Balcones Canyonlands Preserve
Karst Monitoring and Management
FY 2019 Annual Report



Tartarocreagris infernalis, Pond Party Pit, Kent Butler Ecological Reserve

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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EXHIBIT A: KARST FAUNAL SURVEY REPORTS: 54
TRAVIS COUNTY (32 REPORTS)
CITY OF AUSTIN (57 REPORTS)

EXHIBIT B: CAVE CRICKET EXIT COUNT DATA REPORTS: 60
TRAVIS COUNTY (19 REPORTS)
CITY OF AUSTIN (50 REPORTS)

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 35 endangered species caves and 27 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 2019 (FY19), 50 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. s*tagnalis*
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 10/01/18-9/30/19 (FY19). In FY19, 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 (Pennie's, Pipeline, Cave X, and Lost Gold Caves) have protection agreements that include development setbacks from the cave entrance, and two caves (Lost Oasis and Whirlpool Caves) are located on lands owned by Texas Cave Management Association (TCMA). Even though the latter of these have some protections in place (including faunal surveys, fire ant treatments, cave access accounting since 1996, and cave gates to regulate access) they do not have formal agreements with the BCP. However, COA BCP and TCMA are actively working on a cave management agreement. TC BCP also conducts species monitoring for the privately owned Cold Cave for the Preston Oaks HOA. This brings the total to 53 caves that are afforded some level of "protection" or monitoring, and nine (Armadillo Ranch Cave, Bandit Cave, Bee Creek Cave, Ceiling Slot, Fossil Garden Cave, Hole-In-The-Road Cave, Jacks Joint, McNeil Bat Cave and Moss Pit) that are still "unprotected" and it is unclear what management activities are conducted, if any at these nine caves. It should be noted that some of these "protected" caves only have protected entrances, but are threatened by surrounding development or planned development. The 46 BCCP caves that are formally part of the BCP are currently managed as follows: 22 caves protected as part of the BCP on COA land (even though they are managed as such, 12 of these lack interdepartmental agreements to fully implement management practices of the Karst Land Management Plan); one cave protected on The Nature Conservancy (TNC) 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 faunal surveys annually for 15 caves, bi-annually for 23 caves, and quarterly for two caves; cricket exit counts are conducted at 26 caves, and red-imported fire ant treatments are performed at various times of the year for 33 caves. Of the permit caves, COA BCP conductes faunal surveys in 22 caves, cricket exit counts at 17 caves, and red imported fire ant treatments at 18 caves. TC BCP conductes faunal surveys in 17 caves, cricket exit counts at nine caves, and red imported fire ant treatments at 14 caves. COA and TC BCP collaborate for faunal surveys at Whirlpool Cave, and Zara Environmental is contracted to conduct bi-annual faunal surveys and red imported fire ant treatments at Pennie's Cave.

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 FY19, 11 endangered species karst features which were not listed on the BCCP permit are being protected on BCP lands (six features on TC BCP; five features on COA BCP; Table 4). Additionally, 11 SOC karst features not listed on the Permit are also being protected on BCP lands (six features on TC BCP; five 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)
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
Spider Cave	BCP Park West/COA	Jollyville Plateau			X 2004 (Reddell)		X 2004 (Reddell)	

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*
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 (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)

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*
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			
Geode Cave	TC	Jollyville Plateau		X 2008	X 2008			X 2008
LU-11	TC	Jollyville Plateau		X 2008				
LU-12	TC	Jollyville Plateau						X 2008
Little Black Hole	COA	Rollingwood					X 2009c	
Pond Party Pit	COA	Jollyville Plateau			X 2016			X 2010
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.

Key: X = confirmed occurrence based on collected specimen.

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																				
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												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						
Pickle Pit					X															
Pipeline Cave														X						
Rolling Rock Cave						X								X						
Root Cave					X															
Slaughter Creek Cave				X																
Spanish Wells Cave		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								
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.

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).

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. stygalis*	*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.*
Brewpot Cave	TC										X										
Cortana Cave	COA						X														
Down Dip Cave	COA						X														
Geode Cave	TC					X		X													
IV-3	COA					X															
LU-29	TC						X														
Pond Party Pit	COA					X							X								
RI-1	TC						X														
RI-3	TC						X														
Siebert Sink	COA				X					X										X	
Two Trunks Cave	TC					X															

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

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.

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 the majority of 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. The first Austin Water (AW) BCP karst preserve, Village at Western Oaks Karst Preserve and Watershed Management Area, was formally established in June 2017 (management report below).

Twelve of the 62 caves lie on City of Austin property that is managed by Austin Parks & Recreation Department (PARD). An interdeapartmental management agreement between PARD and AW that specifies management in compliance with the BCCP permit and BCP land management plans is 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 with 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, and eliminate toxic chemical application in sensitive water source areas.

William H. Russell Karst Preserve

While Blowing Sink Cave is the deepest cave on BCCP permit, extending 240 feet 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 co-managed by Austin Nature Preserves of Parks and Recreation. There is no formal interdepartmental agreement yet that would allow dual management and restoration by AW BCP. However, Austin Nature Preserves and AW BCP are in the process of drafting a land management plan as required for BCCP permit compliance and as directed by Austin City Council. 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. Furthermore, the City regulatory requirements for cave restoration are currently under discussion between AW, Watershed Protection Department, and the Development Services Department. Potentially, the scope for development-styled project (with engineer designed site

plans, tree surveys, environmental resource inventory, potentially damaging sedimentation erosion controls, etc..) may outweigh limited resources to implement cave restoration. The goal is to facilitate cave restoration while also working in compliance with City code.

On March 21, 2019, Austin cave explorer William Russell passed away. William played a major role in discovery, mapping, and education of caves including many on the BCCP permit. On June 6, 2019, Austin City Council passed a resolution (Resolution No. 20190606-048) that renamed the Blowing Sink Research Management Area, where William discovered many caves and played a major role in deeding the property to the City of Austin, as William H. Russell Karst Preserve. The resolution has additional directives including:

- "The City Manager is directed to coordinate Austin Water, the Parks and Recreation Department, and the Watershed Protection Department to collaboratively develop and establish a shared land management plan for the William H. Russell Karst Preserve with the goal of protecting water quality, increasing recharge, protecting sensitive and endangered species habitat, and continuing the legacy of Bill H. Russell's work on behalf of the City of Austin to further explore and document the City's karst resources with knowledgeable stakeholders in the community. The City Manager is directed to report back to Council on this land management plan by October 3, 2019."

- "The City Manager is directed to develop a report on existing cave and karst feature enhancement or restoration projects and programs that have been implemented or are in planning by Austin Water, the Parks and Recreation Department, and the Watershed Protection Department. The report should include potential opportunities for process improvements, regulatory considerations, additional water quality monitoring, guided public access, and best practices for engaging knowledgeable stakeholders in the community. The City Manager is directed to report back to Council on this report by January 2020."

- "The City Manager is directed to develop a memorandum of understanding among Austin Water, the Parks and Recreation Department, and the Watershed Protection Department to address cave restoration and water quality monitoring related to caves on City-owned land. The City Manager is directed to report back to Council on this memorandum of understanding by March 1, 2020."

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 the BCCP permit Get Down Cave and was acquired by the City of Austin in June 2016 under Watershed Protection Department management. An interdepartmental

agreement in June 2017 delegated AW BCP with management of the karst preserve and Watershed Protection responsibility for the water quality ponds and Millenium 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. AW BCP placed rule signs in FY19 at each entrance, specifying among other things that pesticide use is prohibited.

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. An annual report by the Friends of the Karst Preserve is presented in Appendix S.

Whirlpool Karst Preserve

Whirlpool Cave is the third largest cave of the 62 permit caves and has historically been used in public education. In FY19, AW BCP proposed a formal management agreement with TCMA for Whirlpool, Lost Oasis, and Avery Ranch (non-BCCP permit education) caves. The agreement is expected to be ratified in FY20.

Whirlpool Cave is managed by Liz Herren on behalf of TCMA. Liz Herren, Justin Shaw, Rich Zarria and other members of TCMA discovered a new room south of the mapped cave extent which potentially has active drip formations that might be used in conducting future hydrogeological studies.

The owner of an adjacent lot, Reina Biggs, approached Liz Herren at the preserve and inquired if TCMA wanted to purchase the adjacent lot. Based on georeferencng and overlaying the cave maps, most of the cave actually underlies the private lot. In 2012, TC BCP was not successful in its attempt to purchase it since the appraised value was too low for the lot owner. Consequently, AW BCP paid for an updated appraisal and is taking steps in FY20 to acquire the lot after the owner agreed to the new appraisal. Once a formal agreement is ratified with

TCMA and the preserve is expanded, an attempt will be made to formally induct Whirlpool Cave Karst Preserve into the BCP.

In FY19, planning of a cave mural on the Mopac underpass wall adjacent to Whirlpool Cave Preserve was conducted by Hill Country Conservancy (HCC), COA Public Works, and AW BCP and contract artist Barbara Attwell. HCC suggested the idea of a cave scene painting adjacent to the Violet Crown trail.

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 is being 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, vistor traffic counts, etc…

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, Japigid, and MWA caves) of the 62 permit caves in a private karst preserve. 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.

