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In Reply refer to:
02EKOK00-2018-F-2361

January 11, 2021

Basharat Siddiqi, Division Administrator
Federal Highway Administration
5801 North Robinson Avenue, Suite 300
Oklahoma City, Oklahoma 73118

Subject: Biological Opinion for Federal Highway Administration Funding of Oklahoma Department of Transportation's JP 27982(07) – Bridge and Approaches on State Highway 109 (SH-109) over Kiamichi River in Choctaw County, Oklahoma.

Dear Mr. Siddiqi:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (Opinion) based on our review of the effects of the proposed Oklahoma Department of Transportation's project, Choctaw County JP 27982(07) (Project), on the federally-listed endangered Ouachita rock pocketbook *(Arkansia wheeleri*), pursuant to section 7(a)(2) of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*). Your request for formal consultation was received on January 2, 2020. We initiated formal consultation on October 7, 2020.

Based on the information submitted to the Service, you have determined that the action may affect, but will not adversely affect the federally-listed endangered winged mapleleaf (*Quadrula fragosa*) and scaleshell (*Leptodea leptodon*) mussels. The Service concurs with that determination and these species will not be addressed further in this Opinion.

Impacts to the federally-listed endangered American burying beetle (*Nicrophorus americanus*; Beetle), have been addressed using the Service's June 15, 2017, programmatic consultation regarding Oklahoma transportation projects that may affect the Beetle. The Service recommends that the conservation measures pertaining to temporary nighttime lighting and removal of carcasses/trash, as proposed within the consultation submission for this project, be implemented and maintained during the active season for the Beetle in Oklahoma (May 15 to September 15).

Impacts to the threatened northern long-eared bat (*Myotis septentrionalis*) have been addressed using the January 5, 2016, Intra-Service Programmatic Biological Opinion on the final 4(d) rule for northern long-eared bat for Section 7(a)(2) compliance by notifying the Service that your agency will utilize the streamlined framework, describing the project with sufficient detail to support the required determination, and enabling the Service to track effects and determine if reinitiation of consultation is required per 50 CFR §402.16. Therefore, the incidental take of the northern long-eared bat resulting from the proposed action does not require exemption from the Service.

You also determined that this action will not affect the federally-listed endangered least tern (*Sterna antillarum*) and the threatened piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*). Consequently, these species will not be addressed further in this Opinion.

This Opinion is based on information provided in the December 17, 2019, biological assessment (Assessment), telephone and email conversations with Oklahoma Department of Transportation biologists, field investigations, and other sources of information. Literature cited in this Opinion is not a complete bibliography of all literature available on the species of concern, transportation projects and their effects, or on other subjects considered in this Opinion. A complete administrative record of this consultation is on file at the Service's Oklahoma Ecological Services Field Office (Field Office) in Tulsa, Oklahoma.

CONSULTATION HISTORY

August 17, 2018	Oklahoma Department of Transportation submitted a request for informal consultation.
March 4, 2019	EcoAnalysts, Inc. requested approval for conducting a mussel survey.
March 19, 2019	Field Office approved the scope of work for a mussel survey.
March 29, 2019	EcoAnalysts, Inc. reported to the Field Office a finding of *Arkansia (=Arcidens) wheeleri* during a mussel survey.
October 22, 2019	Correspondence exchange between Field Office and EcoAnalysts, Inc. regarding a scope of work for a mussel relocation plan.
December 17, 2019	The Federal Highway Administration requested formal consultation.
January 2, 2020	Field Office requested additional Project information from Oklahoma Department of Transportation.
February 28, 2020	Oklahoma Department of Transportation submitted revised shapefiles to the Field Office.
October 7, 2020	Formal consultation initiated.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Regulations implementing the Act (50 CFR §402.02) define "action" as "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies of the United States or upon the high seas." Proposed construction elements of the project (proposed action) consist of site preparation, bridge construction, existing bridge demolition, construction access and staging areas, in-water work, and post-project site restoration. Detailed descriptions of the proposed action, including project elements, are presented in the Assessment.

Project Overview

The Oklahoma Department of Transportation, in cooperation with the Federal Highway Administration, is proposing to replace a structurally-deficient bridge over the Kiamichi River and improve safety by grading and resurfacing the adjacent sections of State Highway 109 in Choctaw County, Oklahoma. The traffic on State Highway 109 is estimated to be 441 vehicles per day, and future traffic volume is expected to increase to 704 vehicles per day within thirty years. The existing bridge over Kiamichi River will be closed to public traffic during demolition of the existing bridge and construction of the proposed bridge, with no shoofly crossing provided.

The existing five-span bridge (National Bridge Inventory number 16635) over Kiamichi River was constructed in 1965 and is considered structurally deficient. The existing bridge is comprised of two (2) 61-foot (ft; 18.6 meters (m)) long I-beam spans on either end, and three steel pony truss spans which are 100, 180 and 100 ft (31.7 m, 55.5 m, and 31.7 m) in length, respectively. Spacing between joints adds minor length (2 to 4 inches / 5 to 10 centimeters (cm)) between the spans and abutments, for a total span length of 512 ft (156.1 m) and a clear roadway width of 28 ft (8.5 m). The bridge approach roadway is approximately 32 ft (9.8 m) in width. The existing portion of highway to be graded and resurfaced consists of two (2) 12-ft (3.7 m) wide lanes with 2 ft (0.6 m) wide outside shoulders. The existing bridge will be demolished prior to the construction of the proposed bridge.

The proposed bridge over Kiamichi River will be constructed on the same alignment as the existing bridge. The new structure will be a five-span concrete structure supported by four piers. The bridge span lengths from north to south will be 86, 95, 130, 95, and 61 ft (26.2, 29, 39.6, 29, and 18.6 m), respectively. The proposed bridge will have a total length of approximately 466.7 ft (142.3 m), a width of approximately 42.2 ft (12.9 m), and a clear roadway width of 40 ft (12.2 m). Each of the four piers will be comprised of two columns. The drilled shafts for each pier column will be 84 inches (231.4 cm) in diameter. The pier cap for each pair of columns will be 39.5 ft (12 m) long, 4.5 ft (1.4 m) wide, and 4.5 ft (1.4 m) deep.

Both construction and demolition activities will occur within the ordinary high water mark of the Kiamichi River. Ordinary high water mark (also known as bankfull channel width, or OHWM in construction plans) has been defined under Title 33 Navigation and Navigable Waters of the Code of Federal Regulations, as the "line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas (33 CFR §328.3(e)).

Directly below the existing bridge, and within the ordinary high water mark, temporary work roads will be used during demolition to move equipment necessary for removing the steel truss and concrete bridge in pieces. Demolition of existing bridge piers 2 and 3, removal of the center span and removal of the steel pony truss spans also will occur within the ordinary high water mark. The existing center span and piers 2 and 3 will be demolished using mechanical methods and the pier columns will be demolished down to below grade. Removal of the three trusses will entail either the manual breaking apart of the three trusses and removal by crane, or disassembling the truss elements piece-by-piece using an overhead crane, with false decking, netting, or other such capture devices installed temporarily, to avoid and minimize debris falling into the Kiamichi River.

Temporary work roads and drill pads within the ordinary water mark of the Kiamichi River will be necessary for construction activities. All work roads and drill pads will be up to 30 ft (9.1 m) in width to allow for the operation and maneuvering of large equipment. The proposed piers 2 and 3, and corresponding new bridge spans, will be constructed within the ordinary high water mark, and construction of the proposed bridge will involve the placement of beams and corrugated steel deck forms. The contractor(s) will determine the sequencing of the temporary work roads and drill pads; demolition and construction plans will be submitted to the Field Office for review, prior to beginning project activities.

Other than the proposed work roads, staging areas and construction access will be located outside of the ordinary high water mark. Proposed activities outside of the ordinary high water mark of Kiamichi River include the preparation of staging areas, demolition of existing piers 1 and 4 and their corresponding spans, and construction of proposed piers 1 and 4 (and corresponding spans 1, 2, 4 and 5). In preparation for construction of the proposed bridge, the project is anticipated to require removal of vegetation and trees in approximately 4.72 acres (19,101.2 square meters (m^2)). The estimated duration of the proposed action is expected to be approximately nine months (275 days) in total, inclusive of approximately 90 days for activities within the ordinary high water mark. The proposed project is expected to let in 2021.

Proposed Conservation Measures Provided in the Assessment

The following conservation measures were provided in the Assessment for implementation during the proposed action to avoid and minimize adverse impacts to federally-listed mussel species and their habitat:

1. Prior to the start of construction, a portion of the Kiamichi River beginning 330 ft (100 m) upstream of the existing bridge and extending about 1,320 ft (400 m) downstream of the bridge, will be surveyed for the listed mussel species by the Oklahoma Department of Transportation Biologist. Prior to the survey, a suitable mussel bed site for relocation will be identified and confirmed with the Field Office. Any mussels found will be relocated to

this identified suitable habitat outside the action area. Areas cleared of mussels will be clearly marked by a biologist following the relocation.

2. Survey and relocation will be limited to the seasonally dependent low flow periods as well as when water temperatures are higher than 45 degrees Fahrenheit (°F) (7.2° Celsius (°C)), which usually falls between July and October.

3. Vehicles and other motorized equipment will be confined to areas outside of the ordinary high water mark of the Kiamichi River at all times, with the exception of activities related to work road construction, maintenance and use. All work within the ordinary high water mark of the river will be confined to the tops of the work roads (or drill pads).

4. Excavated materials, waste materials, and construction debris will be stockpiled at least 25 ft (7.6 m) outside of the ordinary high water mark of Kiamichi River so that the material cannot fall back into these areas. Waste materials will then be removed and disposed of properly, at least 100 ft (30.5 m) outside of the ordinary high water mark boundaries following the completion of the project.

5. Staging areas for the storage of equipment, hazardous materials, chemicals, fuels, lubricating oils, and other such substances will be at least 100 ft (30.5 m) outside of the ordinary high water mark boundaries of Kiamichi River to protect habitat for federally-listed mussel species. Sediment and erosion control structures will be installed around staging areas to prohibit discharge of materials from these sites. Waste materials will be removed and disposed of properly, at least 100 ft (30.5 m) outside of the ordinary high water mark boundaries following completion of the project. Refueling of construction equipment will also occur at least 100 ft (30.5 m) outside of the ordinary high water mark.

6. Appropriate best management practices to minimize impacts from storm water discharges, as established by the Oklahoma Department of Environmental Quality, will be conscientiously implemented throughout the proposed construction periods. The effectiveness of erosion controls will be maintained for the duration of construction activities. Where appropriate, sediment traps and sediment basins shall be installed to capture sediment. Temporary sediment/erosion control structures shall be retained until vegetation is well established and removed following final site stabilization.

7. All construction or demolition activities will be conducted in a manner such that no debris generated from the activities will fall into the water.

8. No blasting will be permitted for the proposed project.

9. Vegetation clearing and disturbance will be limited to the required construction footprint (toe of slopes or top of cuts). Immediately following construction, in areas where native vegetation could not be preserved, exposed soil will be reseeded with seed mixtures of species native to the ecoregion to reduce potential erosion and sedimentation. Stream bank stabilization along the bridge abutments will be implemented with vegetation,

according to methods deemed site appropriate by the engineer (*i.e.*, live stakes, live fascines/wattles, branch packing, vegetated geo-grids, live crib-walls, joint planting, and/or brush mattresses). Following construction, areas of ground disturbance – outside the safety clear zone – will have the soil ripped and then be re-vegetated with native plant species.

10. Stream flow will be maintained throughout the project site for the duration of the project, and no isolated pools will be allowed to develop. Stream flow will be monitored visually by the assigned personnel (*i.e.*, the biological monitor) to ensure adequate flows are maintained throughout the duration of the project. During low flow conditions, best management practices shall be implemented.

11. Alteration of natural stream features (such as riffles and pools) shall be limited to only what is needed for project construction. The removal of natural stream features (such as riffles and pools) shall be limited to only what is necessary for the project construction, and the natural contours of Kiamichi River channel and banks will be restored, following the completion of the project.

