



## ATTACHMENT C — BAT SURVEY

***Bat Study  
Of  
Proposed I-57 Routes***

Greene, Clay, Randolph, and Lawrence  
Counties Arkansas

Prepared for:

Garver & ArDOT



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October 12, 2021

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## Executive Summary

Mist net surveys for bats were conducted over twelve nights in 2021 (Aug 1-12) on proposed alternative routes 2 and 3 in Greene, Clay, Lawrence, and Randolph Counties, Arkansas. Twenty-five sites were sampled for two nights per site in an effort to determine possible bat use by threatened or endangered bat species.

No federally listed bats species were captured with mist nets during the study. A total of 26 bats representing 4 species were captured in mist nets. The captured species included: 10 Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), 9 Eastern Red Bats (*Lasiurus borealis*), 6 Evening Bats (*Nycticeius humeralis*), and 1 Southeastern Bat (*Myotis austroriparius*). One additional bat was listed as Unknown due to the bat escaping the net before it could be handled. This is not an uncommon occurrence especially with Eastern Red bats. The bat biologist simply did not have a good enough look to determine species simply that a bat flew out of the net upon approaching the net.

## 1.0 INTRODUCTION

Garver working with Arkansas Department of Transportation (ArDOT) has contracted with Mitigation Surveying Services, llc (MSS) to conduct a presence/absence bat study of the proposed Alternate 2 & 3 routes of the expansion of Interstate 57 in Greene, Clay, Randolph, and Lawrence Counties, Arkansas (Figure 1). One mist net for two nights was deployed at each of the sites (Figure 2).

Bat surveys were conducted to determine the possible presence of the northern long-eared bat (*Myotis septentrionalis*) on the property, as well as document other federally listed species such as the Indiana bat (*Myotis sodalis*). Though Indiana bat presence is unlikely, comprehensive studies have been conducted in the area in recent times showing use by *M. sodalis* in bottomland hardwoods. Certain species have shown range expansions with increasing numbers, possibly due to climate change or niche-filling from decimated bat populations due to White-nose syndrome (WNS).

The proposed routes follow the Black River in a north easterly direction with Alternate 2 north of the Black River and Alternate 3 south of the Black River. Landuse in the area is comprised of mostly row crop farm agriculture. The Black River is one of largest intact bottomland hardwoods systems remaining in Arkansas. The Dave Donaldson Black River Wildlife Management Area (DDBR) lies within the two alternate routes with Scatter Creek Wildlife Management Area to the southeast of Alternate 3.

Net placement was devised to achieve maximum coverage of the property. Nets were deployed within flight corridors that force bats into a funnel, such as forested trails, creeks, or as edge nets along agriculture fields.

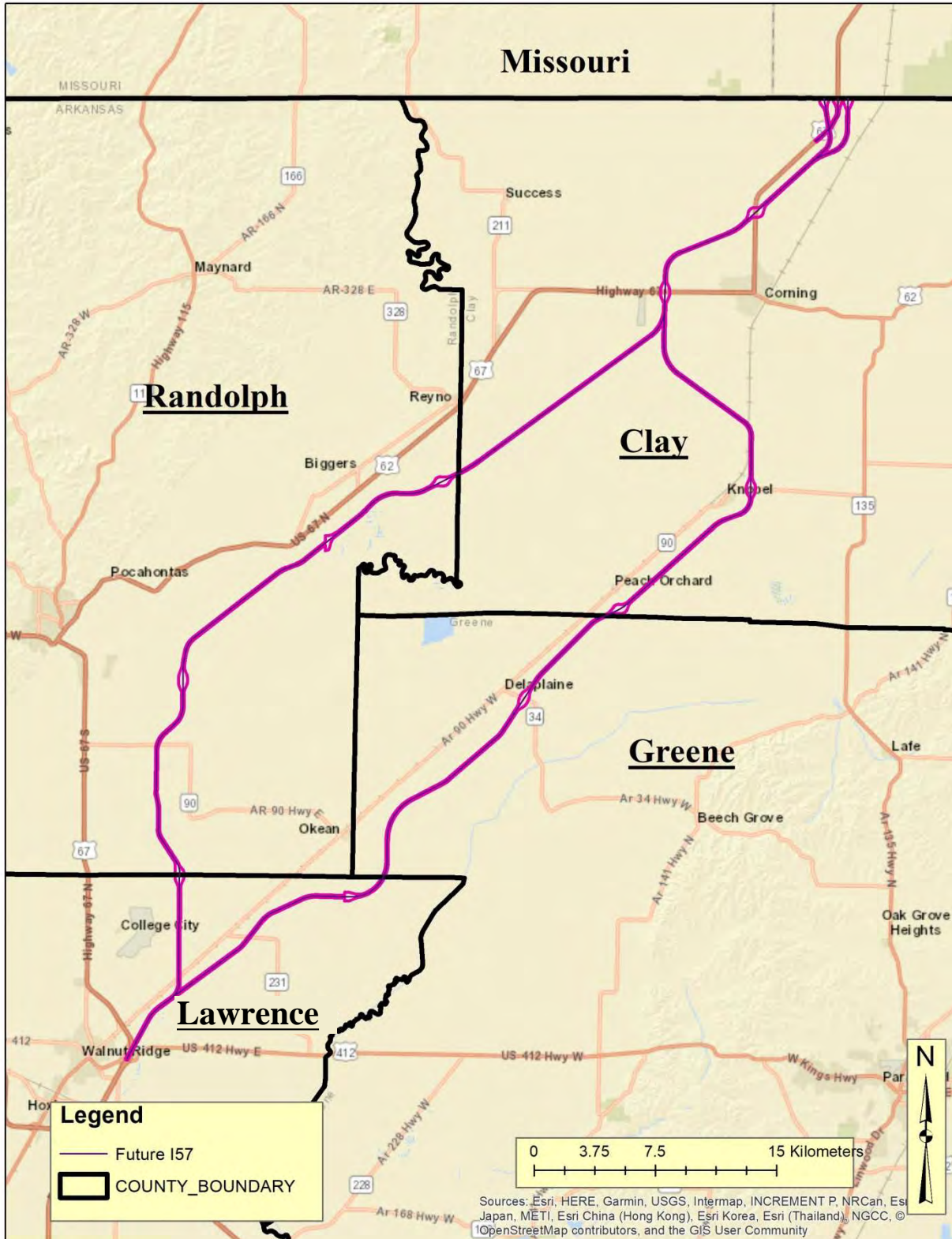


Figure 1. Alternate Routes and Counties

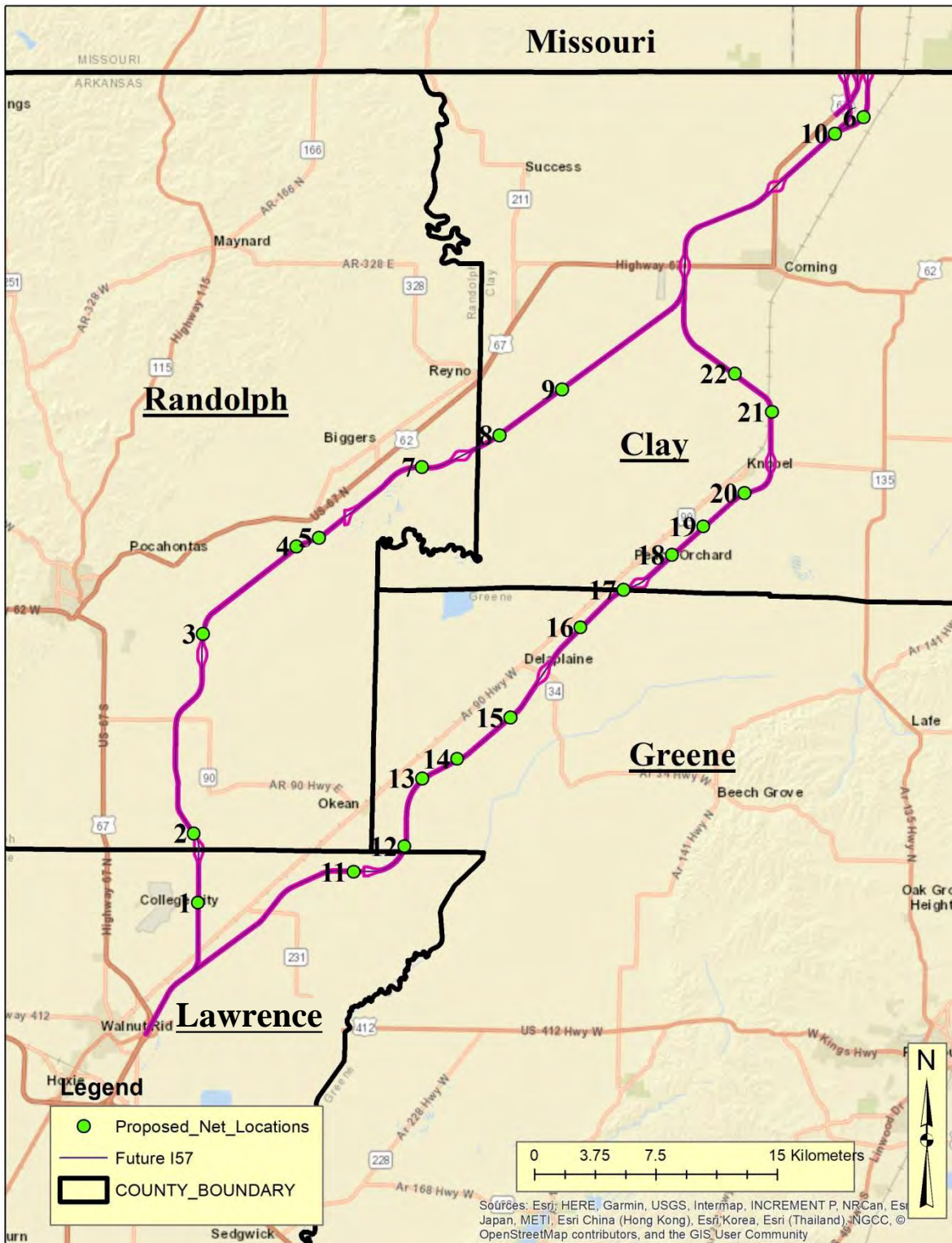


Figure 2. Alternate Routes with Proposed Net Sites



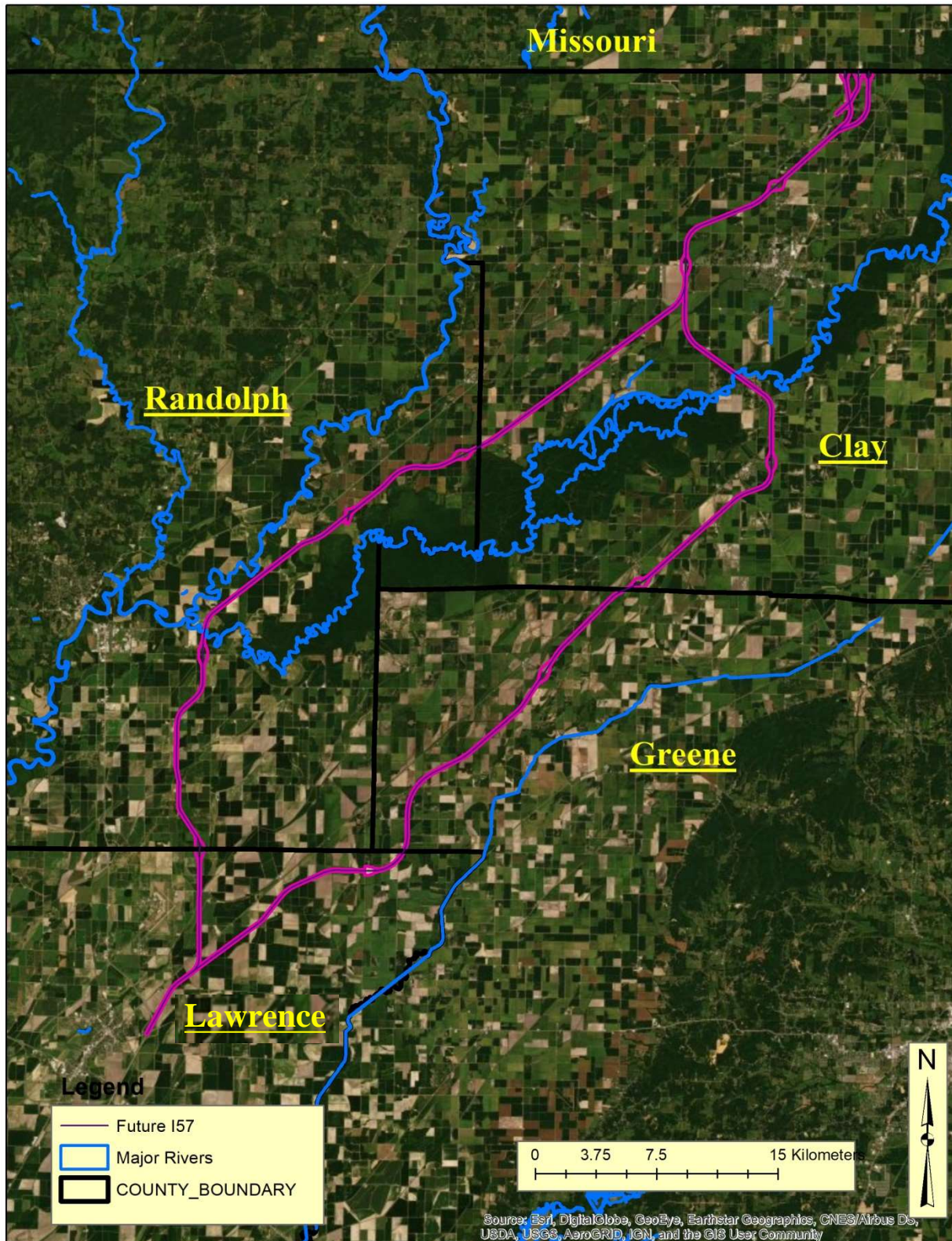


Figure 3. Alternate Routes with Major Rivers

## 2.0 METHODS AND MATERIALS

### 2.1 General Habitat Characteristics

The proposed routes are located in the Western Lowlands Holocene Meander Belts, and Western Lowlands Pleistocene Valley, (L4) of the Mississippi Alluvial Plain (L3) ecoregions in the state. Aside from DDBR most of the remaining suitable habitat is in the form of riparian areas along ditches, and streams any remaining suitable habitat occurs along wind rows, property lines, or wood lots used for hunting.

Vegetation in the areas tends to be dominated by oaks, hickories, hackberries, willow, cypress and tupelos. A few buttonbush type flats were observed. Understory within the areas of hardwoods tended to be nonexistent due to overstory shading and over bank flooding. Numerous trees with cavities and/or exfoliating bark were seen at several of the proposed sites.

### 2.2 Mist Net Survey

Triple, double or single-high mist net systems were deployed throughout the project area. (Table 1, Figure 4). Mist nets used were Avinet 2 ply, 50 denier nylon with a mesh size of approximately 1 1/2 inches. Fifty mist net nights were conducted over twelve calendar nights (250 net-hours). United States Fish and Wildlife Range-Wide Indiana Bat Survey Guidelines were followed throughout the project.

All sampling was done in the late summer of 2021. Mist nets were erected in flight corridors, field edges, and at or in water sources. Mist nets were opened at sunset, staying open for five hours. Mist nets were placed to maximize sampling area.

**Table 1. Site, location, net size, area, total number of hours nets were open, habitat, and date for mist nets deployed.**

Site	Latitude	Longitude	Nets	Net Area (m <sup>2</sup> )	Hours Open	Habitat	Date
Site 1	36.122803	-90.906585	3X9m	70.2	10	Field Edge	8/1/2021
Site 2	36.157737	-90.908528	2x9m	46.8	10	Forest Edge	8/1/2021
Site 3a	36.240313	-90.903588	2x9m	46.8	10	Field Edge	8/1/2021
Site 3b	36.246650	-90.903547	1x6m	15.6	10	Field Edge	8/1/2021
Site 4	36.285630	-90.852208	2x12m	62.4	10	Edge Net	8/1/2021
Site 5	36.290235	-90.839698	2x12m	62.4	10	Creek	8/3/2021
Site 6	36.477455	-90.537394	2X9m	46.8	10	Forest	8/5/2021
Site 7	36.321493	-90.781612	2x9m	46.8	10	Creek	8/3/2021
Site 8a	36.335635	-90.741215	2x9m	46.8	10	Forest	8/3/2021
Site 8b	36.335704	-90.740287	2x6m	31.2	10	Forest	8/3/2021
Site 9	36.356785	-90.704045	2x12m	62.4	10	Edge Net	8/3/2021
Site 10	36.470917	-90.553545	2x12m	62.4	10	Edge Net	8/5/2021
Site 11	36.140386	-90.820881	2x9m	46.8	10	Forest Interior	8/5/2021
Site 12	36.152911	-90.790583	2x18m	93.6	10	Forest Interior	8/5/2021
Site 13	36.182037	-90.781631	1x6m	15.6	10	Riparian Edge	8/7/2021
Site 14	36.189879	-90.763196	2x9m	46.8	10	Forest Interior	8/7/2021
Site 15	36.210991	-90.731605	2x4m	20.8	10	Riparian Edge	8/7/2021
Site 16	36.250349	-90.693282	2x4m	20.8	10	Creek	8/7/2021
Site 17	36.266821	-90.669797	2x12m	62.4	10	Creek	8/9/2021
Site 18	36.282161	-90.642705	2x4m	20.8	10	Forest	8/9/2021
Site 19	36.293922	-90.626774	3x6m	46.8	10	Edge Net	8/9/2021
Site 20	36.310290	-90.601200	2x18m	93.6	10	Edge Net	8/9/2021
Site 21a	36.344385	-90.588663	2x6m	31.2	10	Creek	8/11/2021
Site 21b	36.338168	-90.588058	2x9m	46.8	10	Forest	8/11/2021
Site 22	36.363806	-90.608675	2x12m	62.4	10	Field Edge	8/11/2021

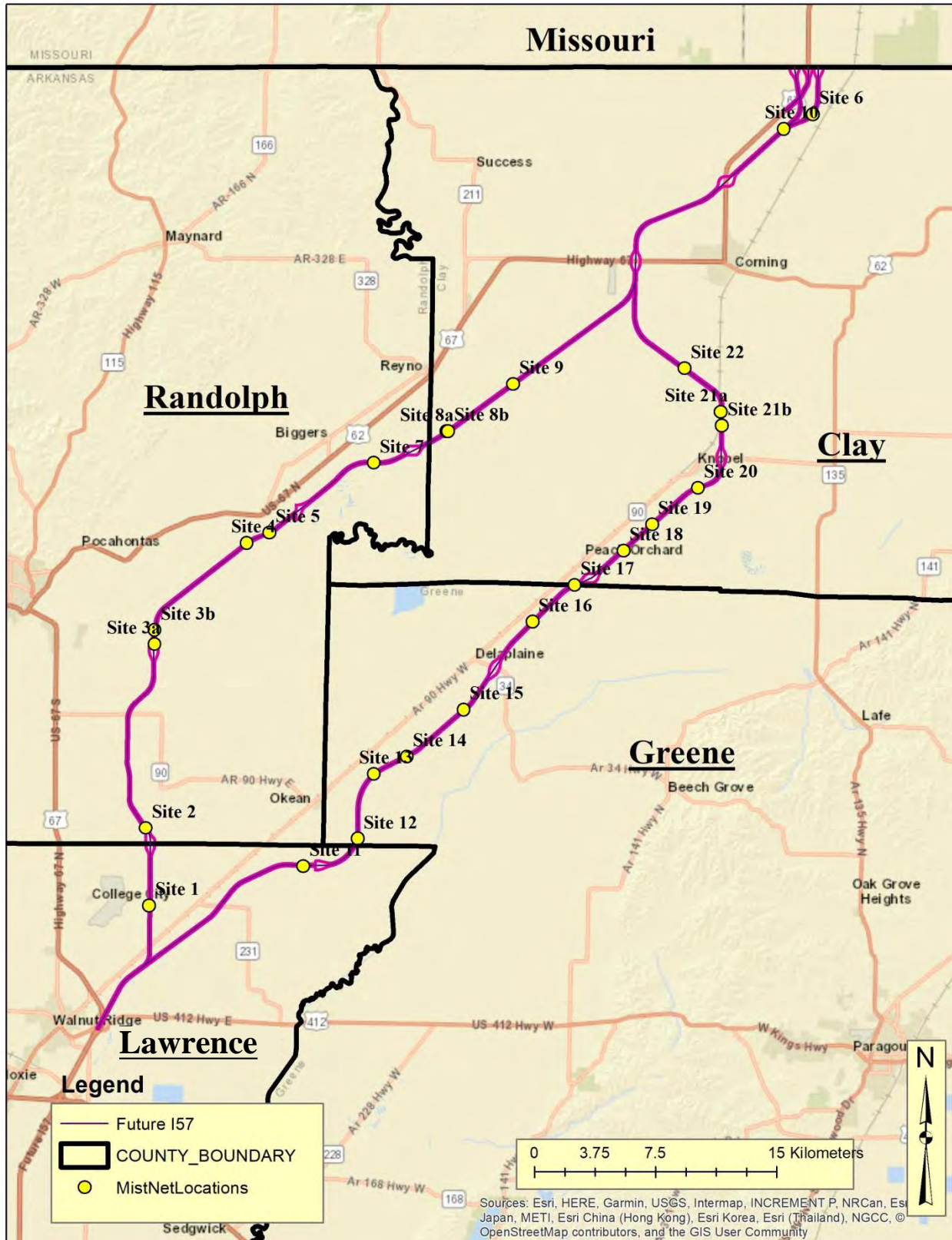


Figure 4. Sampled Mist Net Locations

### 3.0 FINDINGS AND RESULTS

#### 3.1 Mist Net Survey

A total of 26 bats representing 4 species were captured in mist nets. The captured species included 10 Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), 9 Eastern Red Bats (*Lasiurus borealis*), 6 Evening Bats (*Nycticeius humeralis*), and 1 Southeastern Bat (*Myotis austroriparius*). One additional bat was listed as Unknown due to the bat escaping the net before it could be handled. This is not an uncommon occurrence especially with Eastern Red bats. The bat biologist simply did not have a good enough look to determine species. Simply that a bat flew out of the net upon approaching the net. No bats showed signs of White Nose Syndrome (WNS) or effects from WNS.

**Table 2. Site identification, and bat capture information, Reproductive status was characterized as: non-reproductive (NR), pregnant (PR), lactating (LA), post-lactating (PL), or scrotal (SC).**

Site #	Acyo	Capture Time	Species	Sex	Age	Repro Status	LFA	Parasites	Wing Damage	Weight
4	Unkn	22:00	<i>Unknown</i>	Escaped Net upon Approach						
4	CORA	0:00	<i>Corynorhinus rafinesquii</i>	M	A	NR	41.5	N	0	10
4	CORA	23:00	<i>Corynorhinus rafinesquii</i>	F	A	NR	40	N	0	9.5
4	LABO	0:45	<i>Lasiurus borealis</i>	F	A	NR	44	N	0	12
5	CORA	21:40	<i>Corynorhinus rafinesquii</i>	F	A	L	42.1	N	0	10
5	CORA	22:35	<i>Corynorhinus rafinesquii</i>	F	A	L	40.7	N	0	9.5
5	CORA	23:38	<i>Corynorhinus rafinesquii</i>	M	A	TD	42.9	N	0	10
5	MYAU	21:45	<i>Myotis austroriparius</i>	F	A	L	38.3	Y	0	8
5	CORA	21:45	<i>Corynorhinus rafinesquii</i>	M	A	NR	41.6	N	0	9
5	CORA	21:45	<i>Corynorhinus rafinesquii</i>	Escaped Net						
5	CORA	22:30	<i>Corynorhinus rafinesquii</i>	F	A	L	43.2	N	0	11
5	CORA	0:00	<i>Corynorhinus rafinesquii</i>	M	A	TD	42.0	N	0	9
5	CORA	1:30	<i>Corynorhinus rafinesquii</i>	F	A	L	43.1	Y	0	11
7	NYHU	0:10	<i>Nycticeius humeralis</i>	M	A	NR	37	N	0	11
7	NYHU	0:10	<i>Nycticeius humeralis</i>	M	A	NR	36	N	0	10
7	LABO	0:30	<i>Lasiurus borealis</i>	F	J	NR	40	N	0	10
7	NYHU	0:30	<i>Nycticeius humeralis</i>	M	A	NR	36	N	0	10
7	NYHU	1:30	<i>Nycticeius humeralis</i>	M	A	NR	34	N	0	12
7	NYHU	0:15	<i>Nycticeius humeralis</i>	M	A	NR	36	N	0	11
7	NYHU	0:15	<i>Nycticeius humeralis</i>	M	A	NR	37	N	0	13
9	LABO	22:00	<i>Lasiurus borealis</i>	M	A	NR	39.5	N	0	9
9	LABO	23:00	<i>Lasiurus borealis</i>	Escaped Net						
9	LABO	23:00	<i>Lasiurus borealis</i>	M	J	NR	38.9	N	0	9
9	LABO	23:00	<i>Lasiurus borealis</i>	F	J	NR	42.5	N	0	10
10	LABO	21:50	<i>Lasiurus borealis</i>	M	A	NR	41.1	N	0	9
10	LABO	22:20	<i>Lasiurus borealis</i>	M	J	NR	37.3	N	0	9
18	LABO	20:52	<i>Lasiurus borealis</i>	Escaped Net						

## 4.0 CONCLUSION

No federally listed endangered or threatened bat species were captured using mist nets for this study.

## APPENDIX A: Species Acronyms

### List of Acronyms used to describe Common/Scientific names of bats

Common Name	Scientific Name	Acronym
Big brown	<i>Eptesicus fuscus</i>	EPFU
Hoary	<i>Lasiurus cinereus</i>	LACI
Evening	<i>Nycticeius humeralis</i>	NYHU
Tri-colored	<i>Perimyotis subflavus</i>	PESU
Red	<i>Lasiurus borealis</i>	LABO
Seminole	<i>Lasiurus seminolus</i>	LASE
Silver-haired	<i>Lasionycteris noctivagans</i>	LANO
Brazilian free-tailed	<i>Tadarida brasiliensis</i>	TABR
Southeastern	<i>Myotis austroriparius</i>	MYAU
Little brown	<i>Myotis lucifugus</i>	MYLU
Eastern small-footed	<i>Myotis leibii</i>	MYLE
Gray	<i>Myotis grisescens</i>	MYGR
Indiana	<i>Myotis sodalis</i>	MYSO
Northern long-eared	<i>Myotis septentrionalis</i>	MYSE
Rafinesque's big-eared	<i>Corynorhinus rafinesquii</i>	CORA
Ozark big-eared	<i>Corynorhinus townsendii ingens</i>	COTO

## APPENDIX B: Mist Net Pictures



Figure 1. Site 1



Figure 2. Site 2.





Figure 3. Site 3a.



Figure 4. Site 3b.



Figure 5. Site 4.



Figure 6. Site 5.



Figure 7. Site 6.



Figure 8. Site 7.



Figure 9. Site 8a.



Figure 10. Site 8b



Figure 11. Site 9.



Figure 122. Site 10.



Figure 13. Site 11.



Figure 14. Site 12.



Figure 15. Site 13.



Figure 16. Site 14.



Figure 17. Site 15



Figure 18. Site 16.





Figure 19. Site 17.



Figure 20. Site 18.



Figure 21. Site 19.



Figure 22. Site 20.



Figure 23. Site 21a.



Figure 24. Site 21b.



Figure 25. Site 22.



















Location ARROT / Leaver Site 5 Date 3 August 2021  
 Start Time 20:30 Finish Time 01:50  
 Cloud Cover (%) 0% Temperature (C) 23.0  
 Wind Speed 1 Rel. Humidity (%) 59%  
 Moon Phase 20% Waxing Location Type (Forest, Trail, Road, Pond, Creek, Field) Forest, Creek Elevation 83m  
 WAYPOINT NAME \_\_\_\_\_  
 Net A - Coordinates-NAD 27 36.740235 -90.839696 NAD 83 \_\_\_\_\_ Size 2x12  
 Net B - Coordinates-NAD 27 \_\_\_\_\_ NAD 83 \_\_\_\_\_ Size \_\_\_\_\_  
 Net C - Coordinates-NAD 27 \_\_\_\_\_ NAD 83 \_\_\_\_\_ Size \_\_\_\_\_  
 Net D - Coordinates-NAD 27 \_\_\_\_\_ NAD 83 \_\_\_\_\_ Size \_\_\_\_\_

Capture Time	Net	Species	Sex (M/F)	Age (A/J)	Repro. Status	LFA Length	Parasites (Y/N)(Type)	Wing Damage Left	Wing Damage Right	Weight (grams)	Left Band #	Right Band #	Comments/Recapture (Y/N)/Band Injuries
21:45	A	NVAV	F	A	L	38.29	Y <u>Scat Fly</u>			8			28-20
21:45	A	CORA	M	A	NE	41.51	WD			9			29-20
21:45	A	CORA	F	A	ESCAPED	42.7	WD			4			31-20
24:00	A	CORA	M	A	TD	48.02	WD						29-20
01:50	A	CORA	F	A	L	43.11	Y <u>Scat Fly</u>						31-

Figure 34. Field Datasheet Site 5 Night 1.













































Location Graver I-57 Site #: 15 County/State: Greene Co, AR Date: 8-7-2021  
 Start Time 20:30 Finish Time 01:30 Researchers: Ron Redman  
 Cloud Cover (%) 10 Temperature (°C) 26 Moon Phase(%) 0.2 Waxing or Waning/Gibbous or Crescent New Moon  
 Wind Speed (mph) 8 Rel. Humidity (%) 85  
 Location Type (Forest, Trail, Road, Pond, Creek, Field) A-Creekside Elevation (m) 91

Net A - Coordinates - NAD 83 36.210991 -90.731605 Size(#): 2 m 4  
 Net B - Coordinates - NAD 83 \_\_\_\_\_ Size(#): \_\_\_\_\_ m \_\_\_\_\_  
 Net C - Coordinates - NAD 83 \_\_\_\_\_ Size(#): \_\_\_\_\_ m \_\_\_\_\_  
 Net D - Coordinates - NAD 83 \_\_\_\_\_ Size(#): \_\_\_\_\_ m \_\_\_\_\_

Sexual Status: Females: Pregnant (P), Lactating (L), Post Lactating (PL), Non-reproducing (NR), Unknown (U).

Beaufort Wind Scale: 1 (<1 mph): Smoke rises vertically; 2 (1-3 mph): Smoke drifts; 3 (4-7 mph): Wind felt on face; leaves rustle; 4 (8-12 mph): Leaves & small twigs move constantly; 5 (13-18 mph): Dust rises; small branches move; 6 (19-24 mph): Small trees sway; crested waves on water.  
 Wing Score: 0 = No damage (<5 spots); 1 = Light damage (<50% depigmented; no holes; some forearm flaking); 2 = Mod damage (>50% depigmin. scarring easily visible; some dead tissue; small holes); 3 = Heavy damage (Wing very deteriorated; ribles; missing tissue); P = physical damage but no necrotic tissue or splodching  
 Recapture Band Injury Status: 0 = No injury; 1 = Irritations; scar tissue; penetration but no inflammation; 2 = holes; inflammations; embedded; 3 = scrapes on breast from band rubs.

Site Description:  
 Creek is about 20ft wide 2ft deep. Dangerous li.  
 the bottom of the creek will not support weight!!  
 I saw k. they deep 2ft off bank... to feel us try  
 logs as base but they sunk too li.

Capture Time	Net	Species	Sex (M/F)	Age (A/J)	Repro. Status	LFA Length(mm)	Parasites (Y/N)(Type)	Wing Damage		Weight (gr)	Left Band# female	Right Band# male	Comments/Recapture	
								Left	Right				(Y/N)/Band Injuries	BBB Bag
						<u>N0</u>	<u>Bats</u>							

Figure 39. Field Datasheet Site 15 Night 1.

Location Grave I-57 Site #: 15 County/State: Greene Co, AR Date 8-8-2021  
 Start Time 20:20 Finish Time 01:20 Researchers: Ron Redman  
 Cloud Cover (%) 30 Temperature (°C) 27 Moon Phase(%) .3 Waxing or Waning/Gibbous or Crescent  
 Wind Speed (mph) 9 Rel. Humidity (%) 87 Location Type (Forest, Trail, Road, Pond, Creek, Field) A-Creekside Elevation (m) 91

Sexual Status: **Females:** Pregnant (P), Lactating (L), Post Lactating (PL), Non-reproducing (NR), Unknown (U)  
 Net A - Coordinates - NAD 83 36.210991 -90.731605 Size(#) 2 m 4  
 Net B - Coordinates - NAD 83 \_\_\_\_\_ Size(#) \_\_\_\_\_ m \_\_\_\_\_  
 Net C - Coordinates - NAD 83 \_\_\_\_\_ Size(#) \_\_\_\_\_ m \_\_\_\_\_  
 Net D - Coordinates - NAD 83 \_\_\_\_\_ Size(#) \_\_\_\_\_ m \_\_\_\_\_

Beaufort Wind Scale: 1 (<1 mph): Smoke rises vertically; 2 (1-3 mph): Smoke drifts; 3 (4-7 mph): Wind felt on face; leaves rustle; 4 (8-12 mph): Leaves & small twigs move constantly; 5 (13-18 mph): Dust rises; small branches move; 6 (19-24 mph): Small trees sway; crested waves on water.  
 Wing Score: 0 = No damage (<5 spots); 1 = Light damage (<50% depigmented; no holes; some forearm flaking); 2 = Mod damage (>50% depigment; scarring easily visible; some dead tissue; small holes); 3 = Heavy damage (Wing very deteriorated; holes; missing tissue); P = physical damage but no necrotic tissue or splicing  
 Recapture Hand Injury Status: 0 = No injury; 1 = Irritations, scar tissue; penetration but no inflammation; 2 = holes; inflammations; embedded; 3 = scrapes on breast from hand rubs.

Capture Time	Net	Species	Sex (M/F)	Age (A/J)	Repro. Status	LFA Length(mm)	Parasites (Y/N)(Type)	Wing Damage		Weight (gr)	Left Band#	Right Band#	Comments/Recapture
								Left	Right		female	male	
							No BATS						

Site Description:  
 See 8-7-2021 data sheet

Figure 40. Field Datasheet Site 15 Night 2.

Location ARDOT I-57 Site #: 116 County/State: \_\_\_\_\_ Date Aug 7, 2021  
 Start Time 2035 Finish Time 0735 Researchers River Redman  
 Cloud Cover (%) 21% Temperature (°C) 28°C  
 Wind Speed (mph) 6 mph Rel. Humidity (%) 75% Moon Phase(%) 0% Waxing or Waning <sup>new moon</sup> Gibbous or Crescent \_\_\_\_\_  
 Location Type (Forest, Trail, Road, Pond, Creek, Field) Creek Elevation (m) 80m

Net A - Coordinates - NAD 83 30.250349 - 90.693282 Size(##) 2 m 4  
 Net B - Coordinates - NAD 83 \_\_\_\_\_ Size(##) \_\_\_\_\_ m \_\_\_\_\_  
 Net C - Coordinates - NAD 83 \_\_\_\_\_ Size(##) \_\_\_\_\_ m \_\_\_\_\_  
 Net D - Coordinates - NAD 83 \_\_\_\_\_ Size(##) \_\_\_\_\_ m \_\_\_\_\_

Sexual Status: **Females:** Pregnant (P), Lactating (L), Post Lactating (PL), Non-reproducing (NR), Unknown (U).  
**Beaufort Wind Scale:** 1 (<1 mph): Smoke rises vertically; 2 (1-3 mph): Smoke drifts; 3 (4-7 mph): Wind felt on face; leaves rustle; 4 (8-12 mph): Leaves & small twigs move constantly; 5 (13-18 mph): Diet rises; small branches move; 6 (19-24 mph): Small trees sway, crested waves on water.  
**Wing Score:** 0 = No damage (<5 spots), 1 = Light damage (<30% depigmented, no holes, some forearm flaking), 2 = Mod damage (>50% depigment, scarring easily visible, some dead tissue, small holes), 3 = Heavy damage (Wing very deteriorated, holes, missing tissue), P = physical damage but no necrotic tissue or spotting  
**Recapture Band Injury Status:** 0 = No injury; 1 = Irritations, scar tissue, penetration but no inflammation; 2 = holes, inflammations, embedded; 3 = scrapes on breast from band rubs.

Capture Time	Net	Species	Sex (M/F)	Age (A/J)	Repro. Status	LFA Length(mm)	Parasites (Y/N)(Type)	Wing Damage Left	Wing Damage Right	Weight (gr)	Left Band# female	Right Band# male	Comments/Recapture	
													(Y/N)/Band	Injuries

1/2

Site Description: Bottom landward woods with ditch next to it.

Figure 41. Field Datasheet Site 16 Night 1.







Location PRDOT I-57 Site #: 18 County/State: Cle El AR Date: Aug 9, 2021  
 Start Time 2035 Finish Time 0135 Researchers River Rodman  
 Cloud Cover (%) 15% Temperature (°C) 28.0°C Moon Phase (%) 7% Waxing or Waning / Gibbous or Crescent  
 Wind Speed (mph) Empty Rel. Humidity (%) 62% Location Type (Forest, Trail, Road, Pond, Creek, Field) Forest Elevation (m) 80m  
 Net A - Coordinates - NAD 83 30.782161 - 90.642705 Size (#) 2 m 4  
 Net B - Coordinates - NAD 83 \_\_\_\_\_ Size (#) \_\_\_\_\_ m \_\_\_\_\_  
 Net C - Coordinates - NAD 83 \_\_\_\_\_ Size (#) \_\_\_\_\_ m \_\_\_\_\_  
 Net D - Coordinates - NAD 83 \_\_\_\_\_ Size (#) \_\_\_\_\_ m \_\_\_\_\_  
 Sexual Status: Females Pregnant (P), Lactating (L), Post Lactating (PL), Non-reproducing (NR), Unknown (U).  
 Banding Wind Scale: 1 (<1 mph); Smoke rises vertically; 2 (1.3 mph); Smoke drifts; 3 (4-7 mph); Wind felt on face; leaves rustle; 4 (8-12 mph); Leaves & small twigs move constantly; 5 (13-18 mph); Dist. trees, small branches move; 6 (19-24 mph); Small trees sway; crested waves on water.  
 Wing Score: 0 = No damage (<5 spots); 1 = 1 light damage (<50% depigmented, no holes, some forearm flaking); 2 = Mod damage (>50% depigment, scarring easily visible, some dead tissue, small holes); 3 = Heavy damage (Wing very deteriorated, holes, missing tissue) F = physical damage but no necrotic tissue or splinting) 2 = holes, inflammations, embedded; 3 = scrapes on breast from band marks.  
 Recapture Band Injury Status: 0 = No injury; 1 = Irritations, scar tissue, penetration but no inflammation.

Capture Time	Net	Species	Sex (M/F)	Age (A/I)	Repro. Status	LFA Length(mm)	Parasites (Y/N)(Type)	Wing Damage		Weight (g)	Left Band# female	Right Band# male	Comments/Recapture	
								Left	Right				B&B	Bag

ADD PARTS ✓

1/2

Figure 45. Field Datasheet Site 18 Night 1.





Location ABDOT/Corver Site #: 19 County/State: Chey Date 9 August 2021  
 Start Time 2030 Finish Time 0130 Researchers \_\_\_\_\_  
 Cloud Cover (%) 20% Temperature (°C) 26  
 Wind Speed (mph) 4 Rel. Humidity (%) 62% Moon Phase (%) 20% Waxing or Waning / Gibbous or Crescent  
 Location Type (Forest, Trail, Road, Pond, Creek, Field) Field, Forest edge Elevation (m) \_\_\_\_\_

Net A - Coordinates - NAD 83 36.243522 -105.626724 Size(#) 3 m 6  
 Net B - Coordinates - NAD 83 \_\_\_\_\_ Size(#) \_\_\_\_\_ m \_\_\_\_\_  
 Net C - Coordinates - NAD 83 \_\_\_\_\_ Size(#) \_\_\_\_\_ m \_\_\_\_\_  
 Net D - Coordinates - NAD 83 \_\_\_\_\_ Size(#) \_\_\_\_\_ m \_\_\_\_\_

Sexual Status: Females: \_\_\_\_\_ Pregnant (P) Lactating (L) Post Lactating (PL) Non-reproducing (NR) Unknown (U)

Beaufort Wind Scale: 1 (<1 mph): Smoke rises vertically; 2 (1-3 mph): Smoke drifts; 3 (4-7 mph): Wind felt on face; leaves rustle; 4 (8-12 mph): Leaves & small twigs move constantly; 5 (13-18 mph): Dust rises, small twigs move; 6 (19-24 mph): Small trees sway; crested waves on water.  
 Wing Score: 0 = No damage (<5 spots); 1 = Light damage (<50% depigmented, no holes, some forearm tanning); 2 = Mod damage (>50% depigment, scarring easily visible, some dead tissue, small holes); 3 = Heavy damage (Wing very deteriorated, holes, missing tissue); P = physical damage but no necrotic tissue or spotting  
 Recapture Band Injury: 0 = No injury; 1 = Irritations, scar tissue, perforation but no inflammation; 2 = holes, inflammations, embedded; 3 = scrapes on breast from band rubs

Capture Time	Net	Species	Sex (M/F)	Age (A/J)	Repro. Status	LFA Length(mm)	Parasites (Y/N)(Type)	Wing Damage Left	Wing Damage Right	Weight (gr)	Left Band# female	Right Band# male	Comments/Recapture	
													(Y/N)/Band	Injuries
													B&B	Bag

Site Description: Small stand of white pine forest surrounded by agricultural fields

Figure 47. Field Datasheet Site 19 Night 1.

















## APPENDIX D. USFWS Permit



NATIVE ENDANGERED & THREATE  
ENDANGERED & THF

**Permit Nur**

Effective: 04/02/201

Issuing Office:

Department of the Interior  
U.S. FISH & WILDLIFE SERVICE  
Ecological Services Permit Office  
1875 Century Boulevard  
Atlanta, GA 30345  
permitsR4ES@fws.gov

**GREGORY  
MASSON**

Digitally signed  
GREGORY MA  
Date: 2018.04  
06:05:58 -04'0

CHIEF, DIVISION OF ENVIRONMENTAL REVIEW

Permittee:

**RONALD K. REDMAN**  
**345 HICKORY GROVE STREET**  
**BENTON, AR 72015**  
**U.S.A.**

Authority: Statutes and Regulations: 16 USC 1539(a), 16 USC 1533(d); 50 CFR 17.22, 50 CFR 17.32, 50

**Location where authorized activity may be conducted:**

Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, M  
Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Ten  
Virginia, West Virginia, and Wisconsin.

**Reporting requirements:**

Annual Reports are due by January 31 following each year that this permit is in effect.

**Authorizations and Conditions:**

A. General conditions set out in Subpart B of 50 CFR 13, and specific conditions contained in Federal re  
are hereby made a part of this permit. All activities authorized herein must be carried out in accordance w  
purposes described in the application submitted. Continued validity, or renewal of this permit is subject to  
compliance with all applicable conditions, including the filing of all required information and reports.

B. The validity of this permit is also conditioned upon strict observance of all applicable foreign, state, loc  
federal law.

C. The following individuals are authorized to conduct **all activities** as authorized by this permit  
Redman River K Redman and Ronald K Redman The following individuals are authorized to



NATIVE ENDANGERED & THREATE  
ENDANGERED & THF

**Permit Nur**

Effective: 04/02/201

**At least one named permittee must remain present at each mist-net and harp trap site while operated.**

D. Acceptance of this permit serves as evidence that the permittee understands and agrees to abide by this permit and all sections of title 50 Code of Federal Regulations, parts 13 and 17, pertinent to it. Section 11 of the Endangered Species Act of 1973, as amended, provides for civil and criminal penalties for failure to comply with permit conditions. In addition, the permittee shall have all other applicable Federal and/or local government permits prior to the commencement of activities authorized in this permit.

E. Permittee is authorized to take (enter hibernacula or maternity roost caves, capture with mist net, handle, identify, band, radio tag, and swab) Indiana bats (*Myotis sodalis*), gray bats (*Myotis grisescens*), long-eared bats (*Myotis septentrionalis*), Ozark big-eared bats (*Corynorhinus townsendii ingens*), and small-eared bats (*Corynorhinus townsendii virginianus*) for presence/absence surveys and white-nose syndrome as described in permittee's May 11, 2017, application and previous applications and as conditioned by this permit.

F. The permitted activities described above require prior, site-specific approval from the U.S. Fish and Wildlife Service (USFWS) Field Supervisor in the state(s) where the project will occur. Permittee shall notify the USFWS Field Supervisor for the state in which activities are proposed to occur at least 15 days prior to commencing activities. Contact information is in Condition P., below. Your request for this site-specific approval must be in writing and must indicate:

F.1. The purpose and a description of the activities proposed (e.g., surveys, radio telemetry studies, and swabbing) will be conducted, a copy of the applicable study proposal must be provided.

F.2. Location of proposed activities, including project site (legal description and lat/long), county, and state.

F.3. Dates when the project is proposed to take place.

F.4. You may proceed with activities only upon receipt of written concurrence from the applicable USFWS Field Supervisor. *Your concurrence letter/email must be carried with this permit to authorize site-specific activities.*

G. Permittee shall adhere to the following conditions involving capture and handling of bats:

G.1. Federally listed bats may be captured (e.g., mist-nets and harp traps) following the protocol(s) established by USFWS, when available. Permittee must contact the USFWS Field Supervisor in the state(s) in which activities are proposed to ensure correct protocol(s) are used. For example, the current Range-wide Indiana Bat Survey Guidelines are available at:

<http://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html>. The information is available on the USFWS website.



## ATTACHMENT D — FRESHWATER MUSSEL SURVEY

Freshwater Mussel Survey and Comparison of Two Black River  
Alternative Crossings for ARDOT Job 100512  
Walnut Ridge - Missouri State Line (Future I-57) in  
Clay and Randolph Counties, Arkansas

Final Report

17 February 2022

John L. Harris, Ph.D.  
Welch/Harris, Inc.  
10846 Plantation Lake Road  
Scott, Arkansas 72142

Freshwater Mussel Survey and Comparison of Two Black River Alternative  
Crossings for ARDOT Job 100512  
Walnut Ridge - Missouri State Line (Future I-57) in  
Clay and Randolph Counties, Arkansas

### Introduction

Several endangered mussel species presently occur or have historically occurred in the Black River, Arkansas including *Epioblasma triquetra* (Rafinesque 1820), *Lampsilis abrupta* (Say 1831), *Potamilus leptodon* (Rafinesque 1820), and *Theliderma cylindrica* (Say 1817) (Harris *et al.* 2007, 2010; Bouldin *et al.* 2013, Christian *et al.* 2021).

Additionally, substantial mussel assemblages (mussel beds) are known to occur in the Black River that are extremely important to maintaining species richness and genetic diversity throughout the system (Rust 1993).

A mussel survey was performed to determine if federally protected mussel species exist within the area of potential effect for proposed four-lane highway facility alternative crossings of the Black River associated with Arkansas Department of Transportation Project 100512, Walnut Ridge - Missouri State Line (Future I-57). Two alternative river crossings, named Alternative 2 and Alternative 3, are proposed at sites on the Black River as illustrated in Figure 1. Alternative 2 is located approximately 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas. Alternative 3 is located approximately 9.55 river miles (15.4 river kilometers) downstream of and 4.57 air miles (7.35 air kilometers) SW of the U. S. Hwy 62 crossing of Black River east of Corning.

### Methods

A mussel survey of the proposed 400-foot (122-meter) wide Alternative 2 corridor was conducted during 16-17 October and 6 November 2021 and during 30-31 October 2021 for the Alternative 3 corridor. The surveyors utilized dive techniques with surface supplied air provided by a Brownies hookah rig apparatus supported from a boat mounted dive platform consisting of a 16-ft (4.9-m) Weldbilt jon-boat powered by a 30-horsepower Evinrude outboard motor. The diver was equipped with an AGA full face mask allowing diver to surface communication via Mach II-BUDS (diver) and an Ocean Tech STX 101 surface system. Communication was essential for the field assistant to direct the diver on transects in areas without current velocity and for the diver to provide

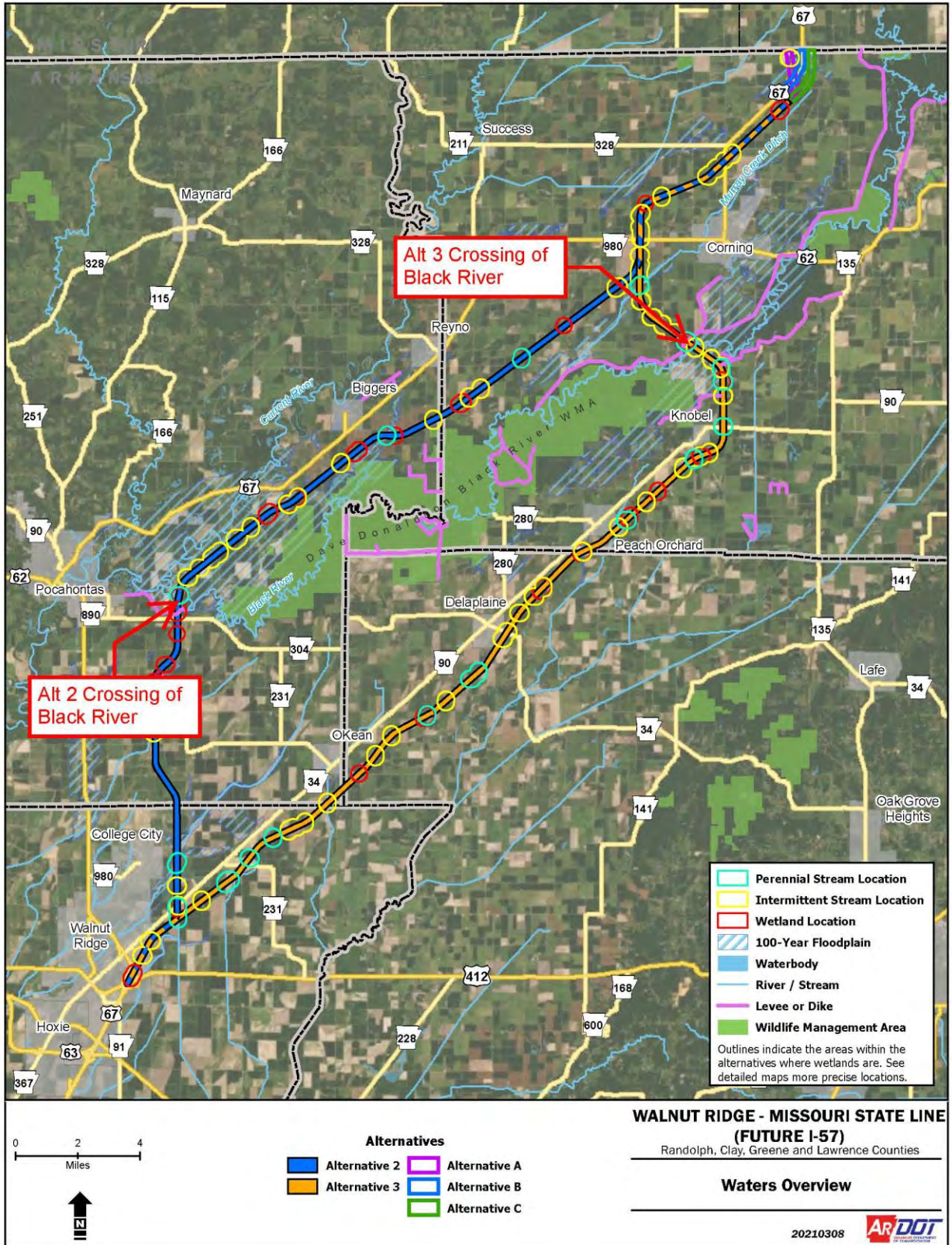


Figure 1. Mussel survey project locations.

mussel density, substrate, and river conditions data to the assistant. Water depths were determined with a Humminbird 560 Fishfinder boat mounted depth finder or a Sokkia fiberglass 25-ft (7.6-m) depth rod. Dive locations within the survey area were recorded utilizing a Garmin GPSMAP 64st global positioning satellite receiver. The diver provided substrate conditions for each search cell by estimating percent surface substrate composition using the modified Wentworth Scale.

The effort required to find protected species is often considerable, and they are rarely collected in quantitative samples (Kovalak *et al.* 1986). Overall, the qualitative timed-search approach with limited excavation may be the best for detecting mussel presence or demonstrating a reasonable probability of mussel absence (EPA 2013); therefore, our preferred survey method was qualitative timed searches.

Searches were conducted along the entire channel width of the Black River at both alternative corridor sites. The proposed alternative corridor crossings are each 400-ft (122-m) in width. Transects perpendicular to river flow were established at approximately 50-ft (15-m) intervals from the downstream to the upstream termini for each alternative. A tape measure was walked along the shoreline where feasible, and pin flags were placed at the upstream and downstream boundary for each search cell. Where vertical riverbanks prevented shoreline access, a Nikon PROSTAFF 7i laser rangefinder was used to measure distances for search cell limits. Cell boundaries in mid-river were marked by anchored buoys with their distance perpendicular from shore measured using the Nikon PROSTAFF 7i laser rangefinder from the anchored boat. GPS coordinates were recorded from the right descending bank (RDB) and left descending bank (LDB) pin flags for the transects established at 50-ft (15.2-m) intervals and at the mid-river buoys of the transects at 100-ft (30.5-m) intervals. The perpendicular transects and centerline points were used to establish 16 rectangular search cells at each alternative crossing. The search cells were abutted end to end so that the entire proposed corridor width of the Black River at each alternative crossing was surveyed.

Survey methodology consisted of tactile searches using a zigzag pattern (near shore to mid-river) from upstream to downstream within each search cell. Search cells were each approximately 50-feet (15 m) long (upstream to downstream) and ranged in width (shoreline to midchannel) from approximately 66 to 82 ft (20 to 25m) at Alternative 2 and 92 to 112 ft (28 to 34 m) at Alternative 3. Search time was recorded for each of the 16 search cells at each proposed crossing. Cell searches began at the downstream limit of the survey areas (cells 1 and 2) and proceeded upstream until completion of all cells. For

Alternative 2 and Alternative 3, all cells along the RDB (odd numbered cells) were searched on the first day at the site, and all cells along the LDB (even numbered sites) were searched on the second day. Alternative 3 required additional search time on a third day to complete the survey effort.