Table 7. FY19 Ownership, protection, monitoring and access status of the 62 BCCP caves/karst features (35 caves with ES and 26 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		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 Formal management agreement with PARD to ensure permit compliance is in progress	COA monthly surface monitoring (volunteers check on gate); bi-annual cave cricket exit counts; bi-annual species monitoring	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	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). Formal management agreement with PARD to ensure permit compliance is in progress	COA quarterly surface monitoring; annual species monitoring	none
Bandit Cave	ES	Private	Gated	Protected by private ecologically 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- 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
Blowing Sink Cave	SOC	BCP/COA	Gated	Protected on preserve (200 acre preserve, but subsurface catchment extends more than a mile west). No formal agreement with PARD for dual management. Tier III plan is being developed.	COA semi-monthly surface and annual species monitoring; bi-annual RIFA control	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). Formal managen agreement with PARD to ensure permit compliance is in progress	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 setback to protect cave entrance. Protected to some extent (not actively managed and the setback is inadequate). Owner recently rejected COA offer on Sept. 19, 2017 to assist in cave management and monitoring.	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 in 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. Lacks formal management agreement to ensure permit compliance .	COA quarterly surface bi-annual species monitoring; bi-annual cave cricket exit counts; 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
Ceiling Slot Cave	SOC	Private		Private - Unknown		none
Cold Cave	ES	Private	Gated	Private - Unknown	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 entrance) Lacks formal management agreement to ensure permit compliance	COA quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring; periodic 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. Formal management agreement with PARD to ensure permit compliance is in progress	COA quarterly surface monitoring; quarterly cave cricket exit counts; quarterly 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 are overlain by the newly constructed SH45 SW).	COA quarterly surface monitoring; quarterly cave cricket exit counts; quarterly species monitoring; bi-annual RIFA control	none
Fossil Cave	ES	BCP/COA	Access protected by large rocks	Protected on parkland. All caves in park are filled in and require restoration. Formal management agreement with PARD to ensure permit compliance is in progress.	Exact location of cave is unknown. COA quarterly surface monitoring of feature suspected to be Fossil Cave	none

Cave Name	ES or SOC	BCP or Private/ Current Owner	Gated/ Fenced	Protection Area Status /Adequate Preserve size	Species Monitoring Status	Public Access
Fossil Garden Cave	ES	Private		Private – Unknown		none
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; bi-annual cave cricket exit counts; bi-annual species monitoring; bi-annual RIFA control	none
Goat Cave	SOC	BCP/COA	Fenced	Protected on parkland. Lacks formal management agreement to ensure permit compliance	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 cave cricket exit count; bi-annual surface 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
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; bi-annual RIFA control	none
Jollyville Plateau Cave	ES	BCP/Private Section 10(a)		Protected by 10a permit, managed by Pla 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	COA negotiated setback (approximately 150')	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; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Lost Gold Cave	SOC	Private	Gated	Private – COA WPD has 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		none
Lost Oasis Cave	SOC	Private/ TCMA	Gated and fenced	Protected by TCMA. Formal management agreement with AW BCP to ensure permit compliance is in progress	COA bi-annual cave cricket exit counts; bi-annual species monitoring; bi-annual RIFA control	controlled access**a

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 Pla Land & Wildlife Management		
Maple Run Cave	SOC	BCP/COA	Gated	Protected on parkland. Lacks formal management agreement to ensure permit compliance	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). Formal management agreement with PARD to ensure permit compliance is in progress	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 species monitoring	none
No Rent Cave	ES	BCP/TC	Gated	Protected on preserve	TC bi-annual surface monitoring; bi-annual cave cricket exit counts; bi-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
North Root Cave	ES	BCP/TC	Fenced	Protected on preserve	TC quarterly surface monitoring; RIFA survey/control; annual species monitoring	none
Pennie's Cave	SOC	Private		Landowner had filled entrance. COA WPD negotiated with Zara Environmental to excavate the entrance, add a cave gate, and placing a 300 ft. buffer around the cave. Management report attached in Appendix T10.	Zara Environmental species monitoring; Zara Environmental RIFA surveys/ control	none
Pickle Pit	SOC	BCP/Private Sec. 7	Gated	Protected by Section 7 permit.	TC/COA occasional species monitoring; monthly surface inspection concerned neighbor	none
Pipeline Cave	SOC	Private	Gated	Private – nearby petroleum pipeline exists. Lacks formal management agreement to ensure permit compliance. Permission granted for temporary access to allow for restoration, faunal surveys, and hydrogeological studies	COA quarterly surface monitoring; quarterly cave cricket exit counts; quarterly 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). Formal management agreement with PARD to ensure permit compliance is in progress	COA quarterly surface and annual species monitoring; bi-annual RIFA control.	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; bi-annual RIFA control	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 species monitoring	none
Tardus Hole	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
Tooth 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
Weldon Cave	ES	BCP/TC	Gated	Protected on preserve	TC quarterly surface monitoring; bi-annual cave cricket exit counts; bi-annual species monitoring	none
Whirlpool Cave	SOC	Private/ TCMA	Gated	Protected by TCMA. Formal management agreement with AW BCP to ensure permit compliance is in progress. AW BCP in process of acquiring private lot that overlies much of the cave	TCMA routine surface monitoring; COA/TC bi-annual species monitoring and cave cricket exit counts to assess 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.

* 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, particularly considering the high demand and its effectiveness as both a teaching tool and management practice to support stewardship for cave ecosystems. 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 1,414 person trips in FY19. 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.

In FY19, AW BCP worked on developing a formal written cave access policy that essentially describes the existing unwritten permit policy. The policy lists qualified guides for each cave, preserve site and delegated cave managers, and a new trip registration calendar. The policy is expected to be finalized in FY20 and requires acceptance by each preserve site manager.

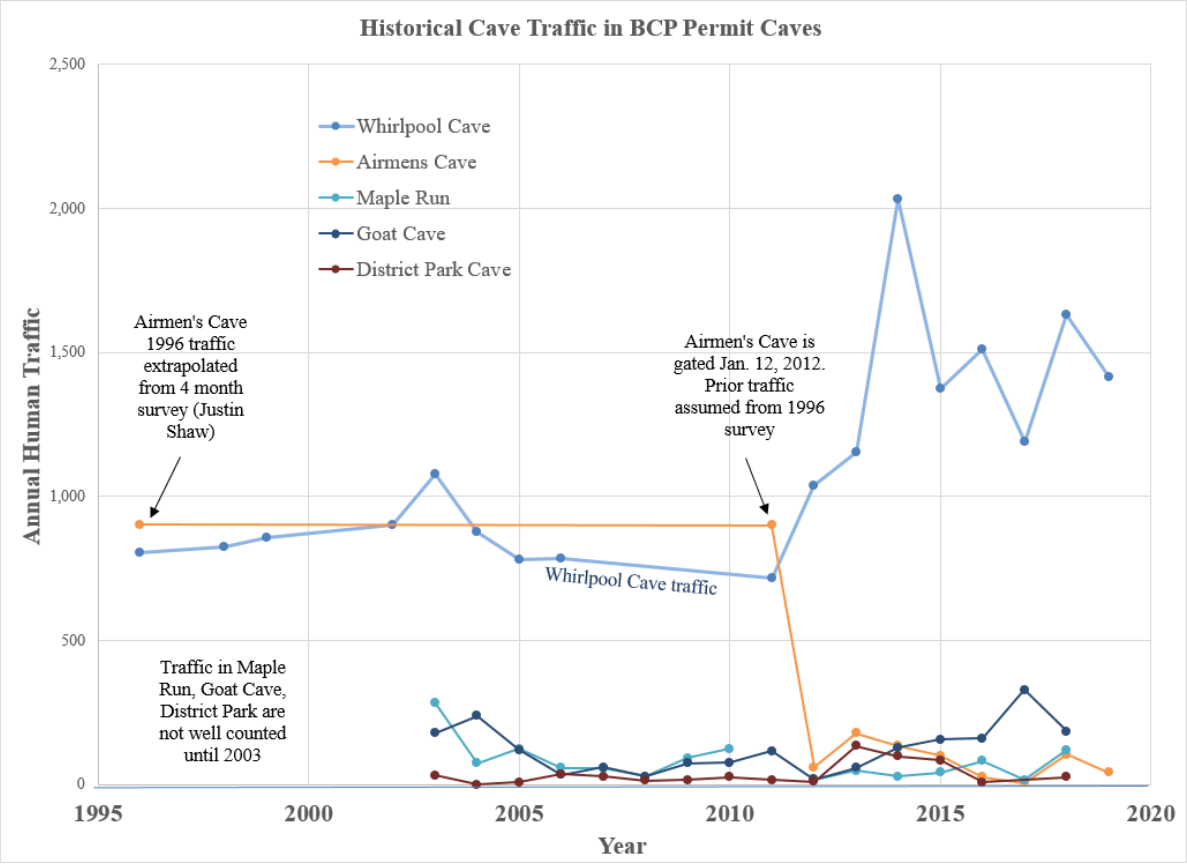
Wildflower and LaCrosse Caves are relatively small non-BCCP caves on the Lady Bird Johnson Wildflower Center that received 2,160 and 877 visitors respectively in FY19. Wildflower Cave has been used for education by COA Earth Camp since 1997 after it was restored by cleaning out trash fill. Wildflower Cave is unsuitable for many cave tours due to its currently limited extent and small size, but is heavily utilized in 5th grade Earth Camp cave education (see Cave Education Summary below).

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 publically 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. Of the 3,508 participants that COA WPD education programs took caving during 2018-2019 school year, 3,040 of the participants toured non-BCCP caves and only 468 of the participants toured BCCP permit caves.

In all, 1,983 toured in grandfathered BCP permit caves (Whirlpool, Lost Oasis, Airmens, District Park, Maple Run, and Goat Caves), similar to best estimates of 1996 levels (1,754 for Whirlpool, Get Down, Lost Oasis, and Airmens alone), compared to 3,734 that toured post permit established education caves including Wildflower, LaCrosse, Grassy Cove, Wade, Avery Ranch, and Bowie High School Caves. While the cave ecosystem boost in education caves such as LaCrosse, Wade, and Wildflower caves are fairly obvious once trash and ranch fill are removed, 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 both 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 Figure 1. In FY19, no significant progress was made in restoring new education caves or improving existing education caves. On February 23, 2019 the Annual Austin Cave Festival was held at the Lady Bird Johnson Wildflower Center.