12. Both construction of the proposed bridge and the demolition of the existing bridge will require temporary work roads to be constructed within the ordinary high water mark of the Kiamichi River. A total of four work roads will be utilized (two for demolition of the existing bridge, and two for construction of the proposed bridge). Work roads and drill pads within the ordinary high water mark will not be allowed to result in erosion and sedimentation of Kiamichi River or alteration of the bed and bank substrates, and will be made of crushed, non-erosive rock material that is free of any fines, clays or silts, and of sufficient size to prevent downstream movement (typically rocks with 12 to 24-inch (30.5 to 61 cm) nominal size with smaller rocks no less than 1.5-in (3.8 cm) in diameter). Work roads and drill pads for this project within the ordinary high water mark of Kiamichi River will be up to 30 ft (9.1 m) in width to allow for the operation and maneuvering of large equipment, and will not impede more than 50 percent of the ordinary high water mark at any given time. After each work road/drill pad is no longer needed, fill material will be removed and the natural contours of Kiamichi River channel and bank restored. When practicable, other measures may be employed to reduce risk of siltation and/or sedimentation from work road construction use and removal, such as staking of flexible, impermeable barriers (turbidity curtains) used to trap sediment in water. Subsequent monitoring for effectiveness will be conducted by a biologist and confirmed with the Service.

13. Immediately following completion of the project, disturbed areas within the project area shall be restored to the natural condition of the area.

14. No water will be pumped from the Kiamichi River for any reason at any time.

Action Area

An action area is defined at (50 CFR §402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The action area, as described in the Assessment, includes approximately 1,450 ft (442 m) along State Highway 109 (SH-109) over Kiamichi River approximately 1.2 miles (mi; 1.9 kilometers (km)) due north of Huskey, Oklahoma. The action area includes an oval buffer around the proposed work zone, extending one mi (1.6 km) north to south and 0.5 mi (0.8 km) east to west around the proposed work zone (Figure 1). The action also extends within the Kiamichi River 1.6 river mi (2.6 river km) downstream of the existing bridge. Based on the information provided in the Assessment, the action area is located in Sections 1, 2, 11, and 12, Township 7 South, Range 19 East, in Choctaw County, Oklahoma, with small sections crossing into Sections 35 and 36, Township 6 South, Range 19 East.

The action area occurs on the Kiamichi River, which is located in the Kiamichi watershed (U.S. Geological Survey Hydrologic Unit Code 11140105) as part of the Arkansas-White-Red River basin which flows into the Mississippi River. Kiamichi River is 172 mi (276.8 km) long and a perennial tributary of the Red River. The majority of the river system flows through floodplains, terraces, and grasslands of the Blackland Prairie (Woods *et al*. 2005). The drainage basin in the Kiamichi watershed is approximately 1,830 to 1,853 square miles (4,739 to 4,800 km^2), flowing in a southeasterly direction. Based on information in the National Land Cover Database, the watershed was 70 percent forest, 15 percent agriculture and low-density pastureland, seven percent grassland/shrubland, three percent urban, two percent water, and one percent other (Fry *et al.* 2012). Between 1992 and 2006, grassland/shrubland increased by over two percent at the expense of forest (Fry *et al.* 2012). The Kiamichi River is known for its high aquatic biodiversity including at least eighty-six fish and thirty-one freshwater mussel species, including Ouachita rock pocketbook and two other federally-listed mussel species (Master *et al.* 1998, Matthews *et al.* 2005, Galbraith *et al.* 2008, Vaughn *et al.* 2015). The State Highway 109 Bridge over the Kiamichi River is approximately 3 mi (4.8 km) upstream of the confluence with the Red River.

Two human-made water impoundments influence the Kiamichi River. Sardis Reservoir is a 22.4 square mi (14,360 acres; 58.1 km^2) surface area impoundment of Jackfork Creek constructed in 1982 (Oklahoma Water Resources Board 2000). Jackfork Creek is a tributary of Kiamichi River, upstream of Hugo Reservoir. Hugo Reservoir is a 20.7 square mi (13,250 acres; 53.6 km^2) surface area impoundment of the Kiamichi River that was constructed in 1974 (Pyron *et al.* 1998) and is located approximately 15 river mi (24.1 river km) upstream of the action area. Hugo Reservoir impounds between 157,600 acre feet (1.944×10^8 cubic meters) and 966,700 acre feet (1.1924×10^8 cubic meters) (Oklahoma Water Resources Board 2000). A stream flow gage on the Kiamichi River at Antlers, Oklahoma has recorded an estimated in-flow into Hugo Lake averaging 1,594,248 acre feet (1.9665×10^5 cubic meters) per year, at an average daily rate of 1,821 cubic feet per second (cfs) Oklahoma Water Resources Board 2000). No stream gages are located below Hugo Reservoir, so the Assessment estimated streamflow statistics using Esralew and Smith (2009) to estimate an average of 2,240 cubic feet per second, with highest streamflow occurring in the winter season and lowest in the summer. The U. S. Army Corps of

Engineers reported releases from Hugo Reservoir Dam into the Kiamichi River as 304 cubic feet per second in October, 2020.

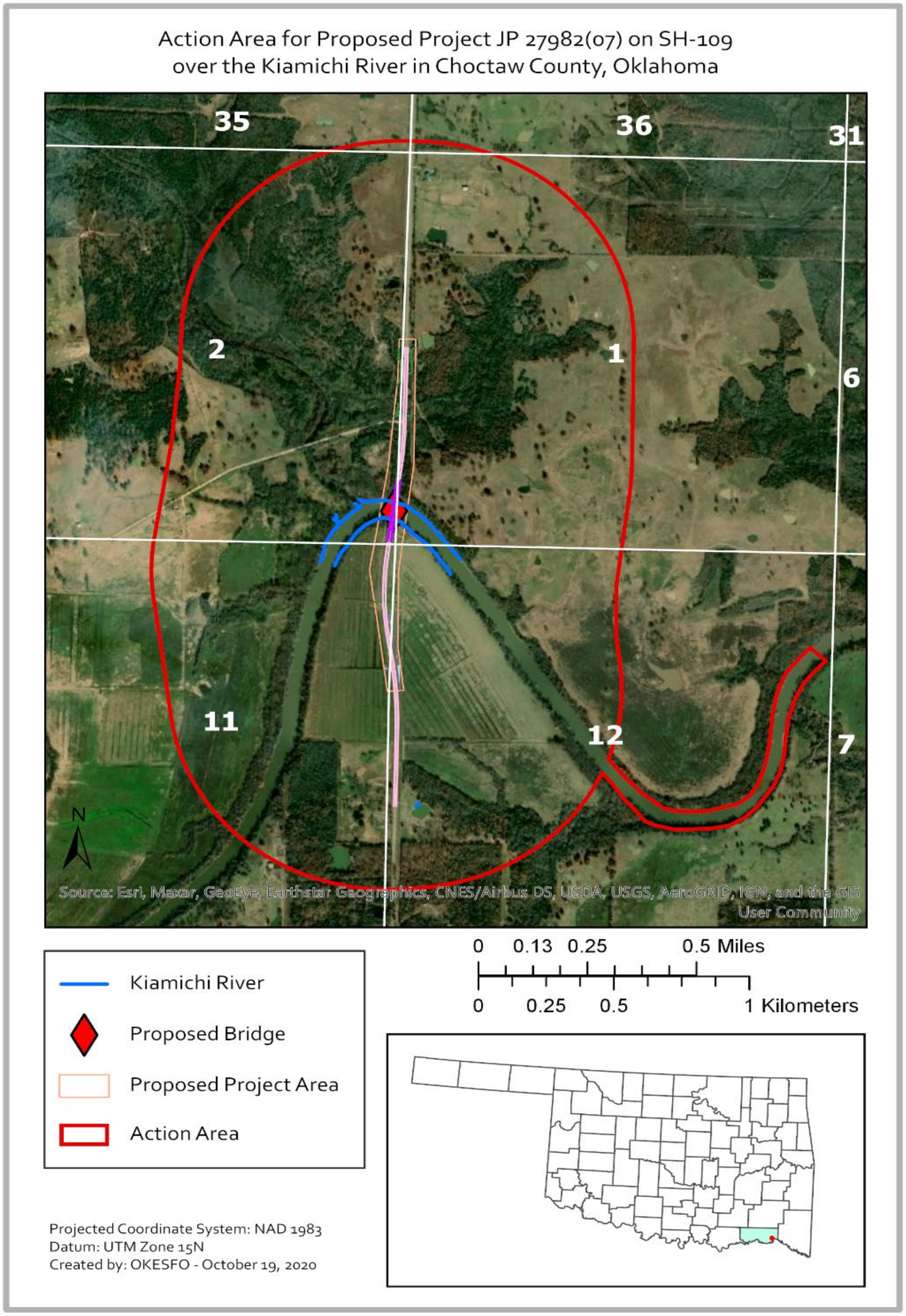

Figure 1. Map showing the action area of proposed Oklahoma Department of Transportation's project JP 27282(07) on State Highway 109 over Kiamichi River in Choctaw County, Oklahoma.

The Service's National Wetlands Inventory database classifies the Kiamichi River in the action area as R2UBH: riverine, lower perennial (with low gradient) flows with some occurrences of oxygen deficits and drought. This classification is indicative of an unconsolidated bottom with at least 25 percent cover by particles smaller than stones less than 2.75 in (6 to 7 cm) in diameter, sand and mud substrate, and a vegetative cover of less than 30 percent. Bird Creek, a perennial stream, empties into the Kiamichi River approximately 410 ft (125 m) upstream of the proposed bridge. An unnamed, intermittent stream is located approximately 720 ft (220 m) upstream of the proposed bridge. According to the Oklahoma Water Resources Board (2000), the entire Choctaw County portion of Kiamichi River Basin is underlain by the Antlers Sandstone formation aquifer; at least 320 square miles of the aquifer's 4,400-square mile (2,816,000 acres; 11,395 km^2) area lies under the basin.

According to Woods *et al*. (2005), climate of the local area consists of mean annual precipitation of 49.2 (125 cm), with mean daytime temperatures ranging from 72 degrees Fahrenheit (°F; 22.2° Celsius (°C)) in summer, to 52°F (11.1°C) in winter. The Assessment states an average growing season range of 221 days. Soils are described as very deep and clayey, moderately well-drained, mildly alkaline and humus-rich on level areas [Class: Coastal Plain, Name: Pledger, Type: Vertisols] (Carter and Gregory 2008). The Natural Resource Conservation Service's interactive Web Soil Survey database indicates the riparian areas of Kiamichi River at this location to be mostly Ships (Vertisols and Redlake (Inceptisols) clays with 0 to 1 percent slopes, and Swink-Hollywood complex (Mollisols and Vertisols) with 5 to 20 percent slopes.

At the site of the existing bridge, the Assessment reported riparian area trees to consist of mostly hickory (*Carya* spp.), elm (*Ulmus* spp.), river birch (*Betula nigra*), red oak (*Quercus rubra*), water oak (*Quercus nigra*) and American sycamore (*Plantanas occidentalis*). Other common species in the understory included woodoats (*Chasmanthium latifolium*), greenbrier (*Smilax* spp.), poison ivy (*Toxicodendron radicans*), coralberry (*Symphoriocarpos orbiculatus*), bristlegrass (*Setaria* spp.), switchcane (*Arundinaria tecta*) and panic grass (*Panicum* spp.).

Land Use and Land Ownership in the Action Area – Land cover in the action area is predominantly mature, bottomland hardwood, oak-hickory forest. Livestock production, grazing and associated watering ponds (farm ponds), road construction and modification, road crossings, residential homesteads, hay fields, cropland, and certain agricultural and industrial practices occur in the proposed action area. In addition, livestock access to the Kiamichi River was observed during the field assessment and cattle were observed grazing near the water's edge. According to the Assessment, Kiamichi River is used largely for recreational activities such as fishing, hunting, kayaking and boating.

STATUS OF THE SPECIES

This section summarizes status of the Ouachita rock pocketbook. This information is used to help assess whether the proposed action would be likely to jeopardize the continued existence of the species. The "**ENVIRONMENTAL BASELINE**" section that follows summarizes similar information on the species, specifically within the action area, and provides the foundation for the Service's assessment of effects of the proposed action, as presented in the "**EFFECTS OF THE ACTION**" section.