Mussels were identified to species, enumerated, and any federally listed species were measured for length, width, and height to the nearest 0.1 mm with digital calipers and photographed. Nomenclature generally follows Williams *et al.* (2017) except where modified by recent research as documented by the FMCS Common and Scientific Names subcommittee (FMCS 2022). Catch per unit effort (CPUE) values were calculated as the number of live mussels obtained per 10 minutes of search effort. Cumulative species richness was plotted against cumulative search time to determine where the plot reached horizontal stability signifying the majority of species were recovered. Ecological Specialists, Inc. (2006) were able to reach species richness asymptotic values in 170 minutes and 270 minutes search time during surveys of two low density mussel concentrations in the White River, DeValls Bluff, AR. Those survey conditions were similar to conditions for the Black River survey sites. Metcalfe-Smith *et al.* (2000) found that 4.5-hrs search time was generally sufficient to recover ~93% of species in their survey rivers. For our survey, three consecutive 20-minute search intervals with no additional species added (after at least 210 minutes search time) was considered the termination point for the survey.

## Results

Tables 1 and 2 summarize the results of 16 dive searches conducted during the survey at Alternative 2 and Alternative 3, respectively. Individual data sheets for each dive search at Alternative 2 and Alternative 3 are found in Appendix A and Appendix B, respectively. The locations of Alternative 2 and Alternative 3 search cells are illustrated in Figures 2 and 3, respectively.

A total of 609 live mussels representing 23 taxa were encountered during 334 minutes (~5.6 hours) of search time for Alternative 2. Alternative 2 catch per 10-minute effort ranged from 3.6 to 38.2 with a mean of 18.2. The cumulative species versus cumulative time searched is illustrated in Figure 4a, and horizontal stability (at 23 species) was reached after approximately 180 minutes search time. Mussel densities were greatest along the right descending bank in search cells 3, 5, 7, 9, 11, 13. Maximum density in the survey area was estimated at approximately 10 live mussels per square meter in search



Search Cell	1	2	3	4	5	6	7	8	9	10	11
Species											
<i>Amblema plicata</i>	0	1	7	0	12	0	7	0	2	0	7
<i>Cyclonaias pustulosa</i>	10	6	28	4	43	4	45	2	66	3	50
<i>Cyprogenia aberti</i>	0	0	0	0	0	0	1	0	0	0	0
<i>Ellipsaria lineolata</i>	0	0	0	0	0	0	2	0	0	0	2
<i>Fusconaia flava</i>	2	0	5	0	8	0	7	0	0	0	4
<i>Lampsilis cardium</i>	0	0	0	9	2	5	2	3	4	3	1
<i>Lampsilis teres</i>	0	2	0	6	2	7	0	6	0	9	0
<i>Lasmigona complanata</i>	0	1	1	0	0	0	0	0	0	0	2
<i>Ligumia recta</i>	0	0	0	0	0	0	0	0	1	0	0
<i>Megalonaias nervosa</i>	0	0	1	0	4	0	0	0	0	0	0
<i>Obliquaria reflexa</i>	1	0	2	0	1	2	4	0	2	1	8
<i>Pleurobema sintoxia</i>	0	0	0	0	0	0	1	0	0	0	1
<i>Potamilus fragilis</i>	0	1	1	0	2	0	1	1	1	0	1
<i>Potamilus ohioensis</i>	0	2	0	0	0	0	0	0	0	0	0
<i>Potamilus purpuratus</i>	2	2	8	0	6	1	1	5	0	1	0
<i>Quadrula quadrula</i>	0	0	0	0	0	0	1	0	0	0	0
<i>Reginaia ebenus</i>	0	0	0	0	0	1	5	0	6	0	2
<i>Strophitus undulatus</i>	0	0	0	0	0	0	1	0	0	0	0
<i>Theliderma cylindrica</i>	0	1	0	1	0	0	0	0	0	0	0
<i>Theliderma metanevra</i>	0	0	0	0	0	0	1	0	0	0	0
<i>Theliderma nobilis</i>	0	0	0	0	0	0	0	0	1	0	2
<i>Tritogonia verrucosa</i>	0	0	3	0	0	0	1	0	0	0	2
<i>Truncilla truncata</i>	1	0	0	0	1	1	2	0	1	0	2
Total Live	16	16	56	20	81	21	82	17	84	17	84
Search Time (minutes)	14	17	23	20	22	22	21	22	22	22	24
Catch Per Unit Effort (10 min)	11.4	9.4	24.3	10.0	36.8	9.5	39.0	7.7	38.2	7.7	35.0

Table 1. Alternative 2 search cell results.

Search Cell	12	13	14	15	16	Total Live	% Total Live	Freq Occur	% Freq Occur
Species									
<i>Amblema plicata</i>	0	5	0	0	0	41	6.7	7	43.8
<i>Cyclonaias pustulosa</i>	7	17	13	2	2	302	49.6	16	100.0
<i>Cyprogenia aberti</i>	0	0	0	0	0	1	0.2	1	6.3
<i>Ellipsaria lineolata</i>	0	0	0	0	0	4	0.7	2	12.5
<i>Fusconaia flava</i>	0	1	0	0	0	27	4.4	6	37.5
<i>Lampsilis cardium</i>	6	0	4	0	2	41	6.7	11	68.8
<i>Lampsilis teres</i>	7	0	5	0	0	44	7.2	8	50.0
<i>Lasmigona complanata</i>	0	1	0	0	0	5	0.8	4	25.0
<i>Ligumia recta</i>	0	0	0	0	0	1	0.2	1	6.3
<i>Megalonaias nervosa</i>	0	0	0	0	0	5	0.8	2	12.5
<i>Obliquaria reflexa</i>	1	8	4	0	0	34	5.6	11	68.8
<i>Pleurobema sintoxia</i>	0	0	0	0	0	2	0.3	2	12.5
<i>Potamilus fragilis</i>	0	1	0	0	0	9	1.5	8	50.0
<i>Potamilus ohioensis</i>	0	0	0	1	0	3	0.5	2	12.5
<i>Potamilus purpuratus</i>	3	12	2	2	5	50	8.2	13	81.3
<i>Quadrula quadrula</i>	0	0	0	0	0	1	0.2	1	6.3
<i>Reginaia ebenus</i>	0	0	0	0	0	14	2.3	4	25.0
<i>Strophitus undulatus</i>	0	0	0	0	0	1	0.2	1	6.3
<i>Theliderma cylindrica</i>	0	0	0	0	0	2	0.3	2	12.5
<i>Theliderma metanevra</i>	0	0	0	0	0	1	0.2	1	6.3
<i>Theliderma nobilis</i>	0	1	0	0	0	4	0.7	3	18.8
<i>Tritogonia verrucosa</i>	0	3	0	0	0	9	1.5	4	25.0
<i>Truncilla truncata</i>	0	0	0	0	0	8	1.3	6	37.5
Total	24	49	28	5	9	609	100.1		
Search Time (minutes)	23	23	30	14	15	334	100.0		
Catch Per Unit Effort (10 min)	10.4	21.3	9.3	3.6	6.0	18.2	100.0		

Table 1 (continued). Alternative 2 search cell results. Freq Occur = Frequency of Occurrence, % Freq Occur = % Frequency of Occurrence.

Search Cell	1	2	3	4	5	6	7	8	9	10	11
Species											
<i>Amblema plicata</i>	4	5	11	3	0	10	20	5	19	2	64
<i>Arcidens confragosus</i>	0	0	0	0	0	0	0	0	0	0	0
<i>Cyclonaias nodulata</i>	0	0	0	0	0	0	1	0	3	1	0
<i>Cyclonaias pustulosa</i>	3	1	2	6	3	3	5	3	4	2	5
<i>Fusconaia flava</i>	0	0	0	1	0	1	1	0	0	0	0
<i>Lampsilis teres</i>	2	0	2	0	0	1	2	0	0	0	0
<i>Lasmigona complanata</i>	0	0	1	0	0	1	2	0	0	0	0
<i>Megalonaias nervosa</i>	0	0	0	0	0	0	0	0	1	0	0
<i>Obliquaria reflexa</i>	2	2	5	0	6	0	3	0	6	1	15
<i>Plectomerus dombeyanus</i>	0	0	0	0	0	0	1	0	0	0	0
<i>Potamilus fragilis</i>	0	0	0	0	0	0	1	0	1	0	3
<i>Potamilus ohioensis</i>	0	0	0	1	0	0	1	1	1	2	0
<i>Potamilus purpuratus</i>	8	8	17	12	2	11	6	7	11	0	4
<i>Pyganodon grandis</i>	0	0	0	0	0	0	0	0	0	0	1
<i>Quadrula quadrula</i>	0	0	0	0	0	0	0	0	0	0	1
<i>Truncilla truncata</i>	0	0	0	0	0	0	0	0	1	0	0
Total	19	16	38	23	11	27	43	16	47	8	93
Search Time (minutes)	17	18	18	19	17	20	21	17	18	17	17
Catch Per Unit Effort (10 min)	11.2	8.9	21.1	12.1	6.5	13.5	20.5	9.4	26.1	4.7	54.7

Search Cell	12	13	14	15	16	Total Live	% Total Live	Freq Occur	% Freq Occur
Species									
<i>Amblema plicata</i>	11	73	4	40	3	274	48.7	15	93.8
<i>Arcidens confragosus</i>	0	0	0	1	0	1	0.2	1	6.3
<i>Cyclonaias nodulata</i>	0	0	0	0	3	8	1.4	5	31.3
<i>Cyclonaias pustulosa</i>	7	7	2	4	4	61	10.8	16	100.0
<i>Fusconaia flava</i>	0	2	0	2	1	8	1.4	6	37.5
<i>Lampsilis teres</i>	0	0	0	1	0	8	1.4	5	31.3
<i>Lasmigona complanata</i>	0	0	0	0	0	4	0.7	3	18.8
<i>Megalonaias nervosa</i>	1	0	0	0	0	2	0.4	2	12.5
<i>Obliquaria reflexa</i>	0	12	1	10	1	64	11.4	12	75.0
<i>Plectomerus dombeyanus</i>	0	0	0	0	0	1	0.2	1	6.3
<i>Potamilus fragilis</i>	0	0	2	0	1	8	1.4	5	31.3
<i>Potamilus ohioensis</i>	2	2	0	5	0	15	2.7	8	50.0
<i>Potamilus purpuratus</i>	0	6	1	11	0	104	18.5	13	81.3
<i>Pyganodon grandis</i>	0	0	0	0	0	1	0.2	1	6.3
<i>Quadrula quadrula</i>	0	0	0	0	0	1	0.2	1	6.3
<i>Truncilla truncata</i>	0	0	0	1	1	3	0.5	3	18.8
Total	21	102	10	75	14	563	100.1	16	100.0
Search Time (minutes)	15	17	16	17	17	281	100.0		
Catch Per Unit Effort (10 min)	14.0	60.0	6.3	44.1	8.2	20.0	100.0		

Table 2. Alternative 3 search cell results. Freq Occur = Frequency of Occurrence, % Freq Occur = % Frequency of Occurrence.

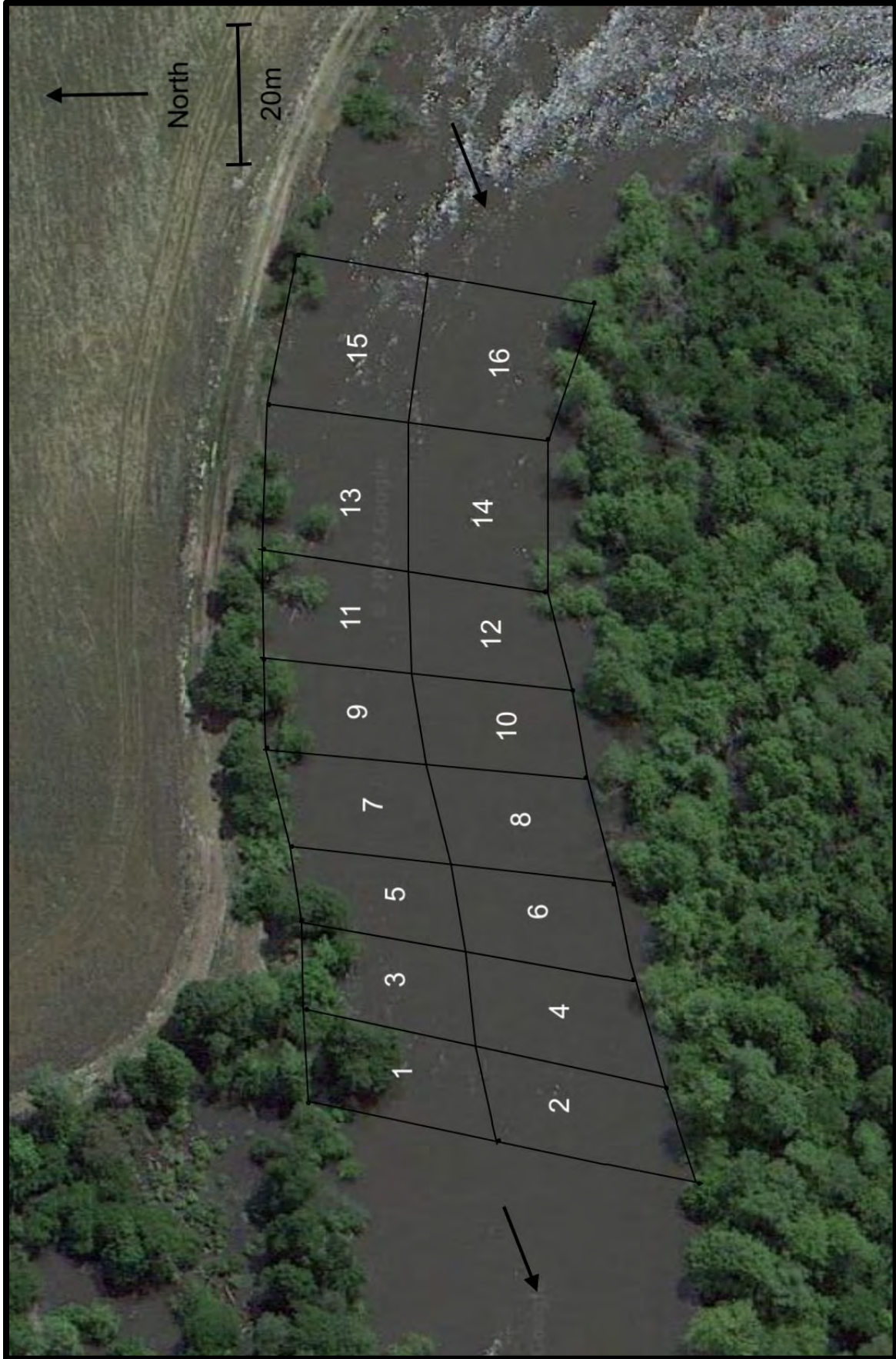


Figure 2. Alternative 2 search cell locations.

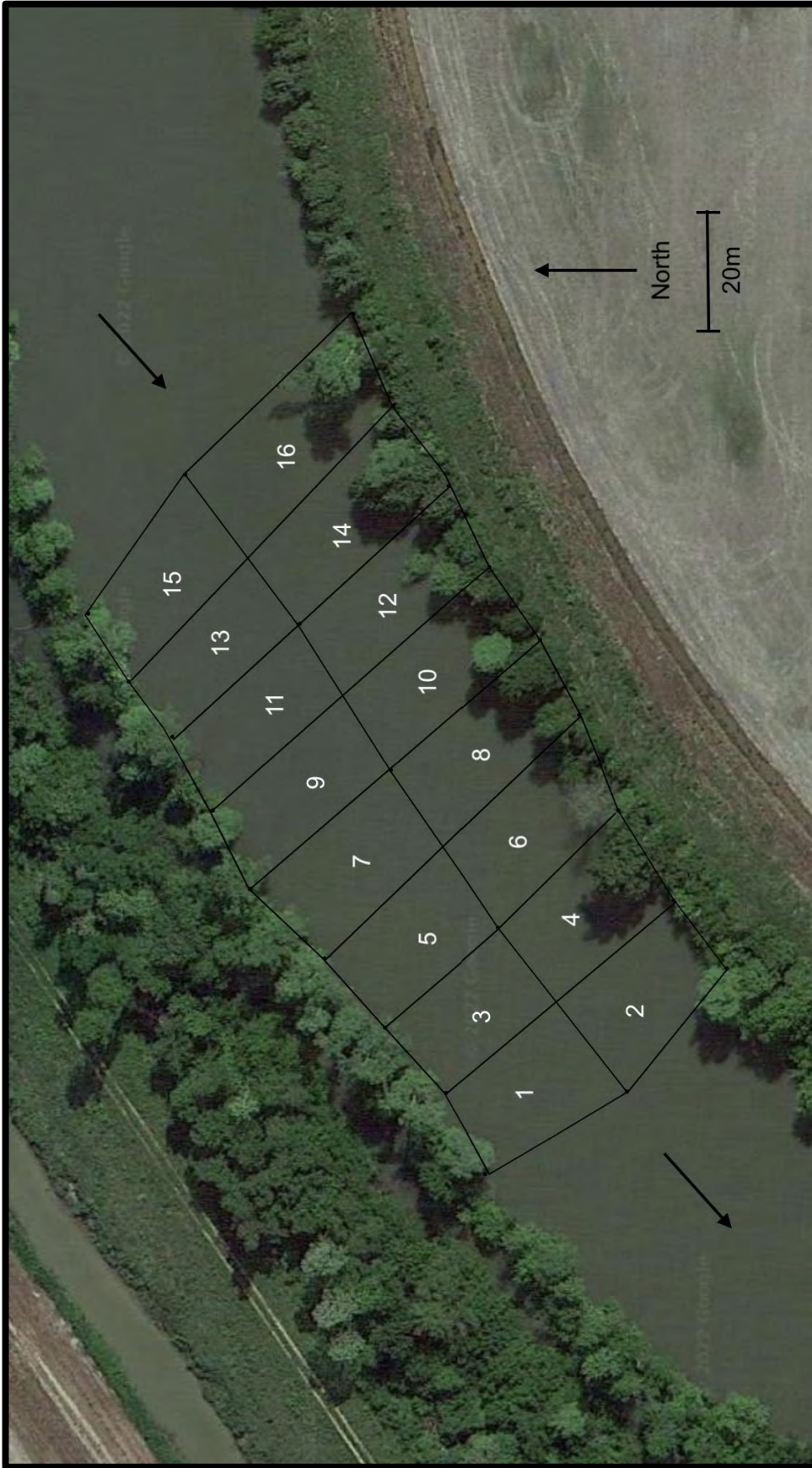


Figure 3. Alternative 3 search cell locations.

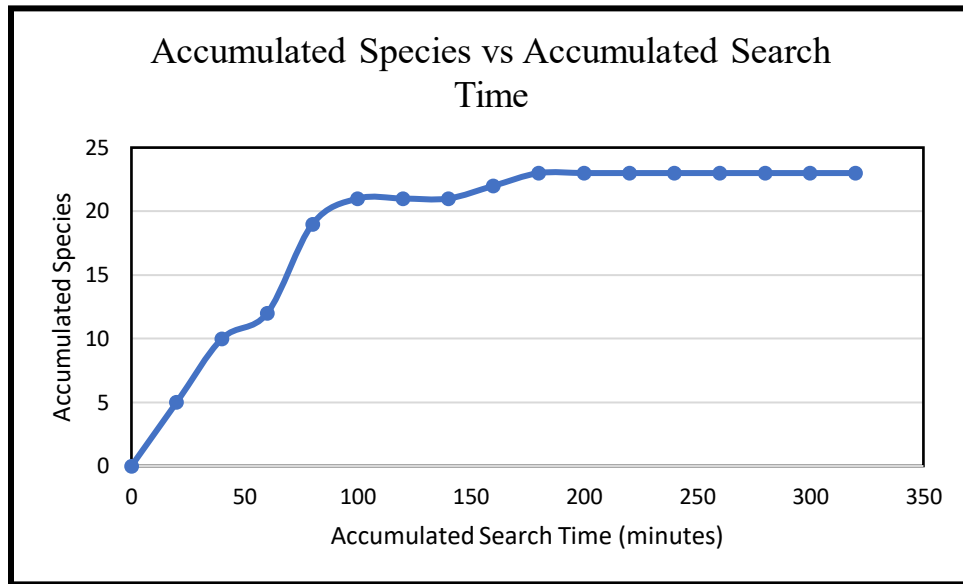


Figure 4a. Alternative 2 cumulative species versus cumulative search time.

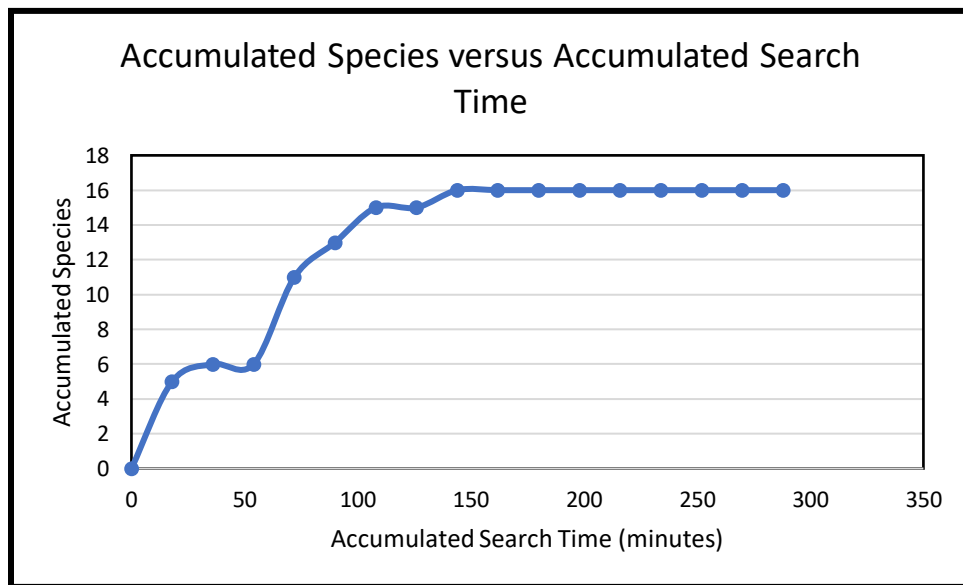


Figure 4b. Alternative 3 cumulative species versus cumulative search time.

cells 5, 7, 9, 11 along the right descending bank. The mussel assemblage at Alternative 2 was dominated by *Cyclonaias pustulosa* (302 of 609 individuals) representing 49.6% of the live mussels found. The next most abundant species was *Potamilus purpuratus* at 8.2% (50 of 609 individuals). The federally protected Rabbitsfoot (*Theliderma cylindrica*), listed as a Threatened species, was represented at Alternative 2 by two live specimens that accounted for 0.3% of the live mussels collected (Figure 5).

A total of 563 live mussels representing 16 taxa were found during 281 minutes (~4.7 hours) of dive search time at Alternative 3. Alternative 3 CPUE ranged from 4.7 to 60.0 with a mean of 20.1. Cumulative species versus cumulative time searched reached horizontal stability (16 species) after approximately 150 minutes search time (see Figure 4b). Mussel densities were greatest along the right descending bank in search cells 11, 13, 15, and maximum density was estimated at approximately 10/m<sup>2</sup> in portions of these cells. *Amblema plicata* was the dominant species at Alternative 3 representing 48.7% (274 of 563 live individuals) of the mussel fauna, and *Potamilus purpuratus* composed 18.5% (104 of 563). Two additional species comprised >10% of live mussels encountered at Alternative 3, and these were *Obliquaria reflexa* (11.4%) and *Cyclonaias pustulosa* (10.8%).

### Discussion and Conclusions

Alternatives 2 and 3 occur in relatively different riverine habitats for mussels. Alternative 2 is in and immediately downstream of a bendway with the outside portion of the bendway possessing moderate to swift current velocities and more armored substrates composed of rock, gravel, sand, and scoured hard clay. The inside portion of the Alternative bendway has relatively slower current velocity and fine sediments (silt and sand) as the primary substrates. At the downstream terminus of Alternative 2, water depth is shallower and current velocity has moderated. In comparison with Alternative 3, Alternative 2 provides more physical habitat diversity potentially accounting for its greater species richness. Alternative 3 is in a straight reach of the river with a wider channel, slower current velocity and deeper water depth compared to Alternative 2. Alternative 3 provides less habitat diversity and is almost lentic in its physical characteristics.

Both Alternatives were dominated by mussel species that have widespread geographic distributions and are considered relatively stable from a conservation status perspective. Alternative 2 has 20 of 23 species (~87%) that are considered Secure (S5) or Apparently Secure (S4) in Arkansas (Harris and Posey 2015). The remaining three species at Alternative 2, *Pleurobema sintoxia*, *Theliderma cylindrica*, *T. nobilis*) were all ranked



Figure 5. *Theliderma cylindrica*. Upper: Alternative 2, Search Cell 2. Lower: Alternative 2, Search Cell 4.



Vulnerable (S3) (Harris and Posey 2015) and comprised 1.3% (8 of 609) of the live mussels collected. Mussels at Alternative 3 were all Secure (S5) or Apparently Secure (S4) species; therefore, all live specimens collected were from common and widespread species.

Mussel habitat at both Alternative crossings has likely been affected by anthropogenic activities. Farming occurs up to the edge of the right descending bank at Alternative 2. There appears to be ongoing bank failure which has contributed treefall and large woody debris deposition causing substrate scouring and likely displacement of mussels in the moderate to swift flow velocity of this outside bendway. This is the likely cause of large numbers of dead shells at Alternative 2 search cells 3, 5, and 7. Similarly, Alternative 3 has farming activities adjacent to the left descending bank, and a levee is present near the bank edge. Large woody debris is prevalent in the channel along the left descending bank for the length of Alternative 3 and likely contributes to sediment deposition in the extremely slow flow velocity at this site.

Design mitigation appears feasible at both proposed Alternative crossings. Spanning the right descending half of the Alternative 2 channel should minimize adverse impacts to the mussel fauna at this crossing. Spanning the right descending third to half of the Alternative 3 channel should minimize adverse effects to mussels at this crossing. Timely implementation and maintenance of effective erosion control measures during construction at either alternative will be particularly important to minimizing adverse effects to Black River mussel resources because of construction of the proposed project.

#### Acknowledgements

Anna M. Pieri was field assistant for the project and is responsible for quality control and bringing the survey to completion. Ron Redman of Mitigation Surveying Services, LLC and Ryan Mountain of Garver provided administrative and logistical support.

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## Appendix A

### Field Data Sheets (Ordered by Search Cell Number)

#### Alternative 2 – Black River

Site Number: Search Cell 1

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 6 November 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: clay, silt, large woody debris, sand			Width: 24.5 - 26 m		
Latitude: 36.248542			Longitude: -90.903592		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	1	
<i>Amblema plicata</i>	10		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>			<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>	2		<i>Potamilus purpuratus</i>	2	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchnus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	1	
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1354			Stop Search: 1408		

Notes: Right descending bank. Lots of substrate scour from fallen tree, large woody debris on descending slope. Most live mussels found at toe of slope. Water depth 2.4 - 3.0 m. Water velocity slow to moderate. Pic 6160 upstream, pic 6161 downstream.

Site Number: Search Cell 2

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 6 November 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: silt, sand			Width: 24.5 - 26 m		
Latitude: 36.248290			Longitude: -90.903654		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>	1		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	6		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>	2	
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	2	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>	1	
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	2		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>	1		<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1237			Stop Search: 1254		

Notes: Left descending bank. Sand descending slope mixed with some woody and organics. Mostly sand from thalweg out - thalweg at toe of slope - deepest part of cell. Water depth 2.1 m. Water velocity moderate. Pics 6154 downstream, pic 6155 across channel to RDB. *Theliderma cylindrica* : L 103.6, W 37.1, H 46.5. Pics 6156-6159.

Site Number: Search Cell 3

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 16 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: clay, large woody debris, sand			Width: 24.5 - 25 m		
Latitude: 36.24860			Longitude: -90.90336		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>	1	
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	2	
<i>Amblema plicata</i>	7		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	28		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>	5		<i>Potamilus purpuratus</i>	8	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchnus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>	3	
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>	1		<i>Uniomerus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomerus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1130			Stop Search: 1152		

Notes: Right descending bank. Clay substrate on descending bank out to thalweg with large chunks of hard clay (boulder size), large woody debris with sand fill in spaces. Scour holes present with lots of dead shell material. Water depth 2.4 - 3.0 m. Water velocity moderate. Max density ca. 10/m<sup>2</sup>.

Site Number: Search Cell 4

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 17 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: silt, sand			Width: 24.5 - 25 m		
Latitude: 36.24807			Longitude: -90.90357		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	4		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>		
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	9		<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>	1	
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	6		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1044			Stop Search: 1104		

Notes: Left descending bank. Thalweg at toe of slope, trough filled with silt and mussels. More sand towards mid-channel. Mussel density <math><1/m^2</math>, scattered. Water depth 1.5 m. Water velocity slow to moderate. Pics 6060, 6064 upstream, pics 6061-6062 downstream. *Theliderma cylindrica*: L 107.7, W 38.5, H 46.4. Pics 6065 - 6066.

Site Number: Search Cell 5

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 16 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: clay, large woody debris, silt, sand			Width: 25 - 26 m		
Latitude: 36.24860			Longitude: -90.90336		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>	4	
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	1	
<i>Amblema plicata</i>	12		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	43		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	2	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>	8		<i>Potamilus purpuratus</i>	6	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	2		<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	2		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	1	
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1208			Stop Search: 1230		

Notes: Right descending bank. Clay substrate on descending slope out to thalweg - more large woody debris against bank wall than Cell 3. Toe of slope with hard gravel / clay substrate with sand fill. Water depth 1.8 - 2.4 m. Water velocity moderate. Max density ca. 10/m<sup>2</sup>.



Site Number: Search Cell 6

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 17 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: silt, sand/gravel			Width: 25 - 26 m		
Latitude: 36.24814			Longitude: -90.90323		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	2	
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	4		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	1	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchnus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	5		<i>Reginaia ebenus</i>	1	
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	7		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	1	
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1126			Stop Search: 1148		

Notes: Left descending bank. Thalweg at toe of slope, trough filled with silt. More coarse sand with loose gravel in mid-channel thalweg. Mussel density <math><1/m^2</math>, scattered. Water depth 1.5 m. Water velocity slow to moderate.

Site Number: Search Cell 7

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 16 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: clay, large woody debris, sand			Width: 25 - 26 m		
Latitude: 36.24842			Longitude: -90.90291		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	4	
<i>Amblema plicata</i>	7		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	45		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>	1		<i>Pleurobema sintoxia</i>	1	
<i>Ellipsaria lineolata</i>	2		<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>	7		<i>Potamilus purpuratus</i>	1	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>	1	
<i>Lampsilis cardium</i>	2		<i>Reginaia ebenus</i>	5	
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>	1	
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>	1	
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>	1	
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	2	
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1538			Stop Search: 1559		

Notes: Right descending bank. Lots of large woody debris against bank slope, thalweg to mid-channel with hard gravel / clay substrate. Lots of dead shell material. Water depth 2.4 - 3.7 m. Water velocity moderate. Max density ca. 10/m<sup>2</sup>, more commonly 3-5/m<sup>2</sup> in cell.

Site Number: Search Cell 8

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 17 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: silt, sand, large woody debris			Width: 26 - 26.5 m		
Latitude: 36.24818			Longitude: -90.90306		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	2		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	5	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	3		<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	6		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1201			Stop Search: 1123		

Notes: Left descending bank. Thalweg at toe of slope, trough filled with silt. Large woody debris in mid-channel with dead shell and sandy substrate. Mussel density <1/m<sup>2</sup>, scattered. Water depth 1.5 m. Water velocity moderate. Pics 6067 downstream, 6068 upstream, 6069 toward right descending bank.

Site Number: Search Cell 9

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 16 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: clay, gravel, sand, large woody debris			Width: 24 - 26.5 m		
Latitude: 36.24842			Longitude: -90.90291		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	2	
<i>Amblema plicata</i>	2		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	66		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Eurynia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>		
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	4		<i>Reginaia ebenus</i>	6	
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>	1	
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	1	
<i>Lasmigona complanata</i>			<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>	1		<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1440			Stop Search: 1502		

Notes: Right descending bank. Not as much large woody debris, toe of slope to mid-channel with hard packed gravel /clay/sand substrate. Water depth 2.4 - 3.7 m. Water velocity moderate. Density ca. 5-7/m<sup>2</sup> - patchy due to large woody debris and sand. Pic 6058 RDB, pic 6059 LDB.

Site Number: Search Cell 10

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 17 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: silt, sand			Width: 24 - 26.5 m		
Latitude: 36.24820			Longitude: -90.90292		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	1	
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	3		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	1	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	3		<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	9		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1322			Stop Search: 1344		

Notes: Left descending bank. Thalweg at toe of slope, not as silty on descending slope. More sand all the way to mid-channel. Mussel density <1/m<sup>2</sup>, scattered. Water depth 1.5 m. Water velocity moderate. Pics 6067 downstream, 6068 upstream, 6069 toward right descending bank.

Site Number: Search Cell 11

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 16 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: hard clay, gravel, sand			Width: 23.5 - 24 m		
Latitude: 36.24851			Longitude: -90.90255		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	8	
<i>Amblema plicata</i>	7		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	50		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>	1	
<i>Ellipsaria lineolata</i>	2		<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>	4		<i>Potamilus purpuratus</i>		
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	1		<i>Reginaia ebenus</i>	2	
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>	2	
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>	2	
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	2	
<i>Lasmigona complanata</i>	2		<i>Uniomerus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomerus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1400			Stop Search: 1424		

Notes: Right descending bank. Gravel/clay mix in center of cell, 1-2 m wide strip with ca. 10/m<sup>2</sup> density. Descending bank slope with hard clay substrate, mid-channel with some sand present. Water depth 2.4 - 3.7 m. Water velocity moderate. Density ca. 5-7/m<sup>2</sup> - patchy due to large woody debris and sand. Pic 6058 RDB, pic 6059 LDB.

Site Number: Search Cell 12

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 17 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: silt, small woody debris, large woody debris			Width: 23.5 - 24 m		
Latitude: 36.24823			Longitude: -90.90276		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	1	
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	7		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Eurynia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	3	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	6		<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	7		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1402			Stop Search: 1425		

Notes: Left descending bank. Thalweg at toe of slope, silty substrate with mussels. Small woody debris all the way to mid-channel, large woody debris in midchannel. Mussel density <math><1/m^2</math>, scattered. Water depth 1.8 m. Water velocity moderate. Pics 6073 downstream, 6072 upstream, 6071 downstream.

Site Number: Search Cell 13

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 16 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: hard clay, large woody debris, sand			Width: 20 - 23.5 m		
Latitude: 36.24851			Longitude: -90.90255		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	8	
<i>Amblema plicata</i>	5		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	17		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>	1		<i>Potamilus purpuratus</i>	12	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchnus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>	1	
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>	3	
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>	1		<i>Uniomerus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomerus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1320			Stop Search: 1343		

Notes: Right descending bank. Hard compact clay throughout, density ca. 1-2/m<sup>2</sup> throughout but somewhat spotty. Large woody debris towards center channel with sand slope coming in from mid-channel. Water depth 2.4 - 3.0 m. Water velocity moderate. Pic 6056 upstream, pic 6057 downstream.



Site Number: Search Cell 14

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 17 October 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: silt, sand, large woody debris			Width: 20 - 23.5 m		
Latitude: 36.24825			Longitude: -90.90261		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	4	
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	13		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Eurynia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	2	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	4		<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	5		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1442			Stop Search: 1512		

Notes: Left descending bank. Descending slope with mostly large woody debris. Thalweg with silt, then all sand out to midchannel. Mussel density <math><1/m^2</math>, scattered. Water depth 2.4 - 3.0 m. Water velocity moderate. Pics 6073 downstream, 6072 upstream, 6071 downstream.

Site Number: Search Cell 15

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 6 November 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: clay pebbles, clay/silt, large woody debris			Width: 19 - 20 m		
Latitude: 36.248384			Longitude: -90.902242		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	2		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>	1	
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	2	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1428			Stop Search: 1442		

Notes: Right descending bank. Lots large woody debris on descending slope and thalweg. Toe of slope with clay balls, mid-channel is scoured with substrate firm packed clay/mud. Water depth 3.0 - 3.7 m. Water velocity moderate to swift. Pic 6162 downstream.

Site Number: Search Cell 16

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 6 November 2021			Drainage: White River		
County: Randolph			Quad: NA		
Substrate: silt, sand			Width: 19 - 20 m		
Latitude: 36.248384			Longitude: -90.902242		
Collectors: J. L. Harris, A. M. Pieri					
Location: Black River ca. 1.6 river kilometers upstream of the confluence of Black River and Current River and approximately 3.74 air miles (6.0 air kilometers) ESE of the U. S. Hwy 63 crossing of Black River in Pocahontas.					
	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	2		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	5	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>	2		<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1202			Stop Search: 1217		

Notes: Left descending bank. Silt/sand descending slope, waves of sand out to mid-channel. Water depth 1.8 m. Water velocity moderate. Pics 6152-6153 downstream.

## Appendix B

### Field Data Sheets (Ordered by Search Cell Number)

#### Alternative 3 – Black River

Site Number: Search Cell 1

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 30 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, clay	Width: 27 - 28.5 m
Latitude: 36.36285	Longitude: -90.60875
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	2	
<i>Amblema plicata</i>	4		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	3		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	8	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	2		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1228			Stop Search: 1245		

Notes: Right descending bank. Clay/silt substrate on descending slope, sharp decline to toe of slope. Silt depth ca. 15 cm. No visibility. Max water depth 4.6 m. Water velocity slow. Mussel density <1.0/m<sup>2</sup>.

Site Number: Search Cell 2

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 31 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, large woody debris	Width: 27 - 28.5 m
Latitude: 36.36321	Longitude: -90.60913
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	2	
<i>Amblema plicata</i>	5		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	1		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	8	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranthus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1036			Stop Search: 1054		

Notes: Left descending bank. Substantial tree fall against bank. Silt substrate, very steep slope - almost vertical - to toe of slope. Mussels buried into vertical wall. Silt depth more than 15 cm from toe of slope to mid-channel. No visibility. Max water depth 4.6 - 6.1 m. Water velocity not detectable. Mussel density < 1.0/m<sup>2</sup>. Pic 6139 upstream, pic 6138 downstream.

Site Number: Search Cell 3

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 30 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, clay	Width: 27 - 28 m
Latitude: 36.36327	Longitude: -90.60898
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	5	
<i>Amblema plicata</i>	11		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	2		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	17	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	2		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>	1		<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1301			Stop Search: 1319		

Notes: Right descending bank. Clay/silt substrate on descending slope, sharp decline to toe of slope. Silt depth ca. 15 cm. No visibility. Max water depth 4.6 m. Water velocity slow. Mussel density <1.0/m<sup>2</sup>.

Site Number: Search Cell 4

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 31 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, large woody debris	Width: 27 - 28 m
Latitude: 36.36303	Longitude: -90.60839
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>	3		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	6		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>	1	
<i>Fusconaia flava</i>	1		<i>Potamilus purpuratus</i>	12	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchnus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1107			Stop Search: 1126		

Notes: Left descending bank. Substantial tree fall against bank. Silt substrate, very steep slope - almost vertical - to toe of slope. Mussels buried into vertical wall. Silt depth more than 15 cm from toe of slope to mid-channel. No visibility. Max water depth 4.6 - 6.1 m. Water velocity not detectable. Mussel density < 1.0/m<sup>2</sup>. Pic 6139 upstream, pic 6138 downstream.



Site Number: Search Cell 5

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 30 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, clay	Width: 28 m
Latitude: 36.36336	Longitude: -90.60886
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	6	
<i>Amblema plicata</i>			<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	3		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	2	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1333			Stop Search: 1350		

Notes: Right descending bank. Clay/silt substrate on descending slope, sharp decline to toe of slope. Silt depth ca. 15 cm. No visibility. Max water depth 4.6 m. Water velocity slow. Increased amount of dead shell at toe of slope. Mussel density <math><1.0/m^2</math>. Pic 6116 upstream, Pic 6115 downstream. LDB pic 6117.

Site Number: Search Cell 6

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 31 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, large woody debris	Width: 28 m
Latitude: 36.36303	Longitude: -90.60839
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>	10		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	3		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>	1		<i>Potamilus purpuratus</i>	11	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	1		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>	1		<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1152			Stop Search: 1212		

Notes: Left descending bank. Substantial tree fall against bank. Silt substrate, steep slope - small flat area about halfway to toe of slope. Mussels buried into vertical wall. Silt depth more than 15 cm from toe of slope to mid-channel. No visibility. Max water depth 4.6 - 6.1 m. Water velocity not detectable. Mussel density < 1.0/m<sup>2</sup>. Pic 6141 upstream, pic 6140 downstream.

Site Number: Search Cell 7

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 30 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, clay	Width: 28 - 31 m
Latitude: 36.36345	Longitude: -90.60873
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	3	
<i>Amblema plicata</i>	20		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>	1	
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>	1		<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	5		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>	1	
<i>Fusconaia flava</i>	1		<i>Potamilus purpuratus</i>	6	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	2		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>	2		<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1422			Stop Search: 1443		

Notes: Right descending bank. Clay/silt substrate on descending slope, more gentle decline to toe of slope. Silt depth ca. 15 cm. No visibility. Max water depth 4.6 m. Water velocity slow. Mussel density <1.0/m<sup>2</sup>. Pic 6119-6120 upstream/RDB, Pic 6118 downstream.

Site Number: Search Cell 8

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 31 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, large woody debris	Width: 28 - 31 m
Latitude: 36.36307	Longitude: -90.60828
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>	5		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	3		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Eurynia dilatata</i>			<i>Potamilus ohiensis</i>	1	
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>		
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1225; 1244			Stop Search: 1235; 1253		

Notes: Left descending bank. Substantial tree fall against bank. Silt substrate, steep slope. Got tangled in debris so had to stop initial dive and then begin again. Silt depth more than 15 cm from toe of slope to mid-channel. No visibility. Max water depth 4.6 - 6.1 m. Water velocity not detectable. Mussel density < 1.0/m<sup>2</sup>. Pic 6142 upstream, pic 6143 downstream.

Site Number: Search Cell 9

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 30 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, clay, large woody debris	Width: 31 - 31.5 m
Latitude: 36.36356	Longitude: -90.60860
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>	1	
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	6	
<i>Amblema plicata</i>	19		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>	3		<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	4		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Eurynia dilatata</i>			<i>Potamilus ohiensis</i>	1	
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	11	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	1	
<i>Lasmigona complanata</i>			<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1457			Stop Search: 1515		

Notes: Right descending bank. Clay/silt substrate on descending slope, flat area extends ca. 15 m toward midchannel. More large woody debris present. Silt depth ca. 15 cm. No visibility. Max water depth 4.6 m. Water velocity slow. Mussel density <1.0/m<sup>2</sup>. Pic 6123 upstream, Pics 6121-6122 downstream.

Site Number: Search Cell 10

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 31 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt	Width: 31 - 31.5 m
Latitude: 36.36313	Longitude: -90.60814
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	1	
<i>Amblema plicata</i>	2		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>	1		<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	2		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>	2	
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>		
<i>Fusconaia ozarkensis</i>			<i>Ptychobranhus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1305			Stop Search: 1322		

Notes: Left descending bank. Silt substrate - gelatinous to the touch, steep slope. Silt depth more than 15 cm from toe of slope to mid-channel. No visibility. Max water depth 4.6 - 6.1 m. Water velocity not detectable. Mussel density < 1.0/m<sup>2</sup>.

Site Number: Search Cell 11

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 30 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, clay, large woody debris	Width: 29.5 - 31.5 m
Latitude: 36.36358	Longitude: -90.60843
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	15	
<i>Amblema plicata</i>	64		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	5		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	3	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	4	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>	1	
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>	1	
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1527			Stop Search: 1544		

Notes: Right descending bank. Clay/silt substrate on gentle descending slope, flat area extends ca. 15 m toward midchannel. More large woody debris present. Silt depth ca. 15 cm. No visibility. Max water depth 4.6 - 4.9 m. Water velocity slow. Mussel density approaching 10.0/m<sup>2</sup> in scattered areas. Pic 6126 upstream, pic 6127, RDB, pic 6124 downstream, pic 6125 LDB.

Site Number: Search Cell 12

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 31 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt	Width: 29.5 - 31.5 m
Latitude: 36.36319	Longitude: -90.60797
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>	1	
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>		
<i>Amblema plicata</i>	11		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	7		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Eurynia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	1	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1332			Stop Search: 1347		

Notes: Left descending bank. Silt substrate - gelatinous to the touch, steep slope. Silt depth more than 15 cm from toe of slope to mid-channel. No visibility. Max water depth 6.1 m. Water velocity not detectable. Mussel density < 1.0/m<sup>2</sup>. Pic 6146 upstream, pic 6145 LDB, pic 6144 downstream.



Site Number: Search Cell 13

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 30 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, clay, large woody debris	Width: 29.5 - 34.5 m
Latitude: 36.36369	Longitude: -90.60830
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	12	
<i>Amblema plicata</i>	73		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	7		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Eurynia dilatata</i>			<i>Potamilus ohioensis</i>	2	
<i>Fusconaia flava</i>	2		<i>Potamilus purpuratus</i>	6	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1559			Stop Search: 1617		

Notes: Right descending bank. Clay/silt substrate on gentle descending slope, flat area extends ca. 15 m toward midchannel. More large woody debris present, large log parallel to bank at toe of slope. Silt depth ca. 15 cm. No visibility. Max water depth 4.6 - 4.9 m. Water velocity slow. Mussel density approaching 10.0/m<sup>2</sup> in some spots. Pic 6129 upstream, pic 6128 RDB, pic 6130 downstream.

Site Number: Search Cell 14

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 31 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, large woody debris	Width: 29.5 - 34.5 m
Latitude: 36.36327	Longitude: -90.60783
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	1	
<i>Amblema plicata</i>	4		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	2		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	2	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohiensis</i>		
<i>Fusconaia flava</i>			<i>Potamilus purpuratus</i>	1	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchnus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>		
<i>Lasmigona complanata</i>			<i>Uniomereus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomereus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1425			Stop Search: 1441		

Notes: Left descending bank. Silt substrate - gelatinous to the touch, steep slope. Large woody debris dominant against bank to toe of slope. Silt depth more than 15 cm from toe of slope to mid-channel. No visibility. Max water depth 6.1 m. Water velocity slow. Mussel density < 1.0/m<sup>2</sup>. Pic 6147 upstream, pic 6146 downstream.

Site Number: Search Cell 15

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 30 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, clay, large woody debris	Width: 34 - 34.5 m
Latitude: 36.36371	Longitude: -90.60818
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	10	
<i>Amblema plicata</i>	40		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>	1		<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>			<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	4		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>		
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Eurynia dilatata</i>			<i>Potamilus ohioensis</i>	5	
<i>Fusconaia flava</i>	2		<i>Potamilus purpuratus</i>	11	
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>	1		<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	1	
<i>Lasmigona complanata</i>			<i>Uniomerus declivis</i>		
<i>Leaunio lienosus</i>			<i>Uniomerus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1633			Stop Search: 1650		

Notes: Right descending bank. Clay/silt substrate on gentle descending slope, flat area extends ca. 15 m toward midchannel. More large woody debris present, large log parallel to bank at toe of slope. Silt depth deeper than 15 cm in mid-channel area - thick. No visibility. Max water depth 4.6 - 4.9 m. Water velocity slow. Mussel density approaching 10/m<sup>2</sup> in some spots. Pic 6131 upstream, pic 6132 downstream.

Site Number: Search Cell 16

## Arkansas Freshwater Bivalves Field Data Sheet

Date: 31 October 2021	Drainage: White River
County: Clay	Quad: NA
Substrate: silt, large woody debris	Width: 34 - 34.5 m
Latitude: 36.36330	Longitude: -90.60769
Collectors: J. L. Harris, A. M. Pieri	
Location: Black River approximately 15.4 river kilometers downstream of and 7.35 air kilometers SW of the U. S. Hwy 62 crossing of Black River east of Corning.	

	Live	Dead		Live	Dead
<i>Actinonaias ligamentina</i>			<i>Margaritifera hembeli</i>		
<i>Alasmidonta marginata</i>			<i>Megalonaias nervosa</i>		
<i>Alasmidonta viridis</i>			<i>Obliquaria reflexa</i>	1	
<i>Amblema plicata</i>	3		<i>Obovaria arkansasensis</i>		
<i>Arcidens confragosus</i>			<i>Obovaria</i> sp. cf <i>arkansasensis</i>		
<i>Arcidens wheeleri</i>			<i>Obovaria olivaria</i>		
<i>Cambarunio hesperus</i>			<i>Plectomerus dombeyanus</i>		
<i>Cumberlandia monodonta</i>			<i>Pleurobema cordatum</i>		
<i>Cyclonaias nodulata</i>	3		<i>Pleurobema riddellii</i>		
<i>Cyclonaias pustulosa</i>	4		<i>Pleurobema</i> sp. cf <i>riddellii</i>		
<i>Cyclonaias tuberculata</i>			<i>Pleurobema rubrum</i>		
<i>Cyprogenia aberti</i>			<i>Pleurobema sintoxia</i>		
<i>Ellipsaria lineolata</i>			<i>Potamilus alatus</i>		
<i>Epioblasma curtisii</i>			<i>Potamilus capax</i>		
<i>Epioblasma triquetra</i>			<i>Potamilus fragilis</i>	1	
<i>Epioblasma turgidula</i>			<i>Potamilus leptodon</i>		
<i>Euryntia dilatata</i>			<i>Potamilus ohioensis</i>		
<i>Fusconaia flava</i>	1		<i>Potamilus purpuratus</i>		
<i>Fusconaia ozarkensis</i>			<i>Ptychobranchnus occidentalis</i>		
<i>Fusconaia</i> cf <i>flava</i> ( <i>sampsoniana</i> )			<i>Pyganodon grandis</i>		
<i>Glebula rotundata</i>			<i>Quadrula fragosa</i>		
<i>Lampsilis abrupta</i>			<i>Quadrula quadrula</i>		
<i>Lampsilis cardium</i>			<i>Reginaia ebenus</i>		
<i>Lampsilis hydiana</i>			<i>Sagittunio subrostratus</i>		
<i>Lampsilis ornata</i>			<i>Simpsonaias ambigua</i>		
<i>Lampsilis powellii</i>			<i>Strophitus undulatus</i>		
<i>Lampsilis rafinesqueana</i>			<i>Theliderma cylindrica</i>		
<i>Lampsilis reeveiana</i>			<i>Theliderma metanevra</i>		
<i>Lampsilis sietmani</i>			<i>Toxolasma lividum</i>		
<i>Lampsilis siliquoidea</i>			<i>Toxolasma parvum</i>		
<i>Lampsilis</i> sp. A cf <i>hydiana</i>			<i>Toxolasma texasiense</i>		
<i>Lampsilis</i> sp. B cf <i>hydiana</i>			<i>Tritogonia nobilis</i>		
<i>Lampsilis streckeri</i>			<i>Tritogonia verrucosa</i>		
<i>Lampsilis teres</i>			<i>Truncilla donaciformis</i>		
<i>Lasmigona costata</i>			<i>Truncilla truncata</i>	1	
<i>Lasmigona complanata</i>			<i>Unio merus declivis</i>		
<i>Leaunio lienosus</i>			<i>Unio merus tetralasmus</i>		
<i>Ligumia recta</i>			<i>Utterbackia imbecillis</i>		
			<i>Utterbackiana suborbiculata</i>		
<i>Corbicula fluminea</i> (invasive)			<i>Venustaconcha ellipsiformis</i>		
<i>Dreissena polymorpha</i> (invasive)			<i>Venustaconcha pleasii</i>		
Start Search: 1511			Stop Search: 1529		

Notes: Left descending bank. Silt substrate - gelatinous to the touch, steep slope. Large woody debris dominant against bank to toe of slope. Silt depth more than 15 cm from toe of slope to mid-channel. No visibility. Max water depth 6.1 m. Water velocity slow. Mussel density < 1.0/m<sup>2</sup>. Pic 6151 upstream, pic 6149 downstream, pic 6150 LDB .



## ATTACHMENT E — PONDBERRY SURVEY MEMO



Survey for Pondberry (*Lindera melissifolia*) within Suitable  
Habitat of the Preferred alternative for Future I-57

Lawrence, Randolph, and Clay Counties  
Arkansas

Prepared by Garver for the Arkansas Department of  
Transportation (ARDOT)

April 2022



# Pondberry Survey Memo

## Summary

Species:	Pondberry ( <i>Lindera melissifolia</i> )
Date(s) of Survey:	April 19, 2022
Project Location:	Future I-57 Preferred Alternative (Randolph, Clay, Greene, and Lawrence Counties, Arkansas)
Surveyor(s):	Bill McAbee of Garver
Findings:	No pondberry was found

## Project Description and General Project Area

The Arkansas Department of Transportation (ARDOT), in cooperation with the Federal Highway Administration (FHWA), is proposing to construct a fully-controlled access interstate facility from Walnut Ridge to the state line within Clay, Lawrence, and Randolph counties, Arkansas (ARDOT Job Number 100512). The Preferred Alternative begins at the Highway (Hwy.) 67/Hwy. 412 interchange at Walnut Ridge, Arkansas and ends on Hwy. 67 at the Arkansas-Missouri State line, a distance of approximately 42 miles. The alignment is almost entirely on new location and generally lies between Hwy. 67 and the Dave Donaldson Black River Wildlife Management Area (Black River WMA). The proposed action would involve construction of a four-lane divided highway with a depressed grass median and up to a 400-foot-wide right of way. Additionally, the proposed action would include construction of a new bridge spanning the Black River as well as several box culverts and cross drains throughout the remainder of project length to accommodate the new roadway.