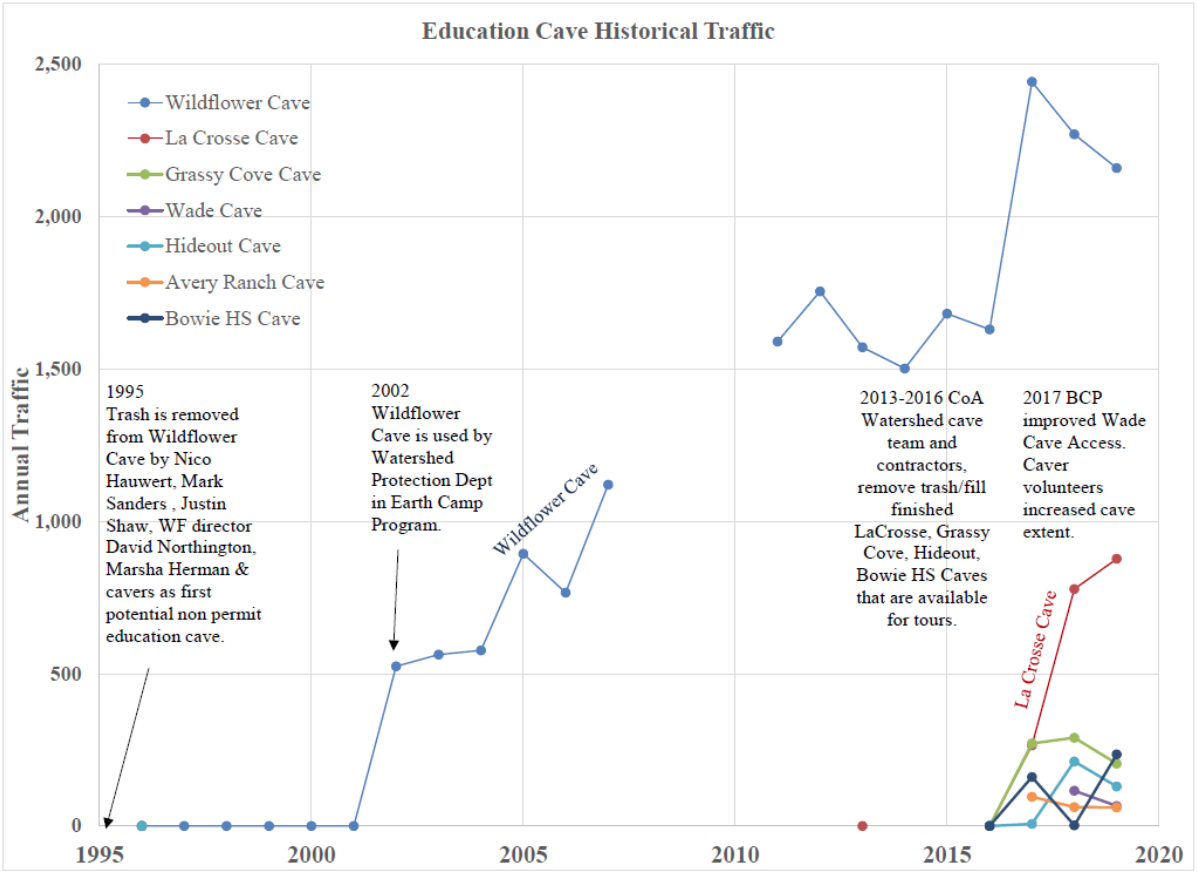


Figure 1. Historical traffic in BCP permit and education caves

FY19 Cave Education Summary

COA Watershed Protection Department (WPD) Education Programs:

COA WPD conducts cave education through Earth Camp and Earth School (fifth grade water quality programs); Watershed Detectives (middle school); Hydrofiles (high school); Austin Cave Festival; Clean Creek Camp (a summer parent/child water quality program); providing cave tours for Nature Nights at the Lady Bird Johnson Wildflower Center (all ages); and adult education such as the Groundwater to the Gulf: Summer Institute (professional development for teachers) and a tour for participants in the One Water Summit. The 2018-2019 school year updates are detailed below and summarized in Table 8.

Earth Camp is available to Title I (low socio-economic) schools in Austin Independent School District (AISD). Students spend one school day at camp immersed in Wildflower Cave looking for clues that water travels through the cave into the Edwards Aquifer, which includes the discovery of cave biota. Students also investigate a sinkhole and flow through karstic rock, as well as visiting Barton Springs and the Splash! Exhibit to learn of the connection of the recharge zone to the discharge area. During the 2018-2019 school year, Earth Camp guided

1,652 fifth-grade students into Wildflower Cave. An additional 4,338 fifth graders in AISD, Eanes ISD and Del Valle ISD received **Earth School**, a hands-on classroom presentation using an Aquifer Model (Table 8). The Lady Bird Johnson Wildflower Center is partnered with Earth Camp. More details on these programs can be found online at: www.austintexas.gov/EarthCamp and www.austintexas.gov/earthschool.

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 2018-2019 school year, 484 middle school students were given educational caving tours (108 in LaCrosse, 53 in Lost Oasis Cave, 242 in Whirlpool Cave, and 81 in Wildflower Cave). Additionally, 393 high school students were given educational caving tours (17 in LaCrosse Cave, 121 in Whirlpool Cave, 20 in Grassy Cove Cave, and 235 in Bowie High School Cave) (Table 8). More details on these programs can be found online at: www.austintexas.gov/ watersheddetectives and www.austintexas.gov/hydrofiles.

Austin Cave Festival: Austin Cave Festival is a free, family event that features hands-on activities, including educational cave tours. Visitors have the opportunity to explore a cave, see how water makes its way to the aquifer and Barton Springs, and learn how to protect cave habitat and water resources. Austin Cave Festival is co-hosted by the Lady Bird Johnson Wildflower Center, the Barton Springs Edwards Aquifer Conservation District, the City of Austin (Austin Parks and Recreation Department, Austin Water Wildland Conservation Division, and WPD), and the caving community. In February 2019, staff from Austin Wildland Conservation Division and WPD worked together to take 389 participants caving at the Wildflower Center (254 in LaCrosse Cave and 135 in Wildflower Cave. There were approximately 3,500 participants at the Austin Cave Festival. Additional activities included exploring CaveSim (a realistic artificial cave) and the children's art cave, an educational tour of a sinkhole, virtual caving, and other hands-on activities related to cave education. More details about this event can be found online at: www.bseacd.org/education/austin-cave-festival/

In summer 2019, 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 52 participants into both LaCrosse and Wildflower

Cave (Table 8). On June 28, the COA WPD and COA Wildland Conservation Division worked together to provide educational tours of LaCrosse Cave and Wildflower Cave to 280 participants during one the Lady Bird Johnson Wildflower Center's Nature Nights event (Table 8). On September 18, WPD took 40 participants in the **One Water Summit** on an educational tour of LaCrosse Cave. More details on these programs can be found online at: www.austintexas.gov/department/clean-creek-camp, www.wildflower.org/nature-nights, and www.uswateralliance.org/sites/uswateralliance.org/files/webform/uswa_sum19_prog_FINAL_RGB.pdf

Groundwater to the Gulf Summer Institute: Groundwater to the Gulf is collaboration among over a dozen local agencies to offer a three-day, field trip-based institute for Central Texas teachers that emphasizes techniques for teaching water-based curricula to students. COA WPD educators and staff from the Barton Springs Edwards Aquifer Conservation District take teachers inside LaCrosse Cave and Wildflower Cave. In this program, the teachers also go to Barton Springs to gain background knowledge to teach about the Edwards Aquifer in their classrooms. In FY19, 32 teachers participated in the Institute (Table 8). More details on this program can be found online at: www.coloradoriver.org/newsite/our-programs/redbud-educational-program/groundwater-to-the-gulf/.

Table 8. Summary of school year 2018-2019 COA WPD education programs providing cave field trips and aquifer outreach.

Program	Grade	Total reached
Earth Camp	5th	1,652
Earth School* (*presentation does not include cave immersion)	5th	4,338*
Watershed Detectives	6th-8th	484
Hydrofiles	9th-12th	393
Austin Cave Festival	N/A	389
Clean Creek Camp	Adults and 4th-8th	52
Nature Nights	N/A	280
One Water Summit	N/A	42
Groundwater to the Gulf	Teachers	32

Austin Water Balcones Canyonlands Preserve Program

AW BCP conducted several media coverages included:

- 2019 Austin Cave Day KVUE Interview: Importance of Caves
- Daily Texan article: https://www.dailytexanonline.com/2019/02/17/austin-cave-festival-tackles-rising-water-worries

Biologist Colin Strickland created the Texas Cave Invertebrates Guide, which contains 35 of the commonly encountered Central Texas cave invertebrates. A hundred laminated copies were made and distributed to all the groups leading cave tours in Austin, including WPD, PARD and members of the UT Grotto. A copy of the guide is in Appendix T11. Additionally, Colin has also produced some 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: Biosubterranea – https://www.youtube.com/channel/UCQFvoKJbPjTF1-HiTrSfugg

In FY19, AW BCP contracted artist Barbara Attwell to create 8 paintings of cave scenes and cave life: **Barbara Attwell Cave Paintings**

AW BCP conducted cave tours for approximately 328 people to immerse the public into their cave heritage. Most focus is directed toward environmental/stewardship groups and East Austin community services such as Explore Austin. AW BCP program manger Nico Hauwert, and cave biologists Mark Sanders, Drew Thompson, Colin Strickland, and Christina Campbell made speaking engagements on caves, cave ecosystems, cave safety, and cave restoration:

