane in the balcony. Drew Thompson squeezed through this passage on Colin Strickland's birthday as Colin was mapping and the passage led to another room dubbed the Birthday Balcony which is approximately 50 ft by 40 ft with a ceiling height of 8 ft in the middle (Figure 22). The relation between the Omelet, the Pulveriolite Staircase, and the Birthday Balcony are shown in Figure 23. The sketching of the rest of the cave and drafting of a map is scheduled for FY24.



Figure 21. Mila Yegorova and Drew Thompson in The Omelet, photo by Colin Strickland



Figure 22. Ethan Perrine and Guin McDaid in the Birthday Balcony, photo by Drew Thompson

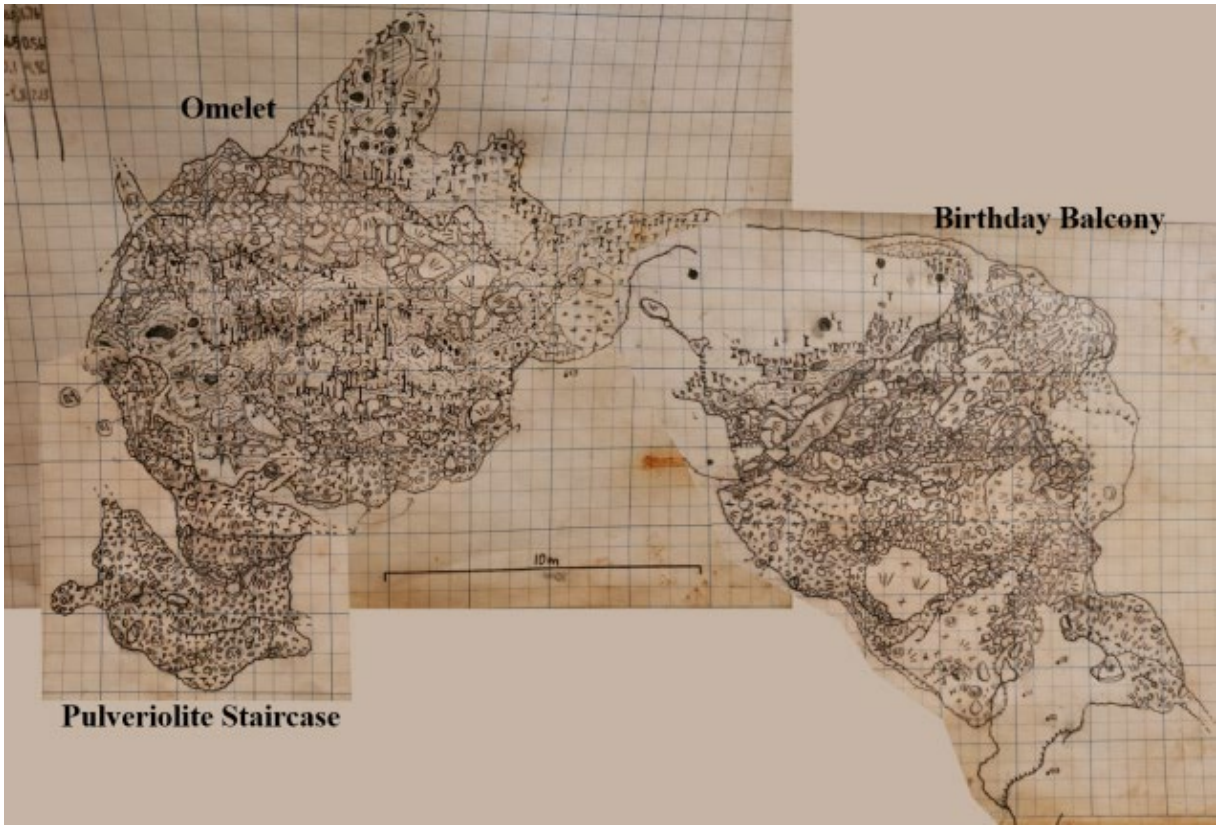


Figure 23. Plan sketch of Cricket Cave lower level by Colin Strickland

8.0 RECOMMENDATIONS

COA and TC should continue to contact the owners of each privately-owned BCCP cave to assess current faunal assemblages and negotiate protection of these caves. The precise location of some of these privately owned caves is currently unknown; therefore, COA and TC should attempt to locate these caves to make a meaningful assessment. Staff will also continue to search for possible substitutions for caves that cannot be acquired or lack adequate protections. Additionally, COA and TC will continue to evaluate the adequacy of protections for all 62 BCCP caves by continuing hydrological studies initiated in FY19 and prioritize efforts accordingly. Karst preserves will be established to preserve the surface and subsurface catchment areas, cave cricket foraging areas, and other guidelines for preserves outlined by USFWS (2012).

Future research needs for the BCP should include an effort to determine to species level currently unknown troglobites such as *Speodesmus* spp., *Eidmannella* spp., and Trichoniscidae found in BCP caves to determine if these species are species of concern listed on the BCCP Permit. A recent research need has also been identified by James Reddell concerning *Rhadine* beetles in the region, with the possibility that potentially two undescribed species could be found within BCP caves. Future research and funding may be needed to answer these research questions.

9.0 KARST MANAGEMENT ACTIVITIES

The BCP Karst Land Management Plan (2016) outlines planned activities concerning the 62 BCCP karst features. Table 10 below includes a summary of monitoring and management activities for these features completed in FY23.