The Preferred Alternative, which is comprised of Alternatives 2 and C, is located in Clay, Lawrence, and Randolph Counties in northeast Arkansas from Walnut Ridge in Arkansas to the Missouri State line. The project occurs within the Mississippi Alluvial Plain ecoregion, which is characterized as mostly a flat, broad alluvial plain with river terraces and levees providing the main elements of relief (Woods et al., 2004). Despite its length, the project limits contain a relatively homogeneous landscape due to its flat topography and abundance of agricultural practices.

## Survey and Memo Purpose

Due to the presence of potentially suitable habitat within the project limits, a survey for the Federally endangered pondberry (*Lindera melissifolia*) is required. In 2022, the U.S. Fish and Wildlife Service (USFWS) confirmed that the required pondberry survey need only be conducted in areas that have suitable habitat and that a habitat assessment can be used to rule out areas that are not suitable due to solid type, too wet, etc. Thus, a pondberry survey of the Preferred Alternative was conducted April 19, 2022 within areas identified a containing potentially suitable habitat.

The purpose of this memo is to summarize the results of the April 2022 pondberry survey.

## Species Information

### Species Description

Pondberry is a member of the Lauraceae family and is also referred to as the southern spicebush. Pondberry, *Lindera melissifolia*, is a deciduous shrub, growing from less than 1 ft. (30 cm) to,

## Future I-57 FEIS: Pondberry Survey Memo



infrequently, more than 6 ft. (2 m) in height (NatureServe, 2022). Leaves are aromatic, alternate, elliptical, somewhat thin and membranaceous, with entire margins. Shrubs usually are sparsely branched, with fewer branches on smaller plants. Plants are rhizomatous, frequently propagating by vegetative sprouts and forming clonal colonies. Plants are dioecious (each plant is either a male or a female) and produce clusters of small, yellow flowers in early spring prior to leaf development from buds on branches produced from the growth during the preceding year (NatureServe, 2022). Fruits are drupes that green when immature and ripen to red by fall.

### Life History

According to NatureServe (2022), pondberry can apparently occupy a variety of habitats as long as hydrological requirements are met. The species occurs in seasonally flooded wetlands such as floodplain/bottomland hardwood forests and forested swales, on the bottoms and edges of shallow seasonal ponds in old dune fields, along the margins of ponds and depressions in pinelands, around the edges of sinkholes in coastal areas with karst topography, and along the borders of Sphagnum bogs. Usually in shade, but tolerates full sun.

Habitat preferences for the pondberry within the project area include forested depressional wetland habitats that are seasonally flooded and that provide shade. These locations with suitable habitat are shown on **Baker, B.** 2018. Final report on *Lindera melissifolia* (Walter) Blume [Pondberry] survey and research work in Arkansas, 2017. Unpublished report to U.S. Fish and Wildlife Service. 60 pp.

NatureServe. 2022. NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. Available online at: <https://explorer.natureserve.org/>. (Accessed: April 19, 2022).

U.S. Fish and Wildlife Service (USFWS). 2021. Pondberry (*Lindera melissifolia*) 5-Year Review: Summary and Evaluation Available online at: [https://ecos.fws.gov/docs/tess/species\\_nonpublish/3612.pdf](https://ecos.fws.gov/docs/tess/species_nonpublish/3612.pdf)

Woods A.J., T.L. Foti, S.S. Chapman, J.M. Omernik, J.A. Wise, E.O. Murray, W.L. Prior, J.B. Pagan Jr., J.A. Comstock, and M. Radford. 2004. Ecoregions of Arkansas (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. Geological Survey (map scale 1:1,000,000).

### Status and Distribution

According to the 5-year review by USFWS (2021), the status review results indicate that of Arkansas's 24 known populations, 6 are extirpated, 1 exists only in cultivation (no longer extant in the wild), 5 (all on state- or federally owned or managed conservation lands) have been confirmed extant, and 12 (all on private lands, including 2 protected by conservation easements) are of uncertain status. Pondberry monitoring and surveys in Arkansas confirmed the continued existence of pondberry at the Stateline Sand Ponds Natural Area (NA) in Clay County (this population is shared by adjacent conservation lands in Ripley County, Arkansas), although the population is in apparent decline (Baker, 2018). Of the 12 populations found on private lands that are of uncertain status, recent aerial imagery indicates that habitat remains intact, suggesting that these populations may yet persist. These populations are found in Clay (1 population), Lawrence (2), Jackson (8), and Woodruff (1) counties.

No known pondberry occurrence records were found within the Preferred Alternative; however, known populations have been identified by the Arkansas Natural Heritage Commission (ANHC) within a forested area located approximately 1.8 miles south of O'Kean and 0.17 mile west of Lawrence





County Road 603 (Main Street). This known population is approximately 4.7 miles from the Preferred Alternative.

## Survey Methods

A pedestrian survey was conducted on April 19, 2022, for pondberry in 12 separate locations previously identified as possible pondberry habitat. These locations are shown on **Baker, B.** 2018. Final report on *Lindera melissifolia* (Walter) Blume [Pondberry] survey and research work in Arkansas, 2017. Unpublished report to U.S. Fish and Wildlife Service. 60 pp.

NatureServe. 2022. NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. Available online at: <https://explorer.natureserve.org/>. (Accessed: April 19, 2022).

U.S. Fish and Wildlife Service (USFWS). 2021. Pondberry (*Lindera melissifolia*) 5-Year Review: Summary and Evaluation Available online at: [https://ecos.fws.gov/docs/tess/species\\_nonpublish/3612.pdf](https://ecos.fws.gov/docs/tess/species_nonpublish/3612.pdf)

Woods A.J., T.L. Foti, S.S. Chapman, J.M. Omernik, J.A. Wise, E.O. Murray, W.L. Prior, J.B. Pagan Jr., J.A. Comstock, and M. Radford. 2004. Ecoregions of Arkansas (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. Geological Survey (map scale 1:1,000,000).

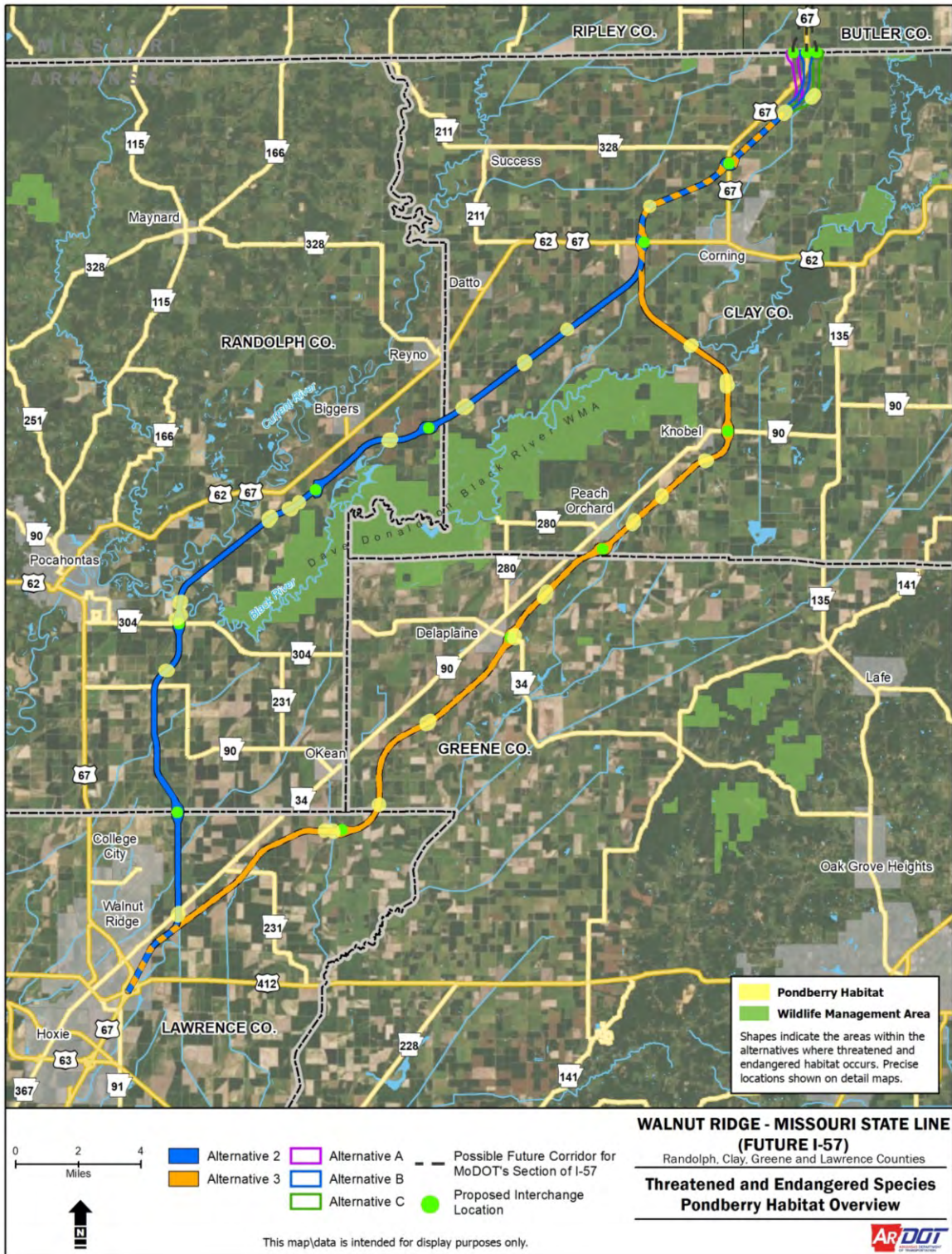
. Only the Preferred Alternative (Alternatives 2 and C) were surveyed per USFWS.

Survey sites were relatively small ranging for a few hundred square feet to approximately five acres. Conditions during the survey were clear and sunny with temperatures ranging from 45-65 degrees Fahrenheit. The hydrological conditions ranged from saturated soils to complete site inundation. The Black River was out of its banks at the time of the survey. One survey location north of the Black River and two survey locations just south of the Black River were inundated and survey was not possible.

Future I-57 FEIS: Ponderberry Survey Memo



Figure 1: Federally-listed Ponderberry Habitat Locations



## Future I-57 FEIS: Pondberry Survey Memo



Spring growth had began and most plants were either flowering or had developed foliage to aide in species identification.

Smaller sites less than 3 acres were visually inspected up to 100% surface area. In larger tracts greater than 3 acres, the surveyor targeted depressional wetlands within forested areas and attempts were made to conduct 100% visual inspections of these depressional areas by a single observer. Thus, portions of some sites may have only been partially inspected. If any suspect plants would have been identified the location would have been documented with handheld GPS and a subsequent visit would have been conducted later in spring when additional diagnostic features of the plants could confirm species identity.

### Survey Results

Nine locations were surveyed within the Preferred Alternative. No populations of pondberry were observed. The survey, which investigated approximately 37 acres over a period of 8 hours, is considered thorough and had a level of effort comparable to other surveys conducted for the species.

### Literature Cited

- Baker, B. 2018. Final report on *Lindera melissifolia* (Walter) Blume [Pondberry] survey and research work in Arkansas, 2017. Unpublished report to U.S. Fish and Wildlife Service. 60 pp.
- NatureServe. 2022. NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. Available online at: <https://explorer.natureserve.org/>. (Accessed: April 19, 2022).
- U.S. Fish and Wildlife Service (USFWS). 2021. Pondberry (*Lindera melissifolia*) 5-Year Review: Summary and Evaluation Available online at: [https://ecos.fws.gov/docs/tess/species\\_nonpublish/3612.pdf](https://ecos.fws.gov/docs/tess/species_nonpublish/3612.pdf)
- Woods A.J., T.L. Foti, S.S. Chapman, J.M. Omernik, J.A. Wise, E.O. Murray, W.L. Prior, J.B. Pagan Jr., J.A. Comstock, and M. Radford. 2004. Ecoregions of Arkansas (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. Geological Survey (map scale 1:1,000,000).



# ATTACHMENT F — USFWS CLEARANCE AND FINAL BIOLOGICAL ASSESSMENT



IN REPLY REFER TO:

# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

Arkansas Ecological Service Field Office  
110 South Amity Road, Suite 300  
Conway, Arkansas 72032



March 30, 2023

Mr. Randal Looney  
Federal Highway Administration  
Arkansas Division  
700 West Capitol Avenue  
Room 3130  
Little Rock, Arkansas 72201-3298

Consultation Code: 2022-0029477

Re: Biological Assessment ARDOT Job 100512 Walnut Ridge – Missouri State Line (Future I-57) Clay, Greene, Lawrence, & Randolph Counties, Arkansas

Dear Mr. Looney:

This letter provides U.S. Fish and Wildlife Service (Service) comments for the Biological Assessment (BA) for the proposed construction of I-57 from Walnut Ridge to the Missouri State line within Clay, Lawrence, and Randolph counties, Arkansas (ARDOT Job Number 100512), developed by the Arkansas Department of Transportation (ARDOT) and the Federal Highway Administration (FHWA). Our comments are submitted in accordance with the Endangered Species Act (ESA) of 1973 (Act; 87 stat. 884, as amended; 16 U.S.C. 1531 et seq.). Comments from the Service were solicited on March 16, 2023.

This biological assessment addresses the Future I-57 project in compliance with Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended. Section 7(a)(2) of the ESA requires that, through consultation with the Service, federal agencies ensure their actions are not likely to jeopardize the continued existence of any listed species or results in the destruction or adverse modification of critical habitat. This assessment evaluates the potential effects of the proposed transportation project on species that are federally listed under the ESA. Specific project design elements are identified that avoid or minimize adverse effects of the proposed project on listed species and designated critical habitat.

The official species list obtained from the Service's Information for Planning and Consultation (IPaC) website identified the following endangered and threatened species as potentially occurring within the project boundaries: the endangered Gray Bat (*Myotis grisescens*), the endangered Indiana Bat (*Myotis sodalis*), the threatened Northern Long-eared Bat (*Myotis septentrionalis*), the threatened Eastern Black Rail (*Laterallus jamaicensis ssp. jamaicensis*), the threatened Piping Plover (*Charadrius melodus*), the threatened Red Knot (*Calidris canutus rufa*),

Curtis Pearlymussel (*Epioblasma curtisii*), Pink Mucket (*Lampsilis abrupta*), Rabbitsfoot (*Theliderma cylindrica*), Scaleshell Mussel (*Potamilus leptodon*; formerly *Leptodea leptodon*), Hine's Emerald Dragonfly (*Somatochlora hineana*), Missouri Bladderpod (*Physaria filiformis*), Pondberry (*Lindera melissifolia*), and Ozark Hellbender (*Cryptobranchus alleganiensis bishopi*).

Mr. Randal Looney

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In addition, the following candidate and proposed species were identified as potentially occurring within the action area and may be affected: the proposed endangered Tricolored Bat (*Perimyotis subflavus*), the candidate Monarch Butterfly (*Danaus plexippus*), the proposed threatened Alligator Snapping Turtle (*Macrochelys temminckii*), the proposed threatened Western Fanshell (*Cyprogenia aberti*), and the proposed threatened Pyramid Pigtoe (*Pleurobema rubrum*).

The Bald Eagle (*Haliaeetus leucocephalus*), though no longer federally listed as threatened or endangered, remains protected through the Bald and Golden Eagle Protection Act of 1940, is also found in Clay, Lawrence, and Randolph Counties.

Based on habitat assessments conducted for the above-listed species, no suitable habitats for the Red Knot, Piping Plover, Missouri Bladderpod, Hine's Emerald Dragonfly, or Ozark Hellbender were identified within the action area. Based on the lack of available habitat and the distance to known populations, a determination was made that the proposed action would have no effect on these species.

The BA identified Gray Bats, Indiana Bats, and Northern Long-eared Bats as potentially occurring along portions of the action area; however, none were captured during surveys and no known roost trees or hibernacula are located within the action area. The Curtis Pearlymussel, Pink Mucket, Rabbitsfoot, Scaleshell Mussel, Western Fanshell, and Pyramid Pigtoe potentially occur within the Black River; however, only the Rabbitsfoot and Western Fanshell were captured during surveys. The Eastern Black Rail, Pondberry, Monarch Butterfly, and Alligator Snapping Turtle also potentially occur along portions of the action area. No Pondberry specimens were found during the survey for the species. The BA analyzed potential impacts to each of these 13 above-listed species.

The Service has reviewed the assessment and determinations of “may affect, not likely to adversely affect” for the listed species identified. Based on the distance to known species locations, limited suitable habitats, effects to forested areas, rivers, and wetlands, negative bat survey results, avoidance and minimization measures (i.e., spanning of the Black River, alternative selection, wetland, floodway, and stream affects minimization and/or avoidance), and sediment erosion and water quality control BMPs, the Service agrees with your assessments and concurs with your determinations. No further consultation or coordination for this project is required for these species at this time. Your agency has met consultation requirements by informing the Service of your “no effect” and “non-jeopardy” determinations. No consultation for this project is required for species that you determined will not be affected by this Action. This concurrence verification letter confirms that you have met the requirements under Section 7(a)(2) of the ESA of 1973 (87 Stat. 884, as amended 16 U.S.C. 1531 et seq.; ESA).

The Service recommends that your agency contact the Arkansas Ecological Services Field Office or re-evaluate this Action in IPaC if: 1) the scope, timing, duration, or location of the proposed project changes; 2) new information reveals the action may affect Bald or Golden Eagles, listed species, or designated critical habitat; and 3) a proposed species is listed, a new species is

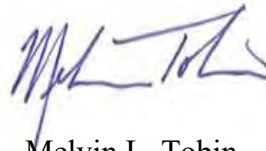
Mr. Randal Looney

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proposed, or critical habitat designated. If any of the above conditions occurs, additional consultation with the Arkansas Ecological Services Field Office should take place before project changes are final or resources committed. This concludes informal consultation in accordance with 50 CFR 402.13.

We appreciate your continued efforts toward the conservation of protected and at-risk species and their habitats. For future correspondence on this matter, please contact Lindsey Lewis at (501) 513-4489.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Melvin L. Tobin', written over a vertical line.

Melvin L. Tobin  
Field Supervisor

cc: Arkansas Department of Transportation, Little Rock, Arkansas

Project File

Read File

Filename: <https://doimspp->

[my.sharepoint.com/personal/lindsey\\_lewis\\_fws\\_gov/Documents/Documents/PROJECTS/FY2023/ARDOT/ARDOT I-57 100512/20230328\\_Ltr\\_Concurrence\\_ARDOT\\_FHWA\\_100512\\_I-57\\_Biological Assessment\\_LCL.docx](https://doimspp-my.sharepoint.com/personal/lindsey_lewis_fws_gov/Documents/Documents/PROJECTS/FY2023/ARDOT/ARDOT%20I-57%20100512/20230328_Ltr_Concurrence_ARDOT_FHWA_100512_I-57_Biological%20Assessment_LCL.docx)

# Biological Assessment

January 2023

## ARDOT Job 100512

### Walnut Ridge – Missouri State Line (Future I-57)

### Clay, Greene, Lawrence, & Randolph Counties, Arkansas

#### Species Analysis of:

*Myotis grisescens* (A.H. Howell, 1909)

Gray Bat

Federally Endangered

*Myotis sodalis* (Miller and Allen, 1928)

Indiana Bat

Federally Endangered

*Myotis septentrionalis* (Trouessart, 1897)

Northern Long-eared Bat

Federally Threatened

*Laterallus jamaicensis jamaicensis* (Gmelin, 1789)

Eastern Black Rail

Federally Threatened

*Lindera melissifolia* (Walt.) Blume

Pondberry

Federally Endangered

*Epioblasma curtisii* (Frierson and Utterback, 1916)

Curtis Pearlymussel

Federally Endangered

*Lampsilis abrupta* (Say, 1831)

Pink Mucket

Federally Endangered

*Theliderma cylindrica* (Say, 1817)

Rabbitsfoot

Federally Threatened

*Potamilus leptodon* (Rafinesque, 1820)

Scaleshell Mussel

Federally Endangered

*Pleurobema rubrum* (Rafinesque, 1820)

Pyramid Pigtoe

Proposed Threatened

*Cyprogenia aberti* (Conrad, 1850)

Western Fanshell

Proposed Threatened

*Macrochelys temminckii* (Troost in Harlan, 1835)

Alligator Snapping Turtle

Proposed Threatened

*Danaus plexippus* (Linnaeus, 1758)

Monarch Butterfly

Federally Candidate

*Perimyotis subflavus* (F. Cuvier, 1832)

Tricolored Bat

Proposed Endangered

#### Primary Contacts:

Randal Looney

U.S. Department of Transportation

Federal Highway Administration



John Fleming

Environmental Division

Arkansas Department of Transportation







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## Chapter 1 – Project Overview

### 1.1 Federal Nexus

This biological assessment is prepared for the Arkansas Department of Transportation (ARDOT) and the Federal Highway Administration (FHWA), the latter being the lead federal agency for Section 7 consultation. This biological assessment addresses the Future I-57 project in compliance with Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended. Section 7(a)(2) of the ESA requires that, through consultation with the U.S. Fish and Wildlife Service (USFWS), federal agencies insure their actions are not likely to jeopardize the continued existence of any listed species or results in the destruction or adverse modification of Critical Habitat. This assessment evaluates the potential effects of the proposed transportation project on species that are federally listed under the ESA. Specific project design elements are identified that avoid or minimize adverse effects of the proposed project on listed species and designated critical habitat.

Federal funding is anticipated for this project and is the Federal nexus. Additionally, impacts to Waters of the United States required the issuance of a Department of the Army Corps of Engineers (USACE) permit (USACE Project No. SWL 2020-00341) pursuant to Section 404 of the Clean Water Act of 1972.

### 1.2 Project Description

The ARDOT in cooperation with the FHWA, is proposing to construct a fully-controlled access interstate facility from Walnut Ridge to the Missouri State line within Clay, Lawrence, and Randolph counties, Arkansas (ARDOT Job Number 100512). The Preferred Alternative (Alternatives 2 and C) begins at the Highway (Hwy.) 67/Hwy. 412 interchange at Walnut Ridge, Arkansas and ends on Hwy. 67 at the Arkansas-Missouri State line, a distance of approximately 42 miles. The alignment is almost entirely on new location and generally lies between Hwy. 67 and the Dave Donaldson Black River Wildlife Management Area (Black River WMA). The Preferred Alternative is hence referred to as the proposed action and would involve construction of a four-lane divided highway with a depressed grass median and up to a 400-foot-wide right of way. Additionally, the proposed action would include construction of a new bridge spanning the Black River at one location to accommodate four travel lanes. Piers and bents may be constructed in stages. Effects determinations presented in this Biological Assessment are based on the current plan for the Black River to be completely spanned, there is no current funding for this project and if that changes as the project moves to final design and construction, then consultation with USFWS would be re-initiated. Several box culverts and cross drains would be constructed throughout the remainder of project length to accommodate the new roadway. Typical cross sections of the proposed roadways can be found in **Appendix A**.

### 1.3 Project Area and Setting

The proposed action is located in Clay, Lawrence, and Randolph Counties in northeast Arkansas from Walnut Ridge to the Missouri State line. A list of each section, township, and range through which the proposed action occurs is listed below.



#### Clay County

S34-T20N-R3E	S18-T20N-R4E	S27-T21N-R4E	S8-T21N-R5E
S34-T20N-R3E	S17-T20N-R4E	S26-T21N-R4E	S9-T21N-R5E
S27-T20N-R3E	S8-T20N-R4E	S25-T21N-R4E	S4-T21N-R5E
S26-T20N-R3E	S9-T20N-R4E	S24-T21N-R4E	S33-T22N-R5E
S25-T20N-R3E	S10-T20N-R4E	S19-T21N-R5E	
S24-T20N-R3E	S3-T20N-R4E	S18-T21N-R5E	
S19-T20N-R4E	S34-T21N-R4E	S17-T21N-R5E	

#### Lawrence County

S24-T17N-R1E	S7-T17N-R2E	S19-T17N-R2E
S25-T17N-R1E	S18-T17N-R2E	S30-T17N-R2E
S36-T17N-R1E	S6-T17N-R2E	S5-T17N-R2E

#### Randolph County

S25-T18N-R1E	S31-T18N-R2E	S1-T19N-R2E	S21-T19N-R2E
S24-T18N-R1E	S30-T18N-R2E	S15-T19N-R2E	S6-T19N-R3E
S13-T18N-R1E	S19-T18N-R2E	S29-T19N-R2E	S5-T19N-R3E
S12-T18N-R1E	S22-T19N-R2E	S31-T19N-R2E	S4-T19N-R3E
S18-T18N-R2E	S14-T19N-R2E	S31-T19N-R2E	S33-T20N-R3E
S7-T18N-R2E	S11-T19N-R2E	S30-T19N-R2E	
S6-T18N-R2E	S12-T19N-R2E	S20-T19N-R2E	

The proposed action occurs within the Mississippi Alluvial Plain ecoregion, which is characterized as mostly a flat, broad alluvial plain with river terraces and levees providing the main elements of relief (Woods et al., 2004). The proposed action is located within four watersheds based on the 8-digit watershed hydrologic unit code (HUC). The 8-digit HUC watersheds located within the project area include the Upper-White-Village, Upper Black, Lower Black, and the Current. Despite its length, the project limits contain a relatively homogeneous landscape due to its flat topography and abundance of agricultural practices. A project location map can be found in **Appendix A**.

## 1.4 Consultation History

Due to the anticipated use of Federal funding and issuance of Federal permits, the proposed action is undergoing the National Environmental Policy Act (NEPA) process. Coordination with USFWS began early and has been ongoing throughout the NEPA process. Coordination with the USFWS began in May 2020 when USFWS accepted the responsibility to be a cooperating agency for development of the Environmental Impact Statement being prepared for the proposed action. A request for technical assistance was submitted to USFWS in mid-November 2020 with initial consultation calls occurring in January and February 2021.

Coordination with USFWS indicated that presence/absence surveys would be required for the federally-listed pondberry, bat, and mussel species to comply with Section 7. As a result, suitable summer roosting forested habitat survey locations for the listed bat species were identified and presented to the USFWS. In March 2021, the USFWS responded with recommendations for bat mist netting survey locations. The USFWS also indicated that the Black River is the only natural watercourse within the study area that would provide suitable mussel habitat and confirmed that a presence/absence survey should be conducted at proposed crossings. In 2022, USFWS confirmed that the required pondberry survey need only be conducted in areas that have suitable habitat and that a habitat assessment can be used to rule out areas that are not suitable due to soil type, too wet, etc. A pondberry



survey of the Preferred Alternative was conducted April 19, 2022. The pondberry survey memo can be found in **Appendix B**.

As required by USFWS, presence/absence surveys were conducted for federally-listed bat species between August 1-5, 2021 at 10 locations along the proposed action (Redman, 2021). Surveys were also performed for the other build alternatives. One mist net for two nights was deployed at each location. The USFWS Range-Wide Indiana Bat Survey Guidelines were followed throughout the survey. A total of 26 bats representing at least four species were captured in mist nets along the proposed action; one bat was not able to be identified due to its escaping the net before it could be handled. No federally-listed bats species were captured with mist nets during the study. The full survey report can be found in **Appendix C**.

With numerous known federally protected mussel species occurring in the Black River, a freshwater mussel survey on October 16-17 and November 6, 2021 was conducted within the Black River at the proposed crossing. One federally protected mussel species (Rabbitsfoot) was found within the proposed crossing area. The full survey report can be found in **Appendix D**.



## Chapter 2 – Federally Protected and Listed Species and Designated Critical Habitat

### 2.1 Federally Listed Species

Fourteen threatened or endangered species are listed as occurring in the action area by the USFWS – Information for Planning and Conservation (IPaC). Those species include the gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), northern long-eared bat (NLEB; *Myotis septentrionalis*), Eastern Black Rail (*Laterallus jamaicensis* ssp. *jamaicensis*), Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus rufa*), Curtis Pearlymussel (*Epioblasma curtisii*), Pink Mucket (*Lampsilis abrupta*), Rabbitsfoot (*Thecliderma cylindrica*), Scaleshell Mussel (*Potamilus leptodon*; formerly *Leptodea leptodon*), Hine’s emerald dragonfly (*Somatochlora hineana*), Missouri bladderpod (*Physaria filiformis*), pondberry (*Lindera melissifolia*), and Ozark hellbender (*Cryptobranchus alleganiensis bishopi*). The bald eagle (*Haliaeetus leucocephalus*) though no longer federally listed as threatened or endangered remains protected through the Bald and Golden Eagle Protection Act of 1940, is also found in Clay, Lawrence, and Randolph Counties.

The monarch butterfly (*Danaus plexippus*) is listed as a candidate species and the Western Fanshell (*Cyprogenia aberti*), Pyramid Pigtoe (*Pleurobema rubrum*), and alligator snapping turtle (*Macrochelys temminckii*) were recently proposed for listing as threatened species under the ESA and the USFWS also proposed a Section 4(d) rule to provide for their conservation. The potential range and habitats for each of the above-listed species intersect the project action area; therefore, USFWS recommends including an assessment of effects to both species. The USFWS decided that critical habitat for the alligator snapping turtle is not determinable at this time. Critical habitat for the Pyramid Pigtoe will be determined within a year of listing. Further updating of the assessments and conservation measures may be necessary through on-going coordination and consultation as new information on these two species becomes available and the Section 4(d) rules are implemented. Section 7(a)(2) of the ESA will be adhered to if a species is subsequently listed.

Based on habitat assessments conducted for the above-listed species, no suitable habitats for the Red Knot, Piping Plover, Missouri bladderpod, Hine’s emerald dragonfly, or Ozark hellbender were identified within the action area. Based on the lack of available habitat and the distance to known populations, it has been determined that the proposed action would have no effect on these species, and they will not be discussed in detail further in this document. A brief summary of suitable habitat for each of these species is provided in **Table 1** of Section 4.2.

Gray bats, Indiana bats, and northern long-eared bats potentially occur along portions of the action area; however, none were captured during surveys and no known roost trees or hibernacula are located within the action area. The Curtis Pearlymussel, Pink Mucket, Rabbitsfoot, Scaleshell Mussel, Western Fanshell, and Pyramid Pigtoe potentially occur within the Black River; however, only the Rabbitsfoot and Western Fanshell were captured during surveys. The Eastern Black Rail, pondberry, monarch butterfly, and alligator snapping turtle also potentially occur along portions of the action area. No pondberry specimens were found during the survey for the species. This document analyzes potential impacts to each of these 13 above-listed species.





## 2.2 Gray bat (*Myotis grisescens*) - Federally Endangered

### Species Description

The gray bat, measuring up to 4 inches in length and weighing 7-16 grams, is the largest species of *Myotis* found in the eastern United States. The gray bat has a distinct unicolored fur on their back that differentiates them from other bat species; however, after molting in July or August, their fur transitions to chestnut brown or a russet color (USFWS, 1997). It is further distinguished from other *Myotis* species by its wing membrane connected to its ankle instead of a toe.

### Life History

Gray bats are year-round cave residents, although different caves are usually occupied in summer rather than winter. Few individuals are found outside of caves. They hibernate primarily in deep, vertical caves during winter, and roost in limestone karst caves along rivers in summer months. Gray bats are also known to use bridges and culverts as roosting habitat during the spring, summer, and fall. Concrete structures seem to be preferred due to their tendency to retain heat longer than other materials; however, metal and wood structures may also be used with less frequency (Keeley and Tuttle 1999; Feldhamer et al., 2003; Cleveland and Jackson, 2013). Foraging habitat occurs primarily over water such as along rivers and lakes, where they feed on aquatic insects, within intact forested interiors near summer caves (Moore et al. 2017, NatureServe, 2022). Fukui et al. (2006) showed that an abundance of aquatic insects positively correlated to increased activity of riparian foraging bat species; therefore, loss of riparian vegetation or degradation of stream habitat quality may have negative effects on bat activities in riparian areas through the reduction of aquatic insects (food resources). Females give birth to single young in late May to June. This bat species is found in northern Arkansas and occupies karst areas, where they are found in caves located along or near rivers in summer months. No such karst areas or caves have been identified within the action alternatives.

### Status and Distribution

The gray bat was added to the U.S. List of Endangered and Threatened Wildlife and Plants on April 28, 1976. Gray bat populations are threatened by a range of stressors including disease, land use change, and direct human disturbance. Factors directly influencing this species include white-nose syndrome, winter and summer habitat modification, disturbance and destruction such as cave vandalism, and climate change (NatureServe, 2022).

The gray bat is found in 14 states across most of the southeastern United States. In Arkansas, the gray bat's range includes over 30 counties, mostly in the Ozark Highlands, Boston Mountains, Arkansas River Valley, and Mississippi Alluvial Plain Ecoregions.

## 2.3 Indiana bat (*Myotis sodalis*) - Federally Endangered

### Species Description

The Indiana bat is a medium-sized *Myotis*, closely resembling the little brown bat (*Myotis lucifugus*) but differing in coloration. Its fur is a dull grayish chestnut rather than bronze, with the basal portion of the hairs on the back a dull-lead color. This bat's underparts are pinkish to cinnamon, and its hind feet are smaller and more delicate than in *M. lucifugus* (USFWS, 2022a). The calcar (heel of the foot) is strongly keeled. This bat species is small, has a wingspan of 9 to 11 inches. According to Whitaker and Mumford (2009), the average weight was 5.7 g (0.20 ounce) for males and 6.6 g (0.23 ounce) for females with weight varying across the annual cycle.

### Life History

The life cycle of the Indiana bat consists of four phases that include winter hibernation (late October –



April), spring migration (April), young rearing (June – July), and fall migration and swarming (September – November) (USFWS, 2022a). The active season is considered to span from April through October. Summer roosting male Indiana bats roost individually or in small groups, which can be located near or further away from winter hibernacula areas. Summer roosting reproductive females group together, forming large (100-300 individuals) maternity colonies that are often further away from winter hibernacula areas.

Indiana bats hibernate in caves during winter (NatureServe, 2022). In summer, Indiana bats are known to roost underneath the peeling bark of dead or dying trees in intact to semi-intact wooded areas, often along streams. Menzel et al. (2001) found that preferred tree roosts, across the species' range, were in dead snags in sunny openings because the crevices under the bark stayed warmer. Also, they're known to roost and forage in upland forests within 1 to 3 miles of small to medium rivers and streams and in riparian areas.

According to the USFWS, roost trees can be characterized as primary roost trees and alternate roost trees. Primary roost sites are larger sized trees or snags that provide for optimized roosting temperatures. According to the USFWS Midwest Region, primary roost trees are usually dead or dying, are greater than 9 inches in DBH, and have loose, peeling bark with high sun exposure. Alternate roost trees are smaller and used during seasonal temperature fluctuations. Males may utilize trees as small as 2.5 inches DBH. Shagbark hickory (*Carya ovata*), maple (*Acer* spp.), hickory (*Carya* sp.), ash (*Fraxinus* spp.), oak, elm (*Ulmus* sp.), pine (*Pinus* sp.), hemlock (*Tsuga canadensis*) and others have been considered to provide suitable habitat (Luensmann, 2005). Primary and alternate roost trees have been identified for use as maternity roost sites, both of which must be available to be considered suitable habitat.

Summer foraging Indiana bats feed on terrestrial and aquatic insects along stream corridors, edges of upland and bottomland forests, and forested edges of agricultural fields. According to the USFWS Midwest region, the use of herbicides near suitable habitat may directly and indirectly affect the species due to direct contact or ingestion, and reduction in foraging insects, respectively. Studies have shown that individual bats may forage within 2.5 miles of summer roosting sites and avoid vast open spaces, such as large agricultural fields, but utilize forested corridors connecting fragmented forest habitat.

### Status and Distribution

Indiana bats have been listed as endangered since 1966 and are found in most of the Eastern half of the United States. In 2019, Arkansas was listed in the top five states with the most hibernacula of Indiana bats with 39 hibernacula identified within the state. The 2019 winter census estimate of the population was 537,297 bats occurring within 223 hibernacula in 16 states. The current population has declined by half compared to when the species was listed as endangered (USFWS, 2022a).

According to the USFWS Environmental Conservation Online System website, the Indiana bat is found in 22 states across most of the eastern United States. In Arkansas, the Indiana bat's range includes 54 counties, mostly in the Ozark Highlands, Boston Mountains, Arkansas River Valley, and Crowley's Ridge Ecoregions.

## 2.4 Northern long-eared bat (*Myotis septentrionalis*) - Federally Threatened

### Species Description

The NLEB is a medium-sized member of the genus *Myotis* whose range includes the eastern United States and Canada. NLEBs have a medium to dark brown back, wings, and ears, and a medium to light brown



underside. Adults of the species weigh 5 to 10 grams (0.17 to 0.35 ounces); have a total length of approximately 77 to 100 mm (3.0 to 3.9 in), and a wingspan of 23 to 26 cm (9.1 to 10.2 in) (Caire et al., 1979). Ears are approximately 14 to 19 mm (0.65 to 0.75 in) and extend past the nose when laid flat. The tragus is very long and distinctly pointed at the tip and is usually about 10 to 12 mm (0.39 to 0.47 in) in length (Amelon and Burhans, 2006). Females of the species tend to be slightly larger than males (USFWS, 2015).

### Life History

Like most bats, the NLEB is insectivorous and feeds by using echolocation in flight and by gleaning flightless insects and arachnids from twigs, leaves, and water surfaces (Lee and McCracken, 2004). The NLEB hibernates in caves during winter that are characterized by cool temperatures between 0-9 °C (32-48 °F), high humidity, and minimal air currents (Caceres and Pybus, 1997). NLEB may leave their hibernacula as early as March, but typically from April to May, in favor of summer roosting sites located near preferred foraging habitat. Migration distances are generally believed to be shorter for NLEB than the other bats of the genus *Myotis*. Average travel distances range from 8 to 270 km (5 to 168 mi) but are most often between 90 and 142 km (59 and 88 mi) (Griffin, 1945). NLEBs tend to utilize edge habitats during migration, choosing to take longer routes with partial canopy that offer better protection from predators and weather, rather than shorter open routes. Roost trees for NLEBs can be of any species, live or dead, that have exfoliating bark, cracks, or crevices. Pups are reared in maternity roosts from late spring to early summer. During the spring and fall, swarming behavior occurs near the hibernacula where individuals congregate for breeding and feeding activities.

### Status and Distribution

The species was listed as threatened April 2, 2015 throughout its entire range. Critical Habitat was not designated at the time of listing. The largest decline in the species populations have occurred in their northeast range, where declines of up to 100% have been observed. The NLEB is the first species of bat proposed for listing where White Nose Syndrome (WNS) is the main cause for declining populations. It is anticipated that as WNS spreads similar declines will be seen throughout the species range. The final 4(d) rule was published on January 14, 2016. The rule states that all purposeful take is prohibited unless permitted or endangering humans. Incidental take is not currently prohibited except in certain circumstances where activities are within the vicinity of a known hibernaculum or maternity roost tree. Actions that follow the guidelines of this rule result in a determination of "May Affect". However, the USFWS proposed on March 22, 2022, to reclassify the NLEB to endangered. If the proposed reclassification is finalized, then the 4(d) rule will no longer apply and incidental take will be prohibited.

The NLEB is found in the United States from Maine to North Carolina on the Atlantic Coast, westward to eastern Oklahoma and north through the Dakotas, extending southward to parts of southern states from Georgia to Louisiana. In Canada it is found from the Atlantic Coast westward to the southern Yukon Territory and eastern British Columbia. Historically, the species was found in greater abundance in the northeast and portions of the Midwest and Southeast and was encountered less frequently along the western edge of the range.

## 2.5 Eastern Black Rail (*Laterallus jamaicensis ssp. jamaicensis*) - Federally Threatened

### Species Description

As described by the species status assessment report for the Eastern Black Rail, the Black Rail is the smallest rail in North America (USFWS, 2019). Adults range from 10-15 centimeters (cm) in total length and have a wingspan of 22-28 cm (Eddleman et al. 1994, unpaginated). Eastern black rails weigh 35



grams (g) on average and are larger but have less brightly colored plumage than California black rails (mean mass = 29 g; Eddleman et al. 1994, unpaginated). Males and females are similar in size, and adults are generally pale to blackish gray, with a small blackish bill and bright red eyes. The underparts from chin to abdomen are uniformly colored but are lighter on the chin and throat. The nape and upper back are chestnut and the remaining back, upper tail feathers, and remiges (wing flight feathers) are dark gray to blackish with small white spots and sometimes washed with chestnut-brown. The lower abdomen, undertail feathers and flanks are blackish streaked with narrow white and dark gray barring, washed with chestnut. Overall, males are darker and have pale to medium gray throats, while females are lighter and have pale gray to white throats (Davidson 1992, p. 120; Eddleman et al. 1994, unpaginated). The tarsi (lower legs) and toes are a brownish gray or gray to blackish-brown (Meanley and Stewart 1960, p. 83; Weske 1969, p. 39).

### Life History

Eastern black rails occupy wetlands and marshes in areas of moist soil or shallow flooding. They require dense vegetative cover that allows movement underneath the canopy, such as rushes, sedges, and grasses. Shallow (0-3 cm) water level during breeding season is required as high water levels can flood nests and drown chicks.

Adult females lay one egg per day and have an average clutch size of seven eggs (range = 6–8 eggs, n=16; Legare and Eddleman 2001, p. 173), although clutches as small as four eggs and as large as 13 eggs have been found (Bent, 1926, p. 329; Taylor and van Perlo, 1998, unpaginated). Both sexes incubate and when one parent is at the nest the other is presumably foraging (Legare and Eddleman, 2001, p. 173). Eastern black rail egg-laying and incubation primarily occur from May to August with some early nesting in March and April (USFWS, 2019). Eastern black rails reach the adult life stage the spring after hatch year once sexually mature. The nature of migration for the subspecies is poorly understood (USFWS, 2019). The bulk of spring migration is thought to occur between mid-April and early May (Todd, 1977, p. 73) and the fall peak appears to be mid-September to mid-October (Eddleman et al., 1994, unpaginated; Watts, 2016, p. 11)

### Status and Distribution

On October 9, 2018, the eastern black rail was proposed for listing under the ESA. The eastern black rail was listed as threatened with a section 4(d) rule published on October 8, 2020 with an effective date of November 9, 2020 (85 FR 63764). In the United States, eastern black rails are found in both coastal and interior areas, but the majority of detections are from coastal sites (USFWS, 2019). The species is likely a vagrant in Arkansas, passing through during migration.

## 2.6 Curtis Pearlymussel (*Epioblasma curtisii*) - Federally Endangered

### Species Description

The oval shell of Curtis Pearlymussel, *Epioblasma curtisii*, is small, usually less than 1.5 in (39mm) in length, with males slightly larger than females (USFWS, 1986). The ratio of shell length to shell height to shell breadth is 6:4:3 (USFWS, 1986). In males, the shell is oval in shape, with the anterior end smoothly rounded, and the posterior end bluntly pointed and biangular. There is generally a slight but wide indentation on the posterior-ventral margin where the double, barely discernable posterior ridge joins the ventral margin (USFWS, 1986). The female shell is smoothly rounded anteriorly and broadly rounded and inflated posteriorly; the posterior edge of the shell is serrated (USFWS, 1986). The annual growth lines are deeply incised. The shell of both sexes is yellowish brown to brown, usually light brown, sometimes with fine, evenly spaced rays over most of its length. The beaks are broad and low, and the beak sculpture is typically eroded away (USFWS, 1986). The interior shell surface is white to whitish blue.



### Life History

The Curtis Pearlymussel is a small mussel species that is found in riffles within large creeks to medium sized rivers with good water quality in Arkansas and Missouri. Females lure fish hosts then expels glochidia directly onto the fish before releasing the fish. The host fish used by the Curtis Pearlymussel to complete its life cycle is uncertain. Most *Epioblasma* species utilize darters or sculpin species (Yeager and Saylor, 1995).

### Status and Distribution

The Curtis Pearlymussel has a small historical range within the Ozark Highlands and is known from the Black, St. Francis, and White river drainages in Southeast Missouri and Northeast Arkansas (USFWS, 2010). The Little Black River remains the last place the Curtis Pearlymussel has been seen alive (USFWS, 2021). *Epioblasma curtisii* was reported from the “Black River at the mouth of the Spring River”, Lawrence-Randolph County with specimens collected and illustrated by J. M. Bates and S. D. Dennis (Ecological Consultants, Inc., 1983, 1984). Attempts to locate these specimens have been unsuccessful, and there is concern as to whether this site represents a valid record of *Epioblasma curtisii*. The Recovery Plan for *E. curtisii* (USFWS, 1986, p. 5) alludes to the fact that these Black River specimens are not *E. curtisii*. M.E. Gordon (personal communication) believes these specimens to represent *E. capsaeformis*, a species restricted to the Tennessee River system, and the reported Black River location the result of accidental label switching for the field collection data (Harris et al., 2007, 2010). No other information is available on the status of the species within its known range in Missouri and Arkansas. Therefore, it is still unknown whether an extant population exists (USFWS, 2021).

## 2.7 Pink Mucket (*Lampsilis abrupta*) - Federally Endangered

### Species Description

The Pink Mucket has a thick, inflated, smooth, round shell with yellowish-brown periostracum. The posterior end is bluntly pointed in males while females are shorter and nearly square. Faint green rays can be found in juveniles but are generally absent in adults. Nacre color is iridescent white with a light pink to salmon color in the umbo cavity. It was first described as *Unio abruptus* by Lea in 1831.

### Life History

Like all unionids, it is a filter feeder of algae, bacteria, detritus, and zooplankton. Spawning occurs in August and September where males release sperm into the water column and females collect sperm by syphoning the water. Glochidia are released onto fish hosts the following year. Suitable host fish that have been identified are bass species (*Micropterus* sp.) and walleye (*Sander vitreus*) (Barnhart et al., 1997). Individuals can be found in sand, mud, or gravel in varying water depths of large rivers and tributaries.

### Status and Distribution

The Pink Mucket has been found in Alabama, Arkansas, Illinois, Kentucky, Louisiana, Missouri, Ohio, Tennessee, Virginia, and West Virginia. It was formerly scattered throughout the Mississippi, Tennessee, Ohio, and Cumberland River systems (USFWS, 1985). In Arkansas, it is known from the Bayou Bartholomew, Black, Current, Eleven Point, Little, Ouachita, Poteau, Saline, Spring, and White Rivers (Harris and Gordon, Undated). According to Harris (2021), *Lampsilis abrupta* was widely distributed in the Black River and found from BRM 50.6 (near Minturn, AR) upstream to BRM 163.4 (upstream of Hwy. 62 near Corning, Arkansas).



## 2.8 Rabbitsfoot (*Theliderma cylindrica*) - Federally Threatened

### Species Description

The Rabbitsfoot (*Theliderma cylindrica*) was first described by Say (1817). Graf and Cummings (2007) and the 2021 Freshwater Mollusk Conservation Society list this species as *Theliderma cylindrica*; however, Williams et al. (2008) continue to use the genus *Quadrula* for this species. Disagreement still occurs between authorities as to the current genus designation and a list of previously used names for this species can be found on The MUSSEL project web site (Graf and Cummings, 2011). It can be distinguished from other mussels by the elongate rectangular shape and large pustules on the shell. Nacre is white and periostracum brown to greenish-brown with very distinct dark chevron zig-zags. Both cardinal and lateral teeth are well developed.

### Life History

The Rabbitsfoot is found near the banks in small to large rivers with gravel and sand substrate with relatively shallow and flowing water. It is thought that this species does not burrow into the substrate but sits on its side on the surface. The species is tachytictic and not sexually dimorphic (Yeager and Neves, 1986). Various species of cyprinid minnows have that been determined to be suitable hosts include (but not limited to) the following: blacktail shiner (*Cyprinella venusta*), cardinal shiner (*Luxilus cardinalis*), red shiner (*C. lutrensis*), spotfin shiner (*C. spiloptera*), bluntface shiner (*C. camura*), rosyface shiner (*Notropis rubellus*), striped shiner (*L. chrysocephalus*), and emerald shiner (*N. atherinoides*) (USFWS, 2012).

### Status and Distribution

Work conducted in 2002 recognizes two subspecies: (*Q. c. cylindrica*), the Rabbitsfoot, with a relatively widespread distribution in the upper Arkansas, White, St. Francis, Ohio, Tennessee, Cumberland, and Mississippi River systems; and the Rough Rabbitsfoot (*Q. c. strigillata*), having a more constricted range and found only in the headwaters in the Clinch, Powell, and Holston Rivers (USFWS, 2002). The Rabbitsfoot species is declining across its range and is now present in only 46 of 137 streams with viable populations in White River, Black River, Strawberry River, and Little River in Arkansas (Butler, 2005). The USFWS listed this species as threatened in September of 2013 (USFWS, 2013).

Distribution of this species includes the Ohio, Tennessee, Cumberland, and Mississippi River systems. It is found in Alabama, Arkansas, Illinois, Indiana, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nebraska, Ohio, Oklahoma, Pennsylvania, Virginia, and West Virginia (USFWS, 2002). Rust (1993) found *Theliderma cylindrica* in four major mussel beds between BRM 65.1 and BRM 76.5, which is in the vicinity of Black Rock, Arkansas near the confluence of the Spring River, approximately 9.4 miles west of Alternatives 2 and 3. *Theliderma cylindrica* represented between 0.3% and 5.1% of the mussels sampled from these beds. Harris (2014a and 2014b) found moderate numbers of *Theliderma cylindrica* in two small mussel beds at approximately river mile 86.0 and river mile 85.5 downstream from Pocahontas, Arkansas.

## 2.9 Scaleshell Mussel (*Potamilus leptodon*) - Federally Endangered

### Species Description

The Scaleshell is a medium sized (1 to 4 inches) mussel with an elongated, compressed, thin, translucent shell with faint green rays and a rounded anterior margin. The beak is low and positioned in the anterior quarter of the shell length and has 4 to 5 very fine double-looped ridges. The cardinal teeth are rudimentary, single, and compressed. The nacre is bluish to purple, occasionally with copper or salmon overcast, and highly iridescent.



### Life History

This species occurs in riffles with moderate to high gradients in creeks to large rivers. It is typically associated with riffles, relatively strong currents, and substrate of mud, sand, or assemblages of gravel, cobble, and boulder (NatureServe, 2022). Baker (1928) surmised that Scaleshell is a long-term brooder. Recent observations support Baker's conclusion (USFWS, 2004). In Missouri, gravid specimens have been observed in the Meramec and Gasconade rivers in August, September, October, April, and June (Barnhart, 2001; data from Roberts and Bruenderman, 2000). This species is probably rather sessile with only limited movement through the substrate. Passive downstream movement may occur when mussels are displaced from the substrate during floods.

### Status and Distribution

This species is severely impacted by alteration and inundation of channels, siltation from agriculture and clear-cutting, chemical and organic pollution. The decline of Scaleshell is primarily due to threats that cause habitat loss and degradation from construction activities and intensive land use (USFWS, 2004).

Historically this species was distributed through 55 streams in much of the Interior Basin and a portion of the St. Lawrence drainage, including 13 states (USFWS, 2004). The only known extant populations are now restricted 13 streams in the Interior Highland divisions in Missouri, Arkansas, and Oklahoma (see Oesch, 1984; 1995; Gordon, 1985; Harris and Gordon, 1987; Clarke, 1987; Cummings and Mayer, 1992; Parmalee and Bogan, 1998; Szymanski, 1998; and USFWS, 1999). In Arkansas, it occurs in widely disjunct occurrences in the northern (White, Strawberry, Spring, Mulberry, Myatt Rivers) and southwestern parts of the state (South Fork Fourche La Fave River, Saline River, Cossatot River, Ouachita River) but all with low viability and few specimens found (Harris and Gordon, 1987; Harris et al., 1997); and Frog Bayou (Gordon, 1985). Rust (1993) did not find *Potamilus leptodon* in his Black River survey. Results of a museum holdings survey suggest that the distributional centers and largest populations of *Potamilus leptodon* in Arkansas have historically occurred in the Ouachita and Saline Rivers of the Ouachita River basin and the Black and Spring Rivers of the White River basin (Bouldin et al., 2013). Despite relatively recent and extensive survey efforts in each of these rivers (as summarized in Harris et al., 2010), live *Potamilus leptodon* have been found only in the Strawberry River (Sanchez-Gonzalez, 2018) and Black River at Black Rock (in 2012, J. Seagraves, ARDOT, personal communication) since 1983 (Bouldin et al., 2013). According to the 5-year review by USFWS (2021b), the status review results indicate the Scaleshell is still present, although rare, within its strong-hold populations in the Meramec, Bourbeuse, and Gasconade rivers in Missouri. It was also collected live in the last 10 years in three streams where it has been documented previously in Arkansas, Missouri, and Illinois.

## 2.10 Pondberry (*Lindera melissifolia*) - Federally Endangered

### Species Description

Pondberry, *Lindera melissifolia*, is a deciduous shrub, growing from less than 1 ft. (30 cm) to, infrequently, more than 6 ft. (2 m) in height (NatureServe, 2022). Leaves are aromatic, alternate, elliptical, somewhat thin and membranaceous, with entire margins. Shrubs usually are sparsely branched, with fewer branches on smaller plants. Plants are rhizomatous, frequently propagating by vegetative sprouts and forming clonal colonies. Plants are dioecious (each plant is either a male or a female) and produce clusters of small, yellow flowers in early spring prior to leaf development from buds on branches produced from the growth during the preceding year (NatureServe, 2022). Fruits are drupes that green when immature and ripen to red by fall.



### Life History

According to NatureServe (2022), pondberry can apparently occupy a variety of habitats as long as hydrological requirements are met. The species occurs in seasonally flooded wetlands such as interior portions of floodplain/bottomland hardwood forests and forested swales, on the bottoms and edges of shallow seasonal ponds in old dune fields, along the margins of ponds and depressions in pinelands, around the edges of sinkholes in coastal areas with karst topography, and along the borders of Sphagnum bogs. Usually in shade but tolerates full sun.