- **Oct 27, 2018:** Talk on caves to Master Naturalist annual conference in Georgetown (~60)
- **Oct 31, 2018:** Cactus Elementary School, Round Rock ISD, cave talk for students prior to Inner Space Caverns tour (150)
- **Nov 21, 2018:** Talk to the Underground Texas Grotto on the restoration of caves for groundwater education (20)
- **Dec 3, 2018:** Training on Hydrology and Water Cycle for spring preservation at Wild Basin (30)
- **Jan 12, 2019:** CAMN Master Naturalist Geology Training at West Cave Preserve (40)
- **Jan 16, 2019:** Cave Guide Training (25)
- **Jan 31, 2019:** Jollyville Master Naturalist Geology Talk (12)
- **Feb 23, 2019:** Nerd Night on Cave Restoration (~50)
- **Apr 17, 2019:** Presentaion with Travis County biologists, Travis Clark and Blake Sissel about underground ecosystems to the Osher Lifelong Learning Institute (OLLI) at the University of Texas
- **June 19, 2019:** Talk on cave restoration projects in Austin to UT Grotto
- **June 28, 2019:** Tour of WQPL and Village at Western Oaks Karst Preserve with Councilwoman Paige Ellis and Wastewater Commissioner Christy Williams
- **June 30, 2019:** Geology talk tour with Vireo volunteers with survey for potential filled caves ()
- **Sept 15, 2019:** Society for Exploration Geophysics field trip at Barton Springs (10)
- **Sept 17, 2019:** Barton Springs University training on cave hydrogeological studies with simulated cave (70)

Outreach was also conducted at McNeil High School, where its courtyard contains two endangered species caves: Millipede and Millipede Annex. In FY19, progress with restoration plans continued with revegetation work to enhance the underlying cave ecosystem. McNeil HS science teacher Tina Vick initiated the project with assistance from Mark Sanders of COA BCP, Jean Krejca of Zara Environmental, Cyndee Watson of USFWS, and landscape architect, Vivian Loftin of the COA WPD cave team. Informal presentations on karst biology and geology were provided by Mark Sanders and Colin Strickland to the McNeil High School Green Club and AP Environmental Science classes as the students were introduced to the courtyard caves.

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

Travis County

In June of FY19, TC BCP participated in an article published by the Austin American Statesman that highlighted the importance of cricket counts and how volunteers help with monitoring.
https://www.austin360.com/entertainmentlife/20190619/click-it-for-crickets-why-volunteers-count-bugs-in-caves-in-travis-county

TC BCP staff, with the help of COA BCP, worked with Alan Fisher and TPWD to finalize a documentary detailing the introduction of tawny crazy ants and their impacts to karst environments. This is expected to air in late November of FY20.

FY19 Access Status

In FY19, 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 FY19, 494 visitors were issued access permits by COA BCP staff to COA-owned BCCP caves including: Airmen's Cave (41), District Park (61), Goat Cave (179), Maple Run Cave (189), and Midnight Cave (24). A total of 1,489 visitors were granted access to TCMA-owned BCCP caves including: Lost Oasis (75) and Whirlpool (1,414) caves. An additional 3,734 visitors toured non-BCCP caves with guides including: Avery Ranch Cave (61), Bowie Cave (235), Grassy Cove Cave (205), Hideout Cave (130), LaCrosse Cave (877), Wildflower Cave (2,160), and Wade Cave (66) (Table 9). Cave tours were supervised by trained staff from WPD, the Austin Nature and

Science Center, COA PARD Rangers, BCP, and the UT Grotto. See Table 3 for access and gating status of all of the BCCP caves.

Table 9. Summary of FY18 educational and recreational cave trips into Non-BCCP Caves compared to BCCP Caves.

Status	Cave	Visitors	Total Visitors
Non-BCCP Caves	Avery Ranch	61	3,734
	Bowie	235	
	Grassy Cove	205	
	Hideout	130	
	LaCrosse	877	
	Wildflower	2,160	
	Wade	66	
BCCP Caves	Airmen's	41	1,983
	District Park	61	
	Goat	179	
	Lost Oasis	75	
	Maple Run	189	
	Midnight	24	
	Whirlpool	1,414	
Non-BCCP and BCCP Caves Combined			5,717

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 current status and compliance with the regional permit, as well as determine future needs of the listed species. In 2009, Rob Clayton (COA WPD) developed the Karst Database that 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 TCAs have not been confirmed, to supplement BMPs created in FY15 focusing on construction activities within known TCA sites. TCAs 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 FY19, these BMPs continue to be disseminated to appropriate TC/COA departments and other agencies.

In FY19, AW BCP contracted Zara Environmental LCC to continue air monitoring in Ireland's Cave and Whilpool Cave. Instruments in Whirlpool and Grassy Cove caves were damaged by severe flooding in April 2019 and a new surface-downloadable system was installed in FY20. The results of this monitoring are presented in Appendix T7. Additional monitoring will continue in FY20.

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 course of 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 TCAs 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).

FY19 TC/COA Collaborative Monitoring Projects

Since FY12, BCP staff have included monitoring for presence of tawny crazy ants (TCAs) at all visits to cave sites, using a TCA 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 Cave and No Rent Cave) 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. 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 as disappeared for unknown reasons.

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 FY19 to gather baseline data for the McNeil High School courtyard restoration project, which commenced in FY15 (EXHIBIT A). 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 improving nutrient input and benefiting cave crickets and cave fauna. In FY18, staff observed and collected an extremely rare arachnid, Order Schizomida from Millipede Cave for species identification. The specimen was determined to be *Stenochrus portoricensis*, believed to be native to the Yucatan Peninsula and has been discovered in greenhouses in Europe. It's likely that this species was inadvertently introduced via plants purchased at local nurseries by school staff. BCP staff will continue to monitor the species to see what impacts it may have on cave fauna.

TC and COA BCP staffs continue to assist with James Reddell's efforts to refine species distribution and range of *Rhadine* beetles of central Texas, by incorporating extensive collecting of *Rhadine* species from known and unknown localities during cave faunal surveys in FY19. For this study, morphological as well as molecular work of collected species will be employed to achieve this goal. To date, TC and COA BCP staff continue to collect from selected caves determined by James Reddell.

In FY18, TC and COA BCP staff assisted with a USFWS funded study to re-examine *Texella* species found in Travis and Williamson County. Marshal Hedin will be conducted molecular analysis of *Texella reyesi* and *Texella reddelli*, to aid in species verification. To date, verification was based on adult male genetiala, so it will be interesting to see if the new DNA work will verify the previous morphological work. TC and COA BCP staffs assisted with

collecting species from various caves requested by Marshal Hedin and James Reddell. There are no results as of now since analysis is still ongoing.

In late FY18, TC BCP was approached by an individual interested in selling a property that contained a cave, which was known to BCP staff as Good Thunder Cave. The property is in close proximity to Lost Gold Cave, and in early FY19, TC and COA BCP collaborated to do a full investigation and evaluate its substitution potential for Lost Gold Cave on the BCCP permit. The analysis included a faunal survey (EXHIBIT A) including specimen collections for identification and cave mapping. The specimens were tuned over to James Reddell or sent to other experts for confirmations. TC and COA BCP are still awaiting most of these confirmations, but one notable specimen was identified as *Rhadine austinica*.

City of Austin FY19 Biological Monitoring

During FY19, COA BCP staff conducted bi-annual monitoring on the following 14 pre-selected caves: Airman's Cave, Broken Arrow Cave, Cave Y, Cortana Cave (non-BCCP cave), Cotterell 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) (EXHIBIT A). In an effort to get a better handle on baseline data, COA BCP staff has completed one year of quarterly faunal surveys at Lost Oasis Cave, Get Down Cave, and Pipeline Cave. Survey frequency for these caves has ben reduced to bi-annual surveys. (EXHIBIT A). Faunal surveys in these caves were conducted by permitted COA biologists in either Fall 2018/Spring 2019 or Winter 2019/Summer 2019. In addition, COA BCP staff conducted quarterly surveys at Flint Ridge Cave and District Park Cave. District Park Cave has a high probability that it will be impacted by TCA's in the near future, and the increased frequency of surveys will help determine what adverse effects they may have on cave fauna (EXHIBIT A). As part of a long term site restoration project, COA BCP staff continued to conduct bi-annual surveys at Millipede and Millipede Annex Cave (EXHIBIT A). Annual faunal surveys were also conducted in Arrow Cave, Beard Ranch Cave, Blowing Sink, Collaboration Cave, Elm Sink, Goat Cave, Hoskins Hole, LaCrosse Cave, Mossy Rock Cave, Rolling Rock Cave, Spare Rib Cave, Slaughter Creek Cave, and Wyoaka Cave. (EXHIBIT A).

COA BCP continued working with the property manager of Pipeline Cave. BCP staff has been given permission to manage and monitor this cave as well as the adjacent Confusion Cave (non-BCCP cave). Staff initiated a hydrogeological study for Pipeline Cave which will also include other features found on that property as well as the adjacent Circle C Metro Park. COA BCP staff provided a written report of their efforts (Appendix T5).

In FY19, COA BCP staff, with the help of volunteers, conducted bi-annual cave cricket exit counts (quarterly at Flint Ridge Cave and District Park Cave) at the same 14 caves pre-selected for faunal surveys (EXHIBIT B). COA BCP staff continued to conduct cave cricket exit counts at the newly restored caves located on the Blowing Sink tract, but due to a lack of staffing, reduced survey efforts from the original four caves to focus on two (Sinky Dinky and Wyoaka Caves). (EXHIBIT B). COA BCP staff have completed one year of quarterly cave cricket exit counts at Lost Oasis Cave, Get Down Cave, and Pipeline Cave, and has now reduced servey efforts to bi-annual surveys (EXHIBIT B). COA BCP staff also conducted one cave cricket exit count at Jest John Cave (EXHIBIT B).