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
Adobe Springs Cave The Nature Conservancy 1. TC was granted continued permission from TNC to perform bi-annual faunal surveys and cave cricket exit counts for the expanded BCP Cave Monitoring program. 2. TC performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 3. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 4. TC conducted bi-annual cave cricket exit surveys due (See EXHIBIT B).
Airmen's Cave City of Austin 1. Conducted annual cave faunal surveys (See EXHIBIT A). 2. COA installed a cave gate within 18 ft of the entrance of the cave in January 2012. The cave gate not only protects the cave from ongoing vandalism, but also serves to protect the public from future accidents involving un-trained access. Access is still allowed via permit. 3. Conducted quarterly site inspections and continued to operate security camera. No signs of vandalism to the cave gate were noted, however, vandals spray painted graffiti at the entrance, staff removed the graffiti and reported the incident to Park Rangers. 4. An interdepartmental agreement between PARD and AW BCP is being sought necessary to establish formal BCCP karst preserve management. 5.An access easement with one of the overlying property owners was approved on August 16, 2023 it secures future access for monitoring and management activities.
Amber Cave Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA. A total of seven mounds was treated within the 80 m buffer and none outside of it in Spring 2023. 4. TC conducted annual cave faunal surveys (see EXHIBIT A). 5. TC conducted annual cave cricket exit surveys due (See EXHIBIT B).
Armadillo Ranch Sink Private
Arrow Cave City of Austin 1. Completed annual cave faunal survey (See EXHIBIT A). 2. Conducted quarterly site inspections with no signs of vandalism to the cave entrance/ gate, however, city staff continues to deal with ongoing dumping problems from the adjacent neighborhood. COA PARD Rangers continue to conduct occasional patrols at these problematic sites. 3. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
Bandit Cave Private
Beard Ranch Cave (Featherman's Cave) City of Austin 1. Completed annual cave faunal survey (See EXHIBIT A). 2. Conducted quarterly site inspections. 3. No RIFA were found. A healthy population of native fire ants was found near the cave.
Bee Creek Cave Private 1. The owner was contacted in FY21 to inquire about acquisition or management, with negative results 2. AW BCP will continue seeking acquisition of Bee Creek Cave or acquisition of substitution cave.
Blowing Sink Cave City of Austin 1. Inspected monthly and continued to operate security cameras, no signs of vandalism were noted. 2. Completed annual cave faunal survey (See EXHIBIT A). 3. The lower passageways have been inaccessible since the October 2013 flood; however, it is possible that some of the recently restored adjacent caves may lead to the water table. With the recent installation of the shaft allowing direct entry into the main passage of the cave, future excavation work will be feasible, thus allowing rock and silt to be removed which would open up the lower passageways of the cave. 4. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management. 5. COA BCP appreciates permission from PARD Natural Resources Division Austin Nature Preserves to access the site.
Broken Arrow Cave City of Austin 1. Inspected quarterly with no sign of human visitation or vandalism. 2. Completed bi-annual faunal surveys (See EXHIBIT A). 3. Completed bi-annual cave cricket exit counts. (See EXHIBIT B). 4. Staff continue to observe one Jollyville Plateau salamander in the cave pool, taking photos to determine if it's the same individual. 5. Staff conducted twice yearly RIFA control with boiling water.
Buda Boulder Spring City of Austin 1. COA BCP staff conducted bi-annual site visits and noted signs of recent transient camps near the spring. COA PARD Rangers were notified and now periodically patrol the site. 2. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
Cave X Private 1. COA entered into a Private Landowner Agreement entitled "Cave X, Management and Monitoring Plan, Covenants and Restrictions" with the property owners (Regent's School) in Oct. 1999. The agreement sets aside a 4.5-acre area to protect the cave footprint. USFWS was involved in the discussions on protection. 2. Cave entrance is gated and has a fence for added protection. 3. Regent's School staff conduct periodic surface inspections of the cave including gate and lock maintenance. 4. To get a better understanding of CO_2 levels in Cave X and assist in managing/monitoring, COA BCP staff requested access to install air monitoring equipment but were declined by the owner in September 2017. 5. Regents built a sports field within the Cave X buffer, over the footprint of the cave sometime between January 2018 and November 2019. Regents School sent WP staff a proposed restoration plan on December 6, 2022, which was approved in March 2023.

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
Cave Y City of Austin 1. Conducted quarterly site inspections. 2. Completed bi-annual cave faunal survey (See EXHIBIT A). 3. Completed bi-annual cave cricket exit counts. (See EXHIBIT B). 4. Surveyed site for RIFA; no mounds were discovered within the cave's treatment area. 5. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
Ceiling Slot Cave Private
Cold Cave 1. TC is negotiating with the landowners concerning the possibility of purchase, conservation easement, or a management agreement for this 8-acre tract. 2. TC gained continued permission from landowner to perform bi-annual faunal surveys and cave cricket exit counts for the expanded BCP Cave Monitoring program. 3. TC performed surface inspections with no signs of vandalism to the cave entrance or in the cave, but the cave gate still in need of repair 4. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 5. TC conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).
Cotterell Cave City of Austin 1. Conducted quarterly site inspections. 2. RIFA surveys determined that the ants were located approximately 300 ft from the cave, so no treatment was needed. 3. Conducted bi-annual cave faunal surveys (see EXHIBIT A). 4. Conducted bi-annual cave cricket exit surveys. (See EXHIBIT B). 5. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
Disbelievers Cave Private 10a Permit: PRT-808694
District Park Cave City of Austin 1. BCP staff conducted bi-annual cave faunal surveys (See EXHIBIT A). 2. BCP staff and volunteers conducted bi-annual cave cricket exit counts (See EXHIBIT B). 3. Conducted site surveys quarterly, other than trash at the entrance no new major problems noted. 4. Permitted access to this cave was allowed. 5. BCP staff removed trash from the un-gated portion of the cave. 6. COA BCP hydrogeologist continued to work on a hydrological study to determine the sub-surface drainage and to see if the adjacent developed area of the park could negatively impact the cave (ongoing). 7. Surveyed site for RIFA; no mounds were discovered within the cave's treatment area. 8. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
Eluvial Cave Private 10a Permit: PRT-808694

