Osage County Oil and Gas Draft Environmental Impact Statement

United States Department of the Interior
Bureau of Indian Affairs
Eastern Oklahoma Regional Office
Osage Agency

November 2019

Estimated Costs to
Develop this EIS:
$591,000

BIA Mission Statement

The Bureau of Indian Affairs' mission is to enhance the quality of life, to promote economic opportunity, and to carry out the responsibility to protect and improve the trust assets of American Indians, Indian tribes, and Alaska Natives.

TABLE OF CONTENTS

Chapter Page

TABLES

Page

FIGURES *(see Appendix E)* Page

APPENDICES

Executive Summary

ES.1 Introduction and Regional Setting

The United States (US) Department of the Interior (DOI), Bureau of Indian Affairs (BIA) Eastern Oklahoma Regional Office prepared the Osage County Oil and Gas Draft Environmental Impact Statement (EIS), in accordance with the National Environmental Policy Act of 1969 (NEPA). This programmatic EIS analyzes the potential impacts of future oil and gas development on the surface estate and subsurface mineral estate in Osage County, Oklahoma. Osage County, the planning area for this EIS, is located in northeast Oklahoma and encompasses approximately 1,474,500 acres.

In accordance with the Osage Allotment Act of 1906 (1906 Act), as amended, the subsurface mineral estate underlying Osage County (Osage Mineral Estate) is held in trust by the United States for the benefit of the Osage Nation and is administered by the BIA. The federal actions analyzed in this EIS are the approval of oil and/or gas leases, drilling permits, and workover permits. All leases and permit applications in Osage County are approved under the authority of the 1906 Act and 25 Code of Federal Regulations (CFR) Part 226 – Leasing of Osage Reservation Lands for Oil and Gas Mining.

Oil and gas development in Osage County has been ongoing since 1896. While the planning area has been substantially developed for conventional oil and gas production and coalbed methane production, historical development is heavily concentrated in certain parts of the county, leaving much of the area pristine. In addition to oil and gas development, Osage County also supports residential, agricultural, commercial, and recreational land uses.

Four alternatives were selected for detailed analysis in this EIS: (1) the No Action Alternative; (2) Emphasize Oil and Gas Development; (3) Hybrid Development; and (4) Enhanced Resource Protection. The alternatives are designed to promote development of the Osage Mineral Estate in a manner that is economical and efficient while minimizing or avoiding adverse impacts on the environment, historic properties, and cultural resources significant to federally recognized Tribes (Tribes).

The impact analysis uses the best available data and is based on the reasonably foreseeable development of oil and gas resources under each alternative over the next 20 years.

ES.2 PURPOSE OF AND NEED FOR THE EIS

The purpose of the BIA's action is to promote leasing and development of the Osage Mineral Estate in the best interest of the Osage Nation pursuant to the 1906 Act, as amended, balancing resource conservation and maximization of oil and gas production in the long term. In addition, the BIA is required, under more generally applicable statutes, to include in the best interest calculation, protection of the environment in Osage County in order to enhance conservation of resources and protection of the health and safety of the Osage people. Based on those considerations, the BIA's action will promote the maximization of oil and gas production from the Osage Mineral Estate in a manner that is economic, efficient, and safe; prevents pollution; and is consistent with the mandates of federal law.

The BIA needs this EIS in order to fulfill its trust responsibility under the 1906 Act to administer leasing and development of the Osage Mineral Estate. In the Hayes I litigation, the US District Court for the Northern District of Oklahoma ruled that the programmatic 1979 Environmental Assessment for the Oil and Gas Leasing Program of the Osage Indian Tribe (1979 EA) was no longer valid. Accordingly, the BIA may not rely on the 1979 EA to review and approve oil and gas leases and permits. The BIA's current NEPA review process utilizes three separate NEPA documents - the 2014 Programmatic Environmental Assessment for Leasing Activities (Leasing PEA), the 2015 Programmatic Environmental Assessment for the Approval of Workover Operations (Workover PEA), and site-specific EAs. This EIS will allow the BIA to streamline the NEPA review process by replacing the Leasing and Workover PEAs with a single NEPA document that provides comprehensive impacts analysis and reducing the size and cost of site-specific EAs. The efficiencies gained by streamlining the NEPA review process will expedite lease and permit processing.

ES.3 EIS DECISION FRAMEWORK

The EIS will replace the Leasing and Workover PEAs and serve as the sole NEPA review for leases and workover operations that do not require new ground disturbance. Site-specific EAs will be required for all drilling, workover, and other operations involving new ground disturbance, but operators will be able to tier to the comprehensive impacts analysis in the EIS. The EIS does not impose restrictions on how large an area a site-specific EA may cover. Operators may prepare a site-specific EA for one individual well, a "batched" group of wells that will be located within the same area, an entire lease, a quarter-section, a section, or any larger area that they so choose. The location of wells, well pads, access roads, rights-of-way (ROWs), and other surface facilities will be determined at the permitting stage.

The Record of Decision (ROD) associated with this EIS will approve a plan for the development of the Osage Mineral Estate. The ROD could approve one of the alternatives or a combination of the alternatives.

ES.4 PUBLIC INVOLVEMENT AND COOPERATING AGENCY COORDINATION

ES.4.1 Public Involvement

Public involvement is a critical component of the NEPA process. In accordance with BIA and Council on Environmental Quality (CEQ) regulations and guidance, the BIA conducted two formal scoping periods to identify significant issues associated with the agency's proposed land and resource management issues. The scoping periods presented individuals from federal, state, and local agencies; Tribes; interest groups; and the general public with opportunities to provide meaningful input via in-person participation at public scoping meetings and the submission of written comments by comment card, email, or letter.

The final scoping report for the first scoping period is available online at https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=renderDefaultPlanOrProjectSite&projectId=72142. The final scoping report for the second scoping period is available online at https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-andgas-eis.

ES.4.2 Cooperating Agency Coordination

The Osage Nation, Osage Minerals Council, US Environmental Protection Agency (EPA), and US Geological Survey are cooperating agencies for this EIS.

The BIA is engaging in formal government-to-government consultation with the Osage Nation. It also is conducting formal consultation under Section 7 of the Endangered Species Act of 1973 (ESA) with the US Fish and Wildlife Service (USFWS; the Biological Opinion [BO] and Biological Assessment [BA] are included in this EIS as **Appendix B**) and consultation under Section 106 of the National Historic Preservation Act of 1966 (NHPA) with the State Historic Preservation Officer (SHPO) and Osage Nation Tribal Historic Preservation Officer (THPO).

ES.5 SUMMARY OF THE REASONABLY FORESEEABLE DEVELOPMENT SCENARIO AND DEVELOPMENT PROJECTIONS

For purposes of the analysis in this EIS, the BIA needed to prepare a reasonably foreseeable development scenario (RFD) of potential oil and gas development activity in the planning area. The RFD indicates that the number of annual wells drilled is expected to increase over the current rate during the next 20 years (2018–2037). During that time, the RFD estimates that 4,761 new wells may be drilled: 3,208 oil wells, 1,369 gas wells, and 184 injection, disposal, or service wells. Most new wells are expected to be drilled vertically, due to the lack of unconventional oil and gas reservoirs in the planning area and poor results from existing horizontal wells. Under Alternative 1 (No Action) and Alternative 2, it is estimated that the baseline RFD scenario for the number of new wells drilled over the next 20 years would remain correct. Under Alternative 3, it is estimated that approximately 4,011 new wells would be drilled. Under Alternative 4, it is estimated that 3,095 new wells would be drilled.

ES.6 ALTERNATIVES

The BIA identified a reasonable range of alternatives, including a No Action Alternative (as required by 43 CFR Section 1502.14). These are based on issues, concerns, and ideas raised in public comments during scoping, interdisciplinary interaction between resource professionals, and collaboration with cooperating agencies.

Under all alternatives, lessees must comply with and obtain any necessary permits or authorizations required under federal laws, such as the Clean Water Act of 1972 (CWA), Clean Air Act of 1963 (CAA), Safe Drinking Water Act of 1974, the ESA, and the NHPA. Determinations pursuant to the NHPA will be made in consultation with interested Tribes.

Additionally, lessees must comply with all requirements set forth in 25 CFR Part 226 and any instructions, orders, or notices to lessees (NTLs) issued by the BIA Osage Agency Superintendent in accordance therewith. Under all alternatives, site-specific conditions of approval (COAs) could be applied on a case-by-case basis.

ES.6.1 Alternative 1, No Action

Under Alternative 1 (No Action), the BIA would continue to administer oil and gas leasing and workover activities in Osage County, in accordance with the measures outlined in the Leasing PEA and Workover PEA. The EIS will replace the existing Leasing and Workover PEAs as the NEPA review for leasing and workover actions.

ES.6.2 Alternative 2, Emphasize Oil and Gas Development

Alternative 2 emphasizes oil and gas development. Under this alternative, the BIA would publish a list of best management practices (BMPs) for all operations on leases in Osage County; however, it would not mandate compliance with BMPs or prescribe specific actions that lessees must take in order to comply with applicable laws and regulations (specific actions may still be required at the site-specific level). In addition, the BIA would waive many of the COAs for drilling and workover operations.

ES.6.3 Alternative 3, Hybrid Development

Alternative 3 represents a hybrid approach to the alternatives; it blends concepts of Alternatives 2 and 4. COAs would be applied based on the density of wells in a Public Land Survey System section. Under Alternative 3, fewer COAs would be applied in high-density sections where there is more historical oil and gas development; more COAs would be applied in low-density sections, where there is little historical oil and gas development.

Regardless of the density of wells, the BIA would not approve permits for new ground-disturbing activities in specified sensitive areas (see **Figure 2-2**).

ES.6.4 Alternative 4, Enhanced Resource Protection

Alternative 4 emphasizes resource protection by adding additional COAs that could apply throughout the planning area, including in sensitive areas. The BIA would issue permits based on site-specific NEPA analysis tiered to the analysis in this EIS. Under this alternative, the BIA would not approve permits for new ground-disturbing activities in specified sensitive areas (see **Figure 2-3**).

ES.7 Alternatives Considered but Eliminated from Detailed Analysis

Eight alternatives were eliminated from detailed study because they would not meet the stated purpose of and need for the BIA's action (see **Section 1.3**) or because they would not be technically, economically, or legally feasible. These alternatives are described in detail in **Section 2.5**, Alternatives Considered but Eliminated from Detailed Analysis.

- No leasing alternative (eliminated because it does not meet the purpose of and need for the EIS)
- Leasing with no constraints (eliminated because it is not legally viable, since the BIA is required to comply with laws and regulations such as the ESA and NHPA)
- Transfer the BIA's management authority to another agency (eliminated because delegations of authority are out of the scope of this EIS)
- Alternatives based on oil price (eliminated because the BIA does not have control over oil prices)
- Alternatives based on the total number of acres that can be leased at any given point in time (eliminated because the BIA does not have control over the number of acres leased)
- Alternatives based on a total number of active leases (eliminated because the BIA does not have control over the number of active leases)
- Reduce the royalty or annual rental rate in the planning area (eliminated because the BIA does not have the authority to lower royalty or rental rates)
- Increasingly stringent COAs as the number of leases and permits increases (eliminated because this wouldn't consider the impacts on sensitive areas)

ES.8 Summary of Environmental Consequences

The impact analyses of key resource issues identified during public scoping and subsequent meetings with the cooperating agencies are summarized below; see

Chapter 4 for detailed analyses and discussions of other resource issues. The analyses here are organized in the same order as they are in the EIS.

ES.8.1 Topography, Geology, Paleontology, and Soils

Under all alternatives, oil and gas development would continue to affect topography, geology, paleontology, and soils in the planning area. Under all alternatives, the risk of induced seismicity from injection of wastewater would continue, as would damage to soils due to spills. Alternatives that reduce surface disturbance and require post-disturbance reclamation would reduce some adverse impacts.

ES.8.2 Water Resources

Under all alternatives, water resources, including surface water and Waters of the United States, groundwater, and aquatic environments, are susceptible to depletion or contamination by oil and gas development. Alternatives 3 and 4 would reduce the risk of spills or surface disposal of wastewater compared with Alternative 1 (No Action), by preventing new drilling in areas with sensitive waters and applying COAs designed to protect water resources.

ES.8.3 Special Status Species

Under all alternatives, special status species would continue to be affected by habitat loss and fragmentation and disruption from noise and traffic. Under all alternatives, requirements to comply with the ESA and USFWS guidelines would mitigate or reduce impacts. Alternatives 3 and 4 would reduce the risk of habitat loss and species takes compared with Alternative 1 (No Action), since they would prevent new drilling near some lakes and rivers, and apply COAs designed to minimize surface disturbance, which would incidentally protect species habitat.

ES.8.4 Cultural Resources

Under all alternatives, incidental loss of or damage could occur to cultural resources, including those of significance to the Osage Nation and interested Tribes. Required compliance with the provisions of the NHPA, specifically Section 106 (36 CFR Part 800), would minimize and mitigate impacts. The BIA would consult with the THPO, interested Tribes, and other interested parties.

ES.8.5 Socioeconomics and Environmental Justice

Oil and gas operations in Osage County will continue to provide employment and income. Only gradual changes are expected in employment levels and area population as a result of oil and gas development; therefore, population change or strain on public services and housing are likely minimal. Under all alternatives, due to the lack of significant disproportionate adverse impacts on low-income or minority populations, environmental justice impacts from proposed management would be negligible at the county level.

Chapter 1.
Introduction and Purpose and Need

1.1 INTRODUCTION

The BIA Eastern Oklahoma Regional Office is preparing an EIS under NEPA. The BIA will use this EIS to guide the management of oil and gas resources held in trust by the United States for the benefit of the Osage Nation in Osage County, Oklahoma. The EIS is a programmatic document that will allow the BIA to streamline the NEPA review process by replacing the existing Leasing and Workover PEAs with a single NEPA document that provides comprehensive impacts analysis and reducing the size and cost of site-specific EAs.

In 1872, Congress established a reservation for the Osage Nation in what is now Oklahoma. Upon statehood, Oklahoma was divided into 56 districts, and the Osage Indian Reservation became Osage County, Oklahoma. Congress enacted the 1906 Act, providing for the disposition of the Osage Nation's lands to its members. The 1906 Act, as amended, severed the Osage Mineral Estate from the surface estate, reserving all mineral rights to the Osage Nation, in perpetuity. Accordingly, Osage County is a "split-estate," with separate surface and mineral ownership.

The 1906 Act required that royalty income derived from the Osage Mineral Estate be distributed to Osage headright holders on a quarterly, pro rata basis. Under the 1906 Act, the Osage Nation is authorized to lease the Osage Mineral Estate for oil and gas exploration and development with the approval of the Secretary of the Interior and subject to such rules and regulations as the Secretary may prescribe.

The Secretary delegated the authority for management of the Osage Mineral Estate to the Superintendent of the BIA Osage Agency. In addition to managing oil and gas mining, the Superintendent manages all other mining of the Osage Mineral Estate, including, but not limited to, the mining of sandstone, gravel, clay, sand, and limestone. The BIA's regulations governing oil and gas mining are set forth in 25 CFR Part 226, and those governing all other mining are set forth in 25 CFR Part 214.

This EIS analyzes impacts on both the surface estate and subsurface mineral estate in the planning area and examines four alternatives (including the No Action Alternative) for the BIA's management of oil and gas development.

1.2 PROJECT BACKGROUND

In July 2013, the BLM, Oklahoma Field Office, published a Notice of Intent (NOI) to work with the BIA to prepare the OKT Joint EIS, BLM RMP/BIA IRMP. Osage County is within the planning area for this project; however, the BIA is the sole federal agency with authority over managing the subsurface mineral estate in Osage County. This is unlike management in the rest of the planning area, where the BLM and BIA share authority.

When scoping for the OKT Joint EIS/BLM RMP/BIA IRMP began, the BLM and BIA contemplated analyzing the Osage oil and gas leasing program; however, in response to issues raised during internal and external scoping for these projects, and at the request of the Osage Minerals Council, the BIA determined that NEPA analysis of the Osage oil and gas leasing program needed to be expedited. Accordingly, the two agencies decided that the Osage County Oil and Gas EIS would be removed from the OKT Joint EIS/BLM RMP/BIA IRMP; instead, it would be prepared as a separate document.

The scope of the Osage County Oil and Gas EIS is limited to the impacts of oil and gas leasing and development in Osage County. The BIA addressed Osage County planning issues that are not related to oil and gas leasing and development in the Oklahoma, Kansas, and Texas (OKT) Joint EIS/Bureau of Land Management (BLM) Resource Management Plan (RMP)/BIA Integrated Resource Management Plan (IRMP).

In November 2015, the BIA published the Osage County Oil and Gas Draft EIS. Following the public comment period, the BIA determined that the 2015 Draft EIS should be revised in order to address comments received and to take additional information into consideration. On April 11, 2016, the BIA published the NOI to revise the 2015 Draft EIS. The agency held one additional public scoping meeting in Pawhuska, Oklahoma, on April 28, 2016.

With the help of the Indian Energy Service Center, the BIA has prepared an RFD for the planning area. For the RFD, the BIA uses a data-driven approach to project future development of oil and gas resources in Osage County under the various alternatives. The complete RFD can be found in **Appendix A**, Reasonably Foreseeable Development Scenario.

1.3 Purpose of and Need for the BIA Action

The 1906 Act, as amended, reserved all rights to the Osage Mineral Estate to the Osage Nation. Pursuant to the 1906 Act, the Osage Mineral Estate is held in trust by the United States for the benefit of the Osage Nation. All leases, applications for permits to drill (APDs), and other site-specific permit applications in Osage County are approved under the authority of the 1906 Act, as amended, and 25 CFR Part 226, Leasing of Osage Reservation Lands for Oil and Gas Mining.

The purpose of the BIA's action is to promote leasing and development of the Osage Mineral Estate in the best interest of the Osage Nation pursuant to the 1906 Act, as amended, balancing resource conservation and maximization of oil and gas production in the long term. In addition, the BIA is required, under more generally applicable statutes, to include in the best interest calculation, protection of the environment in Osage County in order to enhance conservation of resources and protection of the health and safety of the Osage people. Based on those considerations, the BIA's action will promote the maximization of oil and gas production from the Osage Mineral Estate in a manner that is economic, efficient, and safe; prevents pollution; and is consistent with the mandates of federal law.

The federal actions analyzed in the EIS are the approval of leases, drilling permits, and workover permits. The BIA needs this EIS in order to fulfill its trust responsibility under the 1906 Act to administer leasing and development of the Osage Mineral Estate. In the Hayes I litigation, the U.S. District Court for the Northern District of Oklahoma ruled that the 1979 EA was no longer valid. Accordingly, the BIA may not rely on the 1979 EA to review and approve oil and gas leases and permits. The BIA's current NEPA review process utilizes three separate NEPA documents – the Leasing PEA, Workover PEA, and site-specific EAs. This EIS will supersede the Leasing and Workover PEAs, streamline the NEPA review process by having one programmatic NEPA document covering all oil and gas development activities that do not require new ground-disturbance, provide comprehensive impacts analysis, and reduce the size and cost of site-specific EAs. This EIS will allow the BIA to streamline the NEPA review process by: (1) replacing the Leasing and Workover PEAs with a single, programmatic NEPA document that covers all oil and gas leasing and development activities that do not require new ground disturbance; and (2) reducing the size and cost of site-specific EAs for activities requiring new ground-disturbance by providing comprehensive impacts analysis they can tier to. The efficiencies gained by streamlining the NEPA review process will expedite lease and permit processing.

1.4 EIS Framework

This EIS is prepared in accordance with NEPA and in compliance with the Council on Environmental Quality (CEQ) regulations, 40 CFR Parts 1500–1508, the US DOI regulations implementing NEPA, 40 CFR Part 36, and the guidelines set forth in the Indian Affairs NEPA Guidebook, 59 Indian Affairs Manual 3-H (BIA 2012). The BIA is the lead federal agency tasked with preparing the EIS. It fulfills the BIA's

NEPA obligations with respect to the approval of leases, workovers, and plugging permits for the Osage Mineral Estate.[1]

1.5 DECISION TO BE MADE

This EIS evaluates four alternatives: the Alternative 1 (No Action), Emphasize Oil and Gas Development (Alternative 2), Hybrid Development (Alternative 3), and Enhanced Resource Protection (Alternative 4). The locations of well pads, roads, pipelines, and other facilities associated with future drilling and permitted activities under these alternatives are unknown. Accordingly, this EIS is programmatic, providing a comprehensive NEPA analysis of the planning area.

The ROD for this EIS will approve a plan for Osage Mineral Estate development. Under the ROD, one of the above alternatives or a combination of the alternatives could be approved; however, the ROD would not be the final approval for all actions associated with this EIS.

Prior to commencing drilling or workover operations requiring new ground disturbance, lessees must submit an APD and obtain the Superintendent's approval of it. Upon receipt of an APD, the BIA must conduct a site-specific environmental review of the areas proposed for new surface disturbance and/or subsurface mineral extraction. Such site-specific environmental review includes an on-site inspection of the proposed locations for well pads, roads, pipelines, and other facilities. The BIA must document its NEPA compliance by completing a site-specific EA that is tiered to this EIS, a determination of NEPA adequacy, or another type of appropriate review. The CEQ regulations implementing NEPA encourage tiering, which is the process of referencing information presented in other NEPA documents, such as an EIS, to promote efficiency and minimize repetition.

Figure 1-1 and **Figure 1-2**, in **Appendix E**, show the current leasing process and the streamlined process enabled by this EIS. Significant staff time would be saved by tiering future NEPA analysis to this EIS.

1.6 DESCRIPTION OF THE PLANNING AREA

Figure 1-3, Planning Area (in **Appendix E**), represents the area subject to environmental analysis in this EIS. The planning area covers all of the subsurface mineral estate in Osage County, approximately 1,474,500 acres.

Osage County is in northeast Oklahoma, bordering Kansas. The BIA's Eastern Oklahoma Regional Office manages all of the subsurface mineral estate in the county. **Table 1-1**, Planning Area Surface Ownership, and **Figure 1-4**, Surface Administration (in **Appendix E**), show the acreage for each type of surface ownership in the planning area.

[1]Additional NEPA analysis may be needed for workovers involving additional surface disturbance or other impacts beyond the scope of this EIS analysis.

Table 1-1
Planning Area Surface Ownership

Surface Owner/Surface Management Agency	Acres	Percent of Total
Allotted	121,500	8
Private, city, county, or other[1]	1,231,000	83
State	14,500	1
The Nature Conservancy (TNC)	35,200	2
Tribal	1,600	<1
US Army Corps of Engineers (includes water)	70,700	5
Total	**1,474,500**	**100**

Sources: BIA NIOGEMS geographic information system (GIS) 2015; OK GAP GIS 2008
[1] Lands not identified as state, TNC, US Army Corps of Engineers, allotted, or Tribal were included in this category.

1.7 Organization of This EIS

This EIS describes the components of, reasonable alternatives to, and environmental consequences of managing oil and gas resources development in Osage County. Chapters in the EIS are as follows:

- **Chapter 1**, Introduction and Purpose and Need, describes the purpose of and need for action, authorizing actions, and public participation in the EIS process. The BIA collaborated with the Osage Nation, Osage Minerals Council, and other cooperating agencies with jurisdiction or expertise in the county to develop the alternatives.
- **Chapter 2**, Alternatives, describes the alternatives considered for detailed analysis and those considered but eliminated from further analysis.
- **Chapter 3**, Affected Environment, describes the existing social and environmental conditions in the planning area.
- **Chapter 4**, Environmental Consequences, details potential direct and indirect impacts associated with the alternatives. Potential cumulative impacts of the alternatives, as they relate to other projects in the region, are also discussed.
- **Chapter 5**, Consultation and Coordination, lists the state and federal agencies, Tribes, and other entities that the BIA consulted and coordinated with during preparation of this EIS; it also lists authorized users who were notified.

1.8 Public Involvement

Figure 1-5, The BIA EIS Process (in **Appendix E**), illustrates the major steps the BIA is taking in developing this EIS. Throughout the process, the agency is following the public involvement requirements documented in CEQ regulations implementing NEPA (40 CFR Section 1501.7, for scoping and Section 1506.6, for public involvement) and Section 8.3 of the Indian Affairs NEPA Guidebook (59 Indian Affairs Manual 3-H; BIA 2012).

In accordance with BIA and CEQ regulations and guidance, the BIA provided opportunities for meaningful participation in the EIS process, inviting input from the Osage Nation, general public, other federal agencies and bureaus, state and local governments, surface owners, affected Tribes, and other interested groups. Details regarding public and stakeholder involvement are described in **Chapter 5**.

1.9 Relationship to Programs, Policies, and Plans

1.9.1 Federal Laws and Regulations

The BIA's proposed action is analyzed under NEPA and is consistent with federal guidelines for NEPA implementation, including the CEQ regulations set forth in 40 CFR Parts 1500–1508, departmental regulations set forth in 43 CFR Part 36, and the Indian Affairs NEPA Guidebook, 59 Indian Affairs Manual 3-H (BIA 2012).

Under Section 7 of the ESA, the BIA is required to consult with the USFWS when any action the agency carries out, funds, or authorizes may affect a listed endangered or threatened species. If the BIA determines that its action is likely to adversely affect a listed species, it must formally consult with the USFWS. Formal consultation may result in the BIA adopting reasonable and prudent measures recommended by the USFWS in order to implement the proposed action.

Section 106 of the NHPA as implemented at 36 CFR Part 800, requires the BIA to take into account the impacts of its undertakings on historic properties; it must afford the Advisory Council on Historic Preservation and any applicable SHPO, THPO, and interested Tribes, reasonable opportunity to comment. Consultation under Section 106 may result in a memorandum that outlines agreed on measures that the BIA will take to avoid, minimize, or mitigate any adverse impacts on identified historic properties.

1.9.2 Related Land Use Plans

This EIS is not in conflict with any federal, local, county, or state laws or plans. The analysis in this EIS will replace the analyses in the 1979 EA, the Leasing PEA, and the Workover PEA (BIA 1979, 2014, and 2015a). Other relevant land use plans considered during development of the EIS are listed below.

Other Federal Plans

Osage County is in the planning area for the OKT Joint EIS/BLM RMP/BIA IRMP. That document covers all lands and minerals administered by the BLM and all Tribal and restricted lands and minerals administered by the BIA in Oklahoma, Kansas, and Texas, with the exception of oil and gas resources in Osage County. The draft OKT Joint EIS/BLM RMP/BIA IRMP was published in November 2018.

The following federal plans were also considered during the Draft EIS development:

- Lakeshore Management Plan, Hulah Lake, Oklahoma and Kansas (USACE 1996)
- Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the American Burying Beetle in Oklahoma (USFWS 2014a)

Local Government Plans

The local government plan considered during the Draft EIS development was the 2030 Osage County Comprehensive Plan (Osage County 2011).

This page intentionally left blank.

Chapter 2. Alternatives

2.1 Introduction

This chapter describes the alternatives considered in this EIS for oil and gas development in Osage County. In addition, it compares in detail the alternatives, as presented in **Table 2-1**, Alternatives Summary, and **Table 2-3**, Summary Comparison of Conditions of Approval.

2.2 Alternatives Development

The alternatives section is the heart of the EIS. The CEQ regulations implementing NEPA require that federal agencies explore and evaluate all reasonable alternatives that meet the purpose of and need for the Proposed Action (**Section 1.3**, Purpose of and Need for the BIA Action; 40 CFR Section 1502.14).

In the alternatives, the preparers evaluate a reasonable range of management scenarios that cover the full spectrum of issues to be considered and compared. Alternatives analyzed in detail by the BIA in the EIS must be rigorously explored and objectively evaluated. The BIA must also identify any alternatives that were considered but eliminated from detailed analysis in the EIS, briefly discussing the basis for such elimination.

The alternatives development process for this EIS included two public scoping periods, alternatives development workshops (both internally in the BIA and with cooperating agencies), and two public listening sessions to present draft alternatives concepts and receive public feedback thereon. See **Chapter 1**, **Section 1.8**, Scoping, Public Involvement, and Relevant Issues Identified, for a description of these processes. The alternatives development process for the 2015 Draft EIS included public scoping, an alternatives development workshop, and a draft alternatives concepts public listening session. However, this chapter focuses on the alternatives developed subsequent to the second scoping period for this EIS.

The BIA held five workshops between August 2016 and February 2017 with cooperating agencies, including the Osage Nation and Osage Minerals Council, to develop the alternatives presented in this chapter. Based on public scoping and the alternatives development workshops, the BIA and cooperating agencies developed preliminary draft alternatives.

The agency presented these concepts in a newsletter, which was emailed to those on the project mailing list on March 29, 2017. A public listening session was held on April 6, 2017, in Pawhuska, Oklahoma. It was advertised in the newsletter and in the following newspapers: *Fairfax Chief*, *Hominy News Progress*, *Pawhuska Journal Capital*, *Tulsa World*, *The Bigheart Times*, *Skiatook Journal*, and *Barnsdall Times*.

During the April 6 listening session, the BIA presented background information on the EIS process, explained the alternatives development process, presented the preliminary draft alternatives, and offered the public the opportunity to provide spoken comments. Written comments on the alternatives were accepted until May 8, 2017.

Based on the public input, the BIA refined the preliminary draft alternatives into the alternatives presented in this chapter. These are a range of reasonable alternatives for implementing the proposed action. They are evaluated in **Chapter 4**, Environmental Consequences, in accordance with the CEQ regulations set forth in 40 CFR Parts 1500–1508.

The BIA has not yet selected a preferred alternative. The BIA will identify a preferred alternative in the Final EIS based on its consideration of the range of alternatives and the input received during the public comment period on the Draft EIS.

2.3 Alternatives Considered for Detailed Analysis

This EIS analyzes four alternatives for managing oil and gas development in Osage County, including the No Action Alternative. These alternatives represent the range of reasonable actions that could be taken to satisfy the purpose of and need for the BIA's action. The objective of the alternatives is, to the extent possible, to promote oil and gas development while avoiding or minimizing potential adverse impacts on surface owners, wildlife, and natural and cultural resources from noise, traffic, excavation, dust, and other disturbances associated with construction and operations under oil and gas leases.

For purposes of the alternatives, the term lessee means any person, corporation, or entity that has entered into an oil or gas lease in Osage County and any authorized representative thereof, including employees and operators.

Table 2-1, Alternatives Summary, compares the alternatives presented in this chapter. The areas available for development vary under each alternative, as do the standards for lease and permit approval and methods of compliance with the ESA and NHPA. In particular, with respect to drilling and workover permit approvals, the alternatives apply varied COAs, as summarized in **Table 2-3**.

Table 2-1
Alternatives Summary

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development—High- and Low-Density Development Sections	Alternative 4—Enhanced Resource Protection
Leases	New Programmatic EIS: BMPs from the Leasing PEA (BIA 2014) The lessee would be required to comply with COAs, attached to approved permits, during oil and gas operations.	New Programmatic EIS: new BMPs provided at time of lease approval BMPs would be recommended general standards, intended to lessen the impacts of oil and gas development on the environment (e.g., prevention of erosion) but would not dictate specific measures to be taken. If the measures the lessee takes to follow a BMP are insufficient to address the intent of that BMP, then interim mitigation measures may be required. Limited COAs attached to approved permits: COAs would be conditions the lessee is required to comply with during oil and gas operations.	New Programmatic EIS: new BMPs provided at time of lease approval for leases in high-density sections. BMPs would be recommended general standards, intended to lessen the impacts of oil and gas development on the environment (e.g., prevention of erosion) but would not dictate specific measures to be taken. If the measures the lessee takes to follow a BMP are insufficient to address the intent of that BMP, interim mitigation measures may be required. COAs attached to approved permits: the lessee would be required to comply with COAs during oil and gas operations. In low-density sections, there would be additional protective	New Programmatic EIS: The lessee would be required to comply with COAs, attached to approved permits, during oil and gas operations. There would be additional protective COAs for cultural and environmental resources.

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development—High- and Low-Density Development Sections	Alternative 4—Enhanced Resource Protection
			COAs for cultural and environmental resources.	
Workover Approvals	New Programmatic EIS: BMPs from the Workover PEA (BIA 2015a) as enforceable COAs.	New Programmatic EIS	New Programmatic EIS: additional protective COAs for sensitive cultural and environmental resources in low-density development sections	New Programmatic EIS: additional protective COAs for sensitive cultural and environmental resources
Drilling Permits	New Programmatic EIS: tiered EAs	New Programmatic EIS: tiered EAs	New Programmatic EIS: tiered EAs; implement spacing requirements, limiting well pad density in low-density sections. The BIA would not approve permits for new ground-disturbing activities in the following areas: • Municipalities • Sensitive water supplies (designated in Appendix A of the federally approved Oklahoma Water Quality Standards [Oklahoma Administrative Code 785:45]) • Public water supply wells and wellhead protection areas (defined by the Oklahoma Department	New Programmatic EIS: tiered EAs; implement spacing requirements, limiting well pad density. The BIA would not approve permits for new ground-disturbing activities in the following areas: • Tallgrass Prairie Preserve • State parks • State wildlife management areas (WMAs) • US Army Corps of Engineers lakes • Municipalities • Sensitive water supplies (designated in Appendix A of the

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development—High- and Low-Density Development Sections	Alternative 4—Enhanced Resource Protection
			of Environmental Quality) • Areas of Class I Special Source Groundwater or areas designated as high vulnerability by the Oklahoma Water Resources Board	federally approved Oklahoma Water Quality Standards [Oklahoma Administrative Code 785:45]) • Public water supply wells and wellhead protection areas (defined by the Oklahoma Department of Environmental Quality) • Areas of Class I Special Source Groundwater or areas designated as high vulnerability by the Oklahoma Water Resources Board • BLM wild horse and burrow pasture facilities

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development—High- and Low-Density Development Sections	Alternative 4—Enhanced Resource Protection
General COAs	Include all standard BMPs as COAs; add special conditions if necessary, based on site-specific EA	Minimize or waive most BMPs and COAs	For high-density sections, apply same COAs as under Alternative 2; for low-density sections, apply same COAs as under Alternative 4; reevaluate applicable COAs if the density of wells in a section changes	Same as Alternative 1 (No Action), plus additional protective COAs for sensitive areas and cultural and environmental resources
ESA	For American Burying Beetle (ABB) compliance, the BIA has prepared a BA, and the USFWS has issued a BO describing the total amount of acreage in the county where incidental take of ABB can occur. The BIA would allow activities to proceed without a 45-day wait period where the ABB survey is negative, as long as appropriate COAs are applied. For other threatened and endangered species, the BA and the concurrence letter issued by the USFWS establish parameters for improved efficiency of BIA consultation on other threatened and endangered species with preliminary	Without the appropriate COAs identified in the current BA, the BIA would likely need to revise the BA and reinitiate formal consultation under Section 7 of the ESA for ABB compliance. Until the new BO is issued, lessees would be solely responsible for documenting compliance under Section 10 of the ESA. Where the ABB survey is negative, activities could proceed without a 45-day wait period only where the BIA can justify a "no effect" determination. For other threatened and endangered species, there would be no agreed on parameters for consultation. The BA would be revised, and	Request new BO that incorporates the hybrid approach. Without the appropriate COAs identified in the current BA, the BIA may need to revise the BA and to reinitiate formal consultation under Section 7 of the ESA for ABB compliance. Until the new BO is issued, lessees may be solely responsible for documenting compliance under Section 10 of the ESA. Where the ABB survey is negative, activities could proceed without a 45-day wait period only where the BIA could justify a "no effect" determination.	Same as Alternative 1 (No Action)

Alternatives Component	Alternative 1—No Action	Alternative 2—Emphasize Oil and Gas Development	Alternative 3—Hybrid Development—High- and Low-Density Development Sections	Alternative 4—Enhanced Resource Protection
	determinations of "no effect" or "may affect/not likely to affect."	informal consultation would be reinitiated.	For other threatened and endangered species, there would be no agreed on parameters for consultation on other threatened and endangered species. The BA would be revised, and informal consultation would be reinitiated.	
NHPA	Standard NHPA procedures apply. Add special COAs if necessary, based on site-specific EA.	Same as Alternative 1 (No Action)	Same as Alternative 1 (No Action), plus apply buffers around identified cultural sites; additional COAs would be applied. Ensure compliance with Section 106 of the NHPA on a case-by-case basis.	Same as Alternative 3

2.3.1 Management Common to All Alternatives

Under all alternatives, lessees must comply with and obtain any necessary permits or authorizations required under federal laws, such as the CWA, CAA, Safe Drinking Water Act of 1974, the ESA, and the NHPA.

Additionally, lessees must comply with all requirements set forth in 25 CFR Part 226 and any instructions, orders, or NTLs issued by the BIA Osage Agency Superintendent. The Superintendent may issue such instructions, orders, or NTLs to, for example, provide interpretation or clarification on the practices, procedures, and requirements necessary to comply with the regulations.

This EIS does not list the exact set of COAs that would be applied to each permit under an alternative. Under all alternatives, the BIA may waive COAs or apply additional COAs based on site-specific determinations. The alternatives analyzed were based on the version of 25 CFR Part 226 in effect at the time of publication of this Draft EIS. In the event that the regulations are revised or amended following publication of the EIS, should any COAs, BMPs, or mitigation measures identified in the EIS conflict with the regulations, the regulations will take precedence. Similarly, if a species in Osage County is added to or removed from the lists of threatened and endangered species under the ESA, this EIS would be updated or supplemented.

Under all alternatives, the EIS will supersede the existing Leasing and Workover PEAs and become the basis for the BIA's NEPA review for the activities and operations analyzed therein. The BIA may, however, require the preparation of a site-specific EA for any leasing or workover activities if it determines, in its discretion, that circumstances warranting site-specific analysis exist. The BIA would be able to incorporate this EIS by reference into site-specific EAs for drilling, leasing, or workover activities, as applicable. Incorporation of this EIS by reference in future site-specific EAs would greatly reduce the time and workload required to prepare the assessment as well as the length of the final document. For example, the description of existing conditions in a site-specific EA could simply refer back to the Affected Environment chapter of this EIS, resulting in a significant reduction in the number of pages in the site-specific EA and the amount of work required to address existing conditions. Analyzed under all alternatives are COAs 1, 2, 7, 12, 18, 23, 25, 26, and 27 (see **Table 2-3**, Summary Comparison of Conditions of Approval, for full text of COAs).

2.3.2 Alternative 1—No Action

In accordance with 40 CFR Section 1502.14(d) and the Indian Affairs NEPA Guidebook (59 Indian Affairs Manual 3-H; BIA 2012), the BIA is required to consider the No Action Alternative as part of the reasonable range of alternatives in the EIS. The No Action Alternative may be thought of in terms of there being no change from current management. This is the only alternative in the EIS that is not required to conform to the purpose of and need for the BIA's action. The

No Action Alternative continues the current Osage oil and gas program without modifying the management direction or practices.

Under Alternative 1 (No Action), the BIA would continue to administer oil and gas leasing and workover activities in Osage County, in accordance with the measures outlined in the Leasing PEA and Workover PEA. The mitigation measures contained in these PEAs would be incorporated into the EIS. Alternative 1 (No Action) would continue present management direction. The BIA would continue approving permits for new ground-disturbing activities anywhere in Osage County and applying COAs based on the Osage Agency's standard list. A Determination of NEPA Adequacy or other appropriate NEPA process would continue being used to document NEPA review. This alternative would allow for the potential permitting of an estimated 4,761 new wells by 2037.

As discussed in **Section 1.3**, Purpose of and Need for the BIA Action, this EIS will supersede the existing Leasing and Workover PEAs and will be considered the NEPA review for all leasing and workover actions. This EIS will expedite the NEPA review process by providing a single, comprehensive analysis of the impacts associated with development of the Osage Mineral Estate.

In accordance with the BIA's current policies and practices, the approval of oil and gas operations would be based on site-specific EAs if the operations are outside the scope of the activities previously covered by the Leasing and Workover PEAs or if they involve ground-disturbing activities. Such EAs would be tiered to the analysis in this EIS. In addition, the BIA would apply BMPs from the standardized lists included in the PEAs as COAs for those activities, as appropriate.

If the No Action Alternative is selected, the efficiency and effectiveness of agency processes involved in the management of the oil and gas development program (such as permitting) may or may not improve over time. Agency resource allocation would continue as is, unless change is prompted by other factors.

The No Action Alternative is analyzed in detail to provide a baseline against which the other alternatives are evaluated, in accordance with CEQ guidance.

National Historic Preservation Act and Clean Water Act Compliance

The BIA would impose permit conditions according to the requirements of 25 CFR Part 226 and applicable laws, such as the CWA and Section 106 of the NHPA. It would do this on a case-by-case basis, prior to APD approval, and standard NHPA procedures, as implemented at 36 CFR Part 800, would apply. The BIA would consult with the Osage Nation THPO, other interested Tribes, and other parties, as appropriate, and may add special COAs, based on a site-specific EA.

Endangered Species Act Compliance

The BIA prepared a BA, based on the current Osage oil and gas program described above in this No Action alternative. The BA assesses all threatened and endangered species in the planning area, including the ABB. The USFWS issued a BO and letter of concurrence based on the BA. The BO identifies measures required for complying with the ESA at the time of lease application.

For ABB compliance, the BO describes the total amount of acreage in the county where incidental take of ABB can occur. The BIA would track the total incidental take acreage remaining, as leases are developed. Lessees would work with the BIA, using a simplified process to document ESA compliance.

Minimization and mitigation measures from the Oil and Gas Industry Conservation Plan (USFWS 2014a) for the ABB are proposed in the BA, and the BO discusses these measures and additional minimization and mitigation measures. The measures outlined in these documents would be applied as COAs to covered activities in areas with a positive ABB survey or presumed ABB presence. The measures in the BA and BO based on the Industry Conservation Plan would continue to apply, regardless of the status of the plan itself. Where the pre-development ABB survey is negative, the BIA would allow activities to proceed without a 45-day waiting period, as long as appropriate COAs are applied.

For other threatened and endangered species, the concurrence letter issued by the USFWS approves the minimization and mitigation measures outlined in the BA and allows for improved efficiency of BIA consultation for preliminary determinations of "no effect" or "may affect/not likely to affect."

Conditions of Approval

In addition to the COAs analyzed under all alternatives (COAs 1, 2, 7, 12, 18, 23, 25, 26, and 27), the following COAs are analyzed under Alternative 1 (No Action): 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15, 16, 17, 19, 20, 21, 22, and 24 (see **Table 2-3** for full text of COAs).

2.3.3 Alternative 2—Emphasize Oil and Gas Development

Alternative 2 emphasizes oil and gas development, allowing for the potential permitting of an estimated 4,761 new wells by 2037. Under this alternative, the BIA would publish a list of BMPs for all operations on leases in Osage County; however, it would not prescribe specific actions that lessees must take in order to comply with the BMPs. (Specific actions may still be required at the site-specific level.) In addition, the BIA would waive many of the COAs for drilling and workover operations.

The BIA would issue drilling permits, tiered to the analysis in this EIS, based on site-specific EAs.

Under Alternative 2, some BMPs that would usually be applied as COAs under the No Action Alternative would not be included as COAs for drilling and workover permit approvals. The BIA would waive COAs that restate requirements of federal laws implemented by agencies other than the BIA, for example, under the ESA.

Pending site-specific analysis, the BIA would also waive most COAs prescribing specific actions or methods that must be used in order to comply with applicable laws and regulations. Lessees would be required to comply with such laws and regulations, but the means used would be the decision of the lessee.

Endangered Species Act Compliance

Alternative 2 measures may improve the efficiency of the NEPA and permitting processes; however, they may delay a BO under the ESA and require allocation of more agency resources for compliance. For ESA compliance, without the appropriate COAs identified in the current BA, the BIA would likely need to revise the BA and reinitiate formal consultation under Section 7 of the ESA for ABB compliance. Until the new BO is issued, lessees would be solely responsible for documenting compliance under Section 10 of the ESA. Activities could not proceed until a 45-day wait period had elapsed, unless there is no suitable habitat and the BIA is willing to make a "no effect" determination for the ABB.

There would be no agreed on parameters for consultation on other threatened and endangered species. The BA would be revised, and informal consultation would be reinitiated.

National Historic Preservation Act Compliance

The BIA would ensure compliance with the regulations of the NHPA as implemented at 36 CFR Part 800, on a case-by-case basis, in consultation with the THPO, interested Tribes, and other parties, as appropriate. Special buffers or protections necessary for historic or cultural resources would be determined, based on individual site conditions. For this reason, there is greater uncertainty in the buffers that would be applied when compared with Alternatives 3 and 4, which have standardized buffers.

Conditions of Approval

In addition to the COAs analyzed under all alternatives (COAs 1, 2, 7, 12, 18, 23, 25, 26, and 27), COAs 28 and 31 are analyzed under Alternative 2. See **Table 2-3**, Summary Comparison of Conditions of Approval, for full text of COAs.

2.3.4 Alternative 3—Hybrid Development of High- and Low-Density Development Sections

Alternative 3 represents a hybrid approach to the alternatives; it blends concepts of Alternatives 2 and 4 while allowing for the potential permitting of an estimated 4,011 new wells by 2037. COAs would be applied based on the density of wells in a Public Land Survey System section. The Public Land Survey System is a way of subdividing and describing lands; it divides them into sections, townships, and ranges. A section is an area of one square mile (640 acres). Under Alternative 3, fewer COAs would be applied in high-density sections where there is more historical oil and gas development; more COAs would be applied in low-density sections, where there is little historical oil and gas development. This would be done to protect resource values in these more pristine areas.

High-density sections are defined as those in which 17 or more total wells have been drilled; low-density sections are those in which fewer than 17 total wells have been drilled. **Figure 2-1**, Alternative 3 – Well Density (in **Appendix E**), shows high- and low-density sections in Osage County by section. In high-density sections, the BIA would apply the same COAs described under Alternative 2. In low-density sections, the BIA would apply additional protective COAs, as described below. In sections where drilling additional wells changes the section from low to high density, existing wells would continue to be managed according to low-density management, and new wells would be managed according to high-density management.

This hybrid approach to the application of COAs acknowledges that different conditions may be applied in areas of the county where there is significant historic development that is already part of the setting, versus areas with less historic development that have maintained a more pristine and pastoral setting.

Regardless of the density of wells, the BIA would not approve permits for new ground-disturbing activities in the sensitive areas listed below (shown in **Figure 2-2**, Alternative 3 - New Drilling Not Permitted [in **Appendix E**]).

- Municipalities
- Sensitive water supplies (designated in Appendix A of the federally approved Oklahoma Water Quality Standards [Oklahoma Administrative Code 785:45])
- Public water supply wells and wellhead protection areas (defined by the Oklahoma Department of Environmental Quality)
- Areas of Class I Special Source Groundwater or areas designated as high vulnerability by the Oklahoma Water Resources Board

Additional COAs may be applied to development on lands enrolled in federal conservation programs, such as the US Department of Agriculture Natural Resource Conservation Service (NRCS) Wetlands Reserve Program, consistent with the protection of the relevant resources. The BIA may also apply additional COAs to protect resources, including sensitive areas, based on site-specific determinations.

Figure 2-1, Alternative 3 - Well Density (in **Appendix E**), shows low-density sections and high-density sections, and highlights areas where the BIA would not approve permits for new ground-disturbing activities.

For drilling permit applications and other activities requiring BIA approval, this EIS would provide a county-wide framework that site-specific NEPA analyses could be tiered to. Low-density sections would have spacing requirements to regulate well density.

Endangered Species Act Compliance

Under this alternative, the BIA may be required to submit a new or revised BA to the USFWS. This would be to reinitiate formal consultation regarding all threatened and endangered species potentially found in Osage County. The new BA and resulting BO would incorporate the hybrid COA approach. During formal consultation, lessees may be solely responsible for documenting compliance under Section 10 of the ESA prior to drilling. Where the pre-development ABB survey is negative, activities could proceed without a 45-day wait period only when the BIA could justify a "no effect" determination.

For other threatened and endangered species, there would be no agreed upon parameters for consultation. The BIA would revise the BA and would reinitiate informal consultations with the USFWS.

National Historic Preservation Act Compliance

Under Alternative 3, in addition to standard NHPA procedures, the BIA would apply buffers around identified cultural sites in low-density sections. **Table 2-2**, Cultural Site Buffers, describes the distance that any surface disturbance on an oil and gas lease would have to be from cultural sites. In high-density sections, the BIA would determine buffers on a case-by-case basis, in consultation with the THPO, interested Tribes, and appropriate other parties. The BIA may apply additional COAs, if necessary, based on a site-specific EA and otherwise would ensure compliance with Section 106 of the NHPA on a case-by-case basis.

Conditions of Approval

In addition to the COAs analyzed under all alternatives—COAs 1, 2, 7, 12, 18, 23, 25, 26, and 27—the following are analyzed under Alternative 3 (see **Table 2-3** for full text of COAs): COAs 3 through 6, COAs 8 through 11, COAs 13 through 17, COAs 19 and 20, COA 22, COA 24, COAs 29 and 30, and COAs 32 through 35, all of which would apply in low-density sections only; COAs 21, 28, and 31, which would apply to both low- and high-density sections; Although COAs 19 and 21, would apply to low-density sections only, in high-density sections, lessees would still be required to comply with the ESA and CWA. However, the BIA would not apply specific COAs dictating the manner in which they comply.

Table 2-2
Cultural Site Buffers

Site Type	Buffer	Reason
Camps and villages (prehistoric and historic)	Minimum buffer zone of 160 feet around waterbodies: The buffer would be extended up to 500 feet in the presence of higher ground near undulating streams.	This site type is frequently close to water sources, such as creeks. The cultural resources are often buried and are frequently found within 160 feet of the water's edge. Sites can extend 500 to 650 feet, particularly in the presence of ridges, terraces, knolls, and other areas of higher ground; some areas exhibiting erosion have deeply buried deposits.
Graves, rock cairns, and cemeteries (prehistoric and historic)	For graves, rock cairns, and family plots, a minimum 330-foot buffer zone; for cemeteries, a minimum 160-foot buffer zone	Buffer zones are required for all graves, family plots, and cemeteries. Historic cemeteries are often close to roads, in which case, buffer zones of this width may not be possible.
Historic bridges and other structures, such as barns	No buffer is required, unless the site is eligible for listing or is listed on the National Register of Historic Places. In that case, the BIA would determine buffer size, in consultation with the SHPO and Osage Nation THPO.	This would be primarily a potential impact on visual setting, but there could be a direct or cumulative impact on the site as well. The need for a buffer would be specific to the site and undertaking.
Historic farmsteads or building complexes	No buffer would be required, unless the site is eligible for listing on or is listed on the National Register of Historic Places or if the household is occupied. In that case, the BIA would determine the buffer size, in consultation with the SHPO, the Osage Nation THPO, and the resident of the building.	This is primarily a potential impact on visual setting, but there could be a direct or cumulative impact on the site as well. The need for a buffer would be specific to the site and undertaking.
Lithic scatter	No buffer required	N/A
Native American churches	Minimum 650 feet	Frequently near other sites, these should have a larger buffer zone than the minimum for graves, particularly for oil wells and access or high-traffic roads; this is because such activities in these areas will have auditory and visual impacts on cultural practices.
Rock art	Minimum 650 feet	Frequently near other sites, these should have a larger buffer zone than the minimum for graves, particularly for oil wells and access or high-traffic roads; this is because such activities in these areas will have auditory and visual impacts on cultural practices.
Rock shelters and caves	Minimum 330 feet	These have the potential to be associated with other sites.

Site Type	Buffer	Reason
Traditional cultural properties	Minimum 650 feet	Frequently near other sites, these should have a larger buffer zone than the minimum for graves, particularly for oil wells and access or high-traffic roads; this is because such activities in these areas will have auditory and visual impacts on cultural practices.
Trails	Minimum 160 feet	Until the Osage Nation THPO for the Osage Indian Trail creates a GIS predictive model, the need for a buffer zone larger than 160 feet would be specific to the location and undertaking; however, proposed buffer zones around waterways should provide sufficient protection for most trails.
Waterways and springs	Minimum 160 feet from the edge of the ordinary high water mark or water source	Most of the site types discussed are close to waterways or springs; sites on sand and gravel bars would also be protected by this buffer.

Note: All site buffers were developed in consultation with the Osage Nation.

The lessee would also be required to comply with site-specific conditions designed to protect listed sensitive areas, where appropriate and necessary, to protect the values associated with the type of sensitive area that may be affected. Examples of site-specific conditions include the following:

- Revegetate with native tallgrass seed in the Tallgrass Prairie
- Confine activities to locations outside of designated state park picnic or camping areas
- Restrict wildlife from accessing any area of contamination until it is appropriately remediated
- Comply with established infrastructure setbacks at US Army Corps of Engineers lakes and conduct activities outside of established picnic, playground, and camping areas
- Observe reasonable setbacks requested by municipalities
- Allow no surface waste pits or disposal near a public water supply well
- Create an emergency plan to supply drinking water in the event that a sensitive public water supply is contaminated by a lessee's activities

2.3.5 Alternative 4—Enhanced Resource Protection

Alternative 4 emphasizes resource protection by adding additional COAs that could apply throughout the planning area, including in sensitive areas. This alternative would allow for the potential permitting of an estimated 3,095 new wells by 2037. The BIA would issue permits based on site-specific NEPA analysis tiered to the analysis in this EIS.

All applicable BMPs from the BIA's current standardized lists would be enforceable as COAs in permits and approvals; moreover, additional protective measures for sensitive cultural and environmental resources would apply. Spacing requirements would apply, so as to limit well density. Alternative 4 would provide clear guidelines and more certainty to lessees to adequately comply with applicable laws and regulations.

The BIA would not approve permits for new ground-disturbing activities in the sensitive areas listed below (shown in **Figure 2-3**, Alternative 4 - New Drilling Not Permitted [in **Appendix E**]).

- Tallgrass Prairie Preserve
- State parks
- State WMAs
- US Army Corps of Engineers lakes
- Municipalities
- Sensitive water supplies (designated in Appendix A of the federally approved Oklahoma Water Quality Standards [Oklahoma Administrative Code 785:45])
- Public water supply wells and wellhead protection areas (defined by the Oklahoma Department of Environmental Quality)
- Areas of Class I Special Source Groundwater or areas designated as high vulnerability by the Oklahoma Water Resources Board
- BLM wild horse and burrow pasture facilities

Additional COAs may be applied to development on lands enrolled in federal conservation programs, such as the NRCS Wetlands Reserve Program, consistent with the protection of the relevant resources. The BIA may also apply additional COAs to protect resources, including the sensitive areas described in Alternative 3, based on site-specific determinations.

Endangered Species Act Compliance

ESA compliance would be the same as under the No Action Alternative, so no delay would affect the BA or BO.

For ABB compliance, the BIA has prepared a BA. The USFWS would issue a BO describing the total amount of acreage in the county where incidental take of ABB could occur. Where the pre-development ABB survey is negative, the BIA would allow activities to proceed without a 45-day wait period, as long as appropriate COAs are applied.

For other threatened and endangered species, the BO issued by the USFWS would establish parameters for improved efficiency of BIA consultation on other threatened and endangered species, with preliminary "no effect" or "may affect/not likely to affect" determinations.

National Historic Preservation Act Compliance

NHPA compliance and cultural site buffers would be the same as those applied in low-density sections under Alternative 3. The BIA would apply buffers around identified cultural sites. Additionally, pursuant to standard NHPA procedures, cultural sites, would be identified according to the provisions of the NHPA, as implemented at 36 CFR Part 800, and in consultation with the THPO, interested Tribes, and other interested parties. It may apply additional COAs, if necessary, based on a site-specific EA; otherwise, it would ensure compliance with Section 106 of the NHPA on a case-by-case basis. Cultural site buffers are described in **Table 2-2**.

Conditions of Approval

In addition to the COAs analyzed under all alternatives (COAs 1, 2, 7, 12, 18, 23, 25, 26, and 27), the following COAs are analyzed under Alternative 4: 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15, 16, 17, 19, 20, 21, 22, 24, 28, 29, 30, 31, 32, 33, 34, and 35. See **Table 2-3**, Summary Comparison of Conditions of Approval, for the full text of COAs.

The lessee would also be required to comply with site-specific conditions designed to protect listed sensitive areas, where appropriate and necessary, to protect the values associated with the type of sensitive area that may be affected. Examples of site-specific conditions include the following:

- Revegetate with native tallgrass seed in the Tallgrass Prairie
- Confine activities to outside designated state park picnic or camping areas;
- Restrict wildlife from accessing any area of contamination until it is appropriately remediated
- Comply with established infrastructure setbacks at US Army Corps of Engineers lakes and conduct activities outside of established picnic, playground, and camping areas
- Observe reasonable setbacks requested by municipalities
- Allow no surface waste pits or disposal near a public water supply well
- Create an emergency plan to supply drinking water if a sensitive public water supply is contaminated by a lessee's activities

2.4 Summary Comparison of Conditions of Approval

Table 2-3, below, summarizes the different COAs that would apply under each alternative. (The table does not list the exact set of COAs that would be applied to each permit under an alternative.) Under all alternatives, the BIA may waive COAs or apply additional COAs, based on site-specific determinations.

Table 2-3
Summary Comparison of Conditions of Approval[1]

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
1.	Avoid impacts on National Register-eligible or unevaluated cultural resources. If cultural resources or human remains are discovered during construction or operation, stop work immediately, secure the affected site, and notify the BIA and THPO, and, in the case of the unanticipated discovery of human remains, law enforcement. In the event of a discovery, halt work in the approved project area until the BIA has issued a written authorization to proceed (BIA 2014, 2015a, 2017a).	X	X	H L	X
2.	All surface disturbances must be kept within the proposed ground disturbance area described in the approved site-specific EA. Expanding or relocating the well pads and access road or implementing additional activities not approved in the EA for the APD are prohibited, unless an appropriate cultural resources survey has been submitted and is determined to be adequate and approved by the BIA Osage Agency, through consultation with the THPO and other appropriate parties, and all appropriate permits have been obtained (BIA 2014, 2015a, 2017a).	X	X	H L	X
3.	Avoid or minimize soil and vegetation disturbance. Do not remove or damage trees, shrubs, and groundcover, to the extent possible (BIA 2014, 2015a, 2017a).	X		L	X
4.	Avoid or minimize alteration of the natural topography and limit activities on steep slopes (BIA 2014, 2015a, 2017a).	X		L	X
5.	Erosion control measures are required for the duration of the construction, drilling, and completion phases of the project. Such measures must effectively minimize moving soil, debris, or contaminants from the well site to adjacent lands and waterways (BIA 2014, 2015a, 2017a).	X		L	X
6.	All vehicles and equipment operators must stay confined to existing and new roads described in the approved EA for the APD; the exception would be if off-road travel is necessary to respond to a blowout, fire, spill, personal injury, or fatality. All other off-road travel requires the prior approval of the BIA Osage Agency Superintendent. Roads must be maintained and upgraded as needed, according to BIA direction or any agreements between the lessee and surface owners (BIA 2014, 2015a, 2017a).	X		L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
7.	No venting or flaring of gas is allowed unless written approval of the BIA Osage Agency Superintendent has been obtained (BIA 2014, 2015a, 2017a).	X	X	H L	X
8.	Store and label chemicals properly, including secondary containment. Do not store equipment or chemicals on-site if they are not being used. Do not leave open containers of chemicals or wastes on-site (BIA 2014, 2015a, 2017a).	X		L	X
9.	Keep sites clean and free of any litter, trash, old equipment, contaminated soil, or unused containers. Promptly dispose of any wastes at an appropriate recycling facility, approved landfill, or other approved location, based on the type of waste. Remove any unused equipment not necessary to the operation of the lease after drilling has been completed (BIA 2014, 2015a, 2017a).	X		L	X
10.	If the well is successful, all production equipment, facilities, and tanks, including well-head and aboveground piping/equipment, shall be properly enclosed to exclude livestock, if present (BIA 2014, 2015a, 2017a).	X		L	X
11.	Tank batteries must have a spill prevention, control, and countermeasures (SPCC) plan, in compliance with EPA regulations under 40 CFR Part 112. A sufficiently fluid-impermeable secondary containment dike/berm must be constructed around any tank battery and facilities, according to 40 CFR Section 112.7. The dike/berm and entire containment area must be covered with gravel. No water collected in the secondary containment can be discharged. In accordance with the SPCC plan and BIA regulations, the lessee will immediately notify the BIA of all spill incidents (BIA 2014, 2015a, 2017a).	X		L	X
12.	All pits, including tank batteries contained within a dike/berm, must be fenced with at least four strands of barbed wire or an approved substitute. No earthen pit, except those used in the drilling, completion, recompletion, or workover of a well, can be constructed, enlarged, reconstructed, or used without approval of the BIA Osage Agency Superintendent. Unlined earthen pits may be used only for storing freshwater and not for the temporary or continued storage of saltwater or other deleterious substances. Deleterious substances must be collected in a pit lined with at least 30-millimeter plastic or a metal tank. The substances must be maintained separately from drilling fluids to allow for separate disposal.	X	X	H L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
13.	In accordance with policy issued by the BIA Osage Agency Superintendent on April 9, 2002, all pits needed for drilling a new well, when using mud rotary equipment, must be emptied and closed within 3 months after the well is completed. All pits needed for drilling a new well, when using an air rig or cable tools, must be emptied and closed within 1 month after the well is completed. All pits needed during workover and plugging operations must immediately be emptied and leveled after operations are complete, unless otherwise directed by the surface owner or user (BIA 2014, 2015a, 2017a).	X		L	X
14.	To the extent possible, minimize disturbing surface owners, wildlife, and natural resources with noise, excessive traffic, dust, or other impacts associated with operations (BIA 2014, 2015a, 2017a).	X		L	X
15.	Do not conduct activities within aquatic environments, as defined in the glossary, without proper authorization. Avoid discharging soil or contaminants or removing stream water that could result in a violation of applicable, federally approved, water quality standards (BIA 2014, 2015a, 2017a).	X		L	X
16.	Return the area to the original contour or as directed by the surface owner. If needed, add clean soil to disturbed areas. Reestablish vegetation in disturbed areas with seed or sod or other approved method. Restore with native species, unless otherwise directed by the surface owner in writing. No noxious or invasive species may be used in revegetation and reclamation (BIA 2014, 2015a, 2017a).	X		L	X
17.	If well drilling, completion, and development are successful, promptly reclaim all areas of surface disturbance—well pad, access road, and pipeline—that are not needed or used in the production or operation of the well, as described in the approved EA for the APD, or as directed by the surface owner. If well drilling, completion, and development are not successful, begin reclamation of the entire area promptly. After a completed well is no longer in production, promptly reclaim the site. Complete reclamation no later than 90 days following the date of rig removal, well abandonment, or final plugging of a well, without the BIA's approval, or as directed by the surface owner (BIA 2014, 2015a, 2017a).	X		L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
18.	Conduct activities in a manner that avoids any potential incidental take or harm to federally listed threatened and endangered species and that complies with any permit or authorization issued by the USFWS. Follow the USFWS's guidance in the Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects (USFWS 2014b) (BIA 2014, 2015a, 2017a).	X	X	H L	X
19.	Follow USFWS-established sampling protocol in areas where the ABB is known or suspected to exist. (See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm.) If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that there is no suitable habitat for the ABB. If proposed operations would affect suitable habitat for the ABB, the lessee would need to obtain authorization from the USFWS to proceed with that portion of the project. If the proposed ground-disturbing activities have not begun by the start of the next active season, the lessee must perform new ABB presence/absence surveys and submit those valid survey results to the BIA and the USFWS. If subsequent surveys are positive for the presence of the ABB, then additional consultation must begin between the BIA and the USFWS before drilling operations may begin. Once the USFWS issues a BO, lessees would work primarily with the BIA on ABB surveys and related issues (BIA 2014, 2015a, 2017a).[4]	X		L	X
20.	Where proposed drilling operations would penetrate formations having zones suspected of containing hydrogen sulfide (H_2S) of 100 parts per million (ppm) in the gas stream, the lessee would implement the air quality BMPs listed in the site-specific EA for the drilling permit, which are hereby incorporated by reference (BIA 2014, 2017a).	X		L	X
21.	The lessee must obtain EPA approval before starting workover options related to underground injection, construction, or conversion of saltwater injection/disposal wells (BIA 2015a, 2017a).[5]	X		H L	X
22.	Suitable habitat for the ABB is present on portions of the existing well pad where vegetation height exceeds 8 inches and the substrate is one that ABBs could dig in (not concrete or packed gravel). Any pit used for the proposed action must be constructed in areas of the well pad where vegetation remains below 8 inches. Vegetation must be maintained until the proposed project is implemented (BIA 2015a, 2017a).	X		L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
23.	Where review of the proposed project location determines that suitable habitat for the endangered ABB is present, no ground-disturbing activities may occur during a proposed workover operation. If the operation requires wastewater containment instead of a pit, the lessee is advised to use a temporary, aboveground storage tank or to take other actions approved by the BIA Osage Agency Superintendent to avoid ground disturbance. The lessee may not excavate any soil in association with the workover. The temporary tank must be removed after the operation is completed (BIA 2015a, 2017a).	X	X	H L	X
24.	The lessee must screen, net, cover, or otherwise render harmless to birds all open-top tanks and pits (standard operating procedure).	X		L	X
25.	All lease operations are subject to the terms of the lease, the regulations set forth in 25 CFR Part 226, the approved APD, and any orders, NTLs, or written instructions adopted or issued by the Superintendent (standard operating procedure).	X	X	H L	X
26.	Before any new ground-disturbing activities or operations begin that were not specifically addressed and approved by the APD, the lessee must submit a written request for authorization to perform such activities or operations. The lessee also must submit any documentation required to demonstrate compliance with NEPA, ESA, NHPA, or other applicable laws and regulations and to obtain the BIA Osage Agency Superintendent's approval thereof (standard operating procedure).	X	X	H L	X
27.	The lessee may submit written requests to the BIA Osage Agency Superintendent for exception, waiver, or modification of an approved drilling, workover, plugging, or geophysical exploration permit; for the COAs or other requirements associated with such permits; or for any oil and gas mining or operations requiring approval. Such requests must include relevant documentation, supporting analysis, and an acceptable plan for mitigating anticipated impacts. The lessee must obtain written approval from the BIA Osage Agency Superintendent before beginning activities or operations that deviate from the approved APD and associated COAs or requirements (standard operating procedure).	X	X	H L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
28.	The lessee may not conduct operations in such a manner that permits disturbance through noise levels or adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors. The BIA may impose additional controls or conservation measures that it deems necessary to prevent a public nuisance or to alleviate an existing nuisance. When imposing these measures, the BIA would also consider any agreement between the lessee and the surface owner (25 CFR Part 226).		X	H L	X
29.	The lessee must conduct an initial test of the H_2S concentration of the gas stream for each well or production facility. For each such well or facility with an H_2S concentration of 100 ppm or more in the gas stream, the lessee must determine the 100 ppm and 500 ppm radius of exposure. In addition, the lessee must post danger or caution signs warning of the presence of H_2S gas and take required measures to ensure the safety of personnel and the general public (Oklahoma Corporation Commission [OCC] 2014).			L	X
30.	The lessee must not locate well sites or pits in areas subject to frequent flooding, according to the NRCS Soil Survey. Facilities in such areas—for example, storage tanks—may be subject to additional controls or conditions that the BIA deems necessary, in order to minimize or eliminate pollution (OCC 2014).			L	X
31.	The lessee is prohibited from applying to the land any waste oil, wastewater, contaminated soil, or the like, unless the lessee submits a written request for such application. The request must include any required documentation, such as that showing compliance with the ESA and NHPA, and must obtain the BIA Osage Agency Superintendent's approval thereof (OCC 2014).		X	H L	X
32.	Drilling pits must be at least 200 feet from streams and waterways, including reservoirs, lakes, wetlands, natural perennial or seasonally flowing streams or rivers, ponds, and aquatic environments (OCC 2014).			L	X
33.	The lessee must avoid new road and pipeline crossings of aquatic environments and alterations to hydrology (the surface and subsurface flow of water), to the extent practicable. Where crossing cannot be avoided, such crossings must be designed and constructed to minimize impacts on riparian and aquatic habitat.			L	X
34.	The lessee must bury pipelines to protect important aquatic environments or sensitive areas,[6] when appropriate (new requirement).			L	X

No.	Condition of Approval (Source)[2]	Alt. 1—No Action	Alt. 2—Emphasize Oil and Gas Development	Alt. 3—Hybrid Alternative[3]	Alt. 4—Enhanced Resource Protection
35.	The lessee must salvage and stockpile topsoil in a manner protected from erosion and then use it for revegetation or reclamation. The location of stockpiled topsoil is subject to the agreement of the lessee and surface owner; however, topsoil may be stockpiled in the outside slopes of berms, provided that it is not mixed with other materials or used for construction. This would be subject to surface owner approval or agreement between the surface owner and lessee (new requirement).			L	X

[1] The BIA may apply additional COAs to protect resources, including sensitive areas, based on site-specific determinations. Additional COAs may be applied to development on lands enrolled in federal conservation programs, such as the NRCS Wetlands Reserve Program, consistent with the protection of the relevant resources.