Travis County FY19 Biological Monitoring

TC's BCP staff conducted bi-annual monitoring on the following 11 pre-selected caves: Adobe Springs Cave, Cold Cave, Gallifer Cave, Geode Cave (non-BCCP cave), Kretschmarr Cave, No Rent Cave, Spanish Wells Cave, Stark's North Mine, Tooth Cave, Weldon Cave, and Whirlpool Cave. Faunal surveys in these caves, with permitted TC biologists, were conducted in Fall 2018/ Spring 2019 or Winter 2019/ Summer 2019 (EXHIBIT A). Annual faunal surveys were also conducted in five other TC-owned BCCP caves with federally listed species: Kretschmarr Double Pit, McDonald Cave, New Comanche Trail Cave, North Root Cave, and Tardus Hole (EXHIBIT A). TC staff also conducted annual faunal surveys at three additional BCCP listed caves: Ireland's Cave, Root Cave, and Talus Springs Cave, and two additional TC-owned non-BCCP caves with listed ES or SOC: Tight Pit and Two Trunks Caves (EXHIBIT A).

TC BCP staff conducted bi-annual cave cricket exit counts in FY19 at all of the caves pre-selected for faunal surveys: Adobe Springs Cave, Cold Cave, Gallifer Cave, Geode Cave, Kretschmarr Cave, No Rent Cave, Spanish Wells Cave, Stark's North Mine, Tooth Cave, Weldon Cave, and Whirlpool Cave. Exit counts were conducted in Fall 2018/ Spring 2019 or Winter 2019/ Summer 2019 (EXHIBIT B).

RIFA surveys were performed in Spring 2019 on eleven of thirteen TC-owned BCCP caves with federally listed species, as well as one other TC-owned cave with ES (Geode Cave). RIFA surveys were also conducted at three additional TC-owned BCCP caves (Ireland's Cave, Spanish Wells Cave, and Talus Spring Cave). Unfortunately, RIFA surveys and treatments did not occur in Fall 2018 due to unfavorable climatic conditions. 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 2019, a total of 486 RIFA mounds were treated within these 80 m cave survey areas, with an

additional 38 RIFA mounds treated in the vicinity of caves but outside of survey areas. Survey results and treatments for individual caves are documented in Table 11.

In addition to managing the karst features required in the BCCP permit, TC voluntarily managed other karst features located on BCP land in FY19 including Cactus Pit, Brew Pot Cave, Kretschmarr Sink, and karst features RI-1, LU-11 and LU-12.

TC BCP staff is still monitoring caves found on the Kotrla Unit for troglobitic significance in hopes of finding suitable substitutes for Ceiling Slot and Moss Pit Caves. There are currently eight caves that have the potential to harbor significant trobolbitic diversity that are undergoing quarterly monitoring. It should be noted that the adjacent ranch (Flying K Ranch) is interested in selling more land to be incorporated into the BCP. TC BCP staff has conducted karst surface surveys on this property to locate caves or features with excavation potential that could lead to quality karst invertebrate habitat. TC BCP is in the process of contracting Zara Environmental to conduct the analyses and excavation of these features in FY20.

In FY19, TC BCP staff conducted a karst faunal survey in Hammett's Cave at West Cave Preserve (EXHIBIT A). This is the first survey conducted there since the 1960s by James Reddell. At that time, the only species observed was *Dolomedes scriptus*, a large fishing spider (James Reddell per. comm. 2019). Specimens were collected during the survey for confirmations at a later date or to be deposited in the Texas Memorial Museum (TMM) collection. It goes without saying, some of the noteable troglobites (including *Texella* sp., *Tayshaneta* sp., and blind *Cicurina*) will more than likely lead to new type localities for these species once they are identified to species level.

Other Biological Monitoring Efforts

Zara Environmental conducted biological monitoring at Pennie's Cave in FY19 as part of an adaptive cave management plan for a development project that began with the reopening of the cave's entrance in 2012. Zara Environmental conducted two (Spring and Fall) RIFA treatments with boiling water in FY19. Due to high CO_2 levels, 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 FY19 was also provided (Zara Environmental 2019a; Appendix T10 of BCCP FY19 Annual Report).

COA BCP staff continues 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. Mark Sanders and Colin Strickland initially visited the BCNWR in May 2018 to look at karst features that were recommended for investigation by James Reddell, the most promising of these were Unnamed Sinks 8 & 9. These two features are connected and 12 ft apart; they've now combined and renamed Collaboration Cave by Scott Rowin (BCNWR biologist), due to the collaborative efforts made between the BCNWR, James Reddell, and COA BCP. Collaboration Cave was initially a 25.5 ft deep shaft plugged with rocks and soil. After 14 days of excavation (ten in FY18 and four in FY19), 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 stygobytic isopods *Caecidotea* sp. and amphipods *Stygobromus* sp. Excavation activities will continue both upstream and downstream until all promising leads have been exhausted. At which point, the cave will be mapped and thorough faunal surveys will be conducted. 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.

COA BCP has been also been collaborating 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 has started monitoring soft tick populations to get a better understand the level of risk that may be associated with caves accessed by the public (Figure 2). 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 that are seeking relief from the Texas heat.

Pit fall traps using dry ice were deployed in 20 caves in the Austin area to survey soft tick populations. Specimens were collected alive and stored in ventilated plastic vials for transport to Texas State University's Professor Dr. Ivan Castro and his students Rosa Ramirez, Matt Milholland, and Michaela Bowlsby. Some ticks were then sent to Job Lopez at Baylor College

of Medicine for *Borrelia* identification and further TBRF research, while Michaela took some to research effective chemical deterrents. 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.

Large numbers of ticks where only found in Bullet and Live Oak Caves, and warning signs have been placed at their entrances to help minimize the public's exposure to TBRF. 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 as a result of irrational fear of rabies. Furthermore, the soft ticks must be infected with *Borrelia turicatae* in order to transmit TBRF. In FY19, caves where people have contracted TBRF and are identified as a high risk for TBRF include Live Oak Cave in Village at Western Oaks Karst Preserve; Airmen's Cave, Spider Wire Cave, and Bullet Caves along Barton Creek greenbelt; and Little Black Hole or possibly other caves near Red Bud Trail and the Colorado River.

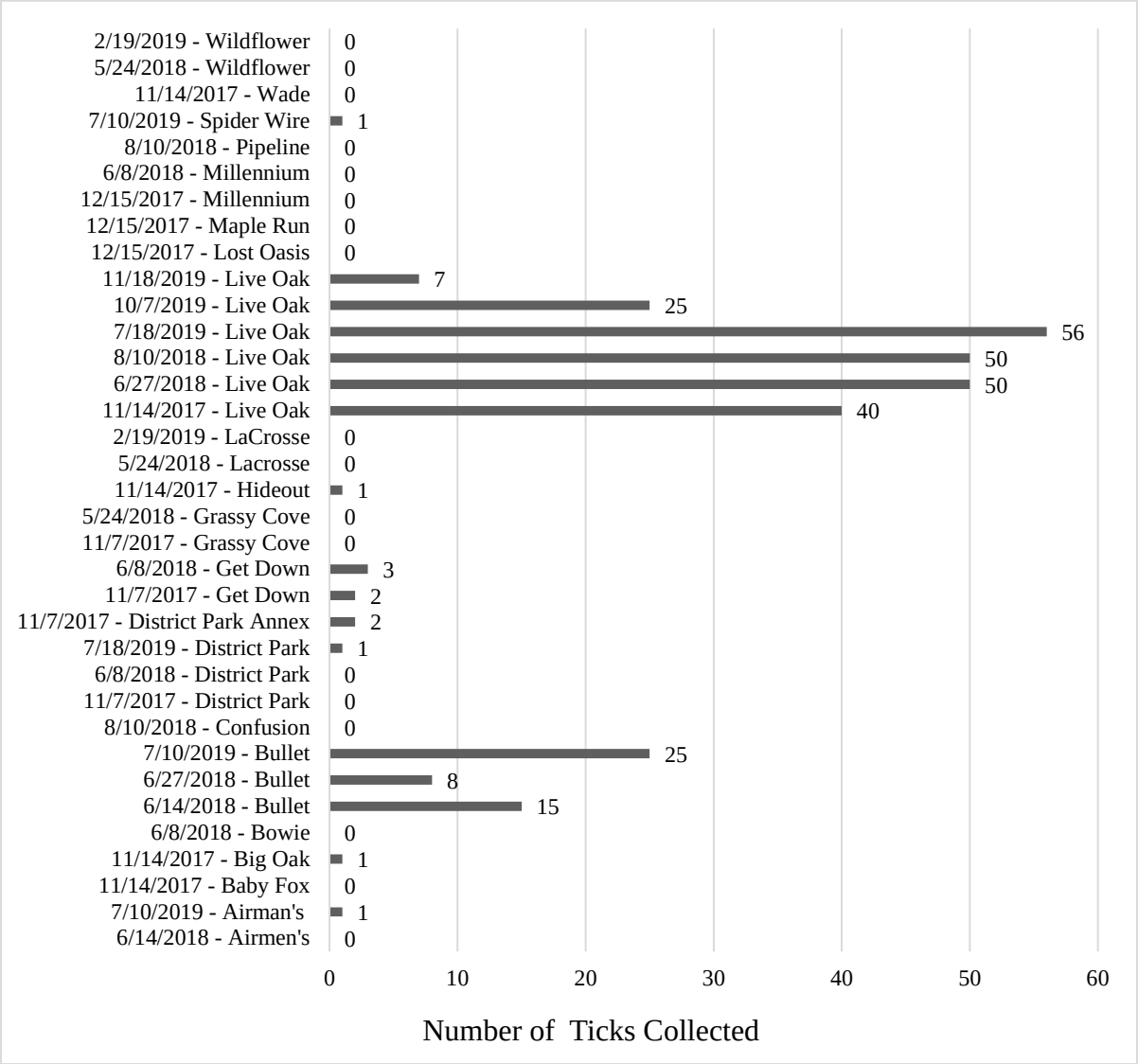


Figure 2. Results for City of Austin BCP soft tick surveys

7.0 HYDROGEOLOGIC STUDIES

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.