Status

The Ouachita rock pocketbook (*Arkansia wheeleri*) is a freshwater mussel listed throughout its range as an endangered species under the Act on October 23, 1991 (56 FR 54950). The Service announced the availability of a final recovery plan for the Ouachita rock pocketbook on June 2, 2004 (69 FR 31129). The most recent five-year review was initiated on May 31, 2018. No critical habitat has been designated for this species. Williams *et al.* (2017) reassigned *Arkansia wheeleri* into the genus *Arcidens*, based on genetic analysis. Change in the genus name to which the Ouachita rock pocketbook is assigned does not affect its protection under the Act. The name under which it was listed (56 FR 54950) is used throughout this opinion.

Species Description

The Ouachita rock pocketbook is a mollusk in the class Bivalvia, family Unionidae (Turgeon *et al.* 1998), originally described as *Arkansia wheeleri* by Ortmann and Walker (1912). Common names include Wheeler's pearly mussel, Arkansas rock-pocketbook, and Ouachita rock-pocketbook (Service 2004). Ouachita rock pocketbook exhibits a number of characteristics that clearly distinguish it from other species, showing no intergradation with other species and is the sole species in the genus *Arkansia* from the time of its discovery. It has subsequently been reassigned to the genus *Arcidens* based on genetic analysis (Williams *et al.* 2017).

The shell of the Ouachita rock pocketbook is truncated posteriorly, moderately inflated, and subcircular to subovate to subquadrate in profile (Service 2004). The average size of an adult of this species is 4.4 in (112 millimeters (mm)) long, 3.4 in (87 mm) high, and 2.4 in (60 mm) wide, up to 0.24 in (6 mm) thick anteriorly and 0.12 in (3 mm) posteriorly (Service 2004). The outer shell layer (periostracum) is chestnut-brown to black with a silky luster (Ortmann and Walker 1912), and appears slightly iridescent when wet (Service 2004). The umbos (raised portion of the dorsal margin) are prominent, projecting over a well-defined lunule (a crescent-shaped formation near the hinge line) depression (Ortmann and Walker 1912). The posterior half of the shell is sculptured with irregular, oblique ridges and sometimes crossed by smaller or indistinct ridges (Ortmann and Walker 1912). Beak sculpturing, rarely intact, is very restricted and consists of weak double loops (Ortmann and Walker 1912). The nacre (inner shell lining) is usually salmon-colored above the pallial line, white to light blue below, with a dark prismatic border (Ortmann and Walker 1912). This species has well-developed hinge teeth which are considered a "complete" dentition (Ortmann and Walker 1912, Service 2004). Its anterior left and right pseudocardinal teeth are both curved and parallel to the lunule; the posterior left pseudocardinal joins a conspicuous, flange-like, interdental projection that runs to the lower lateral. The lateral teeth are moderately short; the upper left lateral is sometimes reduced (Ortmann and Walker 1912, Johnson 1980, Clarke 1981, Service 2004). The gills have well-developed septa and water tubes (Ortmann and Walker 1912). The septa are distant in the male and in the inner area of the female (Walker 1914, Service 2004). While the outer shell of the species is not sexually dimorphic, the female has a marsupial outer gill with very close septa; the edge of this marsupium is slightly thickened (Clarke 1981).

Ouachita rock pocketbook is sometimes mistaken for two more common species to which it bears a superficial resemblance: the pimpleback (*Quadrula pustulosa)* and the threeridge (*Amblema plicata)* (Service 2004). The distinguishing characteristics of Ouachita rock pocketbook are its slightly iridescent periostracum (thin coating or skin) on the exterior and a conspicuous, flange (disk-like projection) on its interior interdental area (Service 2004). In the pimpleback, the periostracum is a light shade of brown and may include greenish rays marking the umbos, while the threeridge exhibits more pronounced oblique ridges than the Ouachita rock pocketbook (Service 2004). The closest living relative to *A. wheeleri* is the rock pocketbook (*Arcidens confragosus)* (Say 1829, Williams *et al.* 2017). *A. wheeleri* has a heavier and more inflated shell than *A. confragosus* (Ortmann and Walker 1912) and can be distinguished from the latter by its fuller and less sculptured anterior beak, presence of a lunule (a crescent shape on the hingeline of the shell); sculpturing on only its posterior half, and well-developed lateral teeth (Service 2004).

Distribution

Historically, distribution of Ouachita rock pocketbook included the Little River in Oklahoma and Arkansas, Kiamichi River and Jackfork Creek in Oklahoma, the Ouachita River in Arkansas, and Pine Creek and Sanders Creek in Texas (Service 2004). Its current range includes approximately 157 mi (252 km) of the Red River system and 111 mi (179 km) of the Ouachita River system (Service 2004, Haag 2012). In 2019, EcoAnalysts, Inc. reported finding Ouachita rock pocketbook in the Kiamichi River within 500 ft (152 m) of the State Highway 109 bridge. An attenuated population occurs through 69 mi (111 km) of the Little River in Oklahoma and Arkansas (Clarke 1987), including a 15 mi (24 km) section of limited habitat in the reach above the Mountain Fork River confluence (Vaughn 1994, Vaughn *et al*. 1995) downstream to approximately 4 river miles (6.5 river km) east of the Oklahoma-Arkansas state line (Vaughn *et al.* 1995).

Life History

The life history of the Ouachita rock pocketbook is generally similar to that of other freshwater mussels (Service 2004). The Ouachita rock pocketbook is considered to have a periodic life history strategy, characterized by moderate to high growth rates, low fecundity, and a smaller body size than opportunistic species (Haag 2012). Most freshwater mussel species with this survival strategy are long-term brooders with a short life span and early age at sexual maturity (1-3 years) (Haag 2012), though age at sexual maturity for Ouachita rock pocketbook is unknown.

Habitat – The Ouachita rock pocketbook always occurs within large mussel beds containing a diversity of mussel species (Service 2004), and Vaughn and Pyron (1995) found that mussel species richness at a given site was the single best predictor of the occurrence of this species. The Ouachita rock pocketbook inhabits pools and side channels of rivers and large creeks, often in backwater areas of rivers with sluggish current and stable substrates (Service 2004). Mehlhop and Miller (1989) noted that these areas are usually adjacent to sand, gravel, and/or cobble bars which are scoured clean or support aquatic vegetation, mainly American water willow, *Justicia* *americana*. Young individuals have been found on sand bars with shallow water and in muddy bottoms on the margins of rivers (Clarke 1987).

Reproduction – Johnson (1980) designated Ouachita rock pocketbook as bradytictic (a winter breeder or long-term breeder), based on a conclusion made by Wheeler (1918) after unsuccessful efforts to find gravid females outside of winter. Clarke (1987) and Vaughn (1997) related Ouachita rock pocketbook's reproductive strategy to that of *Arcidens confragosus*. However, conclusive descriptions of reproductive biology are lacking for this species. While the external shells of both genders appear the same in this species (Ortmann and Walker 2012, Service 2004), the dividing membrane within the gills (septa) is distinct for each gender (Walker 1914, Service 2004). The outer gill alone is marsupial in the female, with very close septa, and the edge of the marsupium is slightly thickened (Ortmann and Walker 1912, Clarke 1981) presumably for incubation of fertilized eggs. Similar to other mussels, males release sperm into the water column, and females siphon in the sperm during feeding and respiration. Fertilization success is apparently influenced by mussel density and flow conditions (Downing *et al.* 1993). Fertilization occurs in upper chambers of the gills, and fertilized eggs develop into glochidia within the marsupium of the female.

Once mature, glochidia are released into the water column and must attach (encyst) to host fish until they transform into juvenile mussels. Ouachita rock pocketbook glochidia have very long stylets (hooks) used to attach to fish fins, tails, scales or gills (Seagraves 2006, Barnhart 2010). Host use may relate to availability, and Ouachita rock pocketbook is considered a generalist in suitable host fish (Haag 2012). Barnhart (2010) observed a positive relationship with two species of shiners. In that study of eight host fish species, successful metamorphosis of attached Ouachita rock pocketbook glochidia occurred in golden shiner (*Notemigonus crysoleucas*) (31 percent), dusky-stripe shiner (*Luxilus pilsbryi)* (11 percent), freshwater drum (*Aplodinotus grunniens*) (3 percent), with no (0 percent) success in blue catfish (*Ictalurus furcatus*), largemouth bass (*Micropterus salmoides*), orangespotted sunfish (*Lepomis humilis*), hybrid sunfish, and walleye (*Sander vitreus*) (Barnhart 2010).

Age and Growth – No quantitative information on the longevity of the Ouachita rock pocketbook is available. Mussel glochidia generally spend from two to six weeks parasitizing the host fish, the duration of encystment being dependent on the mussel species and water temperature (Zimmerman and Neves 2002). Newly-metamorphosed juveniles drop off to begin a free-living existence on the stream bottom. They must drop into suitable habitat or they will not survive (Strayer 2008). Mussels tend to grow rapidly for the first few years of life, but growth slows considerably as the individuals mature. Most mussel species with a periodic life history strategy like the Ouachita rock pocketbook have a moderate life span (8-30 years), moderate to high growth rates, a smaller body size, an early age at sexual maturity (1-3 years), and are long-term brooders (Haag 2012).

Diseases, Parasites, and Predation – No quantitative information on specific diseases, parasites and predation of Ouachita rock pocketbook is available.

Food habits/feeding behavior – No quantitative information on feeding behavior is available for Ouachita rock pocketbook. However, many freshwater mussels are suspension-feeders with a diet consisting of a mixture of algae, detritus, bacteria, and microscopic organisms (Strayer *et al.*

2004, Butler 2005, Fuller 1974). Recent evidence emphasizes the importance of the uptake and assimilation of detritus and bacteria over that of algae to riverine mussels (Silverman *et al*. 1997, Nichols and Garling 2000). It also has been surmised that dissolved organic matter may be a significant source of nutrition (Strayer *et al.* 2004). Their diet may more accurately consist of a mixture of algae, bacteria, detritus, and microscopic animals. Such an array of foods containing essential long-chain fatty acids, sterols, amino acids, and other biochemicals may be necessary to supply total nutritional needs (Strayer *et al.* 2004). Juveniles may burrow, using a pedal (foot) extended outside the shell for bringing food particles inside the shell (Gatenby *et al.* 1996). Ongoing propagation efforts for Ouachita rock pocketbook have documented the importance of fine sediments and pedal feeding for this species (Barnhart 2010).

Population Dynamics

In 2019, a surveying team reported to Oklahoma Ecological Services Field Office that one live Ouachita rock pocketbook was found in the lower Kiamichi River near the State Highway 109 bridge downstream of Hugo Reservoir and upstream of the Red River confluence (EcoAnalysts, Inc. 2019). Kiamichi River population in Oklahoma is considered the most substantial for Ouachita rock pocketbook, albeit with fewer than 1,800 individuals (Service 2004). Vaughn *et al*. (1993) found living Ouachita rock pocketbooks at six sites in the Kiamichi River mainstem, all within the range documented by Clark (1987) and Mehlhop and Miller (1989). Vaughn *et al.* (1995) reported one Ouachita rock pocketbook shell in the Little River in 1994, approximately 4 river mi (6.5 river km) east of the Oklahoma-Arkansas state line. A 1997 study of the Ouachita River in Arkansas reported very low abundance of this species, with only a few individuals of this species found among over 23,000 animals examined (Posey 1997). Subsequent surveys in Arkansas also reported very low abundance of Ouachita rock pocketbook (Service 2004, 2015).

Reasons for Decline

The restricted distribution of Ouachita rock pocketbook and its low abundance (Haag 2012) hinder opportunities to obtain available information on its sensitivity to environmental conditions and tolerance to disturbance. Low abundance is a positive feedback resulting from insufficient individuals in proximity for fertilization and reproductive success (Barnhart 2010). The proposal for listing in 1990 (FR 55 29865 28968) stated that the loss of even a few individuals of this species, such as collection for scientific purposes or private use, could extirpate the species.

