Terrestrial Species of Concern Study for the Pensacola Hydroelectric Project (Project; FERC [Federal Energy Regulatory Commission] No. 1494); Craig, Delaware, Mayes and Ottawa Counties, Oklahoma

Prepared for:



Grand River Dam Authority

Prepared by:



Horizon Environmental Services, Inc.

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1.0 INTRODUCTION AND BACKGROUND

Grand River Dam Authority (GRDA, Licensee) holds a license issued by the Federal Energy Regulatory Commission (FERC, Commission) to operate and maintain the Pensacola Hydroelectric Project (Project). The Project is owned, operated, and maintained by the Licensee. The current license, which designates the Project as FERC No. 1494, expires on May 31, 2025 (FERC, 2018a).

As part of the relicensing of the Project, GRDA filed a Pre-Application Document (PAD) with FERC on February 1, 2017 (GRDA 2017). The GRDA filed its Proposed Study Plan (PSP) for the relicensing on April 27, 2018 (GRDA 2018a). Also, on April 27, 2018, FERC released its Scoping Document 2 for the relicensing of the Project (FERC 2018b). In its PSP, GRDA did not include a specific study to investigate potential Project effects on terrestrial species of concern. Based on comments received from federal and state resource agencies and other stakeholders, GRDA's Revised Study Plan (RSP), filed on September 24, 2018, proposed a Terrestrial Species of Concern Study (Study) to provide further details regarding how potential impacts to these species related to changing water levels due to Project operations will be assessed during the relicensing process.

This Study proposed to collect information to support an assessment of the effects of the Project, if any, on terrestrial species of concern as part of FERC's National Environmental Policy Act (NEPA) analysis for the relicensing of the Project. According to the approved study plan, three Rare, Threatened, and Endangered (RTE) species require analysis: the gray bat, and American burying beetle ("species of concern"). To provide the information needed by FERC to fulfill its requirements under NEPA, GRDA will complete a "desktop" evaluation of the changes due to Project operations, if any, on the two species of bat and field surveys and associated analysis to assess possible impacts on the American burying beetle. The analysis will be based on output from the Comprehensive Hydraulic Model (CHM) that will be developed as part of the Hydrologic and Hydraulic Modeling Study (H&H Study) combined with existing information on the bat species, and data derived from surveys of the American burying beetle in the study area.

Continued operation of the Project will influence water levels of Grand Lake. These water level fluctuations may have the potential to alter the habitat of the species of concern. Understanding the magnitude, duration, and frequency of operational effects on habitat will allow

for a characterization of potential impacts, if any, on the terrestrial species of concern and provide information needed by FERC to fulfill its requirements under NEPA.

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2.0 STUDY YEAR ONE ACTIVITIES

2.1 AMERICAN BURYING BEETLE SURVEY

Horizon coordinated with the United States Fish and Wildlife Service (USFWS) to ensure sufficient Project Area coverage with respect to habitat types across the entire Project Area as well as greatest surface area coverage in areas of potential impacts based on the Upland Model extents associated with the H&H Study. Six baited pitfall bucket traps were deployed within suitable, representative terrain on 18 July 2021 in Delaware and Ottawa Counties (Figure 1). This presence/absence survey was conducted as an early season survey in accordance with the approved study plan. The survey was conducted in accordance with the United States Fish and Wildlife Service American Burying Beetle (*Nicrophorus americanus*; ABB) Range-Wide Presence/Absence Survey Guidance dated May 2018 (Guidance).

The survey continued with five nights of valid weather parameters. Guidance defines valid weather parameters as:

- 1. Nighttime temperature during the survey period above 60° F (15.5 C)
- 2. Wind speeds no greater than 10 mph in excess of 20% of the time (1 hour 24 minutes) between 9:00 p.m. and 4:00 a.m.,
- 3. Precipitation less than 0.5 inches between 9:00 p.m. and 4:00 a.m.

No ABBs were captured or observed during this survey effort. For full details of the survey effort, please refer to the American Burying Beetle Pensacola Hydroelectric Project Survey Report in Appendix A.



Figure 1. ABB Survey Trap Locations

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2.2 GRAY BATS

The approved study plan states that GRDA will assess the degree to which Project operations would inundate the main entrance to Beaver Dam Cave and compare the frequency of inundation with that associated with existing operations. GRDA will determine whether the secondary exit suffices to provide an alternative access by gray bats to the cave (during times of inundation).

Observations from previous exit surveys support historical evidence that during high water or flood events during the maternity season, a maternity colony of the endangered gray bat vacates cave DL-2 (Beaver Dam Cave) —whose passage lies within the flood pool of Grand Lake—and migrates to an alternative cave. Persistent threat of inundation increases the likelihood of "take" of adult females and young. Complete inundation of the cave passage of DL-2 occurs at about elevation 752 feet Pensacola Datum (PD). When Grand Lake is at about elevation 751 feet PD, only about one foot of flyway exists between the top of the water in the cave and the rock ceiling of the flyway, forcing evacuation of the colony. In October 2008 a small, high passage within cave DL-2 was identified and minimally excavated and enlarged. Enlarging this passage was suspected to provide an alternative escape route for exiting bats, particularly during high water. Additional excavation and enlargement of this second-high passage was completed in October 2013. The length of the high passage was about 5m and was widened to about 0.40 meters wide by 0.50 meters tall. An inspection of the passage following flood events since 2011 revealed scattered guano in the enlarged passage indicating use by bats. A post-inundation monitoring visits to the cave following a flood event in 2019 failed to give any indication that take had occurred as a result of inundation, and that the colony had successfully vacated to another location (Table 1).

Table 1. Records of highwater events where the elevation of Grand Lake exceeded elevation 750.00 feet PD from 2005-2019. At elevation 752 feet PD, the existing flyway inside cave DL-2 is completely inundated preventing colony exit and re-entry.

	Date	Date	Maximum	Total	Effect on
Year	Beginning	Ending	Elevation (ft)	Duration	Colony
2011	27-Apr	28-Apr	750.80	2 days	Successfully Vacated
2011	25-May	26-May	751.71	2 days	Successfully Vacated
2015	27 May	22 June	754.89	27 days	Successfully Vacated
2017	30 April	25 May	754.77	26 days	Successfully Vacated

				Chap	ter 2.0: Study Year One Activities
2019	14 May	15 July	755.02	63 days	Successfully Vacated

The full 2021 Summer Report on Monitoring Patterns and Use by Gray Bat Populations in Caves DL-2 and DL-91 in Delaware County, Oklahoma is located in Appendix B. This report (as well as the previous discussion) was generated Dr. Keith W. Martin, Dean and Professor of Biology School of Arts and Sciences Rogers State University Claremore, Oklahoma as part of an ongoing monitoring program incidental to the approved study plan. These baseline data will be used to inform the analysis portion of this Study.

3.0 STUDY YEAR TWO ACTIVITIES

3.1 IMPACT ANALYSIS

The results of the H&H Study demonstrate that future operational changes that may be implemented by GRDA within the conservation pool of Grand Lake will not appreciably influence water levels beyond the current Project boundary (elevation of 750 feet Pensacola Datum). Thus, the areas that may be affected due to future operational changes are limited to a relatively narrow band of terrestrial habitat of a few feet of varying range from the shoreline.

The ABB will only use areas with a soil and/or leaf litter substrate and vegetated cover (as opposed to bare rocky or sandy shorelines) so suitable habitat within the project boundary is limited. The effective survey radius for each trap is 0.5 mile (0.8 km) based on ABB mobility, size, recorded movement distances, and the distance from which ABBs can detect carrion (Guidance). ABBs fly and have been reported moving nightly distances ranging from 0.16 to 30 kilometers (km) (0.10 to 18.6 miles) in various parts of their range (Bedick et al. 1999, Creighton and Schnell 1998, Schnell et al 2011).

In Oklahoma, ABBs have been recorded to move approximately 10 km (6.2 miles) in 6 nights (Creighton and Schnell 1998). With respect to these species' habits, traps would have to be placed within the narrow band of sparsely existing suitable habitat between the shoreline and the 750-foot elevation mark to cover the potentially affected area, and due to the imprecise nature of the survey model, the majority of the effective radius would cover unsuitable habitat (water surface) and potentially preferable habitat outside of the potentially affected area (above 750-foot elevation).

Considering the distance ABBs can travel and the limited terrestrial area potentially affected by future project operations, any ABBs captured could represent ABBs lured from the larger terrestrial area within the effective survey radius but outside of the area potentially affected by future Project operations project area and thus not representative of the species' actual habitat use or occupancy within the Project area as a whole. Positive ABB findings could thus incorrectly be identified as Project effects. Coupled with the negative findings of the 2021 ABB surveys, GRDA proposes to forego the second year survey as the results would not be representative of Project effects.

For gray bats, water levels in cave DL-2 (Beaver Dam Cave) and cave DL-91 (Twin Cave) have the potential to be affected by future operations. However, results from monitoring visits to

the cave following a flood event in 2019 demonstrate that such water levels do not result in any take of the species, and that the colony had successfully vacated to another location.

If it is found anticipated future operations according to the H&H Study will impact cave DL-2, the success of enlarging the passage in cave DL-2 to provide an alternative escape route for exiting bats in avoiding take will again be reviewed in 2022.