### Status and Distribution

According to the 5-year review by USFWS (2021c), the status review results indicate that of Arkansas's 24 known populations, 6 are extirpated, 1 exists only in cultivation (no longer extant in the wild), 5 (all on state- or federally owned or managed conservation lands) have been confirmed extant, and 12 (all on private lands, including 2 protected by conservation easements) are of uncertain status. Pondberry monitoring and surveys in Arkansas confirmed the continued existence of pondberry at the Stateline Sand Ponds Natural Area (NA) in Clay County (this population is shared by adjacent conservation lands in Ripley County, Missouri), although the population is in apparent decline (Baker, 2018). Of the 12 populations found on private lands that are of uncertain status, recent aerial imagery indicates that habitat remains intact, suggesting that these populations may yet persist. These populations are found in Clay (1 population), Lawrence (2), Jackson (8), and Woodruff (1) counties. The Arkansas Natural Heritage Commission (ANHC) has confirmed the occurrence of one of the Lawrence County populations, which is located approximately 5 miles east of the proposed action.

## 2.11 Critical Habitat

Critical habitat for the Rabbitsfoot was finalized April of 2015. Thirty-four (34) critical habitat units in 31 different streams/ivers were finalized, totaling approximately 2,313 km (1,437 miles) in the United States. There is designated critical habitat for the Rabbitsfoot, as listed in 50 CFR part 17, located in the Black River approximately seven river miles downstream of the proposed action. However, the Black River within the project action area is not designated as critical habitat for Rabbitsfoot.

No other species have critical habitat designated near the action area.

## 2.12 Alligator snapping turtle (*Macrochelys temminckii*) - Proposed Threatened

### Species Description

The alligator snapping turtle is the largest species of freshwater turtle in North America and is among the most aquatic. Sexual maturity is achieved in 11-21 years for males and 13-21 years for females (USFWS, 2021d). Alligator snapping turtles display sexual dimorphism with males being distinctly larger than females and having a greater anterior-to-vent tail length.

According to USFWS (2021d), alligator snapping turtles are primitive in appearance and are characterized by a large head, long tail, and an upper jaw with a strongly hooked beak. They have muscular legs and webbed toes with long, pointed claws. They have three keels with posterior elevations on the scutes of the carapace, which is dark brown and often has algal growth that adds to the alligator snapping turtle's camouflage. Their hinge-less plastron is significantly smaller than their carapace and is narrow and cross-shaped with a long, narrow bridge. The plastron is greyish-brown in color in adults; in juveniles it may be somewhat mottled with small whitish blotches. Their eyes are positioned on the side of the head and are surrounded by small, fleshy, pointed projections. Numerous epidermal





projections are also present on the side of the head, chin and neck (Ernst and Lovich, 2009, p. 138-139). Hatchlings look very similar to adults (Ernst and Lovich, 2009, p. 146).

### Life History

According to USFWS (2021d), no more than one clutch per year per female (average 27.8 eggs per clutch) has been observed in the wild, and they exhibit lower reproductive output than the smaller common snapping turtle (*Chelydra serpentina*). They do not appear to be particularly selective about nest sites, but nests have been observed across a range of distances – approximately 8 to 656 ft (2.5 to 200 m) landward from the nearest water. Temperature of the nest site is important because this species also exhibits temperature dependent sex-determination, Type 2 – where more males are produced at intermediate incubation temperatures and more females are produced at the two extremes (Ernst and Lovich, 2009, p. 16, 144-146). Most nesting occurs from May to July (Reed et al., 2002, p. 4) with areas in the southern part of the range (e.g., Georgia, Florida and Louisiana) beginning in April and extending through May and areas in the north/western portion of the range occurring from late May through June to early July (Ernst and Lovich, 2009, p. 145; Carr et al., 2010, p. 87). Nest predation is a major source of mortality in many turtle populations. Growth is rapid until maturity (11-21 years of age), slowing after 15 years of age (Dobie, 1971, p. 654).

Alligator snapping turtles are associated with deeper water (usually large rivers, major tributaries, bayous, canals, swamps, lakes, ponds, and oxbows), with shallower water occupied in early summer and deeper depths in late summer and mid-winter, representing a thermoregulatory shift (Ernst and Lovich, 2009, p. 141). Hatchlings and juveniles tend to occupy shallower water, in comparison. Alligator snapping turtles are also associated with structures (e.g., tree root masses, stumps, submerged trees, etc.), and may occupy areas with a high percentage of canopy cover or undercut stream banks. Alligator snapping turtles are opportunistic predators and foragers and consume a variety of foods. Fish comprise a significant portion of the alligator snapping turtle's diet; however, crayfish, mollusks, smaller turtles, insects, nutria, snakes, birds, and vegetation (including acorns) have also been reported (Ernst and Lovich, 2009, p. 147). Movements can be highly variable. In Black Bayou Lake and Bayou DeSiard daily distance traveled ranged from 91 to 377 ft per day (Sloan and Taylor, 1987, p. 345).

### Status and Distribution

Due to the aquatic nature of the species, the alligator snapping turtle is confined to river systems that flow into the Gulf of Mexico, extending from the Suwannee River in Florida to the San Antonio River in Texas. In the Mississippi Alluvial Valley, it is widely distributed from the Gulf to as far north as Indiana, Illinois, southeastern Kansas and eastern Oklahoma; the species is believed to occur throughout the entire state of Arkansas (USFWS, 2021d).

## 2.13 Pyramid Pigtoe (*Pleurobema rubrum*) - Proposed Threatened

### Species Description

Pyramid Pigtoe adult mussels are reddish to chestnut brown in color with a smooth periostracum, but darken with age (Watters et al., 2009, p. 233). Juveniles may have green rays that typically disappear with age. The shell is thick, triangular, and medium-sized (up to 3.6 inches (in) (91 millimeters (mm))) (Williams et al., 2008, p. 564). It has a shallow sulcus and high anteriorly directed umbo, with a beak that is elevated above the hinge line (Stansbery, 1967, p. 3). The beak cavity of the Pyramid Pigtoe is deep, the hinge teeth are heavy, and the pseudocardinal teeth are thick and low, and near the umbo (Williams et al., 2008, p. 564). The species is not considered to be sexually dimorphic. Like many *Pleurobema* species, *Pleurobema rubrum* identification with certainty is difficult given the paucity of conchological identifying characters and the proclivity for environment driven morphological variation (Harris, 2021). Various museum specimens from Black River localities have been tentatively identified as *P. rubrum*



(e.g., Ohio State University Museum of Zoology [OSUM] 47681, OSUM 47941, OSUM 79505; Arkansas State University Museum of Zoology [ASUMZ] Lot 587, ASUMZ Lot 1067, and ASUMZ Lot 1117).

### Life History

The Pyramid Pigtoe exhibits a preference for sand and gravel in rivers, but also may be found in coarse sand in larger rivers (Gordon and Layzer, 1989, p. 31). They can be found at depths less than 3 ft (1 m), but in large rivers can be commonly found at depths of 13 to 20 ft or greater (4 to 6+ m) (Parmalee and Bogan, 1998, p. 193; Williams et al., 2008, p. 566). Adult freshwater mussels within the genus *Pleurobema* are suspension-feeders that filter water and nutrients to eat. Mussels may shift to deposit feeding, though reasons for this are poorly known and may depend on flow conditions or temperature. Ciliary tracks on the adult foot apparently facilitate this feeding behavior. Their diet consists of a mixture of algae, bacteria, detritus, and microscopic animals (Gatenby et al., 1996, p. 606; Strayer et al., 2004, p. 430). It has also been surmised that dissolved organic matter may be significant source of nutrition (Strayer et al., 2004, p. 431).

The Pyramid Pigtoe is a short-term brooder, typically gravid from May-July (Gordon and Layzer, 1989, p. 50). Host fish species are minnows of the family Cyprinidae and genera *Cyprinella*, *Erimystax*, *Lythrurus*, and *Notropis* (Culp et al., 2009, p. 19). Similar to other species in the *Pleurobemini*, the pyramid pigtoe targets drift-feeding minnow species by releasing glochidia contained in packets called conglutinates (Haag, 2012, p. 163). Following release from the female mussel, the semi-buoyant conglutinates drift in the water column where they are targeted by sight-feeding minnows (Culp et al., 2009, p. 21).

### Status and Distribution

The Pyramid Pigtoe is a freshwater mussel currently found within the states of Virginia, Kentucky, Tennessee, Ohio, Arkansas, Oklahoma, Mississippi, Louisiana, and Alabama (USFWS, 2021e). It is considered extirpated from Pennsylvania, West Virginia, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Kansas, and Missouri; including the entirety of the Upper Mississippi and Missouri basins (USFWS, 2021e). This species is proposed threatened by the USFWS. Rust (1993) did not identify any specimens from the Black River as *P. rubrum*.

## 2.14 Western Fanshell (*Cyprogenia aberti*) - Proposed Threatened

### Species Description

According to USFWS (2020), Western Fanshell mussels have a thick, compressed to moderately inflated, round to triangular shell (up to 3 inches (76 millimeters)). The posterior ridge is prominent and raised with a shallow sulcus from umbo to middle of the ventral margin. Periostracum is a dull tan with a distinctive ray pattern from bands of tiny pigment flecks. The shell has a wrinkled or rough appearance. The pseudocardinal teeth are large and lateral teeth short and slightly curved. The beak cavity is moderately deep with somewhat pointed beaks extending slightly above the hinge line. The nacre is white (McMurray et al., 2012, p. 30).

### Life History

According to USFWS (2020), Western Fanshell mussels are typically found in large creeks and rivers with good water quality, moderate to swift current and gravel-sand substrates. Most freshwater mussels, including the fanshell mussels, occur in aggregations (mussel beds) that vary in size and are often separated by stream reaches where mussels are absent or rare (Vaughn, 2012, p. 983). Specific information on microhabitat requirements is lacking. Like all mussels, the fanshell mussels are omnivores that primarily filter feed on a wide variety of microscopic particulate matter suspended in



the water column, including phytoplankton, zooplankton, bacteria, detritus, and dissolved organic matter (Haag, 2012, p.26).

The fanshell mussels are bradyctictic (long-term) brooders typically spawning from August – October and release conglomerates in early spring (Barnhart, 1997, p. 13). Fanshell mussel conglomerates resemble annelid worms, and this resemblance attracts fish hosts (Eckert and Barnhart, 2008, p. 12). The glochidia for Western Fanshells remain encysted for about a month until transformation to the juvenile stage (Barnhart, 1997, p. 12). Juvenile mussels likely pedal feed in the sediment, whereas adults filter feed from the water column.

### Status and Distribution

This species is evaluated for listing by the USFWS. According to USFWS (2020), the four factors that pose the largest risk to future viability are water quality degradation, altered flow, landscape changes, and habitat fragmentation, all of which are exacerbated by climate change.

The Western Fanshell has a historical range comprising multiple rivers within the Neosho-Verdigris, Lower Mississippi–St. Francis, and Upper White river drainages of Arkansas, Missouri, Kansas, and Oklahoma. The Western Fanshell currently occurs in several river basins, including the Black, Buffalo, Little Red, Spring, Strawberry, and White River in Arkansas (USFWS, 2020). Rust (1993) data found *C. aberti* with a similar distribution to Rabbitsfoot in that it occurred primarily over approximately 20 river miles between Black Rock and Pocahontas in the portion of the Black River that closely abuts the Ozark Highlands Central Plateau (Woods et al., 2004), and in habitat composed of more gravel and rock substrates. One Western Fanshell individual was collected within the Black River during the 2021 mussel survey conducted for this project.

## 2.15 Monarch butterfly (*Danaus plexippus*) - Federal Candidate

### Species Description

Adult monarch butterflies are large and conspicuous, with bright orange wings surrounded by a black border and covered with black veins. The black border has a double row of white spots, present on the upper side of the wings. Monarchs have a wingspan of 8.9-10.2 centimeters (3.5-4.0 inches). Adult monarchs are sexually dimorphic, with males having narrower wing venation and scent patches. Female markings are a dull orange, while males have a much brighter orange coloration and a black spot on each hind wing. The bright coloring of a monarch serves as a warning to predators that eating them can be toxic.

### Life History

In Arkansas, the monarch butterfly is found statewide. Most often monarchs are migrating through Arkansas heading north in late March to early May and migrating south in late August through October. In general, breeding areas are virtually all patches of milkweed in North America, as milkweeds are the larval foodplants (NatureServe, 2022). Milkweeds and other nectar-producing forbs are important energy sources for adult monarchs and help fuel migration. Several sources conclude that the recent large-scale decline of North American monarch populations is primarily the result of changes in the core breeding habitat, not the illegal logging activities of wintering habitat in Mexico. The large decline in milkweed and other nectar-producing forbs is attributed to changes in agricultural practices such as the widespread use of genetically modified herbicide-tolerant crops (NatureServe, 2022).

### Status and Distribution

On December 17, 2020, the USFWS published a 12-month finding on a petition to list the monarch butterfly (*Danaus plexippus*) as a threatened species under the ESA of 1973, as amended. After a



thorough review of the best available scientific and commercial information, the USFWS found that listing the monarch butterfly as an endangered or threatened species is warranted but precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants. The USFWS will develop a proposed rule to list the monarch butterfly as their priorities allow. The monarch butterfly is in the USFWS Listing Workplan for publishing a proposed rule in FY 2024.

North America is a main component of the monarch's range, but the overall range extends through Central America to northern South America. The North American monarch populations are divided into two main groups—the Western, those west of the Rocky Mountains, and the Eastern, those east of the Rocky Mountains—both of which are migratory. Essential overwintering areas for the western and eastern populations are limited to few areas in eucalyptus groves in coastal California and the conifer forests in the mountains of Mexico, respectively. The monarchs' summer range include portions of the coterminous United States and southern portions of Canada bordering the United States. There are some non-migratory populations that occur in south Florida and along the Gulf Coast (NatureServe, 2022).

Several sources conclude that the recent large-scale decline of North American monarch populations is primarily the result of changes in the core breeding habitat, not the illegal logging activities of wintering habitat in Mexico. The large decline in milkweed and other nectar-producing forbs is attributed to changes in agricultural practices such as the widespread use of genetically modified herbicide-tolerant crops (NatureServe, 2022).

## 2.16 Tricolored bat (*Perimyotis subflavus*) - Federally Proposed Endangered

### Species Description

The tricolored bat is a small bat of the genus *Perimyotis* and is distinguishable by their tricolored fur that is dark at the base and top with a lighter middle section. Adults of the species, on average, weigh 4.6 to 7.9 grams (0.16 to 0.28 ounces), and have a total length of approximately 77 to 89 mm (3.0 to 3.5 in). Females of the species are heavier than males (USFWS Northeast Region, et al., 2021).

### Life History

Tricolored bats are opportunistic insectivorous feeders by using echolocation in flight and forage at the treetop level or higher and may move closer to ground level later in the evening. Foraging occurs commonly over waterways and forest edges (USFWS Northeast Region, et al., 2021). The tricolored bat hibernates in caves and mines during winter and appear to favor higher temperatures than other hibernating bat species (temperature ranges of 10.3 – 11.4°C or 50.5 – 52.5°F) and high humidity (USFWS Northeast Region, et al., 2021). Tricolored bats within the southern United States have been documented to use road culverts as winter hibernacula (USFWS Northeast Region, et al., 2021). Primary roosting occurs in live and dead leaf clusters of hardwood trees, Spanish moss (*Tillandsia usneoides*) in southern regions, pine needles, eastern red cedar (*Juniperus virginiana*), and artificial roosting structures in the summer (USFWS Northeast Region, et al., 2021).

Tricolored bats disperse from hibernacula in the spring and migrate to summer roosting habitats. Migration distances can range from 80 to 137 km (50 to 85 mi) (USFWS Northeast Region, et al., 2021). Migration to summer habitats occurs typically in April where summer habitats are utilized during gestation, lactation, and post lactation periods. Fall migration and swarming typically occurs between August and the end of October. Pups are reared in maternity roosts from late spring to early summer with an average of 6.9 females and pups per colony in Arkansas (USFWS Northeast Region, et al., 2021).



### Status and Distribution

The tricolored bat was proposed for listing as endangered on September 13, 2022 throughout its entire range in the United States. Critical Habitat has not yet been defined. Tricolored bat populations had a discernable decline where White Nose Syndrome (WNS) is present and has been estimated to cause 90-100 percent decline in population over 59 percent of the overall species range. Other causes of decline could be attributed to wind energy installations and habitat loss (USFWS Northeast Region, et al., 2021). The tricolored bat original range includes 39 states within the central and eastern United States, southern Canada, Mexico, and Central America.



## Chapter 3 – Project Action Area

### 3.1 Limits of an Action Area

The action area boundaries were established by incorporation of all areas where direct and indirect impacts to threatened or endangered species could occur. Establishment of the action area also considered potential indirect impacts such as noise, visual, and water quality effects. The action area includes the 400-foot-wide corridor that was developed as a conservative impact footprint. This corridor was used because the area encompasses all potential direct impacts by the proposed action and would also encompass many indirect impacts as it is larger than the actual required right of way. Additionally, a 600-foot-wide buffer of the proposed roadway is included in the action area to account for noise impacts associated with construction of the proposed action. Based on the noise analysis conducted for the proposed action, 600 feet was found to be the maximum distance from the proposed roadway where a noise impact could occur. Noise impacts were calculated out to a conservative ambient noise level measured for the land uses in the surrounding areas. The action area also includes 300 feet downstream and 100 feet upstream of the proposed crossings at the Black River and proposed crossings of direct tributaries to the Black River to account for potential indirect impacts to aquatic species habitats. However, none of these additional up and downstream areas extend beyond the 600-foot-wide buffer.



## Chapter 4 – Environmental Baseline

The environmental baseline is defined as “the past and present impacts of all Federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process.” [50 CFR §402.02]

### 4.1 Status within the Action Area

The largest known threats to the federally listed bat species include cave disturbances, white-nose syndrome (WNS), the use of forestry insecticides and crop pesticides in areas adjacent to riparian corridors, and deforestation (NatureServe, 2022). For the eastern black rail, the loss and degradation of wetland habitat due to drainage, dredging, filling, impounding, mining, pollutant discharge, and invasion by non-native plant species are considered the greatest threat (NatureServe, 2022). The principal threats to the federally listed mussel species include structural hydrological alteration (damming and channelization), declining water quality (pollution and siltation), and invasive species (NatureServe, 2022). For the monarch butterfly, recent analyses and reviews (Miller et al. 2012, Brower et al. 2012, Pleasants and Oberhauser 2013, Flockhart et al. 2013, 2014, Butler 2014, Center for Biological Diversity et al. 2014) conclude that the recent large-scale decline of North American monarchs is primarily due to the recent loss of milkweed as a result of two changes in agricultural practices: 1) widespread adoption of genetically modified herbicide-tolerant corn and soybeans and use of the herbicide glyphosate on these crops; and 2) placing approximately 25,000,000 additional acres of mostly Roundup Ready corn since 2007. For pondberry, the loss and alteration of habitat has been and continues to be the most significant threat. Multiple causes of habitat loss/degradation are known, including land clearing, hydrological alteration (drainage, ditching, flooding), timber harvesting, leveling of mound/depression topography, and road building (NatureServe, 2022).

The action area occurs exclusively within a portion of the Mississippi Alluvial Plain ecoregion, which is a broad, nearly level, agriculturally dominated alluvial plain characterized by widespread clayey, poorly-drained soils. According to Woods et al. (2004), land use within the Western Lowlands Pleistocene Valley Trains Ecoregion (73g) is mostly cropland; also deciduous forest and forested wetlands. The ecoregion serves as a wintering ground for waterfowl and duck hunting is seasonally common. Historically the Mississippi Alluvial Plain contained substantially more wetlands than exist today. From the 1780s to the 1980s, Arkansas lost about 72% of their original wetland acreage (Dahl, 1990). Holder (1969) estimated that 90% of the wetland loss in the last 40 years was due to the expansion of soybean production.

The action area occurs entirely within the White River ecobasin of the Mississippi Alluvial Plain, as delineated by the Arkansas Game and Fish Commission (AGFC). According to the AGFC, streams in this ecobasin are some of the most productive, species rich, bottomland hardwood, low gradient systems in the state. Natural channels in this ecobasin are tortuously meandering, having silt, sand, and gravel substrates and abundant cover consisting of mainly large, woody debris. Riparian zones are dense, having some of the largest hardwood trees in the state. Currently, land use changes have decreased riparian zones significantly and caused substantial increases in turbidity due to sedimentation. While stream and connected oxbow lakes are still some of the most productive in the state, native fish fauna, especially large river fishes, have decreased due to upstream flow and thermal modifications from numerous impoundments. Soils in some sub-watersheds have high levels of magnesium and sodium, contributing to higher total dissolved solids. The Black River, which occurs within the action area, is an example of a stream in this ecobasin.



Land use within the action area is characterized by the predominantly rural nature of the area, with large expanses of agricultural lands (cultivated crops) being the dominant land use within the action area. According to data provided by the USDA, Natural Resources Conservation Service (NRCS), the major crops within Lawrence, Randolph, Green, and Clay Counties are soybean and rice. Based on the site investigation conducted in March 2021, the dominant crop within the action area is rice, with some fields planted in corn or soybeans. To the east of the proposed action is the Black River WMA, consisting of approximately 25,510 acres of mostly forested wetlands and guided by a formal master plan to manage wildlife and provide recreational and educational opportunities to the public. Numerous federally listed bat species have been documented within the Black River WMA; however, no federally listed bat species were found during the presence/absence bat survey conducted in the action area for the proposed action. The proposed action will not impact the Black River WMA.

As previously mentioned, the overall ecology of the action area has largely been defined by local agricultural practices, with cropland comprising approximately 90% of the land cover. Thus, despite its length, the action area contains a relatively homogeneous landscape due to its flat topography and abundance of agricultural fields. Beyond cropland and developed areas, the action area contains relatively small quantities of forested wetlands, herbaceous wetlands, and some open water. Forested wetlands within this ecological system are more accurately defined as bottomland hardwood wetlands, which are primarily present along riparian zones associated with the Black and Current Rivers, and as narrow wooded riparian zones of their tributaries. Many of these wooded areas have a connection with the adjacent Black River WMA. Herbaceous wetlands within the action area are primarily present within the floodplains associated with the Black River or other large waterbodies. Natural land cover is also present within the action area as upland woods that primarily exist as small patches of wooded areas and linear wooded and scrub-shrub areas that are present along parcel boundaries, agricultural ditches, and along existing infrastructure right of way. These narrow, vegetated areas, which are immediately adjacent to agricultural fields, create edge habitat. Aquatic habitats within the action area occur primarily at river and stream crossings, but also within agricultural canals, wetlands, and ponds.

The ecology of the action area has also been defined by the presence of three levee systems along the banks of the Black River. These levee systems serve as flood damage reduction for hundreds of thousands of acres of primarily agricultural land, as well as scattered farmsteads and towns such as Corning and Knobel. The U.S. Army Corps of Engineers (USACE) constructed these levees between 1938 and 1940.

According to USGS 7.5-minute U.S. Geological Survey (USGS) topographic quadrangles, named streams within the action area include the Black River, Village Creek, Little Village Creek Ditch, Big Running Water Creek, Murray Creek, Oak Creek Ditch, and Moark Ditch. With the exception the Black River and Murray Creek, nearly all of the streams within the action area have been channelized or rerouted in the past. In addition, several man-made drainage ditches have been created for the primary purpose of draining and/or retaining hydrology in agricultural fields. Hydrology within all the stream and canal systems in the general area are continually influenced by pumping activities and directly related to irrigation associated with farming practices (primarily for rice crops). These manipulated hydrology schemes were observed throughout the action area. Within the action area, the Black River provides the highest level of aquatic habitat and as a result, fish and aquatic species diversity. Substantial mussel assemblages (mussel beds) are known to occur in the Black River that are extremely important to maintaining species richness and genetic diversity throughout the system (Rust, 1993). Several endangered mussel species presently occur or have historically occurred in the Black River, Arkansas including *Epioblasma triquetra* (Rafinesque 1820), *Lampsilis abrupta* (Say 1831), *Potamilus leptodon* (Rafinesque 1820), and *Theliderma cylindrica* (Say 1817) (Harris et al., 2007, 2010; Bouldin et al., 2013; Christian et al., 2021).





Within the action area, the Black River flows east to west and has a substantial wooded riparian zone on its south bank and very minimal to no riparian zone on its north bank at the proposed crossing. The Black River is approximately 200 feet wide near the proposed action's crossing. A USGS bathymetric survey of the Black River indicates that the river is approximately 2.5 feet deep near the proposed action crossing.

Other projects known to be planned within the action area include the Missouri Department of Transportation's section of future I-57, which is planned to connect to the north end of the proposed project and extend north approximately 2 miles to County Road 272. This project is in the Missouri Statewide Transportation Improvement Plan (Job 9P3661) and has NEPA funding with final studies anticipated in late 2022 or early 2023 but does not have an anticipated letting date.

## 4.2 ESA Listed, Proposed, and Candidate Species

The action alternatives were evaluated for the presence of potentially suitable habitat for the ESA listed species. Site investigations were conducted March 2-3, 2021 for the habitat assessment. Additionally, environmental inventory review and research and coordination with the ANHC, AGFC, and USFWS regarding the action area were conducted. As described in Section 1.4, surveys were conducted for federally-listed bat species, federally-listed mussel species (details following **Table 1**), and pondberry for the proposed action. The locations of potentially suitable habitats identified are shown in **Appendix A**. Summaries of suitable habitat for federally listed species within the action area are provided in **Table 1**.

**Table 1: Federally-protected Species' Suitable Habitats in the Action Area**

Species (Status)	Suitable Habitat Present within the Action Area	Potential Presence/Absence within Suitable Habitat of Action Area
<b>Federally Listed Threatened and Endangered Species</b>		
Gray bat (Endangered)	No caves were observed in or near the action area. Bridge* and other structures that provide potentially suitable summer roosting habitat are located within the action area. Forested areas are present that provide foraging habitat.	Survey efforts resulted in a probable absence.
Indiana bat (Endangered)	The action area contains forested areas providing potentially suitable trees for roosting**. No caves or mine portals were observed in or near the action area. Bridge* and other structures are located within the action area that provide potentially suitable summer roosting habitat.	Survey efforts resulted in a probable absence.
Northern long-eared bat (Threatened)	The action area contains trees potentially suitable for roosting. No caves or mine portals were observed in or near the action area. Bridge* and other structures are located within the action area that provide potentially suitable summer roosting habitat.	Survey efforts resulted in a probable absence.

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Species (Status)	Suitable Habitat Present within the Action Area	Potential Presence/Absence within Suitable Habitat of Action Area
Eastern Black Rail (Threatened)	The action area contains emergent wetlands and vast amounts of farm fields that occasionally flood. Potential habitat associated with these farm fields is confined to field edges.	Presence highly unlikely. There are no occurrence records in the state. The species is likely a vagrant in Arkansas, passing through during migration. Use of herbicides to maintain cropland edge habitats reduces the likelihood of emergent wetland vegetation from becoming sufficiently dense/overgrown for extended periods of time.
Piping plover (Threatened)	No suitable habitat is present in the action area for the Piping Plover, which inhabits beaches, shorelines, dry lakebeds, sandbars of major rivers, salt flats, and mudflats of reservoirs.	Presence unlikely due to lack of suitable habitat and no identified occurrences in action area.
Red knot (Threatened)	No suitable habitat is present in the action area for the Red Knot, which is usually found along mudflats associated with reservoirs.	Presence unlikely due to lack of suitable habitat and no identified occurrences in action area.
Curtis Pearlymussel (Endangered)	The Black River flows through the action area and could provide suitable habitat for the Curtis Pearlymussel. No other large creeks or medium sized rivers with good water quality were located within the action area.	Survey efforts resulted in a probable absence. Additionally, believed to no longer be present in Arkansas.
Pink Mucket (Endangered)	The Black River flows through the action area and could provide suitable habitat for the Pink Mucket. No other large streams or rivers are located within the action area.	Survey efforts resulted in a probable absence.
Rabbitsfoot*** (Threatened)	The Black River flows through the action area and could provide suitable habitat for the Rabbitsfoot. No other large streams or rivers are located within the action area.	Presence confirmed; Two Rabbitsfoot mussels collected during the mussel survey.
Scaleshell Mussel (Endangered)	The Black River flows through the action area and could provide suitable habitat for the Scaleshell Mussel. No other streams with stable channels and good water quality were identified within the action area.	Survey efforts resulted in a probable absence.
Ozark hellbender (Endangered)	No suitable habitat is present in the action area for this salamander species, which needs cool, clear streams and rivers with many large flat rocks.	Presence unlikely due to lack of suitable habitat and no identified occurrences in action area.
Pondberry (Endangered)	Forested wetland habitat exists within the action area and could provide suitable habitat.	Survey efforts resulted in a probable absence.
Missouri bladderpod (Threatened)	No suitable habitat is present in the action area for this plant species, which primarily inhabits open limestone glades and dolomite glades.	Presence unlikely due to lack of suitable habitat and no identified occurrences in action area.
Hine's emerald dragonfly (Endangered)	No suitable habitat is present in the action area for this dragonfly species, which inhabits calcareous spring-fed marshes and sedge meadows overlying dolomite bedrock.	Presence unlikely due to lack of suitable habitat and no identified occurrences in action area.
<b>Federally Proposed Threatened and Endangered Species</b>		
Pyramid Pigtoe (Proposed Threatened)	The Black River flows through the action area and could provide suitable habitat for the Pyramid Pigtoe. No other large streams or rivers are located within the action area.	Survey efforts resulted in a probable absence.
Western Fanshell (Proposed Threatened)	The Black River flows through the action area and could provide suitable habitat for the Western Fanshell. No other medium sized rivers are located within the action area.	Presence confirmed; One Western Fanshell was collected during the mussel survey.



Species (Status)	Suitable Habitat Present within the Action Area	Potential Presence/Absence within Suitable Habitat of Action Area
Alligator snapping turtle (Proposed Threatened)	Potential habitat exists in the Black River in the form of slow-moving, deep water. Though the species prefers deep-water habitats, they may occur within Murray Creek as well due to its direct connection to the Black River WMA.	Presence likely within Black River. Presence unlikely within Murray Creek due to shallow water.
Tricolored bat (Proposed Endangered)	The action area contains trees potentially suitable for summer roosting. No caves or mine portals were observed in or near the action area. Culverts, bridges, and other structures are located within the action area that provide potentially suitable summer roosting habitat.	Survey efforts resulted in a probable absence.
Federal Candidate Species		
Monarch butterfly (Candidate)	Few areas of herbaceous native habitat are present in the action area. Riparian habitat is predominantly large trees and scrub-shrub species and does not include milkweed or other flowering nectar plants. However, some habitat is present in the form of fallow fields and emergent wetlands that have the potential to contain milkweed and other flowering plants.	Presence likely within suitable habitat. In Arkansas, monarchs occur statewide from mid-March to mid-October. The USFWS is not aware of monarch population estimates for Arkansas.

\*Bridge structures with gaps >0.5-inch are considered to provide suitable summer roosting habitat. \*\*USFWS defines suitable roosting habitat as forest patches with trees of 5-inches diameter at breast height (DBH) or larger that have exfoliating bark, cracks, crevices, and/or hollows. \*\*\*Critical habitat for the Rabbitsfoot is located in the Black River approximately seven river miles downstream of proposed action. *Source: Project Team, 2021-22*

A freshwater mussel survey was conducted on October 16-17 and November 6, 2021 to assess presence/absence of federally protected mussel species. Results from the mussel survey indicated that 609 live mussels representing 23 taxa were encountered within the Black River at the proposed action's crossing (**Table 2**). Mussel densities were greatest along the right descending bank (in search cells 3, 5, 7, 9, 11, 13, as shown in **Appendix D**), with maximum density in these areas estimated at approximately 10 live mussels per square meter. Maximum density in the survey area was estimated at approximately 10 live mussels per square meter in four of the search cells along the right descending bank. The proposed river crossing for the proposed action (Alternative 2) is in and immediately downstream of a bendway with the outside portion of the bendway possessing moderate to swift current velocities and more armored substrates composed of rock, gravel, sand, and scoured hard clay. The inside portion of the bendway has relatively slower current velocity and fine sediments (silt and sand) as the primary substrates. At the downstream terminus of the proposed action's crossing of the Black River, water depth is shallower and current velocity has moderated.

As a conservative estimate, approximately 50% of the Black River within the action area provides suitable habitat for mussels based on where live individuals were found during the 2021 mussel survey (J.L. Harris, personal communication, June 30, 2022). Based on observations during the 2021 mussel survey, the center channel was sanded in, especially farther downstream from the surveyed bendway. The only suitable habitat was within relatively narrow thalwegs on both sides of the river. The thalweg on the left (facing downstream) was very narrow and it is not anticipated that it widens any outside of the area surveyed. The thalweg on the right (facing downstream) was wider but was impacted by large woody debris creating scour holes and unstable substrate. Some of the more productive habitat was on the descending bank slopes on either side, but these are not especially preferred habitat for either Rabbitsfoot or Western Fanshell. Overall, there was quite a bit of the area surveyed that did not have any mussels, was subject to silt and large woody debris deposition, and also may be subject to drying during drought.



As shown in **Table 2**, two live specimens of Rabbitsfoot (federally threatened) were found, which accounted for 0.3% of the live mussels collected. Additionally, one live specimen of the Western Fanshell, which is proposed for listing as threatened, was collected.

**Table 2: Proposed Action (Alternative 2) Mussel Survey Results**

Species	Total Live	% Total Live	Frequency of Occurrence	% Frequency of Occurrence
<i>Amblema plicata</i>	41	6.7	7	43.8
<i>Cyclonaias pustulosa</i>	302	49.6	16	100.0
<b><i>Cyprogenia aberti</i>*</b>	<b>1</b>	<b>0.2</b>	<b>1</b>	<b>6.3</b>
<i>Ellipsaria lineolata</i>	4	0.7	2	12.5
<i>Fusconia flava</i>	27	4.4	6	37.5
<i>Lampsilis cardium</i>	41	6.7	11	68.8
<i>Lampsilis teres</i>	44	7.2	8	50.0
<i>Lasmigona complanata</i>	5	0.8	4	25.0
<i>Ligumia recta</i>	1	0.2	1	6.3
<i>Megaloniais nervosa</i>	5	0.8	2	12.5
<i>Obliquaria reflexa</i>	34	5.6	11	68.8
<i>Pleurobema sintoxia</i>	2	0.3	2	12.5
<i>Potamilus fragilis</i>	9	1.5	8	50.0
<i>Potamilus ohioensis</i>	3	0.5	2	12.5
<i>Potamilus purpuratus</i>	50	8.2	13	81.3
<i>Quadrula quadrula</i>	1	0.2	1	6.3
<i>Reginaia ebenus</i>	14	2.3	4	25.0
<i>Strophitus undulatus</i>	1	0.2	1	6.3
<b><i>Theliderma cylindrica</i>**</b>	<b>2</b>	<b>0.3</b>	<b>2</b>	<b>12.5</b>
<i>Theliderma metanevra</i>	1	0.2	1	6.3
<i>Theliderma (Tritogonia) nobilis</i>	4	0.7	3	18.8
<i>Tritogonia verrucosa</i>	9	1.5	4	25.0
<i>Truncilla truncata</i>	8	1.3	6	37.5
Total	609	100.1		
Search Time (minutes)	334	100.0		
Catch Per Unit Effort (10 min)	18.2	100.0		

\*Western Fanshell; Proposed threatened. \*\*Rabbitsfoot; Federally threatened.



## Chapter 5 – Project Details

### 5.1 Construction

#### Project Timeline and Sequencing

The proposed action will use federal funds and may take decades to complete in its entirety. The proposed action would be broken out into multiple phases with construction likely ceasing for periods of time between each phase.

One section of the proposed action with independent utility is proposed in the draft 2023-2026 Statewide Transportation Improvement Program (STIP). This approximately 9-mile-long section begins at Highway 62 west of Corning and extends north to the Arkansas-Missouri State line. Within this section of the proposed action, the anticipated project sequence would include:

1. Installation of erosion control best management practices (BMPs) in compliance with the Stormwater Pollution Prevention Plan (SWPPP).
2. Site preparation by clearing the proposed right of way for the roadway, embankment, and interchanges at Highways 62 and 67.
3. Performing any additional necessary grading then constructing the paved roadway.
4. Constructing a proposed bridge/culvert over an existing pipeline and over the existing County Road 154.
5. Complete post-project site restoration.

The project timelines for the remaining sections of the proposed action are unknown, but it is anticipated that construction may require a 12-month duration for one or more of the phased construction projects. For the proposed bridge over the Black River, general project sequencing would include:

- a. Grading/preparing bridge ends and abutments.
- b. Installing piers along each bank (no work within wetted portions of the waterbody is planned to occur).
- d. Constructing the superstructure and deck.
- e. Removing all temporary erosion control features.

#### Site Preparation

The proposed work involves constructing a four-lane highway on new location and would require new right of way along the majority of the length of the proposed action. Additionally, the proposed action would include seven new interchanges. Within new right of way, trees would be mechanically cleared. After vegetation is removed, heavy machinery would be used to grade the roadway embankment and bridge abutments. Clearing, grubbing, or any other disturbance of vegetation shall be limited to the minimum necessary for the completion of the proposed action. The limits of disturbance for the proposed action are shown by the Alternatives 2 and C footprints mapped in **Appendix A**, which also shows the locations of suitable species habitats.

Sediment and erosion control devices would be installed in accordance with the National Pollutant Discharge Elimination System (NPDES) permit obtained for the proposed action. These BMPs would minimize the potential for downstream erosion and sedimentation, thereby reducing stressors to aquatic habitats.

#### Construction Access and Staging

Temporary access roads would be constructed as needed by placing rock fill material on the existing ground surface to provide stability to the driving surface for the construction equipment. All temporary



access roads would be removed prior to project completion. Sediment and erosion control devices would be installed in accordance with the NPDES permit obtained for the proposed action.

Petroleum products from improperly maintained construction equipment and storage areas can make their way into receiving streams if preventative measures are not properly followed. Staging areas would be sited to minimize the potential for such contamination and would abide by all appropriate environmental regulations. Special provisions would be included in the contract to limit quantities and locations of storage tanks.

### **In-Water Work**

Effects determinations presented in this Biological Assessment are based on the current plan for the Black River to be completely spanned, there is no current funding for this project and if that changes as the project moves to final design and construction, then consultation with USFWS would be re-initiated.

No work would occur in the Black River below ordinary high water. In-stream construction activities could be done from a barge, so use of in-stream work pads would not be needed, and no work below ordinary high water would be required. Additionally, the proposed piers necessary for the span bridge will be placed outside of the river's ordinary high water marks and no rip-rap will be placed within the stream or on the banks.

The proposed action would also require new bridge crossings over Village Creek (48,000 ft<sup>2</sup>; 1.1 acres), Big Running Water Creek (24,000 ft<sup>2</sup>; 0.6 acre), Cypress Overcup Lateral (64,000 ft<sup>2</sup>; 1.5 acres), and Murray Creek (39,200 ft<sup>2</sup>; 0.9 acre). Additionally, the proposed action would require numerous smaller stream crossings and installation of various-sized reinforced concrete box (RCB) culverts and cross drains. Specifically, the proposed action would require an estimated 13 small culverts and 8 large culverts. In-water work would be required at each proposed crossing and additional stormwater infrastructure features would be associated with each proposed bridge crossing as needed. Temporary work roads within the above-listed streams may be required during construction of the new bridge structures or culverts. Fill would be temporarily placed below the ordinary high water mark to construct the work roads. Temporary culverts to sufficiently maintain low stream flows and assist the passage of aquatic life would also be provided as necessary. However, all temporary fill materials would be removed from stream channels before project completion. Following culvert construction, a layer of rip-rap may be placed along the stream banks if necessary to prevent scour.

### **Potential Impacts on Water Quality**

Temporary impacts to water quality are common during highway construction activities. Water quality is anticipated to be temporarily affected within each of the previously-described waterways, for approximately 300 feet downstream and 100 feet upstream of each proposed crossing. These impacts can be lessened with the proper implementation of BMPs for erosion control. The NPDES permit requires the preparation and implementation of a SWPPP. The SWPPP would include specifications and BMPs needed for control of erosion and sedimentation. All efforts to reduce and limit adverse effects to water quality would be implemented.

### **Post-Project Site Restoration**

All disturbed areas would be permanently seeded following construction activities. All areas must meet coverage requirements outlined in the NPDES permit. Once vegetation is established, all temporary erosion control measures would be removed.



## 5.2 Operations

One of the primary goals of this project was to identify an interstate highway alternative that would improve system connectivity and mobility from Chicago to Little Rock. From a regional connectivity and system continuity perspective, the proposed action would provide an important interstate link to future I-57 as well an alternative connection to I-40 and I-55. In addition to saving travel time and distance, the proposed action would remove some of the truck traffic from local road network that serve surrounding communities, which improves safety for travelers using these roadways.

**Table 3** show the expected daily volumes along the new corridors for the years 2019 and 2040. The proposed action would provide access for local traffic, serving more than 1,000 additional vehicles per day at all locations south of Hwy. 62. The average daily traffic (ADT) is anticipated to increase over time.

**Table 3: Daily Traffic Volumes on New Alignment (2019 and 2040)**

Location	2019 Proposed Action ADT	2040 Proposed Action ADT
Corning Bypass	4,700	6,100
South of Hwy. 62	6,900	8,300
Black River Bridge (Pocahontas)	7,000	8,600
North of Walnut Ridge	5,400	6,900

Source: Project Team, 2021

## 5.3 Maintenance

The proposed action would construct a new location highway and new span bridge over the Black River. Routine maintenance activities such as mowing, herbicide application, etc. would be anticipated along the entire length of the proposed action. Additionally, there would be, over time, maintenance done to the roads and bridges, including to the bridge deck, culverts, etc.

## 5.4 Alternatives Considered

The proposed action identified by this Biological Assessment is the Preferred Alternative identified in the Draft Environmental Impact Study (DEIS). This proposed action consists of Alternative 2 for the Main Corridor and Alternative C for the Missouri Connector. Numerous other action alternatives were considered for the project including upgrading the existing Hwy. 67 facility to interstate standards (Alternatives 1 and B) as well as another new location interstate alternative located east of the Black River WMA (Alternative 3) and a Missouri Connector Alternative located on the west side of Hwy. 67 (Alternative A). Alternative 1 was dropped from further consideration as it did not address any purpose and need elements better than Alternative 2 and it would cause substantially greater negative impacts to the social, natural, and cultural environments compared to the other action alternatives. Alternatives 3, A, and B were retained for analysis in the DEIS but were not identified as the Preferred Alternative. Alternatives 2 and C form the Preferred Alternative and as detailed in the DEIS, these alternatives best meet the purpose and need of the project while minimizing impacts to the natural, cultural, and social environments to the extent possible. The Preferred Alternative fills in the gap that is currently present in the National Highway System and provides reliable and resilient transportation infrastructure to support economic growth for the region.



## Chapter 6 – Effects Analysis and Effect Determinations

The most likely general effects from the highway construction activities associated with the proposed action are as follows:

- Would remove trees (forested habitat) from the site prior to other construction activities.
- Would remove other important habitat such as emergent wetlands during grading of the roadway and/or embankment.
- Would construct new culverts at stream crossings and would replace or extend any existing culverts (some of which may provide potential roosting habitat for bat species).
- Would cause temporary soil disturbance from heavy equipment operation.
- Could temporarily increase sedimentation by exposing soils susceptible to erosion before the action area could be revegetated.
- Heavy equipment operation could directly impact or crush individual plants or animals on the ground or within the water.

The above construction activities are evaluated to determine potential effects to the nine federally listed and four candidate or proposed species that occur or may occur within the action area. Induced growth may also occur as highway infrastructure improvements have been associated with increases in residential, commercial, and industrial development. Those types of development would likely lead to increased amounts of non-point source pollution which impair water quality. However, induced growth for the proposed action is only anticipated to occur around the seven proposed interchanges.

Proposed management actions would include the use of BMPs outlined in the NPDES and Section 404, Clean Water Act permits that would be required for the proposed action. These BMPs ensure that construction related activities associated with the proposed action would not have detrimental effects on the water quality within the watershed.

Effects determinations are based on the current plan for the Black River to be completely spanned, there is no current funding for this project and if that changes as the project moves to final design and construction, then consultation with USFWS would be re-initiated.

### 6.1 No Effect

#### Red Knot

No suitable habitat is present in the action area for the Red Knot, which is usually found along mudflats associated with reservoirs. Due to the distance to known populations and the lack of suitable habitat within the action area for the Red Knot, the species is believed with reasonable certainty to be absent from the action area. Therefore, it has been determined that the proposed action would have “no effect” on the Red Knot.

#### Piping Plover

No suitable habitat is present in the action area for the Piping Plover, which inhabits beaches, shorelines, dry lakebeds, sandbars of major rivers, salt flats, and mudflats of reservoirs. Due to the distance to known populations and the lack of suitable habitat within the action area for the Piping Plover, the species is believed with reasonable certainty to be absent from the action area. Therefore, it has been determined that the proposed action would have “no effect” on the Piping Plover.





### Missouri bladderpod

No suitable habitat is present in the action area for this plant species, which primarily inhabits open limestone glades and dolomite glades. Due to the distance to known populations and the lack of suitable habitat within the action area for the Missouri bladderpod, the species is believed with reasonable certainty to be absent from the action area. Therefore, it has been determined that the proposed action would have “no effect” on the Missouri bladderpod.

### Hine’s emerald dragonfly

No suitable habitat is present in the action area for this dragonfly species, which inhabits calcareous spring-fed marshes and sedge meadows overlying dolomite bedrock. Due to the distance to known populations and the lack of suitable habitat within the action area for the Hine’s emerald dragonfly, the species is believed with reasonable certainty to be absent from the action area. Therefore, it has been determined that the proposed action would have “no effect” on the Hine’s emerald dragonfly.

### Ozark hellbender

No suitable habitat is present in the action area for this salamander species, which needs cool, clear streams and rivers with many large flat rocks. Due to the distance to known populations and the lack of suitable habitat within the action area for the Ozark hellbender, the species is believed with reasonable certainty to be absent from the action area. Therefore, it has been determined that the proposed action would have “no effect” on the Ozark hellbender.

### Critical Habitat

The Black River is Critical Habitat for the Rabbitsfoot; however, the portion of the Black River within the action area is not Critical Habitat; therefore, it has been determined that there would be no effect on Critical Habitat. No Critical Habitat for any of the other listed species is present in or near the action area.

## 6.2 May Affect, Not Likely to Adversely Affect (NLAA)

### Gray Bat - Federally Endangered

Based on coordination with USFWS and ANHC, no known caves are present within the action area. However, an estimated 36 structures (barns, sheds, abandoned buildings, culverts, or silos), and four existing bridges, are located within the proposed action and could provide suitable summer roosting habitat for the gray bat. No direct impacts would occur to the three existing bridges at the Hwy. 67/Hwy. 412 interchange that are to remain during construction. All other structures within the proposed right of way would be removed by the proposed action. The proposed action would also impact through removal an estimated 65.2 acres of forested areas that provide potentially suitable foraging habitat for the gray bat. Suitable structures and wooded riparian habitat would be directly impacted by the proposed action as a result of grading, clearing, and grubbing for roadway embankment and right of way construction activities. Future traffic noise from the proposed roadway may also have potential long-term effects to bat species. Schaub et al. (2008) found that captive greater mouse-eared bats (*M. myotis*) preferred (80% of the time) silent chambers versus chambers with playback of close traffic noise.

Temporary impacts to bats would include construction noise and potential sedimentation because of ground disturbing activities. Noise and vibration are stressors that may disrupt normal feeding, sheltering, and breeding activities of bats. Sedimentation in streams can hinder bat foraging by affecting aquatic and emerging insects on which the bats feed. All tributaries in the proposed action footprints have the potential to be affected by sedimentation impacts, although larger waterbodies would provide more habitat for aquatic and emerging insects. Temporary disturbance impacts to suitable summer



roosting habitat on the three bridges located at the Hwy. 67/Hwy. 412 interchange could occur as a result of construction activities such as night work, sign mounting, vibration from construction equipment, and demolition required for expanding the facilities.

Surveys for federally-listed bat species in August 2021 resulted in a probable absence for the gray bat within the action area. Further avoidance, minimization, and mitigation measures would be evaluated and implemented, as necessary, for the proposed action. Although an estimated 65.2 acres of forested habitat would be directly impacted by the proposed action, it has been determined that the proposed action “may affect but is not likely to adversely affect” the gray bat due to negative survey results and distance to any known bat occurrences.

### Indiana Bat - Federally Endangered

Based on coordination with USFWS and ANHC, no known occupied bat maternity roost trees were identified within 150 feet of the proposed action; however, potentially suitable roost trees are present within the corridor. Suitable structures and suitable wooded habitat would be directly impacted by the proposed action as a result of grading, clearing, and grubbing for roadway embankment and right of way construction activities. The clearing and grubbing of trees and other vegetated habitat would take place within the proposed right of way, including the expanded areas required for the proposed interchanges. The proposed action would impact through removal an estimated 65.2 acres of forested areas that provide potentially suitable summer roosting habitat for the Indiana bat. Additionally, an estimated 36 structures (barns, sheds, abandoned buildings, culverts, or silos), and four existing bridges, are located within the proposed action and could provide suitable summer roosting habitat for the Indiana bat. No direct impacts would occur to the three existing bridges at the Hwy. 67/Hwy. 412 interchange that are to remain during construction. All other structures within the proposed right of way would be removed by the proposed action. The forested summer roosting habitat, 36 structures, and one existing bridge would be directly impacted by the project as a result of complete removal by clearing, grubbing, and/or demolition activities. For the three existing bridges at the Hwy. 67/Hwy. 412 interchange that are to remain during construction, temporary and indirect impacts to these potentially suitable summer roosting habitats could occur within the action area as a result of construction noise and other activities, although evidence of bats was not observed during field investigations. These indirect impacts could include night work, sign mounting, vibration from construction equipment, and demolition required for expanding the facilities. Future traffic noise from the proposed roadway may also have potential long-term effects to bat species. Schaub et al. (2008) found that captive greater mouse-eared bats (*M. myotis*) preferred (80% of the time) silent chambers versus chambers with playback of close traffic noise.

Temporary impacts to bats would include construction noise and potential sedimentation because of ground disturbing activities. Noise and vibration are stressors that may disrupt normal feeding, sheltering, and breeding activities of bats. Sedimentation in streams can hinder bat foraging by affecting aquatic and emerging insects on which the bats feed. All tributaries in the proposed action footprints have the potential to be affected by sedimentation impacts, although larger waterbodies would provide more habitat for aquatic and emerging insects.

Surveys for federally-listed bat species in August 2021 resulted in a probable absence for all listed species within the action area. The closest known Indiana bat locations (based on ANHC record data) is over 2 miles northeast of the proposed action. Further avoidance, minimization, and mitigation measures would be evaluated and implemented, as necessary, for the proposed action. Although an estimated 65.2 acres of forested habitat would be directly impacted by the proposed action, it has been determined that the proposed action “may affect but is not likely to adversely affect” the Indiana bat due to the negative survey results and distance to any known bat occurrences.



### Northern Long-eared Bat - Federally Threatened

Based on coordination with USFWS and ANHC, and review of the Northern Long-eared Bat Consultation Area map and Final 4(D) Rule Guidance document, no known occupied bat maternity roost trees were identified within 150 feet of the action area; however, potential roost trees and suitable roosting structures are present within the footprint of the proposed action. Suitable structures and forested habitat would be directly impacted by the proposed action as a result of grading, clearing, and grubbing for roadway embankment and right of way construction activities. The proposed action would impact through removal an estimated 65.2 acres of forested areas that provide potentially suitable summer roosting habitat for the northern long-eared bat. Additionally, an estimated 36 structures (barns, sheds, abandoned buildings, culverts, or silos), and four existing bridges, are located within the proposed action and could provide suitable summer roosting habitat for the northern long-eared bat. No direct impacts would occur to the three existing bridges at the Hwy. 67/Hwy. 412 interchange that are to remain during construction. All other structures within the proposed right of way would be removed by the proposed action. The forested summer roosting habitat, 36 structures, and one existing bridge would be directly impacted by the project as a result of complete removal by clearing, grubbing, and/or demolition activities. For the three existing bridges at the Hwy. 67/Hwy. 412 interchange that are to remain during construction, temporary and indirect impacts to these potentially suitable summer roosting habitats could occur within the action area as a result of construction noise and other activities, although evidence of bats was not observed during field investigations. These indirect impacts could include night work, sign mounting, vibration from construction equipment, and demolition required for expanding the facilities. Future traffic noise from the proposed roadway may also have potential long-term effects to bat species. Schaub et al. (2008) found that captive greater mouse-eared bats (*M. myotis*) preferred (80% of the time) silent chambers versus chambers with playback of close traffic noise.

Temporary impacts to bats would include construction noise and potential sedimentation because of ground disturbing activities. Noise and vibration are stressors that may disrupt normal feeding, sheltering, and breeding activities of bats. Sedimentation in streams can hinder bat foraging by affecting aquatic and emerging insects on which the bats feed. All tributaries in the proposed action footprints have the potential to be affected by sedimentation impacts, although larger waterbodies would provide more habitat for aquatic and emerging insects. Temporary disturbance impacts to suitable summer roosting habitat on the three bridges located at the Hwy. 67/Hwy. 412 interchange could occur as a result of construction activities such as night work, sign mounting, vibration from construction equipment, and demolition required for expanding the facilities.

Surveys for federally-listed bat species in August 2021 resulted in a probable absence for all listed species within the action area. Closest known northern long-eared bat locations (based on ANHC record data) are over 2 miles northeast of the proposed action. Although an estimated 65.2 acres of forested habitat would be directly impacted by the proposed action, it has been determined that the proposed action “may affect but is not likely to adversely affect” the northern long-eared bat due to the negative survey results and distance to any known bat occurrences.