Landscape variables are often significant predictors of mussel distribution, abundance, and mussel bed structuring (Brewer and Powers 2014). Such variables include stream size, watershed geology, land use alteration (such as agriculture and urban development), flow regime or hydrologic modification, and sedimentation. Anthropogenic activities leading to degraded water quality, increased water fluctuation (changes to flow regime), accumulation of silt, and reduction of freshwater fauna (loss of biological diversity) have affected mussels negatively (Watters 2000; Vaughn and Taylor 1999, Allen and Vaughn 2011) and have led to reduced mussel distribution (Obermeyer 1997a, 1997b). Mussels transfer energy and nutrients from the water column to the sediment, depositing organic matter and excreting nutrients (Vaughn and Hakenkamp 2001, Vaughn *et al.* 2004, Howard and Cuffey 2006a, Christian *et al*. 2008). Although providing similar general ecosystem services by filter feeding and cycling nutrients, individual mussel species are not functionally equivalent, varying in behavior, morphology, range, substrate, and water temperatures (Haag 2012). Response and tolerance to disturbance likewise varies among mussel species (Haag 2012). As described in greater detail below, impoundments, dredging or channelization, water quality degradation, pollution, mining, stream crossings, poultry husbandry operations, invasive species, and climate change are among the reasons for declines of Ouachita rock pocketbook and other mussel species. Loss of biodiversity in aquatic ecosystems, as a driver of mussel declines, is also detailed below.

Habitat Loss/Fragmentation – Habitat degradation and fragmentation are the leading causes of decline for many species (Bogan 1993, Vaughn 1997, Brewer and Powers 2014, Burlakova *et al.* 2010, Strayer 2008), including mussels (Neves *et al.* 1997, Newton *et al.* 2008). Adult mussels are generally sedentary; with most seasonal movements varying from a few inches to an estimated maximum of 330 ft (100 m) per breeding season (Green *et al.* 1985, Waller *et al.* 1999, Allen and Vaughn 2009). This behavior limits a mussel's ability to escape a habitat disturbance or deteriorated conditions, unlike other more mobile stream organisms such as fish and aquatic insects (Townsend 1989, Matthews 1998, Matthews and Marsh-Matthews 2003). More mobile species likely would move to more suitable areas or less degraded areas (Urban 2015). North American freshwater mussels also are vulnerable to habitat fragmentation due to an obligate host-affiliation for reproduction with fishes (Strayer 2008). Therefore, factors which negatively affect potential host fish also may affect mussels (Downing *et al.* 2010, Douda *et al.* 2013, Galbraith *et al.* 2018). Localized and long distance movements of stream fishes, including known fish hosts for Ouachita rock pocketbook, are constrained by fragmented river systems and impediments to fish movements (Perkin and Gido 2012). Small mussel populations occurring in already-fragmented habitat may become more biogeographically isolated, reducing chances of reproductive success (Barnhart 2010). Additionally, mussels may have restricted ranges related to climatic zones, connectivity between rivers, and suitable host fish availability (Haag 2012). For example, latitudinal restrictions have been observed in several mussel species (Clarke 1973, Haag 2012).

Impoundments – Impoundments and their associated releases may have a negative effect on flow-habitat requirements for this species (Service 2018). As sessile animals reliant on host fish for their reproductive life history, mussels are one of several aquatic organisms adapted to the natural flow regimes on which their survival and the timing of their reproductive life histories depend (Galbraith *et al.* 2018). Impoundments and their associated releases may have a negative effect on flow-habitat requirements for Ouachita rock pocketbook (Service 2018). Most mussel species with a periodic life history strategy are usually highly intolerant to impoundments, and comprise the majority of mussel species driven to extinction by deterioration of existing conditions (Haag 2012). For example, mussels rely on water temperature cues in the timing of glochidia release, and thermal regimes below impoundments may inhibit mussel reproduction (Layzer *et al.* 1993, Heinricher and Layzer 1999, Galbraith and Vaughn 2009, 2011). Mussels have been observed to be more sensitive than fishes to reservoir-caused environmental changes (Bogan 1993). Slow-moving unionids may be more vulnerable to predation and fluctuating and unpredictable water levels especially downstream of dams (Fobian 2007), where mussels may be susceptible to displacement into unsuitable habitat if subjected to high flows from dam releases. Conversely, limited releases from impoundments can contribute to low-flow conditions in mussel-occupied rivers. For example, Vaughn *et al*. (2015) studied the post-construction stream conditions in the Kiamichi River after construction of Sardis Lake, an impoundment of Jackfork Creek. During the years 2004-2011, low- to no flow conditions persisted downstream of the impoundment (Vaughn *et al.* 2015). Vaughn *et al.* (2014) recommended that during droughts, sufficient water should be released from Sardis Dam to maintain flow at both the Clayton and Antlers stream gages in the Kiamichi River, as the reach between these two gages is important mussel habitat.

In addition to loss of immediate habitat, impoundments and related hydrologic changes affect mussels through modified seasonality of flow, water temperature, sediment scour and deposition, and altered transport of particulate organic matter (Ligon *et al.* 1995). Accordingly, an extinction gradient has been observed in mussel communities residing downstream from impoundments, with mussel species richness and abundance highest with increasing distance from an impoundment outflow (Vaughn and Taylor 1999). Changes in flow regimes also affect species assemblages, favoring common mussel species at the expense of locally-adapted endemic and rare species (Burlakova *et al.* 2011).

Dredging and Channelization – In North America, freshwater mussels historically occurred in dense, multi-species assemblages in undisturbed aquatic systems (Vaughn and Hakenkamp 2001, Randklev *et al.* 2019), and dredging and channelization activities, often to promote use by large watercraft, have altered and disturbed riverine habitats (Neves *et al.* 1997, Watters 2000). Because mussels are relatively immobile, they require a stable substrate (Strayer 2008) to survive and reproduce and are particularly susceptible to channel instability and alteration (Neves *et al.* 1997). Channel and bank degradation and loss of natural flow regimes have led to the loss of stable substrates in numerous rivers with commercial watercraft traffic. Channelization affects a stream physically by accelerating erosion, increasing sediment bed load, reducing water depth, decreasing habitat diversity, inducing geomorphic (natural channel) instability, and eliminating riparian canopy. It also affects streams biologically by decreasing species diversity, changing species composition and abundance and decreasing biomass. Changes in the fish host community may occur, affecting mussel reproductive success at the larval stage (Schwalb *et al.* 2013, Turnage 2013). Channel modification for use by watercraft has been shown to increase flood heights (Belt 1975) and stream bed slope (Hartfield 1993). While channelization can decrease flooding in the channelized reach, flood events up and downstream are often more severe, conveying large quantities of sediment into streams (Hutchison *et al.* 2016). Channel maintenance often results in increased turbidity and sedimentation which may smother mussels (Stansbery 1970).

Water Quality Degradation – Hartfield and Hartfield (1996) studied the detrimental effects of excessive sediments to the survival of juvenile mussels. Those effects included reduced growth rates, limited burrowing activity, and physical smothering. The clogging of crevices in the substrate reduces crucial shelter and nutrient uptake areas for juvenile mussels (Brim Box and Mosa 1999). Turbidity reduces the amount of light available for photosynthesis, reducing food supply (Kanehl and Lyons 1992) and the ability of fish hosts to see mussel lures. Exposure to suspended sediment may impair both the attachment and metamorphosis success of glochidia on host fishes (Beussink 2007). Suspended sediment can increase the radius of the gill tips due to fusion, clubbing, and loss of lamellae, providing a less suitable geometry for glochidia to grasp during attachment. In addition to reduced attachment success, the proportion of glochidia successfully transformed is reduced following host exposure to suspended sediment. Fish coughing induced by sediment may dislodge loosely attached glochidia before encapsulation; the mechanism for dislodgmenet may involve the relationship between the keratocyte migration and encapsulation described by Rogers-Lowery and Dimock (2006). Detrimental effects of suspended sediment on mussel reproduction are most likely when high sediment loads coincide with mussel reproductive events.

Mining – Instream and alluvial gravel mining has been implicated in the destruction of mussel populations (Hartfield 1993, Brim Box and Mossa 1999). Negative effects associated with gravel mining include stream channel modification, water quality modifications (*e.g*., increased turbidity, reduced light penetration, and increased temperature), macro-invertebrate population changes (elimination), and changes in host fish populations, resulting from adverse effects to spawning and nursery habitat and food web disruptions (Kanehl and Lyons 1992). Declines of freshwater mussels also have been attributed to the effects of past and present lead mining (Service 2010). For example, in some areas of Missouri where stream sediments are contaminated with high levels of heavy metals (*e.g*., lead, zinc, cadmium) resulting from lead mining in the upper portion of the watershed (Roberts *et al.* 2009), mussel populations have been negatively affected in reaches with contaminated sediments (Service 2010).

Chemical Contaminants – Current national water quality criteria may not be adequately protective of freshwater mussels (77 FR 63440, see Factor D), because such criteria were derived from a toxicity database that pre-dates data available for effects on freshwater mussels (Service 2010). Point source discharges are typically regulated; however, nonpoint source inputs such as silt, fertilizers, animal wastes and other contaminants may not be sufficiently regulated, especially when not adjacent to a waterway (Service 2018). Nonpoint source pollution refers to entry of material into the environment from a diffuse source (Service 1998), and this type of pollution is responsible for more than half of all water pollution (Chesters and Schierow 1985). Discharge of stormwater runoff can contribute a variety of nonpoint source pollutants and contaminants to waterways originating from vehicles, impervious surfaces, chemical use in rights-of-way, and industrial and agricultural operations (Florida Department of Transportation 2017). Other contaminants may include sediment, pesticides, nutrients and metals such as arsenic, copper, chromium, lead, mercury, and nickel (Buckler and Granato 1999, Colman *et al*. 2001, Kayhanian *et al.* 2003). As filter-feeders, freshwater mussels are often much more sensitive to certain chemical pollutants than other species (Conners and Black 2004, Milam *et al.* 2005, Bringolf *et al.* 2007). For example, ammonia is a common pollutant found in both point and nonpoint source discharges that may occur in streams occupied by mussels. Ammonia is associated with animal feedlots, nitrogenous fertilizers, industrial effluents, and municipal wastewater treatment plants (Goudreau *et al*. 1993, Service 2010). In studies since 2001, mussels have been found to be very sensitive to ammonia (Augspurger *et al*. 2003, Wang *et al*. 2007a, Wang *et al*. 2007b). Lime in cement and concrete is toxic to most aquatic organisms, especially when concrete is wet and uncured (Florida Department of Transportation 2017). Additionally, use of heavy construction equipment within the ordinary high water mark of rivers and streams may cause accidental releases of contaminant fluids, oil, and particulate construction material into the water (Florida Department of Transportation 2017). Freshwater mussels are particularly sensitive to organic enrichment in water (Goudreau *et al.* 1988), which can result in chemical alteration of the water and smothering (Dance 1981).

Stream Crossings – Stream crossings (roads, causeways, and certain bridge designs) may obstruct movements of stream fishes (Warren and Pardew 1998), including host species to mussels. Road crossings of streams may alter flow and velocity (Forman *et al.* 2003). Flow is important for freshwater mussels, which respond to velocity and shear stress (the force of water moving against the substrate or shell) (Howard and Cuffey 2006b, May and Pryor 2015, Gates *et al.* 2015). Velocity may be increased as water is restricted through culverts or between piers of bridges, or decreased as the channel widens from scour (Blevins *et al* 2017). If the flow of water becomes blocked with debris (such as logs or sediment) or the crossing structure itself forms a dam, water may pool on the upstream side (Forman *et al*. 2003, Blevins *et al.* 2017). Restricted flows may hinder fish movements and juvenile mussels may drop off into areas which may or may not be suitable mussel habitat (Blevins *et al.* 2017). Such barriers to fish movement also likely affect the persistence of some fish populations, with similar implications for host-affiliate mussels. Additionally, during droughts, low-water stream crossings may temporarily restrict access to host fish spawning areas and thus affect mussels. Miller *et al.* (1985) expressed concern that the number of stream crossings may have a greater influence on sediment delivery to streams than the actual area of roads. Accordingly, large numbers of stream crossings may limit the ability of potential fish hosts of mussels to disperse, and may contribute to reductions in fish genetic diversity (Schwemm *et al*. 2019).

Invasive Species – Several non-native, invasive species are known threats to many species of freshwater mussels (Ricciardi *et al.* 1998, Sousa *et al.* 2014). The Asian clam (*Corbicula fluminea*) has spread throughout the range of the Ouachita rock pocketbook since its introduction in the early twentieth century. This species is native to southeastern China, Korea and southeastern Russia (McMahon 1982), but has since been introduced to the Americas, Africa, and Europe (Rodrigues *et al*. 2007, Cao *et al*. 2017). The Asian clam competes with native mussels, particularly juveniles, for resources such as food, nutrients, and space (Neves and Widlak 1987, Leff *et al.* 1990, Ferreira-Rodriquez *et al*. 2018), and may ingest sperm, glochidia, and newly metamorphosed juveniles of native mussels (Strayer 1999a, Yeager *et al.* 2000). Periodic die-offs and ensuing decomposition of dense populations of Asian clams may produce enough ammonia and consume sufficient dissolved oxygen to kill native mussels in the impacted reach (Strayer 1999b, Gagnon *et al.* 2004, Sousa *et al.* 2014). The hermaphroditic Asian clam also has relatively high fecundity compared to many North American species (McMahon 2000).