In FY19, AW BCP was able to utilize an existing AW lab contract with Lower Colorado River Authority (LCRA) lab for analysis. However, analysis for organic contaminants requires further work and was not available in FY19.

The Flint Ridge Cave Monitoring study was redesigned in FY19.

- Drip gauging data continued in Flint Ridge Cave during FY19. A report on monitoring operations by 4Caves is attached in Appendix T2. An analysis of drip data conducted by Zara Environmental LLC is in Appendix T2.
- **January 3, 2019:** grabbed water samples above and below the surface flumes, in the Balcony Room drip, Culvert Crawl Lower Pool, Fault Dome, and Drip Pit.
- **Jauary 4, 2019:** Watershed Protection Dept informed AW BCP that they had stopped monitoring surface flow into Flint Ridge Cave on October 1, 2018. Consequently, AW BCP ordered replacement flow meters and auto samplers to assume all roles in the Flint Ridge Cave monitoring study.
- AW BCP also re-activated a flow station at Headquarter Flat Cave on J17 WQPL which served as a comparison runoff sinkhole for Flint Ridge Cave until 2009.
- A ribbon cutting ceremony for SH45SW opening was held May 18, 2019, which marks the opening of State Highway 45 SW operation over Flint Ridge Cave.

In February 2018, TxDOT and the USFWS agreed to allow COA BCP to use mitigation fees to conduct hydrogeological studies along FM 2222 and FM 620 in preparation of construction of a connector road to alleviate traffic. TxDOT issued a $390,655 mitigation fee to COA BCP in August 2018. As a prerequisite for hydrogeological studies in FY20, BCP is locating springs, assessing the presence of salamanders and other subterranean life, and restoring previously filled caves and extending deeper portions of known caves in the area. A report on the assessment of AW BCP preserves for aquatic life for FY19 can be found in Appendix T3.

In January 2019, a karst assessment of Stovepipe Karst Preserve (Canyon Creek 3) was conducted by COA BCP staff identifying eight karst features (Canyon Creek Crevasse, Fox Hole, Gaping Maw, Mossy Elm Sink, Sacred Grove Sink, Slab Sink, SP2, and SPF1) in addition to Stovepipe Cave. In March 2019, 4Caves further evaluated Fox Hole revealing a solution cavity with an opening approximately 8 in by 1.5 ft wide and 2 ft deep with a dirt floor. From February 12 - 26, 2019 Zarria Environmental further evaluated Mossy Elm Sink to a depth of ten feet without reaching the extent of fill to solid rock or open aperture. Additional evaluation is necessary on all eight karst features. The evaluation and restoration is a necessary prerequisite for conducting hydrogeological study of the site and developing cave

ecosystems on the preserve. Once restored by removing ranch fill, other caves such as LaCrosse Cave have shown healthy rebound of its troglobitic ecosystem.

On Park West and Cortaña BCP preserves, only relatively shallow caves are known. Karst assessments revealed numerous features that were anthropogenically filled. Spider Cave that is listed on the BCCP federal permit itself only extends to a 10 feet depth with dirt floor. In 1992, the former owner of the Park West tract claimed to Dr. Hauwert that an extensive cave pit was present adjacent to FM 2222. In 2018, caver Mike Grimm also reported that historically an 80 feet deep pit was present near FM 2222 on Park West. In FY19, a karst feature named Elm Sink was evaluated to a depth of 11 feet with dirt-filled floor and side passages remaining. Adjacent to Elm Sink a feature named Spare Rib was evaluated to 10 ft. With continued excavation Elm Sink and Spare Rib will likely connect. A contract for more extensive karst examination was bid in FY19, although the work is commencing in FY20.

After hydraulically significant karst features are revealed and spring locations are mapped, AW BCP expects to inject organic tracers and monitor cave drips and springs to map subsurface catchment areas. This information can be used to define karst faunal areas where protection can be focused, as described in the 1994 endangered karst invertebrate recovery plan.

Labor expenditures for COA BCP throughout FY19 came to a total of $46,069 and is broken down as follows:

- Stovepipe Preserve - $6,500
- Salamander assessment - $23,507
- Park West - $13,142
- Cortaña - $2,920

In FY19, Austin Corridor Program partnered with AW BCP to conduct a hydrogeological study of BCP permit caves along Slaughter Lane west of Mopac South, including Pipeline and Get Down Cave. Extensive trash fill dated from 1950's and 1960's was removed from Pipeline Cave to allow access into the entrance room and lower level where faunal surveys were conducted (EXHIBIT A). Prerequisite excavation of caves, drip gauge monitoring, water quality sampling, and tracing of source areas is intended to continue in FY20.

Christopher Francke and Dr. Hauwert drafted a report on cave streams in North Austin that are the focus of Jollyville salamander populations and water source to Lake Travis (Appendix T8).

8.0 RECOMMENDATIONS

COA and TC should continue to contact the owners of each privately-owned BCCP cave in order 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 in order to make a meaningful assessment. Additionally, COA and TC will continue to evaluate the adequacy of protection for all 62 BCCP caves during FY19 by initiating hydrological studies, and prioritize efforts accordingly.

Future research needs for the BCP should include an effort to determine to species level currently unknown troglobites such as *Speodesmus* sp., *Eidmannella* sp., and Trichoniscidae found in BCP caves. 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 FY19.

Table 10. FY19 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. (See EXHIBIT B).
Airmen's Cave City of Austin 1. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 2. Conducted bi-annual cave cricket exit counts. (SEE EXHIBIT B) 3. COA installed a cave gate within 18 feet 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. 4. Volunteers monitor the cave gate on call, and in the past have helped COA staff make cave gate and sign repairs.
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. Treated 19 mounds in Spring 2019.

Table 10. FY19 BCCP Karst Feature Monitoring and Management Activities.
Armadillo Ranch Sink Private
Arrow Cave City of Austin 1. Completed annual cave faunal survey (See EXHIBIT A). 2. Conducted quarterly site inspections. 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. Inspected site for RIFA infestations. On all visits RIFA were observed within close proximity of the cave (but not inside the cave).
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 in close proximity to the cave.
Bee Creek Cave Private
Blowing Sink Cave City of Austin 1. Inspected monthly and continued to operate security cameras. 2. Completed annual cave faunal survey (See EXHIBIT A). 3. COA staff removed invasive non-native vegetation from the preserve. 4. 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 will open up the lower passageways of the cave. 5. Annual cave cricket exit counts were conducted on 4 of the 5 restored caves found on the Blowing Sink tract: Sinky Dinky, Sink in the Woods, Winter Woods, and Wyoka Cave (EXHIBIT B). 6. Treated site for RIFA with boiling water. 7. 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. Treated site for RIFA with boiling water.
Buda Boulder Spring City of Austin 1. COA BCP staff conducted quarterly site visits and noted signs of recent transient camps near the spring. COA PARD Rangers were notified and now periodically patrol the site.

Table 10. FY19 BCCP Karst Feature Monitoring and Management Activities.
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 also has a fence for added protection. 3. Regent's School staff conduct periodic surface inspections of the cave including gate and lock maintenance. 4. In an effort to get a better understanding of CO2 levels in Cave X and other area caves, COA BCP staff requested access to install air monitoring equipment but were declined the offer by the owner in September 2017.
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.
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 is 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 feet 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).
Disbelievers Cave Private 10a Permit: PRT-808694
District Park Cave City of Austin 1. BCP staff conducted quarterly cave faunal surveys since there is a high potential for TCA introduction (See EXHIBIT A). 2. BCP staff and volunteers conducted quarterly 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.

Table 10. FY19 BCCP Karst Feature Monitoring and Management Activities.
Eluvial Cave Private 10a Permit: PRT-808694
Flint Ridge Cave City of Austin 1. Conducted six site visits and noted no signs of illegal trespass. 2. Conducted quarterly cave faunal surveys (See EXHIBIT A). 3. BCP staff and volunteers conducted quarterly cave cricket exit counts (See EXHIBIT B). 4. Continuous monitoring of drips was conducted in various rooms. 5. New flow meters and autosamplers were installed at the entrance sink. 6. Four autosamplers were installed inside Flint Ridge Cave. 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 FY20. 8. Treated site for RIFA with boiling water. 9. Construction of SH45SW was completetd and sections of this highway are over portions of the cave and its surface/subsurface catchment areas.
Fossil Cave City of Austin 1. Inspected quarterly 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.
Fossil Garden Cave Private
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. Surveyed site for RIFA. Treated 19 mounds in Spring 2019. 4. Conducted bi-annual cave faunal surveys (see EXHIBIT A). 5. 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 FY17. 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 conducted bi-annual cave faunal surveys (See EXHIBIT A). 5. BCP staff conducted bi-annual cave cricket exit counts (See EXHIBIT B). 6. Treated site for RIFA with boiling water. 8. Removed non-native invasive plants. 9. BCP staff continued to collect soft ticks from Live Oak Cave and to collaborate with Texas State and Baylor researchers whom are trying to determine more information about tick borne relapsing fever (TBRF).

Table 10. FY19 BCCP Karst Feature Monitoring and Management Activities.
Goat Cave City of Austin 1. Completed annual faunal survey (See EXHIBIT A). 2. Conducted quarterly site surveys. 3. Allowed permitted access to this cave. 4. Treated site for RIFA with boiling water.
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. Surveyed site for RIFA. Treated 61 mounds in Spring 2019. 4. TC conducted an annual cave faunal survey (see EXHIBIT A). 5. 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 2 site visits found and no signs of vandalism or human visitation. 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 6 site visits looking for signs of illegally discharged pools, dumped brush and trash from neighbors. It appears that past educational efforts have paid off, since aside from minor brush dumping, no significant illegal activities were observed. 2. Treated site for RIFA with boiling water. 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.
Jollyville Plateau Cave Private 10a Permit: PRT-808694

Table 10. FY19 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 from adjacent development in the form of tree clearing. Reparations have been collected. 4. Surveyed site for RIFA. Treated 69 mounds in Spring 2019. 5. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 6. 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. Treated 5 mounds in Fall 2019. 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 feet south of the cave to a maximum of 340 feet 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 bi-annual cave cricket exit counts. (See EXHIBIT B). 4. In an effort to enhance habitat, COA BCP staff excavated the cave extending the passage by roughly 10 feet.
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.