4.0 REFERENCES CITED

- (FERC, 2018a) Federal Energy Regulatory Commission. 2018. *Study Plan Determination for the Pensacola Hydroelectric Project*. November 8, 2018.
- (GRDA, 2017) Pensacola Hydroelectric Project, P-1494, Pre-Application Document. February 2017.
- (GRDA, 2018a) Pensacola Hydroelectric Project, P-1494, Proposed Study Plan. April 2018.
- (FERC, 2018b) Scoping Document 2, Pensacola Hydroelectric Project No. 1494-438. April 27, 2018.
- (Bedick et al. 1999) Bedick, J.C., B.C. Ratcliffe, W.W. Hoback, and L.G. Higley. 1999. Distribution, ecology and population dynamics of the American burying beetle Nicrophorus americanus Olivier (Coleoptera, Silphidae)] in South-central Nebraska, USA. Journal of Insect Conservation 3(3):171-181.
- (Creighton and Schnell 1998) Creighton, J.C. and G. Schnell. 1998. Short-term movement patterns of the endangered American burying beetle Nicrophorus americanus. Biological Conservation 86:281-287.
- (Schnell et al 2011) Schnell, G. D., A.H. Hiott and V. Smyth. 2011. Evaluation of American burying beetles on the Weyerhaeuser Habitat Conservation Plan Area: 10-year assessment (1997-2006). Final report to Weyerhaeuser Company. Unpublished. MS.

APPENDIX A:

American Burying Beetle Pensacola Hydroelectric Project Survey Report



15 September 2021

Jacklyn Jaggars Director of Hydropower Projects Grand River Dam Authority 420 OK-28 Langley, OK 74350 918-981-8473 Office Jacklyn.Jaggars@grda.com

RE: American Burying Beetle Presence/Absence Survey for the Pensacola Hydroelectric Project (Project; FERC [Federal Energy Regulatory Commission] No. 1494); Craig, Delaware, Mayes and Ottawa Counties, Oklahoma

Dear Ms. Jaggers:

Horizon Environmental Services, Inc. (Horizon) appreciates the opportunity to provide environmental support services to the Grand River Dam Authority (GRDA) for the Pensacola Hydroelectric Project (Project; FERC [Federal Energy Regulatory Commission] No. 1494), spanning Craig, Delaware, Mayes & Ottawa Counties, Oklahoma (Project Area).

As part of the relicensing of the Pensacola Hydroelectric Project the GRDA filed a preapplication document with FERC on February 1, 2017 (GRDA 2017). The GRDA filed its Proposed Study Plan (PSP) for the relicensing on April 27, 2018 (GRDA 2018a). Also, on April 27, 2018, FERC released its Scoping Document 2 for the relicensing of the Project (FERC 2018).

In support of the relicensing effort, Horizon was contracted to conduct a presence/absence survey for the American burying beetle (*Nicrophorus americanus*; ABB) to determine whether the ABB, a federally threatened species, may be present within the proposed Project Area. The Project Area is located within the ABB's current range, but outside of any conservation priority area (CPA) as defined by the US Fish and Wildlife Service (USFWS) (see attached Vicinity Map).

On 18 July 2021, Horizon ABB Specialist Stephanie Rainwater (permit number TE-00284A) placed six (6) traps to cover a representative sample of all suitable habitat types within the Project Area (see attached Trap Maps), as well as covering the largest surface areas of potential terrestrial impact from potential water level fluctuations determined by the output from the Comprehensive Hydraulic Model (CHM) developed from as part of the Hydrologic and Hydraulic Modeling Study (H&H Study) associated with this project. The traps were designed, baited and checked following the guidelines of the *American Burying Beetle Range-wide Presence/Absence Survey Guidance* (USFWS, 2018). Trap locations were oriented in Delaware and Ottawa Counties only, but confirmed with Kevin Stubbs, USFWS National Species Lead via telephone conversation as sufficiently representative of the overall four county Project Area.

The six traps were checked daily for a total of five nights with valid weather parameters and yielded no positive ABB findings. The survey effort concluded on 23 July 2021 (see attached Data Collection Forms). The results of this survey will remain valid until the commencement of the 2022



ABB active season. These negative survey findings indicate that the ABB is not active within the Project Area; thus, take (defined by the Endangered Species Act [ESA] as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species") is not expected as a result of this project.

If you have any questions or concerns, please do not hesitate to contact me.

Sincerely, Slameter

Stephanie Rainwater Project Manager/Biologist (USFWS Permit Number TE-00284A) Horizon Environmental Services, Inc. 321 S. Boston Ave., Suite 300 Tulsa, OK 74103 918-219-9951 srainwater@horizon-esi.com

Attachments:

Maps
 Data Collection Forms



References:

- (Nearmap) Nearmap US, Inc. Nearmap VerticalTM digital orthographic photograph, https://go.nearmap.com. Imagery date 6 May 2021. Accessed 10 August 2021.
- (OSM) OpenStreetMap contributors. OpenStreetMap, <<u>http://www.openstreetmap</u>.org>. Available under the Open Database License (www.opendatacommons.org/ licenses/odbl). Accessed 10 August 2021.
- (USFWS) US Fish and Wildlife Service. *American Burying Beetle (Nicrophorus americanus) Range-wide Presence/Absence Survey Guidance*, <https://www.fws.gov/southwest/ es/oklahoma/Documents/ABB/Surveying%20final/ABB%20Rangewide%20Survey% 20Guidance_Final8May2018.pdf>. Published May 2018.
- (USFWS) US Fish and Wildlife Service, Oklahoma Ecological Services Field Office. *American Burying Beetle: Additional Information*. ABB Range Map and Conservation Priority Area GIS Shapefiles, available at https://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm. Range Map updated 2016; CPA Map updated 14 April 2014. Accessed 10 August 2021.



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Appendix A: Data Collection Forms*** American Burying Beetle Nicrophorus americanus Presence/Absence Live-trapping Survey Guidance															
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	TE Permit #:	TE-00284A								-	Survey End	d Date:	July	23	2021
	Survey Company:	Horizon Enviro	onmental Servi	ces, Inc.											
	-						Trap Loc	ation Data							
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							Weath	er Data							
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Capt Trap No. 1 3 4 4 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	Wind>10mph?6	No (Yes/No) americanus 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	orbicollis 0 0	Nicrop tomentosus 0	Heavy Rain? ⁵ pustulatus pustulatus 0 Additiona the appropri Male New ⁹	No Cies marginatus 0 Cies and	carolinus 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	sayi 0 0 0 0 e of weather? ⁸ COPY each r Female Old ⁹	Soil Moisture ⁴ Necrophilia americana 6 6 6 6 6 0 (No=0/Yes=1) 0 (No=0/Yes=1) 0 0 (No=0/Yes=1) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.4753 Necrodes surinamensis 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Other 0 0 4 Valid Trap Nights: ABB Capture Fo Dead	Trap Night Valid (No=0/Yes=1) 1 1 1 1 1 1 1 1 1 1 Pronotum Width (mm)	Time Checked ¹ : 6:55	442 on Pg 6. Recapture ¹⁰	Newly Marked ¹¹