The zebra mussel (*Dreissena polymorpha*), a species native to the Black and Caspian seas, was introduced to North America in the 1980s from ship ballast water discharged into Lake Erie (Benson and Boydstun 1995). The species has since spread throughout many river systems, including the Mississippi River drainage, where it has established reproducing populations. Both the zebra mussel and quagga mussel (*Dreissena bugensis*) may occur in portions of the Ouachita rock pocketbook's range, although the zebra mussel is more prevalent in Oklahoma than is quagga mussel (D. Martinez 2020, Service, pers. comm.). The most common means by which zebra mussels are introduced to new waterbodies is by fluvial transport in stream flows or on watercraft (Strayer 1999b). However, zebra mussels also may spread through movement of equipment and watercraft from infested waters to another uninfested water body, though this may be curbed with proper cleaning of equipment. Zebra mussels proliferate in native mussel habitats, even attaching in large numbers to the shells of living mussels, where they deplete food resources locally and result in increased waste production. Once attached, they impede normal movements of the native mussels, interfere with normal opening and closing of their shells, deform margins of the shells, and generally increase expenditures of energy required to perform normal activities (Strayer 1999b). These demands can affect native mussel condition, reproductive potential and survival.

A shared trait between zebra mussels and Asian clams is that neither species requires a host fish; instead, both species have a free-swimming planktonic larval stage (Ram *et al.* 1996, Denton *et al.* 2012). Zebra mussel larvae spread unidirectionally with stream flows, attaching with mucilaginous byssal threads (a mass of filaments) on hard substrates or other surfaces, including the shells of other mussels (Haag 2012). Asian clam larvae may disperse upstream using both locomotion and byssal threads to entangle on passing fishes for transport (Prezant and Chalermwat 1984, Haag 2012). This opportunistic attachment to a host for transport is a deviation from native North American freshwater mussels, whose glochidia are obligate host-affiliates for transformation into juveniles (Haag 2012). Therefore, availability of host fish or impediments to fish movement are not limiting factors for continued proliferation of either of the non-native mussel species. Additionally, the larvae and juveniles of both species can pass through the gut of some molluscivorous fish, undigested and alive, furthering dispersal of these invasive species (Gatlin *et al.* 2013).

Climate Change – Ongoing climate change is another factor potentially impacting aquatic organisms, including fish and mussels. Based on a national climate assessment, Kloesel *et al*. (2018) asserted that, in the Southern Great Plains, both aquatic and terrestrial ecosystems are being affected directly and indirectly by climate change. The broad effects of climate change have been well-documented, and such effects are expected to occur across the United States (Portmann *et al.* 2009). The changing climatic conditions are expected to directly or indirectly have an adverse impact on both terrestrial and aquatic ecosystems (Kaushal *et al*. 2010), including freshwater mussels and host fish populations in Oklahoma.

Heat waves and chronic, long-duration hydrological drought are increasing in frequency and duration (U.S. Global Change Research Program 2017). Annual average temperatures and drought have been increasing since the early 20th century and these trends are expected to continue throughout the 21st century (Kloesel *et al*. 2018). Additionally, altered precipitation patterns may occur with heavy rainfall increasing in duration and intensity (Solomon *et al*. 2007, U.S. Global Change Research Program 2017). Increased precipitation may produce more frequent and increased high flows during stochastic flood events. Assuming the timing of these flows is not greatly modified, spawning by host fishes may be enhanced (Tonn 1990), with the ranges of some fish species expanding in streams with extensive free-flowing reaches (Holdgate 1986). However, higher flows may transport host fishes across longer distances and cause mussels to be deposited into unsuitable habitats (Randklev *et al.* 2019), such as downstream of impoundments with low chance of upstream recruitment. Mussels are most likely to occur in stable stream bottoms which remain stable both during high flow events and thermally-buffered, wetted areas during periods of low flow (Strayer 2008). Many mussel species respond negatively to increased velocity and shear stress (the force of water moving against the substrate or shell) (Randklev *et al*. 2019), although species may differ in levels of tolerance (Haag 2012).

More likely to be critical for mussels are declining stream flows and drought. Cook *et al*. (2015) projected a substantial increase in the risk of drought in the southwest and central plains under both moderate and high future emissions scenarios used for current climate change modeling, exceeding droughts observed during the last millennium. Seager *et al*. (2007) suggested that extreme drought conditions similar to the 'dust bowl' of the 1930s could become the new climate of the southwestern United States. Groundwater extraction, surface water withdrawals, and associated appropriations may exceed availability, particularly as human populations expand, increasing demands beyond available stored reserves. Water demands, both availability and use, may be further complicated by extended drought, which may result in a decrease in base flow in streams and protracted low flow conditions (Mashburn *et al.* 2019). As flows decline, aquatic habitats used by fish and mussels are altered and reduced. Vaughn *et al*. (2015) observed mussel declines to be directly linked to drought-induced changes in flow regimes. While fishes and mussels may survive during limited periods of low flow, as those conditions worsen, aquatic species may face oxygen deprivation (Byrne and McMahon 1994, Gagnon *et al*. 2004), increased predation (Gagnon *et al.* 2004), reduced food delivery and waste removal (Byrne and McMahon 1994), and elevated water temperatures (Randklev *et al.* 2019). Vaughn *et al.* (2015) reported observed declines in mussel abundance in the Kiamichi River over a twenty year period, particularly following two extreme droughts. Localized losses in species richness during drought periods favored other mussel species with higher thermal tolerances (Galbraith *et al.* 2010). These types of changes are likely to have a cascading effect on the remaining mussel community as well as ecosystem processes (Vaughn *et al.* 2015).

Warmer air temperatures typically observed during drought may lead to increased evapotranspiration and drier soils (Dong *et al.* 2011, Flanagan *et al*. 2017, Herceg *et al.* 2019). Solar radiation during the growing season, combined with the higher aridity associated with decreased precipitation may contribute to further soil desiccation (Dong *et al*. 2011, Flanagan *et al.* 2017). Reduced soil moisture may be particularly problematic in riparian zones where elevated soil moisture typically exerts a substantial influence over the composition, structure and health of vegetative communities. Riparian areas contribute to bank stability and help to reduce erosion and sedimentation in streams (Oklahoma Cooperative Extension Service 1998). Shade provided by overhanging vegetation helps moderate stream temperatures and reduces algal production (Oklahoma Cooperative Extension Service 1998). Riparian areas also function to provide dissolved carbon compounds and particulate organic matter to streams (Welsch 1991). When droughts alter soil moisture and contribute to reduced stream flows, degradation of the riparian zone may occur. Degradation will ultimately impact the ability of riparian zones to maintain current stream conditions over time and in some instances, altered conditions may even favor establishment of non-native, drought tolerant species (Garssen *et al*. 2014). Shade provided by overhanging vegetation helps moderate stream temperatures and reduces algal production (Oklahoma Cooperative Extension Service 1998). Riparian areas also function to provide dissolved carbon compounds and particulate organic matter to streams (Welsch 1991). However, as water temperatures rise in response to reduced vegetation vigor in riparian zones, water quality will be directly affected (Spooner *et al.* 2005, Strayer 2008). Higher water temperatures often lead to lower dissolved oxygen and may reduce the amount of suitable habitat for all aquatic organisms (Spooner *et al.* 2005, Strayer 2008). While adult mussels may be able to maintain regular metabolism for several weeks at dissolved oxygen levels as low as 1 part per million (1mg/L) by closing their shells (McMahon and Bogan 2001), juvenile mussels are much more limited in this capacity (Strayer 2008). Generally, prolonged or frequent periods of hypoxic conditions may reduce mussel growth and reproductive success, causing females to expel glochidia prematurely (Aldridge and McIvor 2003, Strayer 2008).

Water temperature exerts a considerable influence over community structure and temporal succession in most aquatic organisms (Burton and Likens 1973). Due to their relative immobility and limited dispersal capabilities, mussels may be unable to escape elevated water temperatures or desiccation (drying out) caused by drought, which may be exacerbated by climate change (Galbraith *et al.* 2010). Southeastern Oklahoma experienced severe drought conditions in both 2006 (McLeman *et al*. 2008) and the summer of 2011, with periods of low discharge and reduced water depths in the Little River (Atkinson *et al.* 2014, Irmscher and Vaughn 2015). The 2011 drought changed some areas of the Little River from continuous flow to shallow, isolated pools with elevated water temperatures which caused a catastrophic loss of mussels at multiple sites in the river (Capps *et al.* 2015). Similarly, drought and diminished reservoir releases in recent decades have caused low flow conditions in the Kiamichi River (Spooner and Vaughn 2000), with water temperatures at times exceeding 104°F (40°C), well beyond the tolerance threshold for most freshwater mussel species, including Ouachita rock pocketbook (Galbraith *et al.* 2005, 2010). Additionally, freshwater mussels rely on water temperature as an environmental cue for release of glochidia (Fong *et al.* 1995, Layzer *et al.* 1993, Galbraith and Vaughn 2009, 2011). Accordingly, reproductive success may decline if release of glochidia is mistimed due to water temperature changes.

Mussels have varying degrees of tolerance, resistance, and resilience to stochastic disturbances (Haag 2012). Certain species may be able to adapt to extreme droughts, floods of unprecedented magnitude or frequency, and severe temperatures brought about by climate change, while other species cannot, resulting in impacts to ecosystems (Kloesel *et al*. 2018, Falk *et al.* 2019). The response of both terrestrial and aquatic species to climate change is complex and variable and is often difficult to predict with certainty. However, several responses, many of them negative, are likely. Freshwater ecosystems which are already stressed by a variety of anthropogenic factors may be particularly sensitive to the effects of climate change (Ganser *et al.* 2013, Burton and Likens 1973, Webb and Walling 1988, Wright *et al.* 1999, Kaushal *et al.* 2008). Small populations of mussels occurring in already-fragmented habitat may be more vulnerable to effects of climate change and other stressors, particularly for species with limited dispersal abilities (McLaughlin *et al*. 2002) and latitudinal climate restrictions (Clarke 1973, Haag 2012). More mobile species, such as potential fish hosts for Ouachita rock pocketbook, likely will shift to suitable habitats in response to deteriorated conditions (Urban 2015) and any increases in water temperature caused by warming of the climate (McLaughlin *et al.* 2002, Thomas *et al.* 2004). If conditions continue to deteriorate, mussel beds may be stranded (Gagnon *et al.* 2004), reducing survivorship, reproduction, and recruitment in the population. Vaughn *et al.* (2015) asserted that planned water releases from impoundments could augment stream flows and prevent compounded anthropogenic stressors to mussels.

Loss of Biodiversity – Mussel biodiversity is characteristic of Ouachita rock pocketbook habitat ((D. Martinez 2020, Service, pers. comm.). Biodiversity loss affects nutrient dynamics (Strayer 2013) and water quality (Capps *et al.* 2015), which can all contribute to mussel declines (Neves *et al.* 1997, Strayer and Dudgeon 2010, Vaughn 2010). High species biodiversity in mussel beds is an indicator of good habitat quality, and local biota mutually benefit from the mussels' filtration, excretion and biodeposition (Aldridge *et al.* 2007). Extinction rates in freshwater ecosystems are up to five times higher than those in terrestrial ecosystems (Dudgeon *et al.* 2006, Vaughn 2010). Links between biodiversity and freshwater ecosystem function have been well-documented (Cardinale *et al.* 2002, Hooper *et al.* 2005, McIntyre *et al.* 2007). The ecological services provided by mussels cascade through trophic food webs and stimulate algal and macroinvertebrate production (Spooner and Vaughn 2006, Vaughn *et al*. 2007, 2008). Freshwater mussels directly affect nutrient storage and cycling rates by sequestering nutrients during growth and reproduction, remineralizing nutrients through excretion (Vanni *et al*. 2013, Capps *et al.* 2015). Nutrient excretion rates are not redundant in most mussel species (Spooner and Vaughn 2008), varying with abiotic (flow and temperature) and biotic (community structure) conditions (Vaughn 2010). Species-specific traits influence the rate at which freshwater organisms store and remineralize nutrients (Vanni *et al.* 2002). Loss of biodiversity via species decline and introduction of non-endemic species (Douda *et al.* 2013) may have profound effects on nutrient dynamics (Strayer 2013) and water quality (Capps *et al.* 2015).