[2] Sources in parentheses are those for the measure. In some cases, the measure has been modified from the original source, although the main concept has remained the same.

[3] An "X" in a column indicates that the COA would apply to that alternative. Under Alternative 3, letters are used to indicate which areas a COA applies to. L = low-density sections; H = high-density sections.

[4] Under Alternative 2 and in high-density sections under Alternative 3, lessees would still be required to comply with the ESA; however, the BIA would not apply specific COAs dictating the manner in which lessees must comply.

[5] Under Alternative 2 and in high-density sections under Alternative 3, lessees would still be required to comply with underground injection control provisions of the CWA; however, the BIA would not apply specific COAs dictating the manner in which lessees must comply.

[6] Sensitive areas include the Tallgrass Prairie Preserve; state parks; state WMAs; US Army Corps of Engineers lakes; municipalities; sensitive water supplies; public water supply wells and wellhead protection areas; Class I Special Source Groundwater areas; areas designated as high vulnerability; and BLM wild horse and burro pasture facilities.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

Federal agencies are required to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR Section 1502.14).

Before impact analysis begins, any action alternatives that do not comport with the purpose of and need for the proposed action, in whole or in part, should be eliminated as unreasonable. Such alternatives may be those that are unreasonably expensive, that cannot be implemented for technical or logistical reasons, that do not meet BIA mandates, or that have significant environmental impacts or impacts for which adequate mitigation is not possible.

Eight alternatives were eliminated from detailed study because they would not meet the stated purpose of and need for the BIA's action (see **Section 1.3**) or because they would not be technically, economically, or legally feasible. These alternatives are summarized below.

2.5.1 No Leasing Alternative

The BIA considered an alternative under which it would not approve any new oil or gas leases in Osage County. While the 1906 Act and 25 CFR Part 226 vest the BIA with the authority to approve or deny leases on the Osage Mineral Estate, this alternative would not meet the purpose of and need for the BIA's action. As previously noted, the purpose of the BIA's action is to promote leasing and development of the Osage Mineral Estate in the best interest of the Osage Nation, while balancing resource conservation and the maximization of production from the Osage Mineral Estate.

2.5.2 Leasing with No Constraints

During alternatives development, the BIA considered an alternative under which it would approve oil and gas development leases and permits without any conditions or constraints. This would not be legally viable, because the BIA would not be able to ensure compliance with applicable laws and regulations, such as the ESA and NHPA.

2.5.3 Transfer the BIA's Management Authority to Another Agency

Several public commenters suggested that the BIA transfer its management authority over oil and gas leasing and development in Osage County to another agency, such as the OCC or the BLM. The 1906 Act authorizes the Secretary of the Interior to manage oil and gas development in Osage County. This authority cannot be transferred to a state agency, such as the OCC, without an act of Congress.

Further, the BIA cannot delegate its management of the Osage Mineral Estate to the BLM without the BLM's consent. In addition, because the statutes under which the BLM operates explicitly exclude the Osage Nation from the BLM's jurisdiction, legislative amendments may also be required to achieve such an action. The enactment or amendment of legislation and implementation of delegations of authority are outside the scope of this EIS; accordingly, this alternative was eliminated from consideration.

2.5.4 Alternatives Based on Oil Price

During alternatives development, the BIA considered developing a range of alternatives based on varying levels of development in relation to oil prices. For example, one alternative with oil prices between $40 and $60 per barrel would involve secondary recovery technologies to increase oil development in the planning area. Alternatives with increased development would have increased mitigation measures; however, because the BIA does not have control over oil prices or the technologies used by developers to extract oil in the planning areas, selecting an alternative based on price and development technologies would be outside of the BIA's authority.

This alternative would also require the BIA to continuously supplement the EIS for changes in commodity prices in order to select the applicable alternative. This would result in significant administrative costs and burden; therefore, this alternative concept was eliminated from further consideration.

2.5.5 Alternatives Based on Total Lease Acreage

The BIA considered developing a range of alternatives that placed varying caps on the total number of acres that could be leased at any given point in time. While lease approval or denial is within the BIA's authority under the 1906 Act and 25 CFR Part 226, the BIA does not have control over the number of acres leased.

2.5.6 Alternatives Based on a Total Number of Active Leases

The BIA considered developing a range of alternatives in which the total number of active leases in the planning area would vary under each alternative. While lease approval or denial is within its authority under the 1906 Act and 25 CFR Part 226, the BIA does not have control over the number of active leases in Osage County. Further, the fact that a lease is active does not mean that it will ultimately be placed into production, nor does it provide any indication of the type or amount of development that may occur on it; therefore, this alternative was eliminated from further consideration.

2.5.7 Reduce the Royalty or Annual Rental Rate in the Planning Area

The BIA considered reducing the royalty rate or annual rental for leases within the planning area in order to encourage oil and gas development. The 1906 Act authorizes the BIA to approve or deny leases of the Osage Mineral Estate and to prescribe the rules and regulations applicable thereto.

The regulations in 25 CFR Part 226, contain provisions setting forth the minimum royalty rates for oil and gas, as well as annual rental for leases. The BIA cannot lower royalty or rental rates outside the regulatory process.

Further, while the regulations in 25 CFR Part 226 set forth the minimum royalty rates for oil and gas, the negotiation of royalty rates above those minimums is at the discretion of the Osage Minerals Council. Amending regulations is outside the scope of this EIS; accordingly, this alternative was eliminated from consideration.

2.5.8 Increasingly Stringent Conditions of Approval as the Number of Leases and Permits Increases

During alternatives development, an alternative was proposed for the BIA to administer leasing and development at three different tiers, based on the number of wells drilled in a given year. As the number of wells drilled increased beyond a certain threshold during the year, additional permits issued in that year would be subject to increasingly stringent COAs.

This proposed alternative would not distinguish between sensitive areas in the different tiers. A well drilled in a sensitive area could be subject to minimal restrictions if it were one of the first wells permitted in a given year. Conversely, wells drilled in areas without resource conflicts could be subject to increased restrictions, simply because they were approved later in the year than others; therefore, the alternative proposing increasingly stringent COAs as the number of leases and permits increases was eliminated from further consideration

2.6 Summary Comparison of Environmental Consequences

Table 2-4, in **Appendix D**, briefly describes and compares the impacts of the proposed action on resources and resource uses for each alternative, including the Alternative 1 (No Action). For detailed analysis of the impacts under each alternative, see **Chapter 4**, Environmental Consequences.

This page intentionally left blank.

Chapter 3. Affected Environment

3.1 Introduction

The purpose of this chapter is to describe the existing biological, physical, and socioeconomic characteristics of the planning area, Osage County, Oklahoma. It includes all BIA administered Tribal mineral estate. The affected environment descriptions for individual resources provide a baseline for comparing potential environmental impacts under each alternative analyzed in **Chapter 2**, Alternatives. The resources analyzed are based on federal regulatory requirements and policies, as well as issues identified by the BIA through internal and external scoping.

The level of information presented in this chapter is commensurate with and sufficient to assess the potential impacts discussed in **Chapter 4**, Environmental Consequences, based on the alternatives presented in **Chapter 2**.

Acreages and other numbers used are approximate projections. Readers should not infer that they reflect exact measurements or precise calculations. Because many acreages were calculated using GIS technology, there may be slight variations in total acres between resources.

There are no lands in the planning area that are designated wilderness under the Wilderness Act of 1964, 16 US Code (USC) 1131–1136. Accordingly, that topic is not discussed in this EIS.

3.2 Topography, Geology, Paleontology, and Soils

Topography is the degree of slope, contours of the land, and ranges in elevation. Just as knowledge of area drainage basins, watersheds, and soils is important to planning, so too is the knowledge of slope and contour. Such knowledge aids site planning, site preparation, and final construction by determining the different gradients and contours of a particular area or site (Osage County 2011).

Geologic resources are defined through descriptions of the geology of the planning area and identification of geologic hazards. Geologic hazards are adverse geologic conditions that are capable of causing damage to, or loss of, property and life. Geologic information is used to evaluate the potential development of mineral resources and to regulate land uses, based on slope stability and accessibility. Mineral occurrence and management are discussed in detail in **Section 3.16**, Mineral Extraction.

Paleontological resources are any fossilized remains or traces of organisms that are preserved in or on the earth's crust. They include invertebrate, plant, trace, or vertebrate fossils, which constitute a fragile and nonrenewable record of the history of life. The BLM may, on request, provide expertise to other federal agencies, such as the BIA, in managing paleontological resources and research.

Soil resources are described using the characteristics and distribution of soil types in the planning area that may affect the use and management of the land and the quality of surface water, air, forage, and tree growth. Soil characteristics are important to consider when siting construction activities, such as oil and gas development, including the construction and installation of well pads, roads, pipelines, and other facilities. They are also important considerations when planning rangeland and timber stand improvements and protecting surface water quality by minimizing erosion and stabilizing the soil surface.

3.2.1 Regulatory Framework

Topography

There are no specific regulations and guidelines for topography critical for NEPA compliance. Topography is listed as a topic for discussion, in accordance with the BIA NEPA guidebook.

Geology

There are no specific regulations and guidelines for geology or geologic hazards critical for NEPA compliance. Geology is listed as a topic for discussion in accordance with the BIA NEPA guidebook.

Paleontology

The Indian Affairs Manual, Part 59, Chapter 7, Paleontological Resources, establishes policy on the specific requirements and responsibility of Indian Affairs headquarters and field staff for protecting and managing paleontological resources on Indian lands (BIA 2012).

Soils

The following statutes, regulations, handbooks, and other policies govern soil resources:

- 25 CFR 200–227, Energy and Minerals
- Soil Conservation and Domestic Allotment Act of 1935, as amended

- Soil and Water Resources Conservation Act of 1977
- The American Indian Agricultural Resource Management Act, Public Law 103-177
- Indian Self Determination Act, Public Law 93-638
- The Indian Affairs Manual Part 59, Environmental and Cultural Resources Management

3.2.2 Current Conditions

Topography

Osage County's terrain is characterized by gently rolling rocky hills, bisected by the lowlands of the Arkansas River and its major tributaries. The average elevation of the county is about 860 feet and ranges from around 590 feet in the lowlands to a maximum of 1,407 feet northeast of Foraker (BIA 1979). Northwest Osage County has most of the highest elevation areas of the county, at 1,116 feet or higher. This portion of the county stretches along State Highway 18 from north of US Highway 60 and includes the Kaw WMA, the John Dahl WMA, and the towns of Webb City, Shidler, and Grainola. The range of 985 feet to 1,115 feet of elevation is commonly found along the ridgelines of the drainage basins of the major creeks that begin in the northwest portion of the county and flow southeasterly (Osage County 2011).

The degree of slope in Osage County is shown on **Figure 3-1**, Slope Gradient (in **Appendix E**), and the acres by slope gradient are shown on **Table 3-1**, Slope Gradient. In general, the county is flat, with mostly 0- to 15-degree slopes, but in some of these areas the land slopes in the upper end of the slope gradient range. This can be considered severely sloping for purposes of construction, without incorporating specific site planning measures (Osage County 2011).

Table 3-1
Slope Gradient

Percent Slope	Acres
0–5	881,900
5.1–10	441,400
10.1–20	109,500
20.1–30	41,700

Source: NRCS GIS 2015

A slope of 5 to 10 percent presents moderate constraints to nonresidential land development (Osage County 2011). Slopes of 11 to 20 percent can be impracticable for other than lower density residential or certain park and open space activities. Development in these areas requires careful engineering and construction techniques to ensure that the development constraints are properly addressed (Osage County 2011).

Geology

A geomorphic province is part of the earth's surface where a suite of rocks with similar geologic character and structure underwent similar geologic history and where present-day character and landforms differ significantly from adjacent provinces (Johnson 2008). Osage County is in the Interior Plain division of the Central Lowlands physiographic/geomorphic province. This area is characterized by low-relief plains, punctuated by east-facing escarpments formed by cuestas, with mixed-grass prairie in the west, transitioning to mixed tall grass savannahs and woodlands in the east (USGS 2014).

The northwestern part of the county is in the Northern Limestone Cuesta Plains subdivision, characterized by thin, Permian limestone-capped, west-dipping cuestas rising above broad shale plains (Johnson 2008). The southeastern portion is in the Eastern Cuesta Plains subdivision, characterized by west-dipping, Pennsylvanian sandstone-formed cuestas that overlook broad shale plains (Johnson 2008). The bedrock formations of this area are stereotypically intermixed with layers of sandstone, shale, and thin limestone outcrops, and the bedrock outcrop formations are mainly of the Upper Pennsylvanian and Lower Permian age structures (BIA 2014).

Surface geologic strata (see **Figure 3-2**, Surface Geology, Faults, and Earthquakes (in **Appendix E**), and **Table 3-2**, Major Surface Stratigraphic Units in Osage County, Northeastern Oklahoma) consist primarily of Quaternary (0.005–2.5 millions of years ago [Ma]), Permian (252–298 Ma), and Pennsylvanian (298–323Ma; USGS 2003a). Details of the formation were obtained from the US Geological Survey Mineral Resources On-Line Spatial Data database (USGS 2015a). The most westerly formation is Quaternary Alluvium (loose gravel, sand, or clay deposited by streams) along the Arkansas River and around Kaw Lake (Osage County 2011). This formation is overlain with a large area of the Oscar Group (shale with many layers of limestone with sandstone) and patches of terrace deposits (alluvial deposits on one or more terrace levels of unconsolidated gravels, sand, silt, and clay).

To the east of the Oscar Group is the Vanoss Group (alternating layers of limestone and shale) and then the Ada Group (orange-brown fine-grained sandstone and red-brown to gray shale). The Ada Group is bounded on the east by a wide band of the Vamoosa Formation (alternating layers of shale and fine- to coarse-grained sandstone, with some limestone). East of the Vamoosa Group is a narrow band of the Tallant Formation (alternating layers of shale and sandstone), followed by a similar narrow band of the Barnsdall Formation (fine- to medium-grained sandstone, overlain by shale). The Barnsdall Formation is bordered on the east by Wann limestone (shale and fine- to medium-grained sandstone, with many thin layers of fossiliferous limestone) and Iola limestone (limestone, calcareous sandstone, and shale and underlying Wann).

Table 3-2
Major Surface Stratigraphic Units in Osage County, Northeastern Oklahoma

Time-Stratigraphic Unit	Group	Surficial Deposits and Formations	Lithology	Thickness (Feet)
Quaternary	—	Alluvium	Gravel to clay	0–80
		Terrace	Gravel to clay	0–95
Permian	Summer Group	Wellington Formation	Shale, sandstone	0–850
Pennsylvanian	Oscar Group	Numerous	Shale, limestone, sandstone	0–400
	Vanoss Group	Numerous	Limestone, shale, sandstone	0–500
	Ada Group	Numerous	Shale, limestone, sandstone	0–300
		Vamoosa Formation	Shale, sandstone, limestone	0–500
		Tallant Formation	Shale, sandstone	75–250
		Barnsdall Formation	Sandstone, shake	45–200
		Wann Formation	Shale, sandstone, limestone	50–400
		Iola Limestone	Limestone, sandstone, shale	4–100
		Chanute Formation	Sandstone, shale	10–150
		Dewy Limestone	Limestone, shale	0–60
		Nelly Bly Formation	Shale, sandstone	80–550
		Hogshooter Limestone	Limestone	1–50
		Coffeyville Formation	Shale, sandstone	175–470
		Checkerboard Limestone	Limestone	2–15
		Upper Holdenville Formation	Shale, sandstone, limestone	40–250
Mississippian	—	Pitkin Limestone	Limestone	—
		Fayetteville Shale	Shale	—
		Batesville Formation	Sandstone	—
		Hindsville Limestone	Limestone	—
		Moorefield Formation	Shale	—
		Koekuk Limestone	Limestone	—
		Reeds spring Formation	Limestone	0–100
		St. Joe Formation	Limestone	0–50
Mississippian/ Devonian	—	Chattanooga Shale	Shale	0–30

Table 3-2
Major Surface Stratigraphic Units in Osage County, Northeastern Oklahoma (cont.)

Time-Stratigraphic Unit	Group	Surficial Deposits and Formations	Lithology	Thickness (Feet)
Ordovician	Simpson Group	Bromide Formation	Shale	0–30
		Tulip Creek Formation	Limestone, shale, sandstone	—
		McLish Formation	—	—
		Oil Creek Formation	—	—
		Joins Formation	—	—
		West Spring Creek Formation	Dolomite	200–1,500
		Kindblade Formation	Dolomite	
		Cool Creek Formation	Dolomite	
		McKenzie Hill Formation	Dolomite	
Upper Cambrian	Arbuckle Group	Butterfly Formation	Dolomite	
		Signal Mountain Formation	Dolomite	
		Royer Dolomite	Dolomite	
		Fort Sill Limestone	Dolomite	

Source: USGS 2014

The southeast areas of the county are underlain by the Nellie Bly Formation (shale with a few layers of fine- to medium-grained sandstone), Hogshooter limestone (crinoidal limestone underlying Nellie Bly), and the Coffeyville Formation (shale interbedded with fine- to medium-grained sandstone). **Table 3-2** gives additional details of the stratigraphy in the planning area.

Mineral Resources

Oil and gas production in the county comes mainly from formations at depths of between 200 and 3,000 feet. The Burbank and Bartlesville Sands, Mississippi Chat, and Arbuckle Group are among the formations where oil and gas have been produced. The Burbank and Bartlesville Sands are Pennsylvanian or younger sandstone bodies that are up to 15 miles long and several miles wide and up to 200 feet thick. Both of these sands occur in the Cherokee Group, which includes several other sands, limestones, and coal beds (Thorman and Hibpshman 1979).

The Bartlesville Sand occurs at 1,400 feet in depth, and the Burbank sand occurs at 3,100 feet (Jordan 1957). The Mississippi Chat is a Pennsylvanian or younger basal unit. It consists mainly of conglomerate derived from underlying Mississippi lime, with an irregular channel of siliceous deposits that vary rapidly in thickness from 0 to 100 feet and from 3,000 to 6,000 feet below the surface (Thorman and Hibpshman 1979; IPPA 2015). The Arbuckle Group ranges in age from the Late Cambrian to Early Ordovician and is composed of interbedded limestone, dolomite, and sandstone units, up to 1,200 feet thick.

In addition to oil and gas, Osage County has shale, limestone, sand, and gravel that are quarried or extracted for sale.

Geologic Hazards

Faults and Earthquakes

Faults are discontinuous features in a volume of rock, typically expressed as a fracture or break, with a surficial expression fault line. Faults are rarely individual occurrences; they are more typically formed in a fault zone and result when a body of rock breaks or shifts under stress, which causes an earthquake.

Earthquakes are ground-shaking events that occur at various magnitudes as a result of movement within the earth's crust that releases seismic waves. Earthquakes can vary from slight tremors to building-collapsing events, as shown in **Table 3-3**, Modified Mercalli Intensity Scale; fault lines and recorded earthquakes in and around the planning area are shown on **Figure 3-2** (in **Appendix E**).

Earthquakes are either induced through human activities or occur naturally. Since the mid-1960s, oil and gas development, specifically the injection of fluids into the subsurface, has been known to induce earthquakes (Weingarten et al. 2015). The hazard from these earthquakes was traditionally considered small due to their infrequency and small magnitude, but several damaging earthquakes have occurred since 2011 (Weingarten et al. 2015).

Earthquake activity has increased in the central US, rising from an average of 24 earthquakes per year, with a magnitude of 3 or greater from 1973 to 2008, to an average of 193 magnitude 3 or greater earthquakes per year, from 2009 to 2014 (Rubinstein and Mahani 2015). In Oklahoma in 2016 there were 623 earthquakes with a magnitude of 3 or greater, down from a high of 903 in 2015 (Oklahoma Office of the Secretary of Energy and Environment 2017). Many of those earthquakes are believed to have been induced by fluids injected by wastewater disposal wells, particularly those in the Arbuckle formation (Rubinstein and Mahani 2015; Weingarten et al. 2015). Disposal wells are used to inject wastewater from oil and gas wells back into non-productive formations.

According to the Oklahoma Geological Survey (OGS), there were 1,701 earthquakes in Oklahoma from 1977 to 2005; only 5 had an epicenter in Osage County (Osage County 2011). The seismicity rate in 2013 was 70 times greater than the background seismicity rate observed in Oklahoma before 2008. The 2015 seismicity rate was approximately 600 times greater than the background rate prior to 2008 (OGS 2015).

Table 3-3
Modified Mercalli Intensity Scale

Value	Summary Damage Description Used on Maps	Description of Shaking Severity	Full Description (Shortened from *Elementary Seismology*)
I	Not mapped	Not mapped	Not felt.
II	Not mapped	Not mapped	Felt by people seated or those on the upper floors of buildings.
III	Not mapped	Not mapped	Felt by almost all people indoors. Hanging objects swing. Vibration is like that of a passing light truck. It may not be recognized as an earthquake.
IV	Not mapped	Not mapped	Vibration feels like a passing heavy truck. Stopped cars rock; hanging objects swing; windows, dishes, and doors rattle and glasses clink. In the upper range of IV, wooden walls and frames creak.
V	Light	Pictures move	Felt outdoors. Sleepers are wakened. Liquids are disturbed, some spilled. Small unstable objects are displaced or upset. Doors swing; pictures move; pendulum clocks stop.
VI	Moderate	Objects fall	Felt by all. People walk unsteadily. Many become frightened. Windows crack; dishes, glassware, knickknacks, and books fall off shelves; pictures fall off walls; furniture is moved or overturned. Weak plaster, adobe buildings, and some poorly built masonry buildings crack. Trees and bushes shake visibly.
VII	Strong	Nonstructural damage	Difficult to stand or walk. Noticed by drivers. Furniture is broken. Poorly built masonry buildings are damaged. Weak chimneys break at the roof line. Plaster, bricks, stones, tiles, cornices, unbraced parapets, and porches fall. Some cracks appear in better masonry buildings. Waves are generated on ponds.
VIII	Very strong	Moderate damage	Drivers' ability to steer is affected. Extensive damage to unreinforced masonry buildings, including partial collapse, and some masonry walls fall. Chimneys and monuments are twisted and fall. Wood-frame houses move on foundations if not bolted; loose partition walls are thrown out. Tree branches break.
IX	Violent	Heavy damage	General panic. Damage to masonry buildings ranges from collapse to severe damage, unless buildings are of modern design. Wood-frame structures rack and, if not bolted, shift off foundations. Underground pipes break.
X	Very violent	Extreme damage	Poorly built structures are destroyed with their foundations. Even some well-built wooden structures and bridges are heavily damaged and need to be replaced. Water is thrown on waterbody banks.
XI	Not mapped because these intensities are typically limited to areas with ground failure.		Rails are bent greatly. Underground pipelines are completely out of service.

Table 3-3
Modified Mercalli Intensity Scale (cont.)

Value	Summary Damage Description Used on Maps	Description of Shaking Severity	Full Description (Shortened from *Elementary Seismology*)
XII	Not mapped because these intensities are typically limited to areas with ground failure.		Damage is nearly total. Large rock masses are displaced. Lines of sight and level are distorted. Objects are thrown into the air.

Source: Richter 1958

According to the OGS, it is very unlikely that this increase in seismicity is due to natural processes. The OGS considers it very likely that "the majority of recent earthquakes, particularly those in central and north-central Oklahoma, are triggered by the injection of produced water in disposal wells" (OGS 2015). This culminated in 2016, with a record-setting magnitude 5.8 earthquake, centered near the town of Pawnee, Oklahoma, a few miles from the border of Osage County (*The Oklahoman* 2016a).

In response to the substantial increase in the seismicity of the area, the EPA, which oversees disposal wells in Osage County, ordered a standing shutdown of five produced water disposal wells in southwest Osage County. The agency also ordered volume reductions at 15 other wells in the county. The EPA indicated that it would continue to follow the guidance of the OCC, regarding restrictions on Osage County disposal wells in the Arbuckle Group (*The Oklahoman* 2016b).

<u>Hydrogen Sulfide</u>

Oil and gas exploration and development can release H_2S gas from geologic formations, which can be a public health and safety hazard. H_2S is a colorless gas with the characteristic foul odor of rotten eggs. It is heavier than air, corrosive, flammable, explosive, and very poisonous. At low concentrations it can irritate the eyes and act as a depressant; at high concentrations it can irritate the upper respiratory tract and, during prolonged exposure, lead to pulmonary edema (USGS 2010). A 30-minute exposure to 500 ppm results in headache, dizziness, excitement, staggering gait, and diarrhea, followed sometimes by bronchitis or bronchopneumonia (USGS 2010). The Osage Nation warns that H_2S may be present at oil and gas facilities in the county (Osage Nation 2017a). See **Section 3.11**, Public Health and Safety, for further discussion of H_2S.

<u>Overpressure Zones and Zones of Lost Circulation</u>

Overpressure zones are areas where subsurface pressure is abnormally high and exceeds hydrostatic pressure at a given depth, usually in buried fluid-filled sediments. This could result in the rapid escape of the over-pressurized fluids, leading to a well blowout, which can harm individuals on the drilling rig (Schlumberger 2015).

Lost circulation is the reduced or total absence of returning fluid during drilling, generally classified as seepage (less than 3 cubic meters per hour), partial loss returns (greater than 3 cubic meters per hour), and total loss, where no fluid returns (Schlumberger 2015). The loss of fluid generally translates into financial loss to the drilling company, well damage, and potential risk to the drilling rig and personnel. Overpressure zones and zones of lost circulation are difficult to predict before drilling, but lessees should expect to encounter these conditions occasionally.

Paleontology

During the Early and Middle Paleozoic, a shallow sea covered the planning area and supported small marine animals, such as brachiopods, trilobites, mollusks, and crinoids. Late in the Paleozoic (Carboniferous/Pennsylvanian), vast swampy deltas were deposited by rivers, supporting amphibians and early reptiles and developing a rich growth of vegetation that would later become coal seams. Periodically, the sea would alternately return and retreat, resulting in the cyclic deposition pattern of shales, limestones, and sandstones. Rare fossils of insects, amphibians, and reptiles and vertebrate footprints have been collected from Late Paleozoic rocks in Oklahoma (The Paleontology Portal 2015).

During the Mesozoic, Oklahoma lay above sea level, with the western and southeastern portions being covered again by the sea during the Late Mesozoic. Fossils from these marine deposits include oysters, ammonites, sand dollars, and shark teeth.

During the Early Cenozoic (Tertiary), the Rocky Mountains were being pushed up to the west, causing a period of broad gentle uplift in Oklahoma and surrounding areas. Rivers draining off the rising mountains carried extensive sand and gravel deposits and filled wide shallow valleys. These sediments and rocks contain a rich vertebrate fossil record, including a large assortment of fossil mammals and petrified wood. Quaternary fossils in the planning area are clams and snails and the teeth and bones of horses, camels, bison, and mammoths (The Paleontology Portal 2015).

Potential fossil yield classification maps have not been completed for the planning area. The BIA has not done a paleontological investigation in the planning area because of the limited area subject to BIA surface management and the types of activities that this management typically permits. There is a geological potential for fossils, especially for Pennsylvanian epoch fossils, but there has been relatively little formal investigation.

Soils

Soils are grouped on the basis of their characteristics: permeability, percolation, ponding, drainage conditions, shrink-swell potential, depth to cemented pan, depth to hard/soft bedrock, soil texture, flooding frequency, filtering capacity, topography, seepage, subsistence, and organic content. These characteristics also influence soils' adaptation to non-agricultural uses for roads, residences, and small commercial structures and septic tank absorption. Soils are considered healthy when they are able to support region-specific vegetation communities (i.e., appropriate drainage, porosity, and salinity) and are not eroding at rates above what is considered natural for that specific soil type.

Map units are identified during soil surveys at the county level, which can be used for management of activities involving site-specific disturbance. Soil map units may be designated based on the soil's series, slope, aspect, or texture. Soil series are two or more geographically associated soils that have similar formation, chemistry, or physical properties (NRCS 2017). Examples of soil series properties are runoff capabilities, erosion hazards, associated native vegetation, wildlife habitat, and suitability for community development.

In 2012, the US Department of Agriculture, NRCS conducted a complete and detailed soil survey of Osage County. There are 71 soil map units in the planning area, but only 8 that cover 3 percent or more of the planning area; when the 8 soil units are combined they account for 66 percent of the planning area (NRCS GIS 2015). These 8 dominant soil map units, along with a brief description of their characteristics, are listed in **Table 3-4**, Dominant Soil Map Units, and are shown in **Figure 3-3**, Dominant Soil Map Units (in **Appendix E**).

The characteristics and distribution of soil types in the planning area affect the use and management of the land and the quality of surface water, air, forage, and tree growth. Soil characteristics are important to consider when siting construction locations, such as those for oil and gas well development, roads, and buildings.

Sensitive soils are those with characteristics that make them more susceptible to impacts or that make them more difficult than healthy soils to restore or reclaim after disturbance. Sensitive soils in the planning area are susceptible to increased erosion rates. Steep slopes are discussed under *Topography*, above.

Accelerated erosion is usually in response to a land use practice that causes excessive runoff from even normal intensity storms. This type of erosion persists and worsens until the land use practice is corrected or mitigated. Any land use activity that leads to bare soil or increased impervious areas can cause erosion to accelerate. Soils that are susceptible to erosion may require the addition of protective measures to prevent excessive erosion.

Table 3-5, Wind Erodibility Group, shows the acres of soils susceptible to natural erosion in the planning area. Soils assigned to Group 1 are most susceptible to erosion, and those assigned to Group 8 are least susceptible.

Table 3-4
Dominant Soil Map Units

Map Unit Name	Description	Acres	Percent of Planning Area
Niotaze-Bigheart-Rock outcrop complex, 3 to 45 percent slope	Niotaze—Loamy colluvium derived from sandstone over clayey residuum weathered from shale; depth to bedrock: 20–40 inches (densic) or 31–79 inches (paralithic); somewhat poorly drained Bigheart—Residuum weathered from sandstone; depth to bedrock: 10–20 inches; well drained	229,900	15.9
Bigheart-Niotaze-Rock outcrop complex, 1 to 8 percent slopes	Niotaze—Loamy colluvium derived from sandstone over clayey residuum weathered from shale; depth to bedrock: 20–40 inches (densic) or 31–79 inches (paralithic); somewhat poorly drained Bigheart—Residuum weathered from sandstone; depth to bedrock:10–20 inches; well drained	178,900	12.3
Steedman-Lucien complex, 3 to 25 percent slopes	Steedman—Clayey residuum weathered from sandstone and shale; depth to bedrock: 20-40 inches; moderately well drained Lucien—Loamy residuum weathered from sandstone and shale; depth to bedrock: 10-20 inches; well drained	146,600	10.1
Goodnight loamy fine sand, fine sand, and loamy fine sand, 3 to 15 percent slopes	Reworked stabilized dunes adjacent to floodplains of major streams in the Central Rolling Red Prairie; depth to bedrock: greater than 80 inches; excessively drained	99,300	6.9
Westsum-Shidler-Apperson complex, 3 to 12 percent slopes	Westsum—Calcareous clayey residuum weathered from shale; depth to bedrock: greater than 60 inches; well drained Shidler—Loamy residuum weathered from cherty limestone; depth to bedrock: 4–20 inches; well drained Apperson—Calcareous clayey residuum weathered from limestone; depth to bedrock: 40–60 inches; somewhat poorly drained	96,800	6.7
Verdigris silt or clay loam, 0 to 1 percent slopes, frequently or occasionally flooded	Very deep soils that formed in silty alluvium on floodplains in the Cherokee Prairies; depth to redox concentrations where present: 20 to more than 60 inches; well drained	88,700	6.1
Grant silt loam, 1 to 5 percent slopes, (some eroded)	Deep, moderately permeable soils that formed in material weathered predominantly from siltstone or silty shale of Permian age; depth to paralithic contact: 40–60 inches; well drained	77,600	5.4

Table 3-4
Dominant Soil Map Units (cont.)

Map Unit Name	Description	Acres	Percent of Planning Area
Bartlesville-Bigheart complex, 1 to 5 percent slopes, very rocky	Bartlesville—Loamy residuum weathered from sandstone; depth to bedrock (paralithic): 20–29 inches; well drained Bigheart—Residuum weathered from sandstone; depth to bedrock: 10–20 inches; well drained	43,800	3.0

Source: NRCS GIS 2015

Table 3-5
Wind Erodibility Group

Group	Acres
1: Very fine sand, fine sand, sand, or coarse sand	0
2: Loamy very fine sand, loamy fine sand, loamy sand, and loamy coarse sand; very fine sandy loam and silt loam, with 5 percent or less clay and 25 percent or less very fine sand and sapric soil materials, except folists	34,500
3: Very fine sandy loam (but does not meet wind erodibility group criterion 2), fine sandy loam, sandy loam, and coarse sandy loam; noncalcareous silt loam that has greater than or equal to 20 to less than 50 percent very fine sand and greater than or equal to 5 percent to less than 12 percent clay	308,500
4: Clay, silty clay, noncalcareous clay loam that has more than 35 percent clay and noncalcareous silty clay loam that has more than 35 percent clay; none of these have sesquic, parasesquic, ferritic, ferruginous, or kaolinitic mineralogy (high iron oxide content)	24,900
5: Noncalcareous loam that has less than 20 percent clay; noncalcareous silt loam with greater than or equal to 5 percent to less than 20 percent clay (but does not meet wind erodibility group criterion 3); noncalcareous sandy clay loam; noncalcareous sandy clay; and hemic soil materials	133,500
6: Noncalcareous loam and silt loam that have greater than or equal to 20 percent clay; noncalcareous clay loam and noncalcareous silty clay loam that have less than or equal to 35 percent clay; silt loam that has parasesquic, ferritic, or kaolinitic mineralogy	586,800
7: Noncalcareous silt; noncalcareous silty clay, noncalcareous silty clay loam, and noncalcareous clay that have sesquic, parasesquic, ferritic, ferruginous, or kaolinitic mineralogy and are oxisols or ultisols; and fibric soil materials	339,400
8: Soils not susceptible to wind erosion due to rock and pararock fragments at the surface or wetness and folists	43,800

Source: NRCS GIS 2015

Table 3-6, Erosion Hazard Ratings for Roads, shows the relative potential erosion hazard for the map unit when used as a site for unimproved roads and trails. The erosion hazard is expressed as the rating class for the dominant component in the map unit, based on composition percentage of each map unit component. Map units with moderate or severe ratings would need additional management to prevent excessive erosion.

Table 3-6
Erosion Hazard Ratings for Roads

Rating	Acres
Not rated	40,600
Slight	499,500
Moderate	776,100
Severe	158,300

Source: NRCS GIS 2015

Soils in the planning area have been affected by oil and gas leasing for the past 100 years. Impacts are as follows (USGS 2003b):

- Surface disturbance and soil compaction related to the construction of oil and gas operations and ancillary facilities
- Salt scarring and soil salinization; elevated sodium concentrations in soil kill vegetation and break down cohesion of soil particles, both of which enhance soil erosion
- Tree kills
- Brine and oil contamination from improper disposal or accidental release of large volumes of saline water produced in association with oil and gas production

Before federal laws and regulations were instituted in the 1970s, produced waters were often discharged into streams, creeks, and unlined evaporation ponds, causing salt scars and surface water and groundwater pollution (USGS 2003b). These waters are highly saline (total dissolved solids may exceed 350,000 milligrams per liter) and may contain toxic metals, organic and inorganic components, and radium-226/228 and other naturally occurring radioactive isotopes.

Currently, contaminated water generally comes from accidental hydrocarbon and produced water releases and from incorrectly sealed abandoned wells (USGS 2003b). Areas with salt scarring or oil contamination are unable to support vegetation, leaving the soils susceptible to erosion.

To gauge the potential success of restoration, the soil salt content, nutrients, organic matter, petroleum hydrocarbons, and bacterial activity at individual sites would need to be measured. **Figure 3-4**, Example Salt-scarred Site in the

Planning Area (in **Appendix E**), shows a typical salt-scarred site, with exposed soil and damaged vegetation.

3.2.3 Trends

Topography

Topography, and knowledge thereof, is expected to remain the same. The construction of well pads and ancillary facilities will be analyzed on a site-specific basis, with additional construction or engineering requirements implemented as needed.

Geology

An increased understanding of area geology and geologic hazards can be expected as more knowledge is gained through oil and gas exploration and drilling and through geologic mapping. The risk of induced seismicity is expected to continue.

Paleontology

Continued development of the Osage Mineral Estate could lead to more discoveries but also to potential adverse impacts on the resource. The increase in land use or activities in sensitive areas would require additional measures to manage these resources, in accordance with applicable laws and BIA policies. The scientific, educational, and recreational value of any discovered or known paleontological resource should be carefully examined and evaluated on-site by a paleontological resource specialist.

Soils

Soils in the planning area are affected by continued development of fluid mineral resources. Minerals extraction generally involves disturbing the surface and affecting soil resources; adverse impacts can be long term. Disturbance is associated with such activities as the construction of well pads, roads, utility corridors, and facilities; pipeline installation; seismic exploration; and exploratory drilling. The development of ROWs can include a number of surface-disturbing activities, such as road building, trenching, and construction site clearing.

All of these activities have the potential to create both short-term and long-term impacts on soils. The cumulative extent of surface disturbance or vegetation manipulation that can be supported by soils in the planning area has not been determined. Long-term impacts can be reduced via interim reclamation or by returning the environment to a more natural state through regrading, reseeding, and reestablishing vegetation after ground disturbance. Implementing BMPs for the duration of an individual project would reduce cumulative impacts on soils in the planning area.

3.3 WATER RESOURCES

3.3.1 Regulatory Framework

The following federal laws, statutes, mandates, and authorities govern water resources:

- Appropriations Act of 1952, McCarran Amendment
- Federal Water Pollution Control Act (commonly referred to as the CWA), as amended (33 USC 1251–1387)
- Safe Drinking Water Act of 1974 (42 USC 201)
- Watershed Protection and Flood Prevention Act of 1954, as amended
- Water Resources Development Act of 1974
- Water Resources Planning Act of 1965, as amended
- Water Resources Research Act of 1954, as amended
- Soil and Water Resources Conservation Act of 1977 (Public Law 95-87, 91 Stat. 1407, November 8, 1977, 16 USC 2000 et seq.)
- Executive Order (EO) 11514, as amended by EO 11991, Protection and Enhancement of Environmental Quality, March 5, 1970
- EO 11988, as amended by EO 12148, Floodplain Management, May 24, 1977
- EO 11990, Protection of Wetlands, May 24, 1977
- EO 12088, Federal Compliance with Pollution Control Standards, October 13, 1978
- EO 12322, Water Resources Projects, September 17, 1981
- President's Letter of May 26, 1974 (created the Interagency Committee on Water Resources and established interagency participation in river basin planning)
- The Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management (*65 Federal Register* 62565, [October 18, 2000])

3.3.2 Current Conditions

The primary water sources in the planning area are surface water withdrawn from Skiatook Lake and groundwater withdrawn from alluvial aquifers. Surface water is also withdrawn from other lakes, ponds, creeks, and streams in the planning area. There are no large industries in the planning area using water from public suppliers; therefore, the volume of water withdrawn by cities, towns, rural water districts, and small communities is likely to vary in response to population changes (USGS 2014).

In 2010, approximately 96 percent of the water withdrawn by public suppliers in the planning area was from surface-water sources. Skiatook Lake is the primary source of water for public suppliers in the planning area and for cities in adjoining counties. Planning area residents living outside public water supply service areas rely on private wells.

Industrial use of surface water and groundwater in the planning area is primarily for oil and gas development activities. This industrial water is supplied by the water user and does not impact water rights in the planning area. Surface water in the planning area is also used for livestock and irrigation. Livestock is the second highest water use in the planning area, behind public water suppliers (USGS 2014).

Water Use for Oil and Gas Extraction

The BIA estimates that there are approximately 14,500 producing wells in the planning area; however, production is reported by leasehold rather than individual wells, so the assumption is that the estimate includes idled wells and wells that are no longer productive but are attached to a producing lease (OIG 2014). In 2017, total oil production was approximately 3.22 million barrels. Total gas production was approximately 4.79 million cubic feet in 2017. The potential new oil and gas well spuds between 2018 and 2037 are estimated to be 3,208 oil wells and 1,369 gas wells, for a total of 4,577 producing wells (**Appendix A**).

Water is used throughout the well drilling and completion process. The quantity of water used per well is affected by the geology of the targeted reservoir, lessee preference, total well depth, type of well and other operational factors (Nicot and Scanlon 2012).

Oil and gas production uses water, generates contaminated water, and often involves the use of substances capable of contaminating water. Much of the groundwater extracted in the planning area is reinjected into the petroleum-producing zones to enhance extraction in a process known as water flooding. Petroleum-producing zones are located below drinking water aquifers in the planning area (USGS 2014).

The surface release of contaminated water or substances capable of contaminating water can affect the quality of surface water and groundwater; accordingly, such releases can affect potential uses of this water, such as for domestic consumption. The quantity of water used for well drilling, completion, and production varies by the type of well and drilling technique. Vertical well completion, or conventional drilling, uses an estimated 100,000 to 500,000 gallons per well, with an assumed average of 250,000 gallons per well completion. Coal bed methane wells require significantly less water than other shale gas and tight oil wells (Murray 2013): from 50,000 to 350,000 gallons, with an average of 150,000 gallons per well completion.

Hydraulic fracturing, also referred to as hydrofracking, hydrofracturing, and fracking, is a well development process. Water is injected under high pressure down a wellbore and into the target bedrock formation, creating fractures in the formation. Hydraulic fracturing is used to increase oil or gas flow to a well from petroleum-bearing rock formations, thereby increasing the volumes of oil and gas recovered (USGS 2015c).

Wells may be drilled vertically hundreds to thousands of feet below the surface and may include horizontal (unconventional drilling) or directional sections, extending thousands of feet (EPA 2015a). Drilling a typical horizontal well, in tight oil or shale gas, can consume from 65,000 to more than 1 million gallons of water during drilling; hydraulic fracturing can require an additional 2 to 6 million gallons of water (Koplos 2014). The average volume of water used per fractured well is 2.5 million gallons (Ceres 2014).

Table 3-7, Oil and Gas Wells in Osage County by Well Type, below, shows the number of oil and gas wells drilled by well type in the planning area as of 2016. (Note that this table shows the total number of wells historically drilled in Osage County, not the number of wells currently in operation.) Based on BIA Osage Agency data used for the Osage RFD, 42,012 wells have been drilled and completed in Osage County since production began (**Appendix A**). Well types were divided into wells reported as oil wells, gas wells, both oil and gas wells, injection/disposal/service wells, abandoned wells and unknown/unreported wells.

Table 3-7
Oil and Gas Wells in Osage County by Well Type

Well Type	Number
Oil	25,133
Gas	3,113
Oil and gas	98
Enhanced oil recovery/disposal/service	4,909
Abandoned (dry hole)	8,033
Temporarily abandoned	686
Other (core test/gas storage/monitoring)	40
Total Wells	**42,012**

Source: **Appendix A**

Oil wells dominate the county, with over 59 percent of all drilled wells. Gas wells account for just over 7 percent and injection/disposal/service wells for 11 percent (**Appendix A**). The amount of water used per well can vary, based on well type, well direction, and production formation. The development of oil and gas is discussed further in **Section 3.16**.

Hydraulic fracturing fluid commonly consists of three components, as follows:

- Water
- Proppant, such as sand, ceramic pellets, or other small uncompressible particles that hold open the newly created fractures (EPA 2015a)
- Chemical additives that open and enlarge fractures in the rock formation that can extend several hundred feet from the well bore

Once the injection process is completed, the internal pressure of the rock formation causes fluid hydrocarbons to return to the surface through the wellbore. This fluid, known as both flowback and produced water, may contain the injected chemicals, plus naturally occurring materials, such as brines, metals, radionuclides, and hydrocarbons. The produced water is typically stored on-site in tanks or pits before treatment, disposal, or recycling. In many cases, it is injected underground for disposal. In areas where that is not an option, it may be treated and reused, or processed by certain wastewater treatment facilities and then discharged to surface water (EPA 2015a).

Use of hydraulic fracturing to extract the remaining oil and gas from existing fields and previously undeveloped shale units may have increased the saline groundwater reinjection in the planning area's heavily developed Burbank Oil Field (Murray 2013). In 2016, there were 4,909 injection/disposal/service wells in Osage County (**Appendix A**).

The Burbank Oil Field is one of several oil and natural gas producing fields in the planning area. The volume of saline groundwater reinjected into the oil field was considerably larger than the volume of freshwater estimated to have been withdrawn for all other purposes in the planning area between 1950 and 2012.

Additional volumes of produced saline groundwater are likely reinjected in other producing fields in the planning area, but data are not available from those fields. Freshwater also may be used for hydraulic fracturing in the planning area, but no data for such water use are available (USGS 2014).

Exploration and production of oil and gas have affected surface water and groundwater in the planning area. Such impacts are primarily from the improper disposal of large volumes of saline water produced with oil and gas, from accidental hydrocarbon and produced water releases, and from abandoned oil wells that were not correctly sealed. In 2016, 116 spills resulted in saltwater being released; 20 of these spills resulted in more than 100 barrels worth of saltwater being released (BLM 2017).

Lands in the planning area have been affected by salt scarring, tree kills, soil salinization, and brine and oil contamination. These conditions are due to the leakage of produced water and associated hydrocarbons from brine pits and accidental releases from active and inactive pipes and tank batteries (USGS 2005).

In 2005, the US Geological Survey conducted a study of saline water contamination at two oil production sites in the planning area. Results demonstrated that the produced water source is a brine of sodium, calcium, and chloride (about 150,000 milligrams per liter [mg/L] total dissolved solids), with relatively high concentrations of magnesium, strontium, and ammonium, but low sulfate and H_2S. With the exception of iron and manganese, the concentrations of trace metals were low.

Results showed that the bulk of inorganic salts and some dissolved organic species in the released brine from the two sites studied would reach Skiatook Lake, approximately 500 feet from the sites (USGS 2005).

The 2005 results showed high salinity water (5,000–30,600 mg/L total dissolved solids) at intermediate depths that extend from below the old oil and brine pits to Skiatook Lake. No liquid petroleum was found in the contaminated groundwater, but soluble petroleum byproducts, including organic acid anions and other volatile organic compounds (VOCs) were present.

Test results showed that significant amounts of salts from produced water releases and petroleum hydrocarbons remained in the soils and rocks of the affected area, after more than 60 years of natural attenuation. Significant amounts of produced water from the two active brine pits percolated into the surficial rocks and flowed toward the Skiatook Reservoir; however, only minor amounts of liquid oil left the brine pits and reached the reservoir.

Spills associated with oil and gas development may affect surface water and groundwater quality, if pollutants are released. In fiscal year 2015, there were 223 spills in the planning area associated with oil and gas development; in fiscal year 2016, there were 143 spills. **Section 3.11**, has a more detailed discussion of oil and gas spills in the planning area.

Groundwater

There are three major aquifers in the planning area (see **Figure 3-5**, Principal Aquifers [in **Appendix E**]). The first is composed of alluvial and terrace aquifers (hereinafter referred to as alluvial), made up of unconsolidated sands, silts, clays, and gravels deposited along streams and rivers in the Quaternary. The second is the Vamoosa-Ada aquifer, consisting of a sequence of sandstones, siltstones, shales, conglomerates, and limestones deposited in marine environments in the Pennsylvanian. The third major aquifer in the planning area is really a series of minor bedrock aquifers. They were deposited during the Pennsylvanian in the eastern part of Osage County and during the Pennsylvanian through Permian in the western part of Osage County, where the Vamoosa-Ada aquifer is absent (USGS 2014).

Alluvial aquifers adjoining rivers and streams in Osage County consist of unconsolidated lens-shaped beds of sand, silt, clay, and gravel. Alluvium underlies river valleys and adjoins active stream channels, whereas terrace aquifers are at higher elevations and were deposited when the riverbed was at a higher elevation. Alluvial aquifers underlie approximately 186,800 acres of the planning area and range in thickness from 0 to 80 feet (Bingham and Bergman 1980; Abbott 2000; USGS GIS 2014). Terrace aquifers near the Arkansas River, which are grouped with alluvial aquifers in this section, range in thickness from 0 to about 95 feet (Mashburn et al. 2003).

The Vamoosa-Ada aquifer underlies approximately 667,100 acres of the planning area (USGS GIS 2014). It consists of stacked sequences of fine-grained to very fine-grained sandstone, siltstone, shale, and conglomerates that are interbedded with very thin limestones (D'Lugosz et al. 1986).

The supply of potable groundwater in the alluvial aquifers and the Vamoosa-Ada aquifer is adequate for current domestic and other purposes. Approximately 48 percent of the water pumped from the alluvial aquifer is used for public water supply, about 13 percent is used for livestock and agriculture, and about 39 percent for domestic and commercial use (Stephens, Daniel B., and Associates, Inc. 2016).

In areas where these aquifers are absent, groundwater must be pumped from minor bedrock aquifers that generally produce smaller volumes of water (Bingham and Bergman 1980). In these areas surface water is sometimes used for non-potable uses.

Domestic uses of water are for household purposes, for farm and domestic animals up to the normal grazing capacity of the land, and for irrigating gardens, orchards, and lawns. Domestic use also includes water for agriculture, fire protection, and for non-household drinking water, restrooms, and lawn watering (OWRB 2016).

Private wells do not serve public water supply systems and have fewer regulations than public supply wells. **Figure 3-6**, Domestic Water Wells (in **Appendix E**), shows the high density of domestic water wells in the planning area. Domestic wells can be subject to groundwater contamination from seepage through landfills, failed septic tanks, underground storage tanks, fertilizers and pesticides, and runoff from urban areas (EPA 2015b).

In parts of the planning area without the alluvial or Vamoosa-Ada aquifers, wells produce water from permeable rocks that occur intermittently in the subsurface. These minor bedrock aquifers are associated with nine sedimentary rock units of Pennsylvanian through Permian (USGS 2014). Wells completed in these minor aquifers typically produce less than 25 gallons per minute and underlie approximately 540,800 acres of the planning area (Bingham and Bergman 1980; Abbott 2000).

The US Geological Survey analyzed groundwater quality in the planning area in 2014 (USGS 2014). The entire planning area is underlain by brines containing concentrations of sodium and chloride and total dissolved solids of greater than 1,500mg/L (D'Lugosz et al. 1986); therefore, all freshwater aquifers in the planning area are subject to contamination by brines from natural seepage or oil and gas development activity (USGS 2014).

Chloride, a component of total dissolved solids, is a conservative element in hydrologic systems. Chloride can indicate sources and movement of groundwater, such as upward discharge of saline groundwater to springs and streams or the effects of disposal or leakage of brines brought to the surface during oil and natural gas extraction.

Chloride concentrations were significantly greater in water samples collected from wells completed in the Vamoosa-Ada aquifer than in water samples collected from wells in alluvial aquifers in the planning area. Chloride concentrations in the few water samples collected from wells completed in minor aquifers were not significantly different from those in water samples collected from wells completed in alluvial and the Vamoosa-Ada aquifers in the planning area. Water sampled from wells completed in alluvial, the Vamoosa-Ada, and minor bedrock aquifers generally contained smaller concentrations of dissolved chloride than water samples collected at Hominy Creek (USGS 2014).

Local effects may cause the substantial variations in dissolved chloride concentration in groundwater in the planning area (USGS 2014). These effects can be caused by brines seeping into shallow groundwater or by leaks and spills from oil and natural gas extraction near the land surface. No general geographic patterns of dissolved chloride concentration are apparent in groundwater samples collected in the planning area (USGS 2013).

Surface Water

The planning area generally receives approximately 45 inches of annual precipitation in the southeastern portion and approximately 36 inches in the western and northeastern portions. May and September are typically the wettest months of the year. Snowfall ranges from 1 to over 10 inches per year (Oklahoma Climatological Survey 2013).

The US Geological Survey delineated watersheds in the United States using a national standard hierarchical system. This system classifies surface hydrologic features into hydrologic units: region (first field), subregion (second field), accounting unit (third field), and cataloging unit (fourth field). Each hydrologic unit is identified by a unique hydrologic unit code: region (2-digit), subregion (4-digit), accounting unit (6-digit), and cataloging unit (8-digit).

A cataloging unit is a geographic area representing part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature (USGS 2015d). Cataloging units, sometimes called watersheds, are the most widely used hydrological units in water resource planning, management, and policy (Daniels et al. undated). **Table 3-8**, Hydrologic Cataloging Units, shows the cataloging units in the planning area.

Table 3-8
Hydrologic Cataloging Units

Cataloging Unit Name	Total Acres	Acres in Planning Area
Bird	727,904	574,400
Black Bear-Red Rock	1,366,773	432,900
Caney	1,340,509	365,000
Kaw Lake	609,945	76,800
Polecat-Snake	846,226	25,400

Source: NHD GIS 2015

The planning area is drained by the Caney River in the northeast, Bird Creek in the southeast, and Salt Creek in the west. The Arkansas River borders the western and southwestern portions of the planning area for 123 miles (USGS 2014).

There are 69 lakes in the planning area, ranging from 2-acre ponds to the 10,400-acre Skiatook Lake and portions of the larger Keystone and Kaw Lakes along the planning area boundary. Hulah Lake (2,640 acres) near Bowring is the major lake in the Caney River basin, in the northeastern portion of the planning area. The major reservoirs in the Bird Creek basin are Bluestem Lake (860 acres) near Pawhuska, Birch Lake (1,040 acres) near Barnsdall, and Skiatook Lake (10,400 acres) near Skiatook (OWRB GIS 2015; USGS 2002). Approximately 2,180 miles of rivers and creeks traverse the planning area (OWRB GIS 2015). **Figure 3-7**, Hydrologic Features (in **Appendix E**), shows streams, rivers, and lakes in the planning area.

Water quality standards consist of the designation of beneficial uses, water quality criteria to protect the designated uses, and antidegradation policies. Under Section 303(d) of the CWA, states, territories, and authorized Tribes are required to develop lists of impaired waters that do not meet water quality standards set by states, territories, or authorized Tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop their total maximum daily loads. This is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards (EPA 2015c). There are 18 waterbodies in the planning area that are on the EPA's 303(d) list of impaired waters (see **Table 3-9**, Waterbodies on the 303(d) List of Impaired Waters, and **Figure 3-7** [in **Appendix E**]).

As shown in **Table 3-9**, oil and natural gas activities are considered a probable source in 3 out of the 18 impaired waterbodies in the planning area: Hominy Creek, Bigheart Creek, and Harlow Creek. No total maximum daily load has been established for the pollutants that could be related to oil and natural gas activities on these waterbodies (EPA 2015d).

Table 3-9
Waterbodies on the 303(d) List of Impaired Waters

Waterbody	Waterbody ID	Miles Impaired in Planning Area	Oil/Natural Gas Activities a Probable Contributor?
Delaware Creek*	OK121300010150_00	21.84	Yes
Bluestem Lake	OK121300030300_00	6.35	Unknown
Hominy Creek	OK121300040280_00	39.42	Yes
Keystone Lake, Arkansas River Arm	OK621200010050_00	24.21	Unknown
Keystone Lake	OK621200010020_00	3.62	Unknown
Arkansas River	OK621200010200_00	25.33	No
Kaw Lake, Lower	OK621210000020_00	5.68	Unknown
Kaw Lake, Upper	OK621210000040_00	0.15	Unknown
Bigheart Creek	OK120420010140_00	2.40	Yes
Harlow Creek	OK120420010170_00	4.29	Yes
Shell Lake	OK120420010250_00	5.47	Unknown
Flat Rock Creek	OK121300010120_00	3.89	Unknown
Birch Lake	OK121300030040_00	9.44	Unknown
Pawhuska Lake	OK121300030230_00	1.02	Unknown
Hominy Lake	OK121300040350_00	0.35	Unknown
Mission Creek	OK121400020190_00	18.63	No
Hulah Lake	OK121400030020_00	14.59	Unknown
Buck Creek	OK121400030170_00	25.36	No

Sources: EPA GIS 2015; EPA 2015d
*Delaware Creek was removed from Oklahoma's CWA section 303(d) list for pH (2006), *E. coli* (2008), total dissolved solids (2010), sulfates (2010), and turbidity (2012; EPA 2016a).

Chloride is one of the pollutants causing impairment in Hominy Creek (EPA 2015d). In the planning area, chloride in surface water can come from natural upward seepage of brines underlying fresh groundwater and from brines pumped to the surface and reinjected or otherwise disposed of as a byproduct of oil and natural gas extraction. Chloride concentrations measured in surface water in 1999 at sites distributed throughout the planning area were generally greatest in the southern and eastern sections. This is also where the most oil and gas wells had been drilled. Chloride levels are particularly high in the Little Hominy Creek watershed in the Bird Creek basin (USGS 2014).

Floodplains

A floodplain is a geographic area of relatively level land that is occasionally inundated by surface water from rivers or streams. A floodplain would be covered by water in the event of a 100-year flood. This is a flood that has a 1 percent chance of being equaled or exceeded in magnitude in any given year. Areas in the 100-year floodplain are considered special flood hazard areas, and special insurance and construction requirements apply.

The Federal Emergency Management Agency (FEMA) has different requirements for different types of areas, or flood zones, in the 100-year floodplain. The planning area contains areas in three different flood zones, as follows:

- Zone A is subject to inundation by a 100-year flood but has not had detailed hydraulic analyses completed
- Zone AE is subject to inundation by a 100-year flood and has been the subject of more detailed analysis on flood elevations
- Zone AO is subject to inundation by 100-year shallow flooding (usually sheet flow on sloping terrain) and has been the subject of detailed analysis on average flood depths

The number of acres in each of these flood zones in the planning area is shown in **Table 3-10**, FEMA Flood Zones; **Figure 3-7** (in **Appendix E**) shows the locations of these zones.

Table 3-10
FEMA Flood Zones

Flood Zone	Acres in Planning Area
A	107,100
AE	41,300
AO	100

Source: FEMA GIS 2013

3.3.3 Trends

Public water supplies, agriculture, and oil and gas development are expected to remain the primary uses of surface water and groundwater supplies in the planning area. Oil and gas development activity and population in the planning area are expected to increase in the next 20 years (see **Section 3.16.3**, Mineral Extraction, Trends, and **Section 3.10**, Socioeconomics and Environmental Justice). Between 2018 and 2037, there are estimated to be 3,208 new oil wells and 1,369 new gas wells, for a total of 4,577 producing wells (**Appendix A**).

As oil and gas development and populations increase, the demand for water will likely increase. Injecting produced water is also expected to increase, with the continuation of hydraulic fracturing and conventional oil and gas development in the planning area.

Additionally, there could be increased pressure to use other sources of groundwater, to recycle produced water, and to focus more on technologies for removing excess brine and other pollutants. This would make it possible to use wastewater and non-freshwater sources of groundwater for oil and gas development activities.

3.4 AIR QUALITY AND CLIMATE

3.4.1 Air Quality

Air quality is influenced by a combination of factors: climate, weather, the magnitude and distribution of pollution sources, and the chemical properties of emitted pollutants. Air quality is a component of air resources that may be affected by oil and gas development in the planning area. Accordingly, the BIA must consider and analyze the potential impacts of authorized oil and gas development on air quality.

Regulatory Framework

The CAA (42 USC 7401–7642) established the principal framework for national, state, and local air quality protection. The EPA prescribes regulations and standards implementing the requirements of the CAA. While the EPA retains authority for certain air quality rules, including most pertaining to emission standards for mobile sources, it may authorize states and, in some cases, Tribal governments to implement portions of the CAA.

Under the 1990 amendments to the CAA, Tribal governments are to be treated as states; however, unlike states, Tribes are not required to implement all CAA requirements. Instead, they are authorized to develop and implement CAA requirements that they deem appropriate. In the event that a Tribe does not have the desire or capability to administer CAA programs, the EPA generally oversees the implementation of the CAA on Tribal lands.

In Oklahoma, the EPA has delegated responsibility for implementing the CAA to the Oklahoma Department of Environmental Quality. In parts of Osage County that are not considered Indian country, the Oklahoma Department of Environmental Quality is responsible for most permitting under the CAA; however, the EPA retains responsibility for some parts of the CAA.

Ambient Air Quality Standards

Under the authority of the CAA, the EPA has established nationwide air quality standards, known as the National Ambient Air Quality Standards (NAAQS; **Table 3-11**, National Ambient Air Quality Standards). These standards represent the maximum allowable atmospheric concentration of the six criteria pollutants that are considered to be key indicators of air quality: carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead, and two categories of particulate matter (less than 10 microns in diameter [PM_{10}] and less than 2.5 microns in diameter [$PM_{2.5}$]).

There are primary and secondary standards for these pollutants. Primary standards set limits to protect public health, including the health of sensitive populations, such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including against decreased visibility and damage to animals, crops, vegetation, and buildings. Averaging periods vary by

Table 3-11
National Ambient Air Quality Standards

Pollutant	Averaging Time	National Standards		
		Primary	Secondary	Form
Ozone	8-hour	0.070 ppm[1]	Same as primary	Annual 4th-highest daily maximum 8-hour concentration, averaged over 3 years
Carbon monoxide	8-hour	9 ppm	—	Not to be exceeded more than once a year
	1-hour	35 ppm	—	
Nitrogen dioxide	Annual (arithmetic mean)	0.053 ppm	Same as primary	Annual mean
	1-hour	100 ppb	—	98th percentile, averaged over 3 years
Sulfur dioxide	3-hour	—	0.5 ppm	Not to be exceeded more than once a year
	1-hour	75 ppb[2]	—	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
PM_{10}	24-hour	150 µg/m³*	Same as primary	Not to be exceeded more than once a year, on average, over 3 years
$PM_{2.5}$	Annual (arithmetic mean)	12 µg/m³	15 µg/m³	Annual mean, averaged over 3 years
	24-hour	35 µg/m³	Same as primary	98th percentile, averaged over 3 years
Lead[3]	Rolling 3-month average	0.15 µg/m³	Same as primary	Not to be exceeded

Source: EPA 2017a
[1]**ppm**—parts per million. Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the 2008 ozone standards and a transition to the 2015 standards will be addressed in the implementation rule for the current standards.
[2]**ppb**—parts per billion. Final rule signed June 2, 2010. The 1971 annual and 24-hour sulfur dioxide standards (0.03 ppm annual and 0.14 ppm 24-hour) were revoked in that same rulemaking; however, these standards remain in effect until 1 year after an area is designated for the 2010 standard. One exception is in areas designated as nonattainment for the 1971 standards; in such cases the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.
***µg/m³**—micrograms per cubic meter. Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m³) remains in effect until 1 year after an area is designated for the 2008 standard. The one exception is in areas designated as nonattainment for the 1978 standard; in such cases the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

pollutant, based on the potential health and welfare impacts of each pollutant. Individual states must meet the NAAQS but have the option of adopting their own standards that are at least as stringent at the NAAQS.

The EPA periodically reviews the standards and the science that they are based on. The existing standards can be revised, or new standards can be introduced, to ensure that they provide adequate health and environmental protection.

Clean Air Act General Conformity

Section 176(c) of the CAA requires that federal actions conform to the appropriate state implementation plan. The EPA has promulgated rules establishing conformity analysis procedures for transportation-related actions and for other general federal agency actions (40 CFR 6, 51, and 93).

The EPA general conformity rule requires a formal conformity determination document for federal agency actions that are undertaken, approved, or funded in federal nonattainment or maintenance areas. This rule applies when the total net change in direct and indirect emissions of nonattainment pollutants (or their precursors) exceeds specified thresholds. Osage County is not in a nonattainment or maintenance area; therefore, CAA conformity does not apply to federal actions in the planning area.

Prevention of Significant Deterioration

In addition to the NAAQS, the CAA also has prevention of significant deterioration (PSD) provisions. They establish a permitting process intended to limit incremental increases of specific pollutant concentrations above a legally defined baseline level. They apply to new or modified major stationary sources in attainment or unclassified areas.

The purpose of the program is to protect public health and welfare. It also preserves, protects, and enhances the air quality of national parks and wilderness areas, national monuments, seashores, and other areas of recreational, scenic, or historic value.

The PSD regulations prevent areas that are in attainment of the NAAQS from being polluted, up to the level of the standards. The CAA directs the EPA to classify areas of the US as Class I, II, or III. Class I areas are national parks and wilderness areas of a certain size that existed before 1977 or additional areas that have since been designated by federal regulation. The PSD regulations place limits on the total incremental increase in ambient pollution levels above established baseline levels for sulfur dioxide, nitrogen dioxide, and PM_{10} that are allowed in these areas (see **Table 3-12**, PSD Class I and Class II Increments). Class II areas allow a greater degree of degradation and comprise the remaining areas in the US (outside of nonattainment and maintenance areas). National Park System units over 10,000 acres are given more resource protection than other Class II areas. No Class III areas, which would allow the greatest level of degradation, have been designated.

There are two Class I airsheds in Oklahoma, but neither is in the planning area (National Park Service 2011). There are no Tribal Class I airsheds in the planning area (National Park Service 2011). Class II airsheds are the remaining areas outside nonattainment and maintenance areas, and these make up the entire planning area. No areas have been designated as Class III.

Hazardous Air Pollutants

Toxic air pollutants, also known as hazardous air pollutants, are those that are known to cause or are suspected to cause cancer or other serious health impacts. No ambient air quality standards exist for hazardous air pollutants; instead, emissions of these pollutants fall under a variety of regulations that target the specific source class and industrial sectors for stationary, mobile, and product use and formulations.