Table 10. FY19 BCCP Karst Feature Monitoring and Management Activities.
Lost Gold Cave Private
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 monthly site inspections and removed trash from preserve area. 4. Permitted access to this cave is allowed. 5. Treated site for RIFA with boiling water.
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 bi-annually for RIFA. No RIFA mounds observed during surveys. 4. Conducted annual cave faunal surveys (see EXHIBIT A).
McNeil Bat Cave Private
Midnight Cave City of Austin 1. Conducted quarterly site inspections; on multiple occasions in the past vandals cut the chain to the gate. 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. Treated site for RIFA 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. Surveyed site for RIFA. Treated 60 mounds in Spring 2019. 4. Conducted annual cave faunal survey (see EXHIBIT A).
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. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 5. TC conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).

Table 10. FY19 BCCP Karst Feature Monitoring and Management Activities.
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. Treated 23 mounds in Spring 2019. 4. Conducted 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 secured a one year contract to conduct quarterly cave faunal surveys, map the interior of the cave 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.
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 feet to the east and up to 300 feet west of the cave and an additional setback of 300 feet 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, staff collected several species of concern that was not known to occur in this cave. (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. 8. COA initiated a hydrological study by contracting Zara Environmental to conduct the work with help from COA staff.
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). 3. Treated site for RIFA with boiling water.
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. Treated 23 mounds in Fall 2019. 4. Conducted annual cave faunal survey (see EXHIBIT A).

Table 10. FY19 BCCP Karst Feature Monitoring and Management Activities.
Slaughter Creek Cave City of Austin 1. Conducted quarterly site inspections,. 2. Conducted one cave faunal survey. (See EXHIBIT A) 3. Treated site for RIFA with boiling water
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. Treated 32 mounds in Spring 2019. 4. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 5. 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. Treated site for RIFA with boiling water.
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. Performed surface inspections and detected signs of vandalism to the cave entrance and inside the cave. Cave gate was subsequently repaired by Zara Environmental. 3. Surveyed site bi-annually for RIFA. No mounds found within 80 m of cave. 4. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 5. Conducted bi-annual cave cricket exit counts (See EXHIBIT B). 6. Performed non-native plant removal projects on tract to increase native plant diversity.
Stovepipe Cave 1. Conducted 6 site inspections, and continued to remove new and old trash from the preserve. 2. Repaired perimeter fence. 3. Conducted bi-annual cave faunal surveys (See EXHIBIT A). 4. Conducted bi-annual cave cricket exit counts (See EXHIBIT B). 5. Surveyed site for RIFA; no mounds were discovered within the cave's treatment area. 6. Conducted karst assessment of site in FY19.
Talus Spring Cave 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 homeowners association donate the land to TC. 2. Performed surface inspections with no signs of vandalism to the cave entrance or in the cave. 3. Surveyed site bi-annually for RIFA. No mounds found within 80 m of cave. 4. Conducted annual cave faunal survey (see EXHIBIT A). 5. Performed a non-native plant removal project on tract to increase native plant diversity.

Table 10. FY19 BCCP Karst Feature Monitoring and Management Activities.
Tardus Hole 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. Treated 6 mounds in Spring 2019. 4. Conducted annual cave faunal survey (see EXHIBIT A).
Tooth Cave 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. 4. Zara Environmental replaced old cave gate with a newer elevated gate in FY18. 3. Surveyed site for RIFA. Treated 26 mounds in Fall 2017. 4. Conducted bi-annual cave faunal surveys (see EXHIBIT A). 5. Conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).
Weldon Cave 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. TC conducted bi-annual cave faunal surveys (see EXHIBIT A). 5. TC conducted bi-annual cave cricket exit surveys. (See EXHIBIT B).
Whirlpool Cave TCMA 1. TC/COA continued increased monitoring efforts and incorporated new methods to document the arrival and impacts of a nearby TCA population. 2. TC/COA conducted bi-annual cave faunal surveys (see EXHIBIT A). 3. TC/COA conducted bi-annual cave cricket exit surveys. (See EXHIBIT B). 4. TCMA continued to allow permitted access to the cave; however, in an effort to limit access and to raise funds for cave management, they are now charging a fee for access. 5. Continuous monitoring of CO_2, humidity, and airflow is being conducted in the East caverns passage by Zara Environmental on behalf of COA BCP.

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EXHIBIT A:

KARST FAUNAL SURVEY REPORTS

FY19 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 buwata***	***Eidmannella sp.***	***Speodesmus sp.***	***Speodesmus bicornourus***	***Tartarocreagris infernalis***	***Tayshaneta sp.***	***Texoreddellia texensis***	**Other notable species detected**
Adobe Springs Cave	11/20/2018	TC																									
Adobe Springs Cave	5/22/2019	TC																									
Airmen's Cave	1/15/2019	COA								13											68		8				*Perimyotis subflavus* (6) Pseudoscorpionida (5) *Texella mulaiki* (2)
Airmen's Cave	8/1/2019	COA								33									4		60		5				
Arrow Cave	9/11/2019	COA								13											4	3					*Texoreddellia* sp. (3)
Beard Ranch Cave	8/6/2019	COA						9			5																
Blowing Sink Cave	9/12/2019	COA								23			1														*Batrisodes* sp. (1) Japygidae (1)
Broken Arrow Cave	11/14/2018	COA							2											4		8					
Broken Arrow Cave	5/7/2019	COA	1						6											7		1					
Cave Y	1/15/2019	COA								3													6				*Perimyotis subflavus* (9)
Cave Y	8/1/2019	COA								10													10				*Texella grubbsi* (4)
Cold Cave	2/12/2019	TC						2						1						5		74					*Batrisodes* sp. (2) *Cambala speobia* (47)
Cold Cave	8/12/2019	TC																		9		6					*Batrisodes* sp. (16) *Cambala speobia* (33) *Perimyotis subflavus* (1)
Collaboration Cave	12/20/2018	COA							18												1	7					*Batrisodes* sp. (1) Trichoniscidae (3)
Cortana Cave	1/28/2019	COA			62			4			5	5										1					
Cortana Cave	8/14/2019	COA			39			12			15										34	8					
Cotterell Cave	1/29/2019	COA						14		23				3									14	6			
Cotterell Cave	8/12/2019	COA						36		63				4									30	7			
District Park Cave	11/29/2018	COA								23												2					*Texella mulaiki* (1)
District Park Cave	1/14/2019	COA								12												3					
District Park Cave	5/28/2019	COA								31												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 buwata***	***Eidmannella* sp.**	***Speodesmus* sp.**	***Speodesmus bicornourus***	***Tartarocreagris infernalis***	***Tayshaneta* sp.**	***Texoreddellia texensis***	**Other notable species detected**
Elm Sink	3/8/2019	COA									2																
Flint Ridge Cave	11/15/2018	COA								17			1								11	110					*Stygobromus russelli* (2)
Flint Ridge Cave	1/14/2019	COA								13											4	74				3	*Perimyotis subflavus* (6) *Stygobromus russelli* (11) Trichoniscidae (1)
Flint Ridge Cave	5/28/2019	COA								12			3								5	16					*Batrisodes* sp. (1) *Stygobromus russelli* (11) *Texella mulaiki* (2)
Gallifer Cave	1/31/2019	TC	24		50			53			167											14					*Cambala speobia* (50) *Tartarocreagris* sp. (1) *Texoreddellia* sp. (1)
Gallifer Cave	8/16/2019	TC	4	1	40			67			104										5	12					*Cambala speobia* (241) *Tartarocreagris* sp. (1)
Geode Cave	1/23/2019	TC	5		34						9	3															
Geode Cave	8/21/2019	TC			38			8			5	11										8					*Cambala speobia* (7)
Get Down Cave	11/29/2018	COA								14											1	3					
Get Down Cave	5/20/2019	COA								40			1									9					Pseudoscorpionida (6)
Goat Cave	9/11/2019	COA								6											3						*Texella mulaiki* (2) Trichonisicidae (2)
Good Thunder Cave	10/30/2018	TC/COA											5								2	49					*Cambala speobia* (86) *Cicurina* sp (blind) (26) *Tartarocreagris* sp. (5) *Texoreddellia* sp. (1) Trichonisicidae (5)
Hammett's Cave	9/10/2019	TC																				3			2		*Cambala speobia* (3) *Cicurina* sp (blind) (4) *Texella* sp. (9)
Hoskins Hole	3/22/2019	COA																			2	4					Pseudoscorpionida (1)
Ireland's Cave	1/31/2019	TC																		6			1				*Texoreddellia* sp. (1)
Jester Estates Cave	11/14/2018	COA		2	2		13				2											3					
Jester Estates Cave	5/7/2019	COA		2	3		17				2											1					Trichonisicidae (1)
Kretschmarr Cave	11/15/2018	TC									13										22		9				*Cambala speobia* (8)
Kretschmarr Cave	5/29/2019	TC				1					28										26		3				*Cambala speobia* (14)
Kretschmarr Double Pit	11/27/2018	TC									2										2						*Perimyotis subflavus* (1) *Texella grubbsi* (1)
Little Bee Creek Cave	11/15/2019	COA					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 buwata***	***Eidmannella sp.***	***Speodesmus sp.***	***Speodesmus bicornourus***	***Tartarocreagris infernalis***	***Tayshaneta sp.***	***Texoreddellia texensis***	**Other notable species detected**
Little Bee Creek Cave	5/16/2019	COA					3															1					Pseudoscorpionida (1)
Lost Oasis Cave	11/15/2018	COA								39											1	79					*Tartarocreagris* sp. (3) *Texella mulaiki* (3)
Lost Oasis Cave	5/16/2019	COA								46												34					*Batrisodes* sp. (1) *Texoreddellia* sp. (14)
Maple Run Cave	1/8/2019	COA								6																	*Anapistula* sp. (2) *Batrisodes* sp. (1) Pseudoscorpionida (1) *Texella mulaiki* (3)
Maple Run Cave	8/2/2019	COA								6												1					*Anapistula* sp. (5) Pseudoscorpionida (1) *Texella mulaiki* (1)
McDonald Cave	7/31/2019	TC						10			66												24	1			*Cambala speobia* (49) *Eidmannella restrata* (56) *Texoreddellia* sp. (4)
Midnight Cave	1/8/2019	COA								9			2								16	1					*Batrisodes* sp. (1) Trichoniscidae (26)
Midnight Cave	8/2/2019	COA								19											29	1					*Batrisodes* sp. (1) Pseudoscorpionida (1) *Texella mulaiki* (1) Trichoniscidae (26)
Millipede Annex Cave	12/5/2018	COA						15												5					5		Trichoniscidae (7)
Millipede Annex Cave	5/22/2019	COA			3			25												22	1						*Texoreddellia* sp. (1) Trichoniscidae (8)
Millipede Cave	12/5/2019	COA						1												10	1				6		*Stenochrus portoricensis* (11) Trichoniscidae (2)
Millipede Cave	5/22/2019	COA			2			1												14	1						*Stenochrus portoricensis* (11) *Tartarocreagris domina* (1) Trichoniscidae (3)
Mossy Rock Cave	1/25/2019	COA								4											40	7			2		*Batrisodes* sp. (3) *Tartarocreagris* sp. (1) *Texoreddellia* sp. (3) Trichoniscidae (1)
New Comanche Trail Cave	8/21/2019	TC						2																			*Cambala speobia* (2)
No Rent Cave	2/13/2019	TC						1												59	2						*Cambala speobia* (28) *Perimyotis subflavus* (1)
No Rent Cave	8/14/2019	TC						3												14	1	2					*Cambala speobia* (29)
North Root Cave	5/29/2019	TC																			1						*Cambala speobia* (14)
Pipeline Cave	11/29/2018	COA								28											3						*Batrisodes* sp. (2) *Texella mulaiki* (5)
Pipeline Cave	1/17/2019	COA								23											1						*Anapistula* sp. (1) *Texella mulaiki* (4) *Texoreddellia* sp. (1) Trichoniscidae (2)
Pipeline Cave	5/20/2019	COA								13			1														*Batrisodes* sp. (2) *Texella mulaiki* (9) *Texoreddellia* sp. (5)