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
Flint Ridge Cave City of Austin 1. Conducted monthly site visits and continued to operate security cameras, no signs of vandalism were noted. 2. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 3. BCP staff conducted bi-annual cave cricket exit counts (See EXHIBIT B). 4. Continuous monitoring of drips was conducted in various rooms. 5. Flow meters and autosamplers were maintained at the entrance sink. 6. The four autosamplers were installed inside Flint Ridge Cave were monitored and maintained. 7. COA BCP drafted a hydrogeologic study report that will delineate the subsurface catchment areas of water sources. This is expected to be released in FY24. 8. BCP staff continuously monitor temperature, pH, dissolved oxygen, salinity, and turbidity with a mini-sonde hydrolab. 9. Construction of SH45SW was completed and sections of this highway are over portions of the cave and its surface/subsurface catchment areas. 10. Staff conducted a Spring RIFA control with boiling water
Fossil Cave City of Austin 1. Inspected bi-annually and found no new signs of vandalism 2. Inspected for RIFA infestations on all visits. RIFA were observed within close proximity of the "suspected" cave. 3. While there are about 10 filled caves located in Schroeter Park, and it is unclear which might be Fossil Cave, once an interdepartmental Agreement with PARD is completed that would allow AW BCP to restore Fossil Cave and establish a formal karst preserve with protective measures within a city park.
Fossil Garden Cave Private 1. Apple Inc completed construction of their new campus in November 2020, the new campus is located immediately adjacent to Fossil Garden Cave.
Gallifer Cave Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. In FY21, Zara Environmental restored the entrance of the cave including the removal of the old gate and the construction of a new one. 4. Surveyed site for RIFA. A total of three mounds was treated within the 80 m buffer and one outside of it in Spring 2023. 5. Conducted bi-annual cave faunal surveys (see EXHIBIT A). 6. Conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).
Get Down Cave City of Austin 1. In July of FY18, COA BCP and WPD signed an Interdepartmental Agreement which allows COA BCP to manage the karst preserve and Get Down Cave according to the Tier II karst management plan and allows WPD to manage the water quality ponds and underlying Millennium Cave, which they use in their aquifer education. 2. BCP staff continued to work with neighbors regarding ways to limit negative impacts to cave crickets while treating for RIFA on adjacent private property. The protocol was posted on their web site in FY23. 3. COA BCP staff helped support neighbor Stephanie Simmons with her "Texas Most Wanted" campaign, whose goal is to promote native plants by offering free plants to the public and encouraging neighbors to remove invasive non-native species. It is hoped that this type of public education will indirectly improve habitat on the preserve. 4. BCP staff completed annual cave faunal survey (See EXHIBIT A). 5. Conducted quarterly site visits and continued to operate security cameras, no vandalism was noted at the cave entrance/ gate. 6. Removed non-native invasive plants. 7. BCP staff continued to collect soft ticks from Live Oak Cave and to collaborate with Texas State and Baylor

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
researchers who are trying to determine more information about tick borne relapsing fever (TBRF). 8. BCP staff approved the HOA plan to hire a contractor to clear the trail of the remaining downed vegetation after the February 2023 ice storm. 9. Staff conducted twice yearly RIFA control with boiling water.
Goat Cave City of Austin 1. Completed annual faunal survey (See EXHIBIT A). 2. Conducted quarterly site surveys, staff continue to operate a cellular game camera to continuously monitor the cave 3. Allowed permitted access to this cave. 4. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management. 5. Surveyed site for RIFA; no mounds were discovered within the cave's treatment area.
Hole-in-the-Road Cave Private
Ireland's Cave Travis County 1. TC acquired the 4.8-acre tract containing the cave from Muirfield Homeowner Association and began full management of the cave and surrounding property in FY12. 2. Fencing was completed in FY15 on the perimeter of the Ireland's Cave tract to protect the cave preserve from trespass. 3. TC conducted an annual cave faunal survey (see EXHIBIT A). 4. TC and COA contracted with Zara Environmental to continuously monitor air quality in Irelands Cave. Ireland's Cave is known to have elevated levels of CO_2, and this study will provide vital information to staff on cave safety.
Jack's Joint Cave Private
Japygid Cave Private 10a Permit: PRT-808694
Jest John Cave City of Austin 1. Conducted biannual site visits. 2. Inspected site for RIFA infestations, no RIFA were observed near the cave. 3. Conducted one cave cricket exist count. (See EXHIBIT B).
Jester Estates Cave City of Austin 1. BCP staff conducted 10 site visits looking for signs of illegally discharged pools, dumped brush and trash from neighbors. It appears that past and current educational efforts have paid off, since aside from minor brush dumping, no significant illegal activities were observed. 2. Shaded fuel break was completed in FY 23. 3. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 4. Conducted bi-annual cave cricket exit counts. (SEE EXHIBIT B). 5. BCP staff removed non-native invasive vegetation. 6. Surveyed site for RIFA; site was treated in the Spring with boiling water.
Jollyville Plateau Cave Private 10a Permit: PRT-808694

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
Kretschmarr Cave Travis County 1. Performed surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Part of the 105 m setback sustained impacts in FY19 from adjacent development in the form of tree clearing. Reparations have been collected and a restoration project was conducted in FY21. 4. In FY21, Zara Environmental restored the entrance of the cave including the removal of the old gate and the construction of a new one. 5. Surveyed site for RIFA. A total of 43 mounds was treated within the 80 m buffer and four outside of it in Spring 2023. 6. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 7. TC conducted bi-annual cave cricket exit surveys (See EXHIBIT B).
Kretschmarr Double Pit Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA. A total of 10 mounds was treated within the 80 m buffer and one outside of it in Spring 2023. 4. Conducted annual cave faunal survey (see EXHIBIT A).
Lamm Cave Section 7 Permit 2-15-93-F-075 (See USFWS files) 1. The City of Austin negotiated protective measures for this cave including a Land Management Plan for this cave. The cave has a setback size of approximately 4.13 acres. The radius of the setback varies from a minimum of 123 ft south of the cave to a maximum of 340 ft north of the cave. 2. The cave was gated, and the preserve area was fenced following COA WPD and BCP staff recommendations and design. 3. No application of fertilizers, pesticides or herbicides will be allowed in the CEF area. 4. TC staff continue to periodically monitor the site to make certain that the gates and fences are secure. 5. Walmart has closed the store and sold the property. COA and TC BCP staff will continue to monitor the site and attempt to contact the new owner regarding management and monitoring needs.
Little Bee Creek Cave City of Austin 1. Conducted quarterly site visits. 2. Conducted bi-annual cave faunal survey (See EXHIBIT A). 3. Conducted annual cave cricket exit counts. (See EXHIBIT B).
Lost Oasis Cave TCMA 1. Conducted five site visits. 2. COA WPD led one cave education trip. 3. COA AW led one cave education trip. 4. COA BCP staff treated the site for RIFA with boiling water. 5. Conducted bi-annual cave faunal survey (See EXHIBIT A). 6. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B). 7. Removed non-native invasive plants. 8. New fencing was installed by TCMA. 9. Formal management agreement with AW BCP to ensure permit compliance was signed by all parties on May 4, 2021 10 COA BCP staff planted tree and shrub saplings to enhance cave cricket habitat.