Table 3-12
PSD Class I and Class II Increments

Pollutant	Averaging Period	NAAQS (μg/m³)	PSD Class I Increment (μg/m³)	PSD Class II Increment (μg/m³)
Nitrogen dioxide	1-hour	188	—	—
	Annual	100	2.5	25
Ozone	8-hour	137	—	—
$PM_{2.5}$	24-hour	35	2	9
	Annual	12	1	4
PM_{10}	24-hour	150	8	30
	Annual	—	4	17
Sulfur dioxide	1-hour	196	—	—
	3-hour	1,3000	25	512
	24-hour	365	5	91
	Annual	80	2	20

Source: 40 CFR 52.21(c)

Sources of hazardous air pollutants from oil and gas operations are benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde from well sites and from compressor station and gas plant combustion. Oil and gas exploration and development can also release H_2S gas from geologic formations, which can be a public health and safety hazard. While H_2S has been removed from the CAA Section 112(b) list of hazardous air pollutants, it is subject to accidental release provisions under Section 112(r). For more discussion on H_2S in the planning area, see **Section 3.11**.

Current Conditions

The planning area is Osage County, Oklahoma. The area of analysis for directly emitted pollutants (those other than ozone) is generally limited to a few miles downwind of a source. The area of analysis for ozone is larger; this is because ozone is formed by photochemical reactions of other pollutants in the atmosphere, primarily VOCs and nitrogen oxides. Ozone may form later and at a greater distance from the sources of precursor emissions.

The CAA requires each state to identify areas that have ambient air quality in violation of federal standards, using monitoring data collected through state monitoring networks, as follows:

- Areas that violate air quality standards are designated as nonattainment for the relevant criteria air pollutants.
- Areas that comply with air quality standards are designated as attainment for the relevant criteria air pollutants.
- Areas that have been redesignated from nonattainment to attainment are considered maintenance areas.

- Areas of uncertain status are generally designated as unclassifiable but are treated as attainment areas for regulatory purposes.

Osage County, like all of Oklahoma, is in attainment or is unclassified for all NAAQS (EPA 2017b). It is part of the Tulsa metropolitan statistical area, which includes Creek, Okmulgee, Osage, Pawnee, Rogers, Tulsa, and Wagoner Counties. This area is represented by the Indian Nations Council of Governments (INCOG), an association of local and Tribal governments in the Tulsa metropolitan area. INCOG is the Metropolitan Planning Organization for the Tulsa region and is responsible for regional transportation plans, in cooperation with the Oklahoma Department of Transportation (ODOT) and the Metropolitan Tulsa Transit Authority. It serves as the planning agency for air quality issues in the region (INCOG and OK DEQ 2017).

Portions of the Tulsa metropolitan statistical area are vulnerable to being designated as nonattainment for ozone, though it is not known how much of the statistical area would be included in a future nonattainment designation.

INCOG was accepted into the EPA Ozone Advance Program. This is a collaboration between the EPA, states, and local governments to enact expeditious emission reductions to help near-nonattainment areas to remain in attainment of the NAAQS (INCOG and OK DEQ 2017).

There are five ozone monitors in the Tulsa Metropolitan Statistical Area, none of which are in Osage County; therefore, measured concentrations of ozone are not available for Osage County.

The north monitor in the Tulsa Metropolitan Statistical Area is in Skiatook, near the border of Osage County with Tulsa County (INCOG and OK DEQ 2017). Data for the last 3 years for which monitoring data have been verified show some instances where the ozone standard has been exceeded; however, the 3-year average of the fourth highest daily maximum (on which the 8-hour ozone standard is based) is below the NAAQS for ozone (**Table 3-13**, Air Quality Monitoring Values Near the Planning Area; EPA 2017c).

Table 3-13
Air Quality Monitoring Values Near the Planning Area

Pollutant	Averaging Time	2013 (ppm)	2014 (ppm)	2015 (ppm)	3-Year Average (ppm)	NAAQS (ppm)	Percent of NAAQS[1]
Site ID 401430137 (1100 South Osage Drive, Skiatook)							
Ozone	8-hour averaging end hour	0.071	0.065	0.066	0.067	0.070	96

Source: EPA 2017c
[1] In 2013 and 2014, the NAAQS for ozone was 0.075 ppm. It was lowered to 0.070 ppm in 2015. See **Table 3-11**, National Ambient Air Quality Standards, for more detail.

The Oklahoma Department of Environmental Quality collects annual point source emissions from permitted sources. Emissions from reported sources in Osage County are shown in **Table 3-14**, below.

Table 3-14
Osage County Annual Point Sources Emissions, 2013–2015

Year	Emissions (Tons per Year)						
	Sulfur Dioxide	Nitrogen Dioxide	Carbon Monoxide	PM_{10}	$PM_{2.5}$	VOCs	Hazardous Air Pollutants
2013	11	558	575	64	30	1,051	245
2014	11	480	521	93	31	1,816	387
2015	Less than 1	428	466	104	29	1,511	373

Source: OK DEQ 2017

An emissions inventory was prepared as part of the air quality analysis for the OKT Joint EIS/BLM RMP/BIA IRMP. That inventory estimated the annual oil and gas-related point and area source emissions in Osage County (Grant et al. 2016a). These emissions are shown in **Table 3-15**, below.

Table 3-15
2011 Area and Point Source Oil and Gas Emissions by Mineral Estate in Oklahoma

Mineral Estate Designation	Emissions (Tons)						
	Sulfur Dioxide	Nitrogen Dioxide	Carbon Monoxide	PM_{10}	$PM_{2.5}$	VOCs	Hazardous Air Pollutants
Osage Indian	**5**	**2,238**	**2,758**	**52**	**52**	**5,859**	**164**
Federal	3	577	552	18	18	872	39
State and private	916	123,070	117,224	3,370	3,365	201,092	7,782
Other Indian	6	1,664	1,712	48	48	2,975	122
Total Emissions	**930**	**127,549**	**122,246**	**3,488**	**3,483**	**210,798**	**8,107**
Percent of statewide emissions from Osage Indian sources	0.54	1.75	2.26	1.49	1.49	2.78	2.02

Source: Grant et al. 2016a
The method used for this baseline emissions inventory is detailed in Section 2.1 of Grant et al. 2016a. Area source emissions estimates were obtained from the Oklahoma Department of Environmental Quality, while point sources were obtained from the EPA's National Emissions Inventory.

Trends

As described under *Current Conditions*, there are no permanent air quality monitoring stations in Osage County.

The 2016 Tulsa Area Ozone Advance Annual Update reported ozone trend data in the Tulsa Metropolitan Statistical Area from 1996 to 2016 (see **Figure 3-8**, Ground Level Ozone Trend (1996–2016) [in **Appendix E**]; INCOG and OK DEQ 2017).

As shown in **Figure 3-8** (in **Appendix E**), ozone concentrations have decreased over time, with occasional spikes in ozone levels.

Forecast

While new sources of ozone precursor emissions will continue to be proposed in the planning area, federal, state, local, and Tribal jurisdictions continue to seek ways to reduce emissions through voluntary and regulatory mechanisms. Climate scientists have predicted that drought conditions and high temperatures will increase through 2050 in the Great Plains (National Climate Assessment 2014); this could contribute to an increase in the instances where the ozone standard is exceeded.

3.4.2 Climate

Climate analysis has two components to be considered in a NEPA analysis. The first is the impact that climate change has on the resources and resource uses in the planning area; the second is the impact that activities and management actions authorized by the NEPA document have on greenhouse gas (GHG) emission levels that contribute to climate change.

This section is an overview of climate and climate change in the region and the sources and levels of GHG emissions at a state and national scale. More information on how climate change is affecting specific resources and resource uses in the planning area is described in the individual resource sections in this chapter.

Climate is the generally prevailing weather conditions of a particular region throughout the year, averaged over a series of years (National Climate Assessment 2014). Climate is both a driving force and a limiting factor for biological, ecological, and hydrological processes. Climate change represents a deviation from the average climate, whether warming or cooling, over an extended period (IPCC 2013); such change has been happening continuously since the formation of the earth and its early atmosphere, billions of years ago. Climate change occurs as a result of a change in the earth's overall energy balance, or a difference in the amount of energy it receives and emits back into space (EPA 2016b).

The earth has a natural greenhouse effect, wherein naturally occurring GHGs, such as water vapor, carbon dioxide, methane, and nitrous oxide, absorb and retain heat. GHGs are efficient in absorbing short-wave radiation emitted by the earth, effectively trapping the heat that would otherwise be lost into space. Also known as the greenhouse effect, this warms the earth and its atmosphere. Increased levels of GHGs trap more heat in the atmosphere (EPA 2016c).

In its Fifth Assessment Report, the International Panel on Climate Change (IPCC 2014) states that the atmospheric concentrations of well-mixed, long-lived GHGs, such as carbon dioxide, methane, and nitrous oxide, have increased to levels unprecedented in at least the last 800,000 years. Globally, atmospheric carbon dioxide concentrations have increased from an estimated 277 ppm before 1750 to approximately 395 ppm in 2013 (Global Carbon Project 2014). From pre-industrial times until 2013, the global average concentration of carbon dioxide in the atmosphere increased by over 40 percent, methane increased by over 150 percent, and nitrous oxide increased by over 20 percent (IPCC 2014).

Following decades of extensive and focused research and a growing body of evidence, the scientific community has reached a consensus that climate change is occurring (NASA 2016). Research indicates that natural causes do not explain most observed warming, especially warming since the mid-twentieth century; rather, it is extremely likely that human activities have been the dominant cause of that warming (IPCC 2013).

Regulatory Framework

In 2007, the US Supreme Court ruled in *Massachusetts v. EPA* that the EPA has the authority to regulate GHGs, such as methane and carbon dioxide, as air pollutants under the CAA. The ruling did not, however, require the EPA to create any emissions control standards or ambient air quality standards for GHGs. At present, there are no ambient air quality standards for GHGs.

Current Conditions

Climate

The planning area is classified as part of the Great Plains. The climate there tends to be characterized by long, hot summers and severe winters (National Climate Assessment 2014). The average temperature in Osage County is about 59 degrees Fahrenheit, with an average high temperature around 93 degrees and an average low temperature around 23 degrees. The annual mean temperature increased by about 1 degree Fahrenheit between 1970 and 2007, as measured at the National Weather Service field station in Pawhuska (USGS 2014).

Annual rainfall in Osage County ranges from about 36 inches in the west and northeast to 45 inches in the southeast, with May and September typically receiving the most precipitation (USGS 2014). The region tends to be susceptible to droughts (National Climate Assessment 2014).

Table 3-16, Average Temperatures and Precipitation in and Near the Planning Area, 1981–2010, shows monthly climate normal data for three representative cities in and near the planning area, from 1981 to 2010. Climate normals are 3-decade averages of climatological variables produced every 10 years by the National Oceanic and Atmospheric Administration, National Climatic Data Center.

Table 3-16
Average Temperatures and Precipitation in and Near the Planning Area, 1981–2010

Location	Average Maximum Temperature (Degrees Fahrenheit)			Average Minimum Temperature (Degrees Fahrenheit)			Average Precipitation (Inches)		
	Jan.	July	Annual	Jan.	July	Annual	Jan.	July	Annual
Pawhuska	47.9	92.3	71.3	24.6	70.3	47.8	1.68	4.56	3.91
Ralston	47.6	93.1	71.5	22.5	69.3	46.1	1.31	3.39	3.28
Ponca City	45.7	92.7	70.1	24.0	70.6	47.4	1.00	3.33	2.90

Source: National Oceanic and Atmospheric Administration 2015

Climate change in the Great Plains is described on the National Climate Assessment website (National Climate Assessment 2014). This website provides an overview of how climate change is affecting the region in five key topic areas, as follows:

- Energy, water, and land use—Rising temperatures are increasing the demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water among communities, agriculture, energy production, and ecological needs.
- Sustaining agriculture—Changes to crop growth cycles due to warming winters and alterations in the timing and magnitude of rainfall have already been observed; as these trends continue, they will require new agriculture and livestock management practices.
- Conservation and adaptation—Landscape fragmentation is increasing, for example, in the context of energy development in the northern Great Plains. A highly fragmented landscape will hinder adaptation of species when climate change alters habitat composition and timing of plant development cycles.
- Vulnerable communities—Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events in an already highly variable climate system.
- Opportunities to build resilience—The magnitude of expected changes will exceed those experienced in the last century. Existing adaptation and planning are inadequate to respond to these projected impacts.

Greenhouse Gases
GHGs are chemical compounds in the earth's atmosphere. Some GHGs occur both naturally and through human activities, while others are created and emitted solely through human activities. Naturally occurring GHG compounds are carbon dioxide, methane, nitrous oxide, ozone, and water vapor. Carbon

dioxide, methane, and nitrous oxide are produced naturally by the following processes:

- Respiration and other physiological processes of plants, animals, and microorganisms
- Decomposition of organic matter
- Volcanic and geothermal activity
- Naturally occurring wildfires
- Natural chemical reactions in soil and water

Ozone is not released directly by natural sources. It forms during complex chemical reactions in the atmosphere between organic compounds and nitrogen oxides in the presence of ultraviolet radiation. While water vapor is a strong GHG, its concentration in the atmosphere is primarily a result, and not a cause, of changes in temperatures on the surface and in the lower atmosphere.

Carbon dioxide, methane, and nitrous oxide are also produced by industrial processes, motor vehicles and other transportation sources, urban development, agricultural practices, and other human activities.

Global Emissions

The World Resources Institute's (WRI) Climate Analysis Indicators Tool provides data on GHG emissions from 186 countries and all 50 states (WRI 2016). In 2012, global GHG emissions were 46,049 million metric tons (MMT) of carbon dioxide equivalent (CO_2e).

US Emissions

The WRI's Climate Analysis Indicators Tool reports total US GHG emissions of 5,420.7 million MMT CO_2e in 2012 (WRI 2016); this represented nearly 12 percent of the total global emissions.

The WRI reports 2012 statewide GHG emissions in Oklahoma of 804.8 MMT CO_2e; this accounts for 2.2 percent of total US GHG emissions. Electricity generation, transportation, and industry were the largest sources of GHG emissions in Oklahoma, as follows:

- Electricity—34 percent
- Transportation—23 percent
- Industry—16 percent

County Emissions

There are no county-wide estimates of GHG emissions; however, the BLM and BIA developed a GHG emissions inventory for the oil and gas sector, as part of the air and climate analysis for the OKT Joint EIS/BLM RMP/BIA IRMP (Cosic and Vijayaraghavan 2016). This inventory included upstream and midstream sources, including well sites, compressor stations, gas plants, and off-road equipment.

Table 3-17, 2011 Oil and Gas-Related GHG Emissions in Oklahoma by Mineral Estate, below, shows total oil and gas GHG emissions in Oklahoma by mineral estate designation for the baseline year 2011. As shown in this table, Osage County oil and gas emissions represented 1.7 percent of state oil and gas emissions in 2011.

Table 3-17
2011 Oil and Gas-Related GHG Emissions in Oklahoma by Mineral Estate

Mineral Estate Designation	CO_2e (MMTs per Year)
Osage Indian	0.8
Federal	0.2
State and private	44.3
Other Indian	0.6
Total Emissions	**46.0**
Percent of statewide oil and gas emissions from Osage Mineral Estate	1.7

Source: Cosic and Vijayaraghavan 2016

Trends

Climate

Changes in climate over the past 100 years are well documented. The earth's surface has become incrementally warmer in the past 3 decades, compared with any preceding decade since 1850. There is a 95 to 100 percent certainty that the period from 1983 to 2012 was the warmest 30-year period of the last 800 years in the Northern Hemisphere. Moreover, this is likely the warmest 30 years of the last 1,400 years (IPCC 2014).

The global average of the combined land and ocean surface temperature data show a warming of 1.5 degrees Fahrenheit from 1880 to 2012. The increase between the average from 1850 to 1900 and from 2003 to 2012 is 1.4 degrees Fahrenheit. From 1901 to 2012, the longest period when calculation of regional trends is sufficiently complete, almost the entire globe experienced surface warming (IPCC 2014).

On a global scale, the ocean surface has warmed by 0.2 degrees Fahrenheit per decade from 1971 to 2010; since 1901, average sea level has increased by 7.5 inches. Late summer Arctic Ocean sea ice coverage has decreased by half since 1979, and glaciers have receded and lost significant mass since the 1970s (IPCC 2014).

Most of Oklahoma did not become warmer during the last 50 to 100 years, but soils became drier, annual rainfall increased, and more rain has been in the form of heavy downpours. While most of the earth warmed during the last century, natural cycles and sulfates in the air cooled eastern Oklahoma. This trend is not expected to continue. This is because sulfate emissions are declining and the factors that once prevented parts of the state from warming are unlikely to persist (EPA 2016d).

Greenhouse Gases

From 1990 to 2010, global GHG emissions increased by 42 percent, or at an average annual rate of 1.9 percent. From 1970 to 2000, global GHG emissions increased at an average annual rate of 1.3 percent, while from 2000 to 2010 these emissions increased at an average annual rate of 2.2 percent. Between 2000 and 2010, GHG emissions increased in all sectors, except in agriculture, forestry, and other land use (IPCC 2014).

From 1990 to 2015, US GHG emissions increased by 3.5 percent, or at an average annual rate of 0.2 percent. Over this period, total emissions in the energy, industrial processes and product use, and agriculture sectors grew by 4.1 percent, 10.4 percent, and 5.5 percent, respectively (EPA 2017d).

Between 1990 and 2012, GHG emissions in Oklahoma increased by 18 percent. Over this period, total emissions in the energy and industrial processes sectors increased by 20 percent and 66 percent, while the agriculture sector decreased by 7 percent (WRI 2017).

Forecast

Climate

Climate models predict that annual temperatures will continue to increase through the twenty-first century. Extreme weather, such as severe drought and intense rainfall, is also expected to increase in frequency.

According to the EPA (EPA 2016b), the following conditions will apply:

- Increases in average global temperatures are expected to be within the range of 0.5 to 8.6 degrees Fahrenheit by 2100, with a likely increase of at least 2.7 degrees Fahrenheit for all scenarios, except the one representing the most aggressive mitigation of GHG emissions.
- By 2100, the average US temperature is projected to increase by about 3 to 12 degrees Fahrenheit, depending on emissions scenarios and climate models.
- Northern areas of the US are projected to become wetter, especially in the winter and spring. Southern areas, especially the Southwest, are projected to become drier.

- The proportion of precipitation falling as rain rather than snow is expected to increase, except in far northern areas of the country.

In the Great Plains, climate projections indicate that droughts, heat waves, and extreme rainfall will occur with greater frequency and intensity. Currently, the southern portion of the Great Plains, including the planning area, has an average of 7 days a year where maximum temperatures exceed 100 degrees Fahrenheit. Mid-century projections show the number of days with temperatures exceeding 100 degrees Fahrenheit will quadruple (National Climate Assessment 2014).

Changing extremes in precipitation are projected across all seasons, including higher likelihoods of both increasing heavy rain and snowstorms and more intense droughts. Osage County is likely to experience more severe and frequent heavy snowfalls than the rest of the state, aside from the panhandle (National Weather Service 2017). Projections show an increase in the length of dry spells in Oklahoma (National Climate Assessment 2014).

Greenhouse Gases

In its publication, What Climate Change Means for Oklahoma (EPA 2016d), the EPA identified the following:

- Precipitation and water sources—The demand for water will increase, but water will be less available. As rising temperatures increase evaporation and water use by plants, soils are likely to become drier. Increased evaporation and decreased rainfall are likely to reduce the average flow of rivers and streams. Conventional power plants need adequate water for cooling. Compounding the challenges for electric utilities, rising temperatures are expected to increase the demand for electricity for air conditioning.
- Agriculture—Increasing droughts and higher temperatures are likely to interfere with Oklahoma's farms and cattle ranches. Hot weather causes cows to eat less and grow more slowly, and it can threaten their health. Reduced water availability would create challenges for ranchers, as well as farmers who irrigate crops such as wheat. Yields are likely to decline by about 50 percent in fields that can no longer be irrigated. The early flowering of winter wheat could have negative repercussions on livestock farmers who depend on it for feed.
- Floods and tornadoes—Although summer droughts are likely to become more severe, floods may also intensify. Over the next several decades, the amount of rainfall during the wettest days of the year is likely to continue to increase, which would increase flooding. Scientists do not know how the frequency and severity of tornadoes will change; rising levels of GHGs increase humidity and

unstable conditions, but decreased wind shear discourages tornadoes.

- Wildfires and landscape change— Higher temperatures and droughts are likely to increase the severity, frequency, and extent of wildfires. The combination of more fires and drier conditions may change parts of Oklahoma's landscape.

3.5 Fish, Wildlife, and Migratory Birds

3.5.1 Regulatory Framework

Migratory Bird Treaty Act of 1918, as amended

The Migratory Bird Treaty Act of 1918 (MBTA; 16 USC 703–712) makes it unlawful to, among other things, pursue, hunt, take, capture, kill, or possess any migratory bird or part, nest, or egg of such bird listed in four separate wildlife protection treaties between the US, Great Britain, Mexico, Japan, and Russia. The MBTA covers 1,007 species, as specified in 50 CFR 10.13.

3.5.2 Current Conditions

Fisheries

Lands in the planning area contain ponds, lakes, and other waterways that provide habitat for a diverse assortment of game and nongame fish species. Many of the ponds and lakes are stocked with game fish; some of the most common species are bass (*Micropterus* spp.), crappie (*Pomoxis* spp.), and catfish (*Ictalurus* spp.). Other game species are paddlefish (*Polyodon spathula*), sauger (*Sander canadensis*), sunfish (*Mola mola*), rainbow and brown trout (*Oncorhynchus mykiss*, *Salmo trutta*), and walleye (*Sander* spp.).

A 1991 survey of the Sand Creek watershed and Hickory Creek in the Bird Creek system identified 23 species with representative characteristics of both Ozarkian and Osage Plains river systems; several of these species are intolerant of degraded habitat and water quality. The fish included suckers (family Catostomidae); topminnows (family Fundulidae); silversides (family Atherinopsidae); perches (family Moronidae); darters (family Percidae); sunfishes (family Centrarchidae); gars (family Lepisosteidae); catfishes (family Ictaluridae); and carps, stonerollers, and shiners (family Cyprinidae) (Stewart et al. 1991).

Some lakes in the planning area, such as Keystone, Skiatook, Hulah, and Kaw, have been combined with WMAs and waterfowl refuges. Approximately 2,080 miles of rivers and creeks and 25,230 acres of lakes are found in the planning area (OWRB GIS 2015).

Wildlife

The Cross Timbers and Flint Hills Ecoregions dominate most of the planning area and provide habitat for an array of wildlife species.

Five bat species are known to occur in Osage County: the big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus),* silver-haired bat (*Lasionycteris noctivagans*), and tri-colored bat (*Permyotis subflavus*). These species roost in a variety of habitats, such as caves, rock crevices, tree hollows and cracks, tree foliage, and buildings (ODWC 2013a).

White-nose syndrome is a disease affecting hibernating bats and is named for a white fungus that appears on the muzzle and other parts of infected bats. A newly discovered fungus, *Pseudogymnoascus* (formerly *Geomyces*) *destructans*, has been demonstrated to cause white-nose syndrome (Coleman 2014). The disease is responsible for extensive mortality of bats in eastern North America; while no incidents have been recorded in the planning area, white-nose syndrome has been confirmed in eastern Oklahoma (ODWC 2017a).

Other mammals found in the planning area are moles (*Scalopus aquaticus*), shrews (family Soricidae), opossums (*Didelphis virginiana*), rabbits (family Leporidae), armadillos (*Dasypus novemcinctus*), squirrels (family Sciuridae), beavers (*Castor canadensis*), gophers (family Geomyidae), mice (families Cricetidae and Zapodidae), raccoons (*Procyon lotor*), red foxes (*Vulpes Vulpes*), coyotes (*Canis latrans*), bobcats (*Lynx rufus*), and woodchucks (*Marmota monax*). Payne et al. (2001) conducted an inventory of the Tallgrass Prairie Preserve in Osage County between June 1991 and May 1992. They reviewed previous literature to determine historical accounts of mammals in the preserve. Based on the collected information, Payne et al. found 43 species of mammals in the preserve.

Big game species, such as white-tailed deer (*Odocoileus virginianus*), are common in the planning area. Deer harvest counts for Osage County in 2013 were 3,755, more than any other county in Oklahoma for that year (ODWC 2013b). Distribution and abundance of big game species vary by habitat type and ecoregion. White-tail deer are typically found at the edges of woodlands and forested areas (American Society of Mammalogists 2015).

Migratory Birds

Lands in the planning area are used for nesting and foraging grounds by large numbers of migratory birds, including songbirds, waterfowl, shorebirds, and raptors. Some species overwinter in the planning area, while others breed or reside there.

The one important bird area in the planning area is the 38,700-acre Tallgrass Prairie Preserve in northern Osage County. It contains large tracts of grasslands that provide nesting, breeding, and migratory stopover habitat for a variety of bird species. According to eBird (2017) 236 species of birds have been observed in the Tallgrass Prairie Preserve. Species commonly associated with the preserve are Bell's vireo (*Vireo bellii*), greater prairie-chicken (*Tympanuchus cupido*), Henslow's sparrow (*Ammodramus henslowii*), northern bobwhite (*Colinus* *virginianus*), painted bunting (*Passerina ciris*), and the red-headed woodpecker (*Melanerpes erythrocephalus*).

The USFWS Wildlife Research Center in Patuxent, Maryland, collects migratory bird survey data and has identified three breeding bird survey routes in Osage County. Bird species that have been recorded at one or more of these routes are presented in **Table 3-18**, Birds Recorded in Breeding Bird Survey Routes in Osage County; species identified as Birds of Conservation Concern are also noted.

Table 3-18
Birds Recorded in Breeding Bird Survey Routes in Osage County

Scientific Name	Common Name	Bird of Conservation Concern
Empidonax virescens	Acadian flycatcher	X
Corvus brachyrhynchos	American crow	–
Spinus tristis	American goldfinch	–
Falco sparverius	American kestrel	X
Turdus migratorius	American robin	–
Peucaea aestivalis	Bachman's sparrow	X
Icterus galbula	Baltimore oriole	–
Hirundo rustica	Barn swallow	–
Strix varia	Barred owl	–
Vireo bellii	Bell's vireo	X
Megaceryle alcyon	Belted kingfisher	–
Thryomanes bewickii	Bewick's wren	X
Coragyps atratus	Black vulture	–
Mniotilta varia	Black-and-white warbler	–
Coccyzus erythropthalmus	Black-billed cuckoo	X
Passerina caerulea	Blue grosbeak	–
Cyanocitta cristata	Blue jay	–
Polioptila caerulea	Blue-gray gnatcatcher	–
Buteo platypterus	Broad-winged hawk	–
Toxostoma rufum	Brown thrasher	X
Molothrus ater	Brown-headed cowbird	–
Branta canadensis	Canada goose	–
Poecile carolinensis	Carolina chickadee	–
Thryothorus ludovicianus	Carolina wren	–
Bubulcus ibis	Cattle egret	–
Chaetura pelagica	Chimney swift	–
Spizella passerina	Chipping sparrow	–
Caprimulgus carolinensis	Chuck-will's-widow	X
Petrochelidon pyrrhonota	Cliff swallow	–
Quiscalus quiscula	Common grackle	–

Table 3-18
Birds Recorded in Breeding Bird Survey Routes in Osage County (cont.)

Scientific Name	Common Name	Bird of Conservation Concern
Chordeiles minor	Common nighthawk	–
Geothlypis trichas	Common yellowthroat	X
Accipiter cooperii	Cooper's hawk	–
Spiza americana	Dickcissel	X
Picoides pubescens	Downy woodpecker	–
Sialia sialis	Eastern bluebird	–
Tyrannus	Eastern kingbird	–
Sturnella magna	Eastern meadowlark	–
Sayornis phoebe	Eastern phoebe	–
Caprimulgus vociferus	Eastern whip-poor-will	X
Contopus virens	Eastern wood-pewee	–
Streptopelia decaocto	Eurasian collared-dove	–
Sturnus vulgaris	European starling	–
Spizella pusilla	Field sparrow	X
Corvus ossifragus	Fish crow	–
Ammodramus savannarum	Grasshopper sparrow	X
Dumetella carolinensis	Gray catbird	–
Ardea herodias	Great blue heron	–
Myiarchus crinitus	Great crested flycatcher	–
Ardea alba	Great egret	–
Bubo virginianus	Great horned owl	–
Tympanuchus cupido	Greater prairie-chicken	–
Geococcyx californianus	Greater roadrunner	–
Quiscalus mexicanus	Great-tailed grackle	–
Butorides virescens	Green heron	–
Picoides villosus	Hairy woodpecker	–
Ammodramus henslowii	Henslow's sparrow	X
Eremophila alpestris	Horned lark	X
Carpodacus mexicanus	House finch	–
Passer domesticus	House sparrow	–
Troglodytes aedon	House wren	–
Passerina cyanea	Indigo bunting	–
Charadrius vociferus	Killdeer	–
Chondestes grammacus	Lark sparrow	–
Egretta caerulea	Little blue heron	X
Lanius ludovicianus	Loggerhead shrike	X
Anas platyrhynchos	Mallard	–
Ictinia mississippiensis	Mississippi kite	X
Zenaida macroura	Mourning dove	–
Colinus virginianus	Northern bobwhite	–

Table 3-18
Birds Recorded in Breeding Bird Survey Routes in Osage County (cont.)

Scientific Name	Common Name	Bird of Conservation Concern
Cardinalis	Northern cardinal	–
Colaptes auratus	(Yellow-shafted flicker) Northern flicker	X
Circus cyaneus	Northern harrier	–
Mimus polyglottos	Northern mockingbird	–
Setophaga americana	Northern parula	–
Stelgidopteryx serripennis	Northern rough-winged swallow	–
Icterus spurius	Orchard oriole	X
Passerina ciris	Painted bunting	X
Dryocopus pileatus	Pileated woodpecker	–
Protonotaria citrea	Prothonotary warbler	X
Progne subis	Purple martin	–
Melanerpes carolinus	Red-bellied woodpecker	–
Vireo olivaceus	Red-eyed vireo	–
Melanerpes erythrocephalus	Red-headed woodpecker	X
Buteo lineatus	Red-shouldered hawk	–
B. jamaicensis	Red-tailed hawk	–
Agelaius phoeniceus	Red-winged blackbird	–
Phasianus colchicus	Ring-necked pheasant	–
Columba livia	Rock pigeon	–
Archilochus colubris	Ruby-throated hummingbird	–
Tyrannus forficatus	Scissor-tailed flycatcher	X
Asio flammeus	Short-eared owl	X
Actitis macularius	Spotted sandpiper	–
Piranga rubra	Summer tanager	X
Buteo swainsoni	Swainson’s hawk	X
Baeolophus bicolor	Tufted titmouse	–
Cathartes aura	Turkey vulture	–
N/A	Unidentified buteo hawk	–
Bartramia longicauda	Upland sandpiper	X
Vireo gilvus	Warbling vireo	–
Tyrannus verticalis	Western kingbird	–
Sturnella neglecta	Western meadowlark	–
Sitta carolinensis	White-breasted nuthatch	–
Vireo griseus	White-eyed vireo	–
Meleagris gallopavo	Wild turkey	–
Hylocichla mustelina	Wood thrush	X
Setophaga petechia	Yellow warbler	X
Coccyzus americanus	Yellow-billed cuckoo	X
Icteria virens	Yellow-breasted chat	–

Table 3-18
Birds Recorded in Breeding Bird Survey Routes in Osage County (cont.)

Scientific Name	Common Name	Bird of Conservation Concern
Nyctanassa violacea	Yellow-crowned night-heron	–
Vireo flavifrons	Yellow-throated vireo	–
Dendroica dominica	Yellow-throated warbler	–

Sources: USFWS 2008; Pardieck et al. 2015

3.5.3 Greater Prairie-Chicken (*Tympanuchus cupido*)

The greater prairie-chicken is a chunky hen-like bird, barred with dark brown, cinnamon, and pale buff. It is slightly larger, darker, and more barred than the closely related lesser prairie-chicken, a federal threatened species. Its preferred habitat is grasslands with herbaceous cover; it may also be found in cultivated lands and pastures. Males gather in leks for communal courtship, and females nest in the vicinity, in a scrape on the ground lined with vegetation. Both sexes show site fidelity and most do not migrate. Ranges vary from 25 to 500 acres.

The diet of the greater prairie-chicken consists primarily of insects, especially grasshoppers in summer. At other times of the year it eats fruits, leaves, flowers, shoots, and grain. Formerly widespread in the grasslands of Canada and the western US, the greater prairie-chicken is now found locally in much reduced numbers in the Great Plains, south to Texas.

The species' decline is mainly the result of loss and fragmentation of tallgrass prairie from roads, infrastructure development, and incursion of trees, such as red cedar. The largest remaining populations are in Kansas, Nebraska, Oklahoma, and South Dakota. Northwestern Osage County is a stronghold for the species and contains 32,700 acres of highest importance habitat (see **Figure 3-9**, Greater Prairie-Chicken Habitat [in **Appendix E**]).

The closely related lesser prairie-chicken is also diminished in range, and the subspecies *Tympanuchus cupido cupido* (heath hen) of the eastern seaboard has been extinct since the 1930s (NatureServe 2015).

3.5.4 Trends

River impoundments are common throughout the planning area and, in some instances, have changed downstream fish assemblages by altering flow regimes (Taylor et al. 2014). For example, higher flow conditions and loss of low- to no-flow periods associated with post-impoundment habitats at the Skiatook Lake area, corresponded with increases in frequency and abundance of stream-dependent species (Taylor et al. 2014). The extent of impacts on stream species by altered habitat and deteriorated water quality in Osage County is unknown.

Some reptiles, such as the alligator snapping turtle (*Macrochelys temminckii*) and Texas horned lizard (*Phrynosoma cornutum*), have declined in the planning area;

these are both Oklahoma Natural Heritage species of concern. River channel manipulations and thermal alterations of aquatic environments have reduced populations of the alligator snapping turtle (Riedle et al. 2005). The spread of fire ants and use of insecticides to control them, heavy agricultural use, and other habitat alterations has contributed to a decline of the Texas horned lizard (Hammerson 2007).

A fungus known as *Batrachochytrium dendrobatidis* (also known as Bd or chytrid) is an amphibian infectious disease, which has increased in Osage County. Surveys in 2015 found that the prevalence of chytrid is more common than previously thought (Cameron Siler 2017).

Much of the tallgrass prairie has declined greatly in acreage due to agriculture conversion throughout the region, although large intact tallgrass prairie landscapes still remain in Osage County (ODWC 2005). Invasive species continue to threaten native habitat for wildlife by changing community structure in a way that is harmful to native wildlife species.

Trends for all bird species in the region are unknown, although many species, such as Bell's vireo, northern bobwhite, and red-headed woodpecker, appear to be in decline (ODWC 2005). Climate conditions play an important role in wildlife production and habitat quality and quantity. Persistent droughts have contributed to range-wide bobwhite quail population declines since the 1960s (ODWC 2016a). The Audubon Society identified 50 bird species that occur in Oklahoma that are threatened by climate change (National Audubon Society 2013). For other upland game species, such as wild turkey, long-term population trends have generally increased since the second half of the twentieth century, in part due to restocking and restoration.

3.6 Special Status Species

3.6.1 Regulatory Framework

Endangered Species Act of 1973

The ESA of 1973 (16 USC 1531 et seq.), as amended, provides for the conservation of federally listed plant and animal species and their habitats. The ESA directs federal agencies to conserve listed species. It imposes an affirmative duty on such agencies to ensure that any action authorized, funded, or implemented does not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of a listed species' designated critical habitat.

Critical habitat is defined in the ESA as "the specific areas within the geographical area occupied by the species . . . on which are found those physical or biological features (I) essential to the conservation of the species, and (II) which may require special management considerations or protection; and . . . specific areas outside the geographical area occupied by the species . . . upon a determination by the Secretary [of the Interior] that such areas are essential for the conservation of the species" (16 USC 1532[5][A]).

Species proposed for listing are not protected by the ESA; however, the USFWS works with federal agencies, state, local, and Tribal governments, surface owners and others to implement conservation actions that prevent a proposed species further decline.

Under the ESA, Section 7 consultation is required when a federal action may affect a listed species or designated critical habitat. During this process, the federal action agency submits a BA to the USFWS or the National Marine Fisheries Service, which includes the following:

- A list of potentially and actually occurring listed species and designated critical habitat that may be affected by the project
- A description of the proposed project
- An evaluation of the potential impacts of the project on such species and habitat

During formal consultation, for actions that may affect and are likely to adversely affect listed species or designated critical habitat, the USFWS and the federal agency will exchange information and gather any necessary additional information. Section 7 formal consultation concludes with the USFWS issuing a BO, detailing its conclusion of jeopardy or no jeopardy to a species and adverse modification/no adverse modification to a critical habitat. All reasonable and prudent measures and any incidental take statements are contained in the BO.

Section 7 consultation for the proposed project began on September 11, 2017, with USFWS formal acceptance of a BA and requested addenda submitted by the BIA. The USFWS issued a BO and letter of concurrence with the BIA's effects determinations in July 2018.

If a species is listed after completion of this EIS, the EIS would remain valid, but the BIA would need to reinitiate consultation with the USFWS.

Biological Assessment

The BIA has prepared a BA to evaluate existing habitat and endangered species with respect to oil and gas development in Osage County. The BA is included in this EIS as **Appendix B**, Osage County Oil and Gas Biological Opinion and Biological Assessment. The BIA developed the BA for the proposed ongoing exploration, development, extraction, transport, and distribution of crude oil, natural gas, and petroleum products in Osage County. The USFWS has issued a BO and letter of concurrence with the BIA's effects determinations (included in **Appendix B**).

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC 668–668d) applies primarily to taking, hunting, and trading activities that involve bald or golden eagles. The act prohibits the taking of any individuals of these two species, as well as any part, nest, or egg.

Migratory Bird Treaty Act of 1918, as amended

The MBTA (16 USC 703–712) makes it unlawful to, among other things, pursue, hunt, take, capture, kill, or possess any migratory bird or part, nest, or egg of such bird listed in four separate wildlife protection treaties between the United States, Great Britain, Mexico, Japan, and Russia. The MBTA covers 1,007 species, as specified in 50 CFR 10.13.

3.6.2 Current Conditions

Osage County is characterized by rolling uplands bisected by drainages, with narrow floodplains in the south and level to rolling uplands in the north (BIA 2013). Elevation ranges from 750 feet to 1,000 feet above mean sea level. The highest elevation in Osage County is near the town of Wynona, northeast of Pawnee; the lowest elevation is found along the Caney and Arkansas Rivers.

Predominant vegetation cover is rangeland and native pastureland. Native grass meadows, prairie, and oak savannah also are found in Osage County (BIA 2013), along with bottomland forest along the Arkansas River (Hoagland 2000). TNC's Tallgrass Prairie Preserve (39,650 acres) in Osage County is part of the 3.8 million-acre Flint Hills, the largest remaining intact tallgrass prairie in North America. The preserve is a center for rangeland research, focusing on conserving and restoring prairie ecosystems.

American Burying Beetle (Nicrophorus americanus), Endangered

The ABB is a federally endangered species that occurs in 31 counties in Oklahoma, including Osage (USFWS 2012a). The USFWS published the recovery plan for ABB in 1991. On March 15, 2016, it announced its finding that a petition to delist ABB has substantial information that the petitioned action may be warranted. The USFWS is now reviewing the status of the species. If the ABB is removed from the endangered species list, the BIA would update its required COAs, as appropriate.

This beetle is shiny black, and its most diagnostic feature is the large orange-red markings on the raised portion of the pronotum (foremost three segments of the thorax, including the first pair of legs). The species is up to 1.5 inches long. The ABB has been frequently found in upland grasslands or near the edge of grassland/forest. Sandy/clay loam soils and food (carrion) availability are also important. The species appears to prefer loose soil in which carrion can be easily buried. It is a habitat generalist, and all vegetation types are considered habitat within its range, excluding developed areas, tilled lands, mowed grasslands, saturated soils, and unvegetated areas (USFWS 2014a).

This large, strikingly colored beetle is nocturnal and belongs to a small group of beetles known to bury small dead animals. It is threatened by disease, pesticides, habitat loss, competition for food, isolation and loss of genetic diversity, decrease in prey abundance, agriculture and grazing, and invasive species (USFWS 1991, 2014a). The ABB was once found in 35 eastern states but now occupies only the periphery of its former range. It has been documented in Rhode Island, South Dakota, Nebraska, Oklahoma, Arkansas, and Kansas, with reintroductions attempted in Massachusetts and Ohio (GPNC 2012; USFWS 2012b).

The ABB is present in the planning area and would be affected by oil and gas development. Most of Osage County is within the range of this species, and the northeastern part of the county is considered a Conservation Priority Area for ABB (USFWS 2014a; see **Figure 3-10**, American Burying Beetle [in **Appendix E**]).

Whooping Crane (*Grus americana*), Endangered

The whooping crane is a federal endangered species that has been observed in Osage County, Oklahoma. It is the tallest North American bird and is named for its whooping sound. It and the sandhill crane are the only two crane species found in North America (USFWS 2012c).

An adult whooping crane is white with a red crown and a long, dark, pointed bill. Immature whooping cranes are cinnamon brown. While in flight, their long necks are kept straight and their long dark legs trail behind. Adult whooping cranes' black wing tips are visible during flight.

The muskeg of the taiga in Wood Buffalo National Park, Alberta, Canada, and the surrounding area was the last remnant of the former nesting habitat of whooping crane summer range; however, with the recent Whooping Crane Eastern Partnership Reintroduction Project, whooping cranes nest naturally for the first time in 100 years in the Necedah National Wildlife Refuge in central Wisconsin.

Whooping cranes nest on the ground, usually on a raised area in a marsh. The female lays one or two blotchy, olive green eggs, usually in late April to mid-May. The incubation period is 29 to 31 days. Both parents brood the young, although the female is more likely to directly tend to them. Usually no more than one young bird survives in a season.

Breeding populations winter along the Gulf Coast of Texas, near Corpus Christi on the Aransas National Wildlife Refuge, and along Sunset Lake, Matagorda Island, Isla San Jose, and portions of the Lamar Peninsula and Welder Point, on the east side of San Antonio Bay. The Salt Plains National Wildlife Refuge in Oklahoma is a major migratory stopover for the crane population; it hosts over 75 percent of the species annually.

The whooping crane is endangered mainly as a result of habitat loss, although they are also still illegally hunted.

Whooping cranes migrate through western Oklahoma during spring and fall. Osage County is on the eastern edge of this migration route, and whooping cranes may use the Arkansas River as a stopover area. While migrating, they are typically found in shallow wetlands, marshes, the margins of ponds and lakes, sandbars and shorelines of shallow rivers, wet prairies, and crop fields near wetlands (ODWC 2017b).

The whooping crane's lifespan is estimated to be 22 to 24 years in the wild. After being pushed to the brink of extinction by unregulated hunting and loss of habitat to just 21 wild and two captive whooping cranes by 1941, conservation has led to a limited recovery. As of 2011, there are an estimated 437 birds in the wild and more than 165 in captivity (**Appendix B**).

The nearest critical habitat for the whooping crane is the Salt Plains National Wildlife Preserve, approximately 60 miles west of Osage County. The species does not nest in or near Osage County. Although the bird has been observed migrating in Osage County, it is unlikely to be affected by oil and gas development.

Red Knot (*Calidris canutus rufa*), Threatened

Calidris canutus rufa is a subspecies of red knot, a sandpiper-like shorebird with a round body, long legs, a small head, and tiny eyes. The beak tapers and is not much longer than its head. Males and females vary slightly in size and color. It migrates over long distances, breeding in Arctic tundra and wintering on sandy beaches and barren flats in the Americas (NatureServe 2015).

Although the breeding plumage of *C. c. rufa* is the dullest of all red knot subspecies, the face, chest, and belly remain a striking reddish brown. The head is dark gray, the eye stripe, back, and rump are rust, while the rear belly is white. The wing feathers are gray, with a pale edging and oblong rust-colored center. When not breeding, the species has a white eye stripe; the head, back, and tail are a plain gray, while the face, chest, and belly are a dingy white. The upper chest has dark streaking that may extend down the flanks. In juveniles there is no distinction between male and female, which both have a dark gray head with a white eye stripe. The back and tail are gray, with distinct white outlines on the feathers, giving each feather a predominant shape. The chest and belly are white with light streaking (Harrington 2001; Niles et al. 2008).

Red knot populations have been in substantial decline from overharvesting of horseshoe crabs, whose eggs are a primary food source during migration. Although this species has been observed migrating in Osage County, it does not nest in the vicinity (NatureServe 2015) and is unlikely to be affected by oil and gas development.

Interior Least Tern (*Sternula antillarum athalassos*), Endangered

The interior least tern is a federal endangered species that has been observed in Osage, Pawnee, and Payne Counties, Oklahoma. The breeding season lasts from May through August. The terns gather at staging areas with high concentrations of fish, their primary prey, to rest and eat before the long flight to southern wintering grounds. Low wet sand or gravel bars at the mouths of tributary streams and floodplain wetlands are important staging areas. Interior least terns often return to the same breeding site, or one nearby, year after year.

Least terns nest in colonies, where nests can be as close as 10 feet but are often 30 feet or more apart. The nest is a shallow depression in an open, sandy area, a gravelly patch, or an exposed flat. Small twigs, pieces of wood, small stones, or other debris usually are found near the nest (Crawford 2012; KDWPT 2011; MDC 2011; USFWS 2011). Nesting habitat of the interior least tern is bare or sparsely vegetated sand, shell and gravel beaches, sandbars, islands, and salt flats associated with rivers and reservoirs. The birds prefer open habitat and tend to avoid thick vegetation and narrow beaches.

The interior least tern is migratory, breeding along inland river systems in the United States and wintering along the Central American coast and the northern coast of South America, from Venezuela to northeastern Brazil. Today, the interior least tern continues to breed on sandy flats in most of the major river systems, but its distribution is generally restricted to the less altered and more natural or little disturbed river segments. It has been observed migrating in Osage County and may breed along the Arkansas River in Osage County (USFWS 1990). As a result, it may be affected by oil and gas development.

Piping Plover (*Charadrius melodus*), Threatened

The piping plover is a federal threatened species that has been observed in Osage, Pawnee, and Payne Counties, Oklahoma. It is a small, sand-colored, sparrow-sized shorebird that nests and feeds along coastal sand and gravel beaches in North America. The adult has yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the neck. This chest band is usually thicker in males during the breeding season, and it is the only reliable way to tell the sexes apart. The piping plover is difficult to see when standing still as it blends well with open, sandy beach habitats. It typically runs in short starts and stops (USFWS 2012d).

Its breeding habitat is beaches or sand flats on the Atlantic coast, the shores of the Great Lakes, and the Midwest of Canada and the United States. It nests on sandy or gravel beaches or shoals and forages for food on beaches, usually by sight, moving across the beaches in short bursts. Generally, piping plovers will forage for food around the high tide wrack zone and along the water's edge. It eats mainly insects, marine worms, and crustaceans (USFWS 2014c).

Piping plovers migrate north in the summer and winter to the south on the Gulf of Mexico, the southern Atlantic coast of the United States, and the Caribbean.

They begin migrating north beginning in mid-March. Their breeding grounds extend from southern Newfoundland south to the northern parts of South Carolina. Males begin claiming territories and pairing up in late March. They also perform elaborate courtship ceremonies, including stone tossing and courtship flights, featuring repeated dives. Piping plovers begin mating and nesting on the beach in mid-April.

Migration south begins in August for some adults and fledglings, and by mid-September most piping plovers have headed south for the winter. Although this species has been observed migrating in Osage County, it does not nest in the vicinity and is unlikely to be affected by oil and gas development.

Northern Long-Eared Bat (**Myotis septentrionalis*****), Threatened***

A small insectivorous bat, the northern long-eared bat hibernates in winter and has a single pup in May or June. It forages primarily over springs and waterways and roost in small colonies in mines, caves, or trees. This bat has a wide but scattered distribution in the eastern and north-central United States and southern Canada. It has suffered severe recent declines in abundance associated with the fungal white-nose syndrome in eastern North America. The disease is expected to spread across the species' range.

The northern long-eared bat was listed as threatened on May 4, 2015. It is also threatened by wind-energy development, habitat modification, destruction and disturbance (e.g., hibernation site vandalism and roost tree removal), climate change, and contaminants, particularly for populations reduced by white-nose syndrome (NatureServe 2015). Osage County is on the edge of the range for this species, and because it does not roost in grassland areas (USFWS 2017), it is unlikely to be affected by oil and gas development.[1]

Neosho Mucket Mussel (**Lampsilis rafinesqueana*****), Endangered***

The Neosho mucket is a federal endangered species known to exist in Osage County. It is a medium to large mussel in the Lampsilinae subfamily. The shell of the Neosho mucket is relatively oblong, and the umbones[2] are low and project only slightly or not at all above the dorsal curvature of the shell (Shiver 2002).

The Neosho mucket is associated with shallow riffles and runs with gravel substrate and moderate to swift currents. Channel stability is an important factor determining the location of Neosho muckets. They need substrate loose enough to allow burrowing; typically they are deeply imbedded in the substrate in a variety of habitats in large streams and small rivers. The Neosho mucket spawns in late April and May and broods larvae from May through August (Shiver 2002; KDWPT 2012).

[1] Kevin Stubbs, USFWS biologist, phone conversation with Katie Patterson, EMPSi environmental planner, February 17, 2015.

[2] Rounded knobs or protuberances

The preferred habitat of this species is along rivers; because of this, the likelihood of a threat from oil and gas development in Osage County is low, if appropriate measures are implemented to protect habitat from disturbance related to oil and gas development (**Appendix B**).

Rattlesnake Master Borer Moth (**Papaipema eryngii*****), Candidate***

The rattlesnake master borer moth has simple antennae and is generally characterized by a long thoracic tuft that often slants forward and ends abruptly at the far end. *P. eryngii* is a large chocolate-colored moth with bold white disk markings on the wings. Nearly all the larvae in the genus are purplish brown and have a pattern of longitudinal white stripes. They can be placed into one of four groups, based on stripe configurations. *P. eryngii* is a member of the group with zero stripes. The adult of the species is readily distinguished by male genitalia or external spots (Forbes 1954).

P. eryngii larvae rely on the rattlesnake master, which is the sole host plant for this species; a population of 100 to 1,000 rattlesnake master plants are needed for *P. eryngii* to persist. *P. silphii* and rarely *P. baptisiae* will also feed on rattlesnake master in June.

Mating and egg laying are strictly nocturnal. Females deposit 200 or more eggs in the duff on or near host plants. Larvae emerge from overwintered eggs in late May and immediately begin to bore into the rattlesnake master host. Larvae enter stems near the ground and slowly eat their way into the root of the plant. Feeding continues through early August, at which time mature larvae cease all activity and lay dormant for approximately one week. Larvae pupate in late August, either in the root or in the soil, and emerge as adults roughly 18 to 21 days later (**Appendix B**).

The rattlesnake master borer moth is threatened by prairie habitat loss, fragmentation, degradation, modification, and illegal collections and population isolation (USFWS 2013).

Three populations of the species are known to occur in Osage County, in TNC's Tallgrass Prairie Preserve (USFWS 2013).

Sprague's Pipit (**Anthus spragueii*****), Candidate***

A pale, slender, sparrow-sized bird with white outer tail feathers and a heavily streaked back, Sprague's pipit is known for its jingling call and high flight. It feeds on insects and grains and nests in depressions in the ground, concealed in clumps of grass or other dense vegetation. Nests are difficult to find, and females do not flush from the nest until they are almost stepped on. On the ground, the bird is extremely secretive and flies away in a long, undulating flight when approached. It walks instead of hops and usually lands only on the ground.

Its breeding habitat is short-grass plains, mixed grass prairie, alkaline meadows, and wet meadows. The breeding season extends from late April through early

September. Sprague's pipits may raise two broods of young a year. Clutch size is usually four or five eggs. It breeds mainly on the northern Great Plains but has bred as far south as Osage County. Tallgrass prairie, particularly in northwestern Osage County, provides high value nesting habitat for Sprague's pipit. It winters from Texas to Arizona and in Mexico. It forms flocks with horned larks and longspurs for migration and typically occurs in Oklahoma for spring and fall migration (ODWC 2015).

It is found in grasslands, including upland mixed-grass prairie, alkaline meadows, and wet meadow zones around alkali and freshwater lakes. The USFWS found the pipit's listing under the ESA to be warranted but precluded by higher priority species; thus, it is considered a candidate species. Its population has declined as a result of loss, degradation, and fragmentation of habitat due to cultivation, wetland drainage, overgrazing, and nonnative vegetation (NatureServe 2015; USFWS 2010). Since the species may use grasslands in Osage County for nesting, it may be affected by oil and gas development.

Bald Eagle (*Haliaeetus leucocephalus*), Bird of Conservation Concern

The USFWS has identified the bald eagle as a Bird of Conservation Concern, meaning that it is a species that represents the agency's highest conservation priorities. In addition, the species is of cultural significance to the Osage Nation, as the feathers are highly valued.

The eagle has a distinctive white head and tail, bright yellow bill, and dark plumage; it occurs in Osage County throughout the year. It can be found along the Arkansas River, including Kaw and Keystone Lakes (ODWC 2017c). The species prefers areas near water for hunting fish or waterfowl. It also nests in tall trees or cliffs near water. Clutch size is one to three eggs. Defended territories are relatively small, from 27 to 279 acres, but feeding home ranges around active nests are larger, from 1,729 to 5,337 acres. Wintering eagles tend to avoid areas with high levels of nearby human activity and development (NatureServe 2015); as such, the species may be affected by oil and gas development.

3.6.3 Trends

Tallgrass prairie acreage has declined greatly due to agricultural conversion throughout the region, and riparian vegetation is threatened by use as farmland or pastureland and urban encroachment (ODWC 2005). Habitat for Sprague's pipit and other prairie-dwelling birds is being increasingly fragmented by roads and development.

Increased road density and has led to soil erosion, soil compaction, disturbance, and noise in wetlands (ODWC 2005), including areas potentially used by interior least tern and whooping crane,

For the ABB, threats described above are expected to continue to reduce its populations and to fragment habitat in Osage County. Oil and gas companies are expected to continue to construct, operate, and reclaim well pads, pipelines, and accompanying facilities, including access roads, electric distribution lines and substations, and off-site impoundments.

Oil and gas development in some portions of Osage County are likely to result in take of ABBs or impacts on their habitat. Activities occurring during the ABB active season could reduce the species' foraging and reproduction efficiency for the duration of the active season. This would affect prey species and reproduction and their habitat in project areas. This likely would reduce the available food sources, decrease reproduction potential, and decrease ABB use of the area. Any permanent facilities, such as access roads, would remove ABB breeding, feeding, and sheltering habitat.

3.7 Vegetation, Wetlands, and Noxious Weeds

3.7.1 Regulatory Framework

Clean Water Act

The CWA, as amended in 1977, established the basic framework for regulating discharges of pollutants into the Waters of the United States, including wetlands. The US Army Corps of Engineers regulates the discharge of dredged and fill material into Waters of the United States, including wetlands, in accordance with Section 404 of the CWA.

The US Army Corps of Engineers describes wetlands as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

The US Army Corps of Engineers provides guidelines for determining the areas under Section 404 jurisdiction (Environmental Laboratory 1987). These guidelines require that at least one positive indicator for each of three criteria (hydrophytic vegetation, hydric soils, and wetland hydrology) exist for an area to be designated as a wetland. The numerous and varied indicators for each of the criteria are described in detail in the guidelines. If these areas meet the criteria, certain activities, such as placing fill in these areas, would be subject to US Army Corps of Engineers regulation. The planning area is under the US Army Corps of Engineers Tulsa District.

Federal Noxious Weed Act

The Federal Noxious Weed Act of 1974 provides for the control and management of nonindigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, and public health. The act prohibits importing or moving any noxious weeds identified by the regulations and allows for inspection and quarantine to prevent their spread.

Executive Order 13112, Invasive Species

Signed in 1999, EO 13112 directs federal agencies to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts that invasive species cause.

Oklahoma Agricultural Code—Noxious Weeds

Title 2 of the Oklahoma Agricultural Code advises that controlling noxious weeds is the responsibility of every surface owner or occupant. According to the Noxious Weed Laws and Rules of Oklahoma (OSDA 2000), every surface owner and any public, private, or corporate entity that maintains ROWs in Oklahoma is responsible for removing any thistle infestation on their land. Noxious weeds in Oklahoma were listed by the passage of Oklahoma House Bill 2277 (NRCS 2012a).

Biological Assessment

The BIA has prepared a BA (**Appendix B**) to evaluate habitat and endangered species with respect to oil and gas development in Osage County. The USFWS has issued a BO and letter of concurrence with the BIA's effects determinations (included in **Appendix B**). (For a discussion of special status wildlife species, including those addressed by the BA, see **Section 3.6**, Special Status Species.) The BA addresses noxious weeds, including the potential for their establishment and spread, when assessing impacts on sensitive species habitat from oil and gas development. The BIA developed the BA for the proposed ongoing exploration, development, extraction, transport, and distribution of crude oil, natural gas, and petroleum products in Osage County.

3.7.2 Current Conditions

Vegetation in Oklahoma is influenced by larger regional patterns of climate, particularly the precipitation gradient. Precipitation averages 55 inches in southeast Oklahoma, enough to support dense oak-pine forests. Shortgrass prairie grasslands are the predominant vegetation in the far western portion of the state, which receives only 13 inches of precipitation annually (Hoagland 2008). Vegetation in the planning area reflects its intermediate location along this precipitation gradient. It is also influenced by geology and soils, as well as disturbances from fires and grazing.

According to the Oklahoma Biological Survey, the planning area contains three potential vegetation types: post oak-blackjack forest, tallgrass prairie, and bottomland forest along the Arkansas River (Hoagland 2008).

Table 3-19, Potential Vegetation Types, summarizes acreages of each potential vegetation type in the planning area. The potential vegetation types reflect the distribution of vegetation in the absence of human intervention and thus do not depict urban or agricultural areas.

Table 3-19
Potential Vegetation Types

Vegetation Type	Acres
Post oak-blackjack forest	772,700
Tallgrass prairie	656,700
Bottomland forest	41,400
Total[1]	**1,470,800**

Source: OK Biological Survey GIS 1943
[1] Due to a data discrepancy, potential vegetation type total acres do not precisely match the planning area total acres.

Approximately 74,000 acres (5 percent) of the planning area is developed or barren. Developed areas consist of small cities and towns and the northwest edge of the Tulsa metropolitan area, near the southeast corner of the planning area (USGS 2014). Developed and barren areas are not included in the potential vegetation types in **Table 3-19**.

Post Oak-Blackjack Forest

Post oak-blackjack forest, also locally known as the cross timbers, is characterized by a mix of forest, woodland, and grassland vegetation. Common woody species are post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), black oak (*Q. velutina*), blackhaw (*Viburnum prunifolium*), black hickory (*Carya texana*), gum bumelia (*Sideroxylon lanuginosum*), Mexican plum (*Prunus mexicana*), redbud (*Cercis* spp.), roughleaf dogwood (*Cornus drummondii*), and sumac (*Rhus* spp.).

The understory is made up of little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), and other species, depending on the site (Hoagland 2008; Duck and Fletcher 1943), though understory and regeneration are limited where cattle graze in this vegetation type (ONENRD 2006). Between 1910 and 1980, post oak-blackjack forests in the planning area approximately doubled in size due to fire suppression (ONRNRD 2006).

Post oak-blackjack forest is commercially managed, in part to produce harvestable wood products under the Osage Nation Forest Management Plan (ONENRD 2006). Commercial management was limited before the forest management plan. Forest stands may lack sufficient regeneration due in part to the cattle grazing, fire suppression, and lack of forest management in place before the forest management plan was developed. Management goals are to provide a source of income from sustained commercial harvest and sale of timber and wood products, to improve habitat for game and nongame wildlife, and to protect and enhance the aesthetic and cultural value of the resource.

Prescribed fire is a primary management tool in upland forest vegetation in the planning area; it is used on approximately 4,500 acres annually to reduce fuel loading and the severity or likelihood of wildland fire (ONENRD 2006).

Tallgrass Prairie

Tallgrass prairies contain primarily grasses, such as little bluestem, big bluestem, Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*). Other herbaceous plants found in the tallgrass prairie are lead plant (*Amorpha canescens*), Indian plantain (*Arnoglossum plantagineum*), prairie clover (*Dalea purpurea*), heath aster (*Aster ericoides*), pallid coneflower (*Echinacea pallida*), ashy sunflower (*Helianthus mollis*), and Missouri goldenrod (*Solidago missouriensis*).

Tallgrass prairie has declined greatly in acreage due to agricultural conversion throughout the region; however, large expanses of this vegetation type still occur in Osage and adjacent counties (Hoagland 2008; Duck and Fletcher 1943; ONENRD 2006).

The largest protected remnant of tallgrass prairie left on earth is in the planning area (TNC 2015). The 38,100-acre Tallgrass Prairie Preserve has been managed since 1989 by TNC, which conducts research, prescribed burning, and bison grazing management in the preserve to maintain and improve ecological diversity. The preserve is a single parcel (with several inholdings), so habitat fragmentation within it is low.

Prescribed fire is also used to improve rangelands in the planning area; it is used on approximately 39,000 acres annually to reduce woody species encroachment and the likelihood of wildland fire (ONENRD 2006).

Bottomland Forest

Bottomland forest extends from eastern to western Oklahoma, along major rivers, as mapped by Duck and Fletcher (1943). As a result, there is tremendous variation in species composition of bottomland forests. Typical stream growth in central Oklahoma within the tallgrass prairie vegetation type consists of American elm (*Ulmus americana*), chinquapin oak (*Quercus muhlenbergii*), post oak, blackjack oak, hackberry (*Celtis laevigata* and *C. occidentalis*), chittamwood (*Bumelia lanuginosa*), cottonwood (*Populus deltoides*), chickasaw plum (*Prunus angustifolia*), fragrant sumac (*Rhus trilobata*), smooth sumac (*R. glabra*), and roughleaf dogwood (Hoagland 2008; Duck and Fletcher 1943).

This vegetation type is commercially managed in part to produce harvestable wood products under the Osage Nation Forest Management Plan (ONENRD 2006), as described under *Post Oak-Blackjack Forest*, above.

Riparian Vegetation

In Oklahoma, forested riparian areas are often referred to as bottomland hardwood forests (OSU 1998), as described above (Hoagland 2008). The Oklahoma landscape, crossed by large rivers, formerly contained millions of acres of riparian land prior to Euro-American settlement (OSU 1998).

Between 1910 and 1980, bottomland hardwood (riparian) forests in the planning area shrank by approximately half, due primarily to agricultural conversion

(ONENRD 2006). These areas provide an extensive list of benefits to humans and the natural environment. Riparian areas act as a natural buffer between upland activities and sensitive water resources. They store water, mitigate the effects of flooding, reduce erosion, and provide shelter and forage for wildlife (OSU 1998).

Wetlands

Freshwater wetlands are classified as riverine (rivers, streams, and creeks), lacustrine (lakes and reservoirs), and palustrine (forested, scrub-shrub, and emergent wetlands and ponds [Cowardin et al. 1979]). According to the National Wetland Inventory remote sensing data, approximately 57,700 acres of freshwater wetlands occur in the planning area.

Table 3-20, National Wetland Inventory Wetlands, summarizes the area of each type of freshwater wetlands mapped by the National Wetland Inventory in the planning area.

Table 3-20
National Wetland Inventory Wetlands

Wetland Type	Acres
Freshwater emergent wetland (palustrine)	3,400
Freshwater forested/shrub wetland (palustrine)	12,300
Freshwater pond (palustrine)	5,700
Lake (lacustrine)	16,400
Riverine	19,800
Total	**57,600**

Source: NWI GIS 2017

Riverine

The riverine system includes nontidal freshwater wetland and deep-water habitats contained within a channel (Cowardin et al. 1979). Those wetlands that are in a channel but are dominated by trees, shrubs, or persistent emergent vegetation are described in the palustrine system, below. Riverine wetlands in the planning area are closely associated with major rivers and larger streams in the planning area, including the Arkansas and Caney Rivers and the Salt and Hominy Creeks (NWI GIS 2017).

Lacustrine

The lacustrine system includes wetlands and deep-water habitats situated in a topographic depression or a dammed river channel. Lacustrine systems lack trees, shrubs, and persistent emergent vegetation and generally have a total surface area of at least 20 acres (Cowardin et al. 1979). Lacustrine wetlands in the planning area are Keystone and Kaw Lakes and Hulah and Skiatook Reservoirs (NWI GIS 2017). Several other smaller reservoirs falling under the lacustrine system are also in the planning area.

Palustrine

The palustrine system includes all nontidal freshwater wetlands dominated by trees, shrubs, persistent emergent vegetation, and emergent mosses or lichens. It also includes wetlands lacking such vegetation but with total surface area of less than 20 acres. The palustrine system was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie. It also includes the small, shallow, permanent, or intermittent waterbodies often called ponds.

Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries, on river floodplains, in isolated catchments, or on slopes. They may also occur as islands in lakes or rivers (Cowardin et al. 1979). Palustrine wetlands in the planning area are freshwater forested or shrub wetlands, which are associated with larger river and stream systems, including the Arkansas River.

Freshwater emergent wetlands are also associated with these river and stream systems, as well as along margins of lacustrine wetlands, like reservoirs and lakes. Hundreds of small freshwater ponds are scattered across the planning area for agriculture or livestock grazing; these are also included in the palustrine system. Many of these ponds have freshwater emergent wetlands along portions of their margins (NWI GIS 2017).

A comprehensive planning area-wide delineation of wetlands following US Army Corps of Engineers guidelines (Environmental Laboratory 1987) has not been conducted in the planning area.

Noxious Weeds and Nonnative, Invasive Plants

The Oklahoma state noxious weed list includes three weeds: musk thistle (*Carduus nutans*), Canada thistle (*Cirsium arvense*), and Scotch thistle (*Onopordum acanthium*; NRCS 2012a). These thistles grow mostly unimpeded in the state due to a lack of natural disease and insects to control their growth (OSU 2012).

In addition to noxious weeds, there are also nonnative invasive plants that are not listed but can be problematic. Both noxious and nonnative invasive plants have the potential to impact the ecological integrity of a region, thus both noxious and nonnative invasive plants are discussed in this section.

Noxious Weeds

Musk thistle was first documented in Oklahoma in Payne County in 1944 (OSU 2012), southwest of, but relatively near, the planning area. Musk thistle has now been documented in almost every county in the state, including Osage County, and was declared a noxious weed in Oklahoma in 1994. Integrated control using herbicides and musk thistle weevils (*Rhinocyllus conicus*) can provide satisfactory control (OSU 2012).

The perennial Canada thistle is widely distributed in northern states. Some plants were collected in the Oklahoma panhandle counties over 50 years ago, but currently no infestations are known to exist in the state (OSU 2012); however, this species remains on the Oklahoma state noxious weed list due to the high potential for invasion and rapid spread in the state.

Scotch thistle invaded Oklahoma from the west and is known to exist in several, primarily western, Oklahoma counties. The occurrence nearest to the planning area was reported in 2001 in Garfield County (OSU 2012), west of the planning area. Scotch thistle is difficult to control with herbicides, and no biological control options are currently available.