### Tricolored Bat - Federally Proposed Endangered

Potential roost trees and suitable roosting structures are present within the footprint of the proposed action. Suitable structures and forested habitat would be directly impacted by the proposed action as a result of grading, clearing, and grubbing for roadway embankment and right of way construction activities. The proposed action would impact through removal an estimated 65.2 acres of forested areas that provide potentially suitable summer roosting habitat for the tricolored bat. Additionally, an estimated 36 structures, and four existing bridges, are located within the proposed action and could



provide suitable summer roosting habitat. No direct impacts would occur to the three existing bridges at the Hwy. 67/Hwy. 412 interchange that are to remain during construction. All other structures within the proposed right of way would be removed by the proposed action. The forested summer roosting habitat, 36 structures, and one existing bridge would be directly impacted by the project as a result of complete removal by clearing, grubbing, and/or demolition activities. For the three existing bridges at the Hwy. 67/Hwy. 412 interchange that are to remain during construction, temporary and indirect impacts to these potentially suitable summer roosting habitats could occur within the action area as a result of construction noise and other activities, although evidence of bats was not observed during field investigations. These indirect impacts could include night work, sign mounting, vibration from construction equipment, and demolition required for expanding the facilities. Future traffic noise from the proposed roadway may also have potential long-term effects to bat species. Schaub et al. (2008) found that captive greater mouse-eared bats (*M. myotis*) preferred (80% of the time) silent chambers versus chambers with playback of close traffic noise.

Temporary impacts to bats would include construction noise and potential sedimentation because of ground disturbing activities. Noise and vibration are stressors that may disrupt normal feeding, sheltering, and breeding activities of bats. Sedimentation in streams can hinder bat foraging by affecting aquatic and emerging insects on which the bats feed. All tributaries in the proposed action footprints have the potential to be affected by sedimentation impacts, although larger waterbodies would provide more habitat for aquatic and emerging insects. Temporary disturbance impacts to suitable summer roosting habitat on the three bridges located at the Hwy. 67/Hwy. 412 interchange could occur as a result of construction activities such as night work, sign mounting, vibration from construction equipment, and demolition required for expanding the facilities.

Surveys for federally-listed bat species in August 2021 resulted in a probable absence for all listed species, including the proposed listed tricolored bat within the action area. ANHC data did not reveal a closest known tricolored bat location. Although an estimated 65.2 acres of forested habitat, 36 structures, and one bridge would be directly impacted by the proposed action, it has been determined that the proposed action will not jeopardize the continued existence of the species, due to the negative survey results and distance to any known bat occurrences.

### **Eastern Black Rail - Federally Threatened**

An estimated 4.5 acres of potentially suitable foraging habitat, in the form of emergent wetlands, were observed for the Eastern Black Rail. However, the use of herbicides to maintain cropland edge habitats reduces the likelihood of emergent wetland vegetation from becoming sufficiently dense or overgrown for extended periods of time to offer quality foraging habitat. Regardless, it is unlikely the rail would be present within this habitat. There are no records of occurrence in the State for the Eastern Black Rail and the species is likely a vagrant in Arkansas, passing through only during migration.

The proposed action would directly impact potentially suitable foraging habitat by removal due to fill necessary for the roadway and embankment. Temporary impacts resulting from sediment migration also could occur within the action area with sedimentation having the potential to affect the species foraging abilities and/or impair emergent wetland habitat. However, effects resulting from sedimentation are anticipated to be insignificant due to the implementation of erosion control BMPs.

The proposed action could remove 4.5 acres of potentially suitable habitat, albeit of low quality, for the Eastern Black Rail. However, the species is unlikely to be present and the likelihood of exposure is very low as indicated by the lack of occurrence data for the species within the State; therefore, any effects on



the Eastern Black Rail are expected to be discountable, and it has been determined that the proposed action “may affect but is not likely to adversely affect” the Eastern Black Rail.

### **Pondberry - Federally Endangered**

No known pondberry occurrence records were found within the footprint of the proposed action; however, known populations have been identified by ANHC within a forested area located approximately 5 miles east of the proposed action. Results of the 2022 pondberry survey conducted for the suitable habitat areas identified for the proposed action revealed no positive findings. The proposed action would impact an estimated 37.7 acres of depressional, forested wetland habitat that may be suitable for the pondberry. Direct impacts to suitable habitat would include clearing, grubbing, and filling for both roadway embankment and right of way.

As there are no known populations within the footprint of the proposed action, and pondberry was not observed during the April 2022 survey, the species is unlikely to be present and the likelihood of exposure is very low. Therefore, it has been determined that the proposed action “may affect but is not likely to adversely affect” the pondberry, and any effects on pondberry are expected to be insignificant.

### **Curtis Pearlymussel - Federally Endangered**

No Curtis Pearlymussel individuals were collected during the 2021 mussel survey of the Black River at the proposed action river crossing. Suitable habitat for the Curtis Pearlymussel appears to be present within the Black River, although the species is believed to be locally extirpated.

As the Black River would be spanned no direct impacts to the species or suitable habitat would occur. Temporary impacts to potentially suitable habitat within the action area include downstream sedimentation occurring during construction near the banks of the river and water quality effects from post-construction stormwater runoff. Goldsmith et al. (2020) found that increases in suspended solids could impact mussels by decreasing food availability, physically interfering with filter feeding and respiration, and impeding various aspects of the mussel host relationship. Construction related activities have the potential to disrupt the reproductive cycle of mussels in a variety of ways. Vibrations, which are common during construction, have stimulated mussels to artificially release glochidia in lab settings (USFWS, 2016). Also, temporary impacts to water quality may impact host fish by causing avoidance of the area, limiting visibility of the mussel’s lure, or decreasing available food forage. Both vibrations and sedimentation are common during construction activities. Any disturbances that may reduce the number of fish within the action area have the potential to reduce mussel/host interactions.

As a cooperating agency, the USFWS would be involved to suggest AMMs as the design plans are being developed. Proximity to the construction area, placement of work roads, and temporary impacts to water quality could all impact the species. Timely implementation and maintenance of effective erosion control measures during construction would be particularly important to minimizing adverse effects to Black River mussel resources. Further avoidance, minimization, and mitigation measures would be evaluated and implemented into the proposed action. These measures may include water quality monitoring during construction.

As explained in Section 4.2, approximately 50% of the Black River within the action area provides suitable habitat for mussels. Thus, of the 2.9 acres of the Black River occurring within 300 feet downstream and 100 feet upstream of the proposed action footprint, it is estimated that a total of approximately 1.5 acres of suitable habitat is present for the Curtis Pearlymussel. However, the species is unlikely to be present and the likelihood of exposure is very low as the species is likely extirpated and the proposed action would involve no work within the Black River. Therefore, it has been determined



that the proposed action “may affect but is not likely to adversely affect” the Curtis Pearlymussel, and any effects are expected to be discountable.

### **Pink Mucket - Federally Endangered**

The proposed action is approximately seven river miles upstream from known occurrences of the Pink Mucket within the Black River; however, no Pink Mucket individuals were collected during the 2021 mussel survey, but suitable habitat for the Pink Mucket appears to be present within the Black River.

As the Black River would be spanned, no direct impacts to the species or suitable habitat would occur. Temporary impacts to potentially suitable habitat within the action area include downstream sedimentation occurring during construction near the banks of the river and water quality effects from post-construction stormwater runoff. Goldsmith et al. (2020) found that increases in suspended solids could impact mussels by decreasing food availability, physically interfering with filter feeding and respiration, and impeding various aspects of the mussel host relationship. Construction related activities have the potential to disrupt the reproductive cycle of mussels in a variety of ways. Vibrations, which are common during construction, have stimulated mussels to artificially release glochidia in lab settings (USFWS, 2016). Also, temporary impacts to water quality may impact host fish by causing avoidance of the area, limiting visibility of the mussel’s lure, or decreasing available food forage. Both vibrations and sedimentation are common during construction activities. Any disturbances that may reduce the number of fish within the action area have the potential to reduce mussel/host interactions.

As a cooperating agency, the USFWS would be involved to suggest AMMs as the design plans are being developed. Proximity to the construction area, placement of work roads, and temporary impacts to water quality could all impact the species. Timely implementation and maintenance of effective erosion control measures during construction would be particularly important to minimizing adverse effects to Black River mussel resources. Further avoidance, minimization, and mitigation measures would be evaluated and implemented into the proposed action. These measures may include water quality monitoring during construction.

As explained in Section 4.2, approximately 50% of the Black River within the action area provides suitable habitat for mussels. Thus, of the 2.9 acres of the Black River occurring within 300 feet downstream and 100 feet upstream of the proposed action footprint, it is estimated that a total of approximately 1.5 acres of suitable habitat is present for the Pink Mucket. However, the species was not encountered during the mussel survey and the proposed action would not involve any work within the Black River. Therefore, it has been determined that the proposed action “may affect but is not likely to adversely affect” the Pink Mucket, and any effects are expected to be insignificant.

### **Rabbitsfoot - Federally Threatened**

During the 2021 mussel survey, two Rabbitsfoot mussels were collected in the Black River within the footprint of the proposed action. See Section 4.2 for details.

As the Black River would be spanned, no direct impacts to the species or suitable habitat would occur. Temporary impacts to potentially suitable habitat within the action area include downstream sedimentation occurring during construction near the banks of the river and water quality effects from post-construction stormwater runoff. Goldsmith et al. (2020) found that increases in suspended solids could impact mussels by decreasing food availability, physically interfering with filter feeding and respiration, and impeding various aspects of the mussel host relationship. Construction related activities have the potential to disrupt the reproductive cycle of mussels in a variety of ways. Vibrations, which are common during construction, have stimulated mussels to artificially release glochidia in lab settings



(USFWS, 2016). Also, temporary impacts to water quality may impact host fish by causing avoidance of the area, limiting visibility of the mussel's lure, or decreasing available food forage. Both vibrations and sedimentation are common during construction activities. Any disturbances that may reduce the number of fish within the action area have the potential to reduce mussel/host interactions.

As a cooperating agency, the USFWS would be involved to suggest AMMs as the design plans are being developed. Proximity to the construction area, placement of work roads, and temporary impacts to water quality could all impact the species. Timely implementation and maintenance of effective erosion control measures during construction would be particularly important to minimizing adverse effects to Black River mussel resources. Further avoidance, minimization, and mitigation measures would be evaluated and implemented into the proposed action. These measures may include water quality monitoring during construction.

As explained in Section 4.2, approximately 50% of the Black River within the action area provides suitable habitat for mussels. Thus, of the 2.9 acres of the Black River occurring within 300 feet downstream and 100 feet upstream of the proposed action footprint, it is estimated that a total of approximately 1.5 acres of suitable habitat is present for the Rabbitsfoot. However, as the proposed action would not involve any work within the Black River, the likelihood of exposure is very low and effects are expected to be insignificant. Therefore, it has been determined that the proposed action "may affect but is not likely to adversely affect" the Rabbitsfoot.

#### **Scaleshell Mussel - Federally Endangered**

No Scaleshell Mussel individuals were collected during the 2021 mussel survey of the Black River at the proposed action river crossing; however, suitable habitat for the Scaleshell Mussel appears to be present within the Black River.

As the Black River would be spanned, no direct impacts to the species or suitable habitat would occur. Temporary impacts to potentially suitable habitat within the action area include downstream sedimentation occurring during construction near the banks of the river and water quality effects from post-construction stormwater runoff. Goldsmith et al. (2020) found that increases in suspended solids could impact mussels by decreasing food availability, physically interfering with filter feeding and respiration, and impeding various aspects of the mussel host relationship. Construction related activities have the potential to disrupt the reproductive cycle of mussels in a variety of ways. Vibrations, which are common during construction, have stimulated mussels to artificially release glochidia in lab settings (USFWS, 2016). Also, temporary impacts to water quality may impact host fish by causing avoidance of the area, limiting visibility of the mussel's lure, or decreasing available food forage. Both vibrations and sedimentation are common during construction activities. Any disturbances that may reduce the number of fish within the action area have the potential to reduce mussel/host interactions.

As a cooperating agency, the USFWS would be involved to suggest AMMs as the design plans are being developed. Proximity to the construction area, placement of work roads, and temporary impacts to water quality could all impact the species. Timely implementation and maintenance of effective erosion control measures during construction would be particularly important to minimizing adverse effects to Black River mussel resources. Further avoidance, minimization, and mitigation measures would be evaluated and implemented into the proposed action. These measures may include water quality monitoring during construction.

As explained in Section 4.2, approximately 50% of the Black River within the action area provides suitable habitat for mussels. Thus, of the 2.9 acres of the Black River occurring within 300 feet



downstream and 100 feet upstream of the proposed action footprint, it is estimated that a total of approximately 1.5 acres of suitable habitat is present for the Scaleshell Mussel. However, the species was not encountered during the mussel survey and the proposed action would not involve any work within the Black River; therefore, it has been determined that the proposed action “may affect but is not likely to adversely affect” the Scaleshell Mussel, and any effects are expected to be insignificant.

### **Pyramid Pigtoe - Proposed Threatened**

No Pyramid Pigtoe individuals were collected during the 2021 mussel survey of the Black River at the proposed action river crossing; however, suitable habitat for the Pyramid Pigtoe appears to be present within the Black River.

As the Black River would be spanned no direct impacts to the species or suitable habitat would occur. Temporary impacts to potentially suitable habitat within the action area include downstream sedimentation occurring during construction near the banks of the river and water quality effects from post-construction stormwater runoff. Goldsmith et al. (2020) found that increases in suspended solids could impact mussels by decreasing food availability, physically interfering with filter feeding and respiration, and impeding various aspects of the mussel host relationship. Construction related activities have the potential to disrupt the reproductive cycle of mussels in a variety of ways. Vibrations, which are common during construction, have stimulated mussels to artificially release glochidia in lab settings (USFWS, 2016). Also, temporary impacts to water quality may impact host fish by causing avoidance of the area, limiting visibility of the mussel’s lure, or decreasing available food forage. Both vibrations and sedimentation are common during construction activities. Any disturbances that may reduce the number of fish within the action area have the potential to reduce mussel/host interactions.

As a cooperating agency, the USFWS would be involved to suggest AMMs as the design plans are being developed. Proximity to the construction area, placement of work roads, and temporary impacts to water quality could all impact the species. Timely implementation and maintenance of effective erosion control measures during construction would be particularly important to minimizing adverse effects to Black River mussel resources. Further avoidance, minimization, and mitigation measures would be evaluated and implemented into the proposed action. These measures may include water quality monitoring during construction.

As explained in Section 4.2, approximately 50% of the Black River within the action area provides suitable habitat for mussels. Thus, of the 2.9 acres of the Black River occurring within 300 feet downstream and 100 feet upstream of the proposed action footprint, it is estimated that a total of approximately 1.5 acres of suitable habitat is present for the Pyramid Pigtoe. However, the species was not encountered during the mussel survey and the proposed action would not involve any work within the Black River; therefore, it has been determined that the proposed action “may affect but is not likely to adversely affect” the Pyramid Pigtoe, and any effects are expected to be insignificant.

### **Western Fanshell - Proposed Threatened**

During the 2021 mussel survey, one Western Fanshell mussel was collected in the Black River within the footprint of the proposed action. See Section 4.2 for details.

As the Black River would be spanned, no direct impacts to the species or suitable habitat would occur. Temporary impacts to potentially suitable habitat within the action area include downstream sedimentation occurring during construction near the banks of the river and water quality effects from post-construction stormwater runoff. Goldsmith et al. (2020) found that increases in suspended solids could impact mussels by decreasing food availability, physically interfering with filter feeding and





respiration, and impeding various aspects of the mussel host relationship. Construction related activities have the potential to disrupt the reproductive cycle of mussels in a variety of ways. Vibrations, which are common during construction, have stimulated mussels to artificially release glochidia in lab settings (USFWS, 2016). Also, temporary impacts to water quality may impact host fish by causing avoidance of the area, limiting visibility of the mussel's lure, or decreasing available food forage. Both vibrations and sedimentation are common during construction activities. Any disturbances that may reduce the number of fish within the action area have the potential to reduce mussel/host interactions.

As a cooperating agency, the USFWS would be involved to suggest AMMs as the design plans are being developed. Proximity to the construction area, placement of work roads, and temporary impacts to water quality could all impact the species. Timely implementation and maintenance of effective erosion control measures during construction would be particularly important to minimizing adverse effects to Black River mussel resources. Further avoidance, minimization, and mitigation measures would be evaluated and implemented into the proposed action. These measures may include water quality monitoring during construction.

As explained in Section 4.2, approximately 50% of the Black River within the action area provides suitable habitat for mussels. Thus, of the 2.9 acres of the Black River occurring within 300 feet downstream and 100 feet upstream of the proposed action footprint, it is estimated that a total of approximately 1.5 acres of suitable habitat is present for the Western Fanshell. However, the proposed action would not involve any work within the Black River and any effects are expected to be insignificant. Therefore, it has been determined that the proposed action "may affect but is not likely to adversely affect" the Western Fanshell.

#### **Alligator snapping turtle - Proposed Threatened**

No surveys were conducted for the alligator snapping turtle, but the species occurs in the Black River WMA, which is located approximately 1 mile east of the proposed action, and historical records document occurrence in the Black River within Lawrence, Randolph, and Clay counties (Wagner et al., 1996).

Some potentially suitable habitat for the alligator snapping turtle may occur within the Black River in the form of slow-moving, deep water, though habitat is anticipated to be very limited due to few log jams or other suitable structures (Kelly Irwin [AGFC Herpetologist] personal communication, July 6, 2022). There is also a potential for the species to occur within Murray Creek due to its direct connection to the Black River WMA. However, it is unlikely individuals would be present in Murray Creek, which lacks deep water and is unlikely to contain high densities of prey. A maximum total of approximately 6.9 acres of potentially suitable habitat occurs in these two waterbodies within 300 feet downstream and 100 feet upstream of the proposed action footprint. As the Black River would be spanned, no direct impacts to the species or suitable habitat would occur within the Black River. Due to the lack of deep waters, alligator snapping turtles in Murray Creek, if present, are anticipated to be transient and highly mobile, making the likelihood of exposure very low.

As the alligator snapping turtle is an ambush predator that stays motionless in the water and lures unsuspecting prey with the worm-like appendage on their tongues, sedimentation may hinder their hunting ability. Temporary impacts resulting from sedimentation could occur, which could reduce visibility of the turtles' prey or cause prey to leave the area. However, incorporation of ARDOT Special Provisions, such as Water Pollution Control, Storm Water Pollution Prevention Plan, and Vegetated Buffer Zone Special Provisions would help to limit sediment from entering waterbodies during construction. Furthermore, erosion and sediment control BMPs would further minimize sedimentation



during construction. Further avoidance, minimization, and mitigation measures would be evaluated and implemented into the proposed action. It has been determined that the proposed action “may affect but is not likely to adversely affect” the alligator snapping turtle; however, the effects on the alligator snapping turtle are expected to be insignificant.

### 6.3 May Affect, Likely to Adversely Affect (LAA)

#### Monarch butterfly - Federal Candidate

Monarch butterflies were not observed during site investigations, and no occurrences have been documented in the project area. However, it is known that monarchs migrate through Arkansas (AGFC, 2022). Potentially suitable habitat, within the project area, is characterized as fallow fields and emergent wetlands that have the potential to contain milkweed and nectar-producing plants.

ARDOT has entered into a Voluntary Prelisting Species Conservation Program (VPL), which proposes to implement mowing and herbicide efforts, wildflower plantings, in ARDOT right of ways to benefit the monarch. On January 25, 2021, USFWS issued a Programmatic Conference Opinion (PCO) that concluded the actions proposed in the VPL are not likely to jeopardize the continued existence of these species. The USFWS PCO is provided in **Appendix E**.

Populations of the monarch within the action area are anticipated to be in low densities as suitable habitat is of low density and agricultural practices are prevalent. While direct mortality to adults is anticipated to be low due to their mobility, direct mortality may still occur during construction, especially if larva or caterpillars are present during vegetation removal. Peak monarch migration in Arkansas typically occurs in late September and early October. As detailed in the PCO, vehicle-associated mortality may occur during migration periods once the facility is operational; however, conservation measures implemented through the VPL are anticipated to reduce vehicle-associated mortality through the establishment of a clear zone between the travel lanes and the transition zone and where wildflowers would be allowed to grow. Additionally, conservation measures outlined within the VPL establish seasonal mowing times and frequencies to avoid removing habitat during peak migration times and reduce mortality related to mowing. The VPL also establishes commitments to restore, enhance, maintain, and create pollinator habitat within ARDOT right of way. The proposed action (i.e., a 40-mile new location interstate) would bring an estimated 1,324 acres under the ARDOT right of way system that would be available to plant in wildflowers. Currently, these 1,324 acres are in a predominately agricultural land use, which is not considered suitable habitat for monarchs.

It is anticipated the proposed action would directly impact 9.4 acres of potentially suitable habitat by clearing during construction. However, a portion of these impacts are anticipated to be temporary as areas within the proposed right of way would return to herbaceous habitat and be planted with a wildflower seed mix. Approximately 3.3 acres of potentially suitable habitat would be permanently converted to pavement for the proposed roadway.

The effect of the proposed action to individual monarchs is difficult to quantify due to the species’ small body size, rapid scavenging of larvae, and migratory nature. Although the number of individual monarchs affected by the proposed action cannot be accurately estimated, quantifying permanent and short-term habitat loss should more accurately measure and track effects to the monarch and its habitat since take of individuals is generally unknown. Habitat loss as a surrogate measure reflects the spatial extent of exposure to the proposed action-caused stressors. The spatial extent of habitat in the action area affected by the proposed action is a maximum of 9.4 acres of habitat loss.



ARDOT's VPL when implemented, would provide additional host plants and nectar plants for the monarch butterfly, allowing for increased abundance and distribution of the species with the intent the VPL will provide an overall net benefit to monarchs. Details of the conservation measures are provided in the USFWS PCO (**Appendix E**). Additionally, after construction, ARDOT would sow six native wildflowers at a rate of 4 pounds per acre as a conservation measure. Of the 2,408 acres within the proposed action footprint, an estimated 1,324 acres of right of way would be planted in wildflowers after construction.

The proposed action would remove suitable monarch habitat and may directly impact the species when present. Therefore, it has been determined that the proposed action "may affect, likely to adversely affect" the monarch butterfly.

## 6.4 Interrelated and Interdependent Actions and Activities

The use of offsite areas, for borrow and waste pits, has the potential to increase sediment entering waterways within the action area. Landowners and Contractors are responsible for obtaining NPDES permits for these sites, if applicable. BMPs required by the NPDES permit would reduce sediment from entering waterbodies.

## 6.5 Cumulative Effects

Under Section 7 of the ESA, cumulative effects are defined as "those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." [50 CFR §402.02]. Those effects of future non-federal (state, local, government, private, or any other non-federal entity) and future federal actions are subject to the consultation requirements established in Section 7 and, therefore, are not considered cumulative effects. Future ARDOT projects would likely either utilize federal funding from the USDOT or require a Section 404 Clean Water Act Permit. Both actions would require separate Section 7 consultations. However, areas surrounding the proposed interchanges are on private property and could be developed over time causing habitat loss, possible noise impacts, and water quality effects.

After project completion, mowing of the right of way is done with State Forces and with State dollars; therefore, mowing itself is not a federal action and fits the cumulative effects definition. Mowing would affect all life stages of monarchs (eggs, larvae, pupae, and adults) by cutting or crushing individuals on milkweed in mowed right of way. Mowing conducted during the growing season would affect monarchs through the reduction of resources (i.e., removal of required host plants and nectar-producing plants during the active season).



## Chapter 7 – References

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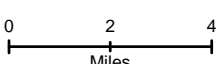
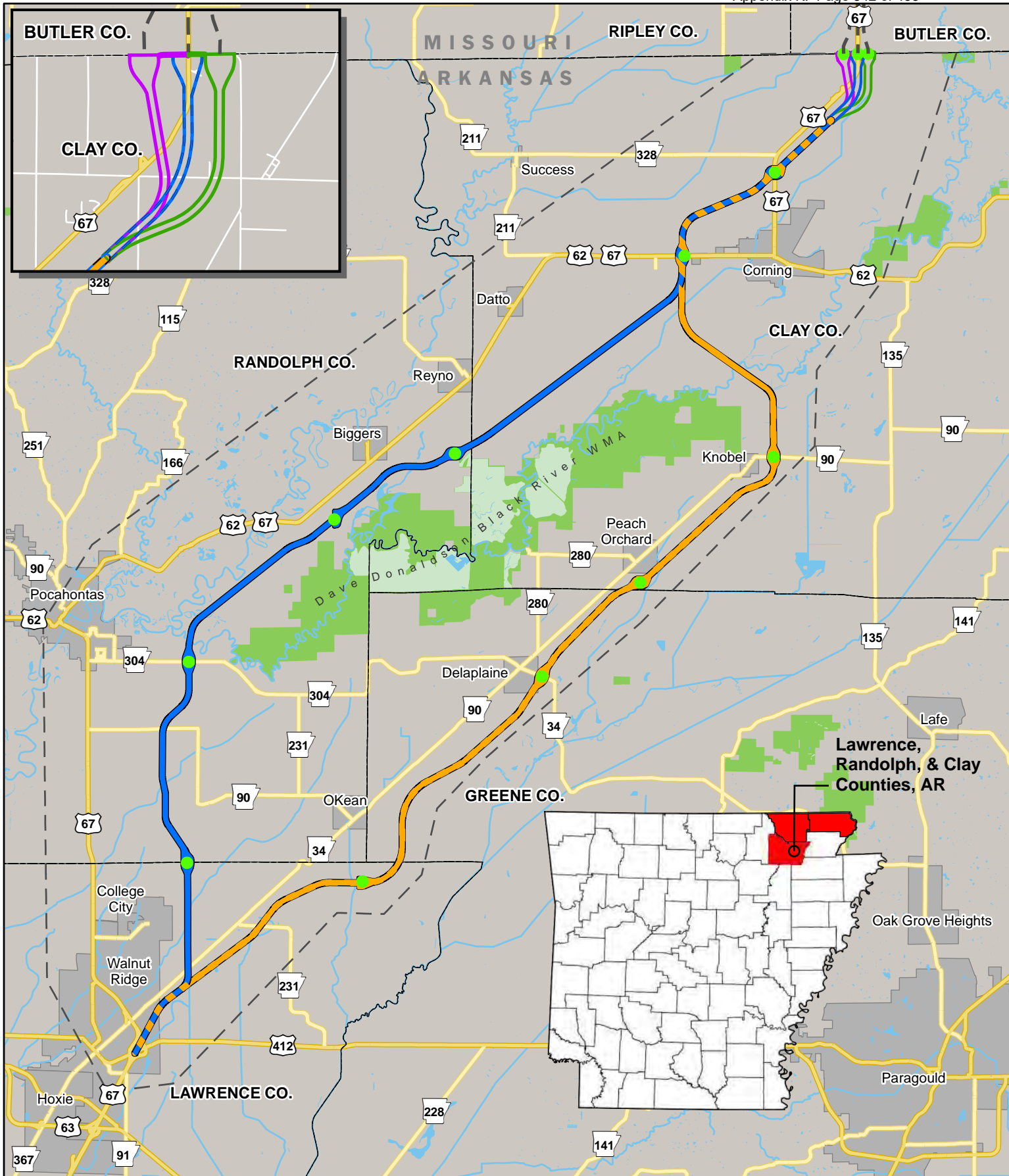


## APPENDIX A — SUPPORTING ILLUSTRATIONS

Project Location Map

Typical Sections of Proposed Roadway

Habitat and Action Area Maps (removed as it's provided in Attachment A of the Biological Technical Report)



- █ Alternative 2
- █ Alternative 3
- █ Alternative B
- █ Alternative C
- █ Alternative
- Project Study
- Possible Future Corridor for MoDOT's Section of I-57
- Proposed Interchange Location

**WALNUT RIDGE - MISSOURI STATE LINE (FUTURE I-57)**  
 Randolph, Clay, Greene and Lawrence Counties

**Alternatives**







## APPENDIX B — PONDBERRY SURVEY MEMO

This memo has been removed from this BA as it is provided in Attachment E of the Biological Technical Report.





## APPENDIX C — BAT SURVEY REPORT

This report has been removed from this BA as it is provided in Attachment C of the Biological Technical Report.



## APPENDIX D — MUSSEL SURVEY REPORT

This report has been removed from this BA as it is provided in Attachment D of the Biological Technical Report.



# **APPENDIX E — PROGRAMMATIC CONFERENCE OPINION FOR ARDOT VOLUNTARY PRELISTING SPECIES CONSERVATION PROGRAM**

**Programmatic Conference Opinion**  
for  
**Arkansas Department of Transportation**  
**Voluntary Prelisting Species Conservation Program**

FWS Log #: 04ER1000-2020-FC-0754



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## EXECUTIVE SUMMARY

This Endangered Species Act (ESA) Programmatic Conference Opinion (PCO) of the U.S. Fish and Wildlife Service (Service) addresses the Arkansas Department of Transportation (ARDOT) Voluntary Pre-listing Conservation Program (VPL). The ARDOT proposes to implement mowing and herbicide efforts, wildflower planting, and actions in right-of-ways (ROW) in Arkansas to benefit at-risk butterfly and crayfish species. The ARDOT determined that the Action is likely to adversely affect Monarch Butterfly, Frosted Elfin Butterfly, Irons Fork Burrowing Crayfish, Ouachita Burrowing Crayfish, Slenderwrist Burrowing Crayfish, Bayou Bodcau Crayfish, and Jefferson County Crayfish and requested formal conference with the Service. The PCO concludes that the Action is not likely to jeopardize the continued existence of these species. This conclusion fulfills the requirements applicable to the Action for completing consultation under §7(a)(2) of the ESA of 1973, as amended, with respect to these species and designated critical habitats.

The ARDOT will mow ROWs a maximum of three times during the growing season. The ROW from the outer pavement edge to 3 m (10 ft) corresponds to the clear zone and will be mowed three times a year (April 1–May 25, July, and October 1–Thanksgiving). The transition zone corresponds to the area of the ROW outside of the clear zone beginning 3m (10 ft) from the outer pavement edge up to 9 m (30 ft) from the outer pavement edge and will be mowed only in the fall cycle. The PCO describes additional conservation mowing efforts are detailed in section 2 *Proposed Action*. Herbicide application will take place 5 to 10 days after the July mowing and will incorporate conservation measures to limit the negative effects of herbicides on covered species. The existing wildflower planting program will be expanded. Actions to benefit burrowing crayfish will be implemented in areas where the endemic species have potential to occur (*e.g.*, within or near known range).

The conservation program, when implemented, will provide additional host plants and nectar plants for the three lepidopteran species, allowing for increased abundance and distribution of these species. The mowing, herbicide application, and taxa-specific conservation efforts will provide a net benefit to crayfish species.

The PCO includes an Incidental Take Statement (ITS) that requires the ARDOT to implement reasonable and prudent measures that the Service considers necessary or appropriate to minimize the impacts of anticipated taking on the covered species, if the Service lists the species under the ESA and adopts this PCO as a PBO. However, the Service recognizes the proposed program's conservation measures and recommends no additional reasonable and prudent measures. Incidental taking of listed species in compliance with the terms and conditions of this statement is exempted from the prohibitions against taking under the ESA.

In the Conservation Recommendations section, the PCO outlines voluntary actions that are relevant to the conservation of the listed species addressed in this PCO and are consistent with the authorities of ARDOT.

Reinitiating consultation is required if ARDOT retains discretionary involvement or control over the Action (or is authorized by law) when:

- (a) the amount or extent of incidental take is exceeded;
- (b) new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this PCO;
- (c) the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this PCO; or
- (d) a new species is listed or critical habitat designated that the Action may affect.

## **CONSULTATION HISTORY**

This section lists key events and correspondence during the course of this consultation. A complete administrative record of this consultation is on file in the Service's Arkansas Ecological Services Field Office (ARFO).

2019-09-25: The Service and ARDOT met to discuss conservation tools to benefit at-risk pollinators and other species of concern.

2019-02-27: The Service and ARDOT met to discuss baseline environmental assessments and monitoring as part of the program.

2020-12-09: ARDOT provided the Service with a final voluntary prelisting conservation program for eight at-risk species and requested informal consultation and elective formal conference for the proposed program.

2020-12-15: The Service provided ARDOT with a letter of concurrence and a letter of initiation of formal conference.

2020-01-04: The Service provided ARDOT with a draft programmatic conference opinion (PCO) for the voluntary prelisting conservation program.

2020-01-08: ARDOT provided comments to the draft PCO.

2020-01-25: The Service provided ARDOT with a finalized PCO for the voluntary prelisting conservation program.



## BIOLOGICAL OPINION

### 1. INTRODUCTION

A biological opinion (BO) is the document that states the findings of the U.S. Fish and Wildlife Service (Service) required under section 7 of the Endangered Species Act of 1973, as amended (ESA), as to whether a federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

A conference opinion (CO) is equivalent to a BO, but addresses species not yet listed under the ESA and/or proposed critical habitats not yet designated. Therefore, the ESA prohibitions against jeopardizing species, destroying critical habitat, and taking animals do not yet apply. The Service may adopt a CO as a BO if and when the evaluated species/critical habitat are listed/designated and while the action agency's discretion and involvement in the Action continue.

A programmatic conference opinion (PCO) addresses multiple actions on a program and/or regional basis, thus achieving efficiencies in the process. The federal action addressed in this PCO is the Arkansas Department of Transportation (ARDOT) proposed statewide voluntary prelisting species conservation program (VPL). This PCO excludes projects that may affect any listed or at-risk species other than the covered species. For right-of-way (ROW) projects that are federally funded, the Federal Highway Administration (FHWA) serves as the lead federal action agency. The ARDOT represents FHWA for the purposes of this consultation and has initiated a formal conference process with the Service. This PCO considers the effects of the Action on Monarch Butterfly, Frosted Elfin Butterfly, Irons Fork Burrowing Crayfish, Ouachita Burrowing Crayfish, Slenderwrist Burrowing Crayfish, Bayou Bodcau Crayfish, and Jefferson County Crayfish. The Action does not affect designated or proposed critical habitat; therefore, this PCO does not address critical habitat.

#### **PBO/PCO Analytical Framework**

A PCO that concludes a proposed federal action is *not* likely to *jeopardize the continued existence* of listed species and is *not* likely to result in the *destruction or adverse modification* of critical habitat fulfills the federal agency's responsibilities under §7(a)(2) of the ESA.

*“Jeopardize the continued existence* means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species” (50 CFR §402.02).

*“Destruction or adverse modification* means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species” (50 CFR §402.02).

The Service determines in a PCO whether we expect an action to satisfy these definitions using the best available relevant data in the following analytical framework (see 50 CFR §402.02 for the regulatory definitions of *action*, *action area*, *environmental baseline*, *effects of the action*, and *cumulative effects*):

- a. *Proposed Action.* Review the proposed federal action and describe the environmental changes its implementation would cause, which defines the action area.
- b. *Status.* Review and describe the current range-wide status of the species or critical habitat.
- c. *Environmental Baseline.* Describe the condition of the species or critical habitat in the action area, without the consequences to the listed species caused by the proposed action. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the Action area, the anticipated impacts of all proposed federal projects in the Action Area that have already undergone formal or early consultation, and the impacts of state or private actions which are contemporaneous with the consultation.
- d. *Effects of the Action.* Predict all consequences to species or critical habitat caused by the proposed Action, including the consequences of other activities caused by the proposed Action, which are reasonably certain to occur. Activities caused by the proposed Action would not occur but for the proposed Action. Effects of the Action may occur later in time and may include consequences that occur outside the Action Area.
- e. *Cumulative Effects.* Predict all consequences to listed species or critical habitat caused by future non-federal activities that are reasonably certain to occur within the Action Area.
- f. *Conclusion.* Add the effects of the action and cumulative effects to the environmental baseline, and in-light of the status of the species, formulate the Service's opinion as to whether the Action is likely to jeopardize species or adversely modify critical habitat.

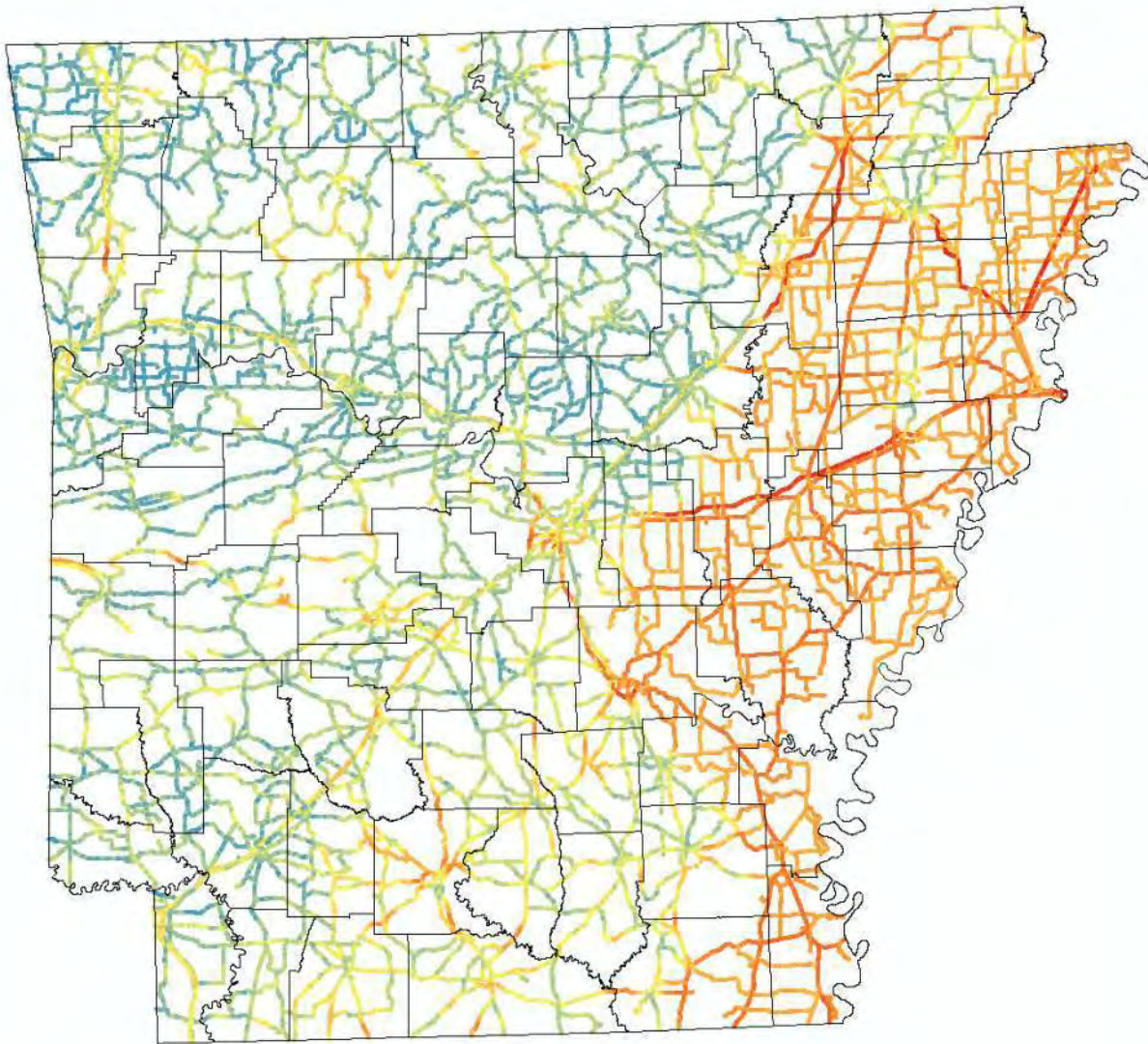
## 2. PROPOSED ACTION

The VPL is a statewide initiative. It covers all roads and highway ROWs in Arkansas where ARDOT has the authority to implement, maintain, and monitor voluntary conservation actions. Approximately 25,598 km (15,906 mi) of state or federally owned or maintained highways is in Arkansas with an estimated 70,221 ha (173,520 ac) of ROW associated with these highways (also state owned and maintained) are included in the program. The VPL covers routine and ongoing road maintenance activities conducted by ARDOT with the potential to affect covered species.

The VPL considers effects to covered species during necessary routine roadside maintenance and ROW projects and proposes conservation actions to preserve, enhance, or restore suitable habitat in selected sites to provide net conservation benefit to the covered species. The VPL includes eight covered species expected to occur on or near the highway ROW expected to be affected by ROW maintenance activities. The ARDOT will modify proposed conservation efforts following adaptive management principles as monitoring results identify the need for adjustment and as new scientifically valid opportunities in line with ARDOT conservation and management goals arise.

Voluntary conservation actions will be coordinated, administered, and carried out by ARDOT staff and contractors. ARDOT maintenance personnel are responsible for much of the mowing and herbicide application along our highway system. Contract mowers maintain the Interstate system, divided highways and other major routes.

ARDOT will use the Landscape Prioritization Tool or other Service accepted tool for initial identification of roadsides with the greatest potential for enhancement or establishment of high quality monarch habitat. An ARDOT preliminary assessment of ROW suitability in Arkansas using this tool to assess the potential for conservation actions to benefit monarchs showed widespread areas of opportunity (Figure 2-1). The ARDOT estimates approximately 10 percent of ROWs in Arkansas contain sufficient herbaceous cover to benefit covered species with implemented conservation mowing and herbicide application efforts.



**Figure 2-1.** ARDOT Roadside Monarch Habitat Suitability results of MJV Landscape Prioritization Model. Red is least suitable, orange somewhat, yellow moderately, green more suitable, and blue is most suitable. Model is based on adjacent land use (landcover and crop type), including pesticide risk.

ARDOT voluntary prelisting conservation actions fall into four broad categories. The ARDOT may implement conservation actions from multiple categories on each site as appropriate to reach ARDOT program goals. Likewise, each site may have different actions each year or

actions may occur seasonally, as determined by site-specific needs. The four categories of conservation efforts include increased implementation of the following:

- 1) conservation mowing timing and methods in ROWs
- 2) conservation herbicide application methods in ROWs
- 3) ARDOT Wildflower Program; and
- 4) actions to benefit endemic burrowing crayfish species.

## 2.1. Conservation Mowing

The voluntary conservation actions in the conservation mowing program seek to increase implementation of the practices and methods detailed below to benefit covered species.

### State forces mowing regime:

All routes will be mowed a maximum of three times a year:

- 1) Prior to the observed date for Memorial Day,
- 2) During the month of July, and
- 3) Between October 1 and Thanksgiving

Mowing will not begin prior to April 15. However, ARDOT may adjust the start date for some limited routes in the pre-emergent herbicide program. The ARDOT will modify mowing widths or schedules to accommodate certain established wildflower areas. The ARDOT will mow 3 m (10 ft) wide swaths on first and second mowings (*e.g.*, ROW clear zone). The swath width for the final (fall clean-up) mowing will be 9 m (30 ft) from the pavement edge or less depending on distance to right-of-way or natural zone. The fall mowing width corresponds to the clear zone and transition zone in the ROW (Figure 2-1). However, ARDOT will mow up to full right-of-way width every cycle in front of residences where owners stop mowing at the right-of-way line and along frontage or properties that are cleared and maintained.

On contract-mowed divided highways, a normal mowing swath extends 9 m (30 ft) from the outside and inside edge. ARDOT will mow the entire median areas less than 18 m (90 ft) in width and other areas designated on the plans. ARDOT will trim vegetation around all fixed objects, including but not limited to guardrails, delineators, signs, culvert headwalls, bridge abutments, and bridge piers concurrently with the mowing operation. If interchanges have transition zones (greater than 9 m (30 ft) out from pavement), ARDOT will mow these as part of the third mowing cycle (Figure 2-3).

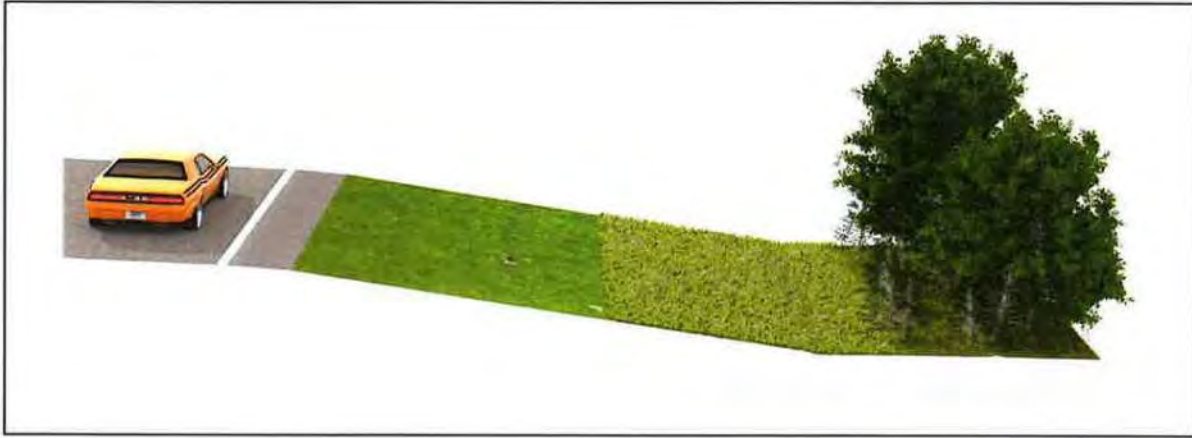


Figure 2-2. Illustration of the three typical zone in ARDOT ROW.



Figure 2-3. Schematic for mowing interchanges along state highways and interstates.

### **Mowing Exceptions - Good Neighbor Policy**

ARDOT's Good Neighbor Policy is the practice of matching the highway right-of-way vegetation height to that of the adjacent privately owned land. Property owners whose property abuts the ROW on non-controlled access roads are allowed to mow and maintain their frontage properties in between our mowing cycles. On controlled access freeways, the ROW is maintained at standard or established mowing widths regardless of the adjacent property. If an

adjoining property owner requests additional mowing and/or clearing, the Department will review the request. Interchanges within city limits in Arkansas are often maintained by the city; therefore, they are also an exception to the statewide transition zone. Urban areas are not included in this program, so the Good Neighbor Policy will be applied infrequently.”

## **2.2. Conservation Herbicide Application**

The goal of ARDOT conservation herbicide program is to eliminate unwanted vegetation, including tall and woody vegetation and non-native invasive species (NNIS). ARDOT seeks to reduce the effect of herbicide use on covered species with an integrated approach that incorporates a range of methods to prevent and manage weeds and non-compatible vegetation including:

- 1) limiting nonselective broadcast applications, which can damage host or nectar plants;
- 2) using herbicides as efficiently as possible to reduce the amount applied;
- 3) reducing off-site movement of herbicides; and,
- 4) limiting direct exposure of covered species to herbicides, when possible.

### **Herbicide Applications for ROW in Contract and Non-contract routes**

ARDOT expects herbicide application to include the following general categories of actions.

- Spraying around guardrails, signs, bridge ends, Interstate service road fences, and cable median barriers
- Spraying gravel shoulders, cracks, and edge of paved shoulders
- Broadcast spraying for annual weeds and grass on primary and secondary routes, as needed
- Broadcast and spot treatment for Johnson grass, dallis grass, and crab grass
- Cut surface treatment of woody vegetation following mechanical brush control
- Pre-emergent herbicide treatments along selected routes
- Adjustments to dates will be made as necessary for routes currently applying pre-emergent and that remain in the pre-emergent herbicide program.

To achieve a net benefit to species, the following conservation actions will apply to all herbicide application for ROW in contract and non-contract routes.

- ARDOT will use broadcast treatments or pellet dispersal only for dense infestations of weeds or non-compatible vegetation in the transition zone.
- Broadcast applications of herbicides during the growing season should be limited to a period of 5 to 10 days after the second mowing cycle in July for both contract and state forces routes.
- Herbicide application will occur only in areas mowed in the second mowing cycle.

- No broadcast spraying will occur on designated Wildflower Routes.
- Spot treatment for Johnson grass, thistles, ragweed, and other targeted invasive weeds may take place at any time during the growing season and on any part of the right-of-way determined necessary to control those plants.
- The ARDOT will selectively apply (spot treatment) herbicide to target plants with a backpack sprayer, weed wiper, or similar technology. Cut stems, stumps, or underneath bark will receive highly targeted herbicide application.

The ARDOT will implement the following general herbicide best management practices in all herbicide applications.

#### Chemical:

- Chemical use is restricted to EPA approved chemicals and those listed in VPL Appendix A. The ARDOT will apply herbicides strictly per the product label and herbicides will not be used off-label.
- All ARDOT herbicide applicators must have a valid license and will use herbicide application techniques that reduce damage to non-target plants.
- In addition, training of field crews to distinguish NNIS and encroaching woody vegetation from desired host and nectar plants.
- Contracts will include specifications to hold contractors accountable to use of proper techniques.
- The herbicide applicator will complete the Daily Herbicide Spray Report each day and file it at the District. These reports are completed for every route and location sprayed. The District will keep records for a period of two years in compliance with state and federal law. Evaluation of monitoring results will consider the site, date, application method, and herbicide.

#### Drift:

- ARDOT uses drift control agents in all broadcast herbicide applications, as recommended by product labeling. Application will not occur when wind speeds are greater than 10 mph or when a temperature inversion (when warmer air above traps cooler air near the ground, suggested by no wind or wind speed below 2 mph) is in place or expected.
- All spray trucks are equipped with a remote control spray system capable of spraying various widths, from 2 to 9 m (6 to 30 ft).
- ARDOT will use nozzles that produce larger droplets (less likely to drift off target) in herbicide application.
- ARDOT will regularly calibrate equipment to avoid over-application.

#### **Environmental Restraining Conditions Maps**

The ARDOT supplies each District with an Environmental Restraining Conditions Map that outlines areas of herbicide restriction for every District and their responsible counties. Since 1990, ARDOT has maintained an inventory of federally listed and state tracked plants and animals found in ARDOT ROWs based on the Arkansas Natural Heritage Commission Records Database. These maps alert District maintenance personnel of sensitive areas and waterbodies to avoid while performing routine maintenance tasks, such as spraying herbicides to maintain the clear zone. The ARDOT will continue to restrict herbicide use and apply any additional voluntary conservation actions as part of this program to sensitive areas and waterbodies.

### **2.3. Wildflower Planting**

ARDOT District staff select areas within highway ROWs where suitable habitat for wildflowers (District Wildflower Plots) can be planted and established. In 2017, approximately 50 acres of highway ROWs were planted in native wildflowers across the state. The Districts have also been identifying ROW with excessive scrub-shrub vegetation and removing said vegetation to reestablish clear line of sight for travelers. Removing woody vegetation from ROWs improves or establishes suitable habitat for all covered species. As part of the voluntary prelisting conservation program, ARDOT will increase these wildflower plots and will incorporate the following measures to ensure success.

- Continue to assess potential sites with a goal of 6 ha (15 ac) per year planted in wildflower seed mix.
  - A GIS Landscape Prioritization Tool or other Service accepted tool will be used for initial identification of roadsides with the greatest potential for high quality monarch habitat development. This tool was developed by Monarch Joint Venture in partnership with the University of Minnesota, Oklahoma State University, Environmental Incentives, and the Xerces Society, with critical input from a variety of road program managers. This project builds on the leadership shown by many transportation departments in providing pollinator habitat and developing pollinator friendly management practices. The Prioritization Tool user manual is included in Appendix B of the voluntary prelisting conservation program.
- Remove woody scrub and shrub vegetation in clear and transition zones.
- Site preparation including mechanical, chemical, or treatment by fire, as appropriate.
- Signage of site for public awareness of conservation actions and site appearance as it matures to wildflower meadow
- Plant a native seed mix, including plants to benefit covered species (includes *Baptisia* spp., and milkweed spp.)

### **2.4. Activities to Benefit Burrowing Crayfish**

In addition to mowing and herbicide conservation actions expected to affect vegetation in species habitat, ARDOT will implement the following practices to affect hydrology within current species' ranges to benefit covered crayfish species:



### Site Inventory and Protection

In counties with covered species occurrence, ARDOT will inventory or catalogue ROW sites with favorable hydrology for crayfish species (as indicated by chimney presence or other signs) as potential sites for conservation efforts. The ARDOT will add identified sites to the herbicide restriction map and place signage where appropriate.

### Ditch Cleanout and Dredging

Within the current ranges for the covered crayfish, ARDOT will carry out ditch cleanout or dredging efforts only when necessary due to actual obstruction of function, not as part of a regularly scheduled maintenance activity.

### Hydrology

Suitable habitat for burrowing crayfish includes treeless, wet seepage areas with an abundance of low grasses and sedges. Most surveys for these species occur along primary, secondary, and tertiary roadways; therefore, species occurrence in ROW is established.

- Areas with suitable hydric soil types, gradual slope, and facultative wetland plant occurrence are potential sites for habitat creation.
- ARDOT may create these conditions by adjusting hydrology with small check dams or removing some soil to allow dip or swale creation (to hold water and facilitate movement of species).
- ARDOT will revegetate created suitable habitat with appropriate sedges and other native vegetation to decrease erosion and allow covered crayfish species cover from predators.

In areas where necessary maintenance occurs (*e.g.*, replacement of culverts, modification or maintenance of approaches or shoulders), creation of suitable habitat and relocation efforts to suitable habitat for the species will take place prior to the maintenance actions.

### Demonstration Area

If the Action creates covered species habitat, ARDOT will work with other agencies, organizations, or academic institutions to facilitate monitoring of the site as a demonstration area to fill data gaps for covered species. Based on monitoring results from the demonstration areas, ARDOT will employ recommended adaptive management strategies to benefit covered crayfish species.

## **2.5. Proposed Monitoring**

The ARDOT will conduct annual monitoring on a minimum of 50 plots in Action Area implementation sites. The ARDOT will use a stratified random sampling approach to choose representative sites (45 m (150 ft) x ROW width). The surveyors will assess each plot using the [Rapid Roadside Habitat Assessment](#) from Monarch Joint Venture (MJV) to collect data and generate a set of habitat quality scores. The monitoring protocol estimates total cover of potentially blooming nectar plants and documents presence of each native species to the extent feasible, based on surveyors expertise. Surveyors count milkweed stems (by species, if possible) and record noxious weed species presence. The ARDOT will enter data into the associated MJV

Habitat Quality Calculator to generate breeding, foraging, threats, and management scores and overall habitat score for that plot.

## **2.6. Other Activities Caused by the Action**

A PCO evaluates all consequences to species or critical habitat caused by the proposed federal action, including the consequences of other activities caused by the proposed Action, that are reasonably certain to occur (see definition of “effects of the action” at 50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities caused by the proposed Action (but not part of the proposed Action) are reasonably certain to occur. These factors include, but are not limited to:

- 1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed Action;
- 2) existing plans for the activity; and
- 3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, ARDOT did not describe, and the Service is not aware of, any additional activities caused by the Action that are not included in the previous description of the proposed Action. Therefore, this PCO does not address further the topic of “other activities” caused by the Action.