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
Lost Gold Cave Private 1. The owner of the lot removed the fence for the buffer lot, cleared vegetation within the surface catchment up to the entrance of Lost Gold Cave, placed mulch and a playscape in the preserve buffer lot, WP staff attempted. to work with the owner to restore the site, however, at some point gave the City Environmental Officer gave the property owner a variance to allow the encroachment to stay in place so therefore the cave is not protected.
Maple Run Cave City of Austin 1. Conducted bi-annual cave faunal survey (See EXHIBIT A). 2. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B). 3. COA BCP staff conducted quarterly site inspections and removed trash from preserve area, no vandalism was noted at the cave gate. 4. Permitted access to this cave is allowed. 5. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
McDonald Cave Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA but no mounds were found in Spring 2023. 4. Conducted annual cave faunal surveys (see EXHIBIT A).
McNeil Bat Cave Private
Midnight Cave City of Austin 1. Conducted quarterly site inspections, no vandalism was noted. Staff continue to monitor a cellular game camera and continue to make improvements to the gate and fence to better secure the site. 2. Conducted bi-annual cave faunal surveys. (See EXHIBIT A). 3. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B). 4. Permitted access to this cave is allowed, though no access permits were granted this fiscal year.5. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management. 5. COA BCP staff planted tree and shrub saplings to enhance cave cricket habitat. 6. Staff conducted twice yearly RIFA control with boiling water.
M.W.A. Cave Private 10a Permit: PRT-808694
Moss Pit Cave Private
New Comanche Trail Cave Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. TC conducted annual cave faunal survey (see EXHIBIT A). 4. TC conducted annual cave cricket exit survey. (See EXHIBIT B).

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
No Rent Cave Travis County 1. TC acquired No Rent Cave and surrounding land that protects a portion of the cave cricket foraging area and surface/subsurface drainage basins in FY19. 2. Zara Environmental installed an elevated cave gate in FY19. 3. TC performed surface inspections with no current signs of vandalism to the cave entrance or in the cave. 4. TCA was first observed in February 2022 around the entrance of the cave as well as within. TC has been working with Dr. Ed LeBrun at BFL to study and inoculate the population. 5. TC conducted quarterly cave faunal surveys (see EXHIBIT A). 6. TC conducted quarterly cave cricket exit surveys. (See EXHIBIT B).
North Root Cave Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA. A total of seven mounds was treated within the 80 m buffer and six outside of it in Spring 2023. 4. TC conducted an annual cave faunal survey (see EXHIBIT A).
Pennie's Cave Private 1 The entrance was re-excavated in 2012, providing access to the cave. 2.The cave entrance has been gated and fenced; boulders were also placed around the cave at the edge of a 300-ft buffer to better define the protected area. 3. Zara Environmental has continued to secure one-year contracts to conduct cave faunal surveys and treat the site for RIFA. Although only a one-year contract, it is hoped that the owner will extend the contract for multiple years. 4. Zara Environmental provided an annual report to the BCP on all monitoring and management activities (report can be seen in Balcones Canyonlands Conservation Plan Annual Report Appendices).
Pickle Pit Cave Private USFWS Section 7 Permit 2-15-93-F-075 1. A volunteer neighbor occasionally monitors the cave entrance/ gate monthly; no problems noted.
Pipeline Cave Private 1. A 2004 agreement between COA and Stratus set aside an approximately 8-acre buffer around Pipeline Cave that varies from 100 ft to the east and up to 300 ft west of the cave and an additional setback of 300 ft to the north and west; 150 ft. to east and south for the adjacent feature known as Confusion Sink. 2. Developer installed cave gate (including a gate on the nearby "Confusion Cave.") 3. In August 2018, COA BCP staff met with the property manager and obtained provisional access to begin monitoring and management of Pipeline and the adjacent Confusion Cave according to the Tier II karst land management plan. 4. Conducted bi-annual cave faunal surveys. (See EXHIBIT A). 5. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B). 6. COA BCP provided a monitoring and management report to the property manager. 7. Staff has removed trash fill from the cave on multiple occasions, which is initially dated to late 1950's and early 1960's.
Rolling Rock Cave City of Austin 1. Inspected quarterly and no sign of human visitation or vandalism was found. 2. Conducted one cave faunal survey. (See EXHIBIT A).

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
Root Cave Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA. A total of eight mounds was treated within the 80 m buffer and six outside of it in Spring 2023.
Slaughter Creek Cave City of Austin 1. Conducted quarterly site inspections. 2. Conducted one cave faunal survey. (See EXHIBIT A) 3. An interdepartmental agreement between PARD and AW BCP is being sought to establish formal BCCP karst preserve management.
Spanish Wells Cave Travis County 1. TC acquired Spanish Wells Cave and surrounding land that protects the cave cricket foraging area and surface/subsurface drainage basins in FY15. 2. Performed surface inspections with no signs of trespass or vandalism to the cave entrance or in the cave. 3. Surveyed site for RIFA. A total of 11 was treated within the 80 m buffer and none outside of it in Spring 2023. 3. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 4. Conducted bi-annual cave cricket exit count. (See EXHIBIT B).
Spider Cave City of Austin 1. Conducted four site visits, and no sign of human access or vandalism was found. 2.Conducted bi-annual cave faunal surveys (See EXHIBIT A). 3. Conducted bi-annual cave cricket exit counts. (See EXHIBIT B). 4. As part of the new adjacent highway expansion work, TXDOT has provided funds for hydrological studies, which includes excavation of features adjacent to Spider Cave, the ultimate goal of finding active drips which would allow for dye trace studies that would accurately determine the subsurface drainage basin.
Stark's North Mine Travis County 1. TC acquired this cave and 0.8 acres surrounding it in FY12. The area surrounding the cave is all previously developed. 2. TC acquired a conservation easement on the adjacent 0.38 acres which contains much of the cave cricket foraging area. 3. Performed surface inspections and detected signs of vandalism to the cave entrance and inside the cave. Cave gate was subsequently repaired by Zara Environmental. 4. Surveyed site bi-annually for RIFA. No mounds found within 80 m of cave. 5. Attempted to collect aquatic species by setting traps in both pools but was unsuccessful. Water samples were taken, and a drip monitor was installed in the cave. 6. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 7. Conducted bi-annual cave cricket exit counts (See EXHIBIT B).
Stovepipe Cave 1. Conducted 6 site inspections and continued to remove new and old trash from the preserve. 2. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 3. Conducted bi-annual cave cricket exit counts (See EXHIBIT B). 4. Surveyed site for RIFA; no mounds were discovered within the cave's treatment area. 5. Continued karst assessment of site in FY23. 6. As part of the new adjacent highway expansion work, TXDOT has provided funds for hydrological studies,