Nonnative, Invasive Plants

The Oklahoma Invasive Plant Council (OkIPC) maintains a list of problem and watch list species that pose a potential threat of invasion in the state (OkIPC 2014), based on a 2009 invasive plant audit for Oklahoma conducted by TNC (Pruett 2009). OkIPC lists 32 problem species and 21 watch list species in the state (**Table 3-21**, OkIPC Problem and Watch List Species). These nonnative invasive species are in addition to the three state-listed noxious weeds described above (NRCS 2012a).

Table 3-21
OkIPC Problem and Watch List Species

Scientific Name	Common Names
Problem Species	
Albizia julibrissin	Mimosa, silk tree
Alternanthera philoxeroides[1]	Alligator weed
Bothriochloa bladhii	Caucasian bluestem
B. ishaemum	Yellow bluestem, King Ranch bluestem
Bromus japonicus	Japanese brome
B. racemosus	Meadow brome
B. tectorum	Cheatgrass
Carduus nutans[2]	Musk thistle, nodding plumeless thistle
Cirsium arvense[2]	Canada thistle
C. vulgare	Bull thistle
Conium maculatum	Poison hemlock
Convolvulus arvense	Field bindweed
Hydrilla verticillata[2]	Hydrilla
Kochia scoparia	Mexican fireweed
Lespedeza cuneata	Sericea lespedeza
Ligustrum sinense	Chinese privet
Lonicera japonica	Japanese honeysuckle
Lythrum salicaria[2]	Purple loosestrife
Microstegium vimineum	Nepalese browntop
Myriophyllum aquaticum[2]	Parrot's feather
M. spicatum[1]	Eurasian watermilfoil

Table 3-21
OkIPC Problem and Watch List Species (cont.)

Scientific Name	Common Names
Perilla frutescens	Beefsteak plant
Potentilla recta	Sulphur cinquefoil
Pueraria montana	Kudzu
Rosa multiflora	Multiflora rose
Saccharum ravennae	Revennagrass
Salsola tragus	Russian thistle, tumbleweed
Sorghum halepense	Johnsongrass
Tamarix chinensis	Chinese salt cedar
T. parviflora	Small-flowered tamarisk
T. ramosissima	Salt cedar, tamarisk
Verbascum thapsus	Common mullein
Oklahoma Watch List	
Ailanthus altissima	Tree of heaven
Arundo donax	Giant reed
Broussonetia papyrifera	Paper mulberry
Cyperus rotundus	Nut grass
Eichhornia crassipes[1]	Water hyacinth
Elaeagnus angustifolia	Russian olive
E. pungens	Thorny olive
E. umbellate	Autumn olive
Egeria densa[1]	Brazilian water weed
Erodium cicutarium	Red stem stork's bill
Ligustrum japonicum	Japanese privet
Lolium arundinaceum	Tall fescue
L. pretense	Meadow ryegrass
L. temulentum	Darnel ryegrass
Lonicera mackii	Bush honeysuckle
Lygodium japonicum	Japanese climbing fern
Melia azedarach	Chinaberry tree
Mililotus officinalis	Yellow sweet clover
Paulownia tomentosa	Princess tree
Pyrus calleryana	Callery pear
Ulmus pumila	Siberian elm

Source: OkIPC 2014
[1] On watch list by law in Oklahoma
[2] Currently banned by law in Oklahoma

Not all of the nonnative invasive species listed in **Table 3-21** necessarily occur in the planning area; however, OkIPC (2014) indicates that the following species all occur in the planning area: Japanese brome (*Bromus arvensis*), cheatgrass (*Bromus tectorum*), sericea lespedeza (*Lespedeza cuneata*), Johnsongrass (*Sorghum halepense*), beefsteak plant (*Perilla frutescens*), poison hemlock (*Conium maculatum*), field bindweed (*Convolvulus arvensis*), Mexican fireweed (*Bassia scoparia*), sulphur cinquefoil (*Potentilla recta*), and common mullein (*Verbascum thapsus*).

In addition, the 1979 EA for oil and gas leasing in the planning area (BIA 1979) found that Japanese brome and other annual weedy grass species (referred to as chess and threeawn [*Aristida* spp.] in the EA) can become common or dominant in tallgrass prairie habitat in response to persistent severe overgrazing. Threeawn is not listed by OkIPC as a problem or watch list species.

Many of these species were formerly recommended forage species that are now recognized as invasive (OkIPC 2014); as such they are now widespread through the planning area and state due to ranching and grazing. Though not included on the OkIPC list, Bermudagrass (*Cynodon dactylon*) is a nonnative invasive perennial grass in the planning area that was widely planted in the 1940s to control old-field erosion (ONENRD 2006) and provide forage for livestock.

Culturally Important Plants

Many native plants in the planning area are culturally important to the Osage. Tribal members use traditional and sacred plants for ceremonies and on an everyday basis. Woody plants are used for firewood, poles and fire ash sticks, and handles for tools. They also provide leaves for smoking and medicinal teas (ONENRD 2006). Culturally important plants are native to the planning area and evolved under historical fire regimes; thus, prescribed fire is used to mimic historical fire regimes and to reduce the risk of wildland fire for the benefit of culturally important plants (ONENRD 2006).

3.7.3 Trends

Upland Vegetation

Tallgrass prairie has declined greatly in acreage due to agricultural conversion throughout the region; however, large expanses of this vegetation type still occur in the planning area in Osage County and in adjacent counties (Hoagland 2008). The Osage grasslands were historically used largely for pasture (Duck and Fletcher 1943). The associated conversion to exotic pasture grasses (yellow bluestem, Bermuda grass, and weeping lovegrass [*Eragrostis curvula*]) is an ongoing threat in tallgrass prairie and other vegetation types in the planning area (Hoagland 2000). Management of the Tallgrass Prairie Preserve will continue to improve ecological integrity of this stronghold of native tallgrass prairie in the planning area.

Upland hardwood forests are commercially managed in part to produce harvestable wood products under the Osage Nation Forest Management Plan (ONENRD 2006). Where upland vegetation is managed under the forest management plan, the quality of the habitat can be expected to improve. This would be due to reduced fuel loads, decreased chances for wildland fire, and improved regeneration. The Osage Nation Environmental and Natural Resource Department coordinates with the BIA, the Forest Service, and the State of Oklahoma to monitor the health of Tribal forests and woodlands, including monitoring for outbreaks of disease and damaging insect pest populations (ONENRD 2006).

Riparian Vegetation

Projections for the future of riparian vegetation in Oklahoma show continued loss of riparian areas (OSU 1998). Threats to riparian areas continue from many sectors. Riparian forests or bottomlands are fertile and often valued as prime farmland because they grow on deep, rich, alluvial soils. Many riparian areas have been cleared for pastureland, row crops, or other agriculture. Many of these activities use fertilizers and pesticides, increasing the potential for both groundwater and surface water pollution. Urban encroachment, channelization, and other water resource development projects also continue to alter riparian areas (OSU 1998).

Bottomland hardwood forests are also commercially managed, as discussed in *Upland Vegetation*, above, and forest health could be expected to improve in properly managed stands. Outbreaks of disease and damaging insect pest populations are monitored in woodlands and forests in the planning area, which would reduce the chances for damaging pest or disease outbreaks in riparian woodlands.

Wetland Vegetation

Wetlands in the planning area are generally under the jurisdiction of the US Army Corps of Engineers regulatory division. It is responsible for protecting aquatic resources, including wetlands, while allowing reasonable development through informed permit decisions. Development projects, agricultural conversion, and water resource projects will likely continue in the planning area and could impact wetlands under the jurisdiction of the US Army Corps of Engineers. US Army Corps of Engineers wetlands permits include mitigation requirements, such as restoring, enhancing, creating, and preserving aquatic functions and values, to offset unavoidable impacts (USACE 2017).

Noxious Weeds and Nonnative Invasive Species

Noxious weed and invasive plant programs through the NRCS, Oklahoma State University, OkIPC, Oklahoma Biological Survey, and others will continue to increase awareness of noxious weeds and nonnative invasive plants in the planning area. Recognition of the sources of noxious weeds and invasives and their economic and ecological impacts, along with early detection and prevention, can help prevent additional infestations in the planning area. Control and management strategies will continue to prevent further expansion of current infestations in the planning area.

Culturally Important Plants

Culturally important plants are native species that are found in the vegetation communities described above. If native upland, riparian, and wetland vegetation continues to decline in the planning area, culturally important plants may also be at risk of decline.

Other Considerations

Oil and gas development will continue throughout the planning area. As part of the BA, the BIA proposes conservation and mitigation measures to reduce or mitigate impacts of oil and gas development on ABB habitat (see **Section 3.6**). This habitat is widespread in the planning area and generally includes upland forests, shrublands, grasslands, and certain types of wetland and riparian areas.

Measures developed by the BIA generally include reducing soil compaction, wildfire risk, and soil erosion, restoring habitat, and monitoring vegetation and noxious weeds (**Appendix B**). Such measures will ensure that impacts on vegetation from oil and gas development are minimized. In the event that the ABB is removed from the endangered species list, the Osage Superintendent could require site-specific protection measures.

3.8 AGRICULTURE

Agriculture in Osage County consists primarily of the production of cattle, corn, wheat, soybeans, sorghum, and other grains, oilseeds, and dry beans and peas. There are 1,325 farms and ranches in Osage County covering 1,216,673 acres[3] (USDA 2012a).

3.8.1 Regulatory Framework

Farmland Protection Policy Act

The Farmland Protection Policy Act (7 USC 4201 et seq.) states that federal agencies must "minimize the extent to which federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses…"

The US Department of Agriculture's NRCS has national leadership for administering the Farmland Protection Policy Act. It is responsible for protecting significant agricultural lands from irreversible conversions that result in the loss of an essential food or environmental resource. Prime farmland has the best physical and chemical characteristics to produce food, feed, forage, fiber, and oilseed crops. Prime farmland is used for food or fiber crops or is available for those crops and is not urban, built-up land, or a water area. The soil qualities, growing season, and moisture supply are those needed to economically produce a sustained, high yield of crops (NRCS 2012b).

American Indian Agricultural Resource Management Act

The American Indian Agricultural Resource Management Act (25 USC 3701 et seq.) was promulgated in recognition of the fact that "Indian agricultural lands are renewable and manageable resources which are vital to the economic, social, and cultural welfare of many Indian Tribes and their members." The act provides that the United States has a responsibility to promote self-determination with respect to the management of such resources. It also calls

[3] A more recent compilation of land use categories in Osage County calculates farms and ranches at 1,023,000 acres by subtracting protected lands, lands dedicated to wind farms, and oil and gas facilities (Storer et al. 2016).

for measures to protect, conserve, develop, and manage Indian agricultural lands in a manner consistent with identified Tribal goals and priorities for conservation, multiple use, and sustained yield.

2030 Osage County Comprehensive Plan

The 2030 Osage County Comprehensive Plan (Osage County 2011) was adopted in June 2011. The Osage County Board of Commissioners and the Osage County Industrial Authority jointly initiated the preparation of the comprehensive land use plan for the County with the assistance of the Indian Nations Council of Governments, a regional planning association of local and Tribal governments in northeast Oklahoma. The plan was prepared with the help of over 40 federal, state, local, and Tribal agencies, other nongovernmental entities, and the public. The land use plan is the basic tool for future physical and economic development for Osage County and includes ranching and agriculture goals and policies to protect and preserve agricultural lands in the county. These are as follows:

Ranching and agriculture area goals

- Preserve and protect land used for agriculture and ranching and control growth in a manner that supports these elements of the County, as set out in the 2030 Plan
- Protect agricultural and ranching areas from premature or unplanned development until a full range of public facilities, services, and utilities is available, and discourage wasteful scattering of non-agricultural development in prime agricultural areas
- Concentrate the development of medium and high intensity land uses in or close to cities and towns and in the south and southeast areas of the county
- Maintain and preserve prime agricultural land for its highest and best use as agriculture and ranching
- Emphasize matters of compatibility of agriculture and ranching with oil and gas production
- Achieve an orderly transition between agriculture and ranching uses with urban development and, in particular, industrial development; concentrate such industrial development in or next to cities and towns and in the south and southeast areas of the county
- Support and plan for ranching and agriculture uses to continue to be basic economic activities of the county
- Encourage and support the Tourism Committee in the development of “agri-tainment” and “agri-tourism” as future basic elements of the economic growth and development of the county

Ranching and agricultural area policies

- Implement and develop, as needed, those planning and land use policies and regulations that support, protect, and encourage agriculture and ranching as a basic economic industry
- Seek financial and technical assistance in developing the necessary agricultural and rural infrastructure from various federal and state agencies to support the agricultural economy and preserve agricultural lands
- Consider the impact on and preservation of agriculture and ranching before extending urban services into agriculture areas
- Protect soil and water quality in ranching and agriculture areas from erosion, uncontrolled runoff, pollution, and other problems sometimes associated with the initial stages of the development process or poor agricultural cultivation practices (Osage County 2011)

3.8.2 Current Conditions

Ranching is the main agricultural enterprise in Osage County. According to the 2012 agricultural census, livestock sales accounted for approximately $114 million, or 94 percent of the total agricultural market. Osage County ranks 17 out of the 77 counties in Oklahoma in total value of agricultural products sold (USDA 2012a). The average farm size is 918 acres, and the median size is 160 acres. Total cropland is 131,371 acres, and harvested cropland totals 68,529 acres. Irrigated farmland totals only 1,338 acres (USDA 2012b). About 78.8 percent of the land on farms or ranches is pastureland, 10.8 percent is cropland, 7.6 percent is woodland, and 1.8 percent is other uses (USDA 2012a). The BIA currently administers 24 active agricultural leases and 309 grazing leases covering 71,632 acres.

Small grains, mainly wheat, alfalfa, grain sorghums, and soybeans are the principal crops (BIA 2014). Corn and sorghums, cut for silage and used by local dairies, and orchard crops are grown on a minor acreage. A large acreage of native grasses and tame pastures are cut for hay, which is mostly used by local farmers and ranchers. The other crops are shipped to local and distant markets. Approximately 75 percent of the annual production on rangeland grows in April, May, and June, coinciding with spring rains and moderate temperatures. A secondary growth period generally occurs in September and October, coinciding with fall rains and cooling temperatures (NRCS 2012b).

The farmland classification of soils found Osage County is prime farmland and not prime farmland, as shown in **Table 3-22**, Farmlands. **Figure 3-11**, Prime Farmland (in **Appendix E**), demonstrates that prime farmland is found along the rivers and major creek systems in areas that correspond to a great extent with the 100-year floodplain.

Table 3-22
Farmlands

Classification	Acres
Prime farmland	382,400
Not prime farmland	1,092,000

Source: NRCS GIS 2015

Additionally, the potential in the planning area for non-irrigated crop production soil capability is shown on **Table 3-23**, Non-irrigated Crop Capability, and **Figure 3-12**, Non-irrigated Land Crop Capability (in **Appendix E**). Land capability classification is a system of grouping soils based primarily on their capability to produce common cultivated crops and pasture plants, without deteriorating over a long period. These are classified as follows:

- Class I soils have slight limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants or that require careful management, or both.
- Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
- Class VI soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
- Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.
- Class VIII soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreation, wildlife habitat, watershed, or for aesthetic purposes (NRCS 2012b).

3.8.3 Trends

The planning area is projected to have increased levels of new oil and gas development and future gross land disturbance of approximately 8,454 acres (**Appendix A**). On receipt of an approved lease, lessees have the right to use as much surface land in the Osage Mineral Estate as may be reasonable for operations and marketing; however, except for surveying and staking a well, no operations of any kind may commence until the lessee meets with the surface

Table 3-23
Non-irrigated Crop Capability

Category	Acres
Class I	14,500
Class II	154,100
Class III	390,500
Class IV	327,800
Class V	89,300
Class VI	342,400
Class VII	111,300
Class VIII	44,600

Source: NRCS GIS 2015

owner to discuss well siting, routes of ingress/egress, and the procedure for settling surface damages. Surface owners can make claims for damages to growing crops and surface improvements, among other things.

Farmlands can be disturbed by topsoil excavation and soils compaction associated with oil and gas development. Stockpiling the soil horizons separately and spreading them across the site in their original order during reclamation could reduce this damage. Surface owners can work with lessees to minimize damage to prime or unique farmland or any unnecessary and irreversible conversion of farmland to nonagricultural uses.

3.9 CULTURAL RESOURCES

Cultural resources are locations of human activity, occupation, or use identifiable through field inventory, historical documentation, or oral evidence. Cultural resources include archaeological, historical, or architectural sites and structures, as well as natural features, plants, animals, and locations that have been identified as traditionally important or sacred to a culture, subculture, or community. The significance of these resources is derived from the role they play in a community's cultural identity, as defined by its beliefs, practices, history, and social institutions.

3.9.1 Regulatory Framework

National Environmental Policy Act

NEPA establishes a federal policy of preserving historic, cultural, and natural aspects of our national heritage. The CEQ regulations implementing NEPA require federal agencies to analyze the impacts of a proposed action on historic and cultural resources (40 CFR 1502.16[g]).

National Historic Preservation Act of 1966, as Amended

The principal federal law addressing cultural resources is Section 106 of the NHPA, as amended (54 USC 300101 et seq.) and its implementing regulations, Protection of Historic Properties (36 CFR 800).

Under the NHPA, the compliance procedure for cultural resources, known as the Section 106 process, outlines the steps for identifying and evaluating historic properties, assessing the impacts of federal actions on historic properties, and conducting consultation to avoid, reduce, or minimize adverse impacts.

Historic properties are cultural resources that meet specific eligibility criteria (36 CFR 60.4) for listing on the National Register of Historic Places. After a cultural resource has been determined eligible for listing, it is afforded procedural protections through the Section 106 process, whether or not it is formally nominated or listed. The Section 106 process does not require historic properties to be preserved but does ensure that the decisions of federal agencies concerning the treatment of these resources result from meaningful consideration of cultural and historic values and the options available to protect them.

The NHPA requires federal agencies to consult with Tribes that attach religious and cultural significance to historic properties that may be affected by undertakings, as defined in the Section 106 process. The NHPA also directed the Secretary of the Interior to establish a National Tribal Preservation Program. Administered by the National Park Service, the program is dedicated to working with Tribes, Alaska Natives, Native Hawaiians, and national organizations to preserve and protect resources and traditions that are of importance to Native Americans by strengthening their capabilities for operating sustainable preservation programs.

A 1992 amendment to the NHPA allows Tribes to assume some or all of the duties of the SHPO under Section 101(d)(2). The Osage Nation requested and received certification and a grant from the National Park Service to appoint a THPO, who has assumed most of the SHPO's duties on Tribal lands.

The Section 106 process is triggered when historic properties may be affected by a federally funded, licensed, or permitted action or by actions on federal land. The identification and evaluation of cultural resources for eligibility for listing on the National Register of Historic Places and the resolution of adverse impacts on historic properties is the responsibility of the lead federal agency, in consultation with the SHPO, THPO, interested Tribes, and other interested parties.

American Indian Religious Freedom Act of 1978, as amended

The American Indian Religious Freedom Act (Public Law 95-431; 92 Stat. 469; 42 USC 1996) says that the policy of the US is to protect and preserve the inherent right of freedom of American Indians to believe, express, and exercise their traditional religions. This includes their access to religious sites, use and possession of sacred objects, and freedom to worship through ceremonial and traditional rites. The act is a specific expression of First Amendment guarantees of religious freedom and has no implementing regulations.

Archaeological Resources Protection Act of 1979

The Archaeological Resources Protection Act of 1979 (ARPA; 16 USC Subsection 470aa-11) establishes requirements to protect archaeological resources and sites on public and Tribal lands and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals. ARPA established civil and criminal penalties for the destruction or alteration of cultural resources.

The DOI has issued regulations under the ARPA (43 CFR 7), establishing definitions, standards, and procedures to be followed by all federal land managers in protecting archaeological resources on public lands and Tribal lands of the US. Permits to excavate or remove human remains and cultural items protected by ARPA require consultation with the Tribe owning or having jurisdiction over the land. Specific regulations at 25 CFR 262, provide guidance to BIA officials on implementing ARPA as it pertains to this agency

Native American Graves Protection and Repatriation Act of 1990, as amended

The Native American Graves Protection and Repatriation Act (Public Law 101-601; 104 Stat. 3048; 25 USC 3001 et seq.) confirms the rights of Tribes and Native Hawaiian organizations to claim ownership or take custody of human remains and of certain cultural items; examples are funerary and sacred objects and objects of cultural patrimony in the possession or control of federal agencies or museums. The act also determines the disposition of human remains and other cultural items found on federal or Tribal land since 1990. The Secretary of the Interior's implementing regulations are at 43 CFR 10.

Oklahoma State Burial Laws Title 21-1167, 21-1168.1–7 and Title 8-187.

The Oklahoma State Legislature has passed a variety of measures protecting cemeteries and access to cemeteries and the display, discovery, use, and disposal of human remains. These measures also require certain institutions and museums to consult Tribal leaders and state entities on the disposition of human remains.

3.9.2 Current Conditions

Cultural Overview

This overview is drawn primarily from Jon D. May (2009), "Osage County," in the *Encyclopedia of Oklahoma History and Culture*.

The cultural resources of Osage County reflect a long history of use and occupation dating back possibly 8,000 years or more and continuing to the present day. Archaeologists have identified sites in the county that are roughly classified to the following periods: Paleo-Indian (before 6000 before Christ [BC]), Archaic (6000 BC to anno Domini [AD] 1), Woodland (AD 1 to 1000), and Plains Village (AD 1000 to 1500). According to Osage oral tradition and research, the ancestors of the Osage migrated from what is now the Ohio River Valley, beginning in AD 400.

From AD 500 to 1300, the ancestral Osage lived in what is now Illinois, Missouri, and Arkansas, with the culmination of settlements in the St. Louis area and at Cahokia during the Late Woodland, Emergent Mississippian, and Mississippian Periods. The Osage left Cahokia approximately AD 1300 and began their westward movement to the central and southwestern portions of Missouri. In 1673, this is where the French record the first historical notation of the Osage (Hunter et al. 2013; Tucker 1942).

The first recorded Euro-American exploration of the region was conducted by Lt. James B. Wilkinson in 1806. He was followed by Capt. John R. Bell of the Maj. Stephen H. Long Expedition in 1820, the Glenn-Fowler Expedition in 1821, and Capt. Nathan Boone in 1843. A branch of the Shawnee Trail, a north/south cattle and emigrant route to Texas, crossed southern and western Osage County during the mid-1800s.

As early as mid-AD 1300, the Osage built villages and had camps throughout southwestern Missouri and began traveling out to the plains for their annual hunts. Osage hunting trails were established that were also used for Osage war parties, mourning parties, and trading expeditions (Spaulding 1968; La Flesche 1930, 1939; McDermott 1940). Some of the mid-continent Osage trails spanned portions of Oklahoma and Kansas, including Osage County.

The Osage ceded their claim to the region in 1825 and were removed to a Kansas reservation in 1839. In 1835 the area was included in treaty land guaranteed to the Cherokee Nation. In 1870, under the Cherokee Reconstruction Treaty of 1866, the Osage began purchasing approximately 1,570,059 acres from the Cherokee Nation. Osage Agent Isaac T. Gibson established the Osage Agency at Deep Ford (present Pawhuska) on Bird Creek in 1872. The historic Osage reservation boundary was finalized in 1875 when the Kaw, or Kansa, acquired approximately 100,000 acres in the reservation's northwest corner. The Kaw lands were included in Kay County at statehood.

The historic Osage reservation was part of the Oklahoma Territory under the Organic Act of 1890 and was made a semiautonomous district by the Enabling Act of 1906. At statehood in 1907, the Osage lands were established as Osage County.

The Osage Allotment Act was approved in June 1906. Between 1906 and 1909 each enrolled member of the Osage Tribe received an average allotment of 659.51 acres; five town sites were withheld from allotment. Each Osage allottee received the surface rights to their allotments and could rent or, if deemed "competent," sell their lands. In some cases, this led to the formation of large ranches, as the surface land was generally considered not suitable for farming.

Pursuant to the 1906 act, the United States holds the Osage Mineral Estate, consisting of the entire subsurface mineral estate in Osage County, in trust for the benefit of the Osage Nation. The 1906 act requires that royalty income derived from the Osage Mineral Estate be distributed to Osage headright holders on a quarterly, pro rata basis. There are 2,229 headrights, one for each individual on the 1906 Osage Tribal membership roll; however, because headrights are subject to succession by inheritance or devise, a headright holder may own one of more full headrights or a fractional share of a headright. Today, headrights are owned by members of the Osage Nation, non-Osage Indians, and non-Indians (May 2009).

Cultural Resources

Prehistoric and historic archaeological sites make up most of the recorded cultural resources in the planning area. These sites are typically discovered by surveys that are conducted during the BIA's review of mineral permit applications. Approval of a permit application is a federal undertaking under the NHPA. Compliance with the NHPA in the approval of oil and gas development in Osage County has generally been done through implementing the Section 106 process at a site-specific (quarter section) level; however, there have been surveys conducted at a greater scale (covering multiple sections), providing lessees with information needed for future development planning.

Archaeological site types encountered in the planning area are prehistoric camps and villages, prehistoric lithic or stone tool scatters, prehistoric rock art and rock shelters, prehistoric and historic graves and cemeteries, abandoned farmsteads, structural remains of the earlier periods of oil and gas development, and refuse deposits. Old trail routes, roads, and waterways are frequently associated with archaeological sites.

According to data gathered from the Oklahoma SHPO, as of 2016 there were 838 prehistoric and historic archaeological sites recorded in Osage County. Of these, 495 are prehistoric, 273 are historic, and 69 are both prehistoric and historic. The most common prehistoric site type classification is open habitation without mounds (435 sites), followed by rock shelters (30 sites) and prehistoric quarries/workshops (10 sites). The most common historic site type includes structural remains of historic farmsteads, homesteads, and cabins (146 sites), followed by trash dumps (38 sites) and the location of mills or other commercial or industrial activities (32 sites). However much of the county has not been surveyed and it is likely that additional archeological sites exist (SRI 2016).

Almost all of the multicomponent sites are prehistoric open habitation sites associated with farmsteads, homesteads, and cabins or trash dumps (SRI 2016). Most of these have not been evaluated for National Register of Historic Places eligibility. In practice, archaeological sites can almost always be avoided, and further fieldwork to formally evaluate them for National Register of Historic

Places eligibility is not conducted. Thus, the potential for adverse effects on historic properties is reduced.

Cultural resources in the county also include historic districts, buildings, bridges, farmsteads, monuments, other standing structures, and groups of buildings. As of April 2017, there were 23 cultural resources formally listed on the National Register of Historic Places; all represent the historic-era built environment. Each of these listed historic-era resources are also included among 31 properties that are designated as Oklahoma State Landmarks.

The Osage Nation THPO, Oklahoma SHPO, and Oklahoma Archeological Survey are notified of each project or permit application where there may be ground-disturbing activities, such as for a road or drilling permit. These agencies carry out programs established under the NHPA to consider the impacts of undertakings on properties listed on, or eligible for listing on, the National Register of Historic Places. They also can assist in determining the potential presence of areas or locations important to contemporary Tribal communities that may be disturbed by permitted activities. These can include ancestral archaeological sites, sacred sites, sensitive sites, or traditional plant gathering or other locations that are included in the category of Traditional Cultural Properties under the NHPA.

The Osage Nation Traditional Cultural Advisors Committee serves as the advisory review board for the Osage Nation Historic Preservation Office. The committee is composed of Osage community members respected for their knowledge, understanding, and appreciation of Osage culture and heritage.

3.9.3 Trends

Cultural Resources

The identification and evaluation of cultural resources under the Section 106 process is integrated into the APD and NEPA compliance. BIA personnel or private contractors conduct cultural resource surveys of individual well locations and access roads or larger block surveys covering full 160-acre leases. The BIA must consult with the Osage Nation before beginning cultural resource surveys, in accordance with 36 CFR 800.4.

The BIA distributes cultural resource survey reports to the Osage Nation THPO, Oklahoma Archeological Survey, and the Oklahoma Historical Society SHPO for consultation and concurrence. Cultural resource surveys and reports must meet SOI standards for qualified personnel, methods, and reporting on surface tracts to identify significant cultural resources. They also must meet the standards outlined in the NHPA's Section 106 Consultation Procedures and the Osage Nation Historic Preservation Office Archaeological Survey Standards.

All sites encountered during surveys are inventoried and evaluated. If a site is not eligible for listing on the National Register of Historic Places no additional consideration is necessary. If a site is eligible for listing on the National Register of Historic Places, or its status is undetermined, a buffer area is defined, and the site must be avoided. If National Register of Historic Places-eligible resources are identified but cannot be avoided, the policy is for the BIA to develop acceptable measures to mitigate or reduce the potential for adverse impacts, in consultation with the Osage Nation THPO and the SHPO.

Compliance activities have steadily increased the rate of site discoveries due to continued mineral and energy development and the use of block surveys to efficiently inventory the cultural resources. Although sites are generally avoided, additional information valuable to archaeological and historical research could be gained by compiling and synthesizing data from these studies.

Continued oil and gas development near sites increases the potential for impacts on cultural resources from unintentional or inadvertent damage, unauthorized collection, vandalism, and erosion. Damage, intentional or otherwise, to historic properties is irreversible and may result in a loss of the site's significance, integrity, or both. These losses may adversely affect the site's eligibility for listing on the National Register of Historic Properties.

Following the provisions of the NEPA and NHPA, particularly the consultation processes provided in 36 CFR 800, significantly reduces the risk of an adverse impact on historic properties. Further, the Osage Nation and other Tribes may attach religious significance to historic properties and even sites not eligible for listing on the National Register of Historic Places. Tight timelines, lack of staffing, and difficulties with mitigation enforcement can lead to cultural resources not being identified or affected.

3.10 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The geographic area of analysis for the purpose of evaluating the potential socioeconomic impacts of oil and gas development is Osage County, Oklahoma. This section characterizes the socioeconomic conditions of the population, economy, housing resources, and community services. Socioeconomic conditions of the Osage Nation are described in **Section 3.18**, Trust Assets and Osage Nation Interests.

3.10.1 Current Conditions and Trends

Population

Population change in Osage County increased from 2000 to 2015, but at a slower rate than that of the state of Oklahoma or the United States as a whole (see **Table 3-24**, Population). Osage County is forecast to have a population increase slightly above that of the state average until 2075 (see **Table 3-25**, Population Projections).

Table 3-24
Population

Population	Osage County	Oklahoma	United States
Population 2015	47,054	3,849,733	316,515,021
Population 2000	44,437	3,450,654	281,421,906
Population change 2000–2015	3,617	399,079	35,093,115
Percent population change 2000–2015	8.1	11.6	12.5

Source: US Census Bureau American Community Survey (ACS) 2015 and 2000 decennial census, as reported in Headwaters Economics 2017
Note: 2015 ACS data in this table are calculated by using annual surveys conducted from 2011–2015 and are representative of average characteristics during this period.

Table 3-25
Population Projections

Population	Osage County	Oklahoma
Population 2020	51,745	4,024,202
Population 2030	55,413	4,302,501
Percent change 2020–2030	7.1	6.9
Population 2040	59,080	4,581,319
Population 2050	62,747	4,860,554
Percent change 2040–2050	6.2	6.1

Source: OK Department of Commerce 2012

Housing

The availability of housing is one indicator of the ability of a community to handle changes in population associated with development. In the planning area, the occupancy rate (85.7 percent) was slightly below the state average (86.1 percent) and the national average (87.7 percent). The type of vacant housing by category was also similar to that for the state (**Table 3-26**, Housing Occupancy, 2015).

The cost of housing can reflect one component of affordability in a community. In Osage County, the cost of housing is below that of the state and national average, with a median monthly mortgage of $1,100 and a median gross rent of $628 (**Table 3-27**, Housing Costs as a Percent of Household Income, 2015).

The Osage Nation Housing Department can assist the Osage with down payment assistance, homeownership assistance, senior housing, home rehabilitation, and housing assistance (Osage Nation 2017b).

The Osage Nation Constitution Article XIV reserves the villages of Grayhorse, Pawhuska, and Hominy exclusively for the use of Tribal members.

Table 3-26
Housing Occupancy, 2015

Housing Occupancy	Osage County	Oklahoma	United States
Total housing units	21,381	1,689,427	133,351,840
Occupied	18,271	1,455,321	116,926,305
	85.7%	86.1%	87.7%
Vacant	3,110	234,106	16,425,535
	14.5%	14.5%	12.3%
For rent	265	44,105	2,949,366
	1.2%	2.6%	2.2%
Rented, not occupied	36	8,893	616,375
	0.2%	0.5%	0.5%
For sale only	259	21,837	1,492,691
	1.2%	1.3%	1.1%
Sold, not occupied	38	9,463	628,160
	0.2%	0.6%	0.5%
For seasonal, recreational, occasional use	553	38,538	5,329,103
	2.6%	2.3%	4.0%
For migrant workers	6	709	35,502
	0.0%	0.0%	0.0%
Other vacant	1,953	101,561	5,374,338
	9.1%	6.5%	4.0%

Source: US Census Bureau ACS 2015 data, as reported in Headwaters Economics 2017
Note: The data in this table are calculated by ACS, using annual surveys conducted from 2011 and 2015, and represent average characteristics during this period.

Table 3-27
Housing Costs as a Percent of Household Income, 2015

Housing Costs	Osage County	Oklahoma	United States
Owner-occupied housing units with a mortgage	7,180	550,249	48,414,291
Monthly cost less than 15% of household income	2,074	149,648	10,168,990
	28.9%	27.2%	21.0%
Monthly cost more than 30% of household income	1,985	139,993	15,648,374
	27.6%	25.4%	32.3%
Specified renter-occupied units	4,068	493,937	42,214,214
Gross rent less than 15% of household income	587	70,326	4,667,482
	14.4%	14.2%	11.1%
Gross rent more than 30% of household income	1,336	202,825	20,210,842
	32.8%	41.1%	47.9%
Median monthly mortgage cost	$1,100	$1,147	$1,492
Median gross rent	$628	$727	$928

Source: US Census Bureau ACS 2015 data, as reported in Headwaters Economics 2017
Note: The data in this table are calculated by ACS, using annual surveys conducted from 2011 to 2015, and represent average characteristics during this period.

Jobs and Employment

Unemployment in Osage County generally followed national trends, peaking in 2010. The Osage Nation has created a program to provide career development and vocational training to the Osage (Osage Nation 2017c). Unemployment levels have remained below the national average, although they have been consistently higher than the state average. Unemployment between 2007 and 2016 is shown in **Table 3-28**, below.

Table 3-28
Average Annual Unemployment

Year	Osage County	Oklahoma	United States
2016	4.6%	4.9%	4.9%
2015	5.1%	4.9%	5.3%
2014	5.1%	4.4%	6.2%
2013	5.9%	5.3%	7.4%
2012	5.8%	5.2%	8.1%
2011	6.8%	5.9%	8.9%
2010	7.8%	6.8%	9.6%
2009	7.5%	6.4%	9.3%
2008	4.2%	3.7%	5.8%
2007	4.2%	4.1%	4.6%

Source: Bureau of Labor Statistics 2017
Note: Not seasonally adjusted

When industry employment is examined, key sectors of the economy can be identified (see **Table 3-29**, below). Based on 2015 data, top economic sectors as a percent of employment were government, mining, agriculture, construction, and retail trade. Between 2001 and 2015, the four industry sectors that added the most jobs were mining (including oil and gas; 615 additional jobs), government (491 additional jobs), construction (345 additional jobs), and manufacturing (288 additional jobs) (BEA 2016, as reported in Headwaters Economics 2017).

Mining (including oil and gas) has represented an important industry in the county since the 1920s. **Figure 3-13**, Mining Employment 1998-2014 (in **Appendix E**), shows trends in mining employment over the past 20 years. Mining employment trends have had large variations based on changes in oil and gas market value and changes in drilling technologies. A downward trend has been observed since 2013 in Osage County, likely due to market conditions (US Census Bureau, as reported in Headwaters Economics 2017).

Table 3-29
Employment by Industry, 2001–2015

Industry	Osage County 2001	Oklahoma 2001	Osage County 2015	Oklahoma 2015
Total employment (number of jobs)	10,830	2,009,163	13,191	2,287,902
Non-services related	~3,406	455,060	~4,297	494,560
	31.4%	22.6%	32.6%	21.6%
Farm	1,687	101,266	1,260	76,515
	15.6%	5.0%	9.6%	3.3%
Forestry, fishing, and related activities	N/A	7,659	N/A	9,594
	N/A	0.4%	N/A	0.4%
Mining (including fossil fuels)	776	58,320	1,391	130,225
	7.2%	2.9%	10.5%	5.7%
Construction	662	111,725	1,007	129,430
	6.1%	5.6%	8.2%	5.7%
Manufacturing	281	176,090	569	148,796
	2.6%	8.8%	4.3%	6.5%
Services related	~4,817	1,219,339	~6,006	1,420,559
	44.5%	60.7%	45.5%	62.1%
Utilities	20	11,269	20	12,437
	0.2%	0.6%	0.2%	0.5%
Wholesale trade	117	61,063	211	68,889
	1.1%	3.0%	1.6%	3.0%
Retail trade	1,042	222,299	1,085	232,908
	9.6%	11.1%	8.2%	10.2%
Transportation and warehousing	138	61,427	209	67,432
	1.3%	3.1%	1.6%	2.9%
Information	52	40,933	~51	26,580
	0.5%	2.0%	0.4%	1.2%
Finance and insurance	281	76,791	382	98,340
	2.6%	3.8%	2.9%	4.3%
Real estate and rental and leasing	182	56,083	386	81,427
	1.7%	2.8%	2.9%	3.6%
Professional and technical services	~219	90,004	371	110,201
	2.0%	4.5%	2.8%	4.8%
Management of companies and enterprises	19	13,255	34	21,532
	0.2%	0.7%	0.3%	0.9%
Administrative and waste services	312	123,664	417	135,124
	2.9%	6.2%	3.2%	5.9%
Educational services	128	22,413	~118	30,750
	1.2%	1.1%	0.9%	1.3%
Health care and social assistance	709	173,642	~875	216,019
	6.5%	8.6%	6.6%	9.4%

Table 3-29
Employment by Industry, 2001–2015 (cont.)

Industry	Osage County 2001	Oklahoma 2001	Osage County 2015	Oklahoma 2015
Arts, entertainment, and recreation	~215	24,466	282	33,353
	2.0%	1.2%	2.1%	1.5%
Accommodation and food services	421	123,294	573	158,400
	3.9%	6.1%	4.3%	6.9%
Other services, except public administration	962	118,736	992	127,167
	8.9%	5.9%	7.5%	5.6%
Government	2,455	334,764	2,946	372,783
	22.7%	16.7%	22.3%	16.3%

Source: BEA 2016, as reported in Headwaters Economics 2017
Note: Estimates for non-disclosed data indicated with tildes (~)

Total personal income by industry provides additional information on key economic sectors. In 2015, the four industry sectors with the largest personal income in Osage County were government ($145,878,000), farming (71,236,000) mining ($60,877,000), and construction ($60,364,000). From 2001 to 2015, the three industry sectors that added the most new personal income (in real terms) were farming, construction, and government; see **Table 3-30**, Personal Income by Industry, 2001-2015 (Thousands of 2016 Dollars).

When average annual wages are examined, total average wages for all sectors for Osage County are lower than that of Oklahoma and the US (**Table 3-31**, Average Annual Wages, 2015 (2016 Dollars)).

Table 3-30
Personal Income by Industry, 2001-2015 (Thousands of 2016 Dollars)

Industry	Osage County 2001	Oklahoma 2001	Osage County 2015	Oklahoma 2015
Labor earnings	306,112	85,493,453	544,849	129,747,857
Non-services related	~76,828	20,137,679	~227,871	34,802,916
	25.2%	27.8%	41.3%	29.6%
Farm	579	1,105,480	71,236	2,069,475
	0.2%	1.2%	12.9%	1.0%
Forestry, fishing, and related activities	N/A	148,692	N/A	232,140
	N/A	0.2%	N/A	0.2%
Mining (including fossil fuels)	41,142	3,031,276	60,877	14,039,214
	13.7%	7.1%	11.0%	12.8%
Construction	22,625	5,180,040	60,346	7,868,224
	7.5%	5.9%	10.9%	6.4%
Manufacturing	12,482	11,994,134	35,411	10,732,438
	4.1%	13.3%	6.4%	9.2%
Services related	~88,258	35,232,012	~175,018	71,266,180
	29.3%	41.2%	31.8%	54.9%

Table 3-30
Personal Income by Industry, 2001-2015 (Thousands of 2016 Dollars) (cont.)

Industry	Osage County 2001	Oklahoma 2001	Osage County 2015	Oklahoma 2015
Utilities	1,368	1,236,031	1,474	1,658,090
	0.5%	1.4%	0.3%	1.3%
Wholesale trade	6,309	3,884,020	12,019	4,907,077
	2.1%	4.5%	2.2%	3.8%
Retail trade	19,891	6,387,355	19,744	7,347,273
	6.6%	7.5%	3.6%	5.7%
Transportation and warehousing	5,226	3,658,667	21,370	14,406,492
	1.7%	4.3%	3.9%	11.1%
Information	2,894	2,344,114	4,428	1,913,564
	1.0%	2.7%	0.8%	1.5%
Finance and insurance	11,797	3,659,784	9,511	4,460,039
	3.9%	4.3%	1.7%	3.4%
Real estate and rental and leasing	2,542	1,417,044	6,174	2,169,185
	0.8%	1.7%	1.1%	1.7%
Professional and technical services	~4,301	4,600,685	11,392	6,722,090
	1.4%	5.4%	2.1%	5.2%
Management of companies and enterprises	~34	1,299,809	-143	1,770,065
	0.0%	1.5%	N/A	1.4%
Administrative and waste services	7,245	3,594,596	10,141	4,788,602
	2.4%	4.2%	1.8%	3.7%
Educational services	3,650	639,720	~2,138	919,568
	1.2%	0.7%	0.4%	0.7%
Health care and social assistance	17,627	8,031,683	~30,262	12,340,713
	5.9%	9.4%	5.5%	9.5%
Arts, entertainment, and recreation	~5,410	462,101	6,368	718,806
	1.8%	0.5%	1.2%	0.6%
Accommodation and food services	4,543	2,947,065	9,903	3,858,965
	1.5%	3.4%	1.8%	3.0%
Other services, except public administration	26,839	3,603,932	32,510	4,212,114
	8.9%	4.2%	5.9%	3.2%
Government	104,511	17,581,168	145,878	22,752,299
	34.7%	20.6%	26.5%	17.5%

Source: BEA Table CA05N, as reported in Headwaters Economics 2017
*All employment data are reported by place of work. Data that were not disclosed were estimated and are indicated with tildes (~).

Table 3-31
Average Annual Wages, 2015 (2016 Dollars)

Sector	Osage County	Oklahoma	United States
All sectors	$36,350	$44,888	$53,625
Private	$35,642	$45,087	$53,561
All Mining	$56,155	$103,215	$103,800
Oil and gas extraction	$63,147	$141,079	$164,039
Mining (except oil and gas)	N/A	$59,177	$75,666
Support activities for mining	$48,678	$74,068	$87,099
Non-mining	$34,242	$45,212	$53,240
Government	$37,396	$44,106	$53,982

Source: Bureau of Labor Statistics 2015 data, as reported in Headwaters Economics 2017

Average annual wages for mining and mining support activities are higher than the average wages for all sectors for all geographic areas examined.

Jobs are typically reported by location of employment. When employees commute into or out of a county for employment, they may spend their earnings in other locations. In Osage County, a significant portion of the workforce travels outside of the county for work (64.5 percent, as opposed to 25.4 percent state average in 2015). As a result, employment statistics for Osage County may not accurately reflect the employment of residents in the county (Headwaters Economics 2017).

Income

A summary of income statistics in the planning area is provided in **Table 3-32**, Income and Employment (2016 dollars). In the planning area, average earnings per job, income per capita, and median household income were lower than the state and national averages.

Table 3-32
Income and Employment (2016 dollars)

Income	Osage County	Oklahoma	United States
Average earnings per job, 2015[1]	$41,305	$56,710	$ 58,985
Per capita income, 2015[1]	$33,831	$46,165	$ 48,737
Median Household income 2015[2]	$46,016	$47,470	$54,568

Sources: [1] BEA Tables CA05N and CA30, as reported in Headwaters Economics 2017, [2] US Census Bureau as reported in Headwaters Economics 2017, converted to 2016 dollars using the Bureau of Labor Statistics' Consumer Price Index inflation calculator (Bureau of Labor Statistics 2016)

Income is composed of two major sources: income from employment compensation and income from dividends, interest, and rent (DIR) and transfer payments. DIR includes personal dividend and interest income, rental income of persons with capital consumption adjustment, and income related to the rental of real property and royalties from natural resource leases. These income sources are sometimes referred to as investment income or property income. In the planning area, non-labor income overall represents a slightly larger share of total income, as compared to Oklahoma and US averages (see **Table 3-33**, Non-Labor Share of Total Personal Income, 2015 (in Thousands of 2016 Dollars)).

Table 3-33
Non-Labor Share of Total Personal Income, 2015 (in Thousands of 2016 Dollars)

Source	Osage County	Oklahoma	United States
Total personal income (in thousands)	1,620,082	180,567,733	15,665,012,930
Non-labor income	601,057	62,555,291	5,659,705,013
	37.1%	34.6%	36.1%
DIR	232,272	30,895,975	2,946,277,104
	14.4%	17.1%	18.8%
Transfer payments	368,326	31,659,317	2,713,427,909
	22.7%	17.5%	17.3%
Labor earnings	1,019,024	31,659,317	10,005,307,917
	62.9%	65.4%	63.9%

Source: BEA Table CA05N, as reported in Headwaters Economics 2017
Note: Non-labor income and labor earnings may not add to total personal income. This is because of adjustments made by the Bureau of Economic Analysis to account for contributions for Social Security, cross-county commuting, and other factors.

Local Finance

General Budget
Osage County revenue and expenses are displayed in **Table 3-34**, Osage County Finances—General Budget. Revenue in the county is primarily from ad valorum taxes (including property taxes) and various fees. Total valuation of property for 2015/2016 was $345,274,661, including $229,816,229 in real property (i.e., land and buildings) and $46,874,605 in personal property. The county tax rate is set at 14.70 mills (or .0147 percent of assessed value) (Osage County 2015). Additional taxes are imposed at the city and school district level, so exact tax rates vary by municipality. County expenditures were chiefly in the areas of roads and bridges, public safety, and administration.

Osage Nation finances and revenues collected from mineral and energy development are discussed in **Section 3.18**.

The production of other natural resources in the planning area is also a source of revenue. Coal bed methane, limestone, sand and gravel, and clay and shale are commonly extracted in Osage County. According to the Oklahoma Department of Mines (ODM) annual report for 2015, Osage County produced 47,420,355 tons of limestone (ODM 2015).

Table 3-34
Osage County Finances—General Budget

Budget Items	2015/2016
Liabilities, reserves, and cash fund balance	$4,233,018
Total revenue	$8,042,030
Cash balance	$3,501,446
Prior year's cash balance	$136,337
Current ad valorem tax	$3,072,969
Miscellaneous revenue	$1,331,278
Requirements	$4,009,384
Additions	$4,032,666
Deductions	-$20
Expenditures (2014/2015)	$7,621,774

Source: Osage County 2015

Community Services

Less than 10 percent of Osage County contains urban development, and there is limited infrastructure development. Communities are served by multiple municipal services: police, fire, water, power, and other utilities.

Utilities

Utilities are provided by wastewater collection and treatment facilities in Pawhuska and the portion of Tulsa that is in Osage County. Municipal water services are provided in the incorporated areas of Avant, Shidler, McCord, Fairfax, Wynona, and Barnsdall. In most rural areas, residents receive services from various water districts.

Education

Osage County contains 25 schools for pre-kindergarten through 12th grade education, within 11 school districts and with a total enrollment of 3,845 in 2014 (**Table 3-35**, Osage County Public Education). The student-to-teacher ratio can be one indication of the ability of a school to accommodate additional students, as may be required if the population grows. Total student-to-teacher ratios vary throughout the county, with most lower than the state and US average of 16.12 and 16.01 (State of Oklahoma 2015).

Overall, the US spent an average of $11,665 per student. There is some indication that increased spending per student may correlate with education ranking (Annie E. Casey Foundation 2014). In Osage County, spending varies, with most districts below the US average.

Health Services

The availability of health services, particularly emergency services, can be an indicator of the ability of a community to accommodate change in population and can influence worker safety during development. Major medical facilities in

Table 3-35
Osage County Public Education

District	Enrollment	Student-to-Teacher Ratio (2012/2013)	Total Spending per Student (2010/2011)
Osage Hills	182	16.73	$7,878
Bowring	75	11.13	$13,677
Avant	80	14.00	$10,000
Anderson	271	14.54	$7,024
McCord	263	14.78	$6,359
Pawhuska	831	14.09	$8,815
Shidler	236	13.54	$9,945
Barnsdall	435	16.63	$8,215
Wynona	124	10.19	$6,450
Hominy	582	14.27	$10,272
Prue	328	13.90	$8,110
Woodland	438	14.73	$11,385

Source: State of Oklahoma 2015

the planning area are Fairfax Community Hospital and Pawhuska Hospital. Fairfax Community Hospital provides emergency, laboratory, and inpatient care and has 15 beds (Fairfax Community Hospital 2017). Pawhuska Hospital is a general hospital and has 27 beds and total of 4,659 patient visits to the emergency room based on 2014 surveys (US News and World Report 2014). Additional services in the region are available in Cleveland, Sand Springs, Ponca City, Bartlesville, Owasso, and Tulsa.

Public Safety

The Osage County Sheriff's Office consists of 34 sworn and 27 civilian law enforcement professionals (Osage Sheriff 2015). Additional law enforcement officers are found in cities in the county. See **Section 3.11** for information on fire safety operations.

Community Values and Social Setting

The project area is generally rural, with small farming communities and rural residences scattered throughout. The borders of Osage County are contiguous with the former Osage Indian Reservation.

Environmental Justice

Environmental justice refers to the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences of industrial, municipal, and commercial operations or the execution of federal, state, local, and Tribal programs and policies.

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that federal agencies identify and address any disproportionately high and adverse human health or environmental impacts of their programs, policies, and activities on minority and low-income populations and Indian Tribes.

The CEQ 1997 guidance states that “In order to determine whether a proposed action is likely to have disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, or Indian Tribes, agencies should identify a geographic scale, obtain demographic information on the potential impact area, and determine if there is a disproportionately high and adverse effect on these populations. Agencies may use demographic data available from the US Census Bureau to identify the composition of the potentially affected population. Geographic distribution by race, ethnicity, and income, as well as a delineation of Tribal lands and resources, should be examined” (CEQ 1997).

Specific guidance on environmental justice terminology is as follows:

- Low-income population—This is determined based on annual statistical poverty thresholds developed by the US Census Bureau. In 2015, the poverty level was based on total income of $12,082 for an individual and $24,036 for a family of four (US Census Bureau 2015). A low-income community may include either a group of individuals living in geographic proximity to one another or dispersed individuals, such as migrant workers or Tribal populations.
- Minority—A member of the following population groups: American Indian, Alaska Native, Asian, Pacific Islander, Black, or Hispanic.
- Minority population area—An area is so defined if either the aggregate population of all minority groups combined exceeds 50 percent of the total population, or if the percentage of the population in the area comprising all minority groups is meaningfully greater than the minority population percentage in the broader region. As with a low-income population, a minority population may include either individuals living in geographic proximity to one another or those who are dispersed.
- Comparison population—For the purpose of identifying a minority population or a low-income population concentration, state populations are compared to the US population; for counties, populations are compared to the respective state population average.

Approximately 35.7 percent of the population in Osage County identified themselves as minority, belonging to one or more racial or ethnic minority group (i.e., a group other than white of non-Hispanic origin). American Indians represent the largest minority group in the planning area; those identifying as

American Indian alone represented 15.1 percent of the population, as compared to 7 percent in Oklahoma and less than 1 percent for the US population as a whole (US Census Bureau ACS 2011–2015 data, as reported in Headwaters Economics 2017). Note that this figure does not include those who are American Indian and some other race who listed themselves as being of two or more races; therefore, the actual percentage of American Indians may be higher.

The largest Tribal groups by population in the planning area were Cherokee (2,362) and Osage (1,960; US Census Bureau ACS 2011–2015, data as reported in Headwaters Economics 2017). See **Table 3-36**, Population by Race and Ethnicity, 2015, for a detailed breakdown of racial and ethnic minorities in the planning area. Note that those identifying as Hispanic/Latino origin may also identify as one or more racial minority.

Table 3-36
Population by Race and Ethnicity, 2015

Race and Ethnicity	Osage County	Oklahoma	United States
Total population	48,054	3,849,733	316,515,021
Hispanic/Latino origin (of any race)	1,534	371,459	54,232,205
	3.2%	9.6%	17.1%
Non-Hispanic/Latino (of any race)	46,520	3,478,274	262,282,816
	96.8 %	90.4%	82.9%
White alone	31,631	2,813,794	232,943,055
	65.8%	73.1%	73.6%
Black or African American alone	5,476	278,571	39,908,095
	11.4%	7.2%	12.6%
American Indian alone	7,263	279,276	2,569,170
	15.1%	7.3%	0.8%
Asian alone	119	74,570	16,235,305
	0.2%	1.9%	5.1%
Native Hawaiian and Other Pacific Islanders alone	51	4,701	546,255
	0.1%	0.1%	0.2%
Some other race alone	347	98,885	14,865,258
	0.7%	2.6%	4.7%
Two or more races	3,4167	299,936	9,447,883
	6.6%	7.8%	3.08%
Aggregate minority population	17,158	1,258,444	119,256,743
	35.7%	32.7%	37.7%

Source: US Census Bureau ACS 2011–2015 data, as reported in Headwaters Economics 2017
Notes: The data in this table are calculated by ACS using annual surveys conducted from 2009 to 2015 and are representative of average characteristics during this period.
Aggregate minority population includes any individuals who identified themselves as belonging to one or more ethnic or racial minority. This population is calculated by total population, minus those of white, non-Hispanic origin.

Based on the county-level data for the American Indian population, the planning area is likely to contain minority populations at a "meaningfully greater" level than the comparison population per CEQ guidelines (CEQ 1997). (This would require analysis for environmental justice impacts for site-specific planning actions.)

Based on US Census Bureau 2015 poverty data, the number of individuals and families below the poverty line in Osage County is less than the state average and does not represent a population for further consideration for environmental justice analysis per CEQ standards (see **Table 3-37**, Poverty, 2015). When broken out by ethnic and racial group, people of white and non-Hispanic origin had substantially lower rates of poverty than people of racial and ethnic minorities (see **Table 3-38**, Poverty by Race and Ethnicity, 2015).

Table 3-37
Poverty, 2015

Poverty	Osage County	Oklahoma	United States
People	46,507	3,734,458	308,619,550
Families	12,576	966,009	77,260,546
People below poverty	7,365	624,043	47,749,043
	15.8%	16.7%	15.5%
Families below poverty	1,395	121,122	8,761,164
	11.1%	12.4%	11.3%

Source: US Census Bureau ACS 2011–2015 data, as reported in Headwaters Economics 2017
Note: The data in this table are calculated by ACS using annual surveys conducted from 2011 to 2015 and are representative of average characteristics during this period.

Table 3-38
Poverty by Race and Ethnicity, 2015

Race/Ethnicity	Osage County	Oklahoma	United States
Hispanic or Latino (of any race)	26.8%	26.9%	24.3%
Not Hispanic or Latino (of any race)	13.3%	12.9%	10.8%
White alone	13.7%	14.0%	12.7%
Black or African American alone	22.2%	30.1%	27.0%
American Indian alone	19.6%	22.8%	28.3%
Asian alone	0.0%	15.3%	12.6%
Native Hawaiian and Pacific Islander alone	0.0%	23.3%	21.0%
Some other race alone	23.0%	25.5%	26.5%
Two or more races	18.8%	22.6%	19.9%

Source: US Census Bureau 2015 ACS data, as reported in Headwaters Economics 2017
Note: The data in this table are calculated by ACS using annual surveys conducted from 2011 to 2015 and are representative of average characteristics during this period. Poverty prevalence is calculated by dividing the number of people by race/ethnicity in poverty by the total population of that race/ethnicity.

Minority status and income level were also examined by census tracts. Based on CEQ criteria, two census tracts qualified as minority populations (see **Table 3-39**, Census Tract Minority Status and Poverty Summary). Census tract 9400.02 has a large Native American population, while tract 9400.06 is predominantly African American. No census tracts were identified with low-income populations, based on CEQ guidelines.

Table 3-39
Census Tract Minority Status and Poverty Summary

Census Tract	Aggregate Minority Population (%)	Individuals in Poverty (%)
9400.01	38.5	18.5
9400.02	**45.0**	18.1
9400.03	24.8	19.6
9400.04	32.8	8.0
9400.05	26.1	12.9
9400.06	**86.1**	21.9
9400.07	23.6	11.9
9400.08	26.0	18.2
9400.09	24.4	9.6
9400.10	20.9	15.4
9400.11	23.6	13
Osage County	35.7	15.8
Oklahoma	32.7	15.8

Source: US Census Bureau 2015
Notes: The data in this table are calculated by ACS using annual surveys conducted from 2011 to 2015 and are representative of average characteristics during this period.
Aggregate minority population includes any individuals who identified themselves as belonging to one or more ethnic or racial minority. This population is calculated by total population minus those of white, non-Hispanic origin. Bold text indicates census tracts qualifying as minority populations.

The EPA's environmental justice guidance (EPA 2015e) recommends additional measures for consideration beyond CEQ guidance.

Education level may be important for identifying, characterizing, and developing strategies for engaging populations. Education level in Osage County was compared to the state level. The percentage of those with a high school degree in Osage County is higher than that of the state level (87.6 percent versus 86.4 percent). In contrast, the percentage of Osage County residents with a bachelor's degree was lower than the state average (16.1 percent versus 23.5 percent). While still within 10 percentage points of the state average, this differential may affect the jobs available to Osage County residents and the level at which job creation presents opportunities (Headwaters Economics 2017).

Population age was also examined, as some impacts may affect those over 65 or under 5 differently. Osage County contained a slightly higher level of those over

65 than the state average (18.5 percent versus 14.5 percent) and a lower level of those under 5 (5.2 percent versus 6.8 percent).

Additional measures may also provide more information on the poverty status of area populations, including median household income and the percent of individuals below twice the poverty level. Median household income in 2015 was also similar for Osage County ($45,443) and Oklahoma ($46,879). The percent of those approximately twice the poverty level was also the same for both Osage County and Oklahoma, at 21 percent of families below $50,000 (Headwaters Economics 2017). These data further support the conclusion that Osage County does not represent a low-income population.

As noted in CEQ guidance, some population groups may have differential patterns of consumption of natural resources, which relates to subsistence and differential patterns of subsistence. This could result in different degrees of impacts. It means differences in rates or patterns of fish, water, vegetation, and wildlife consumption among minority populations, low-income populations, or Tribes, as compared to the general population.

Native Americans in the planning area may also have differential patterns of consumption of natural resources, compared to the general population. For example, collecting native plants for traditional Tribal practices may represent a differential pattern of consumption that may be affected by proposed activities. For detailed analysis of Indian Trust Assets, see **Section 3.18**.

3.11 PUBLIC HEALTH AND SAFETY

This section is an overview of the laws, regulations, and policies that influence the management of public safety, hazards, and potentially hazardous conditions in the planning area.

3.11.1 Regulatory Framework

25 CFR 226

The regulations in 25 CFR 226, govern the leasing of the Osage Mineral Estate for oil and gas development. They include several measures intended to limit risk to public health and safety. For example, the regulations prohibit lessees from allowing unavoidable nuisances on the property they control and require pollution prevention measures to avoid oil, gas, or saltwater from migrating into freshwater-bearing formations.

Occupational Safety and Health Act

The Occupational Safety and Health Act of 1970 recognizes that personal injuries and illnesses incurred in a work setting result in reduced productivity, wage loss, and medical expenses. As a result of the act, the Occupational Safety and Health Administration was established to ensure the health and safety of workers by setting and enforcing standards, providing training, outreach, and education, establishing partnerships, and encouraging continual improvement in workplace safety and health (29 CFR 1910).

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites, provided for liability of persons responsible for releasing hazardous waste at these sites, and established a trust fund to provide for cleanup when no responsible party can be identified (EPA 2015f). Under CERCLA, petroleum and crude oil are not considered hazardous substances.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act of 1976 (RCRA) charges the EPA with controlling the generation, transportation, treatment, storage, and disposal of hazardous waste (42 USC 6901 et seq.). RCRA also promulgated a framework for managing nonhazardous solid wastes. The 1986 amendments to the RCRA enabled the EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances.

Toxic Substances Control Act

The Toxic Substances Control Act of 1976 and RCRA established a program administered by the EPA for regulating the generation, transportation, treatment, storage, and disposal of hazardous waste.

Clean Water Act

The CWA (33 USC 1251 et seq.) was enacted to restore and maintain the chemical, physical, and biological integrity of the Waters of the US. Oil pollution prevention regulations describe the requirements for facilities to prepare, amend, and implement SPCC plans. A facility is subject to SPCC regulations if the total aboveground oil storage capacity exceeds 1,320 gallons or the underground oil storage capacity exceeds 42,000 gallons, and if, due to its location, the facility could reasonably be expected to discharge oil into or on the Navigable Waters of the US.

BIA Regional 10-Year Fire Management Plan for the Eastern Oklahoma Regional Office

The 10-Year Fire Management Plan (FMP) defines the Eastern Oklahoma Regional Office's program for managing wildland and prescribed fire within its service area, based on approved land management goals and objectives. The FMP identifies the planned activities in the region during the relevant period, management practices for initial and extended attack, and prescribed fire and fuels management. The FMP provides for firefighter and public safety and includes fire management strategies, tactics, and alternatives (BIA 2009).

Pipeline and Hazardous Materials Safety Administration

The Pipeline and Hazardous Materials Safety Administration, a federal agency within the US Department of Transportation, is the primary federal regulatory agency responsible for ensuring the safety of America's energy pipelines, including crude oil pipeline systems. As a part of the responsibility, the Pipeline and Hazardous Materials Safety Administration established regulatory requirements for the construction, operation, maintenance, monitoring, inspection, and repair of hazardous liquid pipeline systems (PHMSA 2017).

3.11.2 Current Conditions

Osage County is dominated by farmland and grazed pastures, with residents living in rural or unincorporated communities. The Osage County Sheriff's Office and several local agencies provide law enforcement. In addition, the Osage Nation Police Department is charged with enforcing Tribal, state, and federal laws in Osage County. The chief of police is responsible for the day-to-day operations of the police department (Osage Nation 2012). Rural and municipal fire departments provide fire and emergency response.

The Occupational Safety and Health Administration defines hazardous substances as any solid, liquid, contained gaseous or semisolid waste, or any combination of wastes that pose a substantial present or potential hazard to human health and the environment (29 CFR 1910.120[a][3]). Hazardous substances are primarily generated by industry, hospitals, research facilities, and the government. Improper management and disposal of hazardous substances can lead to pollution of groundwater or other drinking water supplies and the contamination of surface water and soil. The primary federal regulations for managing and disposing of hazardous substances are CERCLA and RCRA.

Health and safety concerns associated with oil and gas development in the planning area include those for H_2S gas that could be released as a result of drilling, hazards introduced by heavy truck traffic, and hazardous materials used or generated during construction, drilling, and production. H_2S is extremely toxic in concentrations above 500 ppm (OSHA 2017) and is known to occur in varying concentrations at Osage County oil and gas operations (Osage Nation 2017a).

Produced water from oil and gas operations typically contains elevated levels of sodium and other chemicals. In the event of a spill or improper disposal of produced water near a drinking water intake, there is a possibility that chemical concentrations in drinking water could exceed federal safe drinking water standards. This could interrupt water supply to residents and could have negative health impacts from water contact. The number of spills will generally correlate with the level of oil and gas development in the county.

3.11.3 Trends

Oil and gas development will continue to introduce risks to public health and safety in Osage County. The risk level depends on such factors as the amount of development and nature and type of mitigation measures implemented.

3.12 Visual Resources

Visual resources refer to the features on a landscape, such as land, water, vegetation, animals, and structures. These features contribute to the scenic or visual quality and appeal of the landscape (BLM 1984).

3.12.1 Regulatory Framework

There are no federal or Tribal laws or programs regarding visual resources in the planning area. At the local level, the 2030 Osage County Comprehensive Plan (Osage County 2011) was developed to guide development in the county by establishing public land use goals and policies, including policies intended to preserve visual resources. This plan is a collaboration of the Osage County Board of Commissioners, the Osage County Industrial Authority, and the Pawhuska-Osage County Planning Commission.

Among the goals and policies that have been adopted for residential land use and recreation, trails, and open space areas, protecting scenic vistas is a stated policy and enhancing visual character is a stated goal. Preservation of public and private open spaces, low impact development, and green building techniques are methods called out for accomplishing this (Osage County 2011).

3.12.2 Current Conditions

The BIA does not have a visual resources management system, nor does it maintain a visual resources inventory; however, in 2016, as part of the OKT Joint EIS/BLM RMP/BIA IRMP, the BLM Oklahoma Field Office, BIA Southern Plains and Eastern Oklahoma Regions completed a visual resource inventory (VRI) which included Osage County (DOI 2016).

The inventory used the process and guidelines established by BLM Manual Handbook H-8410-1 (BLM 1986). Based on the three inventory components, described below, lands in the planning area were placed into one of four VRI classes:

- A **scenic quality** evaluation rates the visual appeal of the inventory area, based on vegetation, landform, water, color, adjacent scenery, scarcity, and cultural modifications. Scenic quality is rated as A, B, or C.
- A **sensitivity level** analysis assesses public concern of the inventory area's scenic quality and the public's sensitivity to potential changes in the visual setting. The evaluation is based on types of users, level of use, public interest (local, regional, national,

and international), adjacent land uses, and the presence of special areas. Sensitivity level is rated as high, moderate, or low.

- A delineation of **distance zones** indicates the relative visibility of the inventory area's landscape from primary travel routes or observation points in the foreground-middle ground zone (less than 3 to 5 miles away), background zone (to a distance of 15 miles away), and seldom seen zone (more than 15 miles away or hidden from view in any zone).

Table 3-40, Visual Resource Inventory Component Distribution, describes the VRI component distribution of Osage County, according to the April 2016 inventory.

Table 3-40
Visual Resource Inventory Component Distribution

Visual Resource Inventory Component	Total Acreage in Decision Area	Total Percent of Decision Area
Scenic Quality		
A	1,474,500	100
B	0	0
C	0	0
Sensitivity		
High	658,500	44.7
Moderate	816,100	55.3
Low	0	0
Distance Zones		
Foreground/middle ground	17,400	1.2
Background	23,700	1.6
Seldom seen	1,433,400	97.2
VRI Class		
Class I	0	0
Class II	1,474,500	100
Class III	0	0
Class IV	0	0

Source: BLM GIS 2016

VRI Classes I and II are the most valued, Class III represents a moderate value, and Class IV represents the least value. VRI class does not establish management direction; instead, it is considered the baseline data for existing conditions. All lands in Osage County were found to be VRI Class II.