Auton	nated Total	0	0	0	0	0	0	0	0	0	0	NA	0	
Comments:														
											-			

Droi	act Name:	Doncocolo Roli	concing	AMERI	CAN BUR	YING BEETL	E SURVE	Y DATA CO	DILECTION	FORM	Survey Night:		2		
Project	t Description:	Hydroelectric I	Relicensing				Bait Type:	Aged Chicken	1		Date Checked ¹ :		July 20, 202	1	
Action Age	ency/Proponent:	Grand River Da	am Authority			Tr	ap Cover Size	24"	1		Permittee:	Ste	phanie Rain	water	
											Survey Company:	Horizon En	vironmenta	Services, Inc.	
						\\/	eather Da	ha							
	Daytime Temps	65.5	83.71	Survey P	Period Temps	66.74	73.04		Humidity	-996	-996				
		(min.)	(max.)	-		(min.)	(max.)	-		(min.)	(max.)	-			
	Wind>10mph?6	No			Heavy Rain?⁵	No]		Soil Moisture ⁴	1.4758					
		(Yes/No)													
Capt	ture Data			Nicrop	ohorus spe	ecies			Necrophilia	Necrodes	Other	Trap Night Valid	Time		
Trap No. 1	Disturbed (Y=1/N=0)	americanus 0	orbicollis 0	tomentosus 0	pustulatus 0	marginatus 0	carolinus 0	sayi O	americana 3	surinamensis 1	1	(No=0/Yes=1) 1	Checked ⁻ :		
Totals	0	0	0	0	0	0	0	0	3	1	1	1			
		-		· · · · · · · · · · · · · · · · · · ·	-	-	-			· · · · ·	_		1		
No.	of disturbed traps	and/or bait (D):	0	J	Additiona	al survey night red	quired becaus	e of weather? ⁸	0 (No=0/Yes=1)] ;	# Valid Trap Nights:	1	J		
		Lict the indi-	idual APP as	TRICS below	d comelete	the appropriat	a columna v			wand DACTE	to Individual 40	R Conture Fe	rm on Perf		
		List the maiv	AGUAI ADD IVII	-mics below an	a-complete	the appropriat	- columnis.	ou wiii then			All multiludi AB	- capture FO	Picture		
ABB Number	Caught in Trap No.	Male	Female	Unknown Sex	Male New ⁹	Male Old ⁹	Female New ⁹	Female Old ⁹	Male Unknown Age ^s	Female Unknown Age ⁹	Dead	Pronotum Width (mm)	(Yes=1/No= 0)	Recapture ¹⁰	Newly Marked ¹¹
												,			
Auto Comments:	mated lot.	0	0	0	U	U	U	U	0	0	U	NA	0		
Proi	ost Namo:	Doncacola Poli	concing	AMERIO	<mark>CAN BUR</mark>	YING BEETL	E SURVE		OLLECTION	FORM	Survey Night		3		
Proj Project	ect Name: t Description:	Pensacola Reli Hydroelectric I	censing Relicensing	AMERI	<mark>CAN BUR</mark>	YING BEETL	E SURVE Trap Type: Bait Type:	Y DATA CC Above Ground Aged Chicken	OLLECTION	FORM	Survey Night: Date Checked ¹ :		3 July 21, 202	1	
Proj Project Action Age	ect Name: t Description: ency/Proponent:	Pensacola Reli Hydroelectric I Grand River Da	censing Relicensing am Authority	AMERIO	<mark>CAN BUR</mark>	YING BEETL	E SURVE Trap Type: Bait Type: rap Cover Size	Y DATA CC Above Ground Aged Chicken 24"	OLLECTION	FORM	Survey Night: Date Checked ¹ : Permittee: TE Permit #:	Ste	3 July 21, 202 phanie Rain TE-00284/	1 water	
Proj Project Action Age	ect Name: t Description: ency/Proponent:	Pensacola Reli Hydroelectric I Grand River Da	censing Relicensing am Authority	AMERI	<mark>CAN BUR</mark>	YING BEETL	E SURVE Trap Type: Bait Type: rap Cover Size	Y DATA CC Above Ground Aged Chicken 24"	DILLECTION	FORM	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company:	Ste Horizon En	3 July 21, 202 phanie Rain TE-002844 vironmenta	1 water A Services, Inc.	
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Action Age	ency/Proponent:	Grand River Da	am Authority			Tr	ap Cover Size	24"			Permittee:	Ste	phanie Rain	water	
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No.	of disturbed traps a	and/or bait (D):	0	J	Additiona	l survey night red	quired becaus	e of weather? ⁸	0 (No=0/Yes=1)	#	# Valid Trap Nights:	1			
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		List the indiv	ndual ABB MI	ETRICS below an	a complete	the appropriat	e columns. \	ou will then	COPY each rov	v and PASTE in	to Individual ABI	s capture Foi	m on Pg 6. Picture		
ABB	Caught in Trap				Mala Naw ⁹	Mala Old ⁹	Female	Female Old ⁹	Male	Female		Pronotum	(Yes=1/No=	Decenture ¹⁰	Newly
Number	NO.	Male	Female	Unknown Sex	Male New	Iviale Old	New	Female Old	Unknown Age	Unknown Age	Dead	width (mm)	0)	Recapture	IVIAIKEU
Auto	mated Tot.	0	0	0	0	0	0	0	0	0	0	NA	0		
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Proj Project Action Age Capt Trap No. 1 Trap No. 1 No. 0 ABB Number	ect Name: t Description: ency/Proponent: Daytime Temps Wind>10mph?6 Wind>10mph?6 Disturbed (Y=1/N=0) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pensacola Relia Hydroelectric F Grand River Da 68.27 (min.) 68.27 (min.) 0 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	censing Relicensing am Authority 90.37 (max.) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AMERIO Survey F Nicrop tomentosus 0 1 1 1 1 1 1 1 1 1 1 1 1 1	CAN BUR CAN BUR CAN BUR Can a special set of the set of	VING BEETL Tr 69.26 (min.) No ecies marginatus o i i o i<	E SURVE Trap Type: Bait Type: ap Cover Size eather Dat 76.81 (max.) <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolinus</i> <i>carolin</i>	Control of the second of th	LLECTION Humidity Soil Moisture ⁴ Necrophilia americana 0 Necrophilia americana 0	FORM 55.35 (min.) 1.6729 Necrodes surinamensis 6 0 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company: 99.3 (max.) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Image: Contract of the second seco	5 July 23, 202 phanie Raim TE-00284A vironmental Checked ¹ : 6:45 6:45 6:45 6:45 7 Picture (Yes=1/No= 0)	1 water Services, Inc. Services, Inc. Image: Service, Inc. Im	Newly Marked ¹¹
Proj Project Action Age Capt Trap No. 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ect Name: t Description: ency/Proponent: Daytime Temps Wind>10mph?6 Wind>10mph?6 Disturbed (Y=1/N=0) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pensacola Relia Hydroelectric F Grand River Da 68.27 (min.) 68.27 (min.) 0 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	censing Relicensing am Authority 90.37 (max.) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AMERIO Survey F Survey F Contactor Conta	CAN BUR CAN BUR CAN BUR Canada and a second	YING BEETL Tr 0 69.26 (min.) No ecies marginatus 0 1 0 1 0 1 0 1 Nale Old ⁹ 1 Male Old ⁹ 1 Male Old ⁹ 1 Male Old ⁹	E SURVE Trap Type: Bait Type: ap Cover Size carolinus (max.) carolinus	Control (Control) Above Ground Aged Chicken 24" a a a a a a a a a a a a a a a a a a a b a	LLECTION Humidity Soil Moisture ⁴ Necrophilia americana 0 <	FORM 55.35 (min.) 1.6729 Necrodes surinamensis 6 3 4 2 4 2 4 4 4 4 4 5 4 5 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company: 99.3 (max.) 99.3 (max.) 0 2 2 4 Valid Trap Nights: to Individual AB Dead Dead 0	Image: Contract of the second seco	5 July 23, 202 phanie Raim TE-00284A vironmental Checked ¹ : 6:45 6:45 6:45 6:45 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	1 water Services, Inc. Services, Inc. Image: Service, Inc. Im	Newly Marked ¹¹

Total Number of Traps:	1

DATA AUTOMATICALLY CALCUATED - DO NOT ENTER DATA IN BLOCKS 1, 3, OR 4

DATA ENTRY IS ONLY REQUIRED IN DATA BLOCK 2

				BLOCK				Ε ΠΔΤΔ ΤΟ		PFCIES					1
												Total Tran	1		-
Trap No.	Disturbed (0/1)	americanus	orbicollis	tomentosus	pustulatus	marainatus	carolinus	savi	Necrophilia	Necrodes	Other	Nights			
1	0	0	0	0	0	0	0	0	30	8	5	5	1		
0	0	0	0	0	0	0	0	0	0	0	0	0			
0	0	0	0	0	0	0	0	0	0	0	0	0			
0	0	0	0	0	0	0	0	0	0	0	0	0	1		
0	0	0	0	0	0	0	0	0	0	0	0	0			
0	0	0	0	0	0	0	0	0	0	0	0	0	-		
0	0	0	0	0	0	0	0	0	0	0	0	0	-		
0	0	0	0	0	0	0	0	0	0	0	0	0	1		
0	0	0	0	0	0	0	0	0	0	0	0	0			
Totals	0	0	0	0	0	0	0	0	30	8	5	5	1		
			_							1					
No. of distur	bed traps and/or b	oait (D):	0		Additiona	l survey night re	quired becaus	se of weather?	0						
				BLOCK	2 - Individ	ual ABB Capt	ure Data -	DATA ENTR	RY <u>IS</u> REQUI	RED IN THIS I	BLOCK				
			COPY	the INDIVIDUAL	ABB Captur	e Data from Ni	ghtly Survey	Forms and P	ASTE into the	appropriate R	OW <u>BY</u> ABB Nun	nber.			
													Picture		
ABB	Caught in Trap				0		Female		Male	Female		Pronotum	(Yes=1/No=	10	Newly
Number	No.	Male	Female	Unknown Sex	Male New ⁹	Male Old ⁹	New ⁹	Female Old ⁹	Unknown Age ⁹	Unknown Age ⁹	Dead	Width (mm)	0)	Recapture ¹⁰	Marked ¹¹
															4
															l
												-			4
Total ABB	0	0	0	0	0	0	0	0	0	0	0	NA	0	0	0
Comments:															_
Total Numbe	er of Traps:	6													
					T FNTER	ΝΥ ΠΑΤΑ ΙΝ	THIS DAT						1		
	BLOCK 3	- Total ABB	Capture Da	ita by Trap / 1	ransect - I	Data from TH	IS BLOCK	utopopula	tes into the s	Survey Sumn	nary Form		1		
												Total			1
					_	0	Female	_	Male	Female		Trap/Bait	10	Newly	