Table 10. FY23 BCCP Karst Feature Monitoring and Management Activities.
which includes excavation of features adjacent to stovepipe cave, the ultimate goal of finding active drips which would allow for dye trace studies that would accurately determine the subsurface drainage basin. 7. As part of a hydrological study, the drip gauge that was installed in FY 20 was continued to be monitored in FY23.
<u>Talus Spring Cave</u> Private 1. The USFWS 10a permit PRT 815447 mitigation requirement intended this cave to go to TC, however, the cave is located on private land just outside of the mitigation area. TC has continued requesting that the homeowner's association donate the land to TC. 2. Performed surface inspections with no signs of vandalism to the cave entrance or in the cave. 3. Conducted annual cave faunal survey (see EXHIBIT A). 4. Performed a non-native plant removal project on tract to increase native plant diversity.
<u>Tardus Hole Cave</u> Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Surveyed site for RIFA. A total of 11 was treated within the 80 m buffer and one outside of it in Spring 2023. 4. Conducted annual cave faunal survey (see EXHIBIT A).
<u>Tooth Cave</u> Travis County 1. Performed periodic surface inspections with no signs of vandalism to the cave entrance or in the cave. However, a homeless camp was found onsite in the Fall of 2108 and was removed. 2. Maintained fencing and signage to protect this area from unauthorized access and dumping. 3. Zara Environmental replaced old cave gate with a newer elevated gate in FY18. 4. Surveyed site for RIFA. A total of 10 was treated within the 80 m buffer and none outside of it in Spring 2023. 5. Conducted bi-annual cave faunal surveys (see EXHIBIT A). 6. Conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).
<u>Weldon Cave</u> Travis County 1. TC acquired Weldon Cave and surrounding land that protects a portion of the cave cricket foraging area and surface/subsurface drainage basins in FY19. 2. Zara Environmental install a cave gate in FY19. 3. TC performed surface inspections with no current signs of vandalism to the cave entrance or in the cave. 4. TCA was observed around the entrance of the cave in February 2022 and within the cave in May of 2022. TC has been working with Dr. Ed LeBrun at BFL to study and inoculate the population. 5. TC conducted quarterly cave faunal surveys (see EXHIBIT A). 6. TC conducted quarterly cave cricket exit surveys. (See EXHIBIT B).
<u>Whirlpool Cave</u> TCMA 1. Formal management agreement with AW BCP to ensure permit compliance was signed by all parties on May 4 2021 2. COA conducted bi-annual cave faunal surveys (see EXHIBIT A). 3. COA conducted bi-annual cave cricket exit surveys. (See EXHIBIT B). 4. Continuous monitoring of CO_2, humidity, and airflow is being conducted in the East caverns passage by COA BCP staff.

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EXHIBIT A:

KARST FAUNAL SURVEY REPORTS

FY23 City of Austin/Travis County Karst Faunal Surveys[1, 2]

			Endangered Species						Species of Concern											Other Significant Troglobites							
Cave	**Survey Date**	**Monitoring Agency**	***Rhadine persephone***	***Tartarocreagris texana***	***Tayshaneta myopica***	***Texamaurops reddelli***	***Texella reddelli***	***Texella reyesi***	***Caecidotea reddelli***	***Cicurina bandida***	***Cicurina travisae***	***Eidmannella reclusa***	***Rhadine austinica***	***Rhadine subterranea***	***Sphalloplana mohri***	***Tartarocreagris comanche***	***Tayshaneta concinna***	***Tayshaneta devia***	***Texella spinoperca***	***Cicurina bawata***	***Speodesmus bicornourus***	***Speodesmus* sp.**	***Tartarocreagris attenuata***	***Tartarocreagris infernalis***	***Tayshaneta* sp.**	***Texella mulaiki***	**Other notable species detected**
Adobe Springs Cave	11/10/2022	TC																		2							*Cambala speobia* (1)
Adobe Springs Cave	6/6/2023	TC																		3							*Cambala speobia* (1)
Airman's Cave	2/10/2023	COA								22									6		12						*Perimyotis subflavus* (1)
Arrow Cave	9/28/2023	COA								4												9				5	*Cambala speobia* (1)
Black-cap Cave	1/23/2023	COA																									*Perimyotis subflavus* (1)
Black-cap Cave	8/7/2023	COA						1			3	5															
Blowing Sink Cave	9/21/2023	COA								30			4									9				2	*Cambala speobia* (1) *Texoreddellia* sp. (2) *Tartarocreagris* sp. (1)
Broken Arrow Cave	11/3/2022	COA																		6		7					*Cambala speobia* (31) *Eurycea tonkawae* (1) *Stygobromus russelli* (3)
Broken Arrow Cave	5/8/2023	COA							1											12		4					*Cambala speobia* (47) *Eurycea tonkawae* (1) *Stygobromus russelli* (1)
Cave Y	1/11/2023	COA																									*Perimyotis subflavus* (12) *Texella grubbsi* (2)
Cave Y	8/15/2023	COA								4																	*Texella grubbsi* (9) *Cambala speobia* (1)
Cold Cave	2/21/2023	TC						1												49		13					*Batrisodes* sp. (2) *Cambala speobia* (~505) Pseudoscorpindia (2)
Cold Cave	8/28/2023	TC						4												17		6					*Cambala speobia* (365) Pseudoscorpindia (2)
Cortana Cave	1/13/2023	COA			42			5			4	36										12					*Cambala speobia* (1)
Cortana Cave	8/4/2023	COA			18			5			5	28															*Cambala speobia* (12)
Cotterell Cave	1/20/2023	COA						22			41										26			4			*Cambala speobia* (16)
Cotterrell Cave	8/4/2023	COA						21			35			1							28			6			*Cambala speobia* (19)
Cricket Cave	10/25/2022	COA								3												1					