The visual conditions of the planning area can also be generally described by its physiographic province. This is a subdivision of physiographic regions that divide the continent based on similar landforms and landscapes. Osage County is in the Central Lowland Province, within the Osage Plains physiographic section (Oklahoma Atlas Institute 2015; Oklahoma Historical Society 2009). The average relief is between 300 and 500 feet elevation (Oklahoma Historical Society 2009) and typically does not change more than 300 feet across the county. Topography is generally flat, with some rolling hills, becoming more varied in the eastern portion of the county where there are more lakes and rivers.

Tallgrasses were the area's predominant vegetation until the late nineteenth century when Euro-American settlers began clearing land for crops and wood (Oklahoma Historical Society 2009). Today, these grasses can be observed in the Tallgrass Prairie Preserve in north-central Osage County. The grassy plains give most of the landscape a tan and light green appearance. Vegetation is darker green around lakes and rivers; more of this dark green vegetation is found in the eastern portion of the county, where there are more of these features.

Another significant visual resource in the planning area is the Osage Nation Heritage Trail Byway. This 70-mile-long byway bisects the entire county and provides unique views and vistas not found along other local roadways, such as the following (America's Scenic Byways 2015; Osage County 2011; Travel OK 2015):

- Buffalo habitat
- The Osage Hills, which are characterized by rolling hills and rolling tallgrass prairie
- Historic landmarks, such as the estates of Oklahoma's historic oil barons and the Constantine Theatre

Lakes, rivers, and state parks are other visual resources in the planning area, offering scenic and recreational value.

The most prominent human-made modifications to the visual landscape are the roads. Several major roadways bisect the county. Cities and towns in the county are characteristic of rural areas. Pump jacks and tank batteries are also frequently visible throughout the landscape.

Night skies are affected by unnatural light sources in the area, including glows from cities and towns. The most populated cities in the county produce the most light pollution: Tulsa, Bartlesville, and Sand Springs, all of which are partially in Osage County. Lighting from oil and gas-related construction also reduces nighttime darkness. Night skies would be most preserved in undeveloped areas, such as the Tallgrass Prairie Preserve and state parks.

Viewers of the visual landscape are the residents, tourists, and through-travelers.

The population of Osage County in 2015 was 47,054 (US Census Bureau 2015, as cited in Headwaters Economics 2017). More details on county demographics can be found in **Section 3.10**).

3.12.3 Trends

The landscape is experiencing some modification due to oil and gas development. As described in **Section 3.16**, 84 percent of the planning area has high or moderate-to-high oil and gas potential. Based on this potential and predicted nationwide price increases (discussed further in **Section 3.16**), oil and gas development activity in the planning area is expected to increase over the next 20 years, accompanied by an increase in visual changes. Features with concentrated recreation, such as lakes and rivers, would be more sensitive to landscape changes, which could affect visual qualities.

3.13 NOISE

Noise is defined as unwanted sound and can be intermittent or continuous, steady or impulsive. Human response to noise is diverse and varies according to the type of noise source, the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source and the receptor.

The decibel (dB) is the accepted unit of measurement for noise. Human hearing is not equally sensitive to all sound frequencies. Because of this, depending on the amplitude of the sound, various frequency weighting schemes have been developed to approximate the way people hear sound. The A-weighted decibel scale (dBA) is normally used to approximate human hearing response to sound. Examples of sound noise levels are shown in **Table 3-41**, Example Noise Levels.

Table 3-41
Example Noise Levels

Characterization	Decibel (dBA)	Example Noise Condition or Event
Painful	140	Jet engine
	130	Jackhammer
	120	Jet plane takeoff, siren
Extremely Loud	110	Maximum output of some MP3 players, model airplane, chain saw
	106	Gas lawn mower, snow blower
	100	Hand drill, pneumatic drill
	90	Subway, passing motorcycle
Very Loud	80-90	Blow-dryer, kitchen blender, food processor
Loud	70	Busy traffic, vacuum cleaner, alarm clock
Moderate	60	Typical conversation, dishwasher, clothes dryer
	50	Moderate rainfall
	40	Quiet room
Faint	30	Whisper, quiet library

Source: American Speech-Language-Hearing Association 2018

In general, sound waves travel away from the noise source as an expanding spherical surface. The energy contained in a sound wave is spread over an increasing area as it travels away from the source. It decreases in loudness at greater distances from the noise source. A doubling of distance results in an approximately 6-dB reduction in sound pressure level for single point sources of noise; doubling the distance results in a 3-dB reduction for multiple point sources moving in a straight line, such as a highway (Hedge 2011). Loudness—the subjective perception of sound by humans—is generally considered to double for approximately every 6- to 10-dB increase in sound level.

3.13.1 Regulatory Framework

Originally, the EPA had the authority to control noise levels to protect human health and welfare, in accordance with the Noise Control Act of 1972 (42 USC 4901 et seq.). Subsequently, the Quiet Communities Act of 1978 (Public Law 95-609) amended the Noise Control Act and encouraged state and local governments to establish noise control programs. In 1981, the federal government transferred substantial authority to regulate noise from the EPA to state and local governments.

There are no Tribal laws regulating noise in Osage County. At the local level, a comprehensive land use plan has been developed to adopt public land use goals and policies to guide development in the county.

The 2030 Osage County Comprehensive Plan is a local document meant to guide future physical and economic development (Osage County 2011). This plan is a collaboration of the Osage County Board of Commissioners, the Osage County Industrial Authority, and the Pawhuska-Osage County Planning Commission. Exterior noise reduction measures are included in the plan to mitigate any negative impacts on adjacent areas, such as sensitive receptors (Osage County 2011). Screening, buffering, setbacks, and landscaping are methods called out for reducing noise (Osage County 2011).

3.13.2 Current Conditions

Existing Noise Sources

Noise levels in the project area are representative of a rural environment. Noise sources in rural areas include vehicles on area roadways, agricultural equipment, and natural sounds, such as wind, weather, and wildlife. Ambient sound levels typical of rural areas range between 30 and 40 dBA (EPA 1978).

The oil and gas industry is also a contributor of noise in the planning area, as it is one of the most important economic industries in the county. Sources of noise from oil and gas development are truck traffic, drilling and completion activities, well pumps, and compressors (Earthworks 2015). **Section 4.13**, Noise (Environmental Consequences), provides typical noise levels for different oil- and gas-associated activities.

Existing Sensitive Receptors

Sensitive receptors in the county include residents of the cities, towns, and communities and users of recreation sites in the county. The population of Osage County in 2015 was 47,054 (US Census Bureau 2015, as cited in Headwaters Economics 2017). Sensitive receptors in the county also include wildlife and livestock; refer to **Section 3.5**, Fish, Wildlife, and Migratory Birds and **Section 3.8**, Agriculture, for information about these sensitive receptors.

Cities in Osage County are the following (US Census Bureau 2010):

- Barnsdall (population 1,243)
- Bartlesville (partially in Osage County; total population 35,750)
- Hominy (population 3,565)
- Pawhuska (population 3,584)
- Sand Springs (partially in Osage county; total population 18,906)
- Shidler (population 441)
- Tulsa (partially in Osage County; total population 603,403)

Towns in Osage County are as follows (US Census Bureau 2010):

- Avant (population 320)
- Burbank (population 141)
- Fairfax (population 1,380)
- Foraker (population 19)
- Grainola (population 31)
- Osage (population 156)
- Prue (population 465)
- Skiatook (partially in the county; total population 7,397)
- Sperry (population 1,206)
- Webb City (population 62)
- Wynona (population 437)

Surface owners next to oil and gas developments may be particularly sensitive to noises from this industry. Recreationists would be those visiting the Tallgrass Prairie Preserve, lakes, rivers, and state parks.

3.13.3 Trends

The population change between 2000 and 2015 was 8.1 percent (US Census Bureau 2015, as cited in Headwaters Economics 2017). This is a slower rate than in Oklahoma and the US as a whole (see **Table 3-24**). This slow growth indicates that the number of sensitive receptors is not likely to increase significantly in the near future.

Approximately 84 percent of the planning area has high or moderate-to-high oil and gas potential (BLM GIS 2015). Based on this potential and predicted nationwide price increases (discussed further in **Section 3.16**), the number of oil and gas wells in the planning area is expected to increase over the next 20 years (**Appendix A**); therefore, noise associated with this industry is also expected to increase.

3.14 Land Use Plans, Utilities, and Timber Harvesting

3.14.1 Regulatory Framework

This section discusses the regulatory framework guiding land use, utilities, and timber harvesting in the planning area.

Tribal Trust Lands

When the federal government acquires land in trust for a Tribe, the land is not subject to state or local land use regulations; only Tribal land use regulations are applicable on trust lands; however, the BIA cooperates with local and state authorities on matters related to land use. The trust land overseen by the BIA consists of approximately 1,600 acres in the 1,474,500 acres of the planning area, which encompass the Osage Mineral Reserve covering Osage County (BIA NIOGEMS GIS 2015). **Table 1-1**, Planning Area Surface Ownership, describes surface ownership in Osage County.

The BIA Osage Agency plans for purchasing and putting land into trust; it oversees mineral leasing of Tribal minerals in the planning area. The agency branches include Executive Direction and Trust Services, which is divided into six subsections: real estate services, probate and estate services, natural resources, mineral subsurface leasing, mineral lease management, and mineral field operations (in accordance with the memorandum of understanding between the EPA and the Osage Nation).

The predominant classification of land use by the County Assessor in the planning area is rural agriculture, which covers approximately 95 percent of the land area. Rural residential and rural commercial comprise approximately 2.6 percent and 2 percent of land use (Osage County 2011).

Osage County Land Use Plan

The Osage County Comprehensive Plan is meant to guide future physical and economic development (Osage County 2011). This plan is a collaboration of the Osage County Board of Commissioners, the Osage County Industrial Authority, and the Pawhuska-Osage County Planning Commission.

The Industrial Authority understands the importance of properly managing growth and development in Osage County and has begun to prepare an industrial land use plan with the INCOG. This is a voluntary association of local and Tribal governments in the Tulsa metropolitan area that provides planning and coordination services in such areas as land use, transportation, and community and economic development. The Industrial Authority also provides the Osage County Tourism Oversight Committee with a seed grant to begin preparing a plan for tourism and marketing.

The planning period and stages of implementation of the goals, policies, and objectives of the comprehensive plan has been divided into the following periods:

- Short term—Adoption of the comprehensive plan and 5 years beyond, 2011 to 2016
- Mid-term—From 6 to 10 years after adoption of the comprehensive plan, 2017 to 2022
- Long term—From 11 years after adoption of the comprehensive plan to the end of the planning period and 2030; the long term also includes those objectives that will take place throughout the planning period, as described at the end of this chapter, 2011 to 2030

Objectives identified in the comprehensive plan address the following:

- Land use planning and intensity
- Public and quasi-public areas and facilities
- Public utilities
- Transportation
- Housing
- Economic development
- Image and appearance
- Quality of life

In general, the objectives for land use planning in Osage County support the preservation and protection of land used for agriculture and ranching (Osage County 2011).

BIA

The BIA manages lands in Osage County in accordance with 25 CFR 150–152, 158, 162, 169, whose regulations set forth the following authorities, policies, and procedures:

- Part 150 governs the recording, custody, maintenance, use, and certification of title documents and the issuance of title status reports for Indian land.
- Part 151 governs the acquisition of land by the US in trust status for individual Indians and Tribes. Acquisition in fee simple status is not covered by these regulations, even though such land may be held in restricted status following acquisition. Acquisition of land in trust status by inheritance or escheat (reversion of lands) is not covered by these regulations.
- Part 152 governs issuing patents in fee, certificates of competency, removal of restrictions, and sale of certain Indian lands.
- Part 158 regulations governs the application and order for change in designating homesteads, exchanging restrictive lands, instituting partition proceedings and partition records, approving deeds, and distributing proceeds of partition sales.
- Part 162 governs leasing certain interests in Indian land.
- Part 169 governs granting ROWs over and across Tribal land and government land.

3.14.2 Current Conditions

Regional Setting

With a total land area of 1,474,500 acres, Osage County has the largest land area of any county in Oklahoma. It is in the northeastern portion of the state and is bounded by Kansas to the north, Kay, Noble, and Pawnee Counties to the west, the Arkansas River to the southwest, and Washington and Tulsa Counties to the east. Although most of the planning area is sparsely populated, a part of metropolitan Tulsa extends into the far southeastern corner. Except for large floodplains along the Arkansas River and several other major streams, gently rolling hills generally characterize the county's topography (BIA 2014).

The population of Osage County in 2015 was 47,054, and the population change between 2000 and 2015 was 8.1 percent (US Census Bureau 2015, as cited in Headwaters Economics 2017). Lands in the planning area are generally rural, with small farming communities and residences scattered throughout.

TNC purchased the Tallgrass Prairie Preserve in the northern portion of Osage County in 1989. There have been additional land purchases and leases since then, and TNC now manages approximately 35,200 acres of preserved area (OK GAP GIS 2008). TNC has worked with numerous energy companies on its preserves; its approach has been to use collaborative conservation within the context of local economies.

As of 2013, the Tallgrass Prairie Preserve contained 220 operating oil and gas wells (TNC [Robert G. Hamilton] 2013), with associated roads, power lines, and pipelines. The preserve has free-ranging bison herds, scenic turnouts, hiking trails, and picnic tables (TNC 2015).

Utilities

The primary utility infrastructure in the planning area consists of underground pipelines used to transport oil, gas, formation water, and secondary recovery chemicals to refineries outside the planning area. In addition, the Osage Agency estimates that there are several hundred miles of pipelines presently in use in the county; these are used for brine disposal or injection (BIA 2014). The BIA has no regulatory authority over interstate pipeline operations, including spill prevention and cleanup, unless those pipelines are on restricted or Indian trust lands in Osage County. The Superintendent of the Osage Agency must approve route locations of interstate lines on restricted Indian lands.

There are approximately 1,000 miles of pipelines identified by the National Pipeline Mapping System (NPMS) in the planning area, most of which are used for crude oil and natural gas transportation (NPMS GIS 2015).

Due to the rural nature of the planning area, electrical transmission and distribution infrastructure is primarily for interstate transmission lines, rural developments, wind and hydroelectric power generation, and oil and gas development activity. There are approximately 300 miles of transmission lines in Osage County (BIA GIS 2017). Electric power distributers in Osage County are the Public Service Company of Oklahoma and the Indian Electric Cooperative.

Wind energy developments in Osage County are the Osage Wind Project and the Mustang Run Wind Farm. Both developments are near Pawhuska, Oklahoma. The Osage Wind Project is a 150-megawatt wind development that encompasses 8,400 acres. Operation began in the summer of 2015 and is expected to produce enough power for approximately 45,000 homes (Tradewind Energy 2016a). The 136-megawatt Mustang Run Wind Farm encompasses 9,500 acres; once operational, it is expected to produce enough power for 41,000 homes (Tradewind Energy 2016b).

Figure 3-14, Rights-of-Way (in **Appendix E**), displays the location of transmission lines, pipelines, and wind projects in the planning area.

Timber Harvesting

Osage County is in the Cross Timbers ecological region (EPA 2012). Forest management is coordinated with other resource and cultural programs of the Osage Nation. Timber harvesting and sale is conducted in cooperation with the BIA Agency Superintendent and the Eastern Oklahoma Regional Forester.

Timber management in the planning area is limited to forest lands having the potential to produce accessible commercial timber. These lands are restricted to bottomlands and mixed hardwood stands on drainage terraces in the southern part of the planning area. Commercial lessees cut native timbers as a cash crop, mostly oak, ash, hackberry, cottonwood, sycamore, cherry, and elm, with specialty cash crops of walnut and pecan (ONENRD 2006).

The hardwood community consists primarily of short oak trees that are not prime timber for harvest; however, forested areas have been cleared to create open sections for rangeland, pastures, and farmland. At the time of writing this EIS, Osage County has not had any timber sales since 2004.

3.14.3 Trends

Land Use Plans

Future land uses in the planning area will continue to include rural residential developments, agriculture (primarily for field crops and tame pastures), oil and gas development, and wind energy generation. Osage County and Osage Nation will continue to share land use authority in the planning area. Osage County will continue to maintain and refine the Osage County Comprehensive Plan.

Utilities

The location and extent of future mineral (e.g., oil and gas) and renewable energy (e.g., wind) development in the planning area will directly influence the location and intensity of future utility development. Utility infrastructure to support this activity is likely to include oil and gas pipelines and electrical distribution and transmission lines. Future population growth in the southeastern portion of the county may also create demand for new electrical infrastructure.

Timber Harvesting

Historical harvesting and land use practices have resulted in fewer acres available for timber harvesting. Of the 47,500 acres that are forested in Osage county, 40,900 are upland woodlands and 6,600 acres are terrace and bottomland forests (ONENRD 2006).

3.15 Traffic and Transportation

3.15.1 Regulatory Framework

The Osage Nation published a long-range transportation plan in 2017; it is the primary planning document for the Osage Nation Roads Department. The plan prioritizes identifying and inventorying roads eligible for the Indian Reservation Roads System so that funding can be sought for road improvements (Osage Nation 2017d).

The Osage Nation Roads Department is responsible for communicating with federal, state, county, and local officials to ensure that the different entities are collaborating, that efforts are being maximized, and that the safety and well-being of travelers within those boundaries are being addressed (Osage Nation 2018).

ODOT's long-range transportation plan focuses on highways and bridges, public transportation, freight movement, passenger rail, bicycle and pedestrian networks, and access to air and water ports (ODOT 2015). There are eight field divisions across the state, each responsible for road repairs, maintenance, and cleaning within their boundaries. Osage County is in Field Division 8.

3.15.2 Current Conditions

Primary Roads

The primary roadway network consists of several federal and state highways maintained by ODOT. The density of primary roads is higher in the more populated southern portion of the county, with fewer highways in the less populated north.

US Highway 60 crosses Osage County from Bartlesville, west to the county line just south of Ponca City in Kay and Osage Counties. Annual average daily traffic (AADT) on this road ranges between 1,900 and 6,700, depending on the location (ODOT 2013). US Highway 60 is a two-lane paved road with center striping and paved shoulders. In March 2008, the ODOT Scenic Byways Program approved the Osage's request to designate US Highway 60 as a state scenic byway.

State Highway 11 enters the southeast corner of Osage County near Skiatook and travels northwest to Pawhuska. It shares its route with US Highway 60 for approximately 20 miles west of Pawhuska to the intersection with State Highway 18. State Highways 11 and 18 then travel north to Shidler, where State Highway 11 continues west across Kaw Lake to the county border. AADT on this road ranges between 450 and 5,300, depending on the location (ODOT 2013). State Highway 11 is a two-lane paved road with center striping and paved shoulders.

State Highway 18 traverses western Osage County in a north-south direction, passing through Shidler and Fairfax. AADT varies between 290 and 1,600, depending on the location (ODOT 2013). State Highway 18 is a two-lane paved road with center striping and paved shoulders.

Other primary roads in Osage County are State Highways 10, 20, 99, and 123. These are all two-lane paved roads with center striping and paved shoulders. AADT is under 4,000 in most areas, except in the vicinity of Tulsa, where AADT for each roadway on State Highway 20 is 16,300 (ODOT 2013).

Other Roads

There are other paved and unpaved roads in populated areas that support public passenger travel. Most of these roads are maintained by the Osage

County Commissioners and the Osage Nation Roads Department. They are categorized by the amount of vehicle traffic they receive. Unpaved roads in rural areas are largely used to access oil and gas wells and are typically owned and maintained by the lessee.

The Osage Nation maintains its own inventory of transportation facilities in the county that are eligible for Tribal Transportation Program (TTP) funding. A TTP route is a public road that is in, or provides access to, an Indian reservation, Indian trust land, or restricted Indian land. These roads, trails, and other facilities provide safe and adequate transportation and public access to, in, and through Indian reservations and native communities for Native Americans, visitors, recreationists, resource users, and others, while contributing to the health and safety and economic development of Native American communities.

The Osage Nation's TTP inventory predominantly uses the county, township, and state roads in its jurisdictional boundaries, which serve all people in Osage County (see **Table 3-42**, Osage Transportation Facility Inventory). The Osage Nation Long-Range Transportation Plan's primary focus is on Tribal economic development, cultural sites, Tribal residences, and headquarters (Osage Nation 2017d).

Other Transportation

Cimarron Public Transit System (CPTS) provides regional demand response transit service for Barnsdall, Pawhuska, and Skiatook in northeastern Oklahoma, including Osage County (ODOT 2017). In 2015, individuals in the CPTS service area made 126,000 trips on CPTS transit vehicles (United Community Action Program, Inc. 2015). CPTS also has contract services in various parts of Osage County, mostly with health-related agencies, to provide demand response and paratransit services. The City of Hominy Senior Citizens Center also offers demand response transit service in the community (United Community Action Program, Inc. 2015).

3.15.3 Trends

Traffic and transportation trends will likely mirror population changes. Population growth will likely increase the number of vehicles on roads in Osage County, especially near Tulsa. New road development and traffic associated with oil and gas development will increase, as exploration and production increases. Roads used for oil and gas exploration and development will continue to provide access for other uses, such as ranching, after oil and gas development is complete (Storer et al. 2016).

Table 3-42
Osage Transportation Facility Inventory

Class	Description	Miles
Class 1	Major arterial roads serving traffic between two large population centers and carrying an average traffic volume of 10,000 vehicles or more per day	65.2
Class 2	Rural minor arterial roads serving traffic between large population centers and smaller towns and communities; generally designed for relatively high overall speeds, with minimum interference to through-traffic, and carrying fewer than 10,000 vehicles per day	223.9
Class 3	Streets and roads serving residential and urban areas	401.8
Class 4	Rural major collectors of traffic from local rural roads	430.7
Class 5	Local rural roads serve areas around villages or provide access to farming areas, schools, tourist attractions, and various small enterprises; also includes roads and vehicular trails for such activities as administering forests, grazing areas, mining and oil operations, and recreation	963.1
Class 6	Minor arterial streets in the communities that provide access to major arterial roads	0
Class 7	City collector streets in communities that provide access to city streets	2.0
Class 8	Paths, trails, walkways, and other routes for public traffic, bicycles, trail bikes, snowmobiles, all-terrain vehicles, and non-vehicular traffic	0.7
Class 9	Parking facilities next to TTP routes and scenic byways, such as rest areas, scenic pullouts, ferry boat terminals, and transit terminals	8.6
Class 10	Public airstrips within the boundaries of the TTP system for inventory and maintenance only	0
Class 11	Overlapping routes; requires no funding because it is already in the inventory under another route number but is in the system to be complete an example of a Class 11 route is Highway 11 overlapping Highway 60; these are two different routes that, at some point, overlap	0
Total	—	**2,096**

Source: Osage Nation 2017d

3.16 Mineral Extraction

3.16.1 Regulatory Framework

Osage Allotment Act of 1906

This act authorizes the Osage Nation to lease the Osage Mineral Estate for oil and gas exploration and development "with the approval of the Secretary of the Interior, and under such rules and regulations as he may prescribe." The Secretary delegated the authority to approve leases to the Superintendent of the Osage Agency. Leases of the Osage Mineral Estate may be obtained through public lease sales or negotiation with the Osage Minerals Council. According to the BIA Osage Agency approximately 782,549 acres are leased for oil and/or gas development, or otherwise held by concession agreements, with 692,804 acres still available for leasing.

BIA Regulations on Leasing of Osage Reservation Lands for Oil and Gas Mining (25 CFR 226)

The regulations in 25 CFR 226 govern the leasing of the Osage Mineral Estate for oil and gas exploration and development.

3.16.2 Current Conditions

The EPA classifies the oil and gas extraction industry into four major processes:

- Exploration
- Well development
- Production
- Site abandonment

Exploration involves the search for rock formations associated with oil or natural gas deposits and geophysical prospecting or exploratory drilling. Wells are developed after an economically recoverable field has been found. Development involves the drilling of one or more wells (called spudding). If no hydrocarbons are found, the well is abandoned; if hydrocarbons are found in sufficient qualities, the well is completed (EPA 2000).

Most wells in the planning area are drilled vertically to a hydrocarbon reservoir; however, horizontal and directional drilling are also used to extract resources in the planning area. These drilling methods allow wells to be drilled diagonally or horizontally to extract resources from multiple points in a reservoir or to reach a reservoir that is not directly below the well pad. These drilling techniques can also allow multiple wells to be drilled in different directions from a single well pad on the surface.

The third major oil and gas extraction process, production, extracts hydrocarbons through the well and then separates the oil and gas from by-products before sale. By-products are often separated at a refinery or natural gas processing plant.

Hydraulic fracturing is a technique that produces fractures in a rock formation to increase hydrocarbon production from a well. Fractures are created by pumping large quantities of fluids at high pressure down a wellbore and into the target rock formation. Hydraulic fracturing fluid commonly consists of water, proppant, and chemical additives that open and enlarge fractures in the rock formation, sometimes extending several hundred feet from the wellbore. The proppants hold open the newly created fractures. Sand, ceramic pellets, or other small incompressible particles may be used as proppants (EPA 2015a).

Once the injection process is completed, the internal pressure of the rock formation causes fluid hydrocarbons to return to the surface through the wellbore. This fluid, known as flowback, wastewater or produced water, may contain the injected chemicals plus naturally occurring materials, such as brines, metals, radionuclides, and hydrocarbons.

The produced water is typically stored on-site in tanks or pits before treatment, disposal, or recycling. In many cases, it is injected underground for disposal. In areas where that is not an option, it may be treated and reused or processed by a wastewater treatment facility and then discharged to surface water (EPA 2015a).

The final major oil and gas extraction process, site abandonment, involves plugging the wells and restoring the site when a producing well becomes no longer economically viable, or when a recently drilled well fails to produce economic quantities of oil or gas (EPA 2000).

The planning area, Osage County, falls within two large oil and gas plays. The Excello-Mulky play overlaps the eastern portion of the planning area, and the Mississippian play overlaps the western portion. Within those plays there are 277 known oil and gas fields in Osage County. **Table 3-43**, Oil and Gas Fields, lists the number of fields with each type of resource in the planning area.

Table 3-43
Oil and Gas Fields

Resource	Number of Fields	Acres of Fields
Coal bed methane	16	78,900
Gas	22	20,500
Oil	220	669,500
Oil and gas	19	34,600

Source: USGS GIS 2014

There are 12,133 active oil wells, 1,630 active gas wells, 84 active wells producing both oil and gas, and 2,749 other (injection, disposal, and service) active wells in the planning area (BIA Osage Agency 2018). **Table 3-44**, Active Oil and Gas Wells, shows the number of currently active wells in the county. **Table 3-45**, below, shows the total number of wells, including plugged and abandoned wells, for each resource broken down by horizontal, directional, and vertical wellbore. Approximately 99 percent of the active wells in the planning area are vertical. **Figure 3-15**, Oil and Gas Development Activity (in **Appendix E**), shows wells and oil and gas fields in the planning area. In addition to extraction wells, the planning area contains 4,909 injection, disposal, or service wells. Three of these wells are horizontal, two are directional, and the rest are vertical (Information Handling Services 2017; BIA Osage Agency 2017).

Table 3-44
Active Oil and Gas Wells

Resource		Number of Wells
Oil		12,885
	Vertical	12,856
	Directional	9
	Horizontal	20
Gas		1,630
	Vertical	1,614
	Directional	5
	Horizontal	11
Oil and gas		84
	Vertical	84
	Directional	0
	Horizontal	0
Other (injection/disposal/service)		2,610

Source: Information Handling Services 2017 and BIA Osage Agency 2018

Table 3-45
Total Oil and Gas Wells (Including Plugged and Abandoned)

Resource		Number of Wells
Oil		25,133
	Vertical	25,003
	Directional	11
	Horizontal	119
Gas		3,113
	Vertical	3,025
	Directional	23
	Horizontal	65
Oil and gas		98
	Vertical	88
	Directional	6
	Horizontal	4
Other (injection/disposal/service)		4,909

Sources: Information Handling Services 2017; BIA Osage Agency 2018

Table 3-46, Annual Oil and Gas Well Completions, shows the number of vertical, horizontal, and directional wells completed in 2013 through 2017. In addition to the oil and gas wells shown, 38 injection wells were completed in 2013, another 11 were completed in 2014, 5 were completed in 2016, and 16 were completed in 2017 (BIA Osage Agency 2018).

Table 3-46
Annual Oil and Gas Well Completions

Resource		Number of Wells
	2013	
Oil		192
	Vertical	178
	Directional	0
	Horizontal	14
Gas		21
	Vertical	20
	Directional	0
	Horizontal	1
Oil and Gas		5
	2014	
Oil		87
	Vertical	81
	Directional	4
	Horizontal	2
Gas		4
	Vertical	4
	Directional	0
	Horizontal	0
Oil and Gas		7
	2015	
Oil		46
	Vertical	44
	Directional	0
	Horizontal	2
Gas		4
	Vertical	4
	Directional	0
	Horizontal	0
Oil and Gas		1
	2016	
Oil		55
	Vertical	55
	Directional	0
	Horizontal	0
Gas		4
	Vertical	4
	Directional	0
	Horizontal	0
Oil and Gas		0

Table 3-46
Annual Oil and Gas Well Completions (cont.)

Resource		Number of Wells
2017		
Oil		45
	Vertical	45
	Directional	0
	Horizontal	0
Gas		7
	Vertical	7
	Directional	0
	Horizontal	0
Oil and Gas		0

Source: Information Handling Services 2017 and BIA Osage Agency 2018

As shown in **Table 3-45** and **Table 3-46**, oil extraction is much more prevalent in the planning area than gas extraction. Most wells are vertically drilled, with directional drilling as the second most common method. From 2000 to 2017, horizontal wells made up just 5 percent of new well completions. While the planning area has been substantially developed, historical development is heavily concentrated in certain parts of the county. Approximately 73 percent of the county is made up of sections with fewer than 17 total wells drilled. Development is concentrated in the 27 percent of the county with sections containing 17 or more total wells.

The RFD for Osage County suggests that geologic conditions and the high costs of horizontal drilling mean that most new wells will continue to be vertical (**Appendix A**).

According to BIA records, in 2017, wells in Osage County produced 3,219,942 barrels of oil and 4,786,035 cubic feet of gas. In 2016, wells produced 4,278,812 barrels of oil and 6,148,775 cubic feet of gas. In 2015, wells produced 4,675,870 barrels of oil and 8,614,966 cubic feet of gas.

3.16.3 Trends

The BIA has classified oil and gas development potential throughout Oklahoma, including the planning area, ranging from no potential to high potential (**Appendix A**). **Table 3-47** shows development potential and existing wells in the planning area.

As shown in **Table 3-47**, Oil and Gas Development Potential, 84 percent of the planning area has high or moderate-to-high oil and gas potential. Most wells (94 percent) have been drilled in these areas, and future development can be expected to follow the same pattern.

Table 3-47
Oil and Gas Development Potential

Development Potential	Acres	Percent	Existing Active Wells (Including injection, disposal and service wells)	Percent
High	973,200	66	13,286	77
Moderate to high	268,200	18	3,255	19
Moderate	231,600	16	678	4
Low to moderate	1,300	Less than 1	0	0
Low	200	Less than 1	0	0
Total	**1,474,500**	**102**	**17,219**	**100**

Source: BLM GIS 2015 and BIA Osage Agency 2018

The Energy Information Administration predicted that, between 2012 and 2040, nationwide oil prices will rise by between 0.8 and 1.4 percent per year and natural gas prices to rise at a rate of 3.7 percent per year (in 2012 dollars; Energy Information Administration 2014). Based on the oil and gas development potential and predicted nationwide price increases, oil and gas development activity in the planning area is expected to increase over the next 20 years.

The Osage RFD estimates that 3,208 new oil wells, 1,369 new gas wells, and 184 new injection wells will be drilled between 2018 and 2037 (**Appendix A**).

3.17 RECREATION AND SPECIAL USE AREAS

3.17.1 Regulatory Framework

While the BIA manages no lands in the planning area specifically for recreation, private, state, and local agencies in Osage County provide diverse opportunities for recreation. Some examples are biking, boating, camping, hiking, horseback riding, hunting, fishing, off-highway vehicle riding, swimming, and tennis playing.

The Osage County Comprehensive Plan is a local document meant to guide future physical and economic development (Osage County 2011). The development of the county's economic potential for tourism and recreation for residents and visitors depends on preserving its natural and human-made recreation and open spaces. Some of the County's objectives for parks, recreation, trails, and open space areas are listed below; a complete list of objectives can be found in Chapter 4 of the 2030 Osage County Comprehensive Plan (Osage County 2011):

- Preserve, maintain, and develop recreation and open spaces for the use and enjoyment of residents, visitors, and tourists
- Meet present and future active and passive recreation needs by setting aside lands for parks, recreation, and open space
- Protect natural open space areas identified as development sensitive and conservation areas to preserve the natural vegetation, wildlife,

and environment, while reducing potential hazards to humans from improperly building on steep slopes with erodible soils or flooding potential

3.17.2 Current Conditions

Hunting and Fishing

Oklahoma provides a diverse hunting experience, with over 12 different ecological regions. The Oklahoma Department of Wildlife Conservation (ODWC) provides habitat conservation and management across the state at designated WMAs. Game species of interest in Osage County are quail, deer, turkey, rabbit, furbearers, dove, waterfowl, squirrel, and various other small game and migratory birds. Nongame species of interest are the greater prairie-chicken and bald eagles (ODWC 2016b).

Hunting seasons vary for species, but in general people hunt in the fall and winter. Additionally, the ODWC manages and stocks lakes and ponds throughout the state. Fish species produced and stocked annually are largemouth bass, smallmouth bass hybrid, walleye, brown trout, and rainbow trout. An average of 11 million fish are stocked annually.

The BIA approves hunting leases on trust and restricted lands. The Osage Nation adopted the Osage Hunting and Fishing Regulations under the Osage Nation Wildlife Conservation Act on April 24, 2017. This act will protect and provide for the conservation and management of wildlife; require hunters and fisherman to obtain licenses and permits to hunt and fish on Osage lands; and establish wildlife offenses and provide for civil and criminal penalties (Osage Nation Congress 2017).

Wildlife Management Areas

In the planning area, there are seven designated WMAs that provide opportunities for hunting, fishing, and camping. Some of the WMAs include US Army Corps of Engineers-operated and controlled reservoirs, though the ODWC operates the park or WMA. The US Army Corps of Engineers creates reservoirs for flood control, water supply, irrigation, hydropower, navigation, recreation, and fish and wildlife (see **Table 3-48**, Wildlife Management Areas in Osage County).

Recreation Areas in Osage County

Osage Hills State Park offers 1,100 acres for recreation. It includes picnic tables and shelters, recreational vehicle campsites, cabins, a swimming pool, hiking trails, a ball field, and a tennis court. Fishing for bass, crappie, catfish, and perch is common in Lookout Lake or in Sand Creek at the south end of the park. The park is also used for fall foliage viewing (OHSP 2017). A system of three trails is open for hiking and mountain biking. These unpaved trails are centrally located in the park.

Table 3-48
Wildlife Management Areas in Osage County

WMA	Area (Acres)	County	Management Agency
Hulah	14,000	Osage	USACE
Osage (Rock Creek Unit and Western Wall Unit)	9,700	Osage	ODWC
John Dahl	500	Osage	ODWC
Candy	3,600	Osage	USACE
Kaw	1,100	Osage	USACE
Keystone	2,900	Creek, Osage, and Pawnee	USACE
Skiatook	4,000	Osage	USACE

Source: OK GAP GIS 2008
Note: USACE is US Army Corps of Engineers

Keystone State Park is along the southern boundary of Osage County, on the south side of the Arkansas River. This park provides fishing areas for striper, walleye, bass, and catfish. It also provides other recreation opportunities, such as boating, water skiing, swimming, camping, picnicking, and hiking (Keystone 2017; see **Table 3-49**, State Parks in Osage County).

Table 3-49
State Parks in Osage County

Recreation Area	County	Size (Acres)	Activities	Management Agency
Osage Hills State Park	Osage	900	Biking, camping, fishing, hiking, swimming, tennis	Oklahoma Tourism and Recreation Department
Keystone State Park	Osage and Pawnee	700	Biking, boating, camping, fishing, hiking, off-highway vehicle riding	Oklahoma Tourism and Recreation Department

Sources: OTRD 2015; OK GAP GIS 2008

The US Army Corps of Engineers operates and controls the Hulah Lake Project in northeast Osage County. Facilities and services are available around the project. Hulah Lake provides opportunities for fishing and hunting, camping, picnicking, swimming, boating, and sightseeing. Approximately 8,900 acres of Hulah Lake project lands are licensed to the ODWC for wildlife management (USACE 2015).

TNC bought the Tallgrass Prairie Preserve in the northern portion of Osage County in 1989. It has purchased and leased additional land since then and now manages approximately 35,200 acres of preserved area (OK GAP GIS 2008). TNC has worked on energy development with numerous energy companies on the preserve. Their approach has been to use collaborative conservation within the context of local economies (TNC [Robert G. Hamilton] 2013). The preserve is open to the general public, with no admission charge, every day from dawn to dusk. The preserve has free-range bison herds, scenic turnouts, hiking trails, and picnic tables (TNC 2015).

3.17.3 Trends

The estimated population of Osage County slightly decreased from 2015 to 2016 (0.17 percent decrease), whereas surrounding communities, such as Tulsa, expanded at a rate of approximately 0.58 percent, between 2015 and 2016 (US Census Bureau 2016). Recreation use is expected to slightly but steadily increase in Osage County as the population continues to rise in surrounding metropolitan areas. Osage County will continue to maintain and refine the Osage County Comprehensive Plan and to implement the objectives listed for parks, recreation, trails, and open space.

3.18 TRUST ASSETS AND OSAGE NATION INTERESTS

This section addresses Tribal trust assets and social, cultural, and economic interests that are specific to the Osage Nation. It has a unique history among Tribes, which is reflected in its relationships with other governmental entities and its interests and priorities. Tribal uses and interests in the planning area include both the exercise of economic and resource rights and those uses and resources that are tied to traditional cultural practices.

This section contains social and economic data specific to the Osage Nation. General social and economic data is included in **Section 3.10**. General planning area cultural and archaeological information is included in **Section 3.9**, Cultural Resources.

Indian trust assets are legal interests held by the federal government for Tribes or nations or for individual Indians. Indian trust assets cannot be sold, leased, or otherwise encumbered without approval of the federal government. Under the government's trust responsibilities to Tribes, the BIA has an obligation to exercise statutory and other legal authorities to protect Tribal resources and rights. The BIA also has a duty to carry out the mandates of federal law with respect to American Indians.

As described in **Section 3.9**, the Osage were displaced from their original territories, including lands in Oklahoma. As part of the Cherokee Reconstruction Treaty of 1866, the Osage purchased land in Oklahoma that became the Osage Reservation. Under the 1906 Act, most of the land surface of the original reservation was allotted to individual Tribal members at that time.

The trust assets most relevant to this EIS are the rights to the subsurface mineral estate in Osage County, which were reserved by the US for the benefit of the Osage Nation and not transferred with the surface allotments. The Osage Nation retains trust status on a relatively small amount of land surface—approximately 1,600 acres—in the county, meaning that the US holds title to the land as well as the mineral rights for the beneficial interest of the Osage Nation.

The Osage Nation has unique traditions and practices associated with its culture. Traditional lifeways may include uses of certain waters, plants, animals, and earth resources. Particular locations or features of the landscape, such as ancestral archaeological sites, sacred sites, or traditional plant gathering sites, may have ceremonial or religious importance. These may be considered as traditional cultural properties under the NHPA, as described in **Section 3.9.1**, Cultural Resources, Regulatory Framework. The presence and potential impacts on these resources are identified in consultation with the Osage Nation Historic Preservation Office.

3.18.1 Regulatory Framework

Consultation and Coordination with Indian Tribal Governments (2000), Executive Order 13175

This EO directs federal agencies to continue to work with Tribes on a government-to-government basis to address issues concerning Tribal self-government, Tribal trust resources, and Tribal treaty and other rights. Its intent is as follows:

- To establish regular and meaningful consultation and collaboration with Tribal officials in the development of federal policies that have Tribal implications
- To strengthen the US government-to-government relationships with Tribes
- To reduce the imposition of unfunded mandates on Tribes

Government-to-Government Relations with Native American Tribal Governments (memorandum signed by President Clinton, April 29, 1994),* Federal Register*, Vol. 59, No. 85

This memorandum directs federal agencies to consult, to the greatest extent practicable and to the extent permitted by law, with Tribal governments before taking actions that affect Tribal governments. Federal agencies must assess the impact of federal government plans, projects, programs, and activities on Tribal trust resources and ensure that Tribal government rights and concerns are considered during such development.

3.18.2 Current Conditions and Trends

Trust Assets

All subsurface mineral resources in the planning area are held in trust by the United States for the benefit of the Osage Nation. The BIA, as an agent for the Secretary of the Interior, is responsible for fulfilling many of the federal government's trust responsibilities to the Osage Nation. Osage County is unique in that the BIA is the sole federal agency with management responsibility for the Osage Mineral Estate. All leases, APDs, and other site-specific permit applications in Osage County are approved under the authority of the 1906 Act.

Under its trust responsibility, the BIA administers the leasing and development of the Osage Mineral Estate in the best interest of the Osage Nation. It balances resource conservation and protection of the environment and health and safety, while maximizing oil and gas production in the long term.

Because the Tribe retains subsurface mineral rights, it leases the right to drill and extract subsurface resources. Tribal members in 1906 received headrights, ensuring an equal share of mineral rights sales. Headrights have been passed down to descendants or otherwise sold and transferred. Development and exploitation of the mineral estate, particularly oil and gas, provides an important source of income among headright holders, including Tribal members.

In 2006, by referendum, the Osage Nation voted for a new constitution; among its provisions was the separation of the Minerals Council, or Mineral Estate, from regular Tribal government. According to the constitution, only Osage members who are also headright holders can vote for the members of the Minerals Council.

With passing generations, the ownership of headrights has been divided among heirs. The Osage Nation has signed a cooperative agreement with the DOI to implement a buy-back program, which would facilitate the purchase of individual fractionated interests and return them to communal Tribal trust ownership (DOI 2015). The Osage Nation has also purchased a 43,000-acre tract of the former reservation lands to bring it into trust status. This will prevent future sales, promote economic development, protect natural resources, and preserve cultural values (Indian Country Today 2016).

Osage Nation Demographics

The federally recognized Osage Reservation has the same borders as Osage County; therefore, demographic data for Osage County provided in **Section 3.10** is reflective of the census bureau data for the Osage Reservation. Osage Nation membership includes Tribal members living in Osage County and those living in adjacent counties and other domestic and international locations. In 2011, the Osage Nation had approximately 13,307 enrolled Tribal members, with 6,747 living in Oklahoma (Oklahoma Indian Affairs Commission 2011).

Osage Nation Economic Data

The Osage Nation identified the strengths and weaknesses of the local economic in its 25-Year Vision and Strategic Plan (Osage Nation 2007). The plan identified the following strengths:

- Gaming revenue
- Civic engagement in government
- Entrepreneurial mentors
- Historical revenue base

- Land base
- Natural resources

The following areas were identified for improvement:

- Size and capabilities of workforce
- Lack of information technology infrastructure
- Lack of adequate public infrastructure
- Transportation
- Lack of housing and hotels
- Resistance to change

General Budget

Major revenue sources and expenses for the Osage Nation are displayed in **Table 3-50**, General Fund—Osage Nation 2016. The largest funding source is revenue from casinos. Top expenditures, in addition to general government, are Tribal health and human services and education programs.

Table 3-50
General Fund—Osage Nation 2016

Revenue and Gaming Distributions	2016 Actual
Tax revenue	$2,456,000
Indirect cost recoveries	$6,596,000
Investment income	$1,887,000
Other revenue	$4,680,000
Casino distribution	$ 60,582,000
Total	**$ 76,201,000**
Expenditures	
Community services	$ 507,000
Culture and language	$ 2,630,000
Education	$ 9,887,000
Environmental management	$ 426,000
General government	$ 25,029,000
Health and human services	$ 8,759,000
Housing services	$ 244,000
Public safety	$ 1,410,000
Capital outlay	$13,070,000
Debt service	$1,098,000
Total	**$ 63,060,000**

Source: Osage Nation 2016

Oil and Gas Production and Revenue

Total oil and gas production from Osage minerals and royalties collected are shown in **Table 3-51**, Osage Minerals Production and Royalties. The Osage Mineral Council retains a portion of revenue for its operating budget.

Table 3-51
Osage Minerals Production and Royalties

Production and Royalties	2011	2012	2013	2014	2015	2016	2017
Gross oil production (barrels)	4,741,997	4,889,366	5,025,974	4,836,713	4,675,870	4,278,811	3,219,942
Oil royalties collected	$69,624,382	$72,867,727	$79,169,159	$71,233,059	$34,394,421	$26,607,151	$31,775,618
Gross natural gas production (thousand cubic feet)	13,022,399	11,857,874	9,806,792	8,823,988	8,615,916	6,236,968	4,786,035
Gas royalty collected	$6,930,679	$3,722,984	$4,167,565	$4,857,455	$2,934,783	$1,575,836	$1,537,723

Source: BIA 2015b, 2015c, 2017b, 2018
Note: Data are rounded to the nearest barrel and dollar.

Headright Royalties

The 1906 Act directed the distribution of Tribal lands and income to enrolled members of the Osage Tribe, now the Osage Nation. The Osage Nation is a federally recognized Tribe, with 13,307 total members residing in the planning area in 2011, adjoining counties, the US, and abroad (Oklahoma Indian Affairs Commission 2011).

Although the surface of the Osage Reservation was allotted to individual members, the subsurface mineral estate was reserved to the Tribe. In accordance with the 1906 act, the subsurface mineral estate in Osage County, known as the Osage Mineral Estate, is held in trust by the US for the benefit of the Osage Nation. The Osage Nation is authorized to lease the Osage Mineral Estate for oil and gas mining, subject to the approval of the Secretary. Leasing the Osage Mineral Estate generates profits derived from lease bonuses, annual rental, and royalty payments.

The 1906 act requires that royalty income derived from the Osage Mineral Estate be distributed to Osage headright holders on a quarterly, pro rata basis. The 1906 act, as amended, allows for the deduction of Tribal operating expenses and gross production taxes from royalty revenues.

There are 2,229 headrights, one for each individual on the 1906 Osage Tribal membership roll; however, because headrights are subject to succession by inheritance or devise, a headright holder may own one of more full headrights or a fractional share of a headright. Today headrights are owned by members of the Osage Nation, non-Osage Indians, and non-Indians. Royalties on mineral revenues are paid quarterly. The royalty rate for oil and gas development of Osage minerals is negotiated in the lease, subject to regulations. Royalties paid from 2000 to 2016 are displayed in **Table 3-52**, Annual Full Headright Royalty Payment, below.

Table 3-52
Annual Full Headright Royalty Payment

Year	Actual	Adjusted to 2016 Dollars
2000	$8,480	$11,776
2001	$10,730	$14,660
2002	$7,675	$10,243
2003	$10,450	$13,689
2004	$13,380	$16,975
2005	$19,380	$23,775
2006	$25,390	$30,376
2007	$25,250	$29,024
2008	$40,130	$46,086
2009	$20,945	$23,416
2010	$28,320	$31,195
2011	$37,375	$39,985
2012	$40,780	$42,881
2013	$36,990	$38,320
2014	$37,545	$38,603
2015	$20,155	$20,573
2016	$12,545	$12,545

Source: Osage Nation 2017e
Note: Dollars were converted to 2016 dollars, using the Bureau of Labor Statistics' Consumer Price Index inflation calculator (Bureau of Labor Statistics 2016)

Gross Production Tax

The act of April 25, 1940 (54 Stat. 168) amended Section 5 of the 1906 act. It authorized the State of Oklahoma to collect a gross production tax, not to exceed the existing rate, on all oil and gas produced in Osage County. The gross production tax is levied in lieu of all other Oklahoma state and county taxes on oil and gas production. The rate of the gross production tax is determined by the State of Oklahoma, but it may not exceed 5 percent. Half of the distribution is apportioned to a fund for the construction and maintenance of Osage County roads and bridges, and the other half is used for maintaining county schools.

Other Minerals
The production of other natural resources in the planning area is also a source of revenue. Coal bed methane, limestone, sand and gravel, and clay and shale are commonly extracted in Osage County. According to the ODM annual report for 2015, Osage County produced 47,420,355 tons of limestone (ODM 2015).

Salable minerals, such as sand and gravel, are also extracted from the planning area. In 2016, a total of 61,702 cubic yards (249,292 tons) of material was extracted, yielding royalties of $346,093.

<u>Gaming Revenue</u>
The Osage Nation Gaming Enterprise Board oversees the Osage Casino, which is a collection of seven casinos: Hominy, Pawhuska, Sand Springs, Tulsa, Bartlesville, Skiatook, and Ponca City. Under the State-Tribal Compact, Tribes pay monthly exclusivity fees from class III games revenue, based on a sliding scale. For the first $10 million in revenue, Tribes pay 4 percent to the state; for the next $10 million, they pay 5 percent, and for revenues more than $20 million, they pay 6 percent.

Total distributions supplied to Osage County from gaming operations was $47,332,127 in 2015 (Osage Nation 2015).

The Osage Nation uses revenues from its casinos for the following enterprises:

- Fund Tribal government and programs
- Provide for the general welfare of the Osage
- Promote Tribal economic development
- Support charitable organizations
- Help fund operations of local government agencies of the Osage Nation

Tribal Community Services
General community services are discussed in **Section 3.10.1**, Socioeconomics and Environmental Justice, Current Conditions and Trends.

In addition to county services, the Osage Nation provides public services, social welfare, and community programs for the Osage.

The Osage Nation Police Department provides law enforcement services under the jurisdiction of the Osage Nation. The officers' primary duty is to enforce the criminal laws of the Osage Nation and the federal government when major crimes have been committed within state and local jurisdictions. The Osage Nation Police Department will also assist the Osage Nation in protecting and enhancing Tribal sovereignty, along with protecting the religious and ceremonial beliefs of the Osage (Osage Nation 2017f).

The Osage Nation provides education to the Osage, including kindergarten through tenth grade outreach programs and education scholarships. The Osage are also eligible to apply for Osage Nation Health, a limited benefit program, and to receive services at any Indian Health Service facility.

Traditional Lifeways and Practices

The Osage Nation is headquartered in Pawhuska. The former Wah-Zha-Zhi Cultural Center in Pawhuska was established in 2004 to maintain the ancestral traditions, values, way of life, and unique identity of the Osage. The Cultural Center hosts classes on traditional craft-wear and artwork exhibits and is home to a library (Osage Nation 2012; Shop Oklahoma 2012).

The extent of traditional religious or resource land use is not public knowledge. Locations of resources are generally considered privileged information that is restricted to specific practitioners. Maintaining confidentiality and customs regarding traditional knowledge may take precedence over identifying and evaluating these resources, unless they are in imminent danger of damage or destruction.

This page intentionally left blank.

Chapter 4. Environmental Consequences

4.1 INTRODUCTION

This chapter describes the anticipated environmental impacts associated with each of the four alternatives set forth in **Chapter 2**, Alternatives. This chapter is organized by topic. Within each topic area the alternatives are analyzed based on alternative-specific actions, operations, and COAs. The indicators, methods, and assumptions relevant to this analysis are identified at the beginning of each topic area.

The evaluations in this section are confined to the actions that have the most prominent, immediate, or direct effects. Some of the proposed management actions and potential future development may affect only certain resources and alternatives. If an activity or action is not addressed in a given section, no impacts are expected, or the impact is expected to be negligible.

The baseline used for the impact analysis is the current condition or situation of the resources in the planning area, as described in **Chapter 3**, Affected Environment. The detailed impact analyses and conclusions set forth in this chapter are based on the interdisciplinary team's knowledge of the planning area and its resources, review of pertinent literature, and information provided by experts from the BIA and other federal agencies.

A summary comparison table of the impacts of each alternative is provided in **Table 2-4**, Summary Comparison of Environmental Consequences of the Alternatives. The discussion of impacts is based on the best available data. Knowledge of the planning area and professional judgment, based on observation and analysis of conditions and responses in similar areas, were used to infer environmental impacts where data are limited. At times, when quantitative data or projections are not available, impacts are described using ranges of potential impacts or in qualitative terms. Impacts on resources and resource uses are analyzed and discussed in detail, commensurate with resource issues and concerns identified throughout the EIS process.

4.1.1 General Method for Analyzing Impacts

Potential impacts or effects are described in terms of type, context, duration, and intensity, which are generally defined as follows:

- Type of impact—Impacts are defined as modifications to the existing environment that are occasioned by the implementation of a specific alternative. Impacts can be beneficial or adverse, the direct or indirect result of the action, and short term, long term, or cumulative in nature. As previously noted, this chapter does not characterize impacts as beneficial or adverse except where such characterization is required by law, regulation, or policy. This analysis provides a quantitative or qualitative comparison of alternative-specific impacts based on available data and the nature of the impact.
- Context—Context describes the area or location (site-specific, local, planning area-wide, or regional) in which the impact would occur. Site-specific impacts would occur at the location of the action, local impacts would occur within the general vicinity, planning area-wide impacts would affect a greater portion of the county, and regional impacts would extend beyond the planning area boundaries.
- Duration—Duration describes the length of time an impact will exist. Impacts may be short term or long term. Short-term impacts are those expected to begin and end within the first 5 years after the action is implemented. Long-term impacts are those expected to last in excess of 5 years after the action is implemented up to and potentially beyond the 20-year planning horizon.
- Intensity—Intensity describes the magnitude of the impacts. Quantitative data are used to analyze the intensity of impacts wherever possible. If quantitative analysis is not possible, qualitative analysis is used.
- Direct and indirect impacts—Direct impacts are caused by implementation of an alternative and generally occur at the same time and place. Indirect impacts are reasonably foreseeable, but usually occur later in time or are removed in location.
- Cumulative impacts—Cumulative impacts are the direct and indirect results of a proposed alternative's incremental impacts, when they are added to other past, present, and reasonably foreseeable actions outside the scope of this EIS, regardless of who carries out the action (40 CFR Part 1508.7). These other actions may be in the planning area or next to it. The list of actions used for cumulative impact analysis is provided in **Section 4.1.3**, Past, Present, and Reasonably Foreseeable Future Actions.

The environmental consequences analyses in the Workover PEA (BIA 2015a) and the Leasing PEA (BIA 2014) are incorporated into this chapter by reference.

The scope of this analysis focuses on impacts on resources and resource uses within the planning area associated with the BIA's administration of the Osage Mineral Estate. This is because the decisions being made by the BIA apply only to oil and gas leasing and development administered by the BIA. As previously discussed in **Chapter 1**, Introduction and Purpose and Need, this EIS provides a programmatic or "big-picture" level of analysis of oil and gas development in Osage County because the future location of well pads, pipelines, access roads, and other surface facilities is unknown. The location of individual wells and facilities, and the impacts associated with them, would be determined as part of the APD process through site-specific environmental, biological, and cultural compliance efforts as directed by the BIA.

Acreage figures and other numbers used in the analyses are approximate projections for comparison and analytic purposes only. Readers should not infer that they reflect exact measurements or precise calculations. Calculations are rounded to the nearest 10 acres for acreages less than 1,000 and to the nearest 100 acres for acreages of 1,000 or more.

4.1.2 Analytical Assumptions

Several assumptions were made to facilitate the analysis of the projected impacts. These assumptions set guidelines and provide reasonably foreseeable projected levels of development in the planning area and relevant time frame. They should not be interpreted as constraining or redefining the management objectives and actions proposed for each alternative, as described in **Chapter 2**, Alternatives.

The following general assumptions apply to all resource categories. Any resource-specific assumptions are provided in the Methods and Assumptions section for that resource topic:

- The BIA would have sufficient funding and personnel available to implement the final decision.
- Implementing actions from any of the alternatives would be in compliance with all valid existing rights, laws, federal regulations, BIA policies, and other requirements.
- Additional site-specific environmental analyses would be conducted as appropriate or necessary to comply with NEPA and other applicable laws for individual APDs, as needed.
- Local climate patterns and conditions affecting plant growth will continue, consistent with historical records.
- The BIA may be able to reevaluate decisions and adjust resource management, as resources respond to variations in climate, physical, and chemical conditions and as tools for predicting those variations improve.

4.1.3 Cumulative Impacts

Cumulative impact analysis is required by CEQ regulations because environmental conditions result from many different factors that act together. The total impact of any single action cannot be determined by considering it in isolation, so it must be determined by considering the likely result of that action in conjunction with many others. Potential impacts are evaluated by considering incremental impacts that could occur from the proposed project, as well as impacts from past, present, and reasonably foreseeable future actions. Assessment data and information could span multiple scales, surface ownerships, and jurisdictions. These assessments involve determinations that often are complex and, to some degree, subjective.

Cumulative Analysis Method

The cumulative impacts discussion in each section considers the alternatives in the context of the broader human environment, specifically, actions that occur outside the scope of this EIS or outside the geographic area covered by the planning area.

Because of the programmatic nature of the Osage County Oil and Gas EIS and cumulative assessment, the cumulative impact analysis tends to be broad and generalized. It addresses the effects that could occur from a reasonably foreseeable BIA management scenario, combined with other reasonably foreseeable activities or projects. This assessment is primarily qualitative for most resources because of a lack of detailed information on future projects, both for the reasonably foreseeable activities or projects included in the cumulative impact analysis and for future projects that would tier to this EIS analysis. Quantitative information is used whenever available and as appropriate to portray the magnitude of an impact.

The analysis assesses the magnitude of cumulative impacts by comparing the environment in its baseline condition with the expected impacts of the alternatives and other actions in the same geographic area. The magnitude of an impact is determined through a comparison of anticipated conditions against the naturally occurring baseline, as depicted in the affected environment (**Chapter 3**) or the long-term sustainability of a resource or social system.

The following factors were considered in this cumulative impact assessment:

- Tribal, federal, nonfederal, and private actions
- Potential for synergistic impacts or synergistic interaction among or between impacts
- Potential for impacts across political and jurisdictional boundaries
- Comparative scale of cumulative impacts across alternatives
- Other spatial and temporal characteristics of each affected resource

Temporal and spatial boundaries used in the cumulative analysis are developed based on resources of concern and actions that might contribute to an impact. The baseline year for the cumulative impacts analysis is 2017; the scope of this analysis is a 20-year planning horizon.

Spatial boundaries vary and are larger for resources that are mobile or migrate, such as deer populations, compared with stationary resources. Occasionally, spatial boundaries for the cumulative impact analysis could encompass a portion of the planning area or a single location within the planning area. Spatial boundaries were developed to facilitate the analysis and are included under the appropriate resource section heading.

Past, Present, and Reasonably Foreseeable Future Actions

Past, present, and reasonably foreseeable future actions in and next to the planning area are considered in the analysis to identify whether and to what extent the environment has been degraded or enhanced, whether ongoing actions are causing impacts, and what the trends are for actions in and impacts on the area. Actions are included in the cumulative impact analysis in this EIS on the basis of proximity to the planning area, connection to the same environmental systems, potential for impacts on the resources or resource uses in the planning area, the likelihood a project will occur, and whether the project is reasonably foreseeable.

Actions considered in the cumulative analysis were identified by reviewing existing decisions and formal proposals, identifying actions that are highly probable, based on known trends, and reviewing federal and nonfederal actions outside the scope of this EIS.

The impacts of past actions are manifested in the current condition of the resources, as described in the affected environment (**Chapter 3**). Reasonably foreseeable future actions are those that proponents have committed to or are known proposals that would take place within a 20-year planning period. Reasonably foreseeable future action scenarios are projections made to predict future impacts; they are not actual planning decisions or resource commitments. Projections, which have been developed for analysis only, are based on current conditions and trends and represent a best professional estimate. Unforeseen changes in such factors as economics, demand, and federal, state, and local laws, regulations, and policies could result in different outcomes than those projected in this analysis.

Some potential future actions have been considered and eliminated from further analysis. This is because there is only a small likelihood these actions would be pursued and implemented within the 20-year planning period, or because so little is known about the potential action that formulating an analysis of impacts would be premature. In addition, potential future actions to protect the environment (such as new potential threatened or endangered species listings) are not analyzed because such actions have a low likelihood of creating major environmental consequences, alone or in combination with this planning process.

Federal actions, such as a new species listing, could require the BIA to reconsider the impact of decisions that would be made in reliance on this EIS, because the consultations and relative impacts might no longer be appropriate. These potential future actions may have greater capacity to affect resource uses in the planning area; however, until more information is developed, no reasonable estimation of impacts can be developed.

Data on the precise locations and overall extent of resources in the planning area are considerable, although the information varies according to resource type and locale. Furthermore, the understanding of the impacts on and the interplay among these resources is evolving. As knowledge improves, management measures (adaptive or otherwise) would be considered to reduce potential cumulative impacts, in accordance with applicable law, regulations, and BIA and Osage Nation policies.

Actions identified as having the greatest likelihood to generate potential cumulative impacts when added to the Osage County Oil and Gas EIS alternatives are displayed in **Table 4-1**, Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions.

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions

Project	Description	Status
EA for the Oil and Gas Leasing Program of the Osage Indian Tribe	This document outlines the general framework within which the BIA administers oil and gas development in the Osage Mineral Reserve in Osage County.	Completed in 1979; the new EIS is intended to replace this document
Leasing PEA	This document outlines alternatives for and discloses consequences of oil and gas leasing in the Osage Mineral Estate in Osage County.	Completed in November 2014; the new EIS is intended to replace this document
Workover PEA	This document outlines alternatives for and discloses consequences of approving workover operations on existing wells in the Osage Mineral Estate in Osage County, including temporarily abandoned and currently active oil and gas wells and facilities.	Completed in April 2015; the new EIS is intended to replace this document
Osage Nation Environmental and Natural Resources Department IRMP	This is the Osage Nation's first IRMP, a long-range, strategic-level plan that integrates the management actions applied to the Tribe's natural resources and other resources of value. It is intended to give Tribal leaders the information necessary to make informed decisions concerning natural resources.	Completed in December 2005

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions (cont.)

Project	Description	Status
OKT Joint EIS/BLM RMP/BIA IRMP	This document will result in a BLM RMP and a BIA IRMP. The BLM RMP will guide the management of BLM-administered lands and federal mineral estate in Oklahoma, Kansas, and Texas. The BIA IRMP will include management direction for allotted and Tribal mineral interests (in Osage County, the IRMP will only apply to solid minerals, such as gravel). It also includes restricted Tribal lands and lands administered by the BIA Eastern Oklahoma and Southern Plains Regional Offices in Oklahoma, Kansas, Texas, and Nebraska.	Draft EIS released in November 2018
Osage Wind Project	This is a 150-megawatt wind farm, encompassing 8,400 acres in the planning area, located approximately 13 miles west of Pawhuska, Oklahoma. It was developed by Tradewind Energy, Inc.	Operation began in 2015; current status subject to pending litigation
Mustang Run Wind Project	This is a 136-megawatt wind farm encompassing 9,500 acres in the planning area, located approximately 13 miles west of Pawhuska, Oklahoma. It was developed by Tradewind Energy, Inc.	Construction date unknown
Osage County Rural Water District #15 Phase 1A Capital Improvement	Two projects are proposed to improve storage and transmission. A new 300,000-gallon water tower is proposed along Highway 20 west of Skiatook, Oklahoma, to replace two standpipes.	Water tower has been completed and is now in service
The Osage Nation Long-Range Transportation Plan 2016–2036	The plan outlines the policies, objectives, and projects intended to improve the transportation system for the Osage Nation through 2036. Recommended roadway system improvements include including reconstructing and improving roads, improving drainages, creating new roads, creating additional parking areas and new recreation areas, and constructing bridges. Specifically, the plan proposes 26.9 miles of route and bridge additions and 10.6 miles of new sections to existing routes.	Plan completed in 2015. Projects to be carried out from 2018 to 2037.
Osage Nation Heritage Scenic Byway	The ODOT designated US Highway 60 as a state scenic byway in 2008, with the purpose of developing tourism stops along the highway.	Tourism stops are under construction

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions (cont.)

Project	Description	Status
ODOT Construction Work Plan	This is an 8-year work plan created by ODOT for road and bridge construction throughout Oklahoma from 2018 to 2025. The plan proposes to improve 47.59 miles of roads in Osage County.	The Osage Nation is considering these projects while it focuses on Osage Tribal transportation needs
Residential Land Use Plans	A 5-year plan exists to develop a 50-lot, single-family home subdivision in Pawhuska, Oklahoma, on the remaining 18 acres of a 23-acre parcel owned by the Housing Authority. The plan will add to a 30-unit apartment complex that was built on the site in 2006.	Construction is anticipated within the next 5 years
Casinos	The Osage Casino Tulsa location broke ground in 2016 on a new expansion, including a hotel, with an expected completion by July 2018. Several parcels of Osage Nation-owned land are being put into trust with the federal government as part of plans to expand other Osage Casino properties in the future. Possible gaming sites are being investigated in Osage Nation historic reservation boundaries.	Casino construction began in 2016. Additional casino construction projects are anticipated.
Osage Prairie Bike Trail Extension	This is a 24-mile project to extend Osage Prairie Trail on the old Midland Valley Railroad ROW to Barnsdall, Oklahoma, and later to Pawhuska, Oklahoma, and the Tallgrass Prairie Preserve. The trail currently begins in north Tulsa, Oklahoma, and ends in Skiatook, Oklahoma.	Project is in the final approval stages
Spearhead Pipeline (Enbridge)	This is a 650-mile, 24-inch pipeline between Flanagan, Illinois, and Cushing, Oklahoma, transporting 193,300 barrels per day of crude oil. Approximately 11.3 miles of the pipeline run through Osage County.	In operation since the 1950s
Flanagan South Pipeline (Enbridge)	This is a 593-mile, 36-inch-diameter interstate pipeline between Pontiac, Illinois, and Cushing, Oklahoma, transporting 585,000 barrels per day of crude oil. After pumping power enhancements are completed, the pipeline will be capable of transporting 880,000 barrels per day. It parallels the Spearhead crude oil ROW. Approximately 11 miles of the pipeline run through Osage County over 34 tracts.	In operation
BLM Wild Horse and Burro Long-Term Holding Facility	There are 11 wild horse and burro long-term holding facilities, covering 130,400 acres.	In operation

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions (cont.)

Project	Description	Status
Agriculture and Livestock Grazing	Ranching is the main enterprise in Osage County. About 95 percent of the county is in agricultural use (Osage County 2011). The BIA administers 24 agricultural leases, and 309 grazing leases covering 71,632 acres.	Ongoing
BIA Eastern Oklahoma Region Fire Plan	This is a 10-year, strategic fire management plan for 2010–2020 for the BIA Eastern Oklahoma Regional Office. It defines a program to manage wildland and prescribed fire on BIA-administered surface, based on approved land management goals and objectives.	Completed in May 2009
USFWS ABB Oklahoma Industry Conservation Plan	Short-Term Oil and Gas Industry Conservation Plan was developed by the USFWS to provide a means for participants in the oil and gas industry to promote ABB conservation.	Completed in May 2014
Other surface leases	The BIA administers 70 active business leases in Osage County, covering approximately 14,700 acres. These leases authorize such uses as hunting, tank battery sites, gas storage locations, smoke shops, casinos, and residences. Another 49 leases covering approximately 12,000 acres are pending.	Ongoing
Limestone quarries	The BIA administers four active limestone or dolomite leases in Osage County: • The Candy Creek Crusher limestone quarry covers approximately 90 acres. • The APAC limestone quarry covers approximately 639 acres. • The Burbank limestone quarry covers approximately 566 acres. • The Sooner Cattle Company limestone quarry covers approximately 40 acres. There are no pending limestone or dolomite leases on Tribal or allotted land in Osage County.	Ongoing
Sandstone leases	The BIA administers three active sandstone leases in Osage County. Two leases cover approximately 80 acres of BIA-administered surface each, and one covers approximately 70 acres. The Hobo Stone sandstone lease is pending and would cover approximately 20 acres.	Ongoing

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions (cont.)