As biodiversity loss continues in freshwater ecosystems, Ouachita rock pocketbook and other mussels are likely to continue declining (Neves *et al.* 1997, Strayer and Dudgeon 2010, Vaughn 2010). When small populations of mussels become biogeographically isolated in fragmented streams, they face genetic drift and in-breeding depression (Love Stowell *et al.* 2017, Service 2010). Biodiversity loss in freshwater systems results in a positive feedback of altered nutrient loads affecting the benthic food web because mussel excretions stimulate primary productivity (Spooner and Vaughn 2009, Vaughn 2010). Preservation of biological diversity at the most basic level requires maintenance of genetic variation (Frankel and Soulé 1981, Schonewald-Cox *et al.* 1983). Sessile as adults, the parasitic phase for mussels is the only mechanism for dispersal and the maintenance of gene flow between populations (Watters 1992), and glochidia dispersal distances depend on the mobility and availability of potential hosts (Chong and Roe 2018) and mates in a positive feedback. An “extinction vortex” (Gilpin and Soulé 1986) may develop, which is a downward spiral of feedback between reduced genetic diversity, reduced reproductive success, and lower resilience to stochastic disturbances (Love Stowell *et al.* 2017).

Recovery and Management

The Service published a recovery plan for Ouachita rock pocketbook in 2004. The plan identified protection of the Kiamichi River population and reestablishment and protection of viable populations in two other streams (Service 2004). The recovery plan proposed that, if the stated criteria were met through specific actions, an estimated date to reclassify the species to threatened would be in year 2023. Protection involves elimination of present and foreseeable threats (such as deauthorization of proposed reservoirs), determining biological requirements, maintenance of suitable habitat and fish hosts, and monitoring of existing conditions. The criteria proposed to meet recovery and delist the species includes establishing and protecting viable populations in four of its historically-inhabited streams, and no date for this was provided. Additional mussel surveys are needed.

Numerous conservation and restoration activities have been undertaken by various stakeholders to benefit other mussel species which likely benefit this species as well, though more watershed-scale habitat enhancement and restoration projects are needed to meet future Ouachita rock pocketbook recovery goals at the national level. As an example, the Service and cooperators intend to continue assessments of flow-habitat relationships in the Little River and negotiate for more formal arrangements to institutionalize protective releases from impoundments (Service 2018).

Previous Formal Consultations

- Previous formal consultations involving Ouachita rock pocketbook include incidental take permits issued pursuant to section 10(a)(1)(A) of the Act to individuals conducting surveys or research. Take associated with these activities have been addressed under section 7 of the Act. The Service anticipates that approximately two to five adult specimens per hundred may be incidentally injured or killed as a result of capture and handling associated with recovery actions authorized under section 10(a)(1)(A).

- In 2015, the Service issued a non-jeopardy biological opinion reviewing the effects of the Federal Highway Administration and Arkansas State Highway and Transportation Department's proposal regarding bridge replacement at the Highway 41 crossing of the Little River in Sevier and Little River Counties, Arkansas (Service 2015). The anticipated incidental take was 35,545 ± 5,530 individual mussels, including 109 ±190 Ouachita rock pocketbook. The opinion stated that the maximum estimated take expected within the directly affected action area would be 36 individual Ouachita rock pocketbook. This project was completed in late 2019.

- In July, 2020, the Service issued a non-jeopardy biological opinion reviewing the effects of the Federal Highway Administration and Oklahoma Department of Transportation's proposal regarding replacement at the NS-4615 (Old Broken Bow Highway/N4625) bridge over the Little River in McCurtain County, Oklahoma. Based on use of habitat as proxy, the total maximum area of incidental take for Ouachita rock pocketbook was 249,615 ft^2 (5.73 acres / 23,190m^2) for the duration of 180 days of project activities within the ordinary high water mark. Construction activities are expected to begin in 2021. Mussel relocation efforts associated with this project began in November of 2020 and preliminary results indicate that several Ouachita rock pocketbooks and other listed mussels were relocated to suitable habitats outside of the project footprint.

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR §402.02) define the environmental baseline as the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat 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 that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Status of the Species and Critical Habitat within the Action Area

In the action area, a 2019 survey within the action area reported finding Ouachita rock pocketbook within approximately 500 ft (152 m) of the proposed bridge for this project (EcoAnalysts, Inc. 2019). The Kiamichi River has historically supported Ouachita rock pocketbook, although Vaughn and Pyron (1995) had speculated the species to have been extirpated below Hugo Reservoir, and reduced in abundance downstream of Sardis Reservoir. Density information for this species in the Kiamichi River below Hugo Reservoir is not available. No critical habitat has been designated for the Ouachita rock pocketbook.

Factors Affecting the Species' Environment within the Action Area

As previously discussed in more detail, habitat fragmentation, impoundments, water quality degradation, climate change, and other variables have affected the Ouachita rock pocketbook throughout its range and within the action area. Such factors occur at various intensities and duration within the action area and are expected to continue to influence the quality and availability of suitable habitat for Ouachita rock pocketbook within the action area.

EFFECTS OF THE ACTION

In accordance with 50 CFR §402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of all other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see §402.17).

While analyzing effects of the proposed action, the Service considered proximity of the action to known species locations in relation to the action area, distribution and location of likely effects from the proposed action, timing in relation to sensitive periods of the species' life cycle, nature of the effects through deconstruction of each stage of the proposed action, duration of the proposed action, disturbance frequency, disturbance intensity, disturbance severity, and whether the effects would be short-term, long-term, or permanent.

The Service anticipates that the local population of Ouachita rock pocketbook occupying Kiamichi River and connected streams within the action area would be adversely affected by the proposed project. In-water activities are anticipated to directly and indirectly impact the Ouachita rock pocketbook and its habitat within the action area. Direct and indirect effects of the proposed action on Ouachita rock pocketbook include habitat alteration and potential mortality. The proposed action involves work within the ordinary high water mark and wetted stream channel of Kiamichi River at State Highway 109. The proposed in-water work on Kiamichi River (including construction of the new bridge and demolition of the existing structure) is estimated to take approximately 90 days.

Areas within the ordinary high water mark are considered to be part of mussel habitat due to providing shade, undercuts, and other habitat characteristics used by mussels. Project activities outside of the ordinary high water mark are not anticipated to directly impact the mussels, but indirect impacts to mussels through activities in the riparian zone of the Kiamichi River are reasonably certain to occur. The temporary work roads necessary for this project are expected to result in increased sedimentation and turbidity. As such, the Oklahoma Department of Transportation will put conservation measures in place for minimizing impacts to streambanks and water quality as a part of the proposed action. Implementation of these conservation measures as a part of the proposed action, inclusive of relocation of mussels in the area of expected direct impact, will help to minimize the anticipated impacts to the mussel community.

The removal of the existing bridge structures, construction of new bridge, and the placement of materials for temporary work roads and scour prevention all have the potential to crush and bury individuals, thereby causing direct mortality. Anticipated indirect effects to mussels include changes to the local environment which affect flow, temperature, transport of sediment, disturbance of substrate, or impacts to host fish behavior or movement. Indirect effects would be expected to occur from implementation of the proposed project, including some level of increased sedimentation from the installation of temporary work roads. The sediment will be deposited downstream and have the potential to smother spawning beds of fish hosts and decrease the abundance of aquatic insects which serve as the forage base for fish hosts. As part of the proposed action, efforts will be employed to decrease sedimentation to the extent feasible and practical. Additionally, restoration of riparian vegetation and streambank stabilization, post-construction, is included in the proposed action to minimize risk of further sedimentation and maintain water quality.

However, despite medium to high confidence in our assessment of the anticipated impacts of climate change, it is difficult to determine with any precision as to whether the proposed project would significantly contribute to an increase in factors which exacerbate climate change and its implications for freshwater mussels. However, restoring riparian vegetation displaced by the project may help to minimize the effects of increasing air temperatures on water temperature (Wondzell *et al.* 2019).

The Service anticipates that local populations of Ouachita rock pocketbook occupying that portion of Kiamichi River within and immediately upstream and downstream of the action area would be adversely affected by the project. Though a relocation of any mussels found will be performed prior to the start of construction, with the intention of minimizing lethal take of listed mussel species, effects from the project on any mussels not detected during the relocation effort would be expected. Direct effects of mussel relocation or translocation include harm and possible mortality due to the stress of being handled, processed, and relocated. These effects can result in premature release of sperm or aborted glochidia, negatively impacting reproductive success; a trained biologist holding an active Section 10(a)(1)(A) permit from the Service would be required, and performing the relocation work would minimize some of these effects.

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" considered in this Opinion (50 CFR §402.02). Non-federal actions that could negatively impact the Ouachita rock pocketbook are reasonably certain to occur within the action area. Such actions will typically include vehicular traffic, recreational use of the river and riparian areas; commercial and residential use of roadside zones; agricultural activities; livestock grazing; and utilities or rights-of-way maintenance. Most of these actions do not have a federal nexus. Consequently, the Service currently lacks planning information that would identify their likely scope and location, such that we could accurately predict the magnitude of their impacts on species and habitats. We do not anticipate that overall land use in the area will be altered by the proposed action, or will change dramatically from recent trends. Therefore, additional non-federal actions will continue to occur in the action area and may have additional, cumulative effects on these species and their habitats. However, we currently are unable to estimate those effects.

CONCLUSION

After reviewing the current status of the Ouachita rock pocketbook, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is our biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Ouachita rock pocketbook. Because sedimentation and direct impacts to the substrates used by federally-listed mussels would occur, as described in this Opinion, we anticipate that the proposed action also may result in alteration of suitable habitat and possibly mortality of the Ouachita rock pocketbook.

We base the above conclusions on the following:

1. The area of occupied range encompassed by the action area is small proportionately compared to the entire occupied range of the Ouachita rock pocketbook.

2. The areas within the ordinary high water mark of Kiamichi River immediately under existing and proposed bridge spans are considered habitat due to potential use by mussels and host fishes at certain times during the year. Substrate disturbance from installation of piers, footings, and permanent casings would permanently impact these areas.

3. Impacts due to placement of work roads and removal of the existing piers would be temporary in nature and primarily related to potential host fish passage restrictions and substrate disturbance.

4. Impacts due to installation of new pier columns, footings, and related permanent casings would be permanent and primarily related to substrate disturbance and displacement.

5. No recovery actions will be affected by implementation of the proposed project.

6. The conservation measures proposed by the Federal Highway Administration and Oklahoma Department of Transportation, as described in the Assessment, will be

implemented. These measures will help minimize the severity, extent and duration of project effects.

The conclusions of this biological opinion are based on full implementation of the project as described in the **DESCRIPTION OF THE PROPOSED ACTION** section of this document, including any conservation measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50 CFR §17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR §17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be undertaken by the Federal Highway Administration and/or its designated representative (Oklahoma Department of Transportation) as appropriate, for the exemption in section 7(o)(2) to apply. The Federal Highway Administration has a continuing duty to regulate the activity covered by this incidental take statement. If the Federal Highway Administration (1) fails to assume and implement the terms and conditions or (2) fails to require the Oklahoma Department of Transportation to adhere to the terms of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Federal Highway Administration and/or the Oklahoma Department of Transportation must report the progress of the action and its impact on the species as specified in the incidental take statement [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

The following levels of take for Ouachita rock pocketbook may be anticipated by disruption of normal behavioral activities and the loss of essential habitat elements due to water quality degradation, placement of foreign material into the stream and sedimentation resulting from the installation, use and removal of work roads, demolition of the old bridge, and construction of the new bridge. The Service concludes that the conservation measures being implemented as a part of this action, inclusive of relocation of mussels in the area of expected direct impact, will help to minimize the anticipated take of the Ouachita rock pocketbook.