1	Total ABB	Male	Female	Unknown Sex	Iviale New	Male Old	New	Female Old	Unknown Age	Unknown Age	Dead	Disturbed	Recapture	IVIAIKEU
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLOCK 4 - Cumulative Survey Period Weather Data Summary - NO DATA ENTRY REQUIRED IN THIS BLOCK														
Daytime Temp Range Survey Period Temp Range Daily Humidity Range														
Daytime Temp RangeSurvey Period Temp RangeDaily Humidity RangeTrap NightMinMaxMinMax														
1	68.65	85.68	69.98	75.92	-996	-996								
2	65.5	83.71	66.74	73.04	-996	-996								
3	63.73	86.52	65.12	71.42	-996	-996								
4	67.1	87.49	67.46	77.9	-996	-996								
5	68.27	90.37	69.26	76.81	55.35	99.3								
6	0	0	0	0	0	0								
7	0	0	0	0	0	0								
8	0	0	0	0	0	0								
0	Ū	Ŭ	Ũ	Ũ	Ũ	0								
*** For cur	vovc involving mo	ra than 10 tran	sosts the surv	war should com	aloto additior	al data torme	Draiget title in	formation cho	uld romain the	cama howovor	the transect numb	or(c) chould	ontinuo in c	oquantial
*** - For sur	veys involving mo	re than 10 tran	sects, the surv	eyor should comp	olete addition	ial data forms. I	Project title ir	formation sho	uld remain the	same, however	the transect numb	per(s) should a	continue in s	sequential
*** - For sur order, i.e. Tr	veys involving mo ap 11, 1220.	re than 10 tran	sects, the surv	eyor should comp	plete addition	ial data forms. I	Project title ir	formation sho	uld remain the	same, however	the transect numb	oer(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr	veys involving mo ap 11, 1220.	re than 10 tran	sects, the surv	eyor should comp	olete additior	ial data forms. I	Project title ir	formation sho	uld remain the s	same, however	the transect numb	er(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim	veys involving mo ap 11, 1220. e refer to when trap is	re than 10 tran	en let/leng MUST	eyor should comp	o NAD 92	al data forms. I	Project title ir	formation sho	uld remain the :	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci	re than 10 tran checked; mal degrees locati	on. Lat/long MUST	eyor should comp	s, NAD 83	al data forms. I	Project title ir	formation sho	uld remain the :	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p	re than 10 tran checked; mal degrees locati prior to checking tr	on. Lat/long MUST	be in decimal degree	s, NAD 83 round.com	al data forms. I	Project title in	formation sho	uld remain the :	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05	on. Lat/long MUST aps, must use data	be in decimal degree from www.wundergr //www.mesonet.org/	s, NAD 83 round.com index.php/weatl	h al data forms. her/daily_data_retri	Project title in	formation sho	uld remain the :	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c om to 4 am, must use d	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu	on. Lat/long MUST aps, must use data is report from http: nderground.com	be in decimal degree from www.wundergr //www.mesonet.org/	s, NAD 83 round.com index.php/weatl	h al data forms. I	Project title in	formation sho	uld remain the s	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p 6. Wind exceed	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c om to 4 am, must use d s 10 mph > than 20% o	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu f time between 9 p	on. Lat/long MUST aps, must use data report from http: nderground.com om to 4 am	be in decimal degree from www.wundergr //www.mesonet.org/	s, NAD 83 round.com index.php/weatl	h al data forms. I	Project title in	formation sho	uld remain the	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p 6. Wind exceed 7. Additional tra	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c om to 4 am, must use d s 10 mph > than 20% o apping required if any r	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu f time between 9 p metrics exceed the	on. Lat/long MUST aps, must use data is report from http: nderground.com om to 4 am allowable thresho	be in decimal degree from www.wundergr //www.mesonet.org/	s, NAD 83 round.com index.php/weatl	her/daily_data_retri	eval.	formation sho	uld remain the	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p 6. Wind exceed 7. Additional tra 8. Determine to	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c om to 4 am, must use d s 10 mph > than 20% o apping required if any r stal number of disturbe	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu f time between 9 p metrics exceed the ed traps over all 5 s	on. Lat/long MUST aps, must use data report from http: nderground.com om to 4 am allowable thresho urvey nights. Any o	be in decimal degree from www.wundergr //www.mesonet.org/ lds.	s, NAD 83 round.com index.php/weatl	her/daily_data_retri	Project title in eval. f survey effort.	formation sho	uld remain the s	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p 6. Wind exceed 7. Additional tra 8. Determine to 9. OLD=breedin	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c om to 4 am, must use d s 10 mph > than 20% o apping required if any r stal number of disturbe g adult; NEW=newly en	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu f time between 9 p metrics exceed the ed traps over all 5 s inclosed adult; UNK	on. Lat/long MUST aps, must use data report from http: nderground.com om to 4 am allowable thresho urvey nights. Any o	be in decimal degree from www.wundergr //www.mesonet.org/ lds. disturbance to 5-gallor etermined.	s, NAD 83 round.com index.php/weatl	hal data forms. I	Project title in eval. f survey effort.	formation sho	uld remain the	same, however	the transect numb	per(s) should a	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p 6. Wind exceed 7. Additional tra 8. Determine to 9. OLD=breedin 10. Recaptures	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c om to 4 am, must use d s 10 mph > than 20% o apping required if any r stal number of disturbe g adult; NEW=newly en refer to color and num	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu f time between 9 p netrics exceed the ed traps over all 5 s nclosed adult; UNK ber of bee tag on b	on. Lat/long MUST aps, must use data report from http: nderground.com om to 4 am allowable thresho urvey nights. Any o =age cannot be de peetles that have b	be in decimal degree from www.wundergr //www.mesonet.org/ vlds. disturbance to 5-gallor etermined.	s, NAD 83 round.com index.php/weatl h traps requires a d.	ner/daily_data_retri	Project title in eval. f survey effort.	formation sho	uld remain the s	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p 6. Wind exceed 7. Additional tra 8. Determine to 9. OLD=breedin 10. Recaptures 11. Newly mark	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci op from 9 pm to 4 am p must be obtained by c om to 4 am, must use d s 10 mph > than 20% o apping required if any r otal number of disturbe g adult; NEW=newly en refer to color and num ed males and females	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu f time between 9 p metrics exceed the rd traps over all 5 s inclosed adult; UNK ber of bee tag on b refers to color, nur	on. Lat/long MUST aps, must use data is report from http: nderground.com om to 4 am allowable thresho urvey nights. Any o =age cannot be de peetles that have b nber of bee tag, ar	be in decimal degree from www.wundergr //www.mesonet.org/ lds. disturbance to 5-gallor etermined. been previously marke	s, NAD 83 round.com index.php/weatl n traps requires a d. {54[old]).	her/daily_data_retri	Project title in eval. f survey effort.	formation sho	uld remain the s	same, however	the transect numb	per(s) should o	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p 6. Wind exceed 7. Additional tra 8. Determine to 9. OLD=breedin 10. Recaptures 11. Newly mark Heavy Rain is do	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c om to 4 am, must use d s 10 mph > than 20% o apping required if any r stal number of disturbe g adult; NEW=newly er refer to color and num ed males and females efined by the World Ma	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu f time between 9 p metrics exceed the ed traps over all 5 s inclosed adult; UNK ber of bee tag on b refers to color, nur eteorological Organ	on. Lat/long MUST aps, must use data is report from http: nderground.com om to 4 am allowable thresho urvey nights. Any o reage cannot be de poetles that have b nber of bee tag, ar hization (http://sev	be in decimal degree a from www.wundergr //www.mesonet.org/ olds. disturbance to 5-gallor etermined. been previously marke and age of beetle (e.g. F	s, NAD 83 round.com index.php/weatl h traps requires a d. R54[old]). g/raindoc.html)	her/daily_data_retri an additional night o	Project title in eval. f survey effort. han or equal to 5	formation sho	uld remain the s	same, however	the transect numb	per(s) should a	continue in s	sequential
*** - For sur order, i.e. Tr 1. Date and tim 2. Check that le 3. Max/Min ten 4. Soil moisture 5. Rain from 9 p 6. Wind exceed 7. Additional tra 8. Determine to 9. OLD=breedin 10. Recaptures 11. Newly mark Heavy Rain is do past 24 hours."	veys involving mo ap 11, 1220. e refer to when trap is gal description fits deci np from 9 pm to 4 am p must be obtained by c om to 4 am, must use d s 10 mph > than 20% o apping required if any r stal number of disturbe g adult; NEW=newly el refer to color and num ed males and females efined by the World Ma	re than 10 tran checked; mal degrees locati prior to checking tr obtaining the TR-05 ata from www.wu f time between 9 p metrics exceed the ed traps over all 5 s inclosed adult; UNK ber of bee tag on b refers to color, nur eteorological Organ	on. Lat/long MUST aps, must use data is report from http: nderground.com om to 4 am allowable thresho urvey nights. Any of =age cannot be de peetles that have b nber of bee tag, ar hization (http://sev	be in decimal degree from www.wundergr //www.mesonet.org/ lds. disturbance to 5-gallor etermined. been previously marke nd age of beetle (e.g. F	s, NAD 83 round.com index.php/weatl n traps requires a d. 854[old]). g/raindoc.html)	her/daily_data_retri	Project title in eval. f survey effort. han or equal to 5	50 mm [1.9685 incl	uld remain the s	same, however	the transect numb	per(s) should a	continue in s	sequential