			Endangered Species						Species of Concern											Other Significant Troglobites							
Cave	Survey Date	Monitoring Agency	*Rhadine persephone*	*Tartarocreagris texana*	*Tayshaneta myopica*	*Texamaurops reddelli*	*Texella reddelli*	*Texella reyesi*	*Caecidotea reddelli*	*Cicurina bandida*	*Cicurina travisae*	*Eidmannella reclusa*	*Rhadine austinica*	*Rhadine subterranea*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Tayshaneta concinna*	*Tayshaneta devia*	*Texella spinoperca*	*Cicurina bawata*	*Speodesmus bicornourus*	*Speodesmus* sp.	*Tartarocreagris attenuata*	*Tartarocreagris infernalis*	*Tayshaneta* sp.	*Texella mulaiki*	Other notable species detected
District Park Cave	11/23/2022	COA								3																	*Cambala speobia* (21) *Perimyotis subflavus* (2)
District Park Cave	5/11/2023	COA								14												1					*Cambala speobia* (35) *Texoreddellia* sp. (1)
Flint Ridge Cave	11/22/2022	COA																				8		1			*Texoreddellia* sp. (4)
Flint Ridge Cave	5/31/2023	COA																				10			2		*Texoreddellia* sp. (4) Japygidae (1)
Flying Kave	8/7/2023	TC																		9							*Cambala speobia* (2) *Eidmannella* sp. (2)
Gallifer Cave	3/1/2023	TC	1		36			12			73											1					*Cambala speobia* (2) *Eidmannella* sp. (9) *Perimyotis subflavus* (1)
Gallifer Cave	8/9/2023	TC			9			6			82											8					*Cambala speobia* (41) *Eidmannella* sp. (1)
Gaping Maw Cave	12/8/2022	COA										9		1													*Cambala speobia* (5) *Tayshaneta devia* (4)
Gaping Maw Cave	5/15/2023	COA						1			1	2		1							1						*Tayshaneta devia* (2)
Gaping Maw Cave	8/23/2023	COA						1			1	8									5						*Cambala speobia* (28) *Tayshaneta devia* (1)
Geode Cave	3/3/2023	TC			5						9																
Geode Cave	8/17/2023	TC			6						6	2															*Cambala speobia* (2) *Tartarocreagris* sp/ (1)
Get Down Cave	3/7/2023	COA								4																	*Cambala speobia* (2)
Goat Cave	9/20/2023	COA								8												2			4		*Cambala speobia* (2)
Hammett's Cave	2/28/2023	TC																									*Cambala speobia* (5) *Eidmannella* sp. (2) Pseudoscorpindia (3) *Tayshaneta paraconcinna* (12) *Texella* sp. (9)
Hammett's Cave	8/15/2023	TC																				1					*Cambala speobia* (1) *Cicurina* sp. blind (1) *Eidmannella* sp. (5) Pseudoscorpindia (3) *Tayshaneta paraconcinna* (6) *Texella* sp. (15)
Ireland's Cave	3/1/2023	TC								16			3								2						*Batrisodes* sp. (3) *Cambala speobia* (16)
Jester Estates Cave	11/23/2022	COA		1	16			41													2						
Jester Estates Cave	5/10/2023	COA		1	4			48			1										6						
Kretschmarr Cave	11/22/2022	TC				1					22			1													*Cambala speobia* (5) *Eidmannella* sp. (11)

			Endangered Species						Species of Concern										Other Significant Troglobites							
Cave	Survey Date	Monitoring Agency	*Rhadine persephone*	*Tartarocreagris texana*	*Tayshaneta myopica*	*Texamaurops reddelli*	*Texella reddelli*	*Texella reyesi*	*Caecidotea reddelli*	*Cicurina bandida*	*Cicurina travisae*	*Eidmannella reclusa*	*Rhadine austinica*	*Rhadine subterranea*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Tayshaneta concinna*	*Tayshaneta devia*	*Texella spinoperca*	*Cicurina bawta*	*Speodesmus bicornourus*	*Speodesmus* sp.	*Tartarocreagris attenuata*	*Tartarocreagris infernalis*	*Tayshaneta* sp.	*Texella mulaiki*	Other notable species detected
Kretschmarr Cave	5/24/2023	TC									13										1					*Cambala speobia* (7) *Eidmannella* sp. (13)
Kretschmarr Double Pit	12/1/2022	TC									1											1					*Cambala speobia* (4)
LaCrosse Cave	10/21/2022	COA								9			1									8			3	*Cambala speobia* (4)
Little Bee Creek Cave	11/2/2022	COA					1			1												2				*Cambala speobia* (3)
Little Bee Creek Cave	5/10/2023	COA					2			2																*Cambala speobia* (51) *Batrisodes uncicornis* (1)
Lost Oasis Cave	11/23/2022	COA								42												23				*Cambala speobia* (55) *Texoreddellia* sp. (1)
Lost Oasis Cave	5/11/2023	COA								30												9			1	*Cambala speobia* (49) *Texoreddellia* sp. (5)
Maple Run Cave	1/23/2023	COA								5												1				*Cambala speobia* (1) *Texoreddellia* sp. (1)
Maple Run Cave	8/15/2023	COA								4																*Texoreddellia* sp. (1)
McDonald Cave	8/18/2023	TC						1			62							22			11					*Batrisodes* sp. (1) *Cambala speobia* (64) *Eidmannella rostrata* (15) *Texoreddellia* sp. (1)
Midnight Cave	1/30/2023	COA								15			2									10				*Batrisodes* sp. (7) *Cambala speobia* (141) *Stygobromus* sp. (2)
Midnight Cave	8/10/2023	COA								18												1				*Cambala speobia* (44)
Millipede Annex Cave	11/18/2022	COA			4															6						
Millipede Annex Cave	5/17/2023	COA			2			4												4						*Cambala speobia* (2) *Stenochrus portoricensis* Campodeidae (6) *Tartarocreagris domina* (2) *Texoreddellia* sp. (1)
Millipede Cave	11/18/2022	COA			1															2						
Millipede Cave	5/17/2023	COA																		11						*Cambala speobia* (3) *Stenochrus portoricensis* (8) *Texoreddellia* sp. (2) *Lymantes* sp. (1)
New Comanche Trail Cave	8/17/2023	TC			6			1			7															
No Rent Cave	11/15/2022	TC						1												40						*Batrisodes* sp. (1) *Cambala speobia* (19) *Nylanderia fulva* (>5,000)
No Rent Cave	3/10/2023	TC																		23						*Cambala speobia* (27) *Eidmannella* sp. (9) *Nylanderia fulva* (~1725) *Texoreddellia* sp. (2)