## **2.7. Action Area**

The action area is defined as “all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the Action” (50 CFR §402.02). Delineating the Action Area is necessary for the federal action agency to obtain a list of species and critical habitats that may occur in that area, which necessarily precedes any subsequent analyses of the effects of the Action to particular species or critical habitats.

It is practical to treat the Action Area for a proposed federal action as the spatial extent of its direct and indirect “modifications to the land, water, or air” (a key phrase from the definition of “action” at 50 CFR §402.02). Indirect modifications include those caused by other activities that would not occur but for the Action under consultation. The Action Area determines any overlap with critical habitat and the physical and biological features therein that we defined as essential to the species’ conservation in the designation final rule. For species, the Action Area establishes the bounds for an analysis of individuals’ exposure to action-caused changes, but the subsequent consequences of such exposure to those individuals are not necessarily limited to the Action Area.

Since this PCO collectively evaluates a large number of individual actions, the Action Area for this PCO includes all locations of ARDOT ROW maintenance consistent with and implemented under the VPL. The VPL is a statewide initiative and covers all roads and highway ROWs in Arkansas where ARDOT has the authority to implement, maintain and monitor voluntary conservation actions. Approximately 26,445 km (16,432 mi) of state or federally owned or maintained highways with an estimated 70,221 ha (173,520 ac) of ROW associated with these highways (also state owned and maintained) occur in the following seven level III ecoregions in

Arkansas: Mississippi Valley Loess Plains, Mississippi Alluvial Plain, Ozark Highlands, Boston Mountains, Arkansas Valley, Ouachita Mountains, South Central Plains (Figure 2-4) (EPA 2010, Chapman *et al.* 2002, 2004a, 2004b; Griffith *et al.* 1998). The ARDOT estimates approximately 10 percent of the ROW in Arkansas, 7,022 ha (17,352 ac), contains sufficient herbaceous cover to benefit covered species with implementation of conservation efforts.



**Figure 2-4.** Level III ecoregions of Arkansas (Environmental Protection Agency 2010).

### 3. SOURCES OF CUMULATIVE EFFECTS

A PCO must predict the consequences to species caused by future non-federal activities within the Action Area, *i.e.*, cumulative effects. “Cumulative effects are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the Action Area of the federal action subject to consultation” (50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities are reasonably certain to occur. These factors include, but are not limited to, existing plans for the activity and any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, ARDOT did not describe, and the Service is not aware of, any future non-federal activities that are reasonably certain to occur within the action area.

Therefore, we anticipate no cumulative effects that we must consider in formulating our opinion for the Action.

## **4. MONARCH BUTTERFLY**

This section provides the Service's PCO of the Action for the Monarch Butterfly. The North American Monarch Butterfly (*Danaus plexippus plexippus*) is an iconic insect known for its inter-generational long distance annual migration from essential overwintering areas in Mexico to Canada and back to Mexico.

### **4.1. Status of Monarch Butterfly**

This section summarizes best available data about the biology and condition of Monarch Butterfly throughout its range that are relevant to formulating an opinion about the Action. On December 17, 2020, the Service published a 12-month finding on a petition to list the Monarch Butterfly (*Danaus plexippus plexippus*) as a threatened species under the Endangered Species Act of 1973, as amended. After a thorough review of the best available scientific and commercial information, the Service found that listing the Monarch Butterfly as an endangered or threatened species is warranted but precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants. The Service will develop a proposed rule to list the Monarch Butterfly as our priorities allow.

#### **4.1.1. Species Description**

Monarch butterflies are bright orange with black and white markings and a wingspan of 8.9–10.2 cm (3½–4 in). Female markings are a dull orange, while males have a much brighter orange coloration and a black spot on each hind wing. Caterpillars have yellow, white, and black bands.

#### **4.1.2. Life History**

The monarch undergoes complete metamorphosis in approximately 30 days (i.e., four stages of egg, larva (caterpillar), pupa (chrysalis) and adult). Females lay eggs on the leaves of milkweed plants, and after three to five days, the caterpillar hatches. Caterpillars eat milkweed leaves as they grow and molt. The caterpillar goes through five instars in a period of 10 to 14 days. After the fifth instar, the caterpillar will pupate and spend 9–14 days as a chrysalis (pupa). When fully developed, the adult butterfly will emerge from the chrysalis and disperse for feeding and breeding. Adults live two to six weeks in the summer, while migrating monarchs live approximately six to nine months through the winter (Jepsen *et al.* 2015).

Monarch caterpillars feed almost exclusively on plant species in the genus *Asclepias*, as well as a few species in closely related genera. In North America, 27 different milkweed species serve as larval food plants. Milkweeds used by monarchs grows in rangelands, agricultural lands, riparian areas, wetlands, deserts, prairies, grasslands, open forests, woodlands and roadsides. In the eastern U.S., the widely distributed common milkweed (*Asclepias syriaca*) is a common monarch larval food, and in the southern U.S., green milkweed (*Asclepias viridis*) is an important host plant for monarchs (Jepsen *et al.* 2015). Monarch caterpillars sequester cardenolides (cardiac glycosides) from milkweed plants, which makes the caterpillars and adults toxic to predators. To fuel their migration and eventual overwintering, monarchs forage from a wide variety of plant species for nectar (Jepsen *et al.* 2015).

The life history of the monarch in North America is subject to its unique migratory life cycle. In eastern North America, monarchs migrate each autumn to high-elevation forests in central Mexico, where they overwinter as reproductively inactive adults in dense clusters on oyamel fir (*Abies religiosa*) trees. Monarchs arrive in the overwintering areas in Mexico between October and December. With reduced metabolism in the cold climate, monarchs live off the nectar obtained during the migration and do not feed again until February. Monarchs that survive the winter fly north in the spring. When they reach areas with patches of milkweed, they mate and lay eggs.

#### *Habitat and Migration*

Monarch Butterfly habitat is complex. In general, breeding areas are practically all areas in North America with patches of milkweed. Monarch butterflies are generalists that use diverse habitats during the breeding season (Flockhart *et al.* 2013). Wintering habitat for eastern monarch populations is chiefly high-elevation, oyamel fir forests in Mexico. The size of the Monarch Butterfly breeding range is over 1,000,000 km<sup>2</sup> (386,102 mi<sup>2</sup>), while their wintering range is only a few hectares (Jepsen *et al.* 2015).

#### **4.1.3. Numbers, Reproduction, and Distribution**

Two distinct migratory populations occur - the central/eastern population and the western population. A non-migratory population occurs in southern Florida. The Monarch Butterfly population has declined significantly (approximately 90 percent) between 1994 when robust annual monitoring first began and 2014 (Jepsen *et al.* 2015).

#### *Eastern Population*

Since 1994, when systematic monitoring of monarchs on their Mexican wintering grounds began, the Eastern population has generally declined (Fig. 4-1; Vidal and Rendón-Salinas 2014). In the winter of 2013-2014, numbers fell to about 14 million after consistently numbering in the hundreds of millions in the 1990s and early 2000s. Population estimates rely on an assumed density of 21.1 million monarchs/hectare occupied on the wintering grounds (Thogmartin *et al.* 2017a).

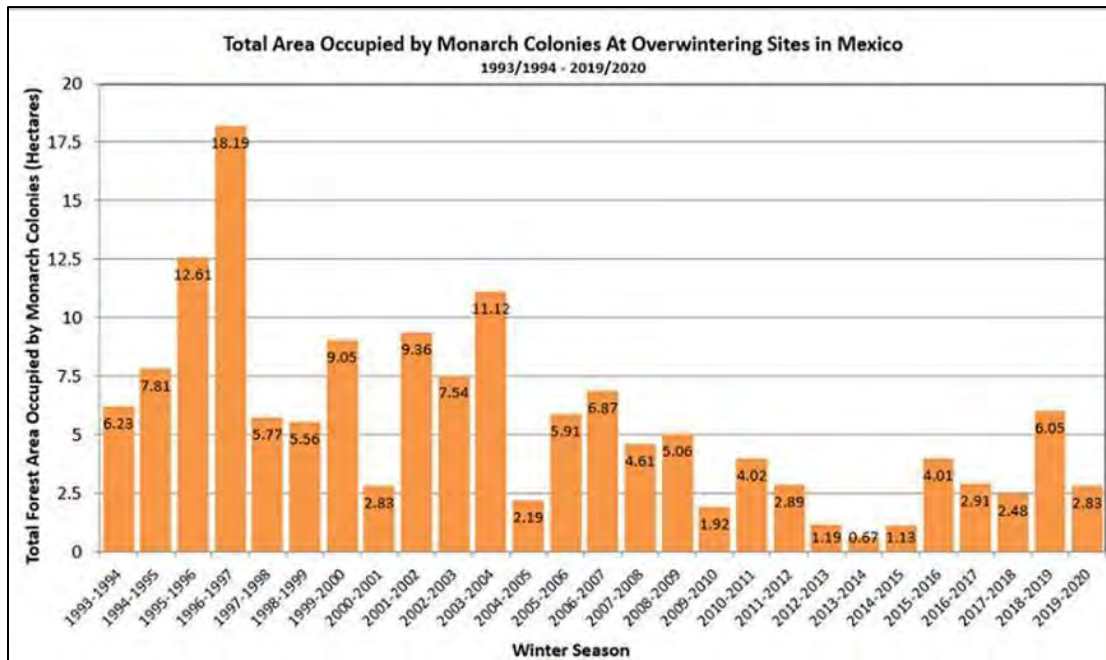
#### *Western North American Population*

Based on annual censuses, the Western population has been declining generally since 1997 (Fig. 4-2). Recent work was able to use surveys conducted before 1997 to document a population that consisted of millions of butterflies in the mid-1980s (Schultz *et al.* 2017).

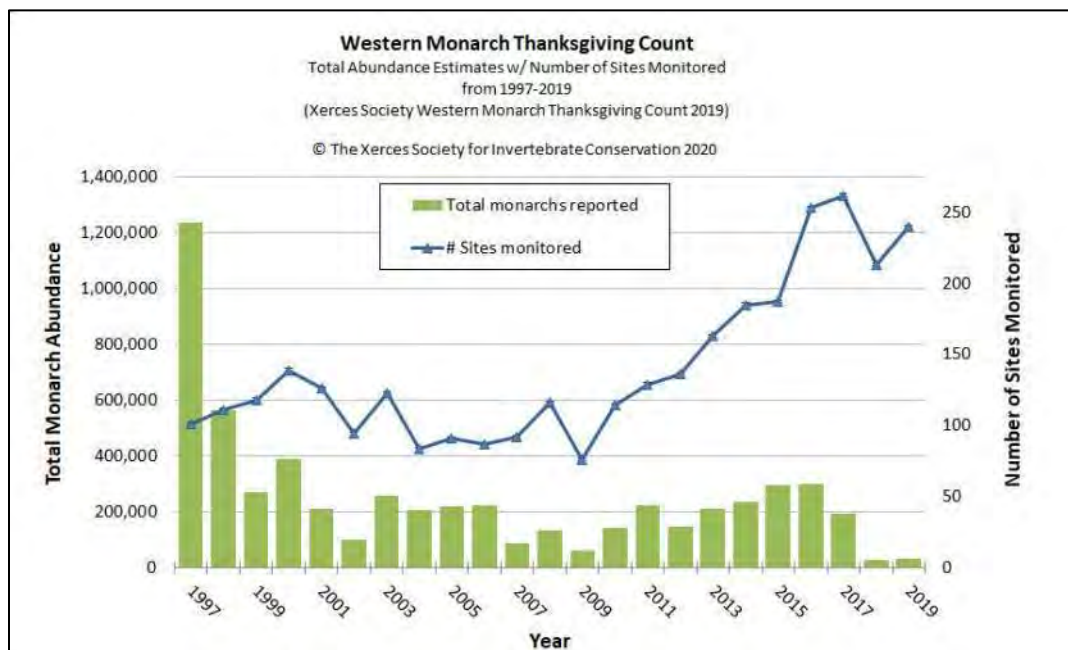
#### **4.1.4. Conservation Needs and Threats**

Sources of the marked population decline include loss of habitat, reduction in host plant (milkweed) populations, reduction in spring and fall nectar plants, deforestation of overwintering habitat in Mexico, and climate change. Recent analyses conclude that the recent decline of North American monarchs is primarily the result of changes in the breeding habitat, not the wintering habitat (Miller *et al.* 2012, Brower *et al.* 2012, Pleasants and Oberhauser 2013, Flockhart *et al.* 2013, Flockhart *et al.* 2014, Butler 2014, Inamine *et al.* 2016). Specifically, a scarcity of milkweed in the landscape can lead to prolonged search time by gravid female monarchs (Zalucki and Lammers 2010), increasing susceptibility to predation, inclement

weather, pesticide exposure, and other threats. This scarcity also leads to decreased larval survival due to resource competition (Flockhart *et al.* 2012).



**Figure 4-1.** Total area occupied by monarch colonies at overwintering sites in Mexico. Data from 1994-2003 were collected by personnel of the Monarch Butterfly Biosphere Reserve (MBBR) of the National Commission of Protected Natural Areas in Mexico. Data from 2004-2020 were collected by the World Wildlife Fund-Telcel Alliance, in coordination with the Directorate of the MBBR. 2000-01 population number as reported by Garcia-Serrano *et al.* (2004). Image Source: Monarch Joint Venture.



**Figure 4-2.** Thanksgiving counts showing the number of western North American Monarch Butterflies observed at overwintering sites (green bars). Blue line shows the number of sites monitored for a given year. Figure from the Western Monarch Count Resource Center (<https://www.westernmonarchcount.org/data/>; accessed February 3, 2020).

Monarchs lay eggs on, and larvae feed only on plants in the milkweed family (Asclepiadaceae), primarily those in the genus *Asclepias* (Zalucki and Brower 1992). Milkweed species have suffered large declines in numbers, primarily as a result of habitat reduction due to recent changes in agricultural practices, including herbicide use and herbicide-tolerant crop varieties (Thogmartin *et al.* 2017). Several authors have pointed to the decline of milkweed on agricultural lands as a primary factor in the decline of the eastern monarch population (Waterbury and Potter 2018, Pleasants and Oberhauser 2013, Brower *et al.* 2012). The density of monarch eggs and larvae in an area may increase with milkweed density up to about 0.6 milkweed stems per m<sup>2</sup> ( $\approx 2,428$  stems per acre) (Kasten *et al.* 2016). Although milkweed conservation alone may not be sufficient to preserve the eastern population and its migration to Mexico (Inamine *et al.* 2016, p. 1089), the loss of milkweed has been substantial. The Service expects efforts to increase milkweed in rights-of-way and across the agricultural landscape will benefit the monarch.

A reduction in nectar availability is a threat to monarchs during reproductive and migratory periods. Grassland nectaring habitats in the Texas and Oklahoma migratory corridors and along the coast from Louisiana to Mexico where monarchs nectar extensively and store fat to survive winter are especially important to the eastern population (Tracy 2018, Brower *et al.* 2006). A diversity of nectar resources ensures areas function as monarch habitat during multiple seasons. During the fall, for example, milkweed is no longer blooming and areas only function as monarch habitat if they contain sufficient amounts of late-blooming species, *e.g.*, members of the aster or sunflower family (Asteraceae/Compositae) (Inamine *et al.* 2016, Rudolph *et al.* 2006).

Other threats to milkweed habitat include excessive roadside mowing, development, reforestation and insecticide use for mosquito control (Oberhauser *et al.* 2006), roadkill mortality, development and conversion of grasslands, and drought (Service 2018b).

The native North American monarch populations are vulnerable to changes to overwintering grounds, although the sites in Mexico and some in California have some level of protection. Overwintering sites in Mexico have been under pressure from logging, agricultural, and urban development.

A recent analysis found that the risk of loss of a viable migratory population of monarchs in eastern North America over the next 20 years was between 11 percent and 57 percent (Semmens *et al.* 2016). The same study estimated that in order to halve this risk, the monarch population would need to increase approximately 5-fold (relative to the winter of 2014–15). The Service has recommended monarch conservation work focusing on geographic priorities, opportunity areas, and threats to be avoided.

## **4.2. Environmental Baseline for Monarch Butterfly**

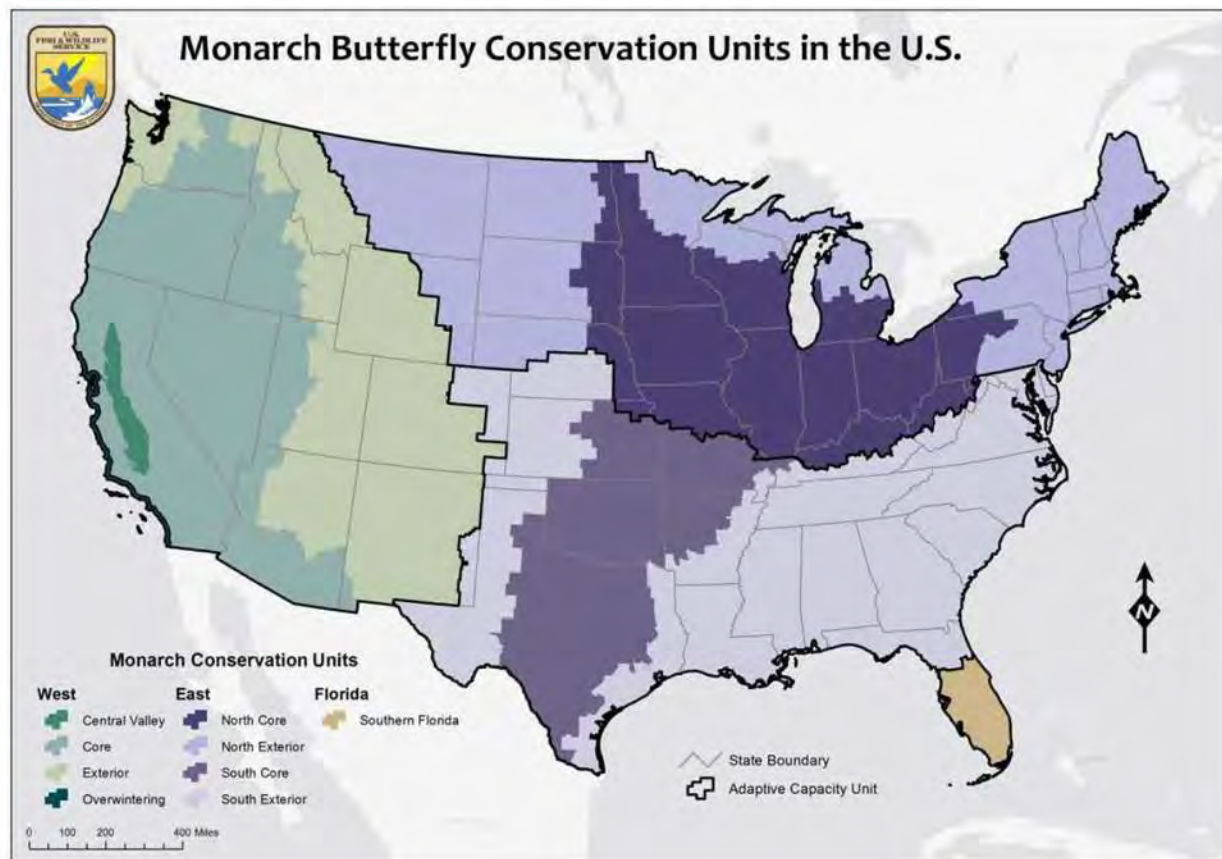
This section describes the best available data about the condition of Monarch Butterfly in the action area without the consequences caused by the proposed Action.

#### 4.2.1. Action Area Numbers, Reproduction, and Distribution

Arkansas is within the eastern monarch population spring (April–May) and fall (September–October) migratory route. In Arkansas, monarchs occur statewide, with larger numbers found in the northwest, northeast, and southwest portions of the state. The Service is not aware of monarch population estimates for Arkansas.

#### 4.2.2. Action Area Conservation Needs and Threats

The Service has defined three population units and nine conservation units for this species. Northwestern Arkansas is in the South Core conservation unit for the eastern monarch population while southeastern Arkansas is in the South Exterior unit (Figure 4-3). The primary threats to the eastern population relevant in the conservation units in Arkansas are changes in milkweed and nectar abundance and herbicide exposure (particularly widespread agricultural use of glyphosate). Voluntary conservation actions by ARDOT to address these conservation needs and threats include compatible habitat management in ROWs, targeted reductions in glyphosate use, and increases in milkweed and nectar stem count density and overall acreage.



**Figure 4-3.** Monarch Butterfly conservation units as defined by the U.S. Fish & Wildlife Service. The dark purple North Core unit constitutes the primary breeding range of monarchs in the eastern U.S., with secondary breeding habitat found in the North Exterior unit. The South Core represents the core of the migratory corridor for monarchs.



### 4.3. Effects of the Action on Monarch Butterfly

In a PCO for a listed species, the effects of the proposed Action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action area. In addition, this analysis describes the net conservation benefit to the Monarch Butterfly as a result of the Action.

We identified and described the activities included in the proposed action in sections 2.1–2.4. We identified and described other activities caused by the proposed action in section 2.5. Our analyses of the consequences caused by each of these activities follows.

Components of the Action intended solely for the benefit of covered crayfish species will have no effect on the Monarch Butterfly. Our effects analyses will not further address those activities.

We focus our effects analyses primarily on how the Action will affect the abundance of milkweed stems. Implicit in these analyses is the assumption that effects to milkweed will include actions that interact directly with monarchs in ways that result in the death or injury of monarchs (*e.g.*, by crushing individuals that are on or near milkweed plants). Actions that affect milkweed will also affect the species indirectly by introducing stressors. These include primarily mowing, broadcast application of herbicides, and other activities in monarch habitat that removes or reduces the availability of larval food plants and adult nectar sources.

#### 4.3.1. Vegetation Management

The Action will implement vegetation management practices of mowing and herbicide application in ROWs.

##### *Mowing*

Mowing methods can be adapted to benefit monarchs, but as Cariveau *et al.* (2019) state with respect to monarchs, “(M)owing, in particular, is a complex topic.” Factors that determine whether it benefits or harms monarchs overall include its timing, frequency, and extent (Webb 2017, p. iv). Several authorities have identified it as a tool that can benefit the species. Thogmartin *et al.* (2017) identified “pollinator-friendly” mowing practices as a possible action to increase milkweed and nectar sources in rights-of-way. However, mowing without planning for effects to monarch can have negative effects to the species.

The proposed action includes mowing of the ROW clear zone adjacent to the pavement in the first two mowing cycles (April 12-May 25 and in July). Milkweed may occur in any part of the ROW, but we expect greater abundance in the ROW transition zone. For milkweed in the clear zone, early and mid-season mowing 2–4 weeks prior to egg-laying may increase monarch egg densities and decreases subsequent predation pressure on the eggs and resulting larvae (Knight *et al.* 2019). Female monarchs preferred to lay eggs on regenerating monarch stems in the recently mowed plots. Although less effective than the later mowing, the earlier mowing also produced modest increases in egg densities relative to controls. These effects could be related to reduced abundance of predators on regenerating milkweeds (Haan and Landis 2019). Mowing may benefit the monarch in the short-term but could reduce seed production (Fischer *et al.* 2015).

In Arkansas, monarchs occur from mid-March to mid-October. The proposed action includes mowing of the entire ROW (clear zone and transition zone) between October 1 and Thanksgiving. Peak monarch migration in Arkansas typically occurs in late September and early October. Mowing during this period would affect adult monarchs. A “fifth generation” of monarchs may be present in Arkansas during this period. Monarch eggs, larvae, and pupae present on milkweed during the fall mowing cycle would be affected through crushing, loss of host plant, increased competition for remaining milkweed resources, and increased exposure to predation.

The Service expects mowing will affect all life stages of monarchs (eggs, larvae, pupae, and adults) by cutting or crushing individuals on milkweed in mowed ROW. Mowing conducted during the growing season will affect monarch through the reduction of resources-removal required host plants and nectar-producing plants during the active season.

### *Herbicide Application*

Although herbicides are formulated to kill plants and do not target insects, recent research indicates that some herbicides may be toxic to butterflies, particularly when ingested by caterpillars eating treated plants. Often, the herbicides are not immediately lethal but still have negative effects such as reducing butterfly size, weight, developmental rates, and survival. (Russell and Schultz 2010, Stark *et al.* 2012, Bohnenblust *et al.* 2013, and Schultz *et al.* 2016). These direct sub-lethal effects may reduce butterfly populations over time (Stark *et al.* 2012). These studies did not focus on monarchs, and further research into the effects of commonly used herbicides, tank mixes, surfactants, and other inert ingredients in formulated products on monarchs will inform ARDOT decisions, when available.

Broadcast herbicide application in July after second cycle mowing on highway rights-of-way will have direct effects on milkweed and nectar plants when present in the ROW clear and transition zones. Milkweed and blooming nectar plant species are herbaceous plants sensitive to the herbicides used in ARDOT maintenance activities. The Service expects the loss of host or nectar plants may negatively affect larval monarchs through reduction in host plant resources and adult monarchs through loss of nectar sources and host plant oviposition sites. ARDOT will minimize negative effects to milkweed and monarchs through conservation efforts including training and selective targeting of woody vegetation and nonnative invasive plant species.

### **4.3.2. Vehicle Mortality**

The Service expects VPL conservation efforts will increase the abundance of monarchs and other pollinators in the ROW through increases in abundance and distribution of host plants and nectar plants. Although vehicle-associated mortality may occur due to the proximity of these species to moving traffic, recent studies have shown that monarch mortality decreases as ROW width and habitat quality (increase in milkweed and nectar-producing plants) increases (Kantola *et al.* 2019, Skorka *et al.* 2013, McKenna *et al.* 2001). McKenna *et al.* (2001) stated that migrating monarchs typically fly “...high enough to avoid collision with vehicles, but during mid-morning and during windy weather, they generally fly lower to the ground (Orley Taylor pers. comm. cited therein).

An exception to this decrease in mortality occurs when migrating monarchs are concentrated and funneled due to topography (*e.g.*, sites in Texas and Mexico) (Kantola *et al.* 2019, Tracy *et al.*

2019). Maintaining the ROW clear zone through mowing and herbicide application may remove suitable or potentially suitable habitat from the highway ROW. This lack of suitable habitat acts as a physical buffer between traffic and butterflies and moths, reducing vehicle-associated mortality.

### 4.3.3. Beneficial Effects

The Service expects the Action will provide an overall net benefit to monarchs through increases in milkweed and nectar plant density in ROWs. The southern core (Figure 4-3) plays a significant role in supporting both the spring and fall migrations (Miller *et al.* 2012, Flockhart *et al.* 2013, Flockhart *et al.* 2017). However, studies have concluded that we need an approach that engages “all hands” and “all regions” to most effectively support the eastern population (Flockhart *et al.* 2017, Thogmartin *et al.* 2017).

Avoidance of routine mowing in the transition zone during the first and second cycles will allow milkweed and nectar plants to bloom and provide resources throughout the growing season (Leston and Koper 2019). This increase in abundance and distribution of both host plant and nectaring resources will provide a benefit to monarchs and other pollinators. The increase in ROW areas or patches of host and nectar plants will decrease fragmentation of suitable habitat and increase the amount of potentially suitable habitat on a landscape level. Patches of suitable habitat along linear ROWs increase connectivity between populations and for long distance migrants (*e.g.*, monarch).

The third cycle mowing of the clear and transition zones by ARDOT will reduce woody encroachment and maintain an open habitat. Removing tall, woody vegetation allows more herbaceous, flowering plant species to colonize ROWs.

Although conservation mowing actions can remove milkweed in the ROW, a single mid-season mow can stimulate a regrowth of milkweed. This regrowth is preferred by monarch females for oviposition. A single, mid-season mowing of the transition zone in the ROW is not proposed in the conservation actions, but the potential benefits of this practice may be considered in adaptive management decisions.

The Service expects beneficial effects to monarchs from spot treatment herbicide application related to reduction in NNIS and woody encroachment, and improvement in habitat conditions for colonization and increase of milkweed and blooming nectar plants.

#### *Milkweed Density on ROW*

The Service expects the Action will increase the occurrence and density of milkweed above current levels in areas where ARDOT implements conservation efforts. Because milkweed is required for monarch breeding, we use milkweed abundance as an index of monarch breeding habitat quality and quantity. There is inadequate information available on current milkweed stem densities in the South and on the degree to which conservation measures may enhance those densities. Estimates of milkweed densities in the East and Upper Midwest informs estimates for the West and South but may be less accurate. We recognize the inherent assumptions and inaccuracies in this methodology likely overestimate the effects on milkweed numbers and monarchs in Arkansas, where we assume milkweed densities are lower (Thogmartin *et al.* 2017). The magnitude of effects should not change substantially when applied to parts of the South –

both the positive and negative effects on milkweed abundance would be lower than in the East and Upper Midwest, but in similar proportions.

We assume that the average density of milkweed across ROW with conservation efforts implemented could provide up to 58 stems/acre (2+ stems per 1,500 square foot monitoring plot) (Thogmartin *et al.* 2017; data supplement, p. 15). This reflects the ‘biologically reasonable’ milkweed stem densities anticipated by Thogmartin *et al.* (2017), based on information they elicited from subject matter experts. Based on expert input, they assumed milkweed amendments on roadside rights-of-way could reasonably increase milkweed density to a biologically reasonable 150 stems per acre in the East and Upper Midwest and at least 58 stems per acre elsewhere (Thogmartin *et al.* 2017 Supplement S3).

The ARDOT may boost milkweed densities in some areas by including milkweed seed in the planting mix, although milkweed is also likely to increase due to natural seed drift. In pollinator plantings in Iowa that were in their third growing season, common milkweed density was about 566 stems per acre where the species was included in the original seed mix, but at only about 162 stems per acre where the seed mix did not include the species (Sinnott *et al.* 2019). This suggests ARDOT should consider the option of seeding milkweed, especially where they plan to establish new pollinator plantings and where stem densities are below anticipated levels. Natural seed drift will occur in some areas and will likely be sufficient to raise milkweed to suitable densities when milkweed occurs in adjacent areas (Lukens *et al.* 2020).

#### *Nectaring Habitat on ROW*

In many areas, nectar resources may typically be poor for monarch in the absence of management intended to foster their abundance and diversity. In Arkansas, in addition to reductions in the diversity of nectar plant species, drought also decreased nectar availability and the ability of migrating monarchs to accumulate lipid reserves for overwintering (Brower *et al.* 2015). Without frequent fire in the forested portions of the Ouachita Mountains Physiographic Region in Arkansas, for example, nectar resources may remain chronically low (Rudolph *et al.* 2006). In areas like this, road and utility rights-of-way also provide nectar resources (Rudolph *et al.* 2006).

The Action will improve nectaring habitat in ROW in Arkansas by implementing conservation mowing and herbicide application to enhance or expand the presence of blooming nectar plants. The Service considers habitat with nectar plants covering >10 percent of a monitored plot suitable habitat for monarchs. The Service expects the Action will increase the percentage of nectaring plants in areas where conservation mowing and herbicide application are implemented to >10 percent. However, the precise benefits to the monarch of having at least 10 percent coverage of nectar plants is difficult to gauge without some understanding of current ROW conditions. At the scale of the proposed action, the current cover of nectar plants varies based on regional, local, and site-specific factors. One study of highway rights-of-way in Mississippi found coverage of flowering herbaceous plants was about 24 percent and 11 percent in spring and fall, respectively (Entsminger *et al.* 2017). Rudolph *et al.* (2006) looked at nectar resources for monarch specifically, but counted flowers in study plots instead of estimating their cover. The Service is not aware of an estimate of the extent of nectar resources in Arkansas ROW.

#### **4.3.4. Wildflower Planting**

Enhancement of vegetation through seeding and planting could reintroduce native plant species not currently present in many locations. In doing so, we anticipate an increase in the abundance of milkweed and other blooming nectar plants, which would increase breeding and foraging habitat for the monarch.

The planting of selected sites in wildflowers has potential for indirect effects to the three covered lepidopterans as an increase in mortality of monarchs has been noted when medians are planted in milkweed or nectar plants. Larger patches are expected to lessen this effect.

#### **4.3.5. Summary**

The ARDOT will implement the vegetation management practices of mowing and herbicide application as part of this Action. We expect the implementation of mowing and herbicide use on areas with milkweed occurrence to cause harm to monarch eggs, larvae, pupae, and adults through the effects of injury, milkweed reduction or removal, and nectar plant reduction or removal. We also expect the Action to result in long-term beneficial effects to monarch due to increased abundance and distribution of suitable habitat with increased host plant and nectar resources for the species.

The effect of the Action to individual monarchs will be difficult to quantify due to the species' small body size, rapid scavenging of larvae, and migratory nature. Although, we cannot estimate the number of individual monarchs affected by the Action, the Service is providing a mechanism to quantify take levels. Permanent and short-term habitat loss is the parameter monitored and should more accurately measure and track effects to monarch and its habitat since take of individuals is generally unknown. Habitat loss as a surrogate measure is the spatial extent of exposure to Action-caused stressors for which the reasonably certain individual response satisfies the definition of harm. The spatial extent of habitat in the action area affected by mowing and herbicide application is a maximum of 7,022 ha (17,352 ac) of annual habitat loss.

### **4.4. Conclusion for Monarch Butterfly**

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the PCO for Monarch Butterfly, which is to provide the information and analyses for a programmatic biological opinion (PBO) to determine whether the Action is likely to jeopardize its continued existence.

Monarch Butterfly occurs in transportation ROWs with milkweed and blooming nectar plants in Arkansas, with larger numbers found in the northwest, northeast, and southwest portions of the state. Individuals or small populations of monarchs may occur in small patches of suitable ROW habitat. Given the migratory nature and lack of population estimates for monarchs in Arkansas, we expect the extent of the monarch population in the state to vary seasonally.

The ARDOT will implement mowing and herbicide application as part of vegetation management in ROW areas as part of this Action. We expect the implementation of mowing and herbicide use on areas with milkweed occurrence to cause harm to monarch eggs, larvae, pupae, and adults through the effects of injury, milkweed reduction or removal, and nectar plant reduction or removal. We also expect the Action to result in long-term beneficial effects to

monarch due to increased abundance and distribution of suitable habitat with increased host plant and nectar resources for the species.

Milkweed and blooming nectar plants will occur on a subset of ROW sites and monarch will occur on a subset of ROW sites with the host plant and nectaring resources. In addition, we expect the condition and habitat to vary on each ROW implementation site. The condition and extent of suitable habitat will vary seasonally, spatially, and annually depending on previous management of the ROW. We recognize the estimate of 7,022 ha (17,352 ac) of habitat affected by the Action is an overestimate as suitable habitat does not occur on all ROW. Current species status and habitat mapping tools do not allow a more precise predication of affected habitat.

After reviewing the status of the species, the environmental baseline for the action area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of Monarch Butterfly.

## **5. FROSTED ELFIN**

This section provides the Service's PCO of the Action for Frosted Elfin.

### **5.1. Status of Frosted Elfin**

This section summarizes best available data about the biology and condition of the Frosted Elfin (*Callophrys irus*) throughout its range that are relevant to formulating an opinion about the Action. The Service is currently conducting a discretionary review of Frosted Elfin to determine if the species warrants listing under the ESA. In 2018, the Service developed an interim species status assessment report for Frosted Elfin (Service 2018a).

#### **5.1.1. Species Description**

The Frosted Elfin is larger than most elfin butterflies with a 22 to 36 millimeters (mm) (0.87 to 1.42 inches (in)) wingspan. The wings are gray brown in color with a dusting of pale scales on the outer margin of the hindwing, with a dark spot and an irregular dark line (Allen 1997). Larvae (caterpillars) are pale greenish white in most locations, and yellow in Oklahoma. The species is similar in appearance to Henry's elfin and hoary elfin and the three species overlap in range.

Three Frosted Elfin subspecies have been described (and generally accepted) and these have regional distributions. In addition to differences in geographic location, *C. i. arsace* and *C. i. hadros* tend to be larger in size with darker coloration than *C. i. irus*. Genetic and/or phenotypic diversity and occupation of geographically distinct areas distinguish the subspecies.

We recognize that there is some uncertainty about the taxonomic validity and/or range of *C. i. arsace* expressed by experts. However, until that uncertainty is resolved with genetic additional data, we will continue to use the published taxonomy as the best available data.

#### **5.1.2. Life History**

The Frosted Elfin is a small non-migratory butterfly dependent on specific host plants wild blue lupine (*Lupinus* spp.) and wild indigo (*Baptisia* spp.). In Arkansas, the species uses wild indigo. The Frosted Elfin completes its entire lifecycle within one year. Adults emerge in early spring, mate, and lay eggs on host plants. Eggs hatch into larvae that rely on specific host plants of wild

lupine or wild indigo. Larvae go through four instars and pupate for most of the year on or near host plants in the leaf litter or beneath the soil surface and remain in this state until the following spring.

Frosted Elfin adults are diurnal during the 4 to 8 week flight period, typically from late April through mid-June, with the peak occurring in mid-May (Allen 1997, Swengel and Swengel 2000, Albanese *et al.* 2007, Pfitsch and Williams 2009).

Larvae feed on one of two specific host plants, either wild lupine or wild indigo, but individuals have not been observed to use both (Schweitzer 1992). In addition to host plants, Frosted Elfin adults require nectar sources that are available during their short flight window. The Frosted Elfin is a generalist when it comes to flower selection for nectaring.

Frosted Elfin is closely associated with its host plants, especially indigo feeders, which occur within 20 m (65.6 ft) from stands of the food plant (NatureServe 2020). Wild lupine and wild indigo plants both rely on disturbance (natural or anthropogenic) and open to semi-open habitats with partial to full sunlight.

Frosted Elfin is sedentary (non-migratory) and, therefore, present within suitable habitat patches year-round. Dispersal distances vary depending on presence of suitable habitat. Periodic dispersal events of individual adult Frosted Elfin may occur as far as 10 km (6.21 mi) from natal patches of indigo/lupine if suitable habitat is present along the way. However, shorter routine distances are anticipated and movements greater than 2 km (1.24 mi) are considered unlikely across areas of unsuitable habitat (no host plants) (NatureServe 2015).

### **5.1.3. Numbers, Reproduction, and Distribution**

The current range of the Frosted Elfin includes 25 states (Figure 6-1). The Service considers the species extirpated in Ontario, Canada, and the District of Columbia, Georgia, Illinois, and Vermont after sites were lost for a variety of reasons including incompatible vegetation management, catastrophic fire, and residential development.

The Frosted Elfin subspecies show regional distribution. *Callophrys irus irus* is the most widespread subspecies, with *C. i. arsace* and *C. i. hadros* occupying limited distributions in the southeast and southwest areas of the range, respectively. *C. i. hadros* occurs in the southwestern states of Texas, Louisiana, west Arkansas, and Oklahoma. *C. i. arsace* occurs along the Atlantic Coast with some scientific disagreement about whether it occurs only in South Carolina (Gatrelle 1991) or also north into southern New England (Shepherd 2005). *C. i. irus* that occupies the remainder of the inland areas from Florida north to New England and New York (and historically, southern Ontario), through Ohio and Michigan to Wisconsin with scattered populations also farther southeast, including eastern Maryland (Committee of the Status of Endangered Wildlife in Canada [COSEWIC] 2000, Shepherd 2005, Schweitzer *et al.* 2011).

### **5.1.4. Conservation Needs and Threats**

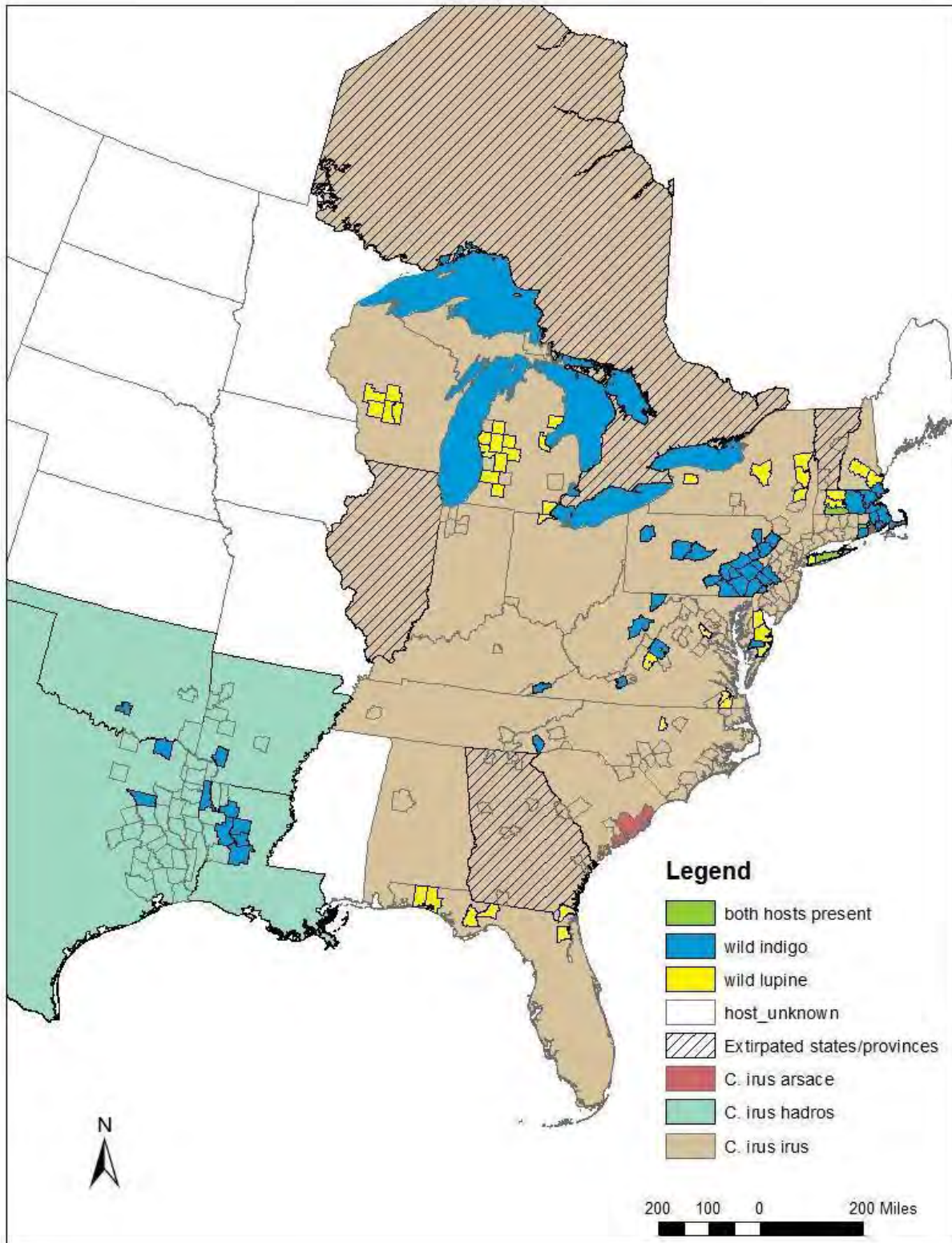
#### **Inherent Factors**

Frosted Elfin exhibits several inherent traits that influence population viability, including: specialized habitat requirements, limited dispersal ability, and small population size, area of occupancy, or extent of occurrence (ECCC 2017).

### **Habitat Loss and Degradation**

The primary external factor affecting Frosted Elfin is habitat availability (COSEWIC 2000). The Frosted Elfin faces habitat loss from a variety of sources, including conversion of habitat as a result of human mediated causes, such as development, invasive plant species, recreational activity, dumping in rights-of-way, and fire exclusion or management, as well as natural causes, such as succession. The Frosted Elfin overlaps with the Karner Blue Butterfly within the northern states and similar factors influence that species (Service 2003).





**Figure 6-1.** Frosted Elfin range by subspecies and counties with information available regarding host plant use.

**Vegetation Management** - Because Frosted Elfin depends on early successional savanna/barrens habitats that support wild lupine/indigo, maintenance and restoration of these habitats are key to the species' conservation. Management techniques, such as prescribed burning or mechanical cutting can be effective tools for maintaining and restoring shrublands and barrens (Wagner *et al.* 2003). However, mortality to individual Frosted Elfin is unavoidable in sites with known species occurrence when conducting land management activities, such as burning, mowing, and herbicide application because Frosted Elfin is present year-round within host plant patches. The degree of mortality on the life stages involved (egg, larvae, pupae, and adult) will depend on the type, timing, and scope of the activities being conducted.

In addition to impacts from compatible management, given the frequent small population sizes (see above), incompatible management activities may result in extirpation of a population. Examples of incompatible management practices that have negatively affected Frosted Elfin includes too frequent mowing, burning, or herbicide application on host plants and nectar plants.

Herbicide application to Frosted Elfin habitat along a right-of-way in New Jersey removed most woody vegetation, grasses, and nectar plants (Golden and Pettigrew 2005). Herbicide application may also reduce the viability and survivability of Lepidopterans by reducing food plant quality (Stark *et al.* 2012, p. 27). Herbicide drift has potential to impact wild blue lupine and nectar plants in Canada (ECCC 2017, p. 32).

Targeted herbicide application can be important for vegetation control, which preserves habitat conditions required by various species of Lepidoptera. However, even if applied in a targeted manner, certain herbicides have lethal and sub-lethal effects on butterflies and moths through contact via dermal and digestive routes (Russell and Schultz 2010). Restricting the timing of herbicide applications until diapause, in many cases, protect sensitive life stages of species of concern (Russell and Schultz 2010).

We are unaware of any research specifically studying the effects of herbicides on the Frosted Elfin; however, there are studies on the habitat associate Karner Blue Butterfly (Sucoff *et al.* 2001). The Service (2003) stated that herbicides, Accord® (glyphosate) and Accord® + Oust® (sulfometuron methyl) (with Entry II surfactant) can be used with minimal negative effect on the Karner Blue Butterfly egg development, pupation of larvae, emergence of adults, size of pupae, or rate of pupal formation (Sucoff *et al.* 2001). Karner Blue Butterfly eggs treated with Accord® + Garlon® 4 (triclopyr ester) resulted in 22 percent fewer adults hatch than in controls; translated to field conditions, the Service anticipated that this would result in a 3.5 percent reduction of adults (Sucoff *et al.* 2001). The Service recommends herbicide application outside of the flight season to minimize negative effects to the Karner Blue Butterfly (Service 2003).

In summary, management is a key component of restoring and maintaining suitable Frosted Elfin habitat. However, management intended to benefit the species can affect small populations and incompatible vegetation management can result in the loss of populations. Compatible management generally affects individual butterflies with overall benefits to populations.

## **Insecticides**

Insecticides are a chemical tool to control the spread of invasive insects. Use of insecticides may result in mortality of non-target species, depending upon the type of chemical, the application method, length of exposure, and the insect's tolerance. The effects of insecticides on non-target

butterflies, especially sub-lethal effects, are not established (Mule *et al.* 2017). However, adult and larval butterflies are susceptible to lethal and sub-lethal effects from insecticide application from direct aerial spraying and from residues on plant foods (Hoang *et al.* 2011). Insecticides approved for gypsy moth spraying (Stafford 2017), mosquito control (Mule *et al.* 2017), and neonicotinoids have negative effects (*e.g.*, increased mortality, interrupted feeding, altered oviposition, and other sublethal effects on growth) to butterflies.

## **5.2. Environmental Baseline for Frosted Elfin Butterfly**

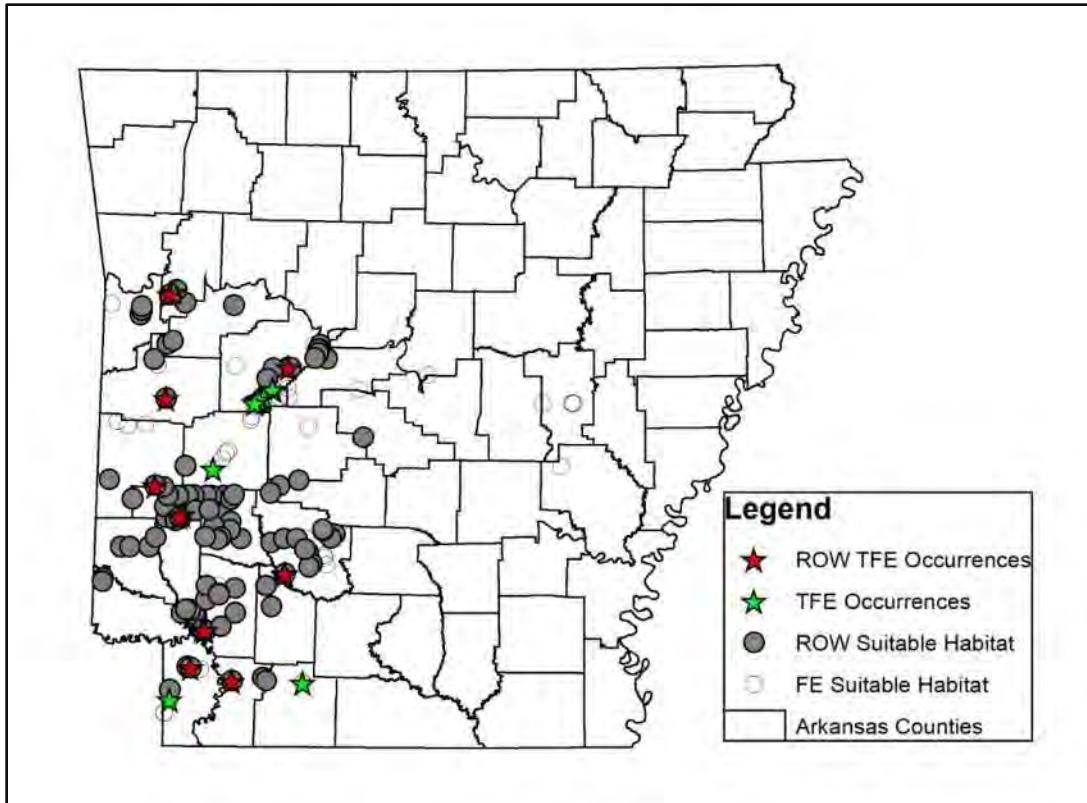
This section describes the best available data about the condition of Frosted Elfin the Action Area without the consequences caused by the proposed Action.

### **5.2.1. Action Area Numbers, Reproduction, and Distribution**

Prior to 2018–2019 surveys, Frosted Elfin occurred historically at 18 sites in Arkansas. A recent two-year study of Texas Frosted Elfin in Arkansas noted 155 instances of the host plant occurrence (suitable habitat patch). Frosted Elfin adults occurred at 3 historical sites and 25 new sites in 6 counties where the species was previously unknown. The authors state, “Our findings suggest that the butterfly is fairly widespread across southern and western Arkansas, although the majority of habitat with host plants does not contain the species.” (Figure 6-1) (Moran and McClung 2019).

Few individuals occur at most sites so population estimate is difficult. Of eleven habitat variables analyzed, only the number of host plants at a site is a significant predictor of Frosted Elfin presence. Frosted Elfin is found in wide variety of habitats, from closed canopy forest to highly modified habitats (powerline rights-of-way). Most occurrences were on roadside and utility ROWs. The largest number of butterflies observed occurred on a nature preserve native prairie (Moran and McClung 2019).

Of 155 host plant habitats surveyed, 103 were in roadside ROWs. This high level of representation of suitable habitat and species occurrence in ROWs is due primarily to observability of host plants, but does provide site-specific data to inform implementation and prioritization of conservation actions. Suitable habitat for Frosted Elfin occurs in ROWs in Franklin, Sebastian, Logan, Scott, Yell, Perry, Saline, Polk, Montgomery, Sevier, Howard, Pike, Hempstead, Miller, Lafayette, Nevada, Clark, Garland, Saline, Perry, Little River, and Hot Spring counties (Figure 6-2). Frosted Elfin ROW populations occur in Miller, Lafayette, Hempstead, Clark, Howard, Polk, Yell, Scott, and Franklin counties (Figure 6-1). Frosted Elfin populations outside of ROWs occur in Yell, Montgomery, Miller, and Columbia counties. The species historically occurred in Grant County, but recent surveys found no current occurrences.



**Figure 6-2.** Frosted Elfin (*C. irus hadros*) habitat and species occurrences in 2018 and 2019 surveys (McClung and Moran, unpublished data).

### 5.2.2. Action Area Conservation Needs and Threats

The conservation needs and threats within the Action Area are the same as the range-wide needs and threats described in section 5.1.4 *Conservation Needs and Threats*. There are no known additional threats in the Action Area beyond those addressed above. Additional work planned in 2020 will address the genetic variability of Texas Frosted Elfin and other eastern subspecies.

### 5.3. Effects of the Action on Frosted Elfin Butterfly

The likelihood of Frosted Elfin occurrence is based on several factors and includes proximity to an extant Frosted Elfin population, land use surrounding the project site (dispersal barriers), and proximity to suitable habitat with host plant occurrence. These factors and other influences cannot be predicted for ROW implementation areas yet to be determined as part of the Action. Some project sites in the Action Area will have suitable habitat for Frosted Elfin and other factors positively influencing species' occurrence. Therefore, ARDOT is reasonably certain and the Service agrees Frosted Elfin is reasonably certain to occur on some VPL implementation sites in the Action Area.

The effects of the proposed Action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action Area.

We identified and described the activities included in the proposed Action in sections 2.1–2.4. We identified and described other activities caused by the proposed Action in section 2.6. Our analyses of the consequences caused by each of these activities follows.

### **5.3.1. Mowing**

We expect a variable extent of effects from mowing depending on a variety of spatial and temporal factors. The Frosted Elfin flight period is early in summer with typical emergence from late April to mid-June. Mowing conducted during the first cycle from April 15–May 25 will cause direct injury or mortality to emerging adults. Frosted Elfin are weak flyers and the Service does not expect individuals to escape the area. Mower blades may destroy or mower tires may crush eggs on wild indigo leaves.

In addition, the first and second mowing cycles will remove all or part of the sole food source for hatching larvae (caterpillars). Larvae may leave the reduced resources of the host plant in search of a new host plant. This movement exposes the caterpillars to injury or mortality through desiccation, inability to find another host plant, increased intra-specific competition for remaining host plants, and increased predation risk.