Project	Description	Status
Mining lease for the mining of sand	The BIA administers five active sand mining leases in Osage County, covering approximately 900 acres of BIA-administered surface.	Ongoing

4.1.4 Incomplete or Unavailable Information

The CEQ established implementing regulations for NEPA, requiring that a federal agency identify relevant information that may be incomplete or unavailable for an evaluation of reasonably foreseeable significant adverse effects in an EIS (40 CFR Section 1502.22). If the information is essential to a reasoned choice among alternatives, it must be included or addressed in an EIS. Knowledge and information is, and will always be, incomplete, particularly with complex ecosystems considered at various scales.

The best available information pertinent to the decisions to be made has been used in developing this EIS. Considerable effort has been taken to acquire and convert resource data, from both the BIA and outside sources, into digital format for use in the EIS.

Certain information was unavailable for use in developing this EIS because inventories have either not been conducted or are not complete. Some of the major types of data that are incomplete or unavailable are planning area-wide field surveys for cultural and paleontological resources, production data for individual wells, and critical habitat designations for the ABB.

The number, type, and significance of these resources were estimated based on previous surveys and existing knowledge. In addition, some impacts could not be quantified, given the proposed management actions. Where this gap occurs, impacts are projected in qualitative terms or, in some instances, are described as unknown. Subsequent project-level analysis, such as NEPA analysis for APDs, will provide the opportunity to collect and examine site-specific data required to determine appropriate application of this planning-level guidance. In addition, ongoing inventory efforts by the BIA and other agencies in the planning area continue to update and refine information for the area.

4.2 Topography, Geology, Paleontology, and Soils

4.2.1 Methods and Assumptions

Impacts on topography, geology, paleontology, and soils were evaluated based on maximum potential disturbance by alternative. Because this is a programmatic EIS, it is not possible to know the exact location of specific construction projects related to oil and gas development.

Indicators

Topography and Geology

Indicators of topographic or geologic change were not used due to the rate and unpredictability of such changes, for example sedimentation over millions of years or sudden shifts in surface geology as a result of faulting. Instead, indicators were formed based on the potential effects of geologic hazards on management scenarios. As such, the indicator is:

- The location of the planning area in relation to geologic hazards, including fault features and areas of induced earthquake activity

Soils

Indicators of impacts on soils include the following:

- Accelerated soil erosion is uncontrolled, or soil productivity is not restored to approximate preconstruction conditions in an area
- Additional areas of salt scarring from improper development by lessees or accidental release of produced fluids or large quantities of saline water
- Areas where new surface disturbance from oil and gas development activities would not be permitted

Paleontology

Indicators of impacts on paleontology include the following:

- Damage to paleontological resources due to surface disturbing activities in rocks or soils bearing paleontological resources.

Assumptions

Direct impacts on topography, geology, paleontology, and soils would result from surface-disturbing activities that would occur during the construction phase of oil and gas development and from spills during operation, abandonment, and reclamation. Oil and gas development activities expected to affect geology, soils, paleontology and topography include construction and operation of the following:

- Well pads
- New access roads
- Flow lines, produced water lines, and satellite compressors at the central delivery point
- Construction staging areas
- Additional transmission lines

- Tank batteries and other facilities
- Oil, gas, injection, disposal or service wells

Direct impacts at the project-specific level could alter topography, damage paleontological resources, compact soils, or accelerate erosion rates of soil resources. Short-term impacts would occur typically during the construction phase, including reclamation of the construction site. Burying power lines instead of constructing overhead lines would result in larger quantities of soil displacement during construction but may result in less disturbance after the construction period. Impacts continuing beyond construction are considered long term. Permanent impacts can be minimized by proper construction and operation, as well as proper abandonment and reclamation of unnecessary features.

Impacts on topography, geology, paleontology, and soils would be concentrated in areas of high to moderate oil and gas potential. These areas are more likely to see continued or increased oil and gas development and associated ground disturbance. Underground injection wells are generally located close to oil and gas wells to save on transportation costs but may be located in other areas when formations used for disposal do not exist. Lessees would be required to comply with all applicable laws and regulations, including the regulations in 25 CFR Part 226, addressing development of the Osage Mineral Estate. Adhering to applicable laws and regulations would mitigate impacts on these resources.

4.2.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue to occur. Surface-disturbing activities associated with oil and gas production, such as road and well pad construction, can lead to soil compaction, vegetation removal, and accelerated erosion. Oil and gas production creates a risk of produced water and petroleum spills. These spills can damage or kill vegetation and create salt scars, leading to accelerated erosion.

Toxic H_2S is considered a geologic hazard that may be released during drilling and completion, as leakage or as incomplete combustion during flaring. Under all alternatives, flaring would be prohibited without permission of the BIA Osage Agency Superintendent. This requirement would reduce the release of H_2S during flaring by ensuring tighter control and monitoring of flaring. Further impacts of H_2S are discussed in **Section 4.11**, Public Health and Safety.

Disposal of produced water in the Arbuckle formation using injection wells has been shown to stimulate earthquakes (i.e., induced seismicity) in Oklahoma. The cause of the induced seismicity is hypothesized to be due to produced water lubricating existing faults (Weingarten et al. 2015; OGS 2015). As discussed in **Section 3.2.2**, Topography, Geology, Paleontology, and Soils, Current Conditions, injection was temporarily stopped or reduced at several wells in Osage County in response to the Pawnee Earthquake. The risk of induced seismicity would likely increase as the volume of wastewater grows due to an increase in well spuds projected under all alternatives.

Hydraulic fracturing (commonly referred to as fracking) of wells to stimulate production has not been linked to induced seismicity in Osage County. Increased amounts of produced water could result in a greater number of spills or in larger spills and increased volume of wastewater injection which could result in increased levels of seismicity. Enhanced oil recovery methods, including water flooding and hydraulic fracturing, have the potential to force oil and contaminated water out of nearby wells that have been improperly abandoned, contaminating soils and groundwater. As discussed in the Osage RFD (**Appendix A**), the majority of new wells drilled during the life of this EIS are anticipated to be conventional wells.

Under all alternatives, the BIA would apply COAs to oil and gas permits to ensure compliance with applicable laws and regulations, such as the ESA, Section 106 of the NHPA, and the Soil and Water Resources Conservation Act, and to prevent environmental degradation. These measures may be applied on a case-by-case basis or to all permits, or a combination of both, depending on the alternative selected. Applying these COAs could result in incidental protection of soil resources if surface disturbance were reduced. Reducing surface-disturbance levels during oil and gas exploration and production would reduce the potential for compaction or erosion impacts on soils and damage to paleontological resources.

4.2.3 Alternative 1 – No Action

Under Alternative 1 (No Action), none of the COAs that would be applied are specific to paleontological resources, topography or geologic hazards; however, soil COAs would continue to limit surface disturbance by enforcing the confinement of work vehicles to existing roads. Limiting vehicle disturbance of areas beyond existing roads would continue to reduce the footprint of impacts on soils, which may reduce potential damage to paleontological resources, and result in lower soil compaction or erosion rates during exploration and production. A requirement to return the area to the original contour would reduce long-term impacts on topography. Erosion-control measures to effectively minimize soil movement during workovers would result in less soil loss from these activities.

To minimize the risk of induced seismicity related to underground injection, approval must be obtained from the EPA prior to the commencement of workover operations related to underground injection, construction, or conversion of saltwater injection/disposal wells.

4.2.4 Alternative 2

Under Alternative 2, the BIA would waive some COAs. Lessees would still be required to comply with all applicable laws and regulations but would have latitude to determine how best to comply. Applying an additional COA prohibiting land application of waste oil, wastewater, contaminated soil, and other contaminated substances would reduce the risk of soil contamination and salt scarring compared with Alternative 1 (No Action); however, removing requirements that lessees implement erosion-control measures and promptly reclaim areas of the site not needed for production following drilling would increase the probability of erosion and soils damage.

Removing requirements that waste and old equipment be removed from sites would increase the risk of soil contamination and salt scarring, compared with Alternative 1 (No Action). Waiving COAs that limit surface disturbance would also increase soil compaction and increase the risk of damage to paleontological resources compared with Alternative 1 (No Action). No COAs protecting topography from changes would be applied. Agreements between surface owners and lessees and voluntary compliance with BMPs could provide some mitigation against these impacts.

4.2.5 Alternative 3

Under Alternative 3, the BIA would manage sections with a historically high density of oil and gas development in the same manner as Alternative 2. At the same time, it would apply additional COAs to sections with a historically low density of oil and gas development.

According to the Osage RFD, future development is expected to occur in generally the same areas as historical development (**Appendix A**); therefore, most of the new wells drilled are projected to be in high-density sections. Under this alternative, the BIA would not approve new ground-disturbing activities in municipalities and certain sensitive groundwater and drinking water sources. In these areas, topography, soils, and paleontological resources would be protected from any additional damage.

This alternative would provide some additional protection of soil resources in low-density sections and sensitive areas, compared with Alternative 1 (No Action). Well spacing and density might shift under this alternative with lessees choosing to locate wells in high-density sections or choosing to locate multiple directional wells on a single well pad to reduce overall surface disturbance in low-density sections and sensitive areas.

Well sites and pits in low-density sections would be outside of areas prone to frequent flooding and at least 200 feet from streams and waterways. This would reduce the chances of soil contamination, compared with Alternative 1 (No Action). Burying pipelines in low-density sections could increase soil disturbance; however, because this COA would be applied only when appropriate, it could be waived when necessary to avoid impacts on sensitive soils. Requirements to salvage and stockpile topsoil to be used for reclamation in these areas would help re-create pre-disturbance soil conditions, reducing the impacts of oil and gas development. A requirement to return the area to the original contour would reduce long-term impacts on topography.

4.2.6 Alternative 4

Under Alternative 4, additional COAs beyond those described under Alternative 1 (No Action) would be applied to all new oil and gas development in the planning area. Compared with the other alternatives, this would provide additional protection to soil resources. Impacts from oil and gas development on geology, soils, and topography would be similar to those described for low-density sections and sensitive areas under Alternative 3; however, impacts would be further reduced under Alternative 4 because the protective COAs would be applied throughout the whole planning area.

Under this alternative, the BIA would not approve new ground-disturbing activities in the Tallgrass Prairie Preserve, state parks, state WMAs, US Army Corps of Engineers lakes, municipalities, certain sensitive groundwater and drinking water sources, and BLM wild horse and burrow pasture facilities. In these areas, topography, soils, and paleontological resources would be protected from any additional damage.

4.2.7 Cumulative Impacts

The cumulative impact analysis area for topography, geology, paleontology, and soils is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect topography, geology, paleontology, and soils are uses that would disturb the surface. Examples are oil and gas development, road and bridge improvements, pipelines, agricultural and livestock grazing, planned and unplanned fires, and other resource extraction or development projects.

All of these activities have created or have the potential to create both short-term and long-term impacts. Impacts on topography, geology, paleontology, and soils would result from alteration of the landscape during construction projects and oil and gas development. Long-term soil compaction and erosion can also occur as a result of surface disturbance. Short-term impacts on soils are generally temporary disturbances during construction and road maintenance. The risk of induced seismicity is expected to continue under all alternatives. Permanent damage could be caused to paleontological resources under all alternatives.

The construction of new facilities could result in long-term impacts on topography.

These activities can be offset by the appropriate use of mitigation to reduce surface disturbance and limit soil erosion. Long-term impacts would result from the completion, construction, or installation of wind energy or oil and gas facilities.

Alternatives Analysis

Under all alternatives, oil and gas development would continue, along with other projects and conditions discussed under **Section 4.2.7**, Cumulative Impacts. Oil and gas associated development would continue to affect topography, geology, paleontology, and soils in the planning area.

Removing COAs that confine vehicles to existing roads and that specify erosion-control measures under Alternative 2 would increase the possibility of erosion and soil damage, compared with Alternative 1 (No Action).

Compared with Alternative 1 (No Action), Alternative 3 would offer additional protections to soil, paleontological, and geologic resources by preventing new ground disturbance from oil and gas development in some sensitive areas.

Compared with Alternative 1 (No Action), Alternative 4 would provide additional protection to topography, paleontological, and soil resources by preventing new ground disturbance from oil and gas development in some areas. It also would provide additional protection by implementing COAs that minimize surface disturbance and require erosion control and prompt reclamation of sites following drilling or workover. Alternative 4 would reduce the risk of soil contamination by prohibiting storage tanks in areas prone to frequent flooding.

4.3 Water Resources

4.3.1 Methods and Assumptions

Indicators

Indicators of impacts on surface water and groundwater resources are the following:

- Alteration of the physical, chemical, or biological characteristics of streams, springs/seeps/fens, wetlands, riparian areas, and groundwater aquifers to a point that these resources are not properly functioning or sustainable
- The inability to meet federally approved state or Tribal and federal water quality standards for surface water or groundwater
- Changes in water quality that affect downstream aquatic or riparian species
- Miles of roads constructed
- Number of spills of hazardous or other harmful materials
- Depletion of water supplies or significant reduction in streamflow

Assumptions

- Water quality associated with oil and gas development is determined by the proximity of development and associated roads to drainages and groundwater wells, location in the watershed, time and degree of disturbance, reclamation potential of the affected area, vegetation, precipitation, and mitigating actions applied to the disturbance.

- In general, the shallower the groundwater, the more susceptible the aquifer is to contamination.
- New transportation facilities will be properly designed (minimum standards).
- Unconfined aquifers or groundwater with depth of less than 100 feet are considered the most vulnerable to leaks and spills of contaminants from oil and gas development.
- The majority of new wells during the life of this EIS are anticipated to be conventional wells.

4.3.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development (see **Section 3.16.3**, Mineral Extraction, Trends, and **Section 4.16.2**, Mineral Extraction, Impacts Common to All Alternatives).

Oil and gas development may affect water resources in several ways, as follows:

- Surface disturbance (e.g., road, power line, pipeline, and well pad construction) can increase runoff or change the physical characteristics of waterbodies.
- Subsurface disturbance can change aquifer properties.
- Leaks and spills can contaminate groundwater and surface water with naturally occurring pollutants or chemicals used for oil and gas drilling and extraction.
- Leaks and spills of brine can inhibit plant growth and affect soil structure, leading to greater erosion of soils to surface water.

Water quality and quantity are susceptible to impacts from surface disturbance, drilling, water use and extraction, and other actions that alter the physical characteristics of surface and groundwater, which are inextricably linked. Every management action that could directly or indirectly alter aquifer properties, water quality or quantity, or the physical features of waterbodies can have accompanying temporary or permanent impacts on water resources.

Oil and gas development utilizes water that may go back into the natural system. Results from prior studies show that significant amounts of salts from produced-water releases and petroleum hydrocarbons have remained in the soils and rocks of the impacted area after more than 60 years of natural attenuation (USGS 2003b). Under all alternatives, lessees would be responsible for complying with the CWA and Safe Drinking Water Act of 1974, as amended. This is to ensure that any water quality degradation would be within federal water quality standards. Applying certain COAs could reduce impacts on water resources by reducing surface disturbance, which would restrict discharge of dredge and fill materials into waterways.

Applying COAs could reduce impacts on water resources if they were to mitigate impacts on groundwater and surface water. Under all alternatives, lessees must comply with the regulations at 25 CFR Part 226, which contains measures to reduce environmental impacts from oil and gas development in Osage County.

Surface Water

Surface-disturbing activities, such as road, power line, pipeline, and well pad construction, can remove or disturb essential soil-stabilizing agents, such as vegetation diversity, soil crusts, litter, and woody debris. These soil features function as living mulch by retaining moisture and discouraging annual weed growth (Belnap et al. 2001). Loss of one or more of these agents increases potential erosion and sediment or pollutant transport to surface waterbodies, leading to surface water quality degradation.

Surface-disturbing activities under certain circumstances can also lead to soil compaction, which decreases water infiltration rates. It also elevates the potential for overland flow, which can increase erosion and sediment or pollutant delivery potential to the surface waterbodies in the area, leading to surface water quality degradation.

Surface-disturbing activities in areas of low reclamation potential, such as sensitive soils (see **Section 3.2**, Topography, Geology, Paleontology, and Soils) and slopes greater than 40 percent, or fragile areas, such as stream channels, floodplains, and riparian habitats, are at higher risk for erosion. Disturbance in such areas creates greater potential for erosion and sediment delivery to surface waters, thereby degrading water quality.

Surface-disturbing activities in stream channels, floodplains, and riparian habitats are more likely to alter natural morphologic stability and floodplain function. Morphologic destabilization and loss of floodplain function accelerate stream channel and bank erosion, increase sediment supply, dewater near-stream alluvium, cause the loss of riparian and fish habitat, and deteriorate water quality (Rosgen 1996). Altering or removing riparian habitats can reduce the hydraulic roughness of the bank and increase flow velocities near the bank (National Research Council 2002). Increased flow velocities near the bank can accelerate erosion, decreasing water quality.

When surface-disturbing impacts are allowed to alter natural drainage patterns, the runoff critical to recharging and sustaining locally important aquifers, springs/seeps/fens, wetlands, and associated riparian habitats is redirected elsewhere. As a result, these sensitive areas can be dewatered, compromising vegetative health and vigor, while degrading the proper function and condition of the watershed.

Directional and horizontal drilling greatly decrease the extent of potential surface disturbance and the potential for adverse impact on surface resources. It also enables the drilling and testing of resources beneath sensitive areas, such as steep slopes, streams, and rivers, while minimizing impacts on those areas. The amount of directional offset possible from the surface location to the bottom hole location is not unlimited; it has generally been less than 2,500 feet in most directional wells or 2 miles in most horizontal wells drilled to date, although longer offsets have been drilled.

Applying COAs 1 and 2 would reduce surface disturbance in culturally sensitive areas and would mitigate potential impacts on surface water, as described above. This would be the result of avoiding surface disturbance or reducing the size and scope of these activities through additional permitting.

Groundwater

Impacts from oil and gas development under all alternatives in the planning area include changes to water availability and quality, increased wastewater disposal, and possible wastewater injection-induced seismicity. Determining the potential impacts on groundwater requires the consideration of all stages of water management during oil and gas development; however, long-term impacts on local groundwater resources have been poorly defined (Alley 2014; NGWA 2016; King 2012).

Most studies of groundwater impacts have been largely based on sampling of domestic wells, which are inadequate for determining contamination migration pathways, attenuation processes, and the overall impacts on freshwater resources (Alley 2014). Lack of adequate scientific information can be a constraint to implementing mitigation (Clement et al. 2014). As groundwater contamination issues become known, such entities as lessees, the US Geological Survey, state agencies, and the EPA will be identified to investigate contamination sources, and mitigation measures can be applied.

Under all alternatives, the availability of freshwater resources would be reduced. While the EPA estimates that fracturing shale gas wells requires, on average, 2.3 to 3.8 million gallons of water per well during production, this number varies greatly by region. The use of several million gallons of water per well completion affects the availability of freshwater resources for other uses, as well as future wastewater disposal and treatment requirements. Extensive withdrawals can reduce groundwater discharge to connected streams and springs, which in turn can damage or remove riparian vegetation and aquatic life. Additionally, groundwater and surface water connectivity has the potential to affect domestic water supply, if oil and gas wells are within the same aquifer or close to domestic water wells.

Groundwater withdrawals that exceed natural recharge rates also have the potential to mobilize lower-quality water from the land surface or adjacent formations. COAs and BMPs may be used to minimize these local impacts.

Soil erosion and runoff from well pads, service roads, pipelines, and other related infrastructure can result in water quality impacts if standard BMPs are not followed, such as those outlined in the BLM Gold Book (BLM and Forest Service 2007). Most groundwater contamination examples arise from historically persistent problems with fluid containment at the surface (Jackson et al. 2013).

Spills commonly occur at and around well sites, from pipelines and storage facilities, through trucks delivering chemicals or removing wastes, and from improper or illegal disposal of wastes (NETL 2013; AWWA 2013). The extent of impacts depends on spill volume, release duration, and water constituent concentrations (i.e., salts, naturally occurring radioactive material, and metals). These risks can be mitigated through use of spill containment systems, established mitigation procedures, the use of reputable disposal companies, and safety-conscious management.

Produced water is typically disposed of either through permitted disposal wells or dedicated wastewater treatment plants; however, in some cases municipal wastewater treatment plants may be used as a disposal option. These plants often are unable to adequately treat produced water, which may contain high levels of heavy metals and radioactivity. In these cases, treatment standards and practices should be updated as necessary to ensure that all potential contaminants are removed before discharge into the environment. Under all alternatives, COA 12 would protect groundwater resources from the disposal of saltwater or other deleterious substances. This would come about by requiring the Superintendent's approval of unlined earthen pits and requiring lined pits for storage of these substances.

Gallegos et al. (2015) describe how detection of oil- and gas-related impacts in aquifers through monitoring depends on many factors, such as the following:

- The depth of the target petroleum reservoir relative to freshwater aquifers
- The subsurface geology characteristics
- The disposition of injected water that does not flow back to the surface

Technical literature describing groundwater monitoring programs at well sites is sparse, suggesting that systematic long-term monitoring is rarely conducted unless spills have been reported (Gallegos et al. 2015; Alley 2014).

Many pollution incidents have been attributed to cement isolation problems, legacy issues with disposal pits, and well abandonment (King 2012). Significant attention has also been directed toward the possibility of subsurface migration of fracturing fluids or hydrocarbons into freshwater aquifers, such as the following:

- Cross communication during drilling

- Cross communication along casing/wellbore annulus
- Connection through hydraulic fracturing from movement of liquids or gases from the production zone through subsurface geologic formations and into a freshwater aquifer

The last example above would result from connecting hydraulic fractures with shallower natural fractures or faults extending into freshwater aquifers.

Orphan, or long-abandoned, oil and gas wells may have poorly cemented wellbores and degraded casings. In this case, higher-pressure gas from deeper formations could find a path behind poorly cemented casings to a shallower, lower-pressure zone of past production. This in turn could infiltrate an even shallower aquifer through the abandoned wellbore.

Each of these situations can be prevented through the application of best practices during drilling, completion, and well production. As stipulated in the COAs, under all alternatives, all lease operations are subject to the terms of the lease, the regulations set forth in 25 CFR Part 226, the approved APD, and any orders, NTLs, or written instructions adopted or issued by the Superintendent. Such orders, NTLs, and instructions would protect surface water and groundwater resources from impairment. Additionally, federal regulations require that a surface casing be installed inside the wellbore from the surface to a point below the deepest drinking water aquifer, plus layers of casing that extend deeper. Proper casing placement and cementing in place are key elements for protecting drinking water aquifers.

Impacts from Disposing of Produced Water

Impacts on drinking water resources occur when flowback or produced water enters surface waterbodies or more shallow aquifers. Isolating disposal wells from freshwater aquifers requires properly cementing casing strings to prevent inter-formation communication and unintended migration of produced water.

Impacts on shallow groundwater have also occurred from surface spills and storage in unlined pits prior to disposal. The potential environmental impact depends on characteristics of the spill and the surrounding environment. Produced water varies in quality, from fresh to highly saline, and can contain high levels of major ions, metals, organics, and naturally occurring radionuclides (EPA 2015g). Under all alternatives, COA 12 would minimize the risk of impacts on drinking water from produced water by requiring disposal pits for substances other than freshwater to be lined.

Table 4-2, Five Common Stages of Water Management During Oil and Gas Development, below, describes potential indirect impacts on drinking water from oil and gas development.

Table 4-2
Five Common Stages of Water Management During Oil and Gas Development

Stage	Description	Activity	Potential Impact on Drinking Water Resources
1	Water acquisition	Water is withdrawn from groundwater or surface water resources to be used during drilling and hydraulic fracturing.	Changes in the quantity and quality of water available for drinking
2	Chemical additive mixing	Once delivered to the well site, the acquired water is combined with chemical additives and proppant to make drilling or hydraulic fracturing fluids, or both.	Releases to surface water and groundwater through on-site spills or leaks
3*	Hydraulic fracturing process	Pressurized fluid is injected into the well, creating cracks in the geological formation that allow oil or gas to escape through the well to be collected at the surface.	Release of hydraulic fracturing fluids to groundwater due to inadequate well construction or operation
4	Flowback and produced water**	Following enhanced recovery by water flood or hydraulic fracturing operations, when pressure in the well is released, fluids, formation water, or natural gas begin to flow back up the well. This combination of fluids containing drilling and hydraulic fracturing additives or naturally occurring substances must be stored on-site—typically in tanks or pits—before treatment, recycling, or disposal.	Release to surface or groundwater through spills or leakage from on-site storage
5	Wastewater treatment and waste disposal	Wastewater is dealt with in one of several ways, including disposal by underground injection, treatment followed by disposal to surface waterbodies, or recycling (with or without treatment) for use in future oil and gas operations.	Contaminants reaching drinking water due to surface water discharge, or contamination of groundwater due to inadequate well design and construction at the disposal well site

Source: Modified from EPA 2015h
*Stage 3 applies only to wells developed through the hydraulic fracturing process.
**Flowback consists primarily of fluids used during the hydraulic fracturing process that are usually flushed out during the first week or two of production (this may contain some produced water). Produced water consists primarily of naturally occurring water produced along with oil or gas, or both (this may contain some flowback).

Indirect Impacts on Water Resources Due to Wastewater Disposal Associated with Hydraulic Fracturing

Indirect impacts on water resources from fluid minerals development could occur through wastewater disposal in the planning area. Wastewater from hydraulic fracturing is disposed of in the following ways: disposal by underground injection, treatment followed by disposal to surface waterbodies, or recycling (with or without treatment) for use in future hydraulic fracturing operations.

Potential impacts on water resources from wastewater disposal from fluid-mineral development in the planning area include contaminants reaching drinking water due to surface water discharge, or inadequate treatment of wastewater and byproducts formed at drinking water treatment facilities by reaction of hydraulic fracturing contaminants with disinfectants. Impacts from underground wastewater injection include groundwater contamination from inadequate well construction, movement of fracturing fluids from the target formation to drinking water aquifers through man-made or natural features, or movement of wastewater fluid into drinking water aquifers of natural substances found underground, such as metals or radioactive materials, which are mobilized during hydraulic fracturing activities (EPA 2016e).

Induced seismicity may also result from wastewater injection in injection wells permitted by the BIA. Indirect impacts on water resources from induced seismicity may result in aquifer disturbances; shifting saturated zones, particularly near fault lines; potential well damage; and potential oil and gas release into aquifers. Indirect impacts on water resources as a result of hydraulic fracturing cannot be identified at the leasing stage. Accordingly, impacts on water resources will be addressed in NEPA review for approval of proposed APDs.

Subsurface disturbances can alter natural aquifer properties; for example, they can enhance hydraulic conductivity of existing fractures, breach confining units, and change hydraulic pressure gradients. This can increase the potential for contaminating surface water and groundwater. Furthermore, altering natural aquifer properties can dewater locally important freshwater sources, such as groundwater, springs, seeps, fens, and streams.

Use, storage, and transportation of fluids, such as saline produced water, hydraulic fracturing fluids, and condensate, creates the possibility of spills that could migrate to surface water or groundwater. Spills of these fluids can affect water quality and human health. Under all alternatives, produced water must be disposed of in pits lined with at least 30 millimeters of plastic and away from freshwater fluids. This would prevent spills that could contaminate groundwater or surface water.

Hydraulic fracturing occurs in gas-producing formations at depth. Water, sand, and chemical additives are pumped into the formation at an extremely high pressure to create fractures that allow gas to flow into the well. Theoretically, improperly completed wells or perforations into zones of geological weakness—faults or fractures—could create conduits that allow fracturing fluids, produced water, and methane to migrate to groundwater. If groundwater is contaminated, there are few cost-effective ways to reclaim it; thus, the long-term impacts of groundwater contamination would be considerable.

If aquifers were to become contaminated from oil and gas development, changes in groundwater quality could affect downstream users who divert groundwater. Municipal and public wells, domestic wells, springs, and surface waters that are hydrologically connected to groundwater could be affected by changes in its quality. The extent of potential contamination would depend on the point of contamination and volume of the contaminant. Rigorous well casing protocols can reduce the risk of such contamination.

Oil and gas development uses water for well stimulation (including hydraulic fracturing and enhanced oil recovery), well drilling with water-based drilling muds, and other minor uses, such as dust suppression and equipment cleaning. Well stimulation uses the most water during oil and gas development (Ceres 2014). Enhanced oil recovery (pumping water underground to increase pressure in a well to boost lagging oil production) can require far larger volumes of water than the average well requirements for hydraulic fracturing (Getches-Wilkinson Center for Natural Resources, Energy, and the Environment 2015).

Under all alternatives, lessees would be responsible for complying with applicable laws and regulations, such as the CWA and Safe Drinking Water Act. Under some Alternatives, COAs stipulating methods of compliance would be applied to oil and gas development. These measures may be applied on a case-by-case basis or up front, or a combination of both, depending on the alternative selected. Applying these measures would reduce impacts on water resources by helping ensure that water quality standards are met. Additionally, under all alternatives, COA 12 would prevent impacts on groundwater from produced water by requiring storage pits for substances other than freshwater to be lined.

4.3.3 Alternative 1 – No Action

Applying the COAs under Alternative 1 (No Action) would continue to mitigate impacts on water resources by imposing permit conditions according to the requirements of 25 CFR Part 226. As described in **Section 4.3.2**, Water resources, the regulations at 25 CFR Part 226 would help reduce surface water and groundwater contamination from oil and gas development. The BIA would continue to prohibit drilling within 200 feet of established watering places, in accordance with 25 CFR Section 226.33. This restriction would protect some sensitive waterbodies from the impacts of surface disturbance described in **Section 4.3.2.**

Applying COAs that reduce the extent of surface disturbance and vegetation removal during oil and gas development would reduce runoff and impacts on surface water quality. Chemical storage requirements and spill prevention measures required for tank batteries and storage pits would reduce the risk of shallow groundwater and surface water contamination from spills.

Potential impacts on surface and water resources would be highest in those areas with high or moderate-to-high oil and gas potential where oil and gas development would be concentrated (see **Appendix A**); however, under Alternative 1 (No

Action), COAs would protect water resources by preventing oil and gas development within stream channels or wetlands without proper authorization and avoiding any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally approved water quality standards.

Alternative 1 (No Action) would require EPA approval before beginning workover operations related to underground injection, construction, or conversion of saltwater injection/disposal wells. This could help prevent contamination of surface and groundwater resources by requiring additional approval, as described in **Section 4.3.2**; however, the EPA could also redesignate aquifers to nondrinking water status and allow contamination.

4.3.4 Alternative 2

In comparison with Alternative 1 (No Action), under Alternative 2 the BIA would waive most BMPs and apply fewer standardized COAs to oil and gas development. This Alternative imposes the least number of COAs and would generally provide the least amount of protection for surface and groundwater resources.

Waiving COAs for drilling and workover operations would increase the potential for impacts on water resources, compared with Alternative 1 (No Action); however, lessees would still be required to comply with existing laws and regulations, such as the CWA (including the Underground Injection Control program) and the Safe Drinking Water Act. This would mitigate impacts on water resources.

Alternative 2 applies some COAs that may protect water resources, compared with Alternative 1 (No Action), including a COA that prohibits land application of waste oil, wastewater, and contaminated soil without first submitting a written request and receiving the Superintendent's approval. This COA may prevent contamination of water resources, as described in **Section 4.3.2**, if the Superintendent requires appropriate documentation and imposes standard BMPs, such as prohibiting land application during rainfall and limiting the application rate. However, this analysis may be less stringent. Because Alternative 2 emphasizes development, there would likely be more impacts on water resources, compared with Alternative 1 (No Action). Agreements between lessees and surface owners and voluntary compliance with BMPs could provide additional mitigation in some cases.

Fluid mineral development may affect water resources through the development of well pads, roads, power lines, and other infrastructure, as described in **Section 4.3.2**, Impacts Common to All Alternatives. Fluid mineral development may affect hydrology and sediment regimes and may increase turbidity. Accidental release of wastewater used in drilling operations could affect water quality. Water depletions from these surface water and groundwater sources would likely continue to occur over the long term.

The lower number of BMPs and COAs imposed under Alternative 2 would result in greater impacts on water resources compared with Alternative 1 (No Action).

4.3.5 Alternative 3

Under Alternative 3, the BIA would apply COAs based on the density of well development, which would result in location-specific water resource impacts. Fewer COAs would be applied in high-density sections, and more COAs would be applied in low-density sections, compared with Alternative 1 (No Action). More COAs in low-density sections would protect surface water and groundwater from the impacts described in **Section 4.3.2**, compared with Alternative 1 (No Action).

The BIA may also apply additional COAs that would indirectly protect water resources, compared with Alternative 1 (No Action). These measures could further reduce surface disturbance and protect water resources; however, their impacts would be analyzed through site-specific NEPA analyses. Until this analysis is completed, it would be difficult to discern the extent of change in impacts on water resources, compared with Alternative 1 (No Action).

Under Alternative 3, in low-density sections, the BIA would require COA 33, which would preclude new road crossings of streams and through riparian and other areas susceptible to inundation. This could reduce sedimentation and surface water quality impairment, compared with Alternative 1 (No Action); however, the extent of the change from Alternative 1 (No Action) is unknown and would depend on the number, type, and location of new wells.

In low-density sections, Alternative 3 would include all COAs in Alternative 1 (No Action) as well as additional COAs. This would further reduce impacts on and would protect water resources in low-density sections. These COAs include limiting surface disturbance, erosion control measures, avoiding conducting activities in wetlands, and avoiding stream crossings. Providing a 200-foot buffer zone from streams and waterways would protect surface water resources from quality impairment, compared with Alternative 1 (No Action).

In high-density sections, COAs would be applied in the same manner as they are applied under Alternative 2. This reduction in protective measures could have short-term and long-term impacts on both surface water and groundwater resources, as described in **Section 4.3.2**. These impacts would be greater, compared with Alternative 1 (No Action).

Under Alternative 3, impacts on water resources would be reduced or eliminated in the areas where the BIA would prevent new ground disturbance from oil and gas development. These include sensitive water-related areas, such as public water supplies. Protected areas would include approximately 80,800 acres of floodplains, 151.2 miles of 303(d) streams and portions of major drinking water aquifers shown in **Table 4-3**, below (BIA GIS 2017).

Table 4-3
No New Ground Disturbance Aquifer Acreage - Alternative 3

Aquifer*	Acres	Percent of Total Aquifer Acreage in Planning Area
Alluvium	51,400	36%
Terrace	30,800	72%
Vamoosa-Ada	89,600	13%

Source: BIA GIS 2017
*Aquifers overlap, total of acres is not equal to total spatial acreage

4.3.6 Alternative 4

Under Alternative 4, additional COAs applied to all oil and gas development would make this alternative the most protective of water resources. In general, under Alternative 4, the application of more COAs, such as those protecting sensitive cultural and environmental resources, would limit the location and type of new oil and gas development. This would in turn protect surface water and groundwater from contamination.

Alternative 4 would provide more stringent COAs to protect water resources, compared with Alternative 1 (No Action). Impacts of surface disturbance would be reduced within buffers surrounding sensitive cultural site types. Some site types (e.g., camps, villages, and waterways) would be defined based on their proximity to waterbodies, providing direct protection to these waterbodies from impacts of surface disturbance described in **Section 4.3.2**.

In other cases, buffers surrounding cultural resources may indirectly protect a nearby waterbody. Overall disturbance could be reduced by these buffers, which would also reduce indirect impacts on water resources in the planning area, as described in **Section 4.3.2.**

Additional COAs that may be applied to protect sensitive areas could include requiring compliance with established infrastructure setbacks at US Army Corps of Engineers lakes, observing reasonable setbacks requested by municipalities, and requiring that no surface waste pits or disposal be near a public water supply well. Additionally, an emergency plan to supply drinking water in the event that a sensitive public water supply is contaminated by a lessee's activities could be required, which would protect public water supplies, compared with Alternative 1 (No Action).

Impacts on water resources would be reduced or eliminated in the areas where the BIA would not approve new ground-disturbing activities under Alternative 4. Impacts would be similar to those under Alternative 3, but the reduction in impacts on water resources would be more widespread because of the broader scope of sensitive areas where new ground disturbance from oil and gas development would be prevented. Protected areas would include 96,300 acres of floodplains, 167.7 miles of 303(d) streams and portions of major drinking water aquifers shown in **Table 4-4**, below (BIA GIS 2017).

Table 4-4
No New Ground Disturbance Aquifer Acreage - Alternative 4

Aquifer*	Acres	Percent of Total Aquifer Acreage in Planning Area
Alluvium	62,400	43%
Terrace	32,500	76%
Vamoosa-Ada	210,900	32%

Source: BIA GIS 2017
*Aquifers overlap, total of acres is not equal to total spatial acreage

4.3.7 Cumulative Impacts

The cumulative impact analysis area for water resources is the planning area. Past, present, and reasonably foreseeable future actions and conditions within the cumulative impact analysis area that have affected and will likely continue to affect water resources are uses that would disturb the surface. The activities described in **Table 4-1** that would cause surface disturbance would further affect water resources, in combination with any of the alternatives; impacts would be the same as those described in **Section 4.3.2**. All of these activities have created or have the potential to create new surface disturbance in Osage County, which would affect water resources as described under **Section 4.3.2**.

Freshwater resources would be depleted for by oil and gas development in combination with agricultural and industrial use in Osage County (Scanlon et al. 2014a, 2014b; Nicot et al. 2012; Murray 2013). FracFocus 1.0 disclosures indicate that annual water use for oil and gas development was 10 percent, or greater, of total annual water use in 6.5 percent of the counties reporting (EPA 2015h).

Alternatives Analysis

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. Oil and gas development and production would increase the amount of surface disturbance on the landscape and could increase the potential for H_2S, produced fluids, or saline water to be leaked or improperly disposed of on the landscape. Impacts on water resources from oil and gas development in the planning area would continue to be mitigated under Alternative 1 (No Action); however, these resources would still be affected by the other projects discussed under **Section 4.3.6**.

The incremental contribution of oil and gas development to cumulative impacts on water resources in Osage County would be reduced in the low-density sections under Alternative 3 and throughout the planning area under Alternative 4. Incremental contributions of oil and gas development to cumulative impacts on water resources in Osage County would also be reduced in areas where new permits for ground disturbing activities would not be issued under Alternative 3 and Alternative 4. Alternative 2 could result in a higher incremental contribution of oil and gas development to cumulative impacts on these resources.

4.4 AIR QUALITY AND CLIMATE

4.4.1 Methods and Assumptions

As part of the OKT Joint EIS/BLM RMP/BIA IRMP planning process, the BLM contracted for emissions inventories for oil and gas and coal mining emissions in the three-state area (Grant et al. 2016a, 2016b). Emissions were estimated for five criteria pollutants, VOCs, hazardous air pollutants (HAPs), and GHGs. The inventories reported emissions by state and by mineral estate designation type (federal, Indian, and private/state). Emissions inventories were developed for a base year of 2011 to estimate existing emissions and forecast to future years 2015, 2020, 2025, and 2030 to evaluate potential increases or decreases in emissions over time. Emissions from oil and gas development in Osage County were included as part of the three-state planning area and are summarized in **Section 4.4.2**, Air Quality and Climate, below.

Impacts from each alternative are discussed qualitatively based on the COAs contained in **Table 2-3** of this EIS.

Indicators

Air Quality

Indicators of impacts on air quality are as follows:

- Changes in oil and gas emissions resulting from BIA-permitted activities
- Changes in visibility and other air quality related values (AQRVs)

Climate

Indicators of impacts on climate are as follows:

- Changes in GHGs resulting from BIA-permitted activities

Assumptions

Air Quality

- Alternatives that apply more COAs would have fewer air quality impacts.
- Oil and gas leasing actions would have no direct impacts on air quality; however, indirect impacts from subsequent oil and gas development would occur.
- Air pollutant emissions presented in this analysis are useful for estimating the scale of future potential emissions but may not represent actual future emissions.
- Projected oil and gas development would be the same across all alternatives; based on the Osage RFD, it is reasonably foreseeable

that 4,761 new wells could be drilled in Osage County between 2018 and 2037. To date, over 42,000 wells have been drilled and completed in the county (**Appendix A**).

- Based on current rates of surface disturbance per well, as presented in the Osage RFD (**Appendix A**), the county can expect a gross disturbance of approximately 9,522 acres between 2018 and 2037. Taking into account potential interim reclamation, the net surface disturbance is estimated to be approximately 3,571 acres (**Appendix A**). However, projected surface disturbance is expected to vary depending on the alternative selected.
- Site-specific NEPA analyses will be undertaken for new drilling permits and workovers involving new surface disturbance.

Climate

- There is a correlation between global concentrations of GHGs and climate change; however, it is not currently possible to link projected GHG emissions associated with any particular activity to specific environmental impacts at a specific site or location. While there are difficulties in attributing specific climate change impacts on any given project or activity and quantifying those impacts, projected GHG emissions can serve as a proxy for a proposed action's climate change impacts.

4.4.2 Impacts Common to All Alternatives

Oil and gas leasing would have no direct impact on air quality but would have indirect impacts from subsequent oil and gas development, described below.

Sources of Air Emissions

Air pollutant emissions would occur as part of field construction and well production activities. Sources of emissions during construction include vehicle traffic, well pad and road construction, pit construction (for hydraulic fracturing), pipeline construction, and well drilling and completion. The primary pollutants emitted during construction are criteria air pollutants (carbon monoxide, nitrogen oxide, sulfur dioxide, PM_{10}, and $PM_{2.5}$), VOCs, and HAPs (benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde). H_2S is present in some oil and gas production zones and can be released during well development. These activities would temporarily elevate pollutant levels, but impacts would be localized and would occur only for the short-term duration of the activities. Fugitive dust emissions (PM_{10} and $PM_{2.5}$) would result from work crews commuting to and from the work site and from the transportation and operation of equipment during construction. Wind-blown fugitive dust emissions would also occur from open and disturbed land during construction. Emissions from well development using hydraulic fracturing methods would be higher than well development using conventional methods (BLM 2016a).

During field production, air pollutant emissions would occur from compressor station operation, well site pumping unit engines, water transfer pump engines, well site heaters, valve/flanges (fugitives), vehicle traffic on roads during field operations and maintenance, and workover activities. The primary pollutants emitted would be carbon monoxide, nitrogen oxide, sulfur dioxide, PM_{10}, $PM_{2.5}$, VOCs, and HAPs. These emissions would affect air quality over the life of production.

Emissions Inventory

Table 4-5, Osage County Oil and Gas Emissions Estimate, shows estimated emissions from oil and gas development in Osage County and compares them to statewide emissions for context. As shown in this table, estimated emissions from oil and gas development in Osage County comprise between 0.44 and 3.27 percent of statewide oil and gas emissions, depending on the year and the pollutant.

Table 4-5
Osage County Oil and Gas Emissions Estimate

Year	Emissions (tons/year)							GHG (MMt CO_{2e}/yr)
	NOx	VOC	CO	PM_{10}	$PM_{2.5}$	SO_2	HAPs	
Osage County Emissions by Year								
2011 (BY)	2,238	5,859	2,758	52	52	5	164	0.8
2015	2,534	7,955	3,133	66	66	6	204	1.0
2020	2,729	8,510	3,351	73	73	6	235	1.1
2025	2,801	8,438	3,422	75	75	6	248	1.2
2030	2,851	8,232	3,466	76	76	6	258	1.2
Total Statewide Oil and Gas Emissions by Year								
2011 (BY)	127,550	210,798	122,246	3,488	3,483	930	8,107	46
2015	137,203	243,343	132,748	3,818	3,814	1,000	9,158	51.2
2020	155,074	273,007	149,984	4,405	4,402	1,174	11,363	59.7
2025	165,420	286,201	159,671	4,732	4,730	1,279	12,685	64.4
2030	175,084	296,646	168,416	5,045	5,043	1,375	13,891	68.6
Percentage of Osage County Emissions to Statewide Oil and Gas Emissions by Year								
2011 (BY)	1.75	2.78	2.26	1.49	1.49	0.54	2.02	1.74
2015	1.85	3.27	2.36	1.73	1.73	0.60	2.23	1.95
2020	1.76	3.12	2.23	1.66	1.66	0.51	2.07	1.84
2025	1.69	2.95	2.14	1.58	1.59	0.47	1.96	1.86
2030	1.63	2.78	2.06	1.51	1.51	0.44	1.86	1.75

Source: Grant et al. 2016a
BY = Base Year
MMt CO_{2e}/yr = MMT of CO_2e per year
Statewide emissions include federal, Indian, and private/state sources.
Future year emissions (emissions in 2015–2030) were based on production activity forecasts presented in an RFD prepared by the BLM for lands in in Kansas, Oklahoma and Texas (BLM 2016b). In 2017, the Indian Energy Service Center prepared an RFD for Osage County (**Appendix A**). Because the Osage RFD is based on well spud forecasts rather than production forecasts, it is difficult to compare the two RFDs; however, the BLM RFD used production forecasts developed prior to the economic downturn in the energy market. Thus, the estimates in the BLM RFD were a conservative estimate of projected oil and gas development, and the emissions in this table are presumed to be a reasonable estimation of likely future emissions from oil and gas development in Osage County.

As shown in **Table 4-5**, continuing to develop oil and gas resources would lead to increases in GHG emissions, which contribute to climate change, and criteria pollutants, VOCs, and HAPs, which could exceed the NAAQS and have impacts on public health and visibility. Well development and production equipment would be subject to EPA emissions control regulations, and lessees would be required to conform to all applicable local, state, Tribal, and federal air quality laws, statutes, regulations, standards, or implementation plans in place at the time of permitting. Current oil and gas emissions control regulations include the following:

- Nonroad diesel engine tier standards (1-4) and fuel sulfur standards
- New Source Performance Standards Subpart OOOO for pneumatic devices, gas well completions, crude oil, and condensate tanks
- New Source Performance Standards Subpart JJJJ for compressor engines
- New Source Performance Standards Subpart HH for dehydrators

Differences among the alternatives would result if the level of oil and gas development were to differ by alternative, or if constraints on oil and gas development among the alternatives resulted in differences in the amount of emissions produced; however, the amount of oil and gas development in the planning area is not likely to change based on the alternatives; the action alternatives may streamline the permitting process but are unlikely to affect the level of development that would occur in the planning area.

Under all alternatives, the BIA would ensure compliance with applicable laws and regulations. The BIA may apply additional COAs or waive COAs based on site-specific determinations. These measures may be applied on a case-by-case basis or up front, or a combination of both, depending on the alternative selected. COAs could have a beneficial impact on air quality and GHG emission levels if they were to reduce emissions or dust levels associated with oil and gas development. The following COA is required under all alternatives and would reduce air pollutant emissions and GHGs:

- COA 7 would prevent the venting or flaring of gas without prior written approval from the BIA Osage Agency Superintendent.

Venting and flaring emit carbon dioxide and methane (a GHG and a precursor to ozone). They also emit VOCs, HAPs, and other criteria pollutants. Globally, venting and flaring are responsible for about 1 percent of total carbon dioxide emissions and 4 percent of the total methane emissions caused by human activity (GAO 2004).

4.4.3 Alternative 1 – No Action

Under Alternative 1 (No Action), the requirements to keep all disturbance within the confines of the historic well pad (COA 2), to avoid or minimize soil and vegetation disturbance (COA 3), to keep vehicles and equipment confined to roads described in the approved APD (COA 6), and to promptly reclaim disturbed areas associated with workovers (COA 17) would continue to limit impacts of dust from workover activities on air quality in the planning area. COA 20, which requires implementation of air quality BMPs from the site-specific EA if concentrations of H_2S greater than 100pmm are anticipated in the gas stream, would reduce H_2S exposure.

4.4.4 Alternative 2

Under Alternative 2, the BIA would apply fewer standardized COAs to oil and gas development. The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would not apply under Alternative 2. This would lead to increases in localized fugitive dust, compared with Alternative 1 (No Action). Emissions from equipment used in drilling, workover, and production operations would be similar to Alternative 1 (No Action). No COAs relating to H_2S emissions would be applied under this alternative, resulting in increases in H_2S exposure compared with Alternatives 1 (No Action), 4, and low-density sections of Alternative 3.

4.4.5 Alternative 3

Under Alternative 3, the BIA would apply COAs based on the density of well development. The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would not apply in high-density sections under Alternative 3. This would lead to increases in localized fugitive dust in these sections, compared with Alternative 1 (No Action).

The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would apply in low-density sections. The effects of limiting fugitive dust impacts in these areas would be the same as described for Alternative 1 (No Action). Overall, localized fugitive dust emissions may be higher in some areas compared with Alternative 1 (No Action), while emissions from equipment used in drilling, workover, and production operations would be similar to Alternative 1 (No Action).

Under Alternative 3, the BIA would apply the additional COAs 20 and 29 in low-density sections. COA 20 is described under Alternative 1 (No Action), and COA 29 would require lessees to conduct an initial test of H_2S in the gas stream for each well and production facility. If the concentrations exceed 100 ppm, lessees would determine the 100 ppm and 500 ppm radius of exposure and post signs warning of the effects of exposure. Compared with Alternative 1 (No Action), Alternative 3 would provide additional protections to workers and the public related to potential public health hazards from H_2S exposure.

Preventing new ground disturbance from oil and gas development on approximately 249,000 acres under this alternative would reduce air emissions and production of GHGs compared with Alternative 1 (No Action). As described in **Section 4.16**, Mineral Development, projected wells in the planning area are expected to decrease by approximately 16 percent under this alternative. The reduction in air emissions and production of GHGs would be proportional to this decrease.

4.4.6 Alternative 4

Under Alternative 4, the BIA would apply the COAs described in Alternative 1 (No Action), as well as additional COAs to protect sensitive cultural and environmental resources. With one exception, the COAs that would minimize impacts on air quality would be the same under Alternative 4, as described for Alternative 1 (No Action); therefore, effects on air quality related to minimizing localized fugitive dust and emissions from drilling, workover, and production operations would be the same as described for Alternative 1 (No Action).

Under Alternative 4, the BIA would apply the additional COA 29, as described in Alternative 3, and COA 20, as described under Alternative 1 (No Action). Compared with Alternative 1 (No Action), Alternative 4 would provide additional protections to workers and the public related to potential public health hazards from H_2S exposure.

Preventing new ground disturbance from oil and gas development on approximately 524,400 acres under this alternative would reduce air emissions and production of GHGs compared with Alternative 1 (No Action). As described in **Section 4.16**, Mineral Development, projected wells in the planning area are expected to decrease by approximately 35 percent under this alternative. The reduction in air emissions and production of GHGs would be proportional to this decrease.

4.4.7 Cumulative Impacts

Air Quality

The cumulative impact analysis area for air quality encompasses the air basins in and around northeastern Oklahoma. Past, present, and reasonably foreseeable future actions and conditions within the cumulative impact analysis area have affected and will continue to affect air quality and AQRVs.

Oil and gas development in Osage County has contributed and will continue to contribute air pollutant emissions. Other past, present, and reasonably foreseeable actions that have contributed to air pollutant emissions in the cumulative impact analysis area include other mineral development (non-Osage County oil and gas development and coal mining), prescribed burning (including annual pasture burning in Osage County), energy generation (coal and natural gas power plants), travel and transportation, and urban development (including population growth).

Air quality monitoring data trends can predict future air quality conditions within the cumulative impacts analysis area. Air monitoring data trends have shown decreases in most criteria pollutant concentrations near Osage County over the past three decades.

Alternatives Analysis
Cumulative impacts on air quality, climate, and AQRVs would be the same under all of the alternatives, as oil and gas development emissions are projected to be the same regardless of the COAs applied.

The air modeling study for the OKT Joint EIS/BLM RMP/BIA IRMP planning process (Jung et al. 2016) evaluated the cumulative effect of federal and Indian oil and gas development using the 2030 future year emissions scenario. The Indian category included Osage County sources, as well as limited other Indian sources, and, therefore, represents a conservative estimate of the contribution of Osage County oil and gas emissions to the cumulative impacts analysis area.

Osage County oil and gas emissions would have a minor incremental cumulative impact on air quality and AQRVs. As reported in the air modeling study (Jung et al. 2016), Indian oil and gas sources would contribute less than one percent of the threshold for the EPA's standards for PSD Increments under the CAA for nitrogen dioxide, sulfur dioxide, PM_{10}, and $PM_{2.5}$ in all Class I and sensitive Class II areas for the 2030 emission scenario. In addition, Indian oil and gas sources would have zero days above the 0.5 deciview (the unit of measurement for haze) visibility threshold at Class I areas and only 2 days above the 0.5 deciview threshold at the Tallgrass Prairie sensitive Class II area for the 2030 emission scenario.

The study also modeled NAAQS concentrations for the 2030 future year scenario. The model shows no exceedances of any of the NAAQS in Kansas. In Oklahoma, the model showed potential exceedances of the ozone standard and the annual $PM_{2.5}$ standard in northeastern Oklahoma, and no exceedances of the other NAAQS. Modeled exceedances all occurred in the Tulsa metropolitan area. The contribution of Osage County oil and gas development to these potential exceedances, while small, would still contribute to the cumulative impact.

Climate Change
Primary climate change indicators that can be monitored include ambient air temperature, precipitation amounts and timing, annual snow pack levels, and stream flow volume and timing. The trends in climate change within the region are discussed in **Section 3.4**, Air Quality and Climate.

Past and present actions in the region have directly emitted GHGs. Actions that have contributed GHGs to the atmosphere are urban development (population increases spurring development), mineral development, energy production, fossil-fuel burning (primarily transportation-related use), and wildfire. Reasonably foreseeable direct and indirect impacts from oil and gas development include the direct GHG emissions from extraction and the indirect GHG emissions from combustion of the resource.

Potential emissions from Osage County oil and gas production are described in **Table 4-5**; these emissions are a very small fraction of total US GHG emissions. US emissions due to petroleum and natural gas use in the energy sector are predicted to increase by 2 percent from 3,410 MMT CO_{2e} in 2011 to 3,465 MMT CO_{2e} in 2020. Total gross US emissions are projected to grow by 2 percent from 6,702 MMT CO_{2e} in 2011 to 6,815 MMT CO_{2e} in 2020; however, these future estimates have considerable uncertainty due to ongoing changes in the selection of fuel for energy use across the country.

4.5 FISH, WILDLIFE, AND MIGRATORY BIRDS

4.5.1 Methods and Assumptions

Indicators

Indicators of impacts on fish, wildlife, and migratory birds are as follows:

- Extent and condition of available habitat
- Likelihood of death, injury, or direct disturbance
- Likelihood of habitat disturbance

Fisheries

Indicators of impacts specific to aquatic species and their habitats are the following:

- Sediment and turbidity—Increased sediment loading in waters containing sediment-intolerant fish species, loss of recruitment, stress, nutrient loading, and habitat loss
- Habitat alteration—Changes in habitat that make it nonfunctional for select species or more conducive to competitive species
- Loss or reduction of streamside vegetation and cover—Increased temperatures, stress, reduced productivity, and impacts on food webs
- Water quality alteration—Actions that alter important water quality parameters, such as pH, dissolved oxygen, temperature, hardness, alkalinity and salinity, and turbidity or other chemical, physical or biological characteristics
- Water depletions—Habitat loss, water quality changes, sediment accumulation, habitat complexity loss, and food source reduction
- Potential direct destruction of aquatic wildlife from motorized vehicles

Wildlife and Migratory Birds

Indicators of impacts specific to wildlife and migratory birds are the following:

- Disturbance or loss of plant communities, food supplies, cover, breeding sites, and other habitat components necessary for population maintenance and used by any species to a degree that would lead to substantial population declines
- Disturbance, fragmentation, or loss of seasonally important habitat (e.g., critical for overwintering or successful breeding) to a degree that would lead to substantial population declines
- Interference with a species' movement pattern that decreases its ability to breed or overwinter successfully to a degree that would lead to substantial population declines

Assumptions

This analysis is based on the following assumptions:

- Disturbance of a key or critical component of a species' habitat would be detrimental, with the degree of detriment dependent on the importance of the habitat component to the maintenance of the population.
- Habitat conditions and quality, including soil and water, are linked to the health, vigor, and cover provided by vegetation communities upon which fish and wildlife depend.
- Impacts on terrestrial wildlife from displacement would depend on the location, extent, timing, or intensity of the disruption.
- In the context of this analysis, avoidance means reduced use and does not imply a complete absence of use by wildlife.
- Impacts on populations that exceed the current carrying capacity that would not reduce those populations below the carrying capacity would not be considered significant.

4.5.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur; such leasing can reasonably be expected to result in oil and gas development. Oil and gas development could affect fish, wildlife, and migratory bird species or habitats through disturbance; direct habitat loss; reduced habitat effectiveness; habitat modification, degradation, and fragmentation; direct mortality; habitat avoidance; and interference with movement patterns. Surface disturbance and vegetation removal may remove or degrade habitat for certain wildlife species, depending on the size and location of the project.

Birds and other wildlife species may be affected by oil field waste pits or hydraulic fracturing reserve pits because they are attracted to oil-covered ponds. Potential impacts are the following:

- Entrapment in oil waste or reserve pits and drowning

- Death or illness from ingestion of toxic quantities of oil or hydraulic fracturing fluids
- Cold stress if oil or fracturing fluids were to damage the insulation provided by feathers
- Increased susceptibility to disease and predation (USFWS 2000)

Under all alternatives, the BIA would ensure compliance with applicable laws and regulations, such as the ESA and MBTA. The BIA may apply additional COAs or waive COAs based on site-specific determinations. These measures may be applied on a case-by-case basis or up front, or a combination of both, depending on the alternative selected. These COAs would limit the extent of surface disturbance and resulting habitat degradation or disturbance of wildlife associated with these activities, such as limiting ground disturbance and restricting the flaring or venting of gas.

Under some Alternatives, measures found in other guidance documents would be incorporated as protective actions for special status species (see **Section 4.7**, Special Status Species). These conservation measures would reduce disturbance to all wildlife habitats and are likely to benefit a variety of other species as well. Specific guidance can be found in the USFWS Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects (USFWS Impact Avoidance guidance; USFWS 2014b). It includes recommendations, such as anti-perching devices on the ends of pipes for flaring, that would reduce but not eliminate the risk of bird deaths from oil and gas development.

4.5.3 Alternative 1 – No Action

In addition to the COAs applied under all alternatives, several additional COAs will be applied under Alternative 1 (No Action). These COAs would help reduce the extent of habitat disturbance or direct disturbance to fish and wildlife from these activities, such as minimizing noise, excessive traffic, and dust, and restricting the discharge of contaminants into waterways.

Under Alternative 1 (No Action), several COAs would apply that would help maintain suitable bird nesting and bat roosting habitats. Under COA 3, lessees would be required to avoid removing or damaging trees, shrubs, and groundcover to the greatest extent possible. COA 16 includes direction to restore the surface to its original contours, add clean soil to disturbed areas, and replant vegetation using seed or sod or other approved methods. Disturbed areas would be restored with native species, unless otherwise directed by the surface owner in writing. No noxious or invasive species would be used in revegetation and reclamation activities; however, habitat fragmentation, noise disturbance, and injury or mortality of birds and bats may still occur.

4.5.4 Alternative 2

Compared with Alternative 1 (No Action), the BIA under Alternative 2 would waive most BMPs and apply fewer standardized COAs to all oil and gas development, including drilling, workover, and other permitted activities. Implementing Alternative 2 would increase flexibility for the methods lessees use to comply with applicable laws and regulations; however, COAs 28 and 31 would be applied under Alternative 2, which limit excessive audible or visual disturbance and also prohibit land application of wastewater, waste oil, and contaminated soil.

Noise-control measures would reduce the potential for habitat avoidance and other behavioral impacts. Prohibiting the land application of waste and contaminated soil would likely keep injurious material out of important fish and wildlife habitat, such as wetlands and riparian zones.

Overall, the impacts of oil and gas development on fish and wildlife under Alternative 2 would increase, compared with Alternative 1 (No Action). Some impacts could be mitigated by voluntary compliance with COAs by lessees, or by agreements between surface owners and lessees.

4.5.5 Alternative 3

Applying COAs based on the density of well development would result in location-specific fish and wildlife impacts. Impacts on fish, wildlife, and migratory birds under Alternative 3 in high-density sections would be similar to those under Alternative 2; however, additional COAs applied under Alternative 3 in low-density sections would make these sections more protective of fish, wildlife, and migratory birds. In low-density sections, impacts would be mitigated by requiring further protections, such as covering or netting open-top tanks and pits to reduce injury and mortality of birds and other wildlife, and buffering streams and waterways by 200 feet.

Preventing new ground disturbance from oil and gas development on approximately 249,000 acres under this alternative would reduce impacts on fish, wildlife, and migratory birds compared with Alternative 1 (No Action). These sensitive areas are important habitats for fish, wildlife, and migratory birds in the planning area.

Overall, compared with Alternative 1 (No Action), Alternative 3 would afford more protections for fish and wildlife, particularly in low-density sections and areas where new ground-disturbing activities would not be approved.

4.5.6 Alternative 4

Impacts from oil and gas development on fish, wildlife, and migratory birds under Alternative 4 would be less than Alternative 1 (No Action). COAs applied under Alternative 4 would make this alternative the most protective. The reduction in oil and gas impacts from applying these additional COAs would be the same as that described for low-density sections under Alternative 3; however, impacts would be reduced throughout the planning area under Alternative 4. Preventing new ground disturbance from oil and gas development on approximately 524,400 acres of sensitive areas under Alternative 4 would provide a reduction in impacts on fish, wildlife, and migratory birds.

Benefits under Alternative 4 may also occur from non-wildlife-specific COAs, such as buffer zones around sensitive cultural sites and streams, rivers, ponds, reservoirs, lakes, and wetlands. In addition, the lessee would be required to avoid new road and pipeline crossings of streams or wetlands and alterations to hydrology, to the extent practicable, as well as bury pipelines to protect aquatic resources and sensitive areas. Thus, Alternative 4 would likely result in the greatest reduction of impacts of oil and gas development on fish, wildlife, and migratory bird species of all the alternatives.

4.5.7 Cumulative Impacts

The cumulative impact analysis area for fish, wildlife, and migratory birds is the planning area. Past, present, and reasonably foreseeable future actions and conditions within the cumulative impact analysis area that have affected and will likely continue to affect fish, wildlife, and migratory birds are oil and gas development, agricultural and livestock grazing, renewable energy projects, and other infrastructure. In addition, the USFWS ABB Oklahoma Industry Conservation Plan (USFWS 2014a) is also likely to affect fish, wildlife, and migratory birds in the planning area, as the plan provides a streamlined permitting process that allows oil and gas development in ABB habitat during the ABB active season.

Oil and gas development, in combination with tallgrass prairie conversion to agriculture, is likely to continue to affect birds, mammals, and other species that depend on prairie habitats for nesting, foraging, and cover. Approximately 95 percent of Osage County is in agricultural use (Osage County 2011), and further conversion of native habitats to agriculture would result in long-term habitat loss or fragmentation for tallgrass prairie-dependent species.

Infrastructure developments (e.g., pipelines, transportation projects, and wind farms) could cross multiple land jurisdictions and contribute to habitat fragmentation. In addition, tall infrastructure could increase prairie bird habitat avoidance. In areas where tall infrastructure is highly concentrated or overlaps with oil and gas development, increased predation and potential population declines may occur for prairie birds.

Past, present, and reasonably foreseeable actions could affect trends in water quality and quantity, which could subsequently affect fish and other aquatic communities. Surface-disturbing activities, as described in **Table 4-1**, could remove or disturb soil-stabilizing agents, such as vegetation, soils crusts, and wood debris. Loss of one or more of these agents could increase erosion and sediment transport to surface waterbodies, which could degrade habitat for sediment-intolerant fish species.

In addition, continued agricultural use would likely contribute to eutrophic (oxygen depleted) conditions in some streams and lakes, by means of nutrient input (e.g., poultry wastes, fertilizer runoff, and cattle and hog feedlot wastes). Eutrophication during periods of drought or low water levels could create anoxia (low-oxygen) conditions, which may decrease habitat suitability for some fish species. Anoxia conditions could destroy other aquatic communities, such as mollusks, which are unable to escape the bottom of aquatic systems where anoxia conditions are most severe (ODWC 2005b).

Alternatives Analysis

Under Alternative 1 (No Action), fish, wildlife, and migratory bird trends described in **Section 3.5.3**, Fish Wildlife and Migratory Birds, Current Conditions, are likely to continue. This is because no additional COAs on oil and gas development would be implemented. Under Alternative 2 and in high-density sections under Alternative 3, most of the COAs that would apply under Alternative 1 (No Action) would be waived. The cumulative impacts of oil and gas development, in combination with construction and infrastructure projects described in **Table 4-1**, would be greatest under Alternative 2 and in high-density sections under Alternative 3.

Low-density sections and areas where permits for new ground-disturbing activity would not be approved under Alternative 3 would have reduced impacts on fish, wildlife, and migratory birds from habitat disturbance. This is because in these areas, there would be additional COAs on oil and gas development that would generally result in reduced ground disturbance. New ground disturbance from oil and gas development activities in certain sensitive areas would be prevented entirely. Under Alternative 4, cumulative impacts on these species would be further reduced. This is because new ground disturbance from oil and gas development activities would be prevented in additional areas, and COAs would be increased for enhanced protection and standardized across all oil and gas development, rather than limited to those in low-density sections.

4.6 Special Status Species

4.6.1 Methods and Assumptions

Only impacts on federally listed, proposed, or candidate species, or state threatened or endangered species are discussed in this section. Direct impacts on special status species habitat are disruption, potential trampling, direct destruction of special status species, and actions that reduce total numbers of a special status species. Indirect impacts are loss of habitat suitable for colonization due to surface disturbance, introduction of noxious weeds, increased noise, and general loss of habitat due to surface occupancy or surface compaction. Potential indirect impacts are those that cannot be absolutely linked to one action, such as decreased plant health from reduced air or water quality.

Indicators

Indicators of impacts on special status species are as follows:

- Acres of special status species habitat removed temporarily and over the long term
- The likelihood that activities would cause or be likely to cause special status species injury; substantial interference with normal breeding, feeding, or sheltering behavior; or nest abandonment
- Direct impact on a special status plant individual or population
- Elimination of, reduction of, or adverse effects on a unique or rare natural plant community

Assumptions

This analysis is based on the following assumptions:

- The health of a special status species is directly related to the overall health and abundance of their habitat. Special status plant health is also directly related to an abundance of individual plants and the condition and abundance of their habitat. This analysis assesses whether managing oil and gas development under each alternative could lead to the destruction, degradation, or modification of habitat, as well as impacts that could improve wildlife, plant, and aquatic habitat.
- In the event of changes to the listing status of a species included in this EIS, or if new species are listed with habitat in the planning area, consultation with the USFWS will be required to identify appropriate avoidance and minimization measures for these species.
- Under all alternatives, regulations prohibit lessees from locating any well or tank within 200 feet of any established watering place, except with written permission of the Superintendent (25 CFR Section 226.33).