		Appendix A	: Data Colle	ection Forms*	*** Amer	ican Burying	Beetle Nic	rophorus a	mericanus P	resence/Abs	ence Live-trap	Ding Survey	Guidance	2	
		ENTER DAT		-SHADED CEL	LS UNLY IN	I CELLS I HAT	REQUIRE	DATA ENTR	Y - DO NOT	ENTER DATA	IN WHITE CEL	LS OK HEAL	DEK ROWS		
					-	-	_								
				AMERIC	CAN BUR	ING BEETLE	E SURVEY	DATA CO	LLECTION F	ORM (Apri	i 2017)				
	Project Name:	Pensacola Reli	censing				No. of Trans	ects Deployed:	6			Survey Night:		1	
Р	roject Description:	Hydroelectric I	Relicensing					Trap Type:	Above Ground		D	ate Checked ¹ :		July 19, 202	1
Action A	gency/Proponent:	Grand River Da	am Authority				-	Bait Type:	Aged Chicken	4			D.4 a st la	D. L.	Maria
	Permittee:	Stephanie Rair	nwater					Trap Cover Size	24"	J	Survey Eng	Data	Wonth	Date	Year
	Survey Company:	TE-00284A Horizon Enviro	nmental Servi	ces. Inc.							Survey End	Date.	July	23	2021
	can coy company.				1										
							Trap Loc	ation Data							
	Trap Coor	dinates		legal Description					Vegetation						Weather
Trap No.	Latitude	Longitude	Township	Range	Section	Gen Location	County	State	Туре	Primary	/ Soil Name	Soil Dese	cription	Area	Station
2	36.805411	-94.815192	27N	23E	22	Ogeechee	Ottawa	ОК	Pasture	Mayes si	lty clay loam	Clay I	oam	521	MIAM
3	36.757715	-94.69898	26N	34E	3	Wyandotte	Ottawa	OK	Forest	Clarksville	stony silt loam	Silt lo	Dam	521	MIAM
4	36.983514	-94.69898	25N 29N	25E 24F	23	Baxter Springs	Ottawa	OK	Mixed	Clarksville	stony slit loam	Silt lo Silt lo	bam Dam	521	MIAM
6	36.898938	-94.981359	28N	22E	20	Miami	Ottawa	ОК	Pasture	Verdig	ris silt loam	Silt lo	bam	521	MIAM
										-					
							Weath	ner Data							
	Daytime Temps	68.23	85.08	Survey l	Period Temps	69.08	76.46		Humidity	53.61	95.7				
		(min.)	(max.)			(min.)	(max.)			(min.)	(max.)				
	Wind>10mph?6	No			Heavy Rain? ⁵	No			Soil Moisture ⁴	1 5867	l				
		(Yes/No)								1.5007					
Cap	ture Data			Nicro	phorus spe	ecies			Necrophilia	Necrodes	Other	Trap Night	Time		
Trap No.	Disturbed (Y=1/N=0)	americanus	orbicollis	tomentosus	pustulatus	marginatus	carolinus	sayi	americana	surinamensis		Valid (No=0/Yes=1)	Checked ¹ :		
2	0	0	1	0	0	0	0	0	0	0	0	1	7:32		
3	0	0	1	0	0	0	0	0	1	0	0	1	7:48		
4	0	0	1	0	0	0	0	0	1	0	2	1	8:02		
5	0	0	1	0	0	0	0	0	2	0	0	1	8:45		
6	0	0	0	0	0	0	0	0	0	0	0	1	9:48		
			-									_			
Totals	0	0	4	0	0	0	0	0	4	0	2	5			
No	of disturbed traps	and/or bait (D).	0		Additiona	ll survey night rec	nuired heraus	se of weather? ⁸	0	1.	t Valid Tran Nighter	E	1		
INU.	or disturbed traps of	unujui balt (D):	U		Additiona		1 an cu becaus		U	J '		5	J		
No. of disturbed traps and/or bait (D): 0 Additional survey night required because of weather?* 0 # Valid Trap Nights: 5 (No=0/Yes=1) (No=0/Yes=1)															
									(No=0/Yes=1)						
	List the ind	ividual ABB M	ETRICS below	v and complete	the appropr	iate columns. Y	ou will then	COPY each r	(No=0/Yes=1)	into Individua	ABB Capture Fo	rm BEGINNIN	IG at Cell A	442 on Pg 6.	
	List the ind	ividual ABB M	ETRICS below	v and complete	the appropr	iate columns. Y	ou will then	COPY each re	(No=0/Yes=1)	into Individua	I ABB Capture Fo	rm BEGINNIN	IG at Cell A	442 on Pg 6.	Neudu
ABB	List the ind Caught in Trap	ividual ABB M	ETRICS below	v and complete	the appropr	iate columns. Y	ou will then Female	COPY each re	(No=0/Yes=1) ow and PASTE Male	into Individua Female	I ABB Capture Fo	rm BEGINNIN Pronotum	NG at Cell A Picture (Yes=1/No=	442 on Pg 6.	Newly Marked ¹¹