Frosted Elfin pupae occur in leaf litter or soil during the third mowing cycle from October 1–Thanksgiving. The Service expects mowers and machinery to crush some Frosted Elfin pupae, but the extent of this effect is unknown.

### **5.3.2. Herbicide Application**

Broadcast herbicide application after the second mowing cycle (July) have potential to negatively affect any *Baptisia* host plants in the affected area. Loss of host plants at this time will affect any larvae on plants. Larvae cannot survive on dead plants and will leave the herbicide treated plant in search of a new host plant. This movement exposes the caterpillar to injury or mortality through desiccation, inability to find another host plant, increased intra-specific competition for remaining host plants, and increased predation risk.

As a component of the activity, ARDOT or contractors will apply herbicide as spot treatments of NNIS or woody vegetation. The ARDOT will ensure applicators recognize and avoid *Baptisia* plants during herbicide application. The Service expects the effects of spot treatment of vegetation on Frosted Elfin to be insignificant and discountable.

### **5.3.3. Wildflower Planting**

As part of the Action, wildflower planting in ROW or interstate exchange areas will establish eco-region specific native warm season grasses and forbs, including at least one *Baptisia* species. When established, the wildflowers will provide additional nectaring and host plant resources to increase suitable habitat and distribution for Frosted Elfin. The Service expects this beneficial effect to occur one to three years after planting and continue, as long as ARDOT maintains the habitat through NNIS and woody vegetation management.

### **5.3.4. Summary**

ARDOT will implement mowing and herbicide application of ROWs as part of this Action. We expect the implementation of mowing on suitable habitat with Frosted Elfin occurrence to cause harm to eggs, larvae, and adults of the species through the effects of crushing and host plant loss.

However, we expect the Action to result in long-term beneficial effects to Frosted Elfin due to increased suitable habitat, increased host plant resources for the species, and improved connectivity (providing additional patches of suitable habitat).

The effect of the Action to individual Frosted Elfin will be difficult to quantify due to the species' small body size, limited flight period, and difficult to observe nature of most life stages. Although, we cannot estimate the number of individual Frosted Elfin affected by the Action, the Service is providing a mechanism to quantify take levels. Permanent and short-term habitat loss is the parameter monitored and should more accurately measure and track effects to Frosted Elfin and its habitat since take of individuals is generally unknown. Habitat loss as a surrogate measure is the spatial extent of exposure to Action-caused stressors for which the reasonably certain individual response satisfies the definition of harm. The spatial extent of habitat in the Action Area affected by mowing and herbicide application is a maximum of 502 ha (1,241 ac) of annual habitat loss.

#### **5.4. Conclusion for Frosted Elfin Butterfly**

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the PCO for Frosted Elfin, which is to provide the information and analyses for a PBO to determine whether the Action is likely to jeopardize its continued existence.

This Action includes ROW management activities conducted in counties with Frosted Elfin occurrence. We expect implementation of mowing and herbicide application as described in the VPL to provide an overall long-term benefit to Frosted Elfin and its habitat in the Action Area.

Frosted Elfin occurs on 28 sites in Arkansas, with the majority of occurrences in transportation and utility rights-of-way. The interim species status assessment report (Service 2018a) lists loss or degradation of habitat as a result of succession, invasive species, and incompatible vegetation management as factors in the viability of the species. Suitable habitat with host plant presence occurs in ROW. Frosted Elfin occurs on approximately 18 percent of sites with suitable habitat (Moran and McClung 2019). Given the short flight distance and influence of connectivity to other suitable habitat on species viability, we infer that the species occurs on other ROW or adjacent habitat in Arkansas. However, the extent of Frosted Elfin occurrence in transportation ROWs is unknown.

ARDOT will implement mowing and herbicide application as routine vegetation management activities as part of this Action. We recognize the estimate of 502 ha (1,241 ac) of habitat affected by the Action is an overestimate. Current species status and habitat mapping tools do not allow a more precise predication of affected habitat. In addition, we expect ARDOT to implement conservation mowing and herbicide application in ROW areas with variable extent of suitable habitat.

The obligate host plant will occur on a subset of ROW implementation areas and Frosted Elfin will occur on a subset of ROW areas with the host plant. However, the Service expects mowing and herbicide application implemented on ROW with species occurrence during spring and summer mowing cycles to cause mortality to eggs, larvae, and adult Frosted Elfin. The Service also expects mowing during the third (fall) cycle to cause mortality to Frosted Elfin pupae.

After reviewing the status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of Frosted Elfin.

## **CRAYFISH SPECIES**

This section provides the Service's PCO of the Action for covered crayfish species: Irons Fork Burrowing Crayfish, Ouachita Burrowing Crayfish, Slenderwrist Burrowing Crayfish, Bayou Bodcau Crayfish, and Jefferson County Crayfish.

This section summarizes best available data about the biology and condition of the Irons Fork Burrowing Crayfish (*Procambarus reimeri*), Ouachita Burrowing Crayfish (*Fallicambarus harpi*), Slenderwrist Burrowing Crayfish (*Fallicambarus petilicarpus*), Bayou Bodcau Crayfish (*Bouchardina robisoni*), and Jefferson County Crayfish (*Fallicambarus gilpini*) throughout the ranges that are relevant to formulating an opinion about the Action. The Service received a petition to list the five covered species of burrowing crayfish on April 20, 2010. The petitioners withdrew Jefferson County Crayfish and Bayou Bodcau Crayfish, Irons Fork Burrowing Crayfish, and Ouachita Burrowing Crayfish from petition on June 8, 2018, February 10, 2020, and February 18, 2020, respectively. The 2015 Arkansas Wildlife Action Plan considers the four crayfish Species of Greatest Conservation Need. The covered crayfish species are endemic to distinct areas in Arkansas and found in wet seepage areas, including roadside ditches.

### **6. IRONS FORK BURROWING CRAYFISH**

This section provides the Service's PCO of the Action for Irons Fork Burrowing Crayfish.

#### **6.1. Status of Irons Fork Burrowing Crayfish**

##### **6.1.1. Species Description**

The Irons Fork Burrowing Crayfish is a 25–50 mm (1–2 in) pink-cream colored crustacean typical of its genus. Hobbs (1989) describes the species detailed phenotypical characteristics.

##### **6.1.2. Life History**

The genus *Procambarus* includes three Arkansas endemics, all of which are primary burrowers. The Irons Fork Burrowing Crayfish is a primary burrowing crayfish (Robison and Allen 1995) and constructs relatively simple burrows in sandy clay soil in wet seepage areas, such as within roadside ditches, lawns, and temporary pools (Robison 2008, Hobbs 1979). People are often aware of primary burrowing crayfish by the mud chimneys they build. Primary burrowing crayfish are those that spend most of their lives underground, leaving their burrows only to forage for supplemental food items and find a mate (Rhoden *et al.* 2016b). These simple burrows may vary from 0.5–1.5 m (1.6–4.9 ft) in depth (Hobbs 1979). Robison (2008) found specimens of Irons Fork Burrowing Crayfish adjacent to the road or highway while juveniles were collected in standing water at the edge of a gravel road.

The Irons Fork Burrowing Crayfish prefers open habitats with low growing herbaceous vegetation and wet microhabitats, such as roadside ditches. Additionally, road surfaces, which are not as permeable, may contribute to the species' preferred habitat by diverting precipitation alongside the road. Groundwater also influences roadside ditches, adding more water to the roadside microhabitat (Rhoden 2016). Rhoden *et al.* (2016b) found canopy cover and presence

of hydrophilic sedges are important factors in predicting crayfish abundance across the landscape and the microhabitat of roadside ditches can be beneficial to the persistence of narrowly endemic specialists.

The following description is from Robison *et al.* (2017) unless noted otherwise. Although highly variable, most crayfishes in Arkansas mate between September and March. Form I males (reproductively active with well-defined terminal elements of the first pleopods) seek out receptive females and mating is accomplished. The female carries sperm until oviposition (egg-laying) which may be in March, April and May, although some species begin as early as December or January. Following oviposition, the eggs are attached to the abdomen of the females and they are said to be ovigerous or "in berry." Females carry the eggs for 2 to 20 weeks depending on the water temperature. After hatching, young move quickly through a series of molts until they reach sexual maturity by late summer or early fall.

### **6.1.3. Numbers, Reproduction, and Distribution**

The Irons Fork Burrowing Crayfish is a local endemic of the Upper Irons Fork watershed in the Ouachita River drainage and a few areas in the Ouachita Mountains near Mena in west central Arkansas (Robison and Allen 1995). Hobbs (1979) first described the Irons Fork Burrowing Crayfish from six localities in Polk County, Arkansas. Robison (2008) reviewed the status of this crayfish and determined that the species only occurred in Polk County, near Mena, Arkansas. Rhoden *et al.* (2016b) further expanded the species' range with 16 new populations, including one found in Montgomery County. Researchers discovered another population less than a kilometer from the Oklahoma state line, which may indicate that the species occurs in Oklahoma as well. This species is more widespread than initially thought, and its total range estimate is approximately 1467 km<sup>2</sup> (566 mi<sup>2</sup>) (Rhoden *et al.* 2016b). The Arkansas Natural Heritage Commission currently considers the species extant in Polk County (Figure 7-1). The ARDOT voluntary prelisting conservation program proposes conservation actions to benefit the species in Polk, Montgomery, and Scott counties with sites prioritized by proximity to known populations and site suitability.

### **6.1.4. Conservation Needs and Threats**

The Irons Fork Burrowing Crayfish is ranked as G1 (global rank-critically imperiled), S1 (state rank-critically imperiled). This species is characterized by a restricted range, low population abundance, and is found in habitats susceptible to degradation. The Arkansas Wildlife Action Plan (AGFC 2015) lists threats to the species and sources of those threats as habitat destruction or conversion from forestry activities and urban development, habitat destruction from road construction, and toxins/contaminants from forestry activities.

## **6.2. Environmental Baseline for Irons Fork Burrowing Crayfish**

The Action Area encompasses the full known range of the species; therefore, the range-wide status of the species is the environmental baseline in the Action Area.

## **6.3. Effects of the Action on Irons Fork Burrowing Crayfish**

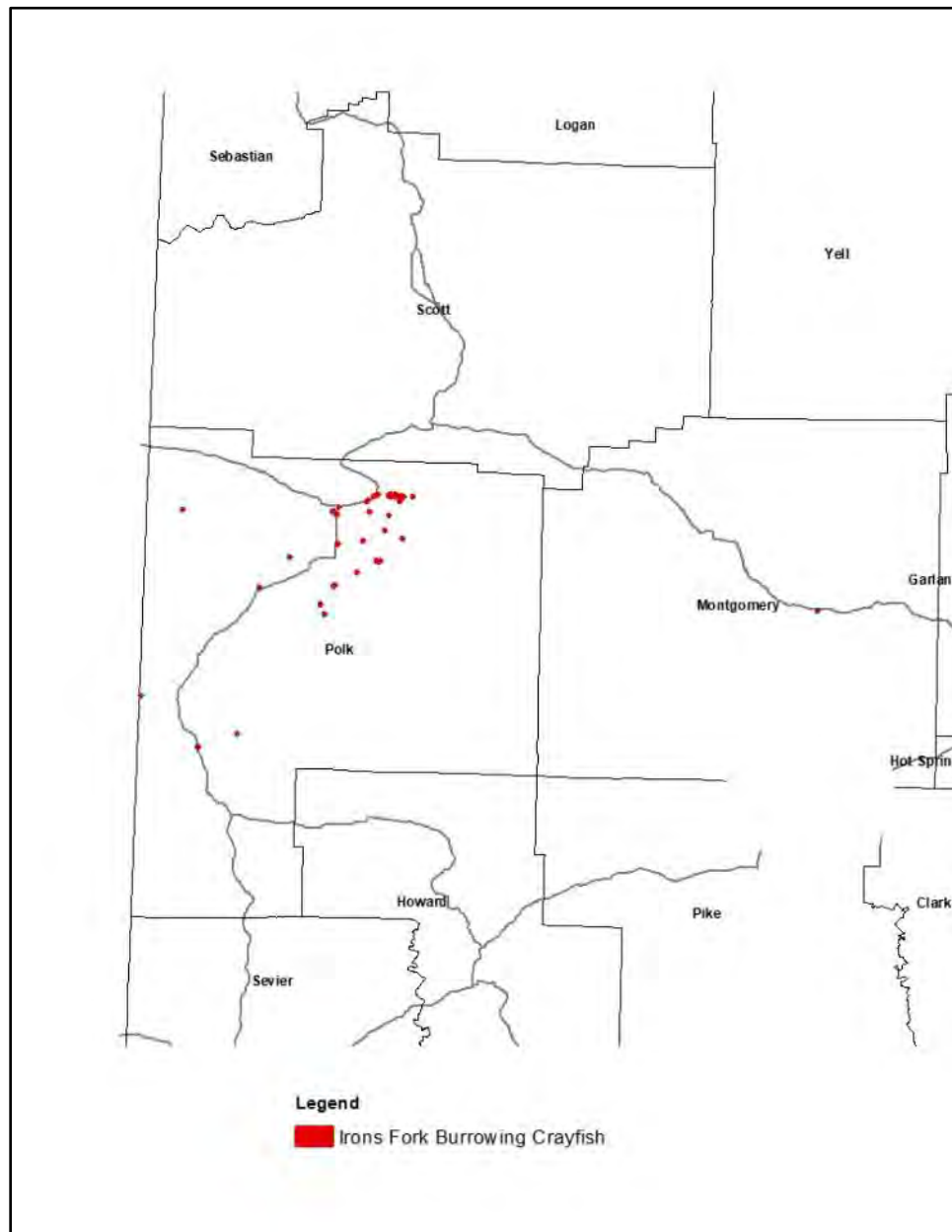
In a PCO for a listed species, the effects of the proposed Action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities



caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action Area.

We identified and described the activities included in the proposed Action in sections 2.1–2.4. We identified and described other activities caused by the proposed Action in section 2.6. Our analyses of the consequences caused by each of these activities follows.

Wildflower planting will not occur in suitable habitat for covered crayfish species; therefore, that activity will have no effect on the species. Our effects analyses will not further address the effects of wildflower planting on covered crayfish species.



**Figure 7-1.** Irons Fork Burrowing Crayfish occurrences (Arkansas Natural Heritage Commission 2018).

### **6.3.1. Vegetation Management -Mowing and Herbicide Application**

Crayfish are a mobile and burrowing species and will be able to move away from noise and vibration disturbance caused by mowing. Moderate reduction in vegetation height is not a known threat or stressor for burrowing crayfish. The Service expects effects to covered crayfish from mowing and herbicide application to be insignificant and discountable. The Service also expects conservation mowing and herbicide efforts to provide a net benefit to covered crayfish species. These benefits are a result of reductions in NNIS, woody encroachment, and provision of “stepping stone” patches of suitable habitat to facilitate dispersal and migration of covered crayfish species.

### **6.3.2. Actions Specific to Burrowing Crayfish**

Components of the Action with potential to affect covered crayfish include ditch cleanouts and changes to hydrology in suitable habitat associated with other maintenance activities. The removal of vegetation and soil in a site with crayfish occurrence, partially or completely, eliminates burrows the species creates and depends on for feeding and sheltering. Ditch cleanouts in suitable habitat within the range of covered species eliminates vegetation and compacts soil in suitable habitats. Creation of sheltering burrows is difficult or impossible in compacted soils. Absence of vegetation leaves crayfish of all life stages vulnerable to predation. The Service expects increased mortality of displaced crayfish as a result of increased predation, desiccation, and inability to find suitable habitat (*i.e.*, vegetation, soils, and hydrology).

The Service expects ARDOT’s avoidance of ROW maintenance activities that reduce or degrade suitable habitat and creation or enhancement of suitable habitat for covered crayfish species to benefit the species numbers and distribution within the known or historic range of the species.

### **6.3.3. Summary**

The ARDOT will implement roadside maintenance activities including ditch cleanout and alteration to ROW hydrology as part of this Action. We expect the implementation of ditch cleanouts on a site with Irons Fork Burrowing Crayfish occurrence to cause harm to eggs, juveniles, and adults of the species through the effects of burrow removal, soil compaction, and vegetation removal. However, we expect the Action to result in long-term beneficial effects to Irons Fork Burrowing Crayfish due to increased suitable habitat, increased host plant resources for the species, and improved connectivity (providing additional patches of suitable habitat).

The effect of the Action to individual crayfish will be difficult to quantify due to the species’ small body size and fossorial nature. Although, we cannot estimate the number of individual Irons Fork Burrowing Crayfish affected by the Action, the Service is providing a mechanism to quantify take levels. Permanent and short-term habitat loss is the parameter monitored and should more accurately measure and track effects to the species and its habitat since take of individuals is generally unknown. Habitat loss as a surrogate measure is the spatial extent of exposure to Action-caused stressors for which the reasonably certain individual response satisfies the definition of harm. The spatial extent of habitat in the Action Area affected by ditch cleanout is a maximum of 240 ha (593 ac) of annual habitat loss.

## 6.4. Cumulative Effects on Irons Fork Burrowing Crayfish

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to Irons Fork Burrowing Crayfish are not relevant to formulating our opinion for the Action.

## 6.5. Conclusion for Irons Fork Burrowing Crayfish

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the PCO for Irons Fork Burrowing Crayfish, which is to provide the information and analyses for a PBO to determine whether the Action is likely to jeopardize its continued existence.

The Irons Fork Burrowing Crayfish is a narrow endemic found primarily in one county in western Arkansas with incomplete population estimate, demographic, and distribution information available. The Action proposed by ARDOT includes activities covered under this PCO likely to cause take of Irons Fork Burrowing Crayfish in the form of harm within Arkansas. However, these losses constitute a one-time or short-duration effect to the population, so we do not expect the Action to affect Irons Fork Burrowing Crayfish population viability within Arkansas (*i.e.*, range-wide). The Action includes activities expected to provide beneficial effects to the species, including avoidance of ditch cleanout unless necessary and activities to enhance or create suitable habitat within the current and historical range of the species.

The Service expects the Action to affect approximately 240 ha per year (593 ac per year) in the Action Area, representing approximately 10 percent of ROW acreage in Polk, Montgomery, and Scott counties. This level of disturbance does not represent an appreciable reduction of suitable habitat that is biologically meaningful at the range-wide scale. The activities in the Action assessed in the PCO are not likely to preclude or significantly delay recovery of the species and on most sites, are conservation actions to benefit the species recovery.

After reviewing the status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of Irons Fork Burrowing Crayfish.

## 7. OUACHITA BURROWING CRAYFISH

### 7.1. Status of Ouachita Burrowing Crayfish

This section provides the Service's PCO of the Action for Ouachita Burrowing Crayfish.

#### 7.1.1. Species Description

The Ouachita Burrowing Crayfish is tan in color with highly variable patterning (Hobbs and Robison 1985). Hobbs (1989) describes the species detailed phenotypical characteristics.

#### 7.1.2. Life History

The Ouachita Burrowing Crayfish is one of six endemic *Fallicambarus* in Arkansas. This species preferred habitat is very similar to the Irons Fork Burrowing Crayfish. This primary burrowing crayfish preferred habitat is wet seepage areas with an open canopy, low growing

vegetation and an abundance of sedges (Rhoden *et al.* 2016a,b). Typically, this habitat occurs in low-lying areas in pastures and roadside ditches (Robison and Crump 2004).

This species is a primary burrower in ditches, lawns, fields, and pastures. Robison and Crump (2004) investigated the distribution, natural history aspects, and its status and found the peak of burrowing activity to occur in April when individuals dig burrows ranging from 45–85 cm (18–33in) deep with chimneys up to 20 cm (7.8 in) height. Soils at Ouachita Burrowing Crayfish occurrences tend to consist of sandy clay with organic material with abundant grasses and sedges (Hobbs and Robison 1985). Hundreds of Ouachita Burrowing Crayfish burrows can occupy a single pasture at a given time.

Reproduction is described in the section 7.1.2 *Life History* for Irons Fork Burrowing Crayfish. The home range for the species is at 25 m (82 ft) diameter (Nature Serve 2020).

### **7.1.3. Numbers, Reproduction, and Distribution**

The Ouachita Burrowing Crayfish (*Fallicambarus harpi*) is a Ouachita River basin endemic burrowing crayfish, found in Garland, Hot Spring, Montgomery and Pike counties of Arkansas (Robison and Crump 2004; Robison *et al.* 2008). Hobbs and Robison (1985) first described the species from two localities in Pike County, Arkansas. Robison and Crump (2004) expanded the range of this endemic crayfish with 12 new populations in Montgomery, Hot Spring, Garland, and Pike Counties. Rhoden *et al.* (2016b) further expanded the species' range with five new populations documented, including one in Clark County (Figure 8-1). Rhoden *et al.* (2016b) estimated the species' total range at 265 km<sup>2</sup> (102 mi<sup>2</sup>). The Service is not aware of any local or range-wide population estimates for the species.

### **7.1.4. Conservation Needs and Threats**

The Ouachita Burrowing Crayfish is ranked as G2 (global rank-imperiled), S2 (state rank-imperiled). This endemic species' restricted range places it more at risk than a widely ranging species. The Ouachita Burrowing Crayfish is susceptible to a number of threats, including habitat degradation and loss, air, soil and water pollution, climate change, and competition from invasive crayfish species (*Orconectes rusticus*, *Procambarus clarkii*, and *Cambarus robustus*). The Arkansas Wildlife Action Plan (AGFC 2015) lists road construction as a source of some threats. Further research is needed to determine the species' population trends and distribution and the extent and effect of threats to species' viability (NatureServe Explorer 2020).

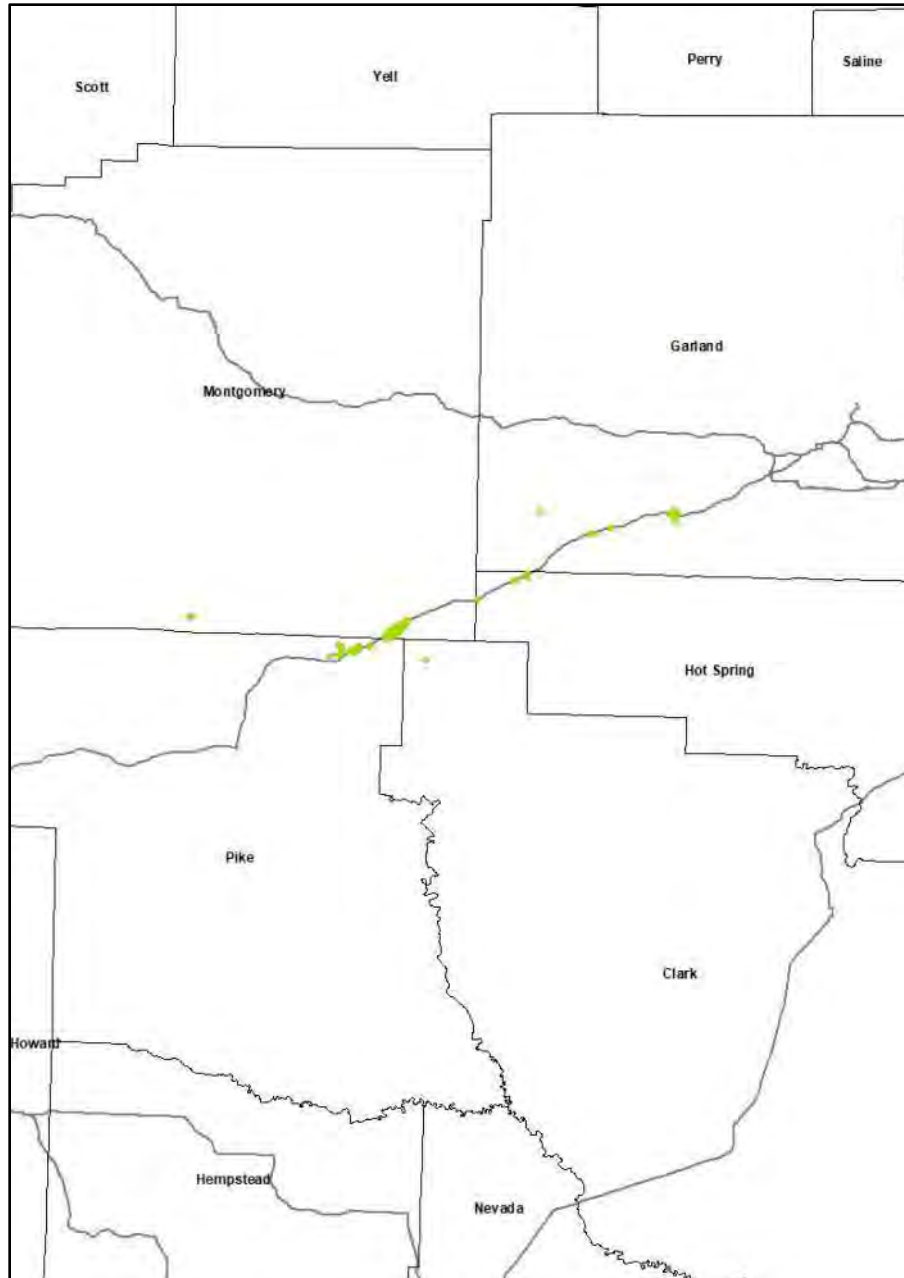
## **7.2. Environmental Baseline for Ouachita Burrowing Crayfish**

The Action Area encompasses the full known range of the species; therefore, the range-wide status of the species is the environmental baseline in the Action Area.

## **7.3. Effects of the Action on Ouachita Burrowing Crayfish**

In a PCO for a listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action Area.

The effects of the Action on Ouachita Burrowing Crayfish are similar to those described in section 7.3 *Effects of the Action on Irons Fork Burrowing Crayfish*.



**Figure 8-1.** Ouachita Burrowing Crayfish occurrences (Arkansas Natural Heritage Commission 2018).

### 7.3.1. Summary

The ARDOT will implement roadside maintenance activities including ditch cleanout and alteration to ROW hydrology as part of this Action. We expect the implementation of ditch cleanouts on a site with Ouachita Burrowing Crayfish occurrence to cause harm to eggs, juveniles, and adults of the species through the effects of burrow removal, soil compaction, and vegetation removal. However, we expect the Action to result in long-term beneficial effects to Ouachita Burrowing Crayfish due to increased suitable habitat and improved connectivity (providing additional patches of suitable habitat).

The effect of the Action to individual crayfish will be difficult to quantify due to the species' small body size and fossorial nature. Although, we cannot estimate the number of individual Ouachita Burrowing Crayfish affected by the Action, the Service is providing a mechanism to quantify take levels. Permanent and short-term habitat loss is the parameter monitored and should more accurately measure and track effects to the species and its habitat, since take of individuals is generally unknown. Habitat loss as a surrogate measure is the spatial extent of exposure to Action-caused stressors for which the reasonably certain individual response satisfies the definition of harm. The spatial extent of habitat in the Action Area affected by ditch cleanout is a maximum of 430 ha (1,064 ac) of annual habitat loss.

#### **7.4. Cumulative Effects on Ouachita Burrowing Crayfish**

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to Ouachita Burrowing Crayfish are not relevant to formulating our opinion for the Action.

#### **7.5. Conclusion for Ouachita Burrowing Crayfish**

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the PCO for Ouachita Burrowing Crayfish, which is to provide the information and analyses for a PBO to determine whether the Action is likely to jeopardize its continued existence.

The Ouachita Burrowing Crayfish is a narrow endemic found primarily in five Arkansas counties with incomplete population estimate, demographic, and distribution information available. The Action proposed by ARDOT includes activities covered under this PCO likely to cause take of Ouachita Burrowing Crayfish in the form of harm within Arkansas. However, these losses constitute a one-time or short-duration effect to the population, so we do not expect the Action to affect Ouachita Burrowing Crayfish population viability within Arkansas (*i.e.*, range-wide). The Action includes activities expected to provide beneficial effects to the species, including avoidance of ditch cleanout unless necessary and activities to enhance or create suitable habitat within the current and historical range of the species.

Approximately 430 ha per year (1,064 ac per year) in the Action Area will be affected, representing approximately 10 percent of ROW acreage in Montgomery, Garland, Hot Spring, Clark, and Pike counties. This level of disturbance does not represent an appreciable reduction of suitable habitat that is biologically meaningful at the range-wide scale. The activities in the Action assessed in the PCO are not likely to preclude or significantly delay recovery of the species and on most sites, are conservation actions to benefit the species recovery.

After reviewing the status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of Ouachita Burrowing Crayfish.

### **8. SLENDERWRIST BURROWING CRAYFISH**

#### **8.1. Status of Irons Slenderwrist Burrowing Crayfish**

This section provides the Service's PCO of the Action for Slenderwrist Burrowing Crayfish.

### **8.1.1. Species Description**

The Slenderwrist Burrowing Crayfish (*Fallicambarus petilicarpus*) is an olive-brown and tan colored crayfish. Hobbs (1989) describes the species detailed phenotypical characteristics.

### **8.1.2. Life History**

The Slenderwrist Burrowing Crayfish is one of six endemic *Fallicambarus* in Arkansas. This primary burrowing crayfish preferred habitat is very similar to the Irons Fork and Ouachita Burrowing Crayfish. *Fallicambarus* species typically prefer wet seepage areas with an open canopy, low growing vegetation and an abundance of sedges. The Slenderwrist Burrowing Crayfish known occurrences are from roadside seepage areas (Hobbs and Robison 1989). The home range for the species likely does not exceed 25 m (82 ft) diameter (Nature Serve 2020).

Reproductively active males of the species were collected in March and April (NatureServe 2020), aligning with general trends in reproduction described in the section 7.1.2 *Life History* for Slenderwrist Burrowing Crayfish.

### **8.1.3. Numbers, Reproduction, and Distribution**

The species was originally described by Hobbs and Robison (1989) from a single locality in western Union County, Arkansas; however, this primary burrower also occurs in adjacent Columbia County in the extreme southern part of the state (Robison 2001, Robison *et al.* 2008). Species occurrence is based on 18 specimens from 2 collections at the type locality and a second locality in Columbia County (Figure 9-1; Tumilson and Robison 2010, Robison 2001). Tumilson and Robison (2010) uncovered specimens from complex burrows ranging from 20 to 48 cm (8 to 19 in) in roadside ditches or seepage areas with abundant rushes (*Juncus* sp.).

### **8.1.4. Conservation Needs and Threats**

The Slenderwrist Burrowing Crayfish is ranked as G1 (global rank-critically imperiled), S1 (state rank-critically imperiled). This endemic species' restricted range places it more at risk than a widely ranging species. The Arkansas Wildlife Action Plan (AGFC 2015) lists habitat disturbance and toxins/contaminants from road construction as threats to Slenderwrist Burrowing Crayfish.

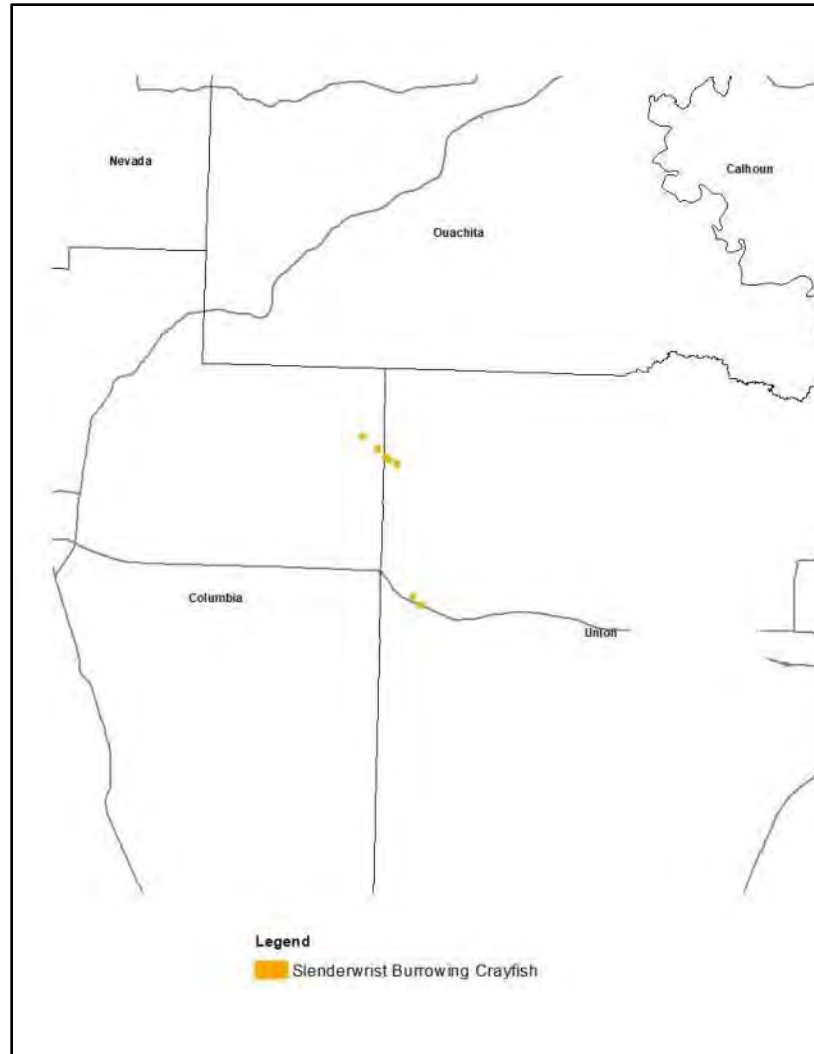
## **8.2. Environmental Baseline for Slenderwrist Burrowing Crayfish**

The Action Area encompasses the full known range of the species; therefore, the range-wide status of the species is the environmental baseline in the Action Area.

## **8.3. Effects of the Action on Slenderwrist Burrowing Crayfish**

In a PBO for a listed species, the effects of the proposed Action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action Area.

The effects of the Action on Slenderwrist Burrowing Crayfish are similar to those described in section 7.3 *Effects of the Action on Irons Fork Burrowing Crayfish*.



**Figure 9-1.** Slenderwrist Burrowing Crayfish known occurrences in Arkansas (Arkansas Natural Heritage Commission 2018).

### 8.3.1. Summary

The ARDOT will implement roadside maintenance activities including ditch cleanout and alteration to ROW hydrology as part of this Action. We expect the implementation of ditch cleanouts on a site with Slenderwrist Burrowing Crayfish occurrence to cause harm to eggs, juveniles, and adults of the species through the effects of burrow removal, soil compaction, and vegetation removal. However, we expect the Action to result in long-term beneficial effects to Slenderwrist Burrowing Crayfish due to increased suitable habitat, increased host plant resources for the species, and improved connectivity (providing additional patches of suitable habitat).

The effect of the Action to individual crayfish will be difficult to quantify due to the species' small body size and fossorial nature. Although, we cannot estimate the number of individual Slenderwrist Burrowing Crayfish affected by the Action, the Service is providing a mechanism to quantify take levels. Permanent and short-term habitat loss is the parameter monitored and should more accurately measure and track effects to the species and its habitat, since take of individuals is generally unknown. Habitat loss as a surrogate measure is the spatial extent of



exposure to Action-caused stressors for which the reasonably certain individual response satisfies the definition of harm. The spatial extent of habitat in the Action Area affected by ditch cleanout is a maximum of 205 ha (507 ac) of annual habitat loss.

#### **8.4. Cumulative Effects on Slenderwrist Burrowing Crayfish**

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to Slenderwrist Burrowing Crayfish are not relevant to formulating our opinion for the Action.

#### **8.5. Conclusion for Slenderwrist Burrowing Crayfish**

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the PCO for Slenderwrist Burrowing Crayfish, which is to provide the information and analyses for a PBO to determine whether the Action is likely to jeopardize its continued existence.

The Slenderwrist Burrowing Crayfish is a narrow endemic found primarily in two counties in south central Arkansas with incomplete population estimate, demographic, and distribution information available. The Action proposed by ARDOT includes activities covered under this PCO likely to cause take of Slenderwrist Burrowing Crayfish in the form of harm within Arkansas. However, these losses constitute a one-time or short-duration effect to the population, so we do not expect the Action to affect Slenderwrist Burrowing Crayfish population viability within Arkansas (*i.e.*, range-wide). The Action includes activities expected to provide beneficial effects to the species, including avoidance of ditch cleanout unless necessary and activities to enhance or create suitable habitat within the current and historical range of the species.

The Service expects the Action will affect approximately 205 ha per year (507 ac per year) in the Action Area, representing approximately 10 percent of ROW acreage in Columbia and Union counties. This level of disturbance does not represent an appreciable reduction of suitable habitat that is biologically meaningful at the range-wide scale. The activities in the Action assessed in the PCO are not likely to preclude or significantly delay recovery of the species and on most sites, are conservation actions to benefit the species recovery.

After reviewing the status of the species, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of Slenderwrist Burrowing Crayfish.

### **9. BAYOU BODCAU CRAYFISH**

#### **9.1. Status of Bayou Bodcau Crayfish**

##### **9.1.1. Species Description**

The Bayou Bodcau Crayfish is a small (approximately 12.7 mm (0.5 in) carapace length) grayish-tan crayfish with reddish-tan carapace with U-shaped rust markings on the sides (Hobbs 1977). Hobbs (1989) describes the species detailed phenotypical characteristics.

### **9.1.2. Life History**

The genus *Bouchardina* includes only one species and is endemic to Arkansas (Robison *et al.* 2008, Robison and Allen 1995, Bouchard and Robison 1981). The Bayou Bodcau Crayfish grows to a maximum size of less than two inches and inhabits seasonally flooded backwaters of Bayou Bodcau in southcentral Arkansas. This species is an example of a secondary burrower, a crayfish that lives in burrows and surface waters. Bayou Bodcau Crayfish typically burrows when drier conditions prevail, but also occurs in backwater areas when water levels increase. Backwater areas with Bayou Bodcau Crayfish occurrence are typically tannin-stained streams over sandy clay bottoms overlain by decaying leaves (Robison and McAllister 2010).

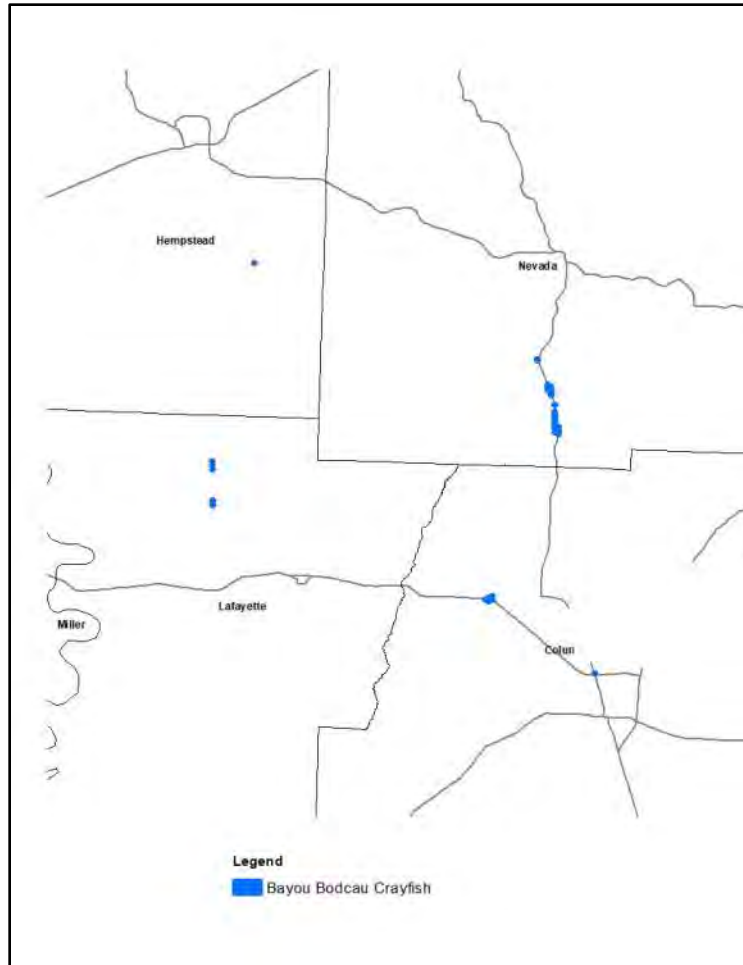
We consider the life history roughly similar to primary burrowing crayfish. Robison and McAllister (2010) collected reproductively active males, females, and juveniles in April, May, and June in Arkansas. General trends in reproduction are described in the section 7.1.2 *Life History* for Irons Fork Burrowing Crayfish.

### **9.1.3. Numbers, Reproduction, and Distribution**

This species occurs in the Bayou Bodcau watershed with nine known occurrences in Hempstead, Nevada, Lafayette, and Columbia counties in Arkansas (Figure 10-1; Robison and McAlister 2010). Researchers also attempted collection in Ouachita, Sevier, Howard, Little River, Miller, and Union counties in 2005 and 2006, but did not find species occurrence (Robison and McAllister 2010).

### **9.1.4. Conservation Needs and Threat**

The Bayou Bodcau Crayfish is ranked as G2 (global rank-imperiled), S1 (state rank-critically imperiled). The Arkansas Wildlife Action Plan (AGFC 2015) lists road construction as a source of the threats of habitat disturbance and toxins/contaminants and forestry activities as a source of the threat of hydrological alteration.



**Figure 10-1.** Bayou Bodcau Crayfish occurrences in Arkansas (Arkansas Natural Heritage Commission 2018).

## 9.2. Environmental Baseline for Bayou Bodcau Crayfish

The Action Area encompasses the full known range of the species; therefore, the range-wide status of the species is the environmental baseline in the Action Area.

## 9.3. Effects of the Action on Bayou Bodcau Crayfish

In a PBO for a listed species, the effects of the proposed Action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action Area.

Habitat loss as a surrogate measure is the spatial extent of exposure to Action-caused stressors for which the reasonably certain individual response satisfies the definition of harm. The spatial extent of habitat in the Action Area affected by ditch cleanout is a maximum of 352 ha (871 ac) of annual habitat loss

### **9.3.1. Conservation Needs and Threat**

The Bayou Bodcau Crayfish is ranked as G2 (global rank-imperiled), S1 (state rank-critically imperiled). The Arkansas Wildlife Action Plan (AGFC 2015) lists road construction as a source of the threats of habitat disturbance and toxins/contaminants and forestry activities as a source of the threat of hydrological alteration.

### **9.4. Cumulative Effects on Bayou Bodcau Crayfish**

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to Bayou Bodcau Crayfish are not relevant to formulating our opinion for the Action.

### **9.5. Conclusion for Bayou Bodcau Crayfish**

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the PCO for Bayou Bodcau Crayfish, which is to provide the information and analyses for a PBO to determine whether the Action is likely to jeopardize its continued existence.

The Bayou Bodcau Crayfish is a narrow endemic found primarily in four counties in southwestern Arkansas (*e.g.*, Lafayette, Hempstead, Nevada, Columbia) with incomplete population estimate, demographic, and distribution information available. The Action proposed by ARDOT includes activities covered under this PCO likely to cause take of Bayou Bodcau Crayfish in the form of harm within Arkansas. However, these losses constitute a one-time or short-duration effect to the population, so we do not expect the Action to affect Bayou Bodcau Crayfish population viability within Arkansas (*i.e.*, range-wide). The Action includes activities expected to provide beneficial effects to the species, including avoidance of ditch cleanout unless necessary and activities to enhance or create suitable habitat within the current and historical range of the species.

Approximately 352 ha per year (871 ac per year) in the Action Area will be affected, representing approximately 10 percent of ROW acreage in the four county range. This level of disturbance does not represent an appreciable reduction of suitable habitat that is biologically meaningful at the range-wide scale. The activities in the Action assessed in the PCO are not likely to preclude or significantly delay recovery of the species and on most sites, are conservation actions to benefit the species recovery.

After reviewing the status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of Bayou Bodcau Crayfish.

## **10. JEFFERSON COUNTY CRAYFISH**

### **10.1. Status of Jefferson County Crayfish**

#### **10.1.1. Species Description**

This Arkansas endemic burrowing crayfish is often blueish in color (Hobbs and Robison 1989). Hobbs (1989) describes the species detailed phenotypical characteristics.

### **10.1.2. Life History**

This crayfish is another primary burrower inhabiting burrows where the water table does not drop more than a meter or so beneath the surface for most of the year. Hydrophilic sedges characterize these areas in ROW ditches or low-lying areas. Surveyors note occurrences only from complex burrows consisting of branching galleries, several of which, except in dry seasons, reach the surface, some of their openings marked by irregular mounds of earthen pellets or, occasionally, slender chimneys (Robison and Wagner 2005, Hobbs and Robison 1989).

Researchers collected reproductive males in March and April and females “in berry” from burrows in March following the general trends in reproduction described in the section 7.1.2 *Life History* for Irons Fork Burrowing Crayfish.

### **10.1.3. Numbers, Reproduction, and Distribution**

Jefferson County Crayfish occurrences are restricted to Jefferson and Cleveland counties (Figure 11-1) (Robison and Wagner 2005). The eight sites of species occurrences have been in roadside ditches and areas of standing water on upslope areas away from static water. Robison and Wagner (2005) did not report occurrences of the species in Lonoke, Arkansas, Lincoln, Grant, and Pulaski counties. The species is highly localized and uncommon, and no population estimate is available.

### **10.1.4. Conservation Needs and Threats**

The Jefferson County Crayfish is ranked as G2 (global rank-imperiled), S1 (state rank-critically imperiled). The Arkansas Wildlife Action Plan (AGFC 2015) lists road construction as a source of the threats of habitat disturbance and toxins/contaminants.

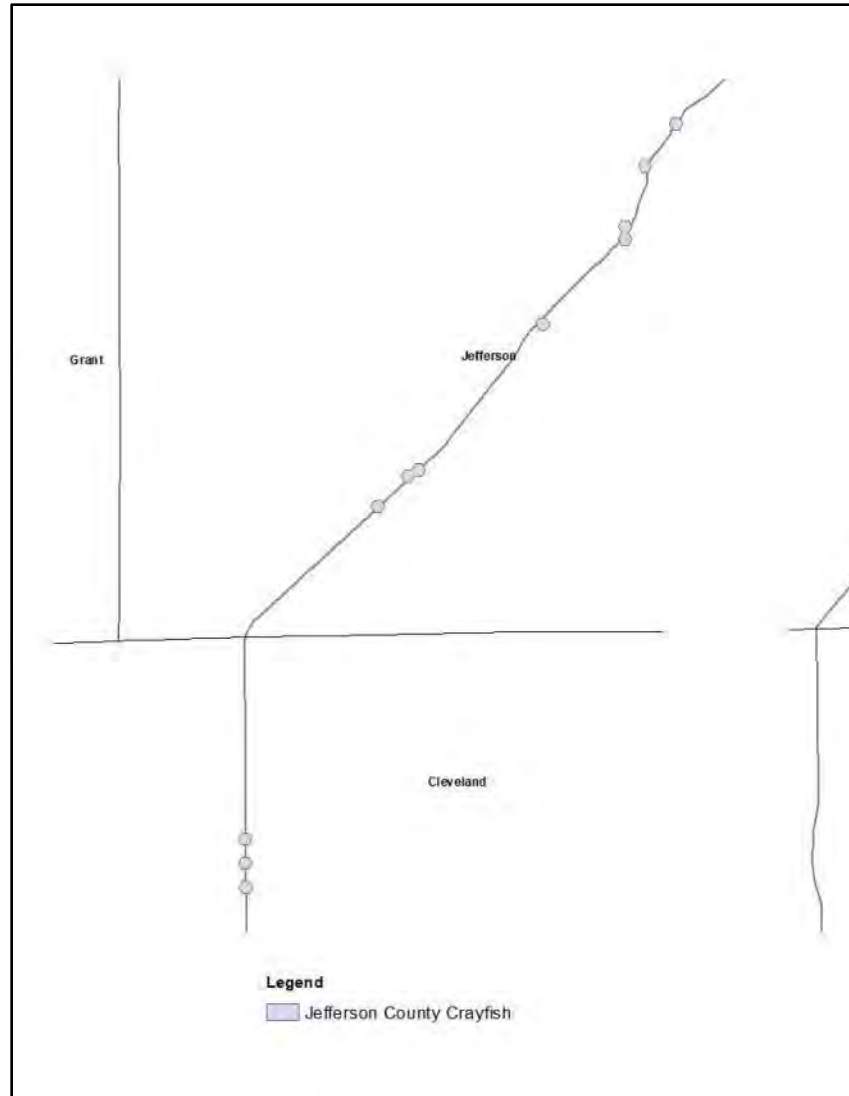
## **10.2. Environmental Baseline for Jefferson County Crayfish**

The Action Area encompasses the full known range of the species; therefore, the range-wide status of the species is the environmental baseline in the Action Area.

## **10.3. Effects of the Action on Jefferson County Crayfish**

In a PBO for a listed species, the effects of the proposed Action are all reasonably certain consequences to the species caused by the Action, including the consequences of other activities caused by the Action. Activities caused by the Action would not occur but for the Action. Consequences to species may occur later in time and may occur outside the Action Area.

The effects of the Action on Jefferson County Crayfish are similar to those described in section 7.3 *Effects of the Action on Irons Fork Burrowing Crayfish*.



**Figure 11-1.** Jefferson County Crayfish occurrences in Arkansas (Arkansas Natural Heritage Commission 2018).

### 10.3.1. Summary

The ARDOT will implement roadside maintenance activities including ditch cleanout and alteration to ROW hydrology as part of this Action. We expect the implementation of ditch cleanouts on a site with Jefferson County Crayfish occurrence to cause harm to eggs, juveniles, and adults of the species through the effects of burrow removal, soil compaction, and vegetation removal. However, we expect the Action to result in long-term beneficial effects to Jefferson County Crayfish due to increased suitable habitat, increased host plant resources for the species, and improved connectivity (providing additional patches of suitable habitat).

The effect of the Action to individual crayfish will be difficult to quantify due to the species' small body size and fossorial nature. Although, we cannot estimate the number of individual Jefferson County Crayfish affected by the Action, the Service is providing a mechanism to quantify take levels. Permanent and short-term habitat loss is the parameter monitored and

should more accurately measure and track effects to the species and its habitat since take of individuals is generally unknown. Habitat loss as a surrogate measure is the spatial extent of exposure to Action-caused stressors for which the reasonably certain individual response satisfies the definition of harm. The spatial extent of habitat in the Action Area affected by ditch cleanout is a maximum of 194 ha (479 ac) of annual habitat loss.

#### **10.4. Cumulative Effects on Jefferson County Crayfish**

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to Jefferson County Crayfish are not relevant to formulating our opinion for the Action.

#### **10.5. Conclusion for Jefferson County Crayfish**

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the PCO for Jefferson County Crayfish, which is to provide the information and analyses for a PBO to determine whether the Action is likely to jeopardize its continued existence.

The Jefferson County Crayfish is a narrow endemic found primarily in two counties in southern Arkansas with incomplete population estimate, demographic, and distribution information available. Action proposed by ARDOT includes activities covered under this PCO likely to cause take of Jefferson County Crayfish in the form of harm within Arkansas. However, these losses constitute a one-time or short-duration effect to the population, so we do not expect the Action to affect Jefferson County Crayfish population viability within Arkansas (*i.e.*, range-wide). The Action includes activities expected to provide beneficial effects to the species, including avoidance of ditch cleanout unless necessary and activities to enhance or create suitable habitat within the current and historical range of the species.

The Service expects the Action will affect approximately 194 ha per year (479 ac per year) in the Action Area, representing approximately 10 percent of ROW acreage in the species range (*e.g.*, Jefferson and Cleveland counties). This level of disturbance does not represent an appreciable reduction of suitable habitat that is biologically meaningful at the range-wide scale. The activities in the Action assessed in the PCO are not likely to preclude or significantly delay recovery of the species and on most sites, are conservation actions to benefit the species recovery.

After reviewing the status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of Jefferson County Crayfish.

### **11. INCIDENTAL TAKE STATEMENT**

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3(19)). In regulations, the Service further defines:

- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife

by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering;” (50 CFR §17.3) and

- “incidental take” as “takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant” (50 CFR §402.02).

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to a federal agency action that would not violate ESA §7(a)(2) is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO, the ARDOT must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. The ARDOT has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if the ARDOT fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of incidental take, the ARDOT must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

## **11.1. Amount or Extent of Take**

This section specifies the amount or extent of take of listed wildlife species that the Action is reasonably certain to cause, which we estimated in the “Effects of the Action” section(s) of this BO. For the Monarch Butterfly, Frosted Elfin, Irons Fork Burrowing Crayfish, Ouachita Burrowing Crayfish, Slenderwrist Burrowing Crayfish, Bayou Bodcau Crayfish, and Jefferson County Crayfish, estimating take of individuals that occurs incidental to the Action is not practical. This section describes the surrogate measures used to express the amount or extent of take anticipated and to monitor take follows for each at-risk wildlife species.

The estimated area of exposure is coextensive with the footprint of the proposed Action activities, therefore the level of anticipated exposure would only be exceeded when the Action is completed or implemented at a larger scale than proposed. We estimate take based on acres of habitat and the expected number of individuals therein and, in this section, identify an alternative surrogate measure for monitoring take in order to provide a clear standard criterion for ARDOT.

### **11.1.1. Monarch Butterfly**

The Service has reviewed the biological information and other information relevant to the Action. Based on this review, the Service anticipates the Action is reasonably certain to cause incidental take of individual monarch consistent with the definition of harm resulting from mowing and herbicide application during the second (July) and third (October 1–Thanksgiving) mowing cycles (see section 4.3 *Effects of the Action on Monarch Butterfly*).



For the monarch, detecting take that occurs incidental to the Action is not practical. The Service anticipates incidental take of monarchs to be difficult to detect and quantify for the following reasons:

- 1) monarchs have a small body size, which makes encountering dead or injured individuals unlikely;
- 2) rapid predation or scavenging of dead or injured monarch larvae and adults;
- 3) temporal fluctuations in numbers due to the migratory nature of the species may mask population changes; and
- 4) lack of availability of standard population estimates.