The Service anticipates that any Ouachita rock pocketbook individuals residing within the action area could be taken as a result of the proposed action. Only a portion of the water occupied by the federally-listed mussel species will be impacted, and detected individual mussels would be removed prior to the start of construction from the direct action area and relocated to suitable habitat. If translocation is not completed, we anticipate that some animals inhabiting the area would be killed as a result of the action. If translocation of all federally-listed mussels from the action area to a suitable translocation site is completed, we anticipate that very few of these species would be killed as a result of the action. However, we anticipate that some undetected adults, juveniles, and glochidia may be killed, as may some host fish. In addition, some adults, juveniles, and glochidia may be harmed subsequent to construction by local flow displacements and/or by increased inputs of fine sediments. Areas covered by work roads and any areas heavily infiltrated by sedimentation will be made unproductive as mussel habitats, and this will constitute a permanent or protracted loss. Juveniles likely will continue to excyst from fish and fall into these areas, but are unlikely to survive to maturity. The majority of the take would be in the form of harm, harassment, capture/collecting and injury, such as wounding or killing, of individual mussels or glochidia.

The Service expects incidental take of individual Ouachita rock pocketbook mussels will be difficult to detect for the following reasons: presence/absence surveys in this reach are not typically exhaustive, the small body size of juvenile mussels, inability to readily observe parasitic larval specimens occupying the gills of host fishes, and losses may be masked by seasonal fluctuations in occurrences of host fishes. We lack information necessary to quantify the number of adult mussels, glochidia, juveniles, or host fish that would be taken. Take will be determined based on the description of activities expected to affect the species and using habitat area as a surrogate for the species. The amount of take will be quantified using a total area of impacted habitat within the ordinary high water mark of the Kiamichi River, including each work road and the adjacent area into which flow will be displaced laterally, an upstream backwash zone, and a downstream zone likely to experience significant, elevated concentrations of fine sediments.

The area of temporary change and displacement of substrate resulting from the construction and demolition of work road sections to be located within the ordinary high water mark, is anticipated to be 18,527.6 ft^2 (1,721.2 m^2) (Table 1). The drilled shafts for each pier column within the ordinary high water mark are proposed to be 84 inches (213.4 cm) in diameter, for an area of 38.5 ft^2 (3.6 m^2) per column; permanent conversion and displacement of substrate will result from the installation of four pier columns totaling 154 ft^2 (14.4 m^2) in area.

Adult mussels may move seasonally, particularly during the breeding season, as much as an estimated 330 ft (100 m) (Green *et al.* 1985, Waller *et al.* 1999, Allen and Vaughn 2009). Consequently, this distance upstream of the proposed action may be impacted by the proposed action and was therefore surveyed for the presence of mussels. Roads, bridges, and culverts may impact the aquatic environment over distances ranging from 33 ft (10 m) to in excess of 3,281 ft (1,000 m) (Forman *et al.* 2003). Accordingly, the survey extent for this project included an estimated zone of impact within the wetted channel beginning 330 ft (100 m) upstream of the proposed bridge and extending downstream 1,320 ft (400 m) of the existing bridge (Figure 2). This surveyed area includes the area of estimated temporary impact from sedimentation. The drilled shafts for the proposed pier columns and the work roads within the ordinary high water mark are not double-counted. Therefore, the total maximum area of incidental take for Ouachita rock pocketbook is 383,328 ft^2 (8.8 acres / 35,612.3 m^2) (Table 1; Figure 2), for the duration of project activities within the ordinary high water mark, which are estimated to require 90 days.

For purposes of this Opinion, the Service is defining incidental take in terms of the amount of suitable habitat acres impacted because habitat loss and disturbance is the primary cause of the take.

Table 1. Area measurements used to estimate incidental take of Ouachita rock pocketbook from JP 27982 (04) on State Highway 109 over Kiamichi River in Choctaw County, Oklahoma.

Type	Description	Area (ft^2)	Area (m^2)
Sedimentation (Temporary)	330 ft (100 m) upstream of proposed bridge to 1,320 ft (400 m) downstream of existing bridge	383,328	35,612.3
Work Roads (Temporary)	Construction (North)	4,723	438.8
	Construction (South)	6,072.3	564.1
	Demolition (North)	4,032.3	374.6
	Demolition (South)	3,700	343.7
		Subtotal: 18,527.6	*1,721.2*
84” diameter drilled shafts for pier column: Substrate displacement (Permanent)	(x4)	38.5	3.6
		Subtotal: 154	*14.4*

Use of Impacts to Habitat as a Surrogate for Take

The use of habitat as a surrogate in expressing the amount or extent of anticipated incidental take is consistent with existing Service policy. As explained in the Service’s May 2015 Final Rule (80 FR 26832), surrogates may be used to express the amount or extent of anticipated take, particularly where it may be impracticable to detect or monitor take of individuals. In these situations, evaluating impacts to a surrogate, such as habitat, ecological conditions or similar affected species may be the most meaningful measure of assessing take and is consistent with the language and purposes of the Act and with relevant case law. As stated in the Service’s May 2015 final rule, the use of surrogates in expressing take must describe the causal link between surrogate and take to the listed species, describe why it is not practical to use individuals for the take estimate and how it would be monitored, and set a clear standard for when the amount of take would be exceeded. For the purposes of this opinion, the Service defines incidental take in terms of the number of acres (square meters; hectares) impacted.

The causal link between using area of habitat as a surrogate (50 CFR §402.14(i)(1)(i)) for take of individual Ouachita rock pocketbook mussels is based on the fact that the stream bottom is

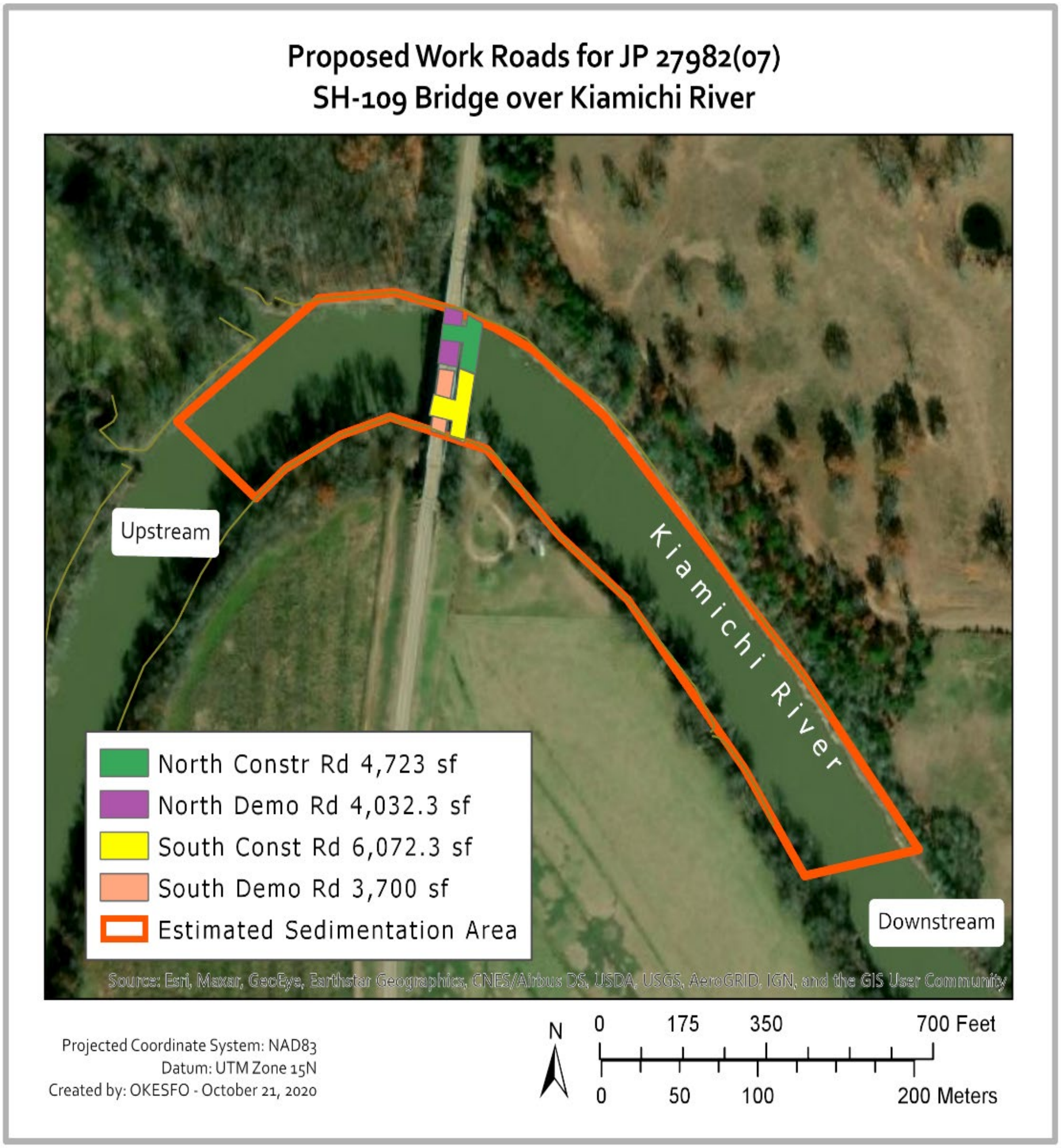

Figure 2. Map showing area of potential sedimentation from the proposed bridge replacement on State Highway 109 over Kiamichi River in Choctaw County, Oklahoma, depicting proposed options for temporary construction and demolition work roads within the ordinary high water mark as related to proposed project JP 27982(07). Area of each work road segment is shown in square ft (sf).

where this species resides, typically resting atop or burrowing into the substrate which forms the stream bottom. When the stream bottom is impacted, direct adverse effects to mussel survival, reproduction and growth occur. All mussels are relatively immobile and are unable to rapidly flee when fill material (such as for a work road) is placed on top of the stream bottom. Consequently they may be crushed when material is deposited. The host fishes used by these mussels for reproduction often feed on small aquatic organisms that reside within and upon the stream bottom. Placement of fill material likely kills all of the small aquatic invertebrates used as forage by these fishes. Consequently, habitat loss impacts the ability of these host fishes to secure food for growth and survival. Deposition of fine sediments on the stream bottom may smother any mussel covered by sedimentation and can adversely alter substrates used for nesting by host fishes and suffocate any eggs previously spawned within these areas.

EFFECT OF THE TAKE

In the accompanying Opinion, the Service has determined that this level of anticipated take is not likely to result in jeopardy to the Ouachita rock pocketbook because most of the impacts associated with the action are temporary in nature and are expected to occur within a very limited extent of the overall known occupied range of the species.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Ouachita rock pocketbook:

I. The Federal Highway Administration shall conduct a mussel relocation (translocation) prior to the start of construction to avoid and minimize take of federally-listed mussel species during the project.

II. The Federal Highway Administration shall ensure that adequate stream flows are maintained in the action area through the duration of the project which allow for mussel fish host movement in Kiamichi River.

III. The Federal Highway Administration shall ensure that the construction footprint will be minimized and the site restored to the greatest extent practicable.

IV. The Federal Highway Administration shall ensure that all contractors and workers on the ground are informed of and will abide by all the terms and conditions set forth within this Opinion.

V. The Federal Highway Administration shall monitor activities throughout the duration of the project to ensure take is not exceeded and will apply best adaptive management strategies for conservation of federally-listed mussel species and their habitat.

Terms and Conditions for Implementation of Reasonable and Prudent Measures

In order to be exempt from the prohibitions of section 9 of the Act, the Federal Highway Administration and/or the Oklahoma Department of Transportation must comply with the following terms and conditions, which implement the reasonable and prudent measures (RPM) described above and outline the reporting/monitoring requirements. These terms and conditions are non-discretionary.

Terms and Conditions for RPM 1:

1. Federal Highway Administration and/or Oklahoma Department of Transportation shall complete a mussel survey for this project site prior to the start of construction. For this project only, the mussel survey conducted in March, 2019 (EcoAnalysts, Inc. 2019), shall be valid until May 31, 2021. Subsequently, any mussel survey which is conducted between March 1 and October 31, shall be valid for up to two years (until last day of February of the second calendar year after the survey); if conducted November 1 through February 28/9, the survey shall be valid until the subsequent May 31.

2. Federal Highway Administration and/or Oklahoma Department of Transportation, in cooperation with the Service, shall identify a suitable relocation site (recipient site) for the federally-listed mussel species, and submit a plan for scope of work for the relocation of any collected individuals along with a post-relocation effectiveness monitoring proposal for approval/suggested revision by the Field Office.