			Endangered Species						Species of Concern										Other Significant Troglobites							
Cave	Survey Date	Monitoring Agency	*Rhadine persephone*	*Tartarocreagris texana*	*Taylsaneta myopica*	*Texamaurops reddelli*	*Texella reddelli*	*Texella reyesi*	*Caecidotea reddelli*	*Cicurina bandida*	*Cicurina travisae*	*Eidmannella reclusa*	*Rhadine austinica*	*Rhadine subterranea*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Taylsaneta concinna*	*Taylsaneta devia*	*Texella spinoperca*	*Cicurina buwata*	*Speodesmus bicornourus*	*Speodesmus* sp.	*Tartarocreagris attenuata*	*Tartarocreagris infernalis*	*Taylsaneta* sp.	*Texella mulaiki*	Other notable species detected
No Rent Cave	5/31/2023	TC						3												100		1					*Cambala speobia* (89) *Eidmannella* sp. (6) *Nylanderia fulva* (~1275) *Texoreddellia* sp. (5)
No Rent Cave	8/29/2023	TC																		12							*Cambala speobia* (8) *Eidmannella* sp. (6) *Nylanderia fulva* (>5000)
North Root Cave	5/25/2023	TC									1																
Persephone Caverns	12/1/2022	COA	2					10			28											12	1				*Cambala speobia* (8) *Perimyotis subflavus* (1) *Batrisodes* sp. (4)
Persephone Caverns	1/25/2023	COA	6			1		7			25	6										24					*Cambala speobia* (16) *Perimyotis subflavus* (4)
Persephone Caverns	5/23/2023	COA	2			1		6			31	12		1								3					*Cambala speobia* (13) *Batrisodes* sp. (1) Campodeidae (1)
Persephone Caverns	8/16/2023	COA	3					15			75	5		2								9					*Cambala speobia* (31)
Pipeline Cave	11/22/2022	COA								14												31				7	*Texoreddellia* sp. (4)
Pipeline Cave	5/16/2023	COA								21												18				8	*Cambala speobia* (1) *Texoreddellia* sp. (3) *Batrisodes* sp. (2)
Pond Party Pit	1/23/2023	COA	1					15				1										26		1			*Cambala speobia* (13)
Pond Party Pit	8/24/2023	COA						20			2	3										20		6			*Cambala speobia* (19) *Texoreddellia* sp. (1)
Rolling Rock Cave	11/3/2022	COA																		9		2					*Cambala speobia* (4) *Perimyotis subflavus* ()
Root Cave	2/23/2023	TC									6																*Cambala speobia* (10)
Sacred Grove Cave	12/8/2022	COA										1															
Sacred Grove Cave	8/4/2023	COA									5																*Cambala speobia* (6) Campodeidae (1) *Texoreddellia* sp. (1)
Seibert Sink	1/11/2023	COA								3							1		3								
Seibert Sink	8/15/2023	COA																	1			4					
Slaughter Creek Cave	9/25/2023	COA								11												2					*Cambala speobia* ()
Spanish Wells	3/7/2023	TC													60												*Stygobromus russelli* (50)
Spanish Wells	8/7/2023	TC													8												*Cicurina* sp. blind (1) *Stygobromus russelli* (21)
Spider Cave	11/28/2022	COA						2			17										3						