4.6.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. Some impacts would be direct; others would be indirect and would affect special status species and their habitats by changing another resource. Oil and gas development could affect special status species or their habitats through disturbance; direct habitat loss; reduced habitat effectiveness; habitat modification, degradation, and fragmentation; direct mortality; habitat avoidance; and interference with movement patterns. These potential disturbances are directly linked to changes in vegetation conditions and water quality and quantity. Under all alternatives, oil and gas development actions would require infrastructure, including well pads, access roads, pipelines, transmission lines, and others. Construction and operation of this infrastructure would result in direct habitat loss, degradation, and fragmentation; displacement; potential death of individuals; and nest abandonment.

Direct impacts include death caused by collision with or electrocution from power lines, collision with vehicles on access roads, or contact with oil waste ponds and hydraulic fracturing reserve pits, resulting in toxicity from oil and chemical ingestion, potential drowning, cold stress from loss of insulation, and susceptibility to disease. Indirect impacts are behavioral changes, such as avoiding nesting habitat due to noise or traffic, increased predation due to increased infrastructure used as perches for predators, invasive plant spread displacing native habitat, and water quality impairment and exposure to hazardous materials in the event of a spill. Noise and traffic impacts dramatically increase for short periods during exploration and production operations.

Under all alternatives, existing leases would remain valid. Lessees would be required to comply with all applicable laws and regulations, such as the ESA, and to prevent environmental degradation. Section 7 of the ESA (16 USC 1531 et seq.) requires federal agencies, in consultation with the USFWS, to ensure that their actions are not likely to jeopardize the continued existence of any listed species or to result in adverse effects on designated critical habitat of such species.

The ESA also prohibits any action that results in a take of any federally protected plant, fish, or wildlife species. The paragraphs below discuss certain special status species likely to be affected by the alternatives in more detail. There would be no effect on other listed, proposed, or candidate species found in the planning area—northern long-eared bat, red knot, piping plover, Neosho mucket mussel, and interior least tern—under any of the alternatives.

Osage County is on the edge of the range for the northern long-eared bat, and it does not roost in grassland areas, thus it is unlikely to be affected by oil and gas development. As discussed under the assumptions section, a 200-foot setback is required from established watering places. When oil and gas development activities covered under the proposed action occur outside of the 200-foot setback, no impacts on red knot, piping plover, interior least tern, or Neosho mucket mussel are anticipated, due to the distance from suitable habitat. Additionally, the aforementioned avian species do not nest, roost, or reproduce in affected habitat.

American Burying Beetle

Activities associated with oil and gas development are likely to result in take of ABBs and to have adverse effects on their habitat. Death or injury to adults, larvae, or eggs may result from the following:

- Crushing and collision
- Temporary and permanent impacts on breeding, feeding, and sheltering habitat

- Increased habitat fragmentation
- Vegetation community changes

Specific activities expected to result in take of the ABB are human, vehicle, and equipment movement and surface disturbance from construction and installation of well pads, pipelines, access roads, transmission lines, and substations and operation and maintenance. This is due to the beetle's small size and the difficulty of avoiding them when working in habitat areas (USFWS 2014a). For the same reason, human, vehicle, and equipment movement and ground disturbance from construction and installation of well pads, pipelines, and access roads, as well as operation and maintenance, are also expected to result in take of ABB.

Oil and gas development would remove vegetation or alter soil moisture. It also may degrade habitat, reduce habitat connectivity, and cause the loss of breeding, foraging, and sheltering habitat. Additionally, these activities may increase the potential for introducing nonnative, invasive species (USFWS 2014a).

Sprague's Pipit and Whooping Crane

Tallgrass prairies, particularly in northwestern Osage County, provide high-value nesting habitat for Sprague's pipit. These areas also provide migratory stopover habitat for whooping crane. Oil and gas development can result in habitat fragmentation and degradation. Noise and traffic associated with oil and gas development at breeding and nesting grounds could disturb reproduction for prairie-nesting birds, and consequences may include nest abandonment or abandonment of leks, the courtship arenas used by whooping crane (Aldridge and Boyce 2007; Pitman et al. 2005). Whooping crane may also face increased energy expenditures from loss of migratory stopover habitat.

Under all alternatives, lessees would be required to follow guidance in the USFWS Impact Avoidance (USFWS 2014b) for migratory birds and eagles. Following this guidance would reduce the risk of habitat degradation.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

Raptors may nest in large trees, cliffs, and ledges nearby prairie vegetation and could be affected by noise disturbance and traffic associated with oil and gas development. They could lose foraging habitat, although this would likely be minor or temporary. Raptors, including eagles, can be injured or killed by collision or electrocution from overhead power lines, unless these lines have avian-safe features designed to minimize electrocution and collision risk (APLIC 2012).

Requiring lessees to follow the USFWS Impact Avoidance (USFWS 2014b) guidance under all alternatives would reduce the risk of eagle and other raptor deaths from oil and gas development. Under this guidance, lessees would be required to document eagle use and conduct eagle nest surveys in winter prior to any development that would alter potential nest-site habitat, which may include construction of pads, roads, pipelines, and electrical distribution lines. If an area is determined to be used by eagles, then installing power lines would be avoided when possible, flared gas pipes would be fitted with anti-perching devices, existing poles would be marked, and new poles would be designed according to Avian Power Line Interaction Committee guidelines to minimize electrocution risk.

Rattlesnake Master Borer Moth

This candidate species depends on the perennial rattlesnake master, which is a plant native to the tallgrass prairie. The rattlesnake master plant is the sole food source for the moth (USFWS 2013). Removing or destroying this plant as a result of surface disturbance associated with oil and gas development would remove the sole food source for the rattlesnake master borer moth and, thus, could cause mortality or increased energy expenditures as the moth seeks out other rattlesnake master plants.

4.6.3 Alternative 1 – No Action

Applying the COAs under Alternative 1 (No Action) would reduce the extent of habitat disturbance or direct disturbance to special status species from oil and gas development, such as minimizing noise, excessive traffic, and dust, and restricting the discharge of contaminants into waterways. COAs to control noxious weeds and reduce drilling footprints for air quality and cultural resource protection would also indirectly benefit the special status species in the vicinity.

American Burying Beetle

For ABB compliance, the BIA prepared a BA, and the USFWS would issue a BO describing the total amount of acreage in the county where incidental take of ABB can occur. Minimization and mitigation measures from the Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) are proposed in the BA and would be concurred with and accepted in the BO or alternative minimization and mitigation measures would be proposed by the USFWS. Requiring lessees to follow USFWS-established protocol regarding areas where the ABB is known or expected to exist would reduce impacts on the ABB from surface-disturbing activities associated with workovers, cover drilling, or plugging. This would improve the likelihood of survival and reproduction of the species (USFWS 2014a).

Migratory Birds

In addition to the requirement to follow USFWS Impact Avoidance (USFWS 2014b) guidance, described in **Section 4.7.2**, other COAs would protect migratory birds by requiring screening or netting open-top tanks and pits. These measures would help protect prairie-nesting birds from disturbance and death; however, birds would continue to be disturbed by habitat fragmentation and degradation. The whooping crane may face increased energy expenditures from loss of migratory stopover habitat.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

In addition to the requirement to follow USFWS Impact Avoidance (USFWS 2014b) guidance, described in **Section 4.7.2**, under Alternative 1 (No Action), specific COAs would continue to be implemented to minimize surface disturbance, noise, excessive traffic, dust, or other impacts associated with oil and gas operations. These measures would reduce the risk of death caused by collision with vehicles on access roads. They also would reduce the risk of coming in contact with oil waste ponds and hydraulic fracturing reserve pits, which could result in toxicity from oil and chemical ingestion, potential drowning, cold stress from loss of insulation, and susceptibility to disease. Measures to reduce traffic and noise could also reduce nest avoidance.

Rattlesnake Master Borer Moth

No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat under Alternative 1 (No Action); however, COAs 2, 3, 6, and 18 applied under Alternative 1 (No Action) would minimize surface disturbance and vegetation removal and may consequently lessen impacts on the rattlesnake borer moth by preventing removal of the rattlesnake master plant. The rattlesnake master borer moth would continue to be affected by oil and gas development, as described in **Section 4.7.2**.

4.6.4 Alternative 2

Compared with Alternative 1 (No Action), the BIA under Alternative 2 would apply fewer standardized COAs to all oil and gas development; however, COAs 28 and 31 would be applied under Alternative 2, which would reduce impacts on special status species by limiting audible or visual disturbance; this would prevent site avoidance or nest abandonment. Additionally, prohibiting land application of wastewater, waste oil, and contaminated soil would reduce the likelihood of direct mortality from chemical ingestion, potential drowning, cold stress from loss of insulation, and susceptibility to disease. Voluntary measures implemented by lessees could provide additional mitigation from impacts.

American Burying Beetle

Like Alternative 1 (No Action), under Alternative 2, lessees would be required to protect the federally endangered ABB; however, without key BMPs and COAs, the BIA would likely need to revise the BA and reinitiate formal consultation under ESA Section 7 for ABB compliance. Until the USFWS issues the new BO, lessees would be solely responsible for documenting compliance under ESA Section 10. Because ESA compliance would still be required under this alternative, impacts on the ABB would be the same as those described under Alternative 1 (No Action).

Migratory Birds

Impacts of oil and gas development on these species under Alternative 2 would increase, compared with Alternative 1 (No Action); there would be a reduction in COAs, and COAs that are aimed at minimizing noise, disturbance to vegetation, and degradation to wetlands may be waived. Noise and traffic at breeding and nesting grounds would disturb reproduction for prairie-nesting birds. In addition, whooping cranes may face increased energy expenditures from loss of migratory stopover habitat. USFWS Impact Avoidance (USFWS 2014b) guidance, described in **Section 4.7.2**, would mitigate some habitat-degradation impacts.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle
Impacts of oil and gas development on raptors under Alternative 2 would increase, compared with Alternative 1 (No Action). Specific COAs that minimize surface disturbance, noise, excessive traffic, dust, or other impacts associated with oil and gas operations would be waived. USFWS Impact Avoidance (USFWS 2014b) guidance, described in **Section 4.7.2**, would mitigate some impacts by reducing the mortality risk.

Rattlesnake Master Borer Moth
No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat under Alternative 2. The rattlesnake master borer moth would continue to be affected by oil and gas development, as described in **Section 4.7.2**.

4.6.5 Alternative 3

In high-density sections, the BIA would apply the COAs described in Alternative 1 (No Action); thus, protections in high-density sections would be the same as under Alternative 1 (No Action) and greater than those in Alternative 2; however, additional COAs applied under Alternative 3 in low-density sections would make these sections more protective of special status species than Alternatives 1 (No Action) and 2.

Alternative 3 would add more COAs in specific areas, based on information about where sensitive resources need to be protected. The BIA may choose to apply additional COAs to protect resources based on site-specific determinations.

The BIA would also no longer approve permits for ground-disturbing activities in certain sensitive areas, totaling approximately 17 percent of the county. These sensitive areas are important habitats for special status species in the planning area. Species in these areas would be protected from the impacts of new oil and gas development activities.

American Burying Beetle
Like Alternative 1 (No Action), under Alternative 3, lessees would be required to follow the provisions of Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) to protect the ABB. In addition, in low-density sections under Alternative 3, the BIA would apply a buffer around culturally sensitive areas, such as historic sites, sacred sites, and grave sites. These buffers would preserve vegetation and habitat for the ABB and other special status species found in these areas by reducing surface disturbance. Under Alternative 3, new oil and gas-related ground-disturbing activities would not be permitted in 209,100 acres of potential ABB range, including 53,600 acres (11 percent) of conservation priority area (BIA GIS 2017).

Migratory Birds

Under Alternative 3, impacts on these species would be the same in high-density sections as those described under Alternative 1 (No Action). Low-density sections would have specific COAs in place to reduce impacts on waterways, streams, and wetland habitats and covering or netting open-top tanks and pits to reduce bird injury and mortality. Additionally, preventing new oil and gas-related ground disturbance in certain sensitive areas would reduce impacts on habitat in these areas.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

Impacts on these species would be the same in high-density sections as those described under Alternative 1 (No Action). In low-density sections, these species would be less affected, with greater protection than under Alternatives 1 (No Action) and 2. Additionally, preventing new oil and gas-related ground disturbance in certain sensitive areas would reduce impacts on habitat in these areas.

Rattlesnake Master Borer Moth

No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat; however, populations present within sensitive areas and low-density sections would be afforded increased protections. This is because new oil and gas-related surface disturbance would be prevented in certain sensitive areas and COAs would be applied in low-density sections that limit surface disturbance and thus incidentally protect habitat. This would reduce impacts of oil and gas development on rattlesnake master borer moths, compared with Alternative 1 (No Action).

4.6.6 Alternative 4

Impacts of oil and gas development on special status species under Alternative 4 would be less than those under Alternative 1 (No Action); additional COAs applied under Alternative 4 would make this alternative the most protective of special status species. Alternative 4 applies the most protective COAs to the entire planning area. The BIA would also no longer approve permits for ground-disturbing activities in certain areas, totaling approximately 36 percent of the county. Species in these areas would be protected from the impacts of new oil and gas development activities.

All applicable BMPs from the BIA's current standardized lists would be implemented for operations under this alternative, and additional protective measures for sensitive resources would apply. Additional COAs may be applied to development on lands enrolled in federal conservation programs, such as the NRCS Wetlands Reserve Program. If additional COAs were applied in these areas under Alternative 4, it would generally result in reduced impacts on special status species.

American Burying Beetle

Under Alternative 4, the ABB would be provided a high level of protections in the same way as in low-density sections under Alternative 3. For example, the

BIA would apply a buffer around culturally sensitive areas, such as historic sites, sacred sites, and grave sites. These buffers would preserve vegetation and habitat for the ABB and other special status species found in these areas by reducing surface disturbance. As a result, impacts of oil and gas development on the ABB would be reduced, compared with Alternative 1 (No Action). Under Alternative 4, new oil and gas-related ground-disturbing activities would not be permitted in 484,700 acres of potential ABB range, including 141,500 acres (29 percent) of conservation priority area (BIA GIS 2017).

Migratory Birds

Impacts of oil and gas development on these species would be less than those described under Alternative 1 (No Action). In addition to the requirement to follow USFWS Impact Avoidance (USFWS 2014b) guidance for migratory birds and eagles, described in **Section 4.7.2**, COAs would be applied, which would minimize the impacts of oil and gas operations on suitable habitat for these species. Under specific COAs, lessees would not conduct operations that may constitute audible or visual harm to sensitive environmental receptors, which may prevent avoidance or nest abandonment. In addition, COAs prohibiting the land application of wastewater, waste oil, and contaminated soil would likely keep injurious material out of important habitat, such as wetlands. Preventing new oil and gas-related ground disturbance in certain sensitive areas would further reduce impacts on habitat in these areas.

Raptors and Birds of Prey, Including Bald Eagle and Golden Eagle

Impacts on these species would be the same type as those described under Alternative 3 in low-density sections; however, the impacts of oil and gas development would be reduced throughout the planning area under Alternative 4. Additionally, preventing new oil and gas-related ground disturbance in more sensitive areas would reduce impacts on habitat in these areas.

Rattlesnake Master Borer Moth

No COAs would require identifying or avoiding the rattlesnake master plant before disturbing its habitat; however, populations would be afforded the most indirect protections under Alternative 4. Buffer zones around cultural sites and waterways throughout the planning area would preserve some suitable habitat for this species. Additionally, new oil and gas-related ground disturbance would be prevented in more sensitive areas. This would reduce impacts of oil and gas development on rattlesnake master borer moths, compared with Alternative 1 (No Action).

4.6.7 Cumulative Impacts

The cumulative impact analysis area for special status species is the regional habitat range for each species. Past, present, and reasonably foreseeable future actions and conditions within the cumulative impact analysis area that have affected, and will likely continue to affect, special status species are oil and gas development, agricultural conversion, quarries, wind farms, and road, casino, and residential development, as discussed in **Table 4-1**.

Oil and gas leasing and development, in combination with converting tallgrass prairie habitat to agricultural use, is likely to continue to affect ABB and special status bird species that use prairie habitat for nesting, foraging, and protection from predators. As discussed, the ABB's small size makes them difficult to avoid. The proliferation of oil and gas projects across ABB habitat means an indeterminate but potentially vast number of individuals will be taken during project construction.

Under all alternatives, the rattlesnake master borer moth also would cumulatively lose an indeterminate but potentially large number of individuals from loss of its host plant and sole food source, the rattlesnake master plant. Losses would occur during construction of oil and gas and infrastructure projects across the region.

Infrastructure development (e.g., oil and gas pipelines, roads projects, and wind farms) across public and private lands would all contribute to habitat fragmentation for special status prairie birds. Approximately 95 percent of Osage County is already in agricultural use (Osage County 2011); further conversion of native habitats to agriculture would result in permanent habitat loss and fragmentation for special status birds that nest and forage in tallgrass prairie. In areas where infrastructure is highly concentrated or overlaps with oil and gas development, increased predation may result from the proliferation of tall structures that provide vantage for predators. The concentration of disturbances may result in population declines for special status prairie birds.

Alternatives Analysis

Under Alternative 1 (No Action), Alternative 2, and Alternative 3 (high-density sections), trends toward habitat loss, fragmentation, and degradation from agricultural conversion and development for special status species described in **Section 3.7.3** are likely to continue. The cumulative impacts of oil and gas development, agricultural and livestock grazing, and other infrastructure projects would be greatest under Alternatives 2 and 3 (high-density sections). For the ABB, trends of death and injury and habitat loss and fragmentation would continue. Implementing measures from the Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) may reduce, but not eliminate, the effects of oil and gas development on ABB and species that share ABB habitat.

Under Alternatives 3 (low-density sections) and 4, applying additional COAs would reduce impacts on special status species, compared with Alternatives 1 (No Action) and 2. Minimizing soil and vegetation disturbance would help preserve tallgrass prairie habitats for special status species. Preventing new ground disturbance from oil and gas development activities in certain areas under Alternatives 3 and 4 would reduce impacts on special status species compared with Alternatives 1 (No Action) and 2.

Cumulative effects would be minimized under Alternative 4, as this alternative would require additional COAs to reduce and mitigate disturbance throughout the planning area and would prevent new ground disturbance from oil and gas development in the most areas; however, under all alternatives, the habitat fragmentation and disturbance impacts from other development projects in the planning area would continue.

4.7 VEGETATION, WETLANDS, AND NOXIOUS WEEDS

4.7.1 Methods and Assumptions

Indicators

Indicators of impacts on vegetation, wetlands, and noxious weeds are as follows:

Upland Vegetation

- Acres and condition of upland vegetation communities
- Extent of fragmentation of upland vegetation communities

Wetlands

- Acres and condition of wetlands and riparian communities
- Extent of fragmentation of wetlands and riparian communities

Noxious Weeds

- The potential for noxious weed or invasive species introduction or spread
- The potential for increases or decreases in noxious weed or invasive species populations
- Acres of ground-disturbing activities

Assumptions

- Impact intensity would be influenced by multiple factors, including the size and location of a project (i.e., the amount of new surface disturbance proposed and the proximity to undisturbed upland vegetation, wetlands and riparian areas, or noxious weed infestations).
- A formal delineation of wetlands and waters of the US that may be under the jurisdiction of the US Army Corps of Engineers under Section 404 of the CWA has not been completed. Before the project begins, potential jurisdictional areas would be delineated, and any necessary US Army Corps of Engineers permits required for impacts on jurisdictional areas would be obtained.
- Weeds would continue to be introduced and spread as a result of ongoing water flows, wind, and other natural factors; vehicle traffic; recreation activities; and wildlife movements in the planning area.

4.7.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development (see **Section 3.16.3**, Mineral Extraction, Trends, and **Section 4.16.2**).

Temporary and permanent vegetation removal associated with construction, drilling, and workover operations directly impacts vegetation and wetland resources. Vegetation could be removed by surface-disturbing activities, such as constructing new or expanding existing access roads or well pads. Where access roads cross wetlands or riparian areas, vegetation could be removed to facilitate construction. Wetlands could be directly affected by filling, draining, or otherwise altering surface or subsurface hydrology. Where disturbed areas are reclaimed and revegetated, impacts would be temporary, lasting less than 5 years. If disturbed areas are not reclaimed and revegetated, for example where a permanent access road or monitoring well was installed, impacts would be permanent.

Indirect impacts on vegetation and wetland resources could include a change in species composition due to invasive plant or noxious weed establishment or spread. Surface-disturbing activities and increased personnel and vehicle presence would facilitate noxious weed establishment or spread. In reclaimed areas, vegetation composition may shift from forest- or shrub-dominated to herbaceous-dominated communities. Indirect impacts on vegetation and wetland resources may also result from changes in watershed function and condition, including changes in groundwater or surface water availability or increased erosion or siltation from runoff. Wetland vegetation communities may be particularly sensitive to such impacts.

Fugitive dust from roads, drilling, or workover activities could cover existing vegetation, which could affect plant photosynthesis and respiration. Impairment of these functions could lower plant vigor and growth rate and increase a plant's susceptibility to disease (Lewis 2013). There is the potential for accidental grass or brush fire from unauthorized vehicle ingress into vegetated areas during certain seasons, but the potential is generally low.

Under all alternatives, lessees must comply with and obtain any necessary permits or authorizations to comply with federal laws, such as the CWA and the Federal Noxious Weed Act. Only a subset of COAs would apply under all alternatives, and some alternatives would incorporate more COAs than others. These measures may be applied on a case-by-case basis or up front, or a combination of both, depending on the alternative selected. Applying certain COAs would reduce impacts on vegetation and wetlands by reducing surface disturbance, reducing the spread of noxious weeds, and restricting discharge of dredge and fill materials into waterways. The COAs that are applicable to all alternatives are not specific to vegetation; they include COAs that protect the ABB (*Nicrophorus americanus*), protect cultural resources, and require submission of a written request, and the approval thereof, prior to the commencement of ground-disturbing activities or operations that were not specifically addressed and approved by the APD.

Under all alternatives, lessees must comply with the regulations at 25 CFR Part 226, which contains measures to reduce environmental impacts from oil and gas development in Osage County. Regulatory measures, such as limits on well pad size and pit lining standards, would help prevent surface water contamination and habitat destruction, thereby protecting wetlands from degradation and maintaining wetlands condition.

4.7.3 Alternative 1 – No Action

Applying the COAs under Alternative 1 (No Action) would continue to limit the extent of surface disturbance from oil and gas development. For example, surface disturbance would continue to be limited to that described in the approved site-specific EA, and soil and vegetation disturbance must be avoided or minimized. COAs limiting surface disturbance would continue to limit direct and indirect impacts on native vegetation from vegetation removal. Those prohibiting noxious weed use and requiring prompt site reclamation would limit the potential for the spread of noxious weeds. Prohibiting lessees from conducting activities within stream channels or wetlands without proper authorization would continue to protect wetlands and riparian vegetation communities from the impacts of surface disturbance. Requiring lessees to minimize excessive dust to the extent possible would continue to provide some level of protection from dust covering plants and impairing their respiration and photosynthesis.

COAs that protect other resources under Alternative 1 (No Action) would also continue to incidentally protect vegetation. For example, maintaining habitat for the ABB would mean maintaining vegetation.

Culturally important plants (see **Section 3.6**, Vegetation) would be protected by implementing COAs in Alternative 1 (No Action). This would come about because COAs would provide protections for habitats where culturally important plants grow. The COAs under Alternative 1 (No Action) specify review of actions that may affect resources that are traditionally important to the Osage Nation (see **Section 4.18.3**, Trust Assets and Osage Nation); this review should provide additional protection for culturally important plants.

4.7.4 Alternative 2

Alternative 2 would apply fewer standardized COAs to all oil and gas development, including drilling, workover, and other permitted activities. It would generally provide the least amount of protection for wetlands and vegetation and the least prevention of noxious weed spread. As a result, habitat would become more fragmented, compared with Alternative 1 (No Action). Acres of ground-disturbing activity, the potential for erosion and sedimentation into waterways, and the potential for noxious weeds or invasive species introduction and spread would increase. Agreements between surface owners and lessees may provide additional mitigation in some situations.

Alternative 2 applies two COAs that are not included under Alternative 1 (No Action), including a COA that prohibits land application of waste oil, wastewater, and contaminated soil without first submitting a written request and receiving the Superintendent's approval. This COA, although not vegetation specific, would incidentally reduce impacts on vegetation and wetlands by potentially keeping waste materials out of wetlands and vegetated areas, helping to maintain the condition and extent of these areas.

Under Alternative 2, the potential for impacts on culturally important plants would increase, compared with Alternative 1 (No Action). The reduction of COAs under Alternative 2 would cause greater impacts on vegetation and wetlands. It would also result in poorer habitat conditions for culturally important plants (ONENRD 2006).

4.7.5 Alternative 3

Under Alternative 3, the BIA would apply COAs based on the density of well development. This would result in location-specific vegetation, wetland, and noxious weed impacts. More COAs would be applied in low-density sections. This would protect vegetation and wetlands and would reduce the spread of noxious weeds. Additionally, by not approving new ground-disturbing activities in sensitive water supply areas, the BIA would reduce impacts on wetlands and vegetation in these areas.

In addition to the COAs applied under Alternative 1 (No Action), additional COAs applied in low-density sections would include avoiding activities in areas subject to frequent flooding, locating drilling pits at least 200 feet from streams and waterways, avoiding road and pipeline aquatic feature crossings, and stockpiling and reusing topsoil. Applying these COAs would protect vegetation and wetlands from the impacts of surface disturbance and vegetation removal, help to maintain acres and condition of native vegetation communities and wetlands, and reduce the potential for noxious weed introduction and spread.

COA 32 would particularly reduce impacts on wetlands in low-density sections because it states that drilling pits must be located at least 200 feet from streams and waterways, including wetlands. Increasing the area subject to the no-drilling buffer would also help prevent noxious weed spread by reducing surface disturbance, which facilitates noxious weed establishment and spread.

COAs that protect other resources in low-density sections would also incidentally protect vegetation. For example, implementing no-drilling buffers around sensitive cultural sites would also reduce surface disturbance, vegetation removal, and the potential for noxious weed establishment and spread.

In high-density sections under Alternative 3, the same COAs as under Alternative 2 would be applied. Because the same COAs would apply to these areas, impacts on wetlands in high-density sections would be the same as described under Alternative 2.

Regardless of the density of wells, new oil and gas-related ground disturbance would be prevented in and near wetlands and waterbodies in 246,800 acres of sensitive areas under Alternative 3. The reduction in new ground disturbance would help to prevent vegetation fragmentation and would reduce the potential for noxious weed establishment and spread.

In summary, in low-density sections and sensitive areas, impacts from oil and gas development on vegetation under Alternative 3 would be less than under Alternative 1 (No Action). This is because of the application of more COAs that would provide protections and because of prevention of new oil and gas-related surface disturbance in sensitive areas. In high-density sections, impacts on vegetation under Alternative 3 would be greater than under Alternative 1 (No Action) because there would be fewer COAs applied. In high-density sections, impacts on vegetation under Alternative 3 would be as described under Alternative 2 because the same COAs would apply.

Culturally important plants would benefit from the increased COAs in low-density sections as described above, as these COAs offer additional protections to native upland, riparian, and wetland vegetation, which provide habitat for culturally important plants. In high-density sections, impacts on culturally important plants would be as described under Alternative 2 because the same COAs would apply.

4.7.6 Alternative 4

Alternative 4 includes additional COAs that would emphasize resource protection; these COAs would apply to the entire planning area.

Applying COAs under Alternative 4 would protect vegetation and wetlands and prevent the spread of noxious weeds to a greater degree than under Alternative 1 (No Action). By salvaging topsoil for use in site reclamation, revegetation would be hastened by using native seed stock and organic soil components stored in topsoil. By not crossing wetlands with new roads and pipelines, there would be less obstruction to hydrology in the area, thereby maintaining the extent of wetland areas. By not approving new ground-disturbing activities in 524,400 acres of sensitive areas, including sensitive water supply areas, US Army Corps of Engineers lakes, state parks, and others, the BIA would reduce impacts on wetlands and vegetation in these areas.

COAs that protect other resources under Alternative 4 would also incidentally protect vegetation. For example, implementing no-drilling buffers around sensitive cultural sites would also incidentally reduce surface disturbance, vegetation removal, and the potential for noxious weed establishment and spread.

Building on COAs applied under Alternative 1 (No Action) and adding more specific measures that would apply to a broader range of actions and in more areas would offer additional protections to vegetation, including wetlands. This would also prevent noxious weeds, for the reasons described above; therefore, of all the alternatives, Alternative 4 would have the greatest reduction in potential impacts from oil and gas development on vegetation and wetlands, and the greatest reduction in noxious weed establishment and spread.

Alternative 4 would provide the most protection of culturally important plants. Under this alternative, the increase in COAs offers protection of native upland, riparian, and wetland vegetation, including the culturally important plants found in these areas.

4.7.7 Cumulative Impacts

The cumulative impact analysis area for vegetation, wetlands, and noxious weeds is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will continue to affect vegetation, wetlands, and noxious weeds are as follows:

- Oil and gas development activities
- Agriculture and livestock grazing
- Other surface development, such as road and housing development
- Vegetation management plans

Generally, impacts on vegetation from these actions could occur due to loss or modification of vegetation communities, altered species composition and vegetation structure, establishment and spread of noxious weeds, and soil disturbance, including compaction, erosion, topsoil removal, and loss of native seed banks.

Vegetation management plans, including the Osage Nation Environmental and Natural Resources Department IRMP, BIA Eastern Oklahoma Region Fire Plan, and USFWS ABB Conservation Plan, have also affected and will continue to affect vegetation in the planning area. These plans would reduce impacts on vegetation by maintaining acres and condition of vegetation and wetlands and reducing weed establishment and spread through management.

Tallgrass prairie has declined greatly in acreage due to agricultural conversion throughout the region; however, large expanses of this vegetation type still occur in the planning area (Hoagland 2008). Historical use of tallgrass prairie for pasture (Duck and Fletcher 1943; Sampson and Knopf 1994) led to the conversion to exotic pasture grasses and is an ongoing threat to tallgrass prairie in the region. Frequency and extent of fire in these systems has dramatically declined as a result of fire suppression and reduction in fuels due to grazing. This can give rise to changes in the plant community, loss of riparian vegetation, and invasion of native or nonnative species, including eastern red-cedar.

Invasive plants are generally spreading or increasing in density in some parts of the planning area, especially in oil and gas fields; along roadways, transmission lines, and other ROWs; and at the margins of agricultural operations where ground disturbance is concentrated and where increased human activities have increased the number of potential invasive plant introductions (Smith and Knapp 2001). Typically, as ground disturbance increases in areas of weed populations, the likelihood that invasive plants move into the disturbance increases. Linear development, such as transmission lines, pipelines, roads, and fences, in particular, can facilitate long-distance weed dispersal (Sheley et al. 1996; Forest Service 2012).

It is likely that impacts from climate change will affect vegetation in the planning area within the 20-year cumulative impacts planning horizon. Current climate change models are projecting a range of potential shifts in climate, including increasing temperatures and more intense rainfall. This is despite a decrease in average amounts of total annual precipitation (Karl et al. 2009). Altered climatic patterns would likely influence species distribution within vegetation communities in the planning area. This may be particularly true in those communities that are sensitive to impacts from drought or altered fire regimes, or that are susceptible to weed establishment and spread.

Alternatives Analysis

Under Alternative 1 (No Action), vegetation trends described in **Section 3.6.3** are likely to continue. This is because no additional COAs on oil and gas development would be implemented. Under Alternative 2 and in high-density sections under Alternative 3, most of the COAs that would apply under Alternative 1 (No Action) would be waived. The cumulative impacts of oil and gas development, in combination with construction and infrastructure projects described in **Table 4-1**, would be greatest under Alternative 2 and in high-density sections under Alternative 3.

Low-density sections and areas where new ground disturbance from oil and gas development would be prevented under Alternative 3 would have reduced impacts on vegetation and wetlands from removal and fragmentation and reduced potential for noxious weed establishment and spread. This is because in these areas, there would be additional COAs on oil and gas development that would generally result in reduced ground disturbance and improved revegetation of temporarily disturbed areas. Under Alternative 4, cumulative impacts on vegetation and wetlands would be further reduced. This is because COAs would be increased for enhanced protection and standardized across all oil and gas development, rather than limited to those in low-density sections. Additionally, new ground disturbance from oil and gas development would be prevented in the most areas under this alternative.

4.8 AGRICULTURE

4.8.1 Methods and Assumptions

Indicators

The indicator of impacts on agriculture is temporary and permanent reductions in farmland acres in the planning area.

Assumptions

Impacts on agriculture and farmlands were evaluated based on potential surface disturbance. Because this is a programmatic EIS, it is not possible to know the exact location of specific oil and gas development projects.

4.8.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. Typical oil and gas operations do not necessarily irreversibly convert farmland to other uses; however, surface-disturbing activities, such as construction of well pads, access roads, and reserve pits, can affect soil properties, increase erosion, and reduce water infiltration. Any of these would affect the characteristics unique to prime or unique farmlands during use, and permanently if the land is not reclaimed for agricultural use. Oil and gas development can also reduce forage and pasture for livestock. Livestock may be injured or killed if they are allowed to access equipment and facilities associated with oil and gas development.

Under all alternatives, lessees must comply with and obtain any necessary permits or authorizations to comply with federal laws. The BIA would review oil and gas development for consistency with the Farmland Protection Policy Act (7 USC 4201 through 4209) and the American Indian Agricultural Resource Management Act (25 USC Chapter 39) to avoid the loss or degradation of agricultural lands. No operations of any kind may commence until the lessee meets with the surface owner to discuss well siting, routes of ingress/egress, and the procedure for settlement of surface damages. Surface owners can make claims for damage to growing crops and surface improvements, among other things. The Farmland Protection Policy Act does not authorize the federal government to regulate the use of private or nonfederal land or, in any way, affect the property rights of owners.

Farmlands can be disturbed by topsoil excavation and soils compaction associated with oil and gas development. Stockpiling the soil horizons separately and spreading them across the site in their original order during reclamation could reduce this damage. Surface owners can work with lessees to minimize damage to prime or unique farmland or any unnecessary and irreversible conversion of farmland to nonagricultural uses. These measures may be applied voluntarily on a case-by-case basis or as part of a COA depending on the alternative selected. Other COAs limiting ground disturbance that apply to all of the alternatives could result in incidental protection of farmlands if surface disturbance were reduced.

4.8.3 Alternative 1 - No Action

Applying the COAs under Alternative 1 (No Action) would continue to limit short- and long-term impacts on farmland. Agricultural uses would continue to benefit from requiring the prompt interim reclamation (no later than 90 days after drilling rig removal) of surface disturbance around producing wells or the final complete reclamation of well sites and surrounding areas no longer in production. Benefits would come from ensuring these areas are returned to their original state as soon as possible. Confining vehicles to existing and new roads would decrease off-road vehicle traffic. This, in turn, could decrease disturbance of agricultural lands. Enclosing production equipment, facilities, and tanks to exclude livestock would reduce the risk of injury or mortality.

4.8.4 Alternative 2

Compared with Alternative 1 (No Action), Alternative 2 would apply fewer COAs to all oil and gas development, including drilling, workover, and other permitted activities. Many of the COAs under Alternative 1 (No Action) would not apply under this alternative. These are the COAs that minimize surface disturbance, require erosion control, minimize alterations to the natural topography, require restoring vegetation, and require reclaiming land promptly. If topsoil excavation and soils compaction were to increase as a result, disturbance of farmland, described in **Section 4.8.2**, would increase, compared with Alternative 1 (No Action). Standard fencing for excluding livestock from production areas would not be a COA, but the lessees would be responsible for determining the need for and sufficiency of fencing to avoid the risk of livestock injury or mortality. The potential for impacts on livestock and disturbance of range from fencing would likely be the same as under Alternative 1 (No Action). Agreements between surface owners and lessees may provide additional mitigation in some situations.

4.8.5 Alternative 3

Under this alternative, additional COAs would be applied in low-density sections, which could protect farm and pastureland from conversion and other impacts. Most prime farmland in the planning area is in low-density sections, where impacts of oil and gas development would be reduced under this alternative.

Farmland within high- and low-density sections is shown in **Table 4-6**, Distribution of Prime Farmland in High- and Low-Density Sections, below. Prime farmland is more likely to be converted or disturbed in high-density sections because fewer protective COAs limiting surface disturbance would be applied, existing oil and gas development is more highly concentrated, and additional oil and gas development would be expected because these areas are where oil and gas potential is highest. There would likely be more fragmentation of productive land and pasture.

Table 4-6
Distribution of Prime Farmland in High- and Low-Density Sections

Farmland Classification	Acres in High-Density Wellbore Sections	Acres in Low-Density Wellbore Sections
Prime Farmland	95,000	287,400
Not Prime Farmland	298,100	793,900
Total	**393,200**	**1,081,300**

Sources: NRCS GIS 2015; BIA GIS 2017

Additionally, prime farmland in sensitive areas where permits for new ground-disturbing activities would not be approved would be protected from impacts of disturbance. Acres of farmland that would be within these sensitive areas are shown in **Table 4-7**, Distribution of Prime Farmland in Sensitive Areas, below.

Table 4-7
Distribution of Prime Farmland in Sensitive Areas

Farmland Classification	Acres in Designated Sensitive Areas – Alt 3	Acres in Designated Sensitive Areas – Alt 4
Prime Farmland	62,900	124,300
Not Prime Farmland	183,900	400,100
Total	**246,800**	**524,400**

Sources: NRCS GIS 2015; OWQS GIS 2017; OK DEQ GIS 2017

In low-density sections and sensitive areas, impacts from oil and gas development on farmland and agricultural uses would likely be less than under Alternative 1 (No Action) because of the application of COAs that would incidentally reduce impacts and prevention of new oil and gas-related surface disturbance. In high-density sections, impacts on farmland and agricultural uses would be greater than under Alternative 1 (No Action) because there would be less COAs applied that would reduce impacts.

4.8.6 Alternative 4

With some exceptions, the COAs that would minimize impacts on farmland and agricultural uses would be similar under Alternative 4 as under Alternative 1 (No Action); therefore, the effects on these uses due to surface disturbance and livestock interaction would be similar to those described under Alternative 1 (No Action). Preventing new ground disturbance in certain sensitive areas would protect farmland in those areas, as shown in **Table 4-7**. Buffers applied as COAs for protection of cultural sites could further reduce ground disturbance, farmland conversion, and impacts on agricultural uses, compared with Alternative 1 (No Action). Stockpiling topsoil would also reduce long-term conversion of farmland.

4.8.7 Cumulative Impacts

The cumulative impact analysis area for agriculture is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect agriculture are projects that disturb farmland acres or soils.

Past and present oil and gas development have disturbed the surface, resulting in land and pasture that may have been converted from agricultural use. Land development, infrastructure projects, and market forces have also reduced the land dedicated to agriculture in the planning area. The proposed projects that may further reduce agricultural lands in the planning area include wind farms, transportation routes, road and bridge improvements, and fire management plans, where these projects cross or are next to agricultural lands. These actions, in addition to the continued oil and gas development proposed under all alternatives, would cumulatively affect farmland and agricultural uses in the planning area.

Currently, the BIA administers 24 agricultural leases, and 309 grazing leases covering 71,632 acres. These surface leases do not prevent oil and gas leasing, and a portion of these agricultural lands may be converted to other uses if developed.

Alternatives Analysis

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. This would increase the amount of surface disturbance on the landscape and may conflict with agricultural uses. Impacts on agriculture from oil and gas development in the planning area under Alternative 1 (No Action) would likely continue, as described in **Section 3.8.3**. This is because no additional COAs on oil and gas development would be implemented.

Under Alternative 2 and in high-density sections under Alternative 3, some of the COAs that would apply under Alternative 1 (No Action) would be waived. The cumulative impacts of oil and gas development, in combination with construction and infrastructure projects, described in **Table 4-1**, on farmland and agricultural uses would be greatest under Alternative 2.

In low-density sections under Alternative 3 and in all areas under Alternative 4, additional COAs that reduce surface disturbance and improve reclamation would slightly reduce impacts on farmland and agricultural uses, compared with the Alternative 1 (No Action); however, the impacts from infrastructure projects described in **Table 4-1**, which are outside of the scope of this EIS, would be the same. Preventing new oil and gas-related ground disturbance in certain sensitive areas under Alternatives 3 and 4 would reduce surface disturbance and impacts on farmland compared with Alternative 1 (No Action). Cumulative effects would likely be least under Alternative 4. This is because it would implement the most restrictive COAs and prevent new oil and gas-related ground disturbance in the largest area to minimize impacts on farmland and agricultural uses from oil and gas development across the planning area.

4.9 CULTURAL RESOURCES

4.9.1 Methods and Assumptions

Indicators

The primary impact indicator for cultural resources is the damage, intentional or otherwise, resulting in a loss of significance, integrity, or both, to historic properties or sacred sites important to Tribes, as considered under NHPA, American Indian Religious Freedom Act, or EO 13007.

The integrity of cultural resources is assessed by the ability of the cultural, archaeological, or historic property to convey the important traditional, scientific, and public values for which it is determined to be significant.

Specific indicators relevant to the approval of drilling, workover, and other permitted oil and gas development within the planning are as follows:

- Extent and relative depth of ground-disturbing activities or extent to which an action approves the removal of existing structural features and their potential to affect known or unknown intact cultural resources or areas of importance to traditional communities
- Increased access to or activity in areas where resources are present or are anticipated
- Extent that an action changes the potential for erosion or other natural process that could affect cultural resources
- Extent that the action alters the visual or aural setting of cultural resources, culturally significant landscapes, or Traditional Cultural Properties and any other sensitive sites identified by Tribes

Assumptions

- Leasing is an administrative process and would not directly affect cultural resources. Subsequent completion of the NHPA Section 106 process, NEPA analysis, and permit approval would be required on a project-specific basis before the ground is disturbed or other actions take place that could affect cultural resources.
- National Register of Historic Places-eligible cultural resources and locations important to contemporary Tribal communities would be avoided whenever possible when considering APDs and other actions.

4.9.2 Impacts Common to All Alternatives

Resolving adverse effects through the NHPA Section 106 process would mitigate any significant impacts under NEPA. The infrastructure and access roads remaining in place for operations and maintenance could lead to indirect impacts on cultural resources from increased access, trespass, vandalism, erosion, and changes to the setting.

The BIA Superintendent will ensure that cultural surveys are performed and clearances obtained, in accordance with the NHPA, before approving new ground-disturbing activities in Osage County.

All cultural resource surveys must be conducted and meet the SOI standards for qualified personnel, methods, and reporting. The surveys also must be conducted and meet the standards outlined in the Osage Nation Historic Preservation Office, NHPA Section 106 Consultation Procedures, and Osage Nation Historic Preservation Office Archaeological Survey.

The cultural resource survey must be submitted to the THPO and interested Tribes for review, comment, and concurrence with findings. Compliance with the NHPA is mandatory for all current and future operations and, therefore, is applicable to all four alternatives. Accordingly, regardless of the alternative selected, the impact on cultural resources would remain relatively unchanged except under Alternative 3 low-density sections.

Under current management, the Superintendent consults with the THPO, SHPO, and Oklahoma Archeological Survey regarding cultural resources identification and protection. If a cultural resource survey for a new project indicates the presence of cultural sites or artifacts, the THPO recommends buffers that should be imposed to protect the resources. The cultural buffers applicable to Alternatives 3 and 4 were developed in coordination with the THPO and are consistent with the buffers currently imposed. Although no specific cultural buffers are listed under Alternative 2, lessees would still be required to coordinate with the Superintendent to ensure NHPA compliance.

4.9.3 Alternative 1 – No Action

Applying the COAs under Alternative 1 (No Action) would continue to reduce potential impacts on cultural resources within the planning area through avoidance, minimization of surface disturbance, implementation of discovery procedures, and completion of the NHPA Section 106 process. Additional COAs and conservation measures could be imposed, when necessary, to ensure the protection of cultural resources.

4.9.4 Alternative 2

Many of the COAs applied under Alternative 1 (No Action) that minimize surface disturbance, require erosion control, minimize alterations to the natural topography, require restoring vegetation, and require reclaiming land promptly, would not apply under Alternative 2; however, the standard NHPA Section 106 process is still required, and additional COAs and conservation measures could be imposed, when necessary, to ensure the protection of cultural resources. Resolving adverse effects through the NHPA Section 106 process would mitigate any significant impacts under this alternative.

4.9.5 Alternative 3

Under Alternative 3, the BIA would apply COAs based on the density of well development. Less COAs would be applied to high-density sections, where development has been concentrated historically. More COAs would be applied in low-density sections, which could reduce the potential for impacts on cultural resources in those areas and possibly preserve the settings of cultural resources therein.

For low-density sections, Alternative 3 would include proactive guidance on minimum expected no-drilling buffer zones for particular site types to assist in development and access road planning. These buffers would be applied based on the results of the preconstruction survey. The buffer sizes would vary based on site type and may be adjusted as necessary, based on site-specific conditions. Siting in the vicinity of cultural resources would still be subject to site-specific review and approval. Applying these additional conservation measures in low-density sections would have a beneficial impact on cultural resources by providing more predictable guidance and standards for siting facilities and avoiding impacts on cultural resources.

In low-density sections, potential impacts from oil and gas development on cultural resources would likely be less than under Alternative 1 (No Action) because of the application of COAs that would incidentally reduce impact potential. Similar to Alternative 2, in high-density sections, potential impacts on cultural resources would be greater than under Alternative 1 (No Action). This is because there would be fewer COAs applied that would reduce impacts. While less COAs apply in high-density sections of the planning area, compliance with the NHPA Section 106 process is still required. In both high- and low-density sections, additional COAs and conservation measures could be imposed, when necessary, to ensure the protection of cultural resources. Resolving adverse effects through the NHPA Section 106 process would mitigate any significant impacts, under this alternative.

The BIA would also no longer approve permits for oil and gas-related ground-disturbing activities in certain areas, totaling approximately 17 percent of the county. Cultural resources in these areas would be protected from the impacts of new oil and gas development activities.

4.9.6 Alternative 4

With some exceptions, the COAs that would reduce the potential for impacts on cultural resources would be the same under Alternative 4 as described for Alternative 1 (No Action); therefore, effects on cultural resources due to surface disturbance would be similar to those described for Alternative 1 (No Action).

Alternative 4 would include proactive guidance on minimum expected no-drilling buffer zones for particular site types to assist in development and access road planning. These buffers would be applied based on the results of the preconstruction survey. The buffer sizes would vary based on site type and may be adjusted as necessary based on site-specific conditions. Siting in the vicinity of cultural resources would still be subject to site-specific review and approval.

The BIA would also no longer approve new permits for oil and gas-related ground-disturbing activities in certain areas, totaling approximately 36 percent of the county. Cultural resources in these areas would be protected from the impacts of new oil and gas development activities.

Applying these additional conservation measures would have a beneficial impact on cultural resources by providing more predictable guidance and standards for siting facilities and avoiding impacts on cultural resources. Additional COAs and conservation measures could be imposed, when necessary, to ensure the protection of cultural resources. Resolving adverse effects through the NHPA Section 106 process would mitigate any significant impacts under this alternative.

4.9.7 Cumulative Impacts

The cumulative impact analysis area for historical, cultural, and archaeological resources is primarily the planning area. Consideration is also given to the following:

- Historic trails that pass through Osage County, when those trails have not been well documented as linear cultural resources
- Actions outside the planning area that may alter the visual, atmospheric, and noise setting of cultural resources, culturally significant landscapes, and traditional cultural properties

Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect historical, cultural, and archaeological resources are as follows:

- Oil and gas development
- Wind energy development
- Infrastructure development
- Commercial and residential development
- Agricultural and ranching uses
- Solid minerals and other minerals material development

These actions and trends can affect historical, cultural, and archaeological resources through ground and physical disturbance; noise, atmospheric, or visual setting disturbance; natural processes, such as erosion and weathering; historic structure abandonment or alteration; and increased access, vandalism, and unauthorized collection.

Cumulative actions that are subject to further review under NEPA, the NHPA, and other laws, statutes, and regulations would require consideration of the effects on historical, cultural, and archaeological resources. Adverse effects would be resolved by modifying the undertaking to avoid, minimize, or mitigate the adverse effects on historical, cultural, or archaeological resources.

Impacts would be avoided or mitigated in many of the actions. Mitigation could provide additional information for scientific study but could preclude other resource management options.

Alternatives Analysis

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. This would increase the amount of surface disturbance and other activities with the potential for affecting cultural resources. Potential impacts on cultural resources from oil and gas development in the planning area under Alternative 1 (No Action) would likely continue, as described in **Section 3.9.3**. This is because no additional COAs would be implemented.

Under Alternative 2 and in high-density sections under Alternative 3, some of the COAs that would apply under Alternative 1 (No Action) would be waived. The cumulative impacts on cultural resources of oil and gas development, in combination with the construction and infrastructure projects described in **Table 4-1**, would be greatest under Alternative 2 and in high-density sections under Alternative 3. However, compliance with the NHPA Section 106 process is required under both alternatives. The NHPA Section 106 process would identify and ensure the avoidance, minimization, or mitigation of adverse effects on eligible resources. Accordingly, the impacts on cultural resources would not be "significant" under NEPA.

In low-density sections under Alternative 3 and in all areas under Alternative 4, additional COAs that limit surface disturbance would reduce the potential for impacts on cultural resources, compared with Alternative 1 (No Action). Both Alternative 3 (low-density sections) and Alternative 4 would include proactive guidance on minimum expected no-drilling buffer zones for particular site types to assist in development and access road planning; however, the impacts from infrastructure projects described in **Table 4-1**, which are outside of the scope of this EIS, would be the same. Preventing new oil and gas-related ground disturbance in certain sensitive areas under Alternatives 3 and 4 would reduce potential damage to undiscovered cultural resources compared with Alternative 1 (No Action).

Cumulative effects would likely be least under Alternative 4. This is because it would implement the most restrictive COAs and prevent the most new oil and gas-related ground disturbance to minimize impacts on cultural resources from oil and gas development across the planning area.

Cumulatively, there is the potential for incremental loss of the regional resource base, inadvertent impacts from access and activities near cultural resources, vandalism, and impacts from actions not subject to NHPA Section 106 review.

4.10 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

4.10.1 Methods and Assumptions

Indicators

Socioeconomics

Indicators of impacts on socioeconomics are as follows:

- Local area employment levels
- County population
- Local government fiscal conditions
- Local area community services
- Quality of life factors, including air and water quality, traffic, and social environment

Environmental Justice

If impacts were to occur in any resource area and these were to disproportionately affect minority or low-income populations, there could be an environmental justice impact.

Assumptions

- The rate of taxes, formulas for calculating oil and gas royalties, and distribution of oil and gas revenue would remain unchanged.
- Based on Osage RFD (**Appendix A**) estimates, approximately 3,208 oil wells and 1,369 gas wells for a total of 4,557 producing wells could be drilled in Osage County between 2018 and 2037. Projected development would be reduced under Alternatives 3 and 4, as described in **Section 4.16**, Mineral Development.
- Oil and gas production would be affected by conditions outside the scope of this EIS, including geology, market price, and state and local regulations.
- While information is provided for Osage County, total economic impacts, including direct and indirect employment, income, and total value added, likely extends beyond this geographic area.
- This analysis includes general information on direct and indirect impacts on jobs and income in the oil and gas industry. Due to the level of uncertainty of impacts on production levels from proposed

actions, no quantitative modeling of impacts by alternative was included.

- Recent studies of economic impacts from the oil and gas industry in Oklahoma were used to provide estimates for standard well economic outputs and economic multipliers (i.e., the factor by which the original jobs or spending in the oil and gas industry results in additional jobs gained or money spent in the economy). Economic multipliers vary, depending on such factors as the location of jobs and the technology used (see, for example, Snead and Barta 2008, PWC 2011, and Region Track 2017).

4.10.2 Impacts Common to All Alternatives

Socioeconomics

The Osage RFD (**Appendix A**) projections indicate approximately 100 oil well spuds per year in 2018 with a steady annual increase over the planning period. For gas wells, year 2018 levels for well spuds are approximately 50 per year with moderate annual increases over the planning period. The actual number of wells drilled and active wells would vary at a given time based on market conditions and site-specific resource availability and constraints. Maximum projected development levels could represent a nearly 11 percent increase in the number of oil wells and 41 percent increase in the number of gas wells by the end of the 20-year planning period.

Oil and gas development result in capital costs, which contribute directly to the local economy in terms of temporary construction jobs and equipment and materials costs. Estimates for the development phase of a representative oil and gas well in Oklahoma are from $6.98 million to $9.85 million in direct economic output in Oklahoma. Approximately 11.7 to 16.6 jobs would be created over a year during the construction period, generating between $979,143 and $1,381,522 in direct labor income (Region Track 2017); however, there is considerable cost variability between individual wells depending on well depth, the number of wells per pad, technology employed, and other factors.

A portion of this spending and employment would occur in the local area, while a portion would result in spending in the wider region. The specific level of local contributions has not been determined. Based on data as presented in **Table 3-29**, Employment by Industry, there were approximately 776 jobs in the minerals and energy sector in Osage County in 2011 to 2015. Additionally, there were 662 jobs in the construction industry, of which a portion were likely to include minerals- and energy-related construction.

It is likely that a portion of employment generated by the anticipated level of drilling would be filled by those currently in the minerals and energy sector, as well as those currently unemployed and energy sector employees in neighboring counties. The specific timing of development, market for energy products, and technology employed determine the level of increase of employment in the energy and construction sectors at a given time.

As noted in the assumptions (**Section 4.10.1**), spending and employment in the oil and gas industry results in additional economic contributions. These include indirect spending (changes in materials and supplies in other industries as the result of the proposed action) and induced impacts (increased household spending as labor income increases). Indirect and induced impacts for a representative oil and gas well were estimated at $3.57 million to $5.04 million per well in economic output, 25.0 to 53.5 additional jobs, and $1.11 million to $1.57 million in additional labor income (Snead and Barta 2008; PWC 2011; Region Track 2017).

The level at which proposed activities would affect overall area population, as well as related demands on public services, including police services, local schools, and utilities, would depend on the timing of development and the degree to which employment demands could be met by the regional workforce. As a gradual increase in development is anticipated in Osage County, it is likely that any additional strain on housing and community services would be minimized.

There is some indication that temporary workers favor long-term hotels and may drive the construction of these facilities in areas with sustained drilling activity. In Osage County, previous drilling and pipeline construction activity resulted in increased demand for additional RV facilities. Counties can also rely on the housing stock of neighboring counties to make up for any lack in housing availability when commuting is feasible. For Osage County, the Tulsa metropolitan area represents a population within commuting distance that may provide employees, housing, and services. Commuting data indicate that there is a higher level of the Osage residents who work in neighboring counties than residents from neighboring counties who commute into Osage County for work (Bureau of Economic Analysis as reported in Headwaters Economics 2017).

While proposed COAs may affect operations, they are not expected to result in development becoming economically unfeasible. Application of the COAs is therefore not anticipated to have a significant impact on the level of oil and gas development in the county under any of the four alternatives analyzed. Further, the BIA Osage Agency Superintendent may approve a modification or waiver of a COA, so long as such modification or waiver does not violate applicable laws and regulations.

Analysis by alternative, below, examines the potential impacts on timing and siting of development and related social and economic impacts. Because the BIA would not approve permits for new ground-disturbing oil and gas development activities in certain sensitive areas of Osage County under Alternatives 3 and 4, production would likely be reduced under these alternatives compared with Alternative 1 (No Action).

As discussed in the Osage RFD (**Appendix A**), production is reported by lease rather than by well in Osage County, making it impractical to generate well-specific production estimates and economic output. Based on the best available data from 2017, annual production resulted in approximately 3.2 million barrels of oil and 4.8 million cubic feet of natural gas. Based on projected well development levels, production would increase over the planning period as additional wells are constructed, particularly for natural gas. As represented by historical data, however, actual production is highly variable and would be determined by multiple factors, including, but not limited to, the timing of the development of wells, well success rate, number of active wells at a given time, technology employed, and oil and gas market conditions (**Appendix A**). Production levels and prices in turn affect the level of taxes and royalties collected and distributed. Under all alternatives, production would continue, and royalties would be distributed to headright owners (see **Section 4.18**, Trust Assets and Osage Nation Interests).

Construction associated with oil and gas development has the potential to result in short-term impacts on local residents' quality of life due to increased potential for erosion, dust, traffic, and noise. Long-term impacts on local air, water quantity and quality, and visual setting also may occur. The level of impacts would be affected by the location of development, mitigation measures employed, and drilling technology. Impacts are detailed in **Sections 4.3**, Water Resources; **4.4**, Air Quality and Climate; **4.11**, Public Health and Safety; and **4.13**, Noise.

In addition, disposal of produced water in underground injection wells has been linked with increased seismicity in Osage County. Under all alternatives, new wells are projected to increase, which is anticipated to increase the amount of wastewater requiring disposal (see **Section 4.2**). Property value has the potential to be affected by induced seismicity in high-risk areas (for example, see Metz et al 2017).

Hydraulic fracturing may represent unique impacts on local communities' quality of life through impacts on water quantity and quality (see **Section 4.3**). As discussed in the Osage RFD (**Appendix A**), the majority of new wells during the life of this EIS are anticipated to be conventional wells, drilled and completed without the use of hydraulic fracturing.

Oil and gas development may conflict with other land uses, including agriculture, timber, and wind development. The degree to which conflict may occur depends on the degree of surface disturbance and would vary by alternative. Conflicts with other land uses could reduce the economic contributions from these resources.

Under all alternatives, oil and gas development may affect nonmarket values in the planning area. Nonmarket values are the benefits derived by society from the uses or experiences that are not dispensed through markets and do not require payment. This can include the preservation of scenic views, plant and animal habitat, clean air and water, and important cultural sites for use and enjoyment by future generations.

As detailed in other resource sections, oil and gas development could alter viewscapes and affect wildlife habitat, air, and water. This may result in changes to the associated nonmarket values and social setting.

Environmental Justice

Environmental justice was analyzed at the county and census tract level, as detailed in **Section 3.10.1**. The population in Osage County identified as minority was within 5 percentage points of the state of Oklahoma population. The American Indian population in Osage County, however, was 15.1 percent, compared with 7.3 percent for the state of Oklahoma; therefore, this population is further examined for environmental justice impacts.

As detailed in **Section 3.10.1**, for all measures of poverty level examined, Osage County was similar to the state reference population; therefore, no low-income populations were identified for further consideration.

As noted in **Section 3.10.1**, Osage County contained a slightly higher level of those over the age of 65 than the state average. As a result, actions that affect social services for the older population could have a slightly higher degree of impacts in the planning area. Under all alternatives, proposed project activities are anticipated to result in only minimal change to the area population, so social services for all groups would not be affected (Headwaters Economics 2017).

In summary, although Osage County as a whole does not meet the standard CEQ definition for low-income or minority populations, Tribal populations in the area may represent those at differential risk for impacts. The planning area represents the cultural seat of the Osage Nation, so any activities have the potential to affect this Tribe. In addition, as noted in **Section 3.10.1**, when the population was examined at the census tracts level, two tracts with minority populations per CEQ guidelines were identified. As detailed in **Chapter 2**, further site-specific analysis would be required at the APD phase; such analysis would examine site-specific impacts on low-income population, minority populations, or Tribal groups.

4.10.3 Alternative 1 – No Action

Socioeconomics

Applying the COAs under Alternative 1 (No Action) would potentially restrict siting of oil and gas development location and operations in the planning area. However, all of the COAs under Alternative 1 (No Action) are currently applied in the planning area. Accordingly, while these COAs may inform the location and timing of development, they have not made, and are not expected to make, development within the planning area uneconomical. Economic contributions from development and production would continue at current rates or increase or decrease depending on market conditions.

Application of these COAs could minimize impacts from development on quality of life factors for area residents by reducing the likelihood of erosion and water contamination and requiring site reclamation, as discussed in **Section 4.10.2** and other relevant resource sections. Reducing disturbance from new development could also minimize impacts on other land uses (e.g., agriculture; see **Section 4.8**) and their economic contributions. Minimizing impacts on other resources, such as special status species, from new development could also help preserve these resources, thus minimizing impacts on nonmarket values, as discussed in **Section 4.10.2**.

The degree to which other land uses such as agriculture, and the jobs and income associated with these uses, would be affected by oil and gas development would differ from project to project based on the site-specific application of COAs. The extent of impacts cannot be known until a site-specific NEPA analysis is conducted on the specific measures to be applied at the project level. As discussed under **Section 4.10.2**, the level of production and economic output would also be affected by factors outside the scope of this EIS, such as market conditions.

Environmental Justice

Continued oil and gas development could benefit all populations, including identified minority and Tribal populations, by creating job opportunities and stimulating local economic growth. Royalties would continue to be paid out to headright owners, primarily Tribal citizens; however, disturbance from construction activities could have continued adverse effects on specific traditional Tribal lifeways and religious and cultural sites due to the presence of Tribal populations in the planning area.

Development could also affect the use of sites for traditional Tribal activities, such as traditional holidays observed at Tribal villages. Impacts on cultural sites would be minimized by COAs that limit surface disturbance, as well as Section 106 of the NHPA consultation requirements. Project activities would not result in disproportionate adverse impacts on identified minority or Tribal populations. Additional site-specific NEPA analysis, including evaluation of environmental justice impacts, would be required at the APD stage.

4.10.4 Alternative 2

Socioeconomics

Under Alternative 2, management actions would emphasize oil and gas development to a greater extent than under Alternative 1 (No Action), minimizing or waiving most COAs for drilling, workover, and other permitted activities. By requiring compliance with applicable laws and regulations without prescribing specific actions lessees must take in order to comply therewith, lessees would have a greater degree of flexibility in how to comply, compared with Alternative 1 (No Action).

This alternative may also result in an increase in the lessee's liability and operating costs. While the waiver of COAs provides greater flexibility in operations, if the actions a lessee takes to comply with applicable laws and regulations are judged to be inadequate, they may be subject to fines, penalties, and the costs associated with the necessary corrective action. With the absence of required COAs, ESA Section 7 compliance would be reinitiated, and lessees would be required to utilize ESA Section 10 until the BO is finalized. This process would likely result in increased costs for ESA compliance and/or a delay in the resumption of drilling until the new BO is issued.

In addition, with reduced standard protection measures, impacts on quality of life and on other land uses, as discussed in **Section 4.10.2**, would likely be increased. The actual level of development and production and related economic effects would continue to be affected by oil and gas market conditions.

Environmental Justice

Compared with Alternative 1 (No Action), there is potential for increased economic output to all populations under Alternative 2, due to the increased flexibility in complying with regulations. Potential impacts from construction activities and to quality of life, including impacts on Tribal populations as discussed under Alternative 1 (No Action), may be increased under Alternative 2. Because impacts would be spread throughout the planning area and the region, proposed oil and gas development is not anticipated to result in disproportionate adverse impacts on identified minority or Tribal populations.

4.10.5 Alternative 3

Socioeconomics

In high-density sections, the BIA would apply the same COAs described under Alternative 2, resulting in few guidelines on siting and timing of development, with the same impacts as described under Alternative 2. Under Alternative 3, however, new oil and gas-related ground disturbance would not be permitted on approximately 169,000 acres or 17 percent of the high potential area, which would reduce the number of new wells in the planning area by roughly 16 percent.

In low-density sections, the BIA would apply additional protective COAs. As a result, in these areas, the impacts of constraints on siting and timing of development may be increased, compared with Alternative 1 (No Action).

In certain areas, including municipalities, sensitive water supply areas, wellhead protection areas, and special source groundwater areas, the BIA would not approve new drilling permits. As a result, the overall number of new wells would be reduced.

Alternative 3 would likely result in preferential development in high-density sections. The potential concentration of development in these areas would concentrate impacts on soil, air, water, noise, and visual resources, as discussed under **Section 4.10.2**. This could reduce the overall impacts on other land uses, nonmarket values, and quality of life factors.

Environmental Justice

Additional COAs for low-density sections and preventing new oil and gas-related surface disturbance in certain sensitive areas could reduce construction impacts for populations in these portions of the planning area. They could also reduce impacts overall on any important Tribal uses or cultural sites, compared with Alternative 1 (No Action).

It is likely that development would shift to the high-density sections of the planning area, and economic contributions would be retained for all populations. Potential impacts may be more likely to occur in census tracts within high-density sections. Of the census tracts identified with minority populations, 42 percent of census tract 9400.2 and 55 percent of census tract 9400.6 are within high-density sections. Impacts would be more likely to occur to the minority populations in these areas.

4.10.6 Alternative 4

Socioeconomics

The enhanced resource protection associated with Alternative 4 may result in limitations on development location and additional reclamation requirements. Under Alternative 4, the BIA would not approve new drilling permits in certain areas, including Tallgrass Prairie Preserve, state parks, state WMAs US Army Corps of Engineers lakes, BLM wild horse and burrow pasture facilities, municipalities, sensitive water supply areas, wellhead protection areas, and special source groundwater areas. New oil and gas-related ground-disturbing activities would not be permitted on approximately 352,000 acres, or 36 percent, of high potential area, which is expected to reduce the number of new wells in the planning area by approximately 35 percent. Actual levels of development and production and related economic effects would continue to be affected by oil and gas market conditions.

The spatial extent of long-term surface disturbance associated with oil and gas development could be reduced from Alternative 1 (No Action). This would provide increased opportunities for activities that do not involve oil and gas. The COAs would also provide additional protections for sensitive resources, thereby reducing impacts on nonmarket and quality of life factors, as discussed under **Section 4.10.2.**

Environmental Justice

Prevention of new oil and gas-related ground disturbance in certain areas under Alternative 4 could reduce production and economic opportunities for all populations, compared with Alternative 1 (No Action), including contributions for identified minority and Tribal populations; however, additional protections from areas where new ground disturbance will not be permitted and from COAs could also help reduce impacts on any important Tribal uses or cultural sites, improve recreation opportunities, and improve local water quality for Tribal populations.

As impacts would be spread throughout the county and the region, project activities are not anticipated to result in disproportionate adverse impacts on low-income, minority, or Tribal populations. Additional site-specific analysis when a lessee applies for a permit to drill would be required to identify any site-specific environmental justice impacts.

4.10.7 Cumulative Impacts

The cumulative impact analysis area for socioeconomics and environmental justice is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect socioeconomics and environmental justice are similar to those described under current conditions (see **Section 3.10.1**).

Oil and gas operations in Osage County will continue to provide employment and income, supported by existing infrastructure. The Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) could affect development timing or siting on a site-specific basis, which may affect the economic contributions from this industry.

The construction industry will continue to represent another important source of jobs and employment in the planning area with some overlap with the energy sector; based on 2015 data (see **Table 3-24**), the construction field represents approximately 6.1 percent of area employment. Proposed projects (see **Table 4-1**), including the residential land use plan and Tribal transportation improvement plan, represent potential sources of construction employment. The level of impacts on area housing or public services would depend on the timing of construction and employment needs.