3. The identification of a recipient site, performance of the survey, mussel identification, relocation, and all handling of mussels shall be directed by a qualified person holding a valid section 10(a)(1)(A) permit for the appropriate region, site, species, and activities involved, and data required by the surveyor's section 10(a)(1)(A) permit) shall be provided to the Service's Field Office.

4. All occurrences of zebra mussel (*Dreissena polymorpha*) and/or Asian clam (*Corbicula fluminia*) from the Kiamichi River within the action area shall be reported to the Field Office. No living Asian clam or zebra mussel, if collected, shall be relocated during relocation efforts. According to the Oklahoma Department of Wildlife Conservation (K. Collins, Service, pers. comm. with C. Tackett, June 2020) euthanizing any zebra mussel or Asian clam collected during relocation efforts is allowed. If any adult zebra mussels are collected, the Oklahoma Department of Wildlife Conservation also should be notified and specimens preserved for later verification.

5. The timing of the mussel survey and/or relocation shall not occur during the sensitive season of any federally-listed aquatic species, as identified by the Field Office.

Terms and Conditions for RPM II:

1. Work roads shall not extend into the stream channel by more than 50 percent of the ordinary high water mark (the bank full channel width) during any phase of construction;

Federal Highway Administration and/or Oklahoma Department of Transportation biologists shall monitor for meeting this requirement.

2. The ordinary high water mark, upstream, and downstream project boundaries shall be clearly marked for ground crews to observe throughout the duration of the project, and confirmed with the Oklahoma Department of Transportation Natural Resources Program Biologist prior to the start of construction activities.

3. During low flow conditions and while work roads are in place, best management practices to maintain adequate streamflow to facilitate fish movement will be identified by an appropriate Oklahoma Department of Transportation representative (*i.e.*, biologist), communicated to the Oklahoma Field Office and the Resident Engineer and implemented accordingly.

<u>Terms and Conditions for RPM III:</u>

1. The area of disturbance within the stream channel, due to the construction of work roads and drilling platforms, will be minimized to the greatest extent practicable as determined by the appropriate Resident Engineer. Additionally, the amount of riparian vegetation cleared shall only include the minimum amount necessary to complete the proposed action.

2. Vehicles or other motorized equipment shall be confined to areas outside of all wetted channels of Kiamichi River, with the exception of activities related to work road construction and use. Once a work road is completed, motorized equipment use within the stream channel shall be confined to the work road and not driven through the wetted channel.

3. After each work road is no longer needed, fill material shall be removed and the natural contours of the river channel and bank restored to mimic the natural and pre-work road conditions to the maximum extent practicable.

4. Vegetation shall be established in areas disturbed during project construction as soon as possible following construction, including but not limited to, reestablishment of vegetation removed from within the riparian zone as a result of this project. Revegetation shall use an appropriate mix of plant species native to the project site (including sodded areas), as per the conservation measures articulated within the Assessment and described in the **DESCRIPTION OF THE PROPOSED ACTION** section above. In areas where native vegetation could not be protected, exposed soil will either be reseeded with seed mixtures of species native to the ecoregion or replanted with native species of shrubs and trees common to the project site. A variety of stream bank stabilization techniques may be considered for use along the bridge abutments, as approved by the Resident Engineer, including live stakes, live fascines (wattles), branch packing, vegetated geo-grids, live crib-walls, joint planting, and brush mattresses.

5. Hazardous materials, chemicals, fuels, lubricating oils, and other such substances shall be stored at least 100 ft (30.5 m) outside of the ordinary high water mark for Kiamichi River which includes the adjacent channel on the north bank. Refueling of construction equipment also shall be conducted at least 100 ft (30.5 m) outside of the ordinary high water mark for the Kiamichi River and the adjacent stream channel on the north bank. These boundaries will be clearly marked for ground crews to observe throughout the duration of the project, and confirmed with the Oklahoma Department of Transportation Natural Resources Program Biologist prior to the start of construction activities.

6. Water shall be obtained (if required for construction purposes or to water seeded/sodded areas) from a source other than Kiamichi River or any other stream known to be occupied by federally-listed aquatic species.

7. Temporary work roads and drill pads will be implemented in a manner that minimizes erosion, sedimentation, or permanent alteration of the stream bed or bank substrates. Work roads and drill pads shall be made of crushed non-erosive rock material of sufficient size to minimize downstream movement. As described by the Oklahoma Department of Transportation in the Assessment, rocks with 12 to 24-inch (30.5 to 61 cm) nominal size with smaller rocks not less than 1.5-inch (3.8 cm) nominal size for the top surface are typically sufficient. Native rock material removed from the stream channel at the project site shall not be used during construction of the work road.

8. Construction activities will be conducted in a manner so that no debris generated from the construction of the proposed bridge or demolition of the existing bridge shall be allowed to fall into the water.

9. Construction equipment must cross Kiamichi River at one confined location over an existing bridge.

10. Asphaltic mulch will not be used. This will prevent the possible seepage of potentially toxic petroleum compounds into the adjacent stream.

11. Water repellant chemicals will not be sprayed on new bridge structure unless spray is confined solely to structure and does not contaminate surrounding surface water.

<u>Terms and Conditions for RPM IV:</u>

1. The contractor(s) employed for the proposed work will attend a pre-construction meeting that will include specific instruction on the implementation of reasonable and prudent measures with their terms and conditions as included in this incidental take statement.

2. Specific instructions to the contractor(s) with respect to implementation of reasonable and prudent measures will be incorporated through written documentation and included in the project plans. A figure showing the project boundary of the allowed disturbance under the incidental take statement will be included in project plans. This figure and the

reasonable and prudent measures with their terms and conditions will be posted and available on site at all times during construction.

Terms and Conditions for RPM V:

1. The Federal Highway Administration and/or the Oklahoma Department of Transportation will monitor the extent of take, throughout the duration of the action, through sufficient on-site inspections scheduled to coincide with those activities anticipated to result in take.

   Monitoring will include the following:

   a. Estimating the actual area of disturbance caused by construction, use and removal of work roads and/or pads/platforms following completion of each road and/or pad/platform. If areas within the ordinary high water mark are disturbed more than once, that area of disturbance should be determined appropriately.

   b. Monitoring of stream flows visually, both upstream and downstream of the action area to ensure that stream connectivity is maintained throughout the duration of the project. If it is anticipated that stream connectivity may be lost, the Oklahoma Field Office shall be contacted immediately. Field biologist(s) from the Oklahoma Field Office will consult with the Oklahoma Department of Transportation's biologist(s) to determine what measures, if any, may be implemented to restore connectivity. In some cases, natural conditions, not related to project activities, could lead to a loss in stream connectivity, in which case no further action would be necessary. If biologists determine that connectivity may need to be restored, numerous options may be explored, including sandbag placement or movement of channel substrate by hand. Heavy equipment shall not be used to restore stream connectivity without first contacting the Service for approval and completing consultation, as needed.

   c. Monitoring length, location, area, and duration of work roads within the ordinary high water mark.

2. Reports of on-site monitoring mentioned above shall be submitted to the Service’s Oklahoma Field Office every two weeks. Reports should include GPS locations of work roads, photographs documenting extent of staining/discoloration caused by any sediment flowing downstream during drilling, and photographs showing work road proximity to bridge as a visual reference for length of work road in relation to ordinary high water mark. If any individual monitoring activities reveal that take may be exceeded, the Oklahoma Field Office should be immediately contacted prior to continuing any construction activities.

3. The Service’s Oklahoma Field Office should be contacted at least one week prior to start of construction to alert staff of commencement of monitoring activities.

4. Appropriate erosion control best management practices, as established by the Oklahoma Department of Environmental Quality to minimize impacts from storm water discharges,

shall be incorporated into the project specifications and included as part of the project plans.

Reporting Requirements

The Federal Highway Administration and the Oklahoma Department of Transportation will be responsible for providing to the Service reports of project initiation, monitoring, and potential modifications as identified in the above terms and conditions.

Disposition of Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the Service's Law Enforcement Office, P.O. Box 610069, DFW Airport, Texas 75261 at Tel. (972) 574-3254 / Fax: (972) 574-4669 / fwsole_dfw@fws.gov and the Oklahoma Ecological Services Field Office at (918) 581-7458 within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office identified above with a copy to Oklahoma Field Office at 9014 E. 21st Street, Tulsa, Oklahoma 74129. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

Additionally, unless directed otherwise, all dead or moribund federally-listed mussels that contain soft tissue and are encountered during project activities shall be preserved according to standard museum practices and in a manner that preserves genetic material (*e.g.* stored at appropriate temperature to prevent decay, or 70 percent natural ethanol). Record of the date(s) and location(s) of each collection shall be kept with the specimens. These specimens may then be provided to the Oklahoma State University museum in Stillwater, the University of Oklahoma Museum of Natural History in Norman, or another similar institution, with concurrence by the Service, for deposition in their collection of mollusks.

CONSERVATION RECOMMENDATIONS

Section 7(a)(l) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans or develop information. Implementation of these measures would further help to minimize effects to the federally-listed species.

The Service recommends that the Federal Highway Administration and Oklahoma Department of Transportation assist in the conservation and recovery of federally-listed mussels such as the Ouachita rock pocketbook. Status information from ongoing survey efforts are used on a regular basis by the Federal Highway Administration and Oklahoma Department of Transportation for section 7 consultations on a wide variety of construction projects across the state of Oklahoma. Contributions also could be made in the form of funding to the Oklahoma Department of

Wildlife Conservation to participate in these survey efforts. Additionally, biological staff from both the Federal Highway Administration and Oklahoma Department of Transportation are encouraged to provide field support during survey efforts or funding the identification and enumeration of field samples collected during surveying.

While the Project will use well-established transportation and storm water best management practices, mussel specialists recently have published a more comprehensive set of best management practices, developed with specific consideration toward protecting freshwater mussels (Blevins *et al.* 2017). In the future, the Field Office intends to refer increasingly to these best management practices in evaluating projects at locations important to freshwater mussels and to fish movement. The Field Office requests that all native mussels in a community be moved during relocations to preserve biodiversity and mussel health, and we encourage Oklahoma Department of Transportation to coordinate with the Oklahoma Department of Wildlife Conservation in developing a consistent mussel survey and relocation protocol. We also encourage the Federal Highway Administration and Oklahoma Department of Transportation to become familiar with these mussel best management practices and to incorporate them into future project plans, where appropriate. The Federal Highway Administration and Oklahoma Department of Transportation may find certain best management practices potentially applicable to many proposed projects, and it is encouraged to discuss such potential application with the Service.

When the banks around bridges are armored with rocks or concrete (rip rap) to protect roads from washout, these armored banks degrade streams by disrupting the surface-subsurface exchange from the riparian zone (Forman *et al*. 2003). Larger bridge and other projects utilizing features such as work roads and removal of riparian vegetation likewise may alter channel geomorphology, flow patterns, water quality, water temperature, and stream bed composition, as well as have direct effects on living mussels and their host fish. As the Federal Highway Administration and Oklahoma Department of Transportation consider potential long-term solutions to these concerns, we encourage the agencies to view each project not simply as a transportation project, but as a concurrent opportunity to conserve listed species. We continue to support early consultation among the Oklahoma Department of Transportation, the Federal Highway Administration, and the Service, and encourage early coordination with interested state agencies as a favorable way to explore conservation opportunities.

The Service requests notification of the implementation of any conservation recommendations as a means of keeping the Service informed of actions undertaken to minimize or avoid adverse effects or provide conservation benefit to listed species or their habitats.

REINITIATION NOTICE

This concludes formal consultation regarding Federal Highway Administration funding of the proposed construction of the Oklahoma Department of Transportation JP 27982(07) Bridge and Approaches on State Highway 109 over Kiamichi River in Choctaw County, Oklahoma. As provided in 50 CFR §402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion or written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Should you have any questions, or require additional assistance regarding this consultation, please contact Ms. Skye Kreisler of the Oklahoma Ecological Services Field Office at (918) 581-7458.

Sincerely,

JONNA POLK

Digitally signed by JONNA POLK
Date: 2021.01.11 20:20:35 -06'00'

Jonna E. Polk
Field Supervisor

cc: Karen Orton, Environmental Projects Manager, FHWA - Oklahoma City, OK
Amber McIntyre, Natural Resources Program Manager, ODOT, Norman, OK
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