Auton	nated Total	0	0	0	0	0	0	0	0	0	0	NA	0	
Comments:														
											-			

Proi	ect Name:	Pensacola Reli	censing	AIVIEKI			Trap Type:	Above Ground		FURIVI	Survey Night:	1	2		
Project	t Description:	Hydroelectric	Relicensing				Bait Type:	Aged Chicken			Date Checked ¹ :		 July 20, 202	1	
Action Age	ency/Proponent:	Grand River Da	am Authority			Tr	ap Cover Size	24"			Permittee: TE Permit #:	Ste	phanie Rain	water	
											Survey Company:	Horizon En	vironmental	Services, Inc.	
						W	eather Da	a							
	Daytime Temps	64.96	83.08	Survey F	Period Temps	65.84	74.3			53.77	97.27				
		(min.)	(max.)			(min.)	(max.)			(min.)	(max.)				
	Wind>10mph?6	No			Heavy Rain?⁵	No			Soil Moisture ⁴	1.5867					
		(Yes/No)													
Capt	ture Data			Nicrop	ohorus spe	ecies			Necrophilia	Necrodes	Other	Trap Night Valid	Time		
Trap No. 2	Disturbed (Y=1/N=0)	americanus 0	orbicollis 0	tomentosus 0	pustulatus 1	marginatus 0	carolinus 0	sayi 0	americana 0	surinamensis 0	0	(No=0/Yes=1)	Checked ¹ :		
3	0	0	4	0	1	0	0	0	28	15	0	1	7:25		
<u>4</u> 5	0	0	0	0	0	0	0	0	15 12	3	2	1	7:49 8:35		
6	0	0	2	0	0	0	0	0	2	5	2	1	9:37		
Totals	0	0	6	0	2	0	0	0	57	26	1	5			
Totals		Ŭ	Ū		2	Ū	Ū	U U	57	20		, ,	1		
No.	of disturbed traps	and/or bait (D):	0	l	Additiona	al survey night rec	quired becaus	e of weather? ⁸	0 (No=0/Vec-1)	J ‡	# Valid Trap Nights:	5			
					1	41			,						
		List the indiv	ndual ABB MI	ETRICS below an	a complete	the appropriat	e columns. \	rou will then	COPY each rov	w and PASTE in	to Individual AB	B Capture Fo	rm on Pg 6. Picture		
ABB Number	Caught in Trap		Fomala	Unknown Sov	Male Now ⁹	Male Old ⁹	Female	Female Old ⁹	Male	Female	Dood	Pronotum Width (mm)	(Yes=1/No=	Recantura ¹⁰	Newly Markod ¹¹
Number	NO.	IVIale	Female	UTIKITOWIT SEX	Male New	Iviale Olu	New	Female Olu	UTIKITUWIT Age	UTIKITOWIT Age	Dead	vviatii (iiiiii)	0)	Recapture	Markeu
Auto	mated Tot.	0	0	0	0	0	0	0	0	0	0	NA	0		
													-		
—															
															_
				AMERI	CAN BUR	YING BEETL	<mark>E SURVE</mark>	<mark>Y DATA CC</mark>		FORM					
Proj	ect Name:	Pensacola Reli	censing	AMERI	<mark>CAN BUR</mark>	YING BEETL	E SURVE Trap Type:	Y DATA CC Above Ground	LLECTION	FORM	Survey Night: Date Checked ¹ :		3	1	
Proj Project Action Age	ect Name: t Description: ency/Proponent:	Pensacola Reli Hydroelectric I Grand River Da	censing Relicensing am Authority	AMERI	<mark>CAN BUR</mark>	YING BEETL	E SURVE Trap Type: Bait Type: ap Cover Size	Y DATA CC Above Ground Aged Chicken 24"	LLECTION	FORM	Survey Night: Date Checked ¹ : Permittee:	Ste	3 July 21, 202 phanie Rain	1 water	
Proj Project Action Age	ect Name: t Description: ency/Proponent:	Pensacola Reli Hydroelectric I Grand River Da	censing Relicensing am Authority	AMERI	<mark>CAN BUR</mark>	YING BEETL	E SURVE Trap Type: Bait Type: ap Cover Size	Y DATA CC Above Ground Aged Chicken 24"	LLECTION	FORM	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company:	Ste Horizon En	<i>3</i> July 21, 202 phanie Rain TE-00284A vironmental	1 water Services, Inc.	
Proj Project Action Age	ect Name: t Description: ency/Proponent:	Pensacola Reli Hydroelectric I Grand River Da	censing Relicensing am Authority	AMERI	CAN BUR	YING BEETL Tr	E SURVE Trap Type: Bait Type: ap Cover Size	Y DATA CC Above Ground Aged Chicken 24"	LLECTION	FORM	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company:	Ste Horizon En	3 July 21, 202 phanie Rain TE-00284A vironmental	1 water Services, Inc.	
Proj Project Action Age	ect Name: t Description: ency/Proponent: Daytime Temps	Pensacola Reli Hydroelectric I Grand River Da	censing Relicensing am Authority 86.29	AMERIO Survey F	CAN BUR	YING BEETL Tr W 66.02	E SURVE Trap Type: Bait Type: ap Cover Size eather Da 70.7	Y DATA CC Above Ground Aged Chicken 24"	Humidity	FORM 49.5	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company: 98.36	Ste Horizon En	3 July 21, 202 phanie Rain TE-00284A vironmental	1 water Services, Inc.	
Project Action Age	ect Name: t Description: ency/Proponent: Daytime Temps	Pensacola Reli Hydroelectric I Grand River Da 63.75 (min.)	censing Relicensing am Authority 86.29 (max.)	AMERI Survey F	CAN BUR	Tr W 66.02 (min.)	E SURVE Trap Type: Bait Type: ap Cover Size eather Dat 70.7 (max.)	Y DATA CC Above Ground Aged Chicken 24"	LLECTION	FORM 49.5 (min.)	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company: 98.36 (max.)	Ste Horizon En	3 July 21, 202 phanie Rain TE-00284A vironmental	1 water Services, Inc.	
Project Action Age	ect Name: t Description: ency/Proponent: Daytime Temps Wind>10mph?6	Pensacola Reli Hydroelectric I Grand River Da 63.75 (min.)	censing Relicensing am Authority 86.29 (max.)	AMERI Survey F	CAN BUR	Tr W 66.02 (min.)	E SURVE Trap Type: Bait Type: ap Cover Size eather Dat 70.7 (max.)	Y DATA CC Above Ground Aged Chicken 24"	LLECTION Humidity Soil Moisture ⁴	FORM 49.5 (min.) 1.6306	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company: 98.36 (max.)	Ste Horizon En	3 July 21, 202 phanie Rain TE-00284A vironmental	1 water Services, Inc.	
Project Action Age	ect Name: t Description: ency/Proponent: Daytime Temps Wind>10mph?6	Pensacola Reli Hydroelectric I Grand River Da 63.75 (min.) No (Yes/No)	censing Relicensing am Authority 86.29 (max.)	AMERI Survey F	CAN BUR	Tr W 66.02 (min.)	E SURVE Trap Type: Bait Type: ap Cover Size eather Da 70.7 (max.)	Y DATA CC Above Ground Aged Chicken 24"	LLECTION Humidity Soil Moisture ⁴	FORM 49.5 (min.) 1.6306	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company: 98.36 (max.)	Ste Horizon En	3 July 21, 202 phanie Rain TE-00284A vironmental	1 water Services, Inc.	
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Project Action Age	ect Name: t Description: ency/Proponent: Daytime Temps Wind>10mph?6 Wind>10mph?6	Pensacola Reli Hydroelectric I Grand River Da 63.75 (min.) No (Yes/No) americanus	censing Relicensing am Authority 86.29 (max.) orbicollis	AMERIO Survey F Nicrop tomentosus	CAN BUR Period Temps Heavy Rain? ⁵ Dhorus spe pustulatus	YING BEETL Tr W 66.02 (min.) No ecies marginatus	E SURVE Trap Type: Bait Type: ap Cover Size eather Da 70.7 (max.) carolinus	Y DATA CC Above Ground Aged Chicken 24"	LLECTION Humidity Soil Moisture ⁴ Necrophilia americana	FORM 49.5 (min.) 1.6306 Necrodes surinamensis	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company: 98.36 (max.) Other	Ste Horizon En Trap Night Valid (No=0/Yes=1)	<i>3</i> July 21, 202 phanie Rain TE-00284 <i>A</i> vironmental vironmental	1 water Services, Inc.	
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Proi	ect Name:	Pensacola Reli	icensing	AIVIEKI	CAN DUR		Trap Type:	Above Ground			Survey Night:		4		
Project	t Description:	Hydroelectric I	Relicensing		1		Bait Type:	Aged Chicken			Date Checked ¹ :		July 22, 202	1	
Action Age	ency/Proponent:	Grand River Da	am Authority]	Tr	ap Cover Size	24"			Permittee: TE Permit #:	Ste	phanie Rain TE-00284A	water	
											Survey Company:	Horizon En	vironmental	Services, Inc.	
						W	eather Dat	a							
	Daytime Temps	67.71	86.77			67.64	75.94		Humidity	58.92	95.8	J			
		(min.)	(max.)		_	(mm.)	(max.)			(mm.)	(max.)				
	Wind>10mph?6	No (Yes/No)			Heavy Rain? ⁵	No	J		Soil Moisture ⁴	1.749					
						•						Tran Night			
Trap No.	ture Data Disturbed (Y=1/N=0)	americanus	orbicollis	NICROP tomentosus	pustulatus	e cies marginatus	carolinus	sayi	Necrophilia americana	Necrodes surinamensis	Other	Valid	Checked ¹ :		
2	0	0	0	0	0	0	0	0	7	20	2	1 1	7:13		
<u> </u>	0	0	0	0	0	0	0	0	6 2	<u>18</u> 5	5	1	7:33		
5	0	0	0	1 0	1 0	0	0	0	3	85 10	5	1	8:45 9:50		
Totals	0	0	2	2	1	0	0	0	20	138	16	5			
No.	of disturbed traps	and/or bait (D):	0]	Additiona	l survey night rea	quired becaus	e of weather? ⁸	0	#	# Valid Trap Nights:	1			
									(No=0/Yes=1)						
		List the indiv	vidual ABB M	ETRICS below an	d complete	the appropriat	e columns. N	ou will then	COPY each rov	v and PASTE in	to Individual AB	B Capture Fo	rm on Pg 6.		
ABB	Caught in Trap		_ ·	Links and C	Mala N. 9	Nada Oli ⁹	Female	Formal - OL 19	Male	Female		Pronotum	(Yes=1/No=	Possition 10	Newly
Number	No.	Male	Female	Unknown Sex	Male New	Male Old	New	Female Old	Unknown Age	Unknown Age	Dead	Width (mm)	0)	Recapture	Marked
Comments:	mated lot.	U	U	U	U	U	U	U	U	U	U	NA	U		
													-		
Proj	ect Name:	Pensacola Reli	icensing	AMERI	<mark>CAN BUR</mark>	<mark>YING BEETL</mark>	E SURVE Trap Type:	<mark>/ DATA CO</mark> Above Ground	LLECTION	FORM	Survey Night:		5		
Proj Project	ect Name: t Description:	Pensacola Reli Hydroelectric I	icensing Relicensing	AMERI	CAN BUR	YING BEETL	E SURVE Trap Type: Bait Type:	<mark>/ DATA CO</mark> Above Ground Aged Chicken	LLECTION	FORM	Survey Night: Date Checked ¹ :		5 July 23, 202	1	
Proj Project Action Age	ect Name: t Description: ency/Proponent:	Pensacola Reli Hydroelectric I Grand River Da	icensing Relicensing am Authority		<mark>CAN BUR</mark>	<mark>YING BEETL</mark>	E SURVE Trap Type: Bait Type: rap Cover Size	/ DATA CO Above Ground Aged Chicken 24"	LLECTION	FORM	Survey Night: Date Checked ¹ : Permittee: TE Permit #:	Ste	5 July 23, 202 phanie Rainy TE-00284A	1 water	
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Project Action Age Action Age Capt Trap No. 2 3 4 5 6 6 7 7 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8	ect Name: t Description: ency/Proponent: Daytime Temps Wind>10mph?e Wind>10mph?e Disturbed (Y=1/N=0) 0 0 0 0 0 0 0 0 0 0 0 0 0	Pensacola Reli Hydroelectric I Grand River Da 69.17 (min.) No (Yes/No) (Yes/No) americanus 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	icensing Relicensing am Authority 90.27 (max.) 90.27 (max.) 0 0 0 0 0 0 0 0 0 0 0 0 0	AMERIO Survey F Survey F Contentosus 0 2 0 0 2 0 0 2 0 0 1 2 0 0 1 2 0 1 2 2 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1	CAN BUR CAN BU	YING BEETL Tr V 70.16 (min.) No Cies marginatus 0 </td <td>E SURVE Trap Type: Bait Type: rap Cover Size (eather Dat 78.08 (max.) Carolinus Carolinus 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Control of the second of th</td> <td>LLECTION Humidity Soil Moisture⁴ Necrophilia americana 0 10 0 10 0 10 0 10 0 10 0 10 0 10 0 10 0 10 0 11 0 13 0 (No=0/Yes=1) Male Unknown Age⁹ 1 <</td> <td>FORM 55.9 (min.) 1.8528 Necrodes surinamensis 34 22 3 70 3 132 4 vand PASTE in Female Unknown Age⁹ 4 132 132 132 132 132 132 132 132</td> <td>Survey Night: Date Checked¹: Permittee: TE Permit #: Survey Company: 98.04 (max.) 98.04 (max.) 98.04 (max.) 30 4 Valid Trap Nights: 30 4 Valid Trap Nights: 1 0 0 0 0 0</td> <td>Image: Control of the second secon</td> <td>5 July 23, 202: phanie Raim TE-00284A vironmental Checked¹: 7:20 7:41 8:05 8:55 10:00 8:55 10:00 0 Picture (Yes=1/No= 0) Picture (Yes=1/No= 0)</td> <td>1 water Services, Inc. Services, Inc. Recapture¹⁰ Recapture¹⁰ Image: Service structure structure</td> <td>Newly Marked¹¹</td>	E SURVE Trap Type: Bait Type: rap Cover Size (eather Dat 78.08 (max.) Carolinus Carolinus 0 0 0 0 0 0 0 0 0 0 0 0 0	Control of the second of th	LLECTION Humidity Soil Moisture ⁴ Necrophilia americana 0 10 0 10 0 10 0 10 0 10 0 10 0 10 0 10 0 10 0 11 0 13 0 (No=0/Yes=1) Male Unknown Age ⁹ 1 <	FORM 55.9 (min.) 1.8528 Necrodes surinamensis 34 22 3 70 3 132 4 vand PASTE in Female Unknown Age ⁹ 4 132 132 132 132 132 132 132 132	Survey Night: Date Checked ¹ : Permittee: TE Permit #: Survey Company: 98.04 (max.) 98.04 (max.) 98.04 (max.) 30 4 Valid Trap Nights: 30 4 Valid Trap Nights: 1 0 0 0 0 0	Image: Control of the second secon	5 July 23, 202: phanie Raim TE-00284A vironmental Checked ¹ : 7:20 7:41 8:05 8:55 10:00 8:55 10:00 0 Picture (Yes=1/No= 0) Picture (Yes=1/No= 0)	1 water Services, Inc. Services, Inc. Recapture ¹⁰ Recapture ¹⁰ Image: Service structure	Newly Marked ¹¹