			Endangered Species						Species of Concern										Other Significant Troglobites							
Cave	Survey Date	Monitoring Agency	*Rhadine persephone*	*Tartarocreagris texana*	*Tayshaneta myopica*	*Texamaurops reddelli*	*Texella reddelli*	*Texella reyesi*	*Caecidotea reddelli*	*Cicurina bandida*	*Cicurina travisae*	*Eidmannella reclusa*	*Rhadine austinica*	*Rhadine subterranea*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Tayshaneta concinna*	*Tayshaneta devia*	*Texella spinoperca*	*Cicurina bunyata*	*Speodesmus bicornuatus*	*Speodesmus sp.*	*Tartarocreagris attenuata*	*Tartarocreagris infernalis*	*Tayshaneta sp.*	*Texella mulaiki*	Other notable species detected
Spider Cave	5/30/2023	COA						7			11										8						*Cambala speobia* ()
Stark's North Mine	12/1/2022	TC																7									*Eidmannella* sp (2) *Perimyotis subflavus* (13)
Stark's North Mine	5/29/2023	TC															7										*Eidmannella* sp (3) *Perimyotis subflavus* (1) Pseudoscorpindia (1)
Stovepipe Cave	2/3/2023	COA	3			11		36			3	16									140		8				*Cambala speobia* (36)
Stovepipe Cave	8/15/2023	COA	4			1		30			4	6									23		6				*Cambala speobia* (117)
Talus Spring Cave	8/23/2023	TC																									
Tardus Hole	12/1/2022	TC																									
Testudo Tube Cave	2/7/2023	COA													20					29		15					*Cambala speobia* (403) *Eurycea tonkawae* (7) *Stygobromus* sp. (40) Campodeidae (1)
Testudo Tube Cave	8/29/2023	COA													12					17		3					*Cambala speobia* (199) *Eurycea tonkawae* (6) *Stygobromus* sp. (40) Campodeidae (1)
Tooth Cave	11/22/2022	TC	1		6			34			79	14									2						*Cambala speobia* (16) *Perimyotis subflavus* (6) *Texoreddellia* sp. (1)
Tooth Cave	5/31/2023	TC	6		9			37			55	3									2						*Cambala speobia* (17) *Texoreddellia* sp. (2)
Two Trunks Cave	2/23/2023	TC									2																*Cambala speobia* (5)
Weldon Cave	11/15/2022	TC						3						4						9							*Aphrastochthonius N.S.* (2) *Cambala speobia* (47) *Nylanderia fulva* (28) *Perimyotis subflavus* (1)
Weldon Cave	3/10/2023	TC						1						9						2							*Cambala speobia* (30) *Nylanderia fulva* (7)
Weldon Cave	5/31/2023	TC						3					1							10	2						*Aphrastochthonius N.S.* (1) *Cambala speobia* (11) *Nylanderia fulva* (~100)
Weldon Cave	8/29/2023	TC																		4							*Cambala speobia* (13) *Eidmannella* sp (3) *Nylanderia fulva* (~7100) *Perimyotis subflavus* (2) *Texoreddellia* sp. (1)
			Endangered Species						Species of Concern										Other Significant Troglobites							

Cave	Survey Date	Monitoring Agency	*Rhadine persephone*	*Tartarocreagris texana*	*Tayshaneta myopica*	*Texamaurops reddelli*	*Texella reddelli*	*Texella reyesi*	*Caecidotea reddelli*	*Cicurina bandida*	*Cicurina travisae*	*Eidmanella reclusa*	*Rhadine austinica*	*Rhadine subterranea*	*Sphalloplana mohri*	*Tartarocreagris comanche*	*Tayshaneta concinna*	*Tayshaneta devia*	*Texella sphoperca*	*Cicurina bowata*	*Speodesmus bicornourus*	*Speodesmus* sp.	*Tartarocreagris attenuata*	*Tartarocreagris infernalis*	*Tayshaneta* sp.	*Texella mulaiki*	**Other notable species detected**
Whirlpool Cave	1/19/2023	COA								17			8									1					*Cambala speobia* (2)
Whirlpool Cave	8/11/2023	COA								28																	
Wildflower Cave	10/28/2022	COA								6			1									3					*Texoreddellia* sp. (1)

[1] All survey data and full species lists available by request through COA and TC.

[2] Surveyors in FY23 include: Samuel Berg, Leslie Bell, Patty Calabrese, Cristina Campbell, Eleonore le Corvaisier, Alex Ciongoli, Travis Clark, Madison Ebest, Chris Franke, Paul Fushille, Nick Gladstone Devin Grobert, Darrell Hutchinson, David Morgan, Julie Murray, Jacob Olson, Ethan Perrine, Mark Sanders, Jonny Scalise, Colin Strickland, Drew Thompson, and Jaya Torres.

EXHIBIT B:

CAVE CRICKET EXIT COUNT DATA REPORTS

FY22 COA/TC CAVE CRICKET EXIT COUNT DATA REPORTS

Surveyed Caves	Fall 2022 (November/ December)				Winter 2023 (January/February)				Spring 2023 (May/ June)				Summer 2023 (August/ September)			
	N:	J:	A:	TI:	N:	J:	A:	TI:	N:	J:	A:	TI:	N:	J:	A:	TI:
Adobe Springs Cave	0	3	61	64					7	218	468	693				
Black-cap Cave					11	8	0	19					0	6	2	8
Broken Arrow Cave	68	46	68	182					196	124	433	753				
Cave Y					12	3	19	34					217	459	135	811
Cold Cave					1628	1337	135	3101					65	127	274	466
Cortana Cave					2	5	11	18					11	23	46	80
Cotterell Cave					792	262	85	1139					1407	300	126	1833
District Park Cave	60	63	25	148					44	78	444	566				
Flint Ridge Cave	1	4	2	7					35	29	69	133				
Gallifer Cave					25	117	0	142					14	9	36	59
Gaping Maw	75	39	321	146					36	95	499	630	29	26	93	148
Geode Cave					84	88	29	201					7	21	177	205
Jest John Cave													54	54	356	464
Jester Estates Cave	51	83	127	261					959	193	2	1154				
Kretschmarr Cave	97	74	16	187					124	98	330	552				
Little Bee Creek Cave	0	0	1	1												
Lost Oasis Cave	80	14	12	106					N/A	N/A	N/A	N/A				
Maple Run Cave					494	269	74	837					219	165	180	564
Midnight Cave					172	13	281	466					4324	3753	3246	11323
No Rent Cave	166	143	85	394	584	396	41	1021	1471	369	1729	3569	250	163	171	584
Persephone Caverns	19	14	38	71	58	24	1	83	87	60	384	531	28	28	158	214
Pipeline Cave	119	26	17	162					N/A	N/A	N/A	N/A				
Pond Party Pit					145	36	7	188					46	7	58	111
Seibert Sink					59	53	22	134					177	63	144	384

Surveyed Caves	Fall 2022 (November/December)				Winter 2023 (January/February)				Spring 2023 (May/ June)				Summer 2023 (August/ September)			
Spanish Wells Cave					28	18	6	52					3	9	682	694
Spider Cave	4	7	7	18					40	42	9	91				
Stark's North Mine	0	1	4	5					2	32	743	777				
Stovepipe Cave					35	31	75	141					62	25	153	240
Testudo Tube					41	128	19	188					7	15	23	45
Tooth Cave	10	8	4	22					19	18	152	189				
Weldon Cave	546	250	13	809	504	3491	150	4145	73	186	2928	3187	29	159	858	1046
Whirlpool Cave					2304	306	19	2629					209	197	120	526

N= nymphs; J= juveniles; A= adults; TI= total individuals.