			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 buwata***	***Eidmannella sp.***	***Speodesmus sp.***	***Speodesmus bicornourus***	***Tartarocreagris infernalis***	***Tayshaneta sp.***	***Texoreddellia texensis***	**Other notable species detected**
Pond Party Pit	1/29/2019	COA						7			1											8					Pseudoscorpionida (2) Trichoniscidae (3)
Pond Party Pit	8/6/2019	COA						8			9										5	10		6			Trichoniscidae (3)
Rolling Rock Cave	11/14/2018	COA																		1							*Perimyotis subflavus* (3) Trichoniscidae (3)
Root Cave	1/30/2019	TC									1																*Cambala speobia* (4)
Seibert Sink	1/8/2019	COA								8			1						11		1	1			1		
Seibert Sink	8/2/2019	COA								3									5			2					Pseudoscorpionida (2) Trichoniscidae (60)
Slaughter Creek Cave	9/11/2019	COA								25											13	55					*Batrisodes* sp. (1)
Spanish Wells Cave	2/11/2019	TC							10						30												*Stygobromus russelli* (50)
Spanish Wells Cave	8/19/2019	TC							2						3												*Crotalus atrox* (1) *Stygobromus russelli* (150)
Spare Rib Cave	3/7/2019	COA									2																
Spider Cave	11/14/2019	COA					3				21										3						
Spider Cave	5/7/2019	COA	1				3				22										1		2				*Batrisodes* sp. (1)
Stark's North Mine Cave	11/29/2018	TC															12										*Cambala speobia* (2) *Perimyotis subflavus* (11) Pseudoscorpionida (24)
Stark's North Mine Cave	5/22/2019	TC																									
Stovepipe Cave	1/29/2019	COA	2		1	7		22			20	3										37					Pseudoscorpionida (4) *Tartarocreagris attenuata* (2) Trichoniscidae (27)
Stovepipe Cave	8/6/2019	COA	3			7		15				9										61					*Tartarocreagris attenuate* (2) Trichoniscidae (52)
Talus Springs Cave	8/30/2019	TC																									*Cambala speobia* (4) *Texella grubbsi* (1)
Tardus Hole	11/27/2018	TC																									
Testudo Tube Cave	1/28/2019	COA													8					16		15					*Batrisodes* sp. (1) *Eurycea tonkawae* (27) Trichoniscidae (1)
Testudo Tube Cave	8/14/2019	COA													10					35		6					*Batrisodes* sp. (1) *Eurycea tonkawae* (19) Japygidae (1) *Rhadine* sp. (1)
Tight Pit Cave	1/30/2019	TC																									
Tooth Cave	11/15/2018	TC	8		1	1		91			94	4											20				*Cambala speobia* (39) *Perimyotis subflavus* (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 buwata***	***Eidmannella* sp.**	***Speodesmus* sp.**	***Speodesmus bicornourus***	***Tartarocreagris infernalis***	***Tayshaneta* sp.**	***Texoreddellia texensis***	**Other notable species detected**
Tooth Cave	5/22/2019	TC	1	1	6	2		55			63	9											26				*Cambala speobia* (22) *Texoreddellia* sp. (1)
Two Trunks Cave	1/30/2019	TC									4																
Weldon Cave	2/13/2019	TC												9						2			4				*Cambala speobia* (8)
Weldon Cave	8/14/2019	TC						3												5	2		5				*Cambala speobia* (4)
Whirlpool Cave	2/8/2019	TC/COA								3			7														*Tayshaneta sandersi* (1)
Whirlpool Cave	8/20/2019	TC/COA								11			5								3						*Tayshaneta sandersi* (2)
Wyoaka Cave	7/23/2019	COA								4																	*Texoreddellia* sp. (1)

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

[2] Surveyors in FY19 include: Samuel Berg, Cristina Campbell, Travis Clark, Amanda Fernandez, Paul Fushille, Kristin Gold, Devin Grobert, Darrell Hutchinson, Audrey Kuhl, Linda Laack, David Morgan, Julie Murray, Mark Sanders, Nancy Sandoval, Johnny Scalise, Blake Sissel, Colin Strickland, Ben Stubs, and Drew Thompson

EXHIBIT B:

CAVE CRICKET EXIT COUNT DATA REPORTS

FY19 COA/TC CAVE CRICKET EXIT COUNT DATA REPORTS

Surveyed Caves	Fall 2018 (November/ December)				Winter 2019 (January/February)				Spring 2019 (May/ June)				Summer 2019 (August/ September)			
	N:	J:	A:	TI:	N:	J:	A:	TI:	N:	J:	A:	TI:	N:	J:	A:	TI:
Adobe Springs Cave	0	2	23	25					51	773	263	1087				
Airman's Cave					569	371	45	985					156	74	9	239
Broken Arrow Cave	73	71	219	363					260	116	321	697				
Cave Y					106	58	36	200					285	101	88	474
Cold Cave					1551	57	0	1608					785	294	776	1855
Cortana Cave					26	31	48	105					17	20	108	145
Cotterell Cave					961	403	287	1651					1412	190	38	1640
District Park Cave	81	100	288	469	229	109	110	448	521	611	1697	2829	127	60	752	939
Flint Ridge Cave	25	64	226	315	6	28	36	70	85	68	78	231	19	34	84	137
Gallifer Cave					7	5	0	12					9	217	496	722
Get Down Cave	64	96	251	411					474	321	53	848				
Geode Cave					0	1	0	1					74	104	34	212
Jest John Cave													58	187	997	1242
Jester Estates Cave	57	179	63	299					1231	233	67	1531				
Kretschmarr Cave	54	64	29	147					23	163	125	311				
Little Bee Creek Cave	1	0	1	2					0	0	28	28				
Lost Oasis Cave	170	45	170	385					203	64	62	329				
Maple Run Cave					262	34	28	324					206	75	74	355
Midnight Cave					2705	2174	1101	5980					3511	6378	6095	15984
No Rent Cave					342	474	2	818					208	114	280	602
Pipeline Cave	670	754	258	1682	597	207	31	835	286	192	262	740				
Pond Party Pit					18	19	4	41					24	37	225	286
Seibert Sink					168	118	29	315					66	11	28	105
Sink in the Woods	81	58	17	156												

Surveyed Caves	Fall 2018 (November/December)				Winter 2019 (January/February)				Spring 2019 (May/ June)				Summer 2019 (August/ September)			
Sinky Dinky													8	2	334	344
Spanish Wells Cave					1	3	1	5					7	25	300	334
Spider Cave	12	5	39	56					23	33	40	96				
Stark's North Mine	0	5	4	9					-	-	-	-				
Stovepipe Cave					97	40	36	173					109	26	292	427
Testudo Tube					155	117	13	285					1	2	122	125
Tooth Cave	4	5	8	17					21	5	16	42				
Weldon Cave					1026	963	0	1989					162	84	238	484
Whirlpool Cave					4676	1851	484	7011					722	473	718	1913
Winter Woods					514	247	37	798								
Wyoka Cave									66	84	245	395				

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