Total Number of Traps:

6

DATA AUTOMATICALLY CALCUATED - DO NOT ENTER DATA IN BLOCKS 1, 3, OR 4

DATA ENTRY IS ONLY REQUIRED IN DATA BLOCK 2

				BLOCK	1 - INDIVI	DUAL TRAF	CAPTUR	E DATA TO	OTALS BY S	PECIES					1
			!!!!!DAT.	A ENTRY IN TH	HIS BLOCK	NOT REQUIR	ED!!!!!!					Total Trap			
Trap No.	Disturbed (0/1)	americanus	orbicollis	tomentosus	pustulatus	marginatus	carolinus	sayi	Necrophilia	Necrodes	Other	Nights			
2	0	0	1	0	2	0	0	0	7	57	14	5			
3	0	0	6	3	2	0	0	0	50	83	7	5	-		
4	0	0	2	1	0	0	0	0	40	23 163	17	5	-		
6	0	0	5	0	4	0	0	0	10	28	18	5	1		
0	0	0	0	0	0	0	0	0	0	0	0	0			
0	0	0	0	0	0	0	0	0	0	0	0	0			
0	0	0	0	0	0	0	0	0	0	0	0	0			
0	0	0	0	0	0	0	0	0	0	0	0	0	1		
Totals	0	0	15	7	9	0	0	0	133	354	66	25	1		
				1						1					
No. of distur	bed traps and/or b	oait (D):	0		Additiona	l survey night red	quired becaus	e of weather?"	0						L
				BLOCK	2 - Individ	ual ABB Capt	ure Data -	DATA ENTR	RY <u>IS</u> REQUI	RED IN THIS I	BLOCK				
			COPY	the INDIVIDUAL	ABB Captur	e Data from Ni	ghtly Survey	Forms and P	ASTE into the	appropriate R	OW <u>BY</u> ABB Num	nber.			
							Famala		Mala	Famala			Picture		Nowly
ABB Number	Caught in Trap	Mala	Famala	Unknown Sex	Male New ⁹	Male Old ⁹	Female	Fomalo Old ⁹		Female	Deed	Pronotum	(Yes=1/No=	Pocanturo ¹⁰	Newly Markod ¹¹
Number	NO.	Iviale	Female	UTKHOWH SEX			New	Terriale Olu	Olikilowii Age	Onknown Age	Dead	width (min)	0)	Recapture	IVIAIKEU
Total ABB	0	0	0	0	0	0	0	0	0	0	0	NA	0	0	0
comments:															-
Total Numbe	er of Traps:	1													
				!!!!!DO NC	DT ENTER A	NY DATA IN	THIS DATA	A BLOCK!!!!!							
	BLOCK 3	B - Total ABB	Capture Da	ata by Trap / 1	ransect - I	Data from TH	IS BLOCK a	utopopulat	tes into the S	Survey Sumn	nary Form				1
							Female		Male	Female		Total Tran/Pait		Newly	
					. 9	0		0				Trap/ Dall	10		

							Feiliale		Ividie	Feilidie		Trap/Bait		Nevviy
Trap No.	Total ABB	Male	Female	Unknown Sex	Male New ⁹	Male Old ⁹	New ⁹	Female Old ⁹	Unknown Age ⁹	Unknown Age ⁹	Dead	Disturbed	Recapture ¹⁰	Marked ¹¹
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BLOCK 4 - Cumulative Survey Period Weather Data Summary - NO DATA ENTRY REQUIRED IN THIS BLOCK														
	Davtime Ten	np Range	Survey Peri	od Temp Range	- Dailv Hur	nidity Range		-						
Trap Night	Min	Max	Min	Max	Min	Max								
1	68.23	85.08	69.08	76.46	53.61	95.7								
2	64.96	83.08	65.84	74.3	42.57	94.22								
3	63.75	86.29	66.02	70.7	49.5	98.36								
4	67.71	86.77	67.64	75.94	58.92	95.8								
5	69.17	90.27	70.16	78.08	55.9	98.04								
6	0	0	0	0	0	0								
7	0	0	0	0	0	0								
, 8	0	0	0	0	0	0								
0	U	U	U	0	U	0								
*** Eorou	ways involving ma	ra than 10 tran	costs the sur	over chould com	alata addition	al data forme	Drojoct title in	formation cha	uld romain the	como housever	the transect num	hor(c) chould	ontinuo in c	oquantial
ordor i o Ti	veys involving ino	re than 10 trai	isects, the surv	eyor should comp			Project title if	normation sho	ulu remain the	same, nowever	the transect num	ber(s) should b	.onunue in s	equential
	αρ 11, 1220.													
Date and tim	e refer to when tran is	chackad												
Chack that la	gal description fits deci	mal degrees locati	on Lat/long MUS	C he in decimal degree										
Max/Min ter	nn from 9 nm to 4 am r	rior to checking tr	ans must use data	from www.wundergr	ound com									
1 Soil moisture	must be obtained by c	btaining the TR-O	report from http:	//www.mesonet.org/	index nhn/weatl	ner/daily data retri	eval							
5 Rain from 9 r	om to 4 am must use d	ata from www.wu	nderground com	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	muck.php/weut	ier/ddiry_ddid_retri								
5. Wind exceed	s 10 mph > than 20% of	f time between 9 r	om to 4 am											
7. Additional tra	apping required if any r	netrics exceed the	allowable thresho	olds.										
8. Determine to	otal number of disturbe	ed traps over all 5 s	urvey nights. Any	disturbance to 5-gallor	n traps requires a	an additional night o	f survey effort.							
). OLD=breedir	g adult: NEW=newly er	nclosed adult: UNK	age cannot be de	etermined.										
10. Recaptures	refer to color and num	ber of bee tag on l	peetles that have h	peen previously marke	d.									
11. Newly mark	ed males and females	refers to color, nur	nber of bee tag a	nd age of beetle (e ø F	854[old]).									
Heavy Rain is d	efined by the World Me	eteorological Orga	nization (http://se	vere.worldweather.or	g/raindoc.html)	as "Rainfall greater t	han or equal to !	50 mm [1.9685 incl	nesl in the					
past 24 hours."									.,					
last 24 hours."														
last updated A	oril 2017													

APPENDIX B:

Monitoring Patterns and Use by Gray Bat Populations in Caves DL-2 and DL-91 in Delaware County, Oklahoma Governmental Interagency Agreement Contract No.43337

Monitoring Patterns and Use by Gray Bat Populations in Caves DL-2 and DL-91 in Delaware County, Oklahoma Governmental Interagency Agreement Contract No.43337

Prepared by:

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Submitted to:

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INTRODUCTION:

Bats are considered by biologists as excellent indicators of general environmental health and integrity on many scales of habitat assessment. Their volant lifestyle allows them to utilize multiple community resources for their diversity of roosting and foraging habits, and a wide variety of ecological factors influence these life-history habits (Fenton 1997; Williams et al. 2006). The volant nature of their nightly and seasonal migratory movements, allows them access to multiple habitats, and in some cases multiple landscapes, decreasing their dependence on any single habitat (Findley 1993; Fenton 1997; Williams et al. 2006).

This study was an assessment of species utilization of colonies of the endangered gray bat (*Myotis grisescens*) in caves DL-2 and DL-91, in Delaware County, Oklahoma. In Oklahoma, gray bats represent a contingent in North America that are year-round, obligate cave dwelling species. All North American bats that are endangered or threatened can be classified as cave-dwelling species or subspecies (McCracken 1989, Harvey et al. 1999, Pierson 1999), and 13 are obligate cave-dwellers year-round (McCracken 1989).

Historical accounts of the cave-dwelling habits of the gray bat are well documented (Grigsby and Puckette 1984; U.S. Fish and Wildlife Service 1982; 1983; Grigsby et al. 1993; Martin et al. 2000, 2003). Since the gray bat is an obligate cave-dwelling species, its distribution is limited to karst-producing geographic regions of the southeastern and eastern U.S. Its prey consists mostly of night flying insects that have aquatic larval stages including mayflies, beetles, flies, stoneflies, and caddisflies (Best et al. 1997). Gray bats select foraging areas where these insects are abundant. Optimal foraging habitat includes open bodies of water such as a stream, river, or reservoir, with nearby wooded riparian areas. Gray bats forage over open water, and within the riparian areas near the water body. Based on recapture data, gray bats travel on average about 12.5-14.3 km each night while foraging (American Society of Mammalogists 1992).

STUDY AREA:

The study area in northeastern Oklahoma occurs within the Ozark Biotic District (Blair and Hubbell 1938) along the western limit of the Boston Mountains of the Ozark Plateau. The Plateau covers about 103,000 km² in the central United States; elevations are 260–460 m above mean sea level (Huffman 1959). The area is dominated by outcrops of alternating layers of limestone and flint and sandstone. Vegetation on mountain slopes is predominantly blackjack oak (*Quercus marilandica*), post oak (*Quercus stellata*), black hickory (*Carya texana*), and winged elm (*Ulmus alata*). Coralberry (*Symphoricarpus orbiculatus*) and sassafras (*Sassafras albidum*) comprise a sparse shrubby understory. Riparian areas occur in lowlands and are dominated by silver maple (*Acer saccharium*), river birch (*Betula nigra*), American elm (*Ulmus americana*), cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), and various oak species (*Quercus* spp.). Sporadic openings of managed grasslands are used for various types of agriculture (Blair and Hubbell 1938; Harvey et al. 1981).