Although, we cannot estimate the number of individual monarchs affected by the Action, the Service is providing a mechanism to quantify take levels and define when take would be considered to be exceeded. For purposes of this BO, the Service defines incidental take in terms of the extent of occupied habitat affected by the proposed Action. The Service used estimates provided in the VPL and supporting documents, as explained in this BO, information exchange between ARDOT representatives and Service staff, and a review of publicly available information and scientific literature to determine the extent of habitat taken.

Based on these calculations, the Service anticipates that incidental take of monarchs may occur in the form of harm or mortality, within a maximum of approximately 7,022 ha (17,352 ac) of habitat on ROW in Arkansas each year. Therefore, the amount of annual incidental take for monarch authorized by this PCO, upon conversion to a PBO, includes all individual monarchs within an area  $\leq 7,022$  ha (17,352 ac) of suitable habitat that occurs within the Action Area.

Strict adherence to the components of the proposed Action through field monitoring and regular reporting during the term of the action as set forth in the section *Monitoring and Reporting* below constitute a reasonable and practical alternative to stay under the exempted take level. The various components of the proposed Action establish certainty that monarch may be exposed to vegetation management practices in ROWs at times and in a manner that conforms to take. In that way, components of the proposed Action link to monarch incidental take. Take will result from exposure of individual monarchs in those areas where mowing and herbicide application will occur in suitable habitat in ROW.

The Service believes that acreage of suitable habitat removed identifies the level of use associated with the Action and is the most practical surrogate for measuring take of monarch. Therefore, the Service determined that if any actions exceed the acreage total, this will trigger reinitiation. The Service will determine if the use associated with take is approaching the amount described above through review of annual monitoring reports submitted to the Service by ARDOT. Any deviation from the proposed action that increases exposure of monarch to mowing and herbicide application will constitute exceedance of the exempted take level requiring immediate coordination with the Service to determine if reinitiation of formal consultation is warranted.

### 11.1.2. Frosted Elfin

The Service anticipates that the Action is reasonably certain to cause incidental take of individual Frosted Elfin consistent with the definition of harm resulting from mowing (see section 6.3 *Effects of the Action on Frosted Elfin*).

For Frosted Elfin, detecting take that occurs incidental to the Action is not practical. The Service expects incidental take of individual Frosted Elfin will be difficult to quantify for the following reasons:

- 1) Frosted Elfin has a small body size, which makes encountering dead or injured individuals unlikely;
- 2) variability in suitable habitat occurrence in the Action Area and species occurrence within suitable habitat
- 3) lack of standard population estimates.

For purposes of this PCO, the Service defines incidental take in terms of the extent of occupied and presumed occupied suitable habitat affected by the proposed action. The Service used estimates provided in the biological assessment, information exchange between ARDOT representatives and Service staff, and a review of publicly available information and scientific literature to determine the extent of habitat that would be taken, which is likely an overestimate. Based on these calculations, the Service anticipates that incidental take of Frosted Elfin may occur in the form of harm or mortality within a maximum of approximately 502 ha<sup>1</sup> (1,241 ac) of potential Frosted Elfin habitat in the Action Area. Therefore, the amount of annual incidental take for Frosted Elfin authorized by this PCO, upon conversion to a PBO, includes all individual Frosted Elfin within an area  $\leq$  502 ha (1,241 ac) of suitable habitat that occurs within the Action Area.

Strict adherence to the components of the proposed action through field monitoring and regular reporting during the term of the action as set forth in the section Monitoring and Reporting below constitute a reasonable and practical alternative to ensure take remains within specified limits. The various components of the proposed Action establish certainty that Frosted Elfin will be exposed to mowing activities, at times, in a manner that conforms to take. In that way, components of the proposed Action link to Frosted Elfin incidental take. Take will result from exposure of individual Frosted Elfin in those areas where mowing and herbicide application will occur on suitable habitat in the ROW.

The Service believes that acreage of suitable habitat removed identifies the level of use associated with the action and is the most practical surrogates for measuring the take of Frosted Elfin. Therefore, the Service determined that if any actions exceed the acreage total, this will

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<sup>1</sup> The estimate of suitable habitat for Frosted Elfin affected by the Action was calculated using ARDOT's estimate of eligible ROW (10% ) multiplied by the total ROW acres in counties with Frosted Elfin occurrence (4,063 mi x 90 ft ROW), resulting in an estimate of 1,794 ha (4,432 ac). In surveys of suitable habitat (host plant presence), Frosted Elfin occurred on approximately 28 percent of sites. The level of habitat alteration expected to take Frosted Elfin is therefore estimated to be 28 percent of 1,794 ha (4,432 ac) or 502 ha (1,241 ac).

trigger reinitiation. The Service will determine if the use associated with take is approaching the amount described above through review of annual monitoring reports submitted to the Service by ARDOT. Any deviation from the proposed action that increases exposure of Frosted Elfin to habitat management practices will constitute exceedance of the exempted take level requiring immediate coordination with the Service to determine if reinitiation of formal consultation is warranted.

### 11.1.3. Covered Crayfish Species

The Service anticipates that the Action is reasonably certain to cause incidental take of individual crayfish consistent with the definition of harm resulting from ditch cleanout and other maintenance activities resulting in changes in hydrology (see sections 7.3 *Effects of the Action on Irons Fork Burrowing Crayfish*).

For the covered crayfish species, detecting take that occurs incidental to the Action is not practical. The Service expects incidental take of individual crayfish will be difficult to quantify for the following reasons:

- 1) crayfish have a small body size, which makes encountering dead or injured individuals unlikely;
- 3) fossorial aspect of species life history and behavior; and
- 4) lack of availability of standard population estimates.

For purposes of this PCO, the Service defines incidental take in terms of the extent of suitable habitat affected by the proposed Action. The Service used estimates provided in the biological assessment, information exchange between ARDOT representatives and Service staff, and a review of publicly available information and scientific literature to determine the extent of habitat that would be taken, which is likely an overestimate. Based on these calculations<sup>2</sup>, the Service anticipates that incidental take of covered crayfish species may occur in the form of harm or mortality within a maximum extent of potential burrowing crayfish habitat in the Action Area (Table 12-1). Therefore, the amount of annual incidental take for covered crayfish species authorized by this PCO, upon conversion to a PBO, includes all individual covered crayfish within the areas of suitable habitat that occurs within the Action Area (Table 12-1).

**Table 12-1.** Estimates of the annual amount of surrogate units of take (extent of suitable habitat) caused by the Action, by species and county of occurrence.

Species	Hectares/ Year	Acres/ Year	Range (counties)
Irons Fork Burrowing Crayfish	240	593	Polk, Montgomery, Scott

<sup>2</sup> We calculated the estimate of suitable habitat for covered crayfish affected by the Action using ARDOT's estimate of eligible ROW (10%) multiplied by the total ROW acres in counties with species' occurrence. We then multiplied the resulting eligible miles in each species' range by the assumed 90 ft ROW. No ratio of positive to negative surveys or population density estimates are available for these species, thus we estimate take as the entire eligible acreage in the covered crayfish species range.

Ouachita Burrowing Crayfish	430	1,064	Clark, Garland, Hot Spring, Montgomery, Pike
Slenderwrist Burrowing Crayfish	205	507	Columbia, Union
Bayou Bodcau Crayfish	352	871	Hempstead, Nevada, Lafayette, Columbia
Jefferson County Crayfish	194	479	Jefferson, Cleveland

Strict adherence to the components of the proposed Action through field monitoring and regular reporting during the term of the Action, as set forth in the section Monitoring and Reporting below, constitute a reasonable and practical alternative to ensure take remains within specified limits. The various components of the proposed Action establish certainty that covered crayfish will be exposed to ditch cleanout and other maintenance activities expected to alter site hydrology, at times, in a manner that conforms to take. In that way, components of the proposed Action link to covered crayfish incidental take. Take will result from exposure of individual crayfish in those areas where ditch cleanout will occur in suitable habitat in the ROW.

The Service believes that acreage of suitable habitat removed identifies the level of use associated with the Action and is the most practical surrogate for measuring the take of covered crayfish. Therefore, the Service determined that if any actions exceed the acreage total, this will trigger reinitiation. The Service will determine if the use associated with take is approaching the amount described above through review of annual monitoring reports submitted to the Service by ARDOT. Any deviation from the proposed Action that increases exposure of covered crayfish to habitat management practices will constitute exceedance of the exempted take level requiring immediate coordination with the Service to determine if reinitiation of formal consultation is warranted.

### **Surrogate Measures for Monitoring**

When it is not practical to monitor take in terms of individuals of the listed species, the regulations at 50 CFR §402.14(i)(1)(i) indicate that an ITS may express the amount or extent of take using a surrogate (*e.g.*, a similarly affected species, habitat, or ecological conditions), provided that the Service also:

- describes the causal link between the surrogate and take of the listed species; and
- sets a clear standard for determining when the level of anticipated take has been exceeded.

We have identified surrogate measures in our analyses of effects that satisfy criteria for monitoring take of the species named above during Action implementation. Table 12-2 lists the species, life stage, surrogate measure, and the section of the BO that explains the causal link between the surrogate and the anticipated taking. We describe procedures for this monitoring in section 12.4.

Table 12-2 identifies the species, life stage(s), surrogate unit, quantity, and the section of the BO that contains the supporting analysis. We describe procedures for monitoring take that occurs during Action implementation for each covered species in section 12.4.

**Table 12-2.** Estimates of the annual amount of take caused by the Action, by species, life stage, surrogate unit for take, and quantity of take collated from the cited PCO effects analyses.

Species	Life Stage(s)	Surrogate (units)	Quantity (acres)	PCO Effects Analysis Section
Monarch	All	Acres/year	17,352	4.3
Frosted Elfin	All	Acres/year	1,241	6.3
Irons Fork Burrowing Crayfish	All	Acres/year	593	7.3
Ouachita Burrowing Crayfish	All	Acres/year	1,064	8.3
Slenderwrist Burrowing Crayfish	All	Acres/year	507	9.3
Bayou Bodcau Crayfish	All	Acres/year	871	10.3
Jefferson County Crayfish	All	Acres/year	479	11.3

We recognize these estimates greatly overestimate the level of take associated with the program, and do not give a meaningful estimate for comparison. Habitat monitoring of VPL ROW sites will provide additional information to be used in reinitiated consultation.

## 11.2. Reasonable and Prudent Measures

The Action includes conservation measures to avoid and minimize effects to monarch, Frosted Elfin, and five covered crayfish species and promote recovery by improving suitable habitat on ROW in the Action Area. Due to the aforementioned commitments from ARDOT and our review of the Action and conservation measures, the Service believes that no reasonable and prudent measures are necessary or appropriate to minimize the impact, *i.e.*, the amount or extent, of incidental take of Monarch Butterfly, Frosted Elfin, and five covered crayfish species caused by the Action. Minor changes that do not alter the basic design, location, scope, duration, or

timing of the Action would not reduce incidental take below the amount or extent anticipated for the Action as proposed. Therefore, this ITS does not provide RPMs for these species.

### **11.3. Terms and Conditions**

As stated previously, the Service believes that reasonable and prudent measures are not necessary for this ITS for these species and this Action. Therefore, this ITS does not provide RPMs or terms and conditions for this Action or these species.

### **11.4. Monitoring and Reporting Requirements**

In order to monitor the impacts of incidental take, ARDOT must report the progress of the Action and its impact on the species to the Service as specified in the ITS (50 CFR §402.14(i)(3)). This section provides the specific instructions for such monitoring and reporting (M&R), including procedures for handling and disposing of any individuals of a species actually killed or injured. These M&R requirements are mandatory.

As necessary and appropriate to fulfill this responsibility, ARDOT must require any contractor or grantee to accomplish the M&R through enforceable terms that ARDOT includes in the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify ARDOT and the Service if the amount or extent of incidental take exceeds that specified in this ITS during Action implementation.

The ARDOT will complete monitoring during the portion of the growing season to effectively determine species presence and abundance and habitat quality for the annual monitoring period. We describe the general monitoring protocol below, but ARDOT may modify this methodology based on site-specific conditions. Any modifications to the monitoring protocol will ensure an accurate representation of abundance, distribution and trend while allowing field crew efficiency to reach a maximum number of sites.

Using a stratified random approach to ensure adequate spatial representation, ARDOT will establish long-term monitoring locations during the first growing season of the program. The ARDOT will not monitor chosen sites with dense tree canopy, development adjacent to the ROW or less than 3 m (10 ft) of herbaceous cover in the transition zone. The ARDOT will prioritize monitoring on sites with conservation efforts, current or historical species occurrence, or suitable habitat for covered species.

The ARDOT will assess a minimum of 50 plots (45 m (150 ft) x ROW width) using the Monarch Joint Venture's Monarch Roadside Habitat Evaluation Tool each year. Monitors will estimate noxious weed cover by species, nectar plant cover by species, counts of all life stage monarchs, and counts of milkweed by species (if known) and flowering status. The habitat quality score will inform site assessment management and adaptive management decisions. This level of monitoring exceeds the minimum required for entities enrolled in the Nationwide Monarch Candidate Conservation Agreement/Assurances (CCA/A).

In addition to the monarch-centered rapid assessment, ARDOT will note presence of wild indigo and, in burrowing crayfish range, an estimate of the area of appropriate habitat and potential occurrence (presence of crayfish "chimneys"). Monitors will note the presence of sedges or other facultative herbaceous wetland vegetation when feasible.

The ARDOT will make the results from annual monitoring efforts available to the Service in an annual report (see M&R 1). If the Service lists any of the covered species under the ESA, ARDOT may make the monitoring reports available with the credit ledger for the species.

### **M&R 1. Extent of Suitable Habitat Alteration**

Upon the listing of monarch, Frosted Elfin, or any of the covered crayfish species under the ESA and the Service adopts this PCO as a PBO, the following reporting requirements will apply. AGFC will provide an annual report in order to ensure the amount or extent of incidental take is not exceeded and activities in the PCO are carried out as described. The report will include (at a minimum):

- 1) Number of acres of conservation mowing, conservation herbicide application, wildflower plantings, and actions to benefit covered crayfish species in the Action Area.
- 2) District in which the efforts were implemented.
- 3) Date(s) the treatments were implemented.
- 4) Brief summary of the implemented activities (*e.g.*, fall mowing to 10 inches, spot treatment with Garlon).

The ARDOT will submit the report to the Arkansas ESFO Field Supervisor no later than February 1 of each year and should include the previous calendar year's actions. For example, the report due February 1, 2021, will include practices conducted January 1, 2020, to December 31, 2020.

### **M&R 2. Disposition of Dead or Injured Covered Species**

The ARDOT will notify the ARFO as expeditiously as possible upon locating a dead or injured monarch, Frosted Elfin, Irons Fork Burrowing Crayfish, Ouachita Burrowing Crayfish, Slenderwrist Burrowing Crayfish, Bayou Bodcau Crayfish, or Jefferson County Crayfish during any aspect of the proposed Action. The ARDOT will take care in handling sick, injured, or dead specimens to preserve biological materials in the best possible state. The finder must ensure that evidence intrinsic to the specimen is not unnecessarily disturbed. The ARDOT (or finder) will preserve all dead or moribund individuals and the date and location of collection recorded. These specimens should then be furnished to the university, museum, or agency specified by the Service. The ARDOT will report the date and location of collection with the annual extent of take monitoring report.

## **12. CONSERVATION RECOMMENDATIONS**

§7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed Action, implement recovery plans, or develop information that is useful for the conservation of listed species. The voluntary pre-listing conservation program incorporates Service conservation recommendations offered in the development of the program. The Service has no additional recommendations relevant to the listed species addressed in this PCO.

### 13. REINITIATION NOTICE

Formal consultation for the Action considered in this PCO is concluded. Reinitiating consultation is required if ARDOT retains discretionary involvement or control over the Action (or is authorized by law) when:

- 1) the amount or extent of incidental take is exceeded;
- 2) new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
- 3) the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
- 4) a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, ARDOT is required to immediately request a reinitiation of formal consultation.

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# ATTACHMENT G — ANHC ELEMENTS OF SPECIAL CONCERN





THE DEPARTMENT OF ARKANSAS  
HERITAGE

Asa Hutchinson  
Governor

Stacy Hurst  
Director

Date: April 17, 2019  
Subject: Elements of Special Concern  
I-57 Study Area  
Clay, Greene, Lawrence, and Randolph Counties, Arkansas  
ANHC No.: P-CF..-19-016

Mr. Ryan Mountain  
Garver  
2049 East Joyce Boulevard  
Suite 400  
Fayetteville, AR 72703

Arkansas Arts Council

.

Arkansas Historic  
Preservation Program

.

Arkansas Natural  
Heritage Commission

.

Arkansas State Archives

.

Delta Cultural Center

.

Historic Arkansas Museum

.

Mosaic Templars Cultural Center

.

Old State House Museum

Dear Mr. Mountain:

Staff members of the Arkansas Natural Heritage Commission (ANHC) have reviewed our files for records indicating the occurrence of rare plants and animals, outstanding natural communities, natural or scenic rivers, or other elements of special concern within the I-57 Study Area in Northeast Arkansas. The results of this review have been provided in an electronic format. Our records indicate the occurrence of 39 species of conservation concern within the project study area.

A list of the sensitive species within the study area is attached for your reference. A legend is included to help you interpret the codes used on the list. The majority of these species are associated with the Current River, the Black River, and/or the Dave Donaldson/Black River Wildlife Management Area (WMA). Efforts should be made to avoid or minimize impacts to these streams and to the WMA. The study area is also known to support several plant species of conservation concern, most notably pondberry (*Lindera melissifolia*), and corkwood (*Leitneria pilosa ssp. ozarkana*). Pondberry is a shrub listed by the U.S. Fish and Wildlife Service as endangered. Corkwood is a small tree or shrub with a distribution limited to southeastern Missouri and eastern Arkansas. Both of these species are associated with seasonally flooded wetlands (bottomland hardwood forests and forested swales), and the margins of sand ponds. There are three known locations for pondberry in the study area. We only can verify that the population at Stateline Sand ponds Natural Area (located on the northwestern edge of the study site) is still extant. Corkwood has been reported from at least 14 locations. Most of the available information for corkwood occurrences is not precise, but the species could be present throughout the study area within small wetlands and along ditches where remnants of native vegetation persist. Available habitat for these species is very limited in this area. To the extent possible, efforts should be made to avoid impacting suitable habitat. Any suitable habitat falling within the final selected alignment should be evaluated for the presence of these species.



1100 North Street  
Little Rock, AR 72201

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fax: (501) 324-9618

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[www.naturalheritage.com](http://www.naturalheritage.com)

Please keep in mind that the project area may contain important natural features of which we are unaware. Staff members of the Arkansas Natural Heritage Commission have not conducted a field survey of the study site. Our review is based on data available to the program at the time of the request. It should not be regarded as a final statement on the elements or areas under consideration. Because our files are updated constantly, you may want to check with us again at a later time.

Thank you for consulting us. It has been a pleasure to work with you on this study.

Sincerely,

A handwritten signature in cursive script that reads "Cindy Osborne".

Cindy Osborne  
Data Manager/Environmental Review Coordinator

Enclosures: Element List  
Legend  
Invoice

4/17/2019

**Arkansas Natural Heritage Commission**  
**Department of Arkansas Heritage**  
**Elements of Special Concern**  
**I-57 Study Area**

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank
<b>Animals-Invertebrates</b>					
<i>Cyprogenia aberti</i>	Ozark Fanshell	-	INV	G2G3Q	S3
<i>Lampsilis abrupta</i>	Pink Mucket	LE	SE	G2	S2
<i>Pleurobema sintoxia</i>	Round Pigtoe	-	INV	G4G5	S3
<i>Theliderma cylindrica</i>	Rabbitsfoot	LT	SE	G3G4	S3
<i>Villosa lianosa</i>	little spectaclecase	-	INV	G5	S3
<b>Animals-Vertebrates</b>					
<i>Ammocrypta clara</i>	western sand darter	-	INV	G3	S3
<i>Calcarius pictus</i>	Smith's Longspur	-	INV	G4G5	S2N
<i>Carpiodes velifer</i>	highfin carpsucker	-	INV	G4G5	S3
<i>Corynorhinus rafinesquii</i>	Rafinesque's big-eared bat	-	INV	G3G4	S3
<i>Cycleptus elongatus</i>	blue sucker	-	INV	G3G4	S3
<i>Etheostoma uniporum</i>	current darter	-	INV	G4	S3
<i>Haliaeetus leucocephalus</i>	Bald Eagle	-	INV	G5	S3B,S4N
<i>Hiodon alosoides</i>	goldeye	-	INV	G5	S2
<i>Hiodon tergisus</i>	mooneye	-	INV	G5	S2
<i>Macrhybopsis hyostoma</i>	shoal chub	-	INV	G5	S3
<i>Moxostoma anisurum</i>	silver redhorse	-	INV	G5	S1
<i>Moxostoma pisolabrum</i>	pealip redhorse	-	INV	G5	S2
<i>Myotis austroriparius</i>	southeastern bat	-	INV	G4	S3
<i>Myotis lucifugus</i>	little brown bat	-	INV	G3	S1
<i>Myotis septentrionalis</i>	northern long-eared bat	LT	SE	G1G2	S1S2
<i>Myotis sodalis</i>	Indiana bat	LE	SE	G2	S1
<i>Notropis atrocaudalis</i>	blackspot shiner	-	INV	G4	S3
<i>Notropis sabiniae</i>	sabine shiner	-	INV	G4	S2
<i>Notropis wickliffi</i>	channel shiner	-	INV	G5	S2
<i>Percina evides</i>	gilt darter	-	INV	G4	S3
<i>Percina phoxocephala</i>	slenderhead darter	-	INV	G5	S2
<i>Percina uranidea</i>	stargazing darter	-	INV	G3	S2
<i>Percina vigil</i>	saddleback darter	-	INV	G5	S3
<b>Plants-Vascular</b>					
<i>Blephilia hirsuta</i>	hairy wood mint	-	INV	G5?	S1
<i>Carex lupuliformis</i>	false hop sedge	-	INV	G4	S1S2
<i>Carex opaca</i>	opaque prairie sedge	-	SE	G4	S2S3
<i>Carex pellita</i>	woolly sedge	-	INV	G5	S1S2
<i>Eleocharis wolfii</i>	Wolf's spike-rush	-	INV	G3G5	S3
<i>Leitneria floridana</i>	corkwood	-	INV	G3	S3
<i>Lindera melissifolia</i>	pondberry	LE	SE	G3	S2
<i>Phacelia giliioides</i>	Brand's scorpion-weed	-	INV	G5	S2S3
<i>Platanthera peramoena</i>	purple fringeless orchid	-	ST	G5	S2
<i>Ptilimnium costatum</i>	big mock bishop's-weed	-	INV	GNR	S1
<i>Tradescantia virginiana</i>	Virginia spiderwort	-	INV	G5	S1

## LEGEND

### STATUS CODES

#### FEDERAL STATUS CODES

C	=	Candidate species. The U.S. Fish and Wildlife Service has enough scientific information to warrant proposing this species for listing as endangered or threatened under the Endangered Species Act.
LE	=	Listed Endangered; the U.S. Fish and Wildlife Service has listed this species as endangered under the Endangered Species Act.
LT	=	Listed Threatened; the U.S. Fish and Wildlife Service has listed this species as threatened under the Endangered Species Act.
-PD	=	Proposed for Delisting; the U.S. Fish and Wildlife Service has proposed that this species be removed from the list of Endangered or Threatened Species.
PE	=	Proposed Endangered; the U.S. Fish and Wildlife Service has proposed this species for listing as endangered.
PT	=	Proposed Threatened; the U.S. Fish and Wildlife Service has proposed this species for listing as threatened.
T/SA E/SA	=	Threatened (or Endangered) because of similarity of appearance.

#### STATE STATUS CODES

INV	=	Inventory Element; The Arkansas Natural Heritage Commission is currently conducting active inventory work on these elements. Available data suggests these elements are of conservation concern. These elements may include outstanding examples of Natural Communities, colonial bird nesting sites, outstanding scenic and geologic features as well as plants and animals, which, according to current information, may be rare, peripheral, or of an undetermined status in the state. The ANHC is gathering detailed location information on these elements.
WAT	=	Watch List Species; The Arkansas Natural Heritage Commission is not conducting active inventory work on these species, however, available information suggests they may be of conservation concern. The ANHC is gathering general information on status and trends of these elements. An "*" indicates the status of the species will be changed to "INV" if the species is verified as occurring in the state (this typically means the agency has received a verified breeding record for the species).
MON	=	Monitored Species; The Arkansas Natural Heritage Commission is currently monitoring information on these species. These species do not have conservation concerns at present. They may be new species to the state, or species on which additional information is needed. The ANHC is gathering detailed location information on these elements
SE	=	State Endangered; this term is applied differently for plants and animals.  Animals – These species are afforded protection under Arkansas Game and Fish Commission (AGFC) Regulation. The AGFC states that it is unlawful to import, transport, sell, purchase, hunt, harass or possess any threatened or endangered species of wildlife or parts. The AGFC lists as endangered any wildlife species or subspecies endangered or threatened with extinction, listed or proposed as a candidate for listing by the U.S. Fish and Wildlife Service or any native species or subspecies listed as endangered by the Commission.  Plants – These species have been recognized by the Arkansas Natural Heritage Commission as being in danger of being extirpated from the state. This is an administrative designation with no regulatory authority.
ST	=	State Threatened; These species have been recognized by the Arkansas Natural Heritage Commission as being likely to become endangered in Arkansas in the foreseeable future, based on current inventory information. This is an administrative designation with no regulatory authority.

### DEFINITION OF RANKS

#### Global Ranks

G1	=	Critically imperiled globally. At a very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
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<b>G2</b>	=	<b>Imperiled globally. At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.</b>
<b>G3</b>	=	<b>Vulnerable globally. At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.</b>
<b>G4</b>	=	<b>Apparently secure globally. Uncommon but not rare; some cause for long-term concern due to declines or other factors.</b>
<b>G5</b>	=	<b>Secure globally. Common, widespread and abundant.</b>
<b>GH</b>	=	<b>Of historical occurrence, possibly extinct globally. Missing; known from only historical occurrences, but still some hope of rediscovery.</b>
<b>GU</b>	=	<b>Unrankable. Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.</b>
<b>GX</b>	=	<b>Presumed extinct globally. Not located despite intensive searches and virtually no likelihood of rediscovery.</b>
<b>GNR</b>	=	<b>Unranked. The global rank not yet assessed.</b>
<b>GNA</b>	=	<b>Not Applicable. A conservation status rank is not applicable.</b>
<b>T-RANKS=</b>		<b>T subranks are given to global ranks when a subspecies, variety, or race is considered at the state level. The subrank is made up of a "T" plus a number or letter (1, 2, 3, 4, 5, H, U, X) with the same ranking rules as a full species.</b>

#### State Ranks

<b>S1</b>	=	<b>Critically imperiled in the state due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors making it vulnerable to extirpation.</b>
<b>S2</b>	=	<b>Imperiled in the state due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it vulnerable to extirpation.</b>
<b>S3</b>	=	<b>Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.</b>
<b>S4</b>	=	<b>Apparently secure in the state. Uncommon but not rare; some cause for long-term concern due to declines or other factors.</b>
<b>S5</b>	=	<b>Secure in the state. Common, widespread and abundant.</b>
<b>SH</b>	=	<b>Of historical occurrence, with some possibility of rediscovery. Its presence may not have been verified in the past 20-40 years. A species may be assigned this rank without the 20-40 year delay if the only known occurrences were destroyed or if it had been extensively and unsuccessfully sought.</b>
<b>SU</b>	=	<b>Unrankable. Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.</b>
<b>SX</b>	=	<b>Presumed extirpated from the state. Not located despite intensive searches and virtually no likelihood of rediscovery.</b>
<b>SNR</b>	=	<b>Unranked. The state rank not yet assessed.</b>
<b>SNA</b>	=	<b>Not Applicable. A conservation status rank is not applicable.</b>

#### General Ranking Notes

<b>Q</b>	=	<b>A "Q" in the global rank indicates the element's taxonomic classification as a species is a matter of conjecture among scientists.</b>
<b>RANGES=</b>		<b>Ranges are used to indicate a range of uncertainty about the status of the element.</b>
<b>?</b>	=	<b>A question mark is used to denote an inexact numeric rank.</b>
<b>B</b>	=	<b>Refers to the breeding population of a species in the state.</b>
<b>N</b>	=	<b>Refers to the non-breeding population of a species in the state.</b>



## ATTACHMENT H — AGFC SPECIES OF GREATEST CONCERN

## Arkansas Endangered, Threatened, Regulated, And Species of Greatest Conservation Need

28 January 2016

**Key:** E = Endangered  
T = Threatened  
R = Regulated

All species on this list are Species of Greatest Conservation Need

		<b>USFWS Status</b>
<b>Crayfish</b>		
<i>Bouchardina robisoni</i>	Bayou Bodcau Crayfish	
<i>Cambarus aculabrum</i>	Benton County Cave Crayfish	E
<i>Cambarus causeyi</i>	Boston Mountains Crayfish	
<i>Cambarus hubbsi</i>	Hubbs' Crayfish	
<i>Cambarus setosus</i>	Bristly Cave Crayfish	
<i>Cambarus zophanastes</i>	Hell Creek Cave Crayfish	E
<i>Fallicambarus dissitus</i>	Pine Hills Digger Crayfish	
<i>Fallicambarus gilpini</i>	Jefferson County Crayfish	
<i>Fallicambarus harpi</i>	Ouachita Burrowing Crayfish	
<i>Fallicambarus jeanae</i>	Daisy Burrowing Crayfish	
<i>Fallicambarus petilicarpus</i>	Slenderwrist Burrowing Crayfish	
<i>Fallicambarus strawni</i>	Saline Burrowing Crayfish	
<i>Faxonella blairi</i>	Blairs' Fencing Crayfish	
<i>Orconectes acares</i>	Redspotted Stream Crayfish	
<i>Orconectes eupunctus</i>	Coldwater Crayfish	
<i>Orconectes leptogonopodus</i>	Little River Creek Crayfish	
<i>Orconectes marchandi</i>	Mammoth Spring Crayfish	
<i>Orconectes macrus</i>	Neosho Midget Crayfish	
<i>Orconectes meeki brevis</i>	Meek's Short pointed Crayfish	
<i>Orconectes menae</i>	Mena Crayfish	
<i>Orconectes neglectus chaenodactylus</i>	Gapped Ringed Crayfish	
<i>Orconectes nana</i>	Midget Crayfish	
<i>Orconectes williamsi</i>	William's Crayfish	
<i>Procambarus parasimulans</i>	Bismarck Burrowing Crayfish	
<i>Procambarus reimeri</i>	Irons Fork Burrowing Crayfish	
<i>Procambarus regalis</i>	Regal Burrowing Crayfish	
<i>Procambarus tenuis</i>	Ouachita Mountain Crayfish	
<b>Snails</b>		

<i>Amnicola cora</i>	Foushee Cave Snail	
<i>Inflectariouus magazinensis</i>	Magazine Mountain Shagreen	
<i>Millerelix peregrina</i>	White Liptooth	
<i>Patera clenchi</i>	Calico Rock Oval	
<i>Paravitrea aulacogyra</i>	Striate Supercoil	
<i>Pyrgulopsis ozarkensis</i>	Ozark Pyrg	
<i>Somatogyrus amnicoloides</i>	Ouachita Pebblesnail	
<i>Somatogyrus crassilabris</i>	Thicklipped Pebblesnail	
<i>Somatogyrus wheeleri</i>	Channelled Pebblesnail	
<i>Stenotrema pilsbryi</i>	Rich Mountain Slitmouth	
<i>Stenotrema unciferum</i>	Ouachita Slitmouth	
<i>Xolotrema occidentalis</i>	Arkansas Wedge	
<b>Mussels</b>		
<i>Alasmidonta marginata</i>	Elktoe	
<i>Alasmidonta viridis</i>	Slippershell mussel	
<i>Arkansia wheeleri</i>	Ouachita rock pocketbook	E
<i>Cumberlandia monodonta</i>	Spectaclecase	E
<i>Cyprogenia aberti</i>	Western fanshell	
<i>Cyprogenia sp. cf aberti</i> (Arkansas, St. Francis, White)	Ozark fanshell	
<i>Cyprogenia sp. cf aberti</i> (Ouachita)	Ouachita fanshell	
<i>Epioblasma florentina curtisi</i>	Curtis pearlymussel	E
<i>Epioblasma triquetra</i>	Snuffbox	E
<i>Epioblasma turgidula</i>	Turgid blossom	E
<i>Fusconaia ozarkensis</i>	Ozark pigtoe	
<i>Lampsilis abrupta</i>	Pink mucket	E
<i>Lampsilis powellii</i>	Arkansas fatmucket	T
<i>Lampsilis rafinesqueana</i>	Neosho mucket	E
<i>Lampsilis streckeri</i>	Speckled pocketbook	E
<i>Leptodea leptodon</i>	Scaleshell	E
<i>Margaritifera hembeli</i>	Louisiana pearlshell	T
<i>Obovaria olivaria</i>	Hickorynut	
<i>Pleurobema cordatum</i>	Ohio pigtoe	
<i>Pleurobema rubrum</i>	Pyramid pigtoe	
<i>Pleurobema sintoxia</i>	Round pigtoe	
<i>Potamilus alatus</i>	Pink heelsplitter	
<i>Potamilus capax</i>	Fat pocketbook	E
<i>Ptychobranhus occidentalis</i>	Ouachita kidneyshell	
<i>Quadrula apiculata</i>	Southern mapleleaf	
<i>Quadrula cylindrica cylindrica</i>	Rabbitsfoot	T
<i>Quadrula fragosa</i>	Winged mapleleaf	E
<i>Quadrula nobilis</i>	Gulf mapleleaf	
<i>Simpsonaias ambigua</i>	Salamander mussel	



<i>Toxolasma lividums</i>	Purple liliput	
<i>Toxolasma parvum</i>	Lilliput	
<i>Toxolasma texasiense</i>	Texas lilliput	
<i>Uniomerus declivis</i>	Tapered pondhorn	
<i>Uniomerus tetralasmus</i>	Pondhorn	
<i>Venustaconcha ellipsiformis</i>	Ellipse	
<i>Venustaconcha pleasii</i>	Bleedingtooth mussel	
<i>Villosa iris</i>	Rainbow	
<i>Villosa lienosa</i>	Little Spectaclecase group	
<i>Villosa sp. Cf lienosa</i> (Arkansas, White, St. Francis drainages)	Northern Spectaclecase	
<i>Villosa sp. Cf lienosa</i> (Ouachita drainage)	Ouachita Spectaclecase	
<i>Villosa sp. Cf lienosa</i> (Red drainage)	Black Spectaclecase	
<b>Fish</b>		
<i>Acipenser fulvescens</i>	Lake Sturgeon	
<i>Alosa alabamae</i>	Alabama Shad	
<i>Ameriurus nebulosus</i>	Brown Bullhead	
<i>Ammocrypta clara</i>	Western Sand Darter	
<i>Anguilla rostrate</i>	American Eel	
<i>Atractosteus spatula</i>	Alligator Gar	
<i>Carpionodes velifer</i>	Highfin carpsucker	
<i>Cycleptus elongates</i>	Blue Sucker	
<i>Cyprinella camura</i>	Bluntnose Shiner	
<i>Cyprinella spiloptera</i>	Spotfin Shiner	
<i>Crystallaria asprella</i>	Crystal Darter	
<i>Erimystax harrisi</i>	Ozark Chub	
<i>Erimyzon sucetta</i>	Lake Chubsucker	
<i>Etheostoma autumnale</i>	Autumn Darter	
<i>Etheostoma clinton</i>	Beaded Darter	
<i>Etheostoma cragini</i>	Arkansas Darter	C
<i>Etheostoma fragi</i>	Strawberry River Darter	
<i>Etheostoma fusiforme</i>	Swamp Darter	
<i>Etheostoma microperca</i>	Least Darter	
<i>Etheostoma moorei</i>	Yellowcheek Darter	E
<i>Etheostoma pallidiorum</i>	Paleback Darter	
<i>Etheostoma parvipinne</i>	Goldstripe Darter	
<i>Etheostoma mihileze</i>	Sunburst Darter	
<i>Etheostoma teddyroosevelt</i>	Highland Darter	
<i>Etheostoma uniporum</i>	Current Darter	
<i>Fundulus blairae</i>	Lowland Topminnow	
<i>Hiodon alosoides</i>	Goldeye	

<i>Hiodon tergisus</i>	Mooneye	
<i>Hybognathus placitus</i>	Plains Minnow	
<i>Lampetra aepyptera</i>	Least Brook Lamprey	
<i>Lampetra appendix</i>	American Brook Lamprey	
<i>Lythrurus snelsoni</i>	Ouachita Mountain Shiner	
<i>Macrhybopsis hyostoma</i>	Shoal Chub	C
<i>Macrhybopsis meeki</i>	Sicklefin Chub	C
<i>Moxostoma anisurum</i>	Silver Redhorse	
<i>Moxostoma pisolabrum</i>	Pealip Redhorse	
<i>Mogil cephalus</i>	Striped Mullet	
<i>Nocomis asper</i>	Redspot Chub	
<i>Notropis atrocaudalis</i>	Blackspot Shiner	
<i>Notropis bairdi</i>	Red River Shiner	
<i>Notropis girardi</i>	Arkansas River Shiner	T
<i>Notropis ortenburgeri</i>	Kiamichi Shiner	
<i>Notropis ozarcanus</i>	Ozark Shiner	
<i>Notropis perpallidus</i>	Peppered Shiner	
<i>Notropis potteri</i>	Chub Shiner	
<i>Notropis sabiniae</i>	Sabine Shiner	
<i>Notropis suttkusi</i>	Rocky Shiner	
<i>Notropis wickliffi</i>	Channel Shiner	
<i>Noturus flavus</i>	Stonecat	
<i>Noturus lachneri</i>	Ouachita Madtom	
<i>Noturus phaeus</i>	Brown Madtom	
<i>Noturus taylori</i>	Caddo Madtom	
<i>Percina brucehompsoni</i>	Ouachita Darter	
<i>Percina evides</i>	Gilt Darter	
<i>Percina nasuta</i>	Longnose Darter	
<i>Percina pantherina</i>	Leopard Darter	T
<i>Percina phoxocephala</i>	Slenderhead Darter	
<i>Percina uranidea</i>	Stargazing Darter	
<i>Percina vigil</i>	Saddleback Darter	
<i>Phenacobius mirabilis</i>	Suckermouth Minnow	
<i>Platygobio gracilis</i>	Flathead Chub	
<i>Polyodon spathula</i>	Paddlefish	
<i>Pteronotropis hubbsi</i>	Bluehead Shiner	
<i>Scaphirhynchus albus</i>	Pallid Sturgeon	E
<i>Troglichthys rosae</i>	Ozark Cavefish	T
<i>Typhlichthys subterraneus</i>	Southern Cavefish	
<i>Umbra limi</i>	Central Mudminnow	
<b>Salamanders</b>		
<i>Ambystoma annulatum</i>	Ringed Salamander	
<i>Ambystoma talpoideum</i>	Mole Salamander	
<i>Ambystoma tigrinum</i>	Eastern Tiger Salamander	

<i>Cryptobranchus bishopi</i>	Ozark Hellbender	E
<i>Desmognathus conanti</i>	Spotted Dusky Salamander	
<i>Eurycea quadridigitata</i>	Dwarf Salamander	
<i>Eurycea spelaea</i> (All recognized clades)	Grotto Salamander	R
<i>Eurycea subfluvicola</i>	Ouachita Streambed Salamander	R
<i>Eurycea tynerensis</i>	Oklahoma Salamander	
<i>Hemidactylum scutatum</i>	Four-toed Salamander	
<i>Plethodon caddoensis</i>	Caddo Mountain Salamander	
<i>Plethodon fourchensis</i>	Fourche Mountain Salamander	
<i>Plethodon kiamichi</i>	Kiamichi Slimy Salamander	
<i>Plethodon kisatchie</i>	Louisiana Slimy Salamander	
<i>Plethodon ouachitae</i>	Rich Mountain Salamander	
<i>Plethodon sequoyah</i>	Sequoyah Slimy Salamander	
<b>Frogs</b>		
<i>Gastrophryne olivacea</i>	Great Plains Narrowmouth Toad	
<i>Hyla avivoca</i>	Bird-voiced Treefrog	
<i>Hyla squirella</i>	Squirrel Treefrog	
<i>Lithobates areolatus</i>	Crawfish Frog	
<i>Lithobates sylvaticus</i>	Wood Frog	
<i>Pseudacris illinoensis</i>	Illinois Chorus Frog	
<i>Pseudacris maculata</i>	Boreal Chorus Frog	
<i>Pseudacris streckeri</i>	Strecker's Chorus Frog	
<i>Scaphiopus holbrookii</i>	Eastern Spadefoot	
<i>Scaphiopus hurterii</i>	Hurter's Spadefoot	
<i>Spea bombifrons</i>	Plains Spadefoot	
<b>Lizards</b>		
<i>Crotaphytus collaris</i>	Eastern Collared Lizard	R
<i>Ophisaurus attenuatus</i>	Slender Glass Lizard	
<i>Plestiodon obsoletus</i>	Great Plains Skink	
<i>Plestiodon septentrionalis</i>	Prairie Skink	
<b>Turtles</b>		
<i>Deirochelys reticularia</i>	Chicken Turtle	R
<i>Terrapene ornata</i>	Ornate Box Turtle	
<i>Macrochelys temminckii</i>	Alligator Snapping Turtle	R
<b>Snakes</b>		
<i>Carphophis amoenus</i>	Midwest Worm Snake	
<i>Crotalus atrox</i>	Western Diamondback Rattlesnake	
<i>Liodytes rigida</i>	Glossy Swamp Snake	
<i>Micrurus tener</i>	Texas Coral Snake	

<i>Regina grahamii</i>	Graham's Crayfish Snake	
<i>Regina septemvittata</i>	Queen Snake	R
<i>Sonora semiannulata</i>	Western Ground Snake	
<i>Tropidoclonion lineatum</i>	Lined Snake	
<b>Crocodylians</b>		
<i>Alligator mississippiensis</i>	American Alligator	R
<b>Birds</b>		
<i>Accipiter striatus</i>	Sharp-shinned hawk (breeding population)	
<i>Aimophila ruficeps</i>	Rufous-Crowned Sparrow	
<i>Ammodramus henslowii</i>	Henslow's Sparrow	
<i>Ammodramus leconteii</i>	Le Conte's Sparrow	
<i>Ammodramus savannarum</i>	Grasshopper Sparrow	
<i>Anas rubripes</i>	American Black Duck	
<i>Anhinga anhinga</i>	Anhinga	
<i>Anthus spragueii</i>	Sprague's Pipit	E??
<i>Arenaria interpres</i>	Ruddy Turnstone	
<i>Botaurus lentiginosus</i>	American Bittern	
<i>Calcarius pictus</i>	Smith's Longspur	
<i>Calidris alba</i>	Sanderling	
<i>Calidris alpine</i>	Dunlin	
<i>Calidris himantopus</i>	Stilt Sandpiper	
<i>Calidris subruficollis</i>	Buff-breasted Sandpiper	
<i>Caprimulgus vociferous</i>	Whip-poor-will	
<i>Chaetura pelagica</i>	Chimney Swift	
<i>Charadrius melodus</i>	Piping Plover	T
<i>Cistothorus platensis</i>	Sedge Wren	
<i>Clionus virginianus</i>	Northern Bobwhite	
<i>Coccyzus americanus</i>	Yellow-billed Cuckoo	
<i>Egretta tricolor</i>	Tri-colored Heron	
<i>Elanoides forficatus</i>	Swallow-tailed Kite	
<i>Empidonax traillii</i>	Willow Flycatcher	
<i>Euphagus carolinus</i>	Rusty Blackbird	
<i>Falco sparverius</i>	American Kestrel	
<i>Gallinula galeata</i>	Common Gallinule	
<i>Haemorphous purpureus</i>	Purple Finch	
<i>Hylocichla mustelina</i>	Wood Thrush	
<i>Ixobrychus exilis</i>	Least Bittern	
<i>Lanius ludovicianus migrans</i>	Migrant Loggerhead Shrike	
<i>Limnodromus griseus</i>	Short-billed Dowitcher	
<i>Limnothlypis swainsonii</i>	Swainson's Warbler	

<i>Nyctanassa violacea</i>	Yellow-crowned Night Heron	
<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	
<i>Peucaea aestivalis</i>	Bachman's Sparrow	
<i>Picoides borealis</i>	Red-Cockaded Woodpecker	E
<i>Pluvialis dominica</i>	American Golden Plover	
<i>Pluvialis squatarola</i>	Black-Bellied Plover	
<i>Porphyrio martinicus</i>	Purple Gallinule	
<i>Rallus elegans</i>	King Rail	
<i>Scolopax minor</i>	American Woodcock	
<i>Setophaga cerulea</i>	Cerulean Warbler	
<i>Sterna antillarum athalassos</i>	Interior Least Tern	E
<i>Thryomanes bewickii</i>	Bewick's Wren	
<i>Vireo bellii</i>	Bell's Vireo	
<b>Mammals</b>		
<i>Corynorhinus rafinesquii</i>	Rafinesque's big-eared bat	
<i>Corynorhinus townsendii ingens</i>	Ozark big-eared bat	E
<i>Geomys bursarius ozarkensis</i>	Ozark pocket gopher	
<i>Mustela frenata</i>	Long-tailed weasel	
<i>Myotis austroriparius</i>	Southeastern bat	
<i>Myotis grisescens</i>	Gray bat	E
<i>Myotis leibii</i>	Eastern Small-footed bat	
<i>Myotis lucifugus</i>	Little Brown Bat	
<i>Myotis sodalis</i>	Indiana bat	E
<i>Myotis septentrionalis</i>	Northern long-eared bat <b>Listed as Endangered by AGFC</b>	T
<i>Notiosorex crawfordi</i>	Crawford's Gray shrew	
<i>Lepus californicus</i>	Black-tailed jackrabbit	
<i>Reithrodontomys montanus</i>	Plains harvest mouse	
<i>Sorex longirostris</i>	Southeastern shrew	
<i>Spilogale putorius</i>	Eastern spotted skunk	
<i>Synaptomys cooperi</i>	Southern bog lemming	
<i>Taxidea taxus</i>	American badger	
<i>Reithrodontomys humulis</i>	Eastern Harvest mouse	
<i>Reithrodontomys megalotis</i>	Western Harvest mouse	

The above listed species of concern were selected based on one or more of the following criteria:

- (1) The species is commercially desirable (i.e. captive propagated for products or pet trade).

- (2) Populations in Arkansas are endemic, allopatric or have a limited geographic distribution.
- (3) Species is regulated by law.
- (4) Species is threatened by habitat loss, commercial exploitation, or other threats.

**This list will remain a working document and is subject to change as more information is gathered on these and other species.**



## ATTACHMENT I — USFWS WORKPLAN

## National Domestic Listing Workplan: Fiscal Years 21-25

## 5-Year Workplan (January 2021 Version)

**Key to Action Types:** 12M/PLPCH – 12-month finding on a petition to list a species. If listing is warranted, we generally intend to proceed with a concurrent proposed listing rule and proposed critical habitat designation, if critical habitat is prudent and determinable.  
 Discretionary Status Review/PLPCH – Status review undertaken by discretion of the Service. Results of the review may be to propose listing, make a species a candidate for listing, provide notice of a not warranted candidate assessment, or other action as appropriate.  
 PLPCH – For species that are already candidates for listing, a proposed listing determination would either propose the species for listing or provide notice of a not warranted finding. We generally intend to propose critical habitat designations concurrent with proposed listing rules, to the extent prudent and determinable.  
 PCH – For species that are already listed, a proposed critical habitat rule will propose to designate critical habitat for the species, if we find critical habitat is prudent  
**Note: Bolded entries where the species' common name is accompanied by an \* have court-ordered dates associated with them.**

Package Name	Common Name	Action Type	Lead FWS Legacy RO	DOI Unified Region	Priority Bin Ranking or LPN	Planned FY	Range	Scientific Name
Western and "Ouachita" Fanshells	western fanshell	12M/PLPCH	R3	4	3	FY21	AR, KS, LA, MO, MS, OK	<i>Cyprogenia aberti</i>
Western and "Ouachita" Fanshells	"Ouachita" fanshell	Discretionary/PLPCH	R4	4	3	FY21	AR	<i>Cyprogenia cf. aberti</i>
	<b>pink pigtoe*</b>	<b>12M/PLPCH</b>	<b>R4</b>	<b>2</b>	<b>2</b>	<b>FY21</b>	<b>AL, AR, KY, LA, MS, NE, OH, OK, TN, VA</b>	<b><i>Pleurobema rubrum</i></b>
Three Bats	little brown bat	Discretionary/PLPCH	R3	3	4	FY22	AK, AL, AR, CN, DC, DE, FL, GA, IA, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, MS, NC, ND, NE, NH, NJ, NY, OH, OK, PA, RI, SC, SD, TN, VA, VT, WI, WV, Canada	<i>Myotis lucifugus</i>
Three Bats	northern long-eared bat	PLPCH	R3	3	N/A	FY22	AL, AR, DE, DC, GA, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NY, NC, ND, OH, OK, PA, RI, SC, SD, TN, VT, VA, WV, WI, WY	<i>Myotis septentrionalis</i>
	Illinois chorus frog	12M/PLPCH	R3	3	3	FY22	AR, IL, MO	<i>Pseudacris illinoensis</i>
	Mammoth Spring crayfish	12M/PLPCH	R3	4	3	FY22	AR, MO	<i>Orconectes marchandi</i>
	salamander mussel	12M/PLPCH	R3	3	3	FY22	AR, IL, IN, KY, MI, MN, MO, NY, OH, PA, TN, WI, WV, Canada (Ontario)	<i>Simpsonaias ambigua</i>
	<b>alligator snapping turtle*</b>	<b>12M/PLPCH</b>	<b>R4</b>	<b>2</b>	<b>4</b>	<b>FY22</b>	<b>AL, AR, FL, GA, IA, IL, IN, KS, KY, LA, MO, MS, OK, TN, TX (possibly fewer)</b>	<b><i>Macroclmys temmincki</i></b>
	longnose darter	12M/PLPCH	R4	4	3	FY22	AR, MO, OK	<i>Percina nasuta</i>
Three Bats	tricolored bat	12M/PLPCH	R5	1	2	FY22	AL, AR, CO, CT, DC, DE, FL, GA, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, NE, NH, NJ, NM, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, WV; Canada (New Brunswick, Nova Scotia, Ontario, Quebec), Mexico (Eastern and southern regions: Coahuila to Chiapas), Central America (Guatemala)	<i>Perimyotis subflavus</i>



	regal fritillary	12M/PLPCH	R6	7	4	FY22	AR, CO, CT, DE, IA, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, NC, ND, NE, NH, NJ, NY, OH, OK, PA, RI, SD, VA, VT, WI, WV, WY	<i>Speyeria idalia</i>
	Texas trillium	12M/PLPCH	R2	6	4	FY23	AR, LA, TX	<i>Trillium pusillum texanum</i>
	Blanding's turtle	12M/PLPCH	R3	3	3	FY23	IA, IL, IN, MA, ME, MI, MN, MO, NE, NH, NY, OH, PA, SD, WI	<i>Emydoidea blandingii</i>
	plains spotted skunk	12M/PLPCH	R3	3	3	FY23	AR, CO, MN, MO, NE, OK, SD, TX, WY	<i>Spilogale putorius interrupta</i>
	streamside salamander	12M/PLPCH	R3	2	3	FY23	AL, IN, KY, OH, TN, WV	<i>Ambystoma barbouri</i>
Caddo Madtom and Paleback Darter	Caddo madtom	12M/PLPCH	R4	4	3	FY23	AR	<i>Noturus taylori</i>
Caddo Madtom and Paleback Darter	paleback darter	12M/PLPCH	R4	4	3	FY23	AR	<i>Etheostoma pallidiorum</i>
	western chicken turtle	12M/PLPCH	R2	6	3	FY24	AR, LA, MO, MS, OK, TX	<i>Deirochelys reticularia miaria</i>
	golden-winged warbler	12M/PLPCH	R3	3	3	FY24	AL, AR, CO, CT, DC, DE, FL, GA, IA, IL, IN, KS, KY, LA, MA, MD, MI, MN, MO, MS, NC, ND, NE, NH, NJ, NY, OH, OK, PA, SC, SD, TN, TX, VA, VT, WI, WV, Canada	<i>Vermivora chrysoptera</i>
	monarch butterfly	PLPCH	R3	3	LPN 8	FY24	All US states (except AK), Canada, Mexico and more	<i>Danaus plexippus</i>
	colorless shiner	12M/PLPCH	R4	4	3	FY24	AR, OK	<i>Notropis perpallidus</i>
	Ozark shiner	12M/PLPCH	R4	4	3	FY24	AR, MO	<i>Notropis ozarcanus</i>
	frosted elfin butterfly	Discretionary/PLPCH	R5	1	4	FY24	AL, AR, CT, DC, DE, FL, GA, IL, IN, KS, KY, LA, MA, MD, MI, NC, NH, NJ, NY, OH, OK, PA, RI, SC, TN, TX, VA, VT, WI, WV, Canada (Ontario)	<i>Callophrys irus</i>
4 Mussels	snuffbox*	PCH	R3	3	N/A	FY25	AL, AR, IL, IN, KS, KY, MI, MN, MS, MO, OH, PA, TN, VA, WV, WI	<i>Epioblasma triquetra</i>
4 Mussels	spectaclecase*	PCH	R3	3	N/A	FY25	AL, AR, IL, IA, KS, KY, MN, MO, TN, VA, WV, WI	<i>Cumberlandia monodonta</i>
	Linda's roadside skipper	12M/PLPCH	R3	3	5	FY25	AR, IL, KS, MO, OK, TN	<i>Amblyscirtes linda</i>
	prairie gray fox	12M/PLPCH	R3	3	5	FY25	AR, IA, KS, MN, MO, ND, NE, OK, SD, WI	<i>Urocyon cinereoargenteus ocythous</i>
	rocky shiner	12M/PLPCH	R4	4	4	FY25	AR, OK	<i>Notropis suttkusi</i>
	small-headed pipewort	12M/PLPCH	R4	4	5	FY25	AR, GA, OK, TX	<i>Eriocaulon kornickianum</i>