Cave DL-2 is located in Section 17 of T23N R23E in Delaware County, OK adjacent to Drowning Creek, a tributary of Grand Lake. The cave passage is <65m long with a single historical roost site for gray bats located 4m above a persistent stream and about 5m inside the entrance to the cave. The floor of the vertical entrance to the cave is <745 ft elevation with backflow into the cave from Grand Lake at 746 ft elevation. Complete inundation of the cave passage occurs at 752 ft elevation. The roost was first documented as housing a colony of gray bats in 1981 when the colony was estimated to be 13,700 bats. Except during major flood events (Table 1), based on recent exit and capture surveys at the entrance, the size and status (lactating females) of the colony remains relatively constant for the past 25 years.

Cave DL-91 is located in the Section 13 of T23N R22E in Delaware County, OK. The cave's location from Grand Lake (1 km) and elevation (840 ft) preclude any threat of inundation. The cave has a mapped passage of 803m and has historical records of nine roost sites for gray bats. Prior to 1973, DL-91 historically housed the largest colony of gray bats in Oklahoma estimated to be as many as 113,000 bats. Recent population estimates of the summer colony have been as high as 31,962 bats. Aquatic pools throughout the passage of the cave and provide documented habitat for the Ozark cavefish (*Troglichthys rosae*), and Delaware County cave crayfish (*Cambarus subterraneus*).

PROCEDURES:

IR-illuminated entrance and night vision optics were used to conduct non-intrusive exit surveys and population estimates of gray bat colonies exiting caves DL-2 and DL-91 in the 2021 summer maternity and post-maternity season. Such surveys are used to document habitation, assist in estimating colony size at the respective caves, and monitor movements of the colony during potential high water and flood events on Grand Lake.

Exit surveys were conducted at cave DL-2 on 22 June and at cave DL-91 on 24 June and again on 16 July 2021 (Table 1). The post-maternity colony population estimate at cave DL-91 during late summer 2021 (Table 1) was within the range of 10,000 to 29,905 bats (ave.=18,245) over the past decade (Table 2).

Table 1.Population estimates of gray bat colonies at caves DL-2 and DL-91 in Delaware County,
OK. Gray bat colony size estimates are based on exit surveys using infrared-illuminated
entrances and night vision optics during summer 2021.

Date	Survey Method	Population at	Population at
Date	Wiethou		
6/22/2021	Exit Survey	11,800	
6/24/2021	Exit Survey		510
7/16/2021	Exit Survey		20,440

	Population at	Population at
Date	Cave DL-2	Cave DL-91
8/20/2012	1	18,000
8/22/2013	0	29,905
9/11/2014	0	18,015
8/5/2015	0	20,585
7/21/2016	0	16,520
9/12/2017	0	19,340
8/30/2018	NA	18,000
5/21/2019	NA	15,200
8/25/2020	NA	16,883
7/16/2021	NA	20,440

Table 2. Population estimates of the colony of gray bats using caves DL-2 and Dl-91 in Delaware County, Oklahoma. Average post-maternity colony size ranged from 15,200 to 29,905 bats, with an average colony size of 19,288 gray bats for the past 10 years.

DISCUSSION:

Cave ecosystems harbor a variety of unique and sensitive organisms, many of which are cave obligates. Unique characteristics common to North American subterranean fauna render them vulnerable to anthropogenic activities and underscore the importance of monitoring sensitive populations. Subsurface habitats typically display decreased diversity in community complexity and reduced species abundance relative to above ground ecosystems translating to fewer species and individuals in subterranean habitats than in surface habitats (Holsinger 1988). Processes that isolate subterranean populations of organisms, and evolutionary adaptation of those species to their environments, can produce extreme patterns of endemism (Barr and Holsinger 1985; Culver et al., 2000). Within the United States, subterranean fauna constitutes more than 50% of the G1-G2 species recorded in the Natural Heritage Program; however, less than 4% have received federal protection (Culver et al. 2000).

Cave abandonment may result from high water events, or late-season migration after young become volant as often occurs in other areas of the species' range. Under favorable conditions, the colony ultimately vacates the maternity cave at DL-2 entirely in late summer and migrates to cave DL-91 located <5 km away (Grigsby et al. 1993; Martin et al. 2000) where the colony tends to remain until migration to hibernacula in November. Although cave DL-91 has intermittently served as a favorable maternity location, it is possible that it provides suboptimal climate conditions for a maternity colony compared to cave DL-2 with respect to microclimate and proximity to an abundant food source for developing young. Annual late-summer migration phenomena are intriguing because migration of any type elicits its own inherent effects on animal populations that are exacerbated in young and

reproductive adults. Observations from previous exit surveys support historical evidence that during high water or flood events during the maternity season, a maternity colony of the endangered gray bat vacates cave DL-2—whose passage lies within the flood pool of Grand Lake—and migrates to cave DL-91.

Persistent threat of inundation increases the likelihood of "take" of adults and young. The U. S. Fish and Wildlife Service defines take as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct. The determination of take was first made in their March 26, 1992, Biological Opinion prepared for the Federal Energy Regulatory Commission for the proposed re-licensing of the Pensacola Hydropower Project. Complete inundation of the cave passage of DL-2 occurs at about elevation 752 feet Pensacola Datum (PD). When Grand Lake is at about elevation 751 feet PD, only about one foot of flyway exists between the top of the water in the cave and the rock ceiling of the flyway, likely resulting in a significant disruption to normal behavior including feeding, rearing of young, and sheltering, and possibly forcing evacuation of the colony to the alternative cave (Table 3).

Forcing the colony to vacate during critical maternity periods (March through July) likely adversely affects pregnant or lactating females, and non-volant or newly volant young. If bats become trapped in cave DL-2, they could survive only a limited amount of time due to the high energy demands of raising young. Other potential adverse effects include the stress of being trapped, drowning, and, if adults are trapped outside the cave, stress and mortality of non-volant young.

In October 2008 a small, high passage within cave DL-2 was identified and minimally excavated and enlarged. Enlarging this passage was suspected to provide an alternative escape route for exiting bats, particularly during high water. Additional excavation and enlargement of this second-high passage was completed in October 2013. The length of the high passage was about 5m and was widened to about 0.40 meters wide by 0.50 meters tall. An inspection of the passage following a flood event in summer 2015 revealed scattered guano in the enlarged passage indicating use by bats. The post-inundation monitoring visit to the cave on 30 July 2019 failed to give any indication that take had occurred as a result of inundation.

Table 3. Records of highwater events where the elevation of Grand Lake exceeded elevation 750.00 feet PD from 2005-2019. At elevation 752 feet PD, the existing flyway inside cave DL-2 is completely inundated preventing colony exit and re-entry.

	Date	Date	Maximum	Total	Effect on
Year	Beginning	Ending	Elevation (ft)	Duration	Colony
2007	3-Jul	16-Jul	754.54	14 days	Successfully Vacated
2008	11-Apr	20-Apr	753.04	10 days	Successfully Vacated
2008	13-Jun	26-Jun	752.48	14 days	Successfully Vacated
2011	27-Apr	28-Apr	750.80	2 days	Successfully Vacated
2011	25-May	26-May	751.71	2 days	Successfully Vacated
2015	27 May	22 June	754.89	27 days	Successfully Vacated
2017	30 April	25 May	754.77	26 days	Successfully Vacated
2019	14 May	15 July	755.02	63 days	Successfully Vacated

SUMMARY/RECOMMENDATIONS:

Management efforts at cave DL-91 over the past 40 years have improved the security and potential for the colony's persistence. The average post-maternity colony size illustrates relative consistency, ranging from 15,200 to 29,905 bats with an average colony size of 19,288 gray bats for the past 10 years. (Table 2). Efforts should be concentrated on maintaining strong ties with the landowner of cave DL-2 who owns the property access, so that similar security efforts can continue there for the long-term. To assist in the long-term management decisions for appropriate entities relative to gray bat conservation efforts at caves DL-2 and DL-91 the following recommendations are proposed:

- 1) Continue monitoring emergence surveys in caves DL-2 and DL-91 to maintain consistent data relative to habitation, population size, movement, and composition of bat colonies.
- 2) Considering the importance of site DL-91 as alternative and favorable habitat for a maternity colony of gray bats during flooding events of Grand Lake, and as a post-maternity colony during normal elevation, periodically inspect the structural integrity of respective gate/grill systems inside cave DL-91 to limit or prevent human entry.
- 3) Monitor elevation changes in Grand Lake during high water events and any subsequent movement of the gray bat colony in DL-2 to alternative habitable sites.
- 4) Continue to effectively engage with the current landowner of cave DL-2, maintaining current contact information and appropriate access to the cave for future monitoring.

In sum, the gray bat colony sharing caves DL-2 and DL-91 each summer appears to maintain a stable population size. Persistent protection is being afforded the internal habitat and other sensitive and imperiled species at cave DL-91 through the integrity of the internal gating system. Consistent and effective landowner engagement at cave DL-2 is appropriate at present.

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