Other current land uses in the area that support employment may conflict with oil and gas development. Most of Osage County is rural, and agriculture represents a major land use and approximately 15.6 percent of employment in the area (see **Table 3-24**). In some cases, agriculture may not be compatible with oil and gas development, for example, if water quantity or quality is affected or if land disturbance impacts agricultural land use.

In addition, as discussed under **Section 4.10.2**, Impacts Common to All Alternatives, oil and gas development has the potential to affect the quality of life for area residents.

Alternatives Analysis

Under all alternatives, contributions to cumulative impacts include continued employment and income in the oil and gas industry. For all alternatives, the exact level of employment and total cumulative number of workers needed at a given time would vary, depending on market conditions for the oil and gas industry and timing and employment needs for other construction activities listed in **Table 4-1**. As a result, quantitative estimates for the level of employees and any related impacts on population, housing, and public services cannot be predicted here.

Only gradual changes are expected in employment levels and area population as a result of oil and gas development; therefore, cumulative contributions to population change or strain on public services and housing are likely minimal. Under all alternatives, due to the lack of significant disproportionate adverse impacts on low-income or minority populations, the cumulative contribution to environmental justice from proposed management would be negligible at the county level.

Under Alternative 1 (No Action), application of COAs for oil and gas development could continue to result in site-specific limitations on development associated with the protection of cultural and environmental resources in accordance with applicable laws and regulations; however, drilling in the planning area should remain economically feasible, and contributions to jobs and economic output would continue. Application of COAs may continue to help reduce cumulative contributions from disturbance and development, including impacts on quality of life and nonmarket values of clean air and water and visual landscape preservation.

Compared with Alternative 1 (No Action), contributions to negative impacts from development on the quality of life, nonmarket values, and other land uses would be increased under Alternative 2. Alternative 3 may encourage development in specific portions of the planning area, and overall economic activity may be reduced compared with Alternative 1 (No Action). This is due to areas where permits for new ground-disturbing activities would not be approved. Under Alternative 4, negative impacts on quality of life, nonmarket values, and other land uses would likely decrease, and overall economic activity may be reduced compared with Alternative 1 (No Action) due to areas where permits for new ground-disturbing activities would not be approved (the most areas of any alternative).

The exact level of impact would depend on market conditions, the technology used, and site-specific restrictions implemented under any alternative.

4.11 PUBLIC HEALTH AND SAFETY

4.11.1 Methods and Assumptions

Indicators

Indicators of impacts on public health and safety are as follows:

- A substantial hazard to people or the environment through the routine transport, use, or disposal of hazardous materials or as a result of an accidental release of hazardous materials
- Hazardous emissions from or handling of hazardous or acutely hazardous materials, substances, or waste
- Exposure of people or structures to a risk of loss, injury, or death involving wildland fires

Assumptions

Adhering to applicable laws and regulations would reduce the risk of H_2S gas exposure under all alternatives.

4.11.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. This would result in continued exposure to and risk associated with public health and safety issues addressed in **Section 3.11**; however, lessees would be required to comply with all applicable federal, state, and local regulations.

Produced water or flowback from wells contains high levels of sodium and is often contaminated with petroleum, chemicals, or naturally occurring radioactive isotopes. If released into the environment by a spill, this contamination could threaten public health by contaminating soil and drinking water. Hydraulic fracturing results in significantly higher quantities of produced water than conventional drilling. The handling and disposal of water increases the chances of unintentional discharge. Disposal of flowback in underground injection wells has the potential to increase the rate of seismicity in Osage County; under all alternatives, new wells are projected to increase, which is anticipated to increase the amount of wastewater requiring disposal.

H_2S is a toxic gas that can be released during drilling completion or operations, and in high concentrations can cause health problems or death. The Occupational Safety and Health Administration recommended exposure limit is 10 ppm, and concentrations greater that 100 ppm are considered as immediately dangerous to life and health (OSHA 2017). Under all alternatives, the risk of H_2S exposure from oil and gas operations would continue.

Oil and gas operations and transportation could potentially spark a wildland fire. Storage tanks, pipelines, or wells damaged by a wildland fire could release chemicals, petroleum products, or hazardous materials into the environment.

Increased traffic associated with oil and gas development could increase the number of traffic accidents in Osage County. Additionally, light and noise from oil and gas development could be a nuisance to or harm nearby residents.

Hazardous materials could be released into the environment in the event of an accident or equipment failure.

4.11.3 Alternative 1 – No Action

Under this alternative, current BMPs would be required as COAs in order to protect the public health and safety. For example, chemicals must be stored and labeled properly and may not be kept on drill sites if they are not being used. Waste containers and contaminated soil must be disposed of promptly and appropriately. Tank batteries must have secondary containment. These requirements would reduce the risk of hazardous chemicals being released into the environment where groundwater could be contaminated, or the public could consume contaminated agricultural products.

When drilling in areas where it is expected that the concentration of H_2S in the gas stream will be 100 ppm or greater, air quality BMPs listed in the site-specific EA for the drilling permit would be implemented by the lessee. This COA would protect workers and the general public from the effects of H_2S exposure. Other risks to health and safety described in **Section 4.11.2**, Impacts Common to All Alternatives, would continue.

4.11.4 Alternative 2

This alternative would disallow the storage of flowback and produced water in unlined pits but would otherwise not apply COAs setting forth specific actions lessees must take with respect to the handling of chemicals or potentially contaminated water; however, applicable laws and regulations would still govern the handling of these materials. If chemicals or water contaminated with petroleum products were released into the environment, they could be ingested by the public and, in some cases, cause adverse health effects.

Adding a COA requiring that operations may not be conducted in such a manner that people are harmed by light or noise levels could reduce the public health impacts described in **Section 4.11.2**, Impacts Common to All Alternatives, compared with Alternative 1 (No Action). Additionally, prohibiting land application of waste oil, wastewater, or contaminated soil without the permission of the Osage Superintendent would reduce the risk of hazardous chemicals release, where groundwater could be contaminated, or the public could consume agricultural products, compared with Alternative 1 (No Action).

This alternative does not specify any COAs for H_2S. People living or working on or near a well site could be exposed to higher levels of H_2S compared with Alternative 1 (No Action) due to the lack of required air quality measures. Lessees would still be required to abide by Occupational Safety and Health Administration and other regulations dictating exposure and emission limits.

Other risks to health and safety described in **Section 4.11.2**, Impacts Common to All Alternatives, would continue. Impacts on public health and safety may increase under this alternative; however, existing laws and regulations would still mitigate them.

4.11.5 Alternative 3

This alternative would manage most high-density sections in the same manner as under Alternative 2. Low-density sections and sensitive areas would have the same management as Alternative 4. It is reasonable to expect that most new development would occur in areas with high oil and gas development potential. Because these areas are generally the areas with a high density of historical production, the impacts of this alternative on public health and safety would be similar to Alternative 2 in most cases.

In sections with a low density of oil and gas wells, additional COAs would require more careful handling of chemicals and flowback. Measures to protect against H_2S exposure and light and noise disturbance would also be required.

New drilling permits would not be approved in certain sensitive areas, including wellhead protection areas, class 1 special source groundwater areas, and sensitive water supply areas. Compared with Alternative 1 (No Action), this would reduce the risk of drinking water source contamination and subsequent exposure to or consumption of contaminated water by the public.

4.11.6 Alternative 4

Under this Alternative, the COAs applied under Alternative 1 (No Action) and additional COAs designed to protect public health and safety would be imposed. For example, a COA would prohibit land application of waste oil, wastewater, or contaminated soil without the permission of the Osage Superintendent. This would reduce the risk of oil and gas development contaminating drinking water sources. Additionally, operations would not be conducted in such a manner that light or noise levels would be harmful to people.

Under this alternative, a COA would require lessees to test the gas stream for the presence of H_2S and to take measures to protect workers and the public if concentrations are greater than 100 ppm. This COA, in addition to the COA requiring air quality BMPs, would protect workers and the general public from the effects of H_2S exposure to a greater degree than management under Alternative 1 (No Action).

New drilling permits would not be approved in certain sensitive areas, including wellhead protection areas, class 1 special source groundwater areas, sensitive water supply areas, and other areas. Compared with Alternative 1 (No Action), this would reduce the risk of drinking water source contamination and subsequent exposure to or consumption of contaminated water by the public.

4.11.7 Cumulative Impacts

The cumulative impact analysis area for public health and safety is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect public health and safety are those projects and activities that result in exposure to hazards or hazardous materials, induced seismicity, or increased wildland fire risk.

Alternatives Analysis

Under all alternatives, oil and gas development would continue to present a threat to public health and safety. The incremental impact of implementing any of the alternatives would be a reduction in adverse impacts on public health and safety because of the COAs applied under each alternative. This reduction in adverse impacts would be the greatest under Alternative 4, because it would implement the most stringent measures to protect public health and safety. These measures would reduce the risk of drinking water source contamination and exposure to H_2S.

Alternative 2 would have the smallest overall reduction in cumulative impacts on public health and safety. This is because it would waive many of the COAs aimed at preventing soil and drinking water source contamination and exposure to H_2S; however, because laws and regulations protecting public health and safety would still apply, the difference in impacts would be limited.

4.12 Visual Resources

4.12.1 Methods and Assumptions

The temporary direct effects on visual resources described below in **Section 4.12.2**, Impacts Common to All Alternatives, would last during construction and oil and gas operation. After construction, all equipment would be removed, and staging, storage, and construction areas would be reclaimed to a pre-disturbance condition; therefore, the impacts on visual resources described for each alternative in the following sections focus on the permanent or long-term effects of implementing COAs that maintain the landscape's form, line, color, and texture (such as those that maintain natural landscapes or reduce surface disturbance), which would incidentally limit the impacts on visual resources.

Indicators

The indicator of impacts on visual resources is changes in the characteristic landscape (e.g., form, line, color, and texture), compared with current conditions.

Assumptions

The severity of a visual effect depends on a variety of factors, including the size of a project (i.e., area disturbed and physical size of structures), the location and design of access roads, the overall visibility of disturbed areas, and the proximity to the viewer.

4.12.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. Temporary direct effects on visual resources would occur from construction and ground disturbance at well pads, access roads, and pipelines. The effects would occur for a short period, such as weeks or months. Construction would disturb the ground surface and remove vegetation. This would affect visual resources by denuding the land. Also, ground disturbances would affect visual resources by creating exposed soil with a different texture and color than undisturbed soil. Depending on growing conditions, trees and shrubs may not regenerate quickly, which would affect the timeline for reclaiming disturbed areas.

During dry periods, ground disturbance, vehicles, and excavation activities can generate dust that is blown across exposed soil, especially on windy days. According to data from the Wynona Mesonet Site weather station in Osage County, from 1994 to 2001, the average wind speed was 9.2 miles per hour, with maximum sustained winds at 49 miles per hour and maximum gust at 73.3 miles per hour (OCS 2013). Fugitive dust would affect visual resources by diminishing atmospheric clarity. This effect would persist until the dust settles or is blown elsewhere.

Construction lighting would reduce nighttime darkness, which would affect nighttime activities, such as stargazing, camping, wildlife observation, and sleeping. Reflective surfaces on construction equipment and vehicles create glare. The intensity and amount of glare would vary, depending on the intensity of sunlight and the time of day. This would affect visual resources by adding artificial points of illumination not found naturally in the landscape.

During construction, a project area would likely be cluttered with equipment, pipes, pits, colored flagging, and other temporary support infrastructure, in contrast with the surrounding natural terrain and vegetation. This can be a visual distraction and often creates new focal points that are not consistent with the color, shape, or form of the natural vegetation and landscape, whether the surrounding area is flat, rolling hills, grassland, or wooded areas. The color of construction equipment and vehicles would not resemble the muted tans and greens of the terrain and vegetation.

Long-term effects are those associated with oil and gas development operations on leased tracts. Long-term, direct effects on visual resources would occur from operating and maintaining sites and facilities. The effects on visual resources would remain through the life of the operations, until a site is abandoned and reclaimed.

The visibility of the features described below would vary, depending on viewer distance and location, topography, color and composition of facilities, and screening vegetation.

New roads would add artificial elements to undeveloped areas. Improving roads typically enhances the contrast of the road with the adjacent landscape. Roads lack vegetation and create an abrupt vegetation edge along the roadside. Smooth roads would stand out against the moderately coarse texture of the terrain. This would affect visual resources by dividing the landscape with areas that lack vegetation and by altering the natural topography and the texture and color of the land surface.

New pipelines and electrical lines would add artificial elements to undeveloped areas. The form, line, and texture of these structures would not resemble nearby structures, unless they were collocated with similar structures. In particular, pipelines would divide the landscape with strips of land lacking vegetation, and electrical lines would introduce prominent vertical elements.

Well pads and facilities, such as flowback pits and compressor stations, would add artificial elements to undeveloped areas. These areas would be cleared of vegetation, thereby leaving a clearing that contrasts with the surrounding landscape. The form, line, color, and texture of these facilities would not resemble nearby structures, unless they were collocated with similar existing industrial facilities. Also, the well pads and facilities would be sources of activity that are not typically found in undeveloped areas.

Lights may be installed for safety and to illuminate work areas, such as drilling rigs, at night. This would reduce nighttime darkness by adding light to areas lacking artificial light. As a result, this would diminish opportunities for viewing visual resources between dusk and dawn, particularly stargazing opportunities.

Under all alternatives, lessees must comply with and obtain any necessary permits or authorizations to comply with federal laws. Under some alternatives, the BIA would apply COAs with direction on methods or compliance. These COAs may be applied on a case-by-case basis or up front, or a combination of both, depending on the alternative selected. Applying these COAs could incidentally reduce impacts on visual resources if they reduce ground disturbance or result in placement of facilities in less visually intrusive locations.

Some COAs that apply to all alternatives would reduce impacts of oil and gas development on visual resources because they protect cultural resources and reduce surface disturbance, which reduces impacts on the form, line, color, and texture of the landscape. COAs that require fence enclosures would exaggerate long-term visual impacts on landscapes that do not have similar features in terms of form, line, color, and texture.

4.12.3 Alternative 1 – No Action

Several of the COAs applied under Alternative 1 (No Action) would incidentally minimize or exaggerate impacts on visual resources. COAs that would reduce impacts of oil and gas development on visual resources under Alternative 1 (No Action) are those that would do the following:

- Reduce surface and vegetation disturbance
- Maintain the natural topography
- Restrict vehicles to existing roads
- Keep sites clean of debris and unused equipment
- Require prompt site reclamation
- Minimize dust disturbance
- Prevent stream channel and wetlands modifications

COAs that require fence enclosures, screens, or additional aboveground infrastructure would exaggerate long-term visual impacts on landscapes that do not have similar form, line, color, and texture.

4.12.4 Alternative 2

Some of the COAs that minimize surface disturbance and alterations to the natural topography would not apply under Alternative 2; however, COA 28 specifically prohibits adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors. This would reduce visual impacts on sensitive receptors, compared with Alternative 1 (No Action). Overall visual impacts may still increase because of the lack of COAs that minimize surface disturbance and topography alterations. Agreements between surface owners and lessees may provide for additional mitigation in some situations.

4.12.5 Alternative 3

Under Alternative 3, the BIA would apply COAs based on the density of well development, which would result in location-specific visual impacts. The COAs from Alternative 1 (No Action), plus additional COAs, would be applied in low-density sections, which would indirectly protect visual resources. This would reduce impacts from oil and gas development on these resources, compared with Alternative 1 (No Action). Examples of additional COAs that would be applied are burying pipelines where appropriate, applying buffers around cultural sites, and not constructing new road crossings in streams and wetlands. Low-density sections are considered more pristine; therefore, this alternative would likely protect areas that have a higher visual quality (compared with high-density sections).

More protective COAs would be applied to the Tallgrass Prairie Preserve and state parks because they are identified as sensitive areas. These areas are also important visual resources in the planning area. The visual quality of these sensitive areas would be preserved by the application of more protective COAs.

In high-density sections, there are 24.8 miles of the Osage Nation Heritage Trail Byway, another important visual resource in the planning area; in these areas, visual resources would be more threatened because less protective COAs would be applied. Impacts would be similar to those described under Alternative 2.

In low-density sections, there are 40.4 miles of the Osage Nation Heritage Trail Byway; in these areas, visual resources would be more preserved because more protective COAs would be applied. Additional COAs that would be designed to protect listed sensitive areas could also incidentally reduce impacts on visual resources by protecting the values associated with the type of sensitive area that may be affected.

VRI components in high- and low-density sections are shown in **Table 4-8**, Visual Resource Inventory Component Distribution in High- and Low-Density Sections, below. Most highly sensitive and scenic areas in the planning area are in low-density sections. As previously described, in low-density sections, impacts on visual resources would be less than under Alternative 1 (No Action). This is because COAs would be applied to incidentally reduce impacts on visual resources. In high-density sections, impacts on visual resources would be greater than under Alternative 1 (No Action). This is because fewer COAs would be applied to reduce impacts on visual resources.

Visual resources would be more threatened in high-density sections, because COAs that are less protective would be applied. The magnitude of these impacts would be greatest where scenic quality or sensitivity is higher. Furthermore, the creation of any new access roads could affect the distance zone of the area. If development were to occur in a seldom seen area, new public access roads could make the development more accessible and thus more visible to the public. This could change the distance zone from seldom seen to background or foreground-middle ground.

As under Alternatives 2 and 4, COA 28 would be applied in both high- and low-density sections under Alternative 3. COA 28 specifically prohibits adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors. This would reduce visual impacts on sensitive receptors, compared with Alternative 1 (No Action).

Under Alternative 3, the BIA would not approve permits for new ground-disturbing activities in certain sensitive areas covering 246,800 acres (17 percent) of the planning area. Visual impacts would be reduced in these areas.

Table 4-8
Visual Resource Inventory Component Distribution in High- and Low-Density Sections

Visual Resource Inventory Component	Acres in High-Density Sections	Acres in Low-Density Sections
Scenic Quality		
A	393,200	1,081,300
B	N/A	N/A
C	N/A	N/A
Sensitivity		
High	125,800	532,600
Moderate	267,300	548,700
Low	N/A	N/A
Distance Zones		
Foreground/middle ground	2,000	15,400
Background	4,400	19,200
Seldom seen	386,800	1,046,600
VRI Class		
Class I	N/A	N/A
Class II	393,200	1,081,300
Class III	N/A	N/A
Class IV	N/A	N/A

Source: BLM GIS 2016
Note: N/A = Not applicable. There were no lands in the planning area found to be in these VRI components.

4.12.6 Alternative 4

Under Alternative 4, the BIA would apply the COAs described under Alternative 1 (No Action) and additional COAs to protect sensitive cultural and environmental resources. With some exceptions, the COAs that would minimize impacts on visual resources would be the same under Alternative 4 as under Alternative 1 (No Action); therefore, the effects on visual resources that would minimize localized fugitive dust and change the visual landscape would be similar to those described for Alternative 1 (No Action).

As under Alternatives 2 and 3, COA 28 would be applied throughout the planning area under Alternative 4. COA 28 specifically prohibits adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors. This would reduce visual impacts on sensitive receptors, compared with Alternative 1 (No Action). Additionally, burying pipelines where appropriate, applying buffers around cultural sites, and not constructing new road crossings in streams and wetlands throughout the planning area would reduce changes to the visual landscape, compared with Alternative 1 (No Action).

Additional COAs that would be required to comply with site-specific conditions designed to protect listed sensitive areas could also incidentally reduce impacts on visual resources by protecting the values associated with the type of sensitive area that may be affected.

Under Alternative 4, the BIA would not approve permits for new ground-disturbing activities in certain sensitive areas covering 524,400 acres (36 percent) of the planning area. Like Alternative 3, visual impacts would be reduced in these areas; however, because new disturbance would be prevented in more areas under this alternative, overall impacts would be further reduced.

4.12.7 Cumulative Impacts

The cumulative impact analysis area for visual resources is the planning area. Past, present, and reasonably foreseeable future actions and conditions within the cumulative impact analysis area that have affected and will likely continue to affect visual resources are those that have caused, are now causing, or would later cause surface disturbance or create large human-made modifications on the landscape.

Past and present oil and gas development and mineral leasing have disturbed the surface, thereby altering the natural visual conditions of the area. Large human-made modifications, such as those from infrastructure projects, could alter the visual resources in the planning area by creating linear disturbances in the landscape. The proposed projects that would affect the visual landscape in this way are wind farms, a water tower, transportation routes, and buildings.

These actions, in addition to the continued oil and gas development proposed under all alternatives, would cumulatively exaggerate impacts on planning area visual resources.

Alternatives Analysis

Under Alternative 1 (No Action), trends for visual resources, as described in **Section 3.12.3**, are likely to continue, as no additional COAs on oil and gas development would be implemented. Under Alternative 2 and in high-density sections under Alternative 3, some of the COAs that would apply under Alternative 1 (No Action) would be waived; however, prohibiting operations that cause adverse visual impacts that constitute a public nuisance would reduce impacts on sensitive receptors. The overall cumulative impacts of oil and gas development, in combination with construction and infrastructure projects described in **Table 4-1**, would be greatest under Alternative 2.

In low-density sections under Alternative 3 and in all areas under Alternative 4, additional COAs would reduce impacts on visual resources, compared with Alternative 1 (No Action); however, the impacts from infrastructure projects described in **Table 4-1**, which are outside of the scope of this EIS, would be the same. Preventing new oil and gas-related ground disturbance in certain sensitive areas under Alternatives 3 and 4 would reduce impacts on visual resources compared with Alternative 1 (No Action). Cumulative effects would likely be least under Alternative 4. This is because it would implement the most restrictive COAs and prevent new oil and gas-related surface disturbance in the most areas to minimize impacts on visual resources from oil and gas development across the planning area.

4.13 NOISE

4.13.1 Methods and Assumptions

Noise from developing and operating gas wells and constructing associated infrastructure could affect sensitive land uses and users in the planning area.

Indicators

The indicator of impacts on noise is the level of noise generated by oil and gas development.

Assumptions

- Actual noise levels at sensitive receptor locations would depend on the exact locations of wells and related infrastructure, the level of development, and the local topography.
- The duration of noise impacts is based on the following estimated average drilling times observed by BIA Osage Agency staff:
  - A 4,500-foot horizontal well (the average length of horizontal wells in Osage County) would take 5 to 21 days drilling time, depending on equipment used and downtime due to problems encountered.
  - A 4,200-foot vertical well drilled to a formation slightly above the granite layer in the western side of the county (the deepest part of Osage County) would take 3 to 14 days drilling time.
  - Most disposal wells are drilled to a formation slightly above the granite layer and so would take 7 to 14 days to drill, running 12-hour shifts.
  - A vertical well in the eastern part of the county (the shallowest part of Osage County) can be drilled in a 3 to 7 days, running 12-hour shifts.
  - Well drilling and completion would take approximately 7 days; this includes the 72 hours of downtime for letting the long string dry after being cemented.

4.13.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. Noise resulting from oil and gas production could affect sensitive receptors in the planning area, including residents, recreationists, and wildlife (the potential noise impacts on wildlife are addressed separately in **Section 4.5**, Fish, Wildlife, and Migratory Birds). The magnitude of the effect would depend on the distance between the receptor and the noise source, the duration and frequency of the noise, and the time of the noise (noise is viewed as more disruptive at night). In addition, individuals react differently to changes in ambient noise levels and to various types of sound; therefore, the perceived level of impact may vary by receptor.

Noise under all alternatives would occur from construction and operations. Construction would increase short-term, localized, and intermittent ambient noise levels, while operations may increase long-term ambient noise levels over the life of the project.

Sources of noise are construction (earth-moving equipment for well drilling, roads, well pads, compressor stations, electrical lines, and pipelines), vehicle traffic, and operation (production). **Table 4-9**, Noise Levels for Oil and Gas Development, shows typical noise levels associated with oil and gas development. Actual noise levels at a given location depend on the topography, atmospheric conditions (temperature, wind speed and direction, and humidity), the vegetation in the vicinity (which can absorb sound), and any structures between a noise source and a noise receptor.

Table 4-9
Noise Levels for Oil and Gas Development

Noise Source	Noise Level
Typical compressor station	50 dBA (375 feet from property boundary)
Pumping units	50 dBA (325 feet from well pad)
Fuel and water trucks	68 dBA (500 feet from source)
Crane for hoisting drilling rigs	68 dBA (500 feet from source)
Concrete pump used during drilling	62 dBA (500 feet from source)
Average well construction site	65 dBA (500 feet from source)

Source: Earthworks 2015

Construction would require the use of earth-moving equipment (e.g., bulldozers, graders, and backhoes), heavy trucks (e.g., dump trucks and water trucks), generators, and air compressors at the construction site. Noise from construction is assumed to be short term but would be loud and constant. In addition, heavy truck and personal vehicle traffic would increase along area roadways to bring personnel and supplies to the staging and construction sites.

Noise from these activities would be short term and intermittent. For access roads, electrical lines, and pipelines, the construction equipment would not remain in one location for a long period, given the linear nature of this type of development. These facilities would be constructed during working hours, which would not affect nighttime ambient noise levels.

The primary noise sources associated with drilling are large diesel engines that power the rotary rig and pumps and the large diesel-driven air compressors. In addition, heavy truck and personal vehicle traffic would increase along area roadways to bring personnel and supplies to the well site. This noise would increase dramatically where hydraulic fracturing is used, due to the increased truck traffic and intensity of operations at the well site.

The primary sources of noise during operation are natural gas or electric pumps at each well, natural gas-fired internal combustion engines to power the compressors at each compressor station, and intermittent traffic related to operations and maintenance. In addition, periodic workovers would be needed for maintenance and to correct problems with producing wells, and road maintenance would occur to replace surface materials and apply dust abatement.

Under all alternatives, the BIA would apply some COAs to oil and gas permits to prevent environmental degradation. These measures may be applied on a case-by-case basis or up front, or a combination of both, depending on the alternative selected, to prevent, minimize, and mitigate environmental impacts. Applying these COAs could incidentally reduce impacts on noise resources if they were to reduce vehicle traffic or relocate noise sources away from sensitive receptors.

4.13.3 Alternative 1 – No Action

Applying the COAs under Alternative 1 (No Action) would incidentally reduce noise impacts. For example, confining vehicles and equipment to existing roads and new roads would reduce noise impacts because impacts would be concentrated to these areas. Avoiding areas with National Register of Historic Places-eligible or unevaluated cultural resources would reduce noise impacts because these areas would be avoided altogether.

4.13.4 Alternative 2

Compared with Alternative 1 (No Action), Alternative 2 would apply fewer standardized COAs to oil and gas development, including drilling, workover, and other permitted activities. Vehicles and equipment would not be confined to existing and new roads, and operational impacts from traffic and due to noise would not be specifically discouraged; however, COA 28 specifically prohibits disturbance through noise levels that may constitute a public nuisance that is harmful to people or sensitive environmental receptors. By applying COA, this alternative could reduce noise impacts compared with Alternative 1 (No Action). Overall noise impacts may still increase because of the lack of COAs restricting vehicles and traffic or because of increased activity. Agreements between surface owners and lessees may provide additional mitigation in some situations.

4.13.5 Alternative 3

Under Alternative 3, the BIA would apply COAs based on the density of well development, which would result in location-specific noise impacts. The COAs from Alternative 1 (No Action), plus additional COAs, would be applied in low-density sections and sensitive areas. With one exception, these COAs would be the same under Alternative 3 as under Alternative 1 (No Action).

COA 28 would be applied in both high- and low-density sections under Alternative 3, which specifically prohibits adverse noise impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors. COA 28 would reduce noise impacts on sensitive receptors in low-density sections and sensitive areas, compared with Alternative 1 (No Action).

Fewer COAs would be applied in high-density sections, which would result in more impacts from noise, compared with Alternative 1 (No Action). Impacts in these areas would be similar to those described under Alternative 2. **Section 3.12.3**, Noise, Current Conditions, identifies towns and cities as sensitive receptors in the planning area since they are concentrated population centers. **Table 4-10**, Cities and Towns in High- and Low-Density Sections, below, identifies which of these sensitive population areas would be susceptible to the more stringent COAs of low-density sections (thus having less impacts from noise) and to the less stringent COAs of high-density sections (thus having more impacts from noise).

Table 4-10
Cities and Towns in High- and Low-Density Sections

Location	Acres in High-Density Sections	Acres in Low-Density Sections
Cities		
Barnsdall	0	400
Bartlesville	200	200
Hominy	0	1,300
Pawhuska	200	2,200
Sand Springs	0	2,400
Shidler	0	500
Tulsa	0	7,000
Towns		
Avant	0	200
Burbank	0	200
Fairfax	0	500
Foraker	0	100
Grainola	0	200
Osage	0	200
Prue	0	300
Skiatook	100	3,000
Sperry	0	100
Webb City	200	0
Wynona	0	300

Source: US Census GIS 2017, BIA GIS 2017

In certain areas, including municipalities and sensitive water supply and groundwater areas, permits for new ground-disturbing activities would not be approved regardless of density. In these areas, noise impacts from oil and gas development would be reduced or eliminated.

4.13.6 Alternative 4

Under Alternative 4, the BIA would apply the COAs described in Alternative 1 (No Action) and additional COAs to protect sensitive cultural and environmental resources. With one exception, the COAs that would minimize impacts on visual resources would be the same under Alternative 4 as under Alternative 1 (No Action); therefore, noise impacts in the planning area would be similar to those described for Alternative 1 (No Action).

As under Alternatives 2 and 3, COA 28 would be applied throughout the planning area under Alternative 4. COA 28 specifically prohibits adverse noise impacts that may constitute a public nuisance harmful to people or sensitive environmental receptors. This would reduce noise impacts on sensitive receptors, compared with Alternative 1 (No Action).

In certain areas, including municipalities, the Tallgrass Prairie Preserve, BLM wild horse and burro holding facilities, state parks and WMAs, and sensitive water supply and groundwater areas, permits for new ground-disturbing activities would not be approved. In these areas, noise impacts from oil and gas development would be reduced or eliminated.

4.13.7 Cumulative Impacts

The cumulative impact analysis area for noise is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area are those that have increased, are now increasing, or would later increase short-term noise from construction activities. This also includes increased long-term noise from infrastructure with noise-emitting sources.

The construction of proposed wind farms, transportation routes, and buildings would have short-term but loud and constant noise impacts on the planning area. New transportation routes and wind farms would have long-term impacts on the planning area by expanding the area for noise-emitting vehicles. These actions, in addition to the continued oil and gas development proposed under all alternatives, would cumulatively exaggerate noise impacts in the planning area.

Alternatives Analysis

Under Alternative 1 (No Action), noise trends described in **Section 3.13.3** are likely to continue. This is because no additional COAs on oil and gas development would be implemented. Under Alternative 2 and in high-density sections under Alternative 3, some of the COAs that would apply under Alternative 1 (No Action) would be waived; however, prohibiting operations that cause a public nuisance could reduce impacts on sensitive receptors in severe cases. The overall cumulative impacts of oil and gas development, in combination with construction and infrastructure projects described in **Table 4-1**, would be greatest under Alternative 2.

In low-density sections under Alternative 3 and in all areas under Alternative 4, the additional COA prohibiting adverse noise impacts that may constitute a public nuisance would reduce noise impacts, compared with the Alternative 1 (No Action); however, the impacts from implementing construction and infrastructure projects in **Table 4-1**, which are outside of the scope of this EIS, would be the same. Cumulative effects would be fewest under Alternative 4. This is because it would implement the most restrictive COAs to minimize noise impacts from oil and gas development across the planning area and because new oil and gas-related ground disturbance would be prevented in the greatest acreage of sensitive areas.

4.14 LAND USE PLANS, UTILITIES, AND TIMBER HARVESTING

4.14.1 Methods and Assumptions

Indicators

Indicators of impacts on land use plans, utilities, and timber harvesting are as follows:

- Actions that influence the ability to carry out land use planning described in existing land use plans
- Actions that increase, reduce, or eliminate the demand for new utilities (e.g., from oil and gas development)
- Actions that increase, reduce, or eliminate opportunities for timber harvesting

Assumptions

- Land use planning authority on Tribal trust lands resides with the Osage Nation; Osage County maintains authority on non-Tribal lands.
- All future utility development on non-Tribal lands will be consistent with existing state and local plans, such as the 2030 Osage County Comprehensive Plan (Osage County 2011).
- The demand for new utilities, especially underground pipeline infrastructure, will increase over time as new oil and gas wells are developed.
- The demand for new electrical transmission infrastructure will increase in response to new wind energy development in and next to the planning area.
- Residential and commercial development will continue to be rural, except for the far southeastern portion of the planning area. The demand for new utility development in the far southeastern portion of the planning area near Tulsa, Oklahoma, will be greater, compared with the remainder of the planning area.
- The availability of and demand for timber for harvesting will remain steady or will gradually decline over time.

4.14.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. Osage County would retain land use planning authority for non-Tribal lands in the planning area, while the Osage Nation would retain such authority on Tribal lands. Within its jurisdiction, the BIA would continue to oversee the administration of trust and restricted Indian land.

As discussed in **Section 3.14**, lands within the planning area are generally rural, with small farming communities and rural residences scattered throughout. Areas where future oil and gas development might occur are currently used for a variety of activities, including recreation, hunting, wind energy development, livestock grazing, and ROW corridors (e.g., roads, pipelines, and transmission lines). Oil and gas development could have a direct effect on these uses, displacing them from the areas being leased and developed. Likewise, currently established uses may also prevent or modify oil and gas development in the planning area.

Indirect impacts of oil and gas development would be associated with changing existing off-lease land uses, including conversion of land in and around local communities from existing agricultural, open space, or other uses to provide services and housing for employees and families that move to the region in support of further oil and gas development. Increases in traffic, increased access to previously remote areas, and development of oil and gas facilities in currently undeveloped areas would continue to change the overall landscape character.

Renewable energy projects could be incompatible with oil and gas development, and future development could be excluded by oil and gas development. Future renewable energy development in the planning area would be evaluated on a site-specific, case-by-case basis with consideration of established oil and gas areas and oil and gas development potential.

Utility development would continue to be allowed according to the existing land use plans under all alternatives. Although transmission and pipeline ROWs associated with oil and gas development would not necessarily preclude other land uses, they would result in both direct and indirect impacts.

Direct impacts (e.g., the loss of available lands to physical structures, maintenance of ROWs free of major vegetation, maintenance of service roads, and noise and visual impacts on recreational users along the ROWs) would last as long as the transmission lines and pipelines were in place. Indirect impacts, such as the introduction of or increase in recreational use in new areas due to improved access, or, alternatively, avoidance of existing recreational use areas near transmission corridors for aesthetic reasons, and increased traffic, could occur and be long term.

Hydraulic fracturing could occur in combination with conventional oil and gas development techniques under all alternatives; however, as discussed in the Osage RFD (**Appendix A**), the majority of new wells drilled during the life of this EIS are anticipated to be conventional wells. COA 12 is being proposed under all alternatives and would ensure deleterious substances that are displaced or produced in well completion or stimulation procedures are collected in a pit lined with plastic or a metal tank and maintained separately from other drilling fluids to allow for separate disposal. This COA would reduce the risk of deleterious substances entering surface waters used by water utilities for municipal water uses.

Hydraulic fracturing typically uses water from available groundwater and/or surface water resources located near hydraulically fractured oil and gas production wells (EPA 2016e). Hydraulic fracturing also typically uses more water than conventional oil and gas development. This would affect water utilities more than conventional oil and gas development by reducing the amount of available water in lakes, rivers, and reservoirs for municipal uses.

The specific impacts on land use, and their magnitude, would depend on future development location; size and scale of operations; proximity to roads, transmission lines, and pipelines; and development technology.

Direct impacts of oil and gas development on timber harvesting for all alternatives are the following:

- Removing wood, plants, and seeds
- Creating roads or trails for equipment
- Increasing traffic on roads from transporting products, potentially introducing invasive or noxious weeds
- Spreading invasive or noxious weeds by equipment or foot traffic
- Trampling understory vegetation
- Compacting soil

Indirect impacts of oil and gas development on timber harvesting would increase the spread of invasive or noxious weeds (colonization of bare mineral soil), reduce regeneration rates where seed material has been removed, and increase the abundance of native understory vegetation. However, because at the time of writing this EIS, Osage County has not had any timber sales since 2004, impacts of oil and gas development on timber harvesting would be minimal under all alternatives.

4.14.3 Alternative 1 – No Action

Existing and proposed oil and gas and wind energy development would continue to increase the need for new or expanded utilities, such as pipelines and electrical distribution and transmission lines. COAs, such as those relating to reclamation of surface areas that are not needed or used during operations of the well, would continue to be imposed. This would ensure that lands are reclaimed for other land uses and developments in a timely manner.

4.14.4 Alternative 2

Under Alternative 2, in addition to the COAs listed in **Section 4.14.2**, the BIA would impose additional COAs prohibiting the land application of waste oil, wastewater, or contaminated soil, unless approved by the Superintendent. The exception would be if the lessee submits a written request for such application. The degree of this impact would be evaluated on a site-specific, case-by-case basis.

Overall, this alternative would apply the fewest COAs, resulting in similar impacts on land use plans and utilities as described in **Section 4.14.2**, but to a lesser degree compared with Alternative 1 (No Action) due to fewer COAs applied to land use. Agreements between surface owners and lessees may provide additional mitigation of impacts in some situations.

4.14.5 Alternative 3

In high-density sections, impacts on land use plans, utilities, and timber harvesting would be the same as those described under Alternative 2. In low-density sections, the BIA would apply additional COAs that limit the spatial extent of surface disturbance associated with oil and gas development more than the current management under Alternative 1 (No Action).

This management approach would apply more COAs to land use authorizations for oil and gas development but would continue to provide opportunities for non-oil and gas development outside of concentrated oil and gas development areas. Additionally, regardless of the density of wells, new ground disturbance would be prevented in the sensitive areas listed in **Section 2.4.4**. This would limit impacts in these areas.

Additional COAs, such as burying pipelines, could create more permanent corridors that other utilities could use. Avoiding new road and pipeline crossings of streams or wetlands could result in increasing tree clearing as lessees reroute roads and pipelines to avoid sensitive resources. Additional COAs could reduce conflicts with other land uses and utilities, such as those that require a lessee to submit a written request before beginning any new ground-disturbing activities or operations that the APD did not specifically approve. The degree of these impacts would be evaluated on a site-specific, case-by-case basis.

4.14.6 Alternative 4

The enhanced resource protection associated with Alternative 4 would be the same as that applied to low-density sections under Alternative 3. These additional COAs would limit the spatial extent of surface disturbance associated with oil and gas development more than under Alternative 1 (No Action). Alternative 4 would impose additional COAs for oil and gas development but would continue to provide opportunities for non-oil and gas development outside of concentrated oil and gas development areas.

Overall, Alternative 4 would apply the most COAs, and new ground disturbance would be prevented in the largest area of the county, resulting in similar impacts on land use plans, utilities, and timber as those described in **Section 4.14.2**; however, they would be to a lesser degree. This is because of the reduced area of surface disturbance under Alternative 4.

4.14.7 Cumulative Impacts

The cumulative impact analysis area for land use plans, utilities, and timber harvesting is the planning area. Cumulative impacts are past, present, and reasonably foreseeable future actions that increase or decrease the demand for land use authorizations and timber harvesting or prompt the need for new or revised land use plans. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect land use plans, utilities, and timber harvesting are oil and gas and renewable energy development.

There are approximately 1,000 miles of pipelines used predominately for crude oil and natural gas transportation in the planning area; of these, 90 miles are on BIA-administered lands (NPMS GIS 2015; BIA NIOGEMS GIS 2015; OK GAP GIS 2008; BIA GIS 2017). Oil and gas production in the planning area is expected to increase in the next 20 years, resulting in the need for additional land use authorizations, and potentially new or revised local land use planning documents, to support that development.

Alternatives Analysis

All alternatives would include COAs to protect soils, vegetation, visual resources, cultural resources, and special status species. Some measures would limit the locations where new authorizations could be approved, while others would ensure that lands are reclaimed for other land uses and development in a timely manner.

In general, there would be the fewest cumulative impacts on land use plans and utilities under Alternative 2, since this alternative imposes the least number of COA on the utilities required by oil and gas development activities. Cumulative impacts on timber harvesting would likely be minimal under all alternatives due to the lack of timber harvesting in the planning area. Any impacts would be the fewest under Alternative 4, however, due to the application of COAs and prevention of new oil and gas-related ground disturbance in certain sensitive areas, which would reduce surface disturbance and lessen the potential for noxious weed establishment and competition with species used for timber harvest.

4.15 Traffic and Transportation

4.15.1 Methods and Assumptions

Indicators

Indicators of impacts on traffic and transportation are as follows:

- Conditions on public roadways, such as roadway surface conditions, roadway design, sight distances, parking supply, and the presence of slow-moving vehicles, that may influence access for all travel modes
- Degree of consistency with an applicable plan, ordinance, or policy establishing measures of effectiveness for the performance of the circulation system, considering all modes of transportation, including mass transit and nonmotorized travel, and relevant components of the circulation system, including intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit

Assumptions

There are no assumptions made for this resource.

4.15.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. An increase in the number of wells drilled would lead to an increase in the number of work vehicles and trucks transporting supplies and equipment to well pads, which would result in higher traffic volumes on local and regional roadways networks. These changes would deteriorate the physical condition of roadway surfaces and increase the risk of vehicle collisions.

Under all alternatives, the BIA would require compliance with applicable laws and regulations, such as the ESA and Section 106 of the NHPA.,

Wells proposed in or directly adjacent to existing transportation ROWs would be required to obtain encroachment permits or other required authorizations from the applicable transportation agency. Any future increase in the width of roads or ROWs would result in the need to plug or abandon wells within the ROW expansion footprint. Future road expansion could decrease oil and gas development potential if it results in the abandonment of existing wells; however, higher-capacity roadways would increase access to operational wells.

Applying COAs could reduce impacts on traffic and transportation if they were to mitigate impacts on road surface conditions, such as through access protocols and road maintenance, and require measures that ensure safe and efficient access for all travel modes.

Under all alternatives, compatibility with applicable traffic and transportation plans, ordinances, and policies would be determined on a case-by-case basis. Implementing COAs would not affect the eligibility of roads for inclusion in the Tribal Transportation Program.

4.15.3 Alternative 1 – No Action

Applying the COAs under Alternative 1 (No Action) would continue to limit impacts on traffic and transportation by requiring lessees to maintain and upgrade roads as needed (COA 6). Maintaining and upgrading new roads according to BIA direction and agreements between the lessee and surface owners would ensure adequate standards to facilitate current and anticipated traffic levels and to reduce damage to public roads.

Because COA 33, which limits new road crossings of streams or wetlands, is not applied under Alternative 1 (No Action), there would continue to be flexibility for new roadways to support expanded oil and gas development; however, new road construction in riparian and other areas subject to frequent inundation could subject roadways and bridges to flooding, which would decrease access during flood events. Infrastructure in areas subject to the continuous erosive forces of water are more likely to experience potholes, cracking, and subgrade deterioration. In the long term, constructing roadway infrastructure over streams and in riparian areas would require regular maintenance to avoid roadway infrastructure deterioration and related access declines.

4.15.4 Alternative 2

Compared with Alternative 1 (No Action), the BIA under Alternative 2 would apply fewer standardized COAs to all oil and gas development, including drilling, workover, and other permitted activities. Under Alternative 2, COA 6 would not apply. This would increase the potential for impacts on traffic and transportation compared with Alternative 1 (No Action) because there would not be a requirement to maintain and upgrade roads as needed. Not applying this COA would allow roadways to deteriorate over time, which, in the long term, would reduce access for all transportation modes. Impacts from not applying COA 33 would be the same as those described under Alternative 1 (No Action).

Although impacts would be determined on a case-by-case basis, the amount of traffic and maintenance required to maintain desired levels of service in the planning area under Alternative 2 could exceed the planned improvements in the adopted Osage Nation and ODOT long-range transportation plans (Osage Nation 2017d; ODOT 2015). An inability to provide adequate infrastructure and maintenance would decrease access for all modes. In the long term, reduced access for all travel modes would not be consistent with adopted transportation plans or policies. The exact location, type, and degree of any inconsistencies is unknown.

4.15.5 Alternative 3

Under Alternative 3, the BIA would apply COAs based on the density of well development, which would result in location-specific traffic and transportation impacts. In low-density sections, the application of COA 6 would require roadway maintenance and upgrading as necessary. Effects on access from roadway maintenance in these locations would be the same as under Alternative 1 (No Action).

Additionally, in low-density sections, the BIA would require COA 33, which would limit new road crossings of streams and through riparian and other areas susceptible to inundation. Avoiding locating new roadways in these areas would maintain short- and long-term access by avoiding areas that would be subject to flooding and roadway infrastructure deterioration but could in some cases require the lessee's vehicles to travel further in order to travel around riparian areas. The extent of the change from Alternative 1 (No Action) is unknown and would depend on the number, type, and location of new wells.

In high-density sections, the impacts on traffic and transportation would be the same as those described under Alternative 2.

In 246,800 acres of sensitive areas where new drilling permits would not be approved, lessees could be required to use existing roads, reducing miles of new road but also potentially increasing traffic congestion and the rate of road wear.

4.15.6 Alternative 4

Impacts under Alternative 4 would be similar to those described under Alternative 1 (No Action), except the application of COA 33 under Alternative 4 would limit new roadway crossings of streams and waterways. Impacts from applying this COA would be the same as those described for low-density sections under Alternative 3 COAs; however, under Alternative 4, COAs would be applied to the entire planning area instead of just low-density sections. The 524,400 acres of sensitive areas where new ground-disturbing permits would not be issued would be expanded under Alternative 4. This could require lessees to use existing roads in some areas, reducing miles of new road but also potentially increasing traffic congestion and the rate of road wear.

In general, under Alternative 4, the application of more COAs, such as those protecting sensitive cultural and environmental resources, could change the location, type, and extent of new oil and gas development. By limiting new stream and riparian crossings, Alternative 4 could in some cases require the lessee's vehicles to travel further in order to travel around riparian areas and utilize existing stream crossings, potentially increasing the risk of crashes.

4.15.7 Cumulative Impacts

The cumulative impact analysis area used to analyze cumulative impacts on traffic and transportation is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect traffic and transportation are transportation plans and projects and other activities that introduce additional traffic on roads in Osage County. An increase in oil and gas development-related traffic in Osage County could also be expected to result in increased traffic in surrounding counties as vehicles carrying supplies and equipment pass through on the way to Osage County.

Alternatives Analysis

Projects identified in the Osage Nation Long-Range Transportation Plan (Osage Nation 2017d) and ODOT Construction Work Plan (ODOT 2015), combined with planned new road construction for oil and gas-related development, would help the county and state achieve transportation planning goals. Other projects, such as ODOT's Osage Prairie Bike Trail Program, would increase multi-modal transportation opportunities in the planning area (see **Table 4-1**).

Under Alternatives 1 (No Action), 3, and 4, COAs would support roadway maintenance on new oil and gas-related roadways. These COAs would mitigate surface deterioration impacts from oil and gas-related vehicles on those roadways, which would maintain access. Of these, there would be the fewest cumulative impacts on traffic and transportation under Alternative 4; this is because new oil and gas-related ground disturbance would be prevented in the most areas and COAs would limit the size, type, and location of new oil and gas development. Fewer wells would result in less traffic and resulting impacts on area roadways.

Conversely, Alternative 2 would introduce the most new oil and gas-related traffic without providing COAs to maintain surface conditions or avoid new roadways in potentially unsuitable areas. Combined with past, present, and reasonably foreseeable future actions, Alternative 2 would result in some roadway surfaces becoming degraded and congested. In some cases, roadways may become impassible for certain vehicles. Collisions resulting from increased congestion and poor-quality road surfaces would decrease access for all travel modes, compared with Alternative 1 (No Action).

4.16 Mineral Extraction

4.16.1 Methods and Assumptions

Indicators

Indicators of impacts on mineral extraction are as follows:

- Applying COAs to drilling that restrict the timing, location, or methods of oil and gas development
- Changes in the accessibility or availability of mineral resources.

Assumptions

- Management actions proposed under the alternatives would apply to oil and gas development wherever the BIA administers the subsurface mineral estate, regardless of surface ownership.
- COAs applied to permits would not eliminate all reasonable opportunity to develop a lease.
- As described in **Section 3.16.3**, Mineral Extraction, Trends, oil and gas development in the planning area is expected to continue to occur over the next 20 years.

- COAs could be added, adjusted, or waived on a site-specific basis in order to protect sensitive resources or to facilitate lease development.

4.16.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas leasing and development would continue to occur in the planning area. Under certain alternatives, the BIA would apply COAs to oil and gas development to prevent, minimize, and mitigate impacts. COAs may be added or waived on a site-specific basis where deemed necessary by the Osage Superintendent. Additionally, the BIA would not approve new drilling permits in specific sensitive areas under some alternatives.

Alternatives that reduce the acreage available for the approval of new drilling permits would reduce the level of development in Osage County.

The regulations in 25 CFR Part 226 governing current oil and gas operations in Osage County require lessees to take all actions necessary to prevent the pollution of surface and subsurface fresh water sources and impose a buffer for the location of wells and tanks. In addition, lessees presently map streams, wetlands, and floodplain areas as part of predevelopment surveys. The COAs that set forth buffers to protect streams and waterways are consistent with the current requirements and, therefore, would minimally affect development.

Under all alternatives, the presence of an oil and gas well may prevent or impede the extraction of solid mineral resources in the immediate surrounding area.

The BIA Superintendent will ensure that cultural surveys are performed, and clearances obtained in accordance with the NHPA prior to approving new ground-disturbing activities in Osage County. Compliance with the NHPA is mandatory for all current and future operations and, therefore, is applicable to all four alternatives. Accordingly, regardless of the alternative selected, the impact on cultural resources would remain relatively unchanged. See **Section 9.4.2** for additional detail regarding NHPA compliance.

4.16.3 Alternative 1 – No Action

Applying the COAs under Alternative 1 (No Action) would continue to impose some reclamation requirements and limitations on disturbance; however, these measures do not prohibit development of leases.

4.16.4 Alternative 2

Under Alternative 2, the BIA would issue drilling permits based on site-specific EAs tiered to the analysis in this EIS.

With the removal of some COAs, the BIA would need to submit a revised BA and reinitiate formal consultation on a new BO. Until a new BO is issued, lessees would be solely responsible for documenting compliance under ESA Section 10. Oil and gas operations could not proceed until a 45-day wait period has elapsed, unless there is no suitable habitat and the BIA is willing to make a "no effect" determination for the ABB. This could delay oil and gas development in the planning area, compared with Alternative 1 (No Action).

By requiring compliance with applicable laws and COAs without prescribing specific actions, the lessees would have a greater degree of flexibility in how to comply with regulations. This could reduce the time required for permitting and site preparation; however, Alternative 2 would open lessees up to liability and additional expense if methods of compliance with BMPs are judged inadequate.

Additionally, until a new BA/BO is issued, responsibility for documenting compliance with ESA Section 10 would fall solely on lessees, and wait times could be increased. This process could delay drilling until the new BO is issued but would not significantly affect the total number of new wells drilled, compared with Alternative 1 (No Action).

4.16.5 Alternative 3

Under Alternative 3, sections with a high density of historical oil and gas development, encompassing approximately 393,200 acres, would be managed in the same manner as Alternative 2; sections with a low density of historical oil and gas development, encompassing approximately 1,081,300 acres, would have current BMPs applied as COAs, as well as some additional COAs applied in order to protect resource values in these more pristine areas. The BIA would not permit new oil and gas-related ground disturbing activities in certain sensitive water supply and groundwater areas. In these areas, future oil and gas production would be reduced. As shown in **Table 4-11**, below, a total of approximately 248,800 acres of sensitive areas would not have new drilling permits approved; of those, 168,800 acres have high oil and gas development potential (BIA GIS 2017).

In low-density sections, the current drilling BMPs would be applied as COAs, and additional COAs stipulating setbacks from identified cultural sites would be added. Spacing limitations would also be applied in low-density sections.

Table 4-11
Alternative 3 No New Ground Disturbance Areas by Oil and Gas Potential

Potential	Acres	Percentage of Total Potential Level
High Potential	168,800	17%
Moderate to High Potential	33,500	12%
Moderate Potential	46,100	20%
Low to Moderate Potential	300	23%
Grand Total*	**248,800**	–

Source: BIA GIS 2017
*Due to rounding of acreages in GIS the sum of acres may not equal the grand total

As under Alternative 2, because some COAs would not be applied in high-density sections under Alternative 3, the BIA would need to submit a revised BA and reinitiate formal consultation on a new BO to incorporate the hybrid approach. Until the new BO is issued, lessees would be solely responsible for documenting compliance under ESA Section 10. Oil and gas operations could not proceed until a 45-day wait period has elapsed, unless there is no suitable habitat and the BIA is willing to make a "no effect" determination for the ABB.

The BIA would apply setbacks from identified cultural sites in low-density sections. In high-density sections, cultural site buffers would be determined by the BIA on a case-by-case basis with site-specific COAs applied as necessary for NHPA compliance.

Operations in low-density sections would be subject to additional COAs that could affect development timing or method. Areas with high oil and gas development potential are generally the same as areas of historically high-density production. Because of this, it is expected that the overall impacts of Alternative 3 on mineral extraction would be similar to those of Alternative 2. However, under this alternative, the total number of new wells drilled in the planning area is likely to be reduced, compared with Alternative 1 (No Action) and Alternative 2 due to new drilling not being permitted in certain sensitive areas.

4.16.6 Alternative 4

Under Alternative 4, current BMPs would be applied to oil and gas permits as COAs, with additional COAs applied in order to protect resource values and sensitive areas. The entire planning area would be managed in the same manner as low-density sections would be managed under Alternative 3. Additionally, BIA would not approve applications to drill in certain sensitive areas. In these areas future oil and gas production would be reduced. As shown in **Table 4-12**, below, under this alternative, a total of 524,400 acres of sensitive areas would not have new drilling permits approved. Of that, 352,000 acres has high oil and gas development potential (BIA GIS 2017).

Table 4-12
Alternative 4 No New Ground Disturbance Areas by Oil and Gas Potential

Potential	Acres	Percentage of Total Potential Level
High Potential	352,000	36%
Moderate to High Potential	86,500	32%
Moderate Potential	85,700	37%
Low to Moderate Potential	300	23%
Grand Total*	**524,400**	–

Source: BIA GIS 2017
*Due to rounding of acreages in GIS the sum of acres may not equal the grand total

For ABB compliance, the BO issued by the USFWS would establish parameters for improved efficiency of BIA consultation on other threatened and endangered species, with preliminary "no effect" or "may affect/not likely to affect" determinations. This would reduce the time required for ESA compliance and allow drilling to commence sooner in most cases.

Due to the small size of the buffers, it is anticipated that lessees would shift planned well pads to avoid buffer areas. In the event of a workover or other operation on an existing well located within a buffer, lessees would seek a waiver from the BIA.

Alternative 4 would provide clear guidelines to lessees. The closure of areas to new drilling would be expected to reduce the number of new wells drilled, compared with Alternative 1 (No Action).

4.16.7 Cumulative Impacts

The cumulative impact analysis area used to analyze cumulative impacts on mineral extraction is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect mineral extraction are other planned land use projects, such as wind farm, quarry, or casino construction, which may conflict with oil and gas development.

Alternatives Analysis

Under all alternatives, current trends for oil and gas development in the planning area are expected to continue (see **Section 4.16.2**, Impacts Common to All Alternatives). Most projects listed in **Table 4-1** are already enacted; pending projects are generally small enough in scale that they are unlikely to significantly conflict with planned oil and gas development, no matter what alternative is selected. The siting of future large footprint projects, such as quarries or casinos, could be affected by the existence of new or existing wells; therefore, managing oil and gas development under the alternatives is not expected to have cumulative impacts beyond the direct impacts described under each alternative in this section.

The Osage RFD (**Appendix A**) estimates that approximately 4,761 wells would be drilled over the next 20 years under a baseline scenario. Under Alternatives 1 and 2, it is expected that the baseline estimate would not change. Under Alternative 3, the projected total number of wells drilled would be approximately 4,011 wells over the next 20 years. Under Alternative 4, the projected total number of wells drilled would be approximately 3,095 wells over the next 20 years.

4.17 RECREATION AND SPECIAL USE AREAS

4.17.1 Methods and Assumptions

Indicators

Indicators of impacts on recreation and special use areas are as follows:

- Short- or long-term elimination or reduction of recreation opportunities, activities, or experiences throughout the planning area
- Inability of special use areas (e.g., state parks and WMAs) to provide desired recreation activities, experiences, and opportunities

Assumptions

Recreation in the planning area will continue as populations grow, with an anticipated increase in motorized recreation, swimming, boating, fishing, wildlife viewing, hiking, and camping.

4.17.2 Impacts Common to All Alternatives

Impacts on recreation primarily occur from management actions related to other resources or resource uses that result in both short- and long-term elimination or reduction of recreation opportunities, or that diminish the quality of the recreation setting and experience (e.g., reduced access, displacement of recreation activities, and the reduction of opportunities for primitive- and solitude-oriented recreation due to the increased presence of human-made facilities, noise, and roads).

Under all alternatives, oil and gas leasing could occur. Such leasing can reasonably be expected to result in oil and gas development. Continued and increased oil and gas production would include increasing developments and infrastructure that could conflict with opportunities for recreation. For example, oil and gas development could degrade hunting opportunities by introducing noise and fragmenting wildlife habitat and could adversely affect fishing due to brine spills and stream degradation.

Under all alternatives, the BIA would ensure compliance with applicable laws and regulations, such as the ESA and Section 106 of the NHPA. The BIA may waive COAs or apply additional COAs based on site-specific determinations. These measures may be applied on a case-by-case basis or up front, or a combination of both, depending on the alternative selected. A summary comparison of these COAs is provided in **Table 2-3**. Applying these COAs could reduce impacts on recreation and special use areas if they were to relocate surface disturbance away from these areas.

Surface disturbance from oil and gas development could reduce the naturalness of the landscape, reduce the scenic and acoustic quality of the recreation setting, and diminish the recreation experience for those seeking solitude and semiprimitive, nonmotorized recreation opportunities.

COA 12 would ensure deleterious substances that are displaced or produced in well completion or stimulation procedures are collected in a pit lined with plastic or a metal tank and maintained separately from other drilling fluids to allow for separate disposal. This COA would reduce the risk of deleterious substances entering surface waters used for contact recreation, such as swimming.

Hydraulic fracturing could occur in combination with conventional oil and gas development techniques under all alternatives; however, as discussed in the Osage RFD (**Appendix A**), the majority of new wells drilled during the life of this EIS are anticipated to be conventional wells. Hydraulic fracturing typically uses water from available groundwater and/or surface water resources located near hydraulically fractured oil and gas production wells (EPA 2016e), which would affect recreation more than conventional oil and gas development by reducing water levels in lakes, rivers, and reservoirs.

The development of access roads could increase the numbers of other recreationists in the area, including off-highway vehicle users and hunters. This increase could indirectly lead to an increase in undesignated, user-created travel routes and allow for increased opportunities for illegal dumping. An increase in noise associated with oil and gas well development and increased truck traffic on additional access roads could also diminish the recreation experience for those seeking solitude-based and primitive-oriented recreation opportunities. Development of additional access roads could also increase road-based recreation opportunities.

Any surface-disturbing activities that displace or otherwise disrupt the normal distribution and movement patterns of big game wildlife, or affect big game wildlife habitat, would affect hunting quality. Impacts on wildlife are discussed in detail in **Section 4.5**, Fish, Wildlife, and Migratory Birds.

4.17.3 Alternative 1 – No Action

In addition to the COAs listed in **Section 4.17.2**, the BIA would continue to apply COAs that limit impacts on recreation and special use areas. These COAs, such as prohibiting expansion or relocation of well pads and access roads not included in the approved EA for the APD, would continue to limit surface-disturbing activities. This, in turn, would protect the naturalness of the landscape and the recreation experience for those seeking solitude and semiprimitive, nonmotorized recreation. Other COAs, such as keeping sites clean and free of any litter or old equipment, would continue to protect the overall naturalness of recreation and special use areas and help prevent the creation of new dump sites.

4.17.4 Alternative 2

Under Alternative 2, in addition to the COAs listed in **Section 4.17.2**, the BIA also would apply COAs 28 and 31. These COAs would limit noise levels, visual impacts, and land applications for waste oil, wastewater, or contaminated soil. Limiting the land application of waste and contaminated soil would likely keep injurious material out of important fish and wildlife habitat, such as wetlands and riparian zones, thereby reducing impacts on recreation opportunities such as wildlife viewing.

Overall, Alternative 2 emphasizes oil and gas development and would apply the fewest COAs. This would result in increased disturbance in areas used for recreation. It also could degrade hunting opportunities by introducing noise and fragmenting wildlife habitat, when compared with Alternative 1 (No Action). Voluntary measures undertaken by lessees could mitigate impacts under this alternative.

4.17.5 Alternative 3

Under Alternative 3, in addition to the COAs that apply under all alternatives, the BIA also would apply COAs based on well development density. In low-density sections, COAs would be applied to minimize soil and vegetation disturbance. This would reduce wildlife habitat fragmentation and reduce impacts on recreation, such as hunting and wildlife viewing. In high-density sections, the impacts on recreation and special use areas would be the same as those described under Alternative 2 unless they are sensitive resource areas.

Regardless of the density of wells, new drilling would not be permitted in certain sensitive areas in order to protect groundwater and drinking water. These are also important recreation areas in the planning area; recreation opportunities would be enhanced in these areas compared with Alternative 1 (No Action) due to reduced noise and adverse visual impacts.

4.17.6 Alternative 4

Alternative 4 emphasizes enhanced resource protection. This would limit the location of surface disturbance associated with oil and gas development more than under Alternative 1 (No Action). Compared with Alternative 1 (No Action), there would be fewer impacts on recreation and special use areas. This is because more COAs, such as prohibiting nuisance through noise or adverse visual impacts, burying pipelines where appropriate, and avoiding disturbance in and near streams and waterways, would be applied. These types of COAs would keep areas available for recreation by decreasing impacts of developments and infrastructure that could conflict with recreation. Impacts on recreation and special use areas would be similar to those described under the low-density sections of Alternative 3; however, they would occur over a greater extent because the COAs would be applied to the entire planning area instead of just low-density sections.

New drilling would not be permitted in certain sensitive areas, including the Tallgrass Prairie Preserve, BLM wild horse and burrow pasture facilities, drinking water and groundwater protection areas, and state parks and WMAs; recreation opportunities would be enhanced in these areas compared with Alternative 1 (No Action) due to reduced noise and adverse visual impacts.

4.17.7 Cumulative Impacts

The cumulative impact analysis area for recreation and special use areas is the planning area and all WMAs that intersect it. The cumulative impact analysis area also extends along major roads, trails, and rivers where management inside the planning area could affect use outside the planning area boundary.

Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect recreation and special use areas are construction of infrastructure for oil and gas and other energy development, such as transmission lines, pipelines, and wind farms. These activities have the potential to affect game populations, which in turn would affect potential recreation benefits (e.g., wildlife viewing and hunting) because of the loss or gain of the number of animals.

Management of vegetation and wildlife that implements strategies to protect or rehabilitate areas would serve to maintain recreation experiences but could also restrict recreation access. In general, cumulative impacts on recreation and special use areas would likely be the lowest under Alternative 4. This would be due to the application of the most COAs over the greatest area and the greatest acreage of areas where new drilling permits would not be approved. This would reduce conflicts with recreation and enhance recreation experiences.

4.18 TRUST ASSETS AND OSAGE NATION INTERESTS

This section addresses impacts on Indian trust assets and social, cultural, and economic interests that are specific to the Osage Nation. General social and economic impacts are included in **Section 4.10**. General planning area cultural and archeological impacts are addressed in **Section 4.9**.

4.18.1 Methods and Assumptions

Indicators

The primary impact indicator for trust assets and economic interests is the extent to which actions could improve or hinder the management of assets, property, or property rights held in trust by the federal government for beneficiaries.

Social and cultural indicators include the extent to which actions affect Osage Nation traditional practices and nonmarket values.

Specific indicators relevant to the BIA decision are the following:

- Constraints on developing or using the Osage Mineral Estate, including prohibitions, timing, location, and methods of oil and gas development
- The extent to which required environmental compliance processes, constraints, and resource protection measures can be addressed more efficiently and with more certainty for lessees

- The level and value of Osage Nation mineral royalties
- The access and continued use of locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation

Assumptions

- The demand for development of the Osage Mineral Estate would continue, be affected by market forces, and remain an important source of income for headright holders.
- Taxes and royalties collected and distributed would follow the current rate structure and percentage.
- Leasing is an administrative process and would not directly affect locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation.
- Locations important to the Osage Nation would be avoided whenever possible, when considering APDs and other actions through the NHPA compliance and consultation.

4.18.2 Impacts Common to All Alternatives

Under all alternatives, oil and gas production from the Osage Mineral Estate would result in the collection of royalties that would be distributed to Osage headright holders following deductions for the gross production tax and Tribal operating expenses, as outlined in **Section 3.18**, Trust Resources and Osage Nation Interests. The level at which mineral royalties would be affected by proposed management would depend on the degree to which proposed management affected oil and gas production, as discussed below. Under all alternatives, market prices for oil and gas, which vary independent of management action selected, would continue to affect mineral royalties and contributions to the Osage Nation and headright owners.

Under all alternatives, the BIA would comply with the NHPA Section 106 process, as described in **Section 4.9**. It would consult with the Osage Nation THPO and the SHPO, when applicable. As part of that process, the THPO reviews projects for effects on locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation. It also works with members of the Osage community respected for their knowledge, understanding, and appreciation of Osage culture and heritage. All alternatives include COAs to avoid impacts on cultural sites and procedures addressing unanticipated discoveries.

4.18.3 Alternative 1 – No Action

Under Alternative 1 (No Action), management actions would support development levels at projections outlined in the Osage RFD (**Appendix A**). As outlined in **Section 4.10.3**, COAs may represent site-specific constraints and changes in siting or timing of development. Overall, however, it is not anticipated that drilling would be made uneconomical, and economic contributions from production to the Osage Nation and headright owners would continue depending on market conditions as described under **Section 4.18.2**.

The COAs under Alternative 1 (No Action) specify review of actions that may affect locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation. These reviews may reduce impacts on these resources by ensuring that potential impacts are identified and mitigated.

4.18.4 Alternative 2

Under Alternative 2, as outlined in **Section 4.10.4**, some additional liability may exist in the absence of COAs, particularly related to ESA compliance. Overall, however, economic contributions from production to the Osage Nation and headright owners would be the same as those under Alternative 1 (No Action) and would continue depending on market conditions.

The emphasis on oil and gas development and the potential increase in surface disturbance under Alternative 2 could increase the potential for oil and gas-related impacts on locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation. Many of the COAs that reduce or minimize surface disturbance would not apply under this alternative. NHPA Section 106 would still provide protections for cultural resources; however, the potential for conflicts with locations important to the Osage Nation would be greater than under Alternative 1 (No Action) based on increased surface disturbance.

4.18.5 Alternative 3

Under Alternative 3, management actions would support a varied level of development in identified high- and low-density sections. As outlined in **Section 4.10.5**, management may result in preferential development in high-density sections. Because new drilling activities would not be approved in some sensitive areas, economic contributions from production to the Osage Nation and headright owners would be reduced compared with Alternative 1 (No Action).

Alternative 3 would allow higher-density surface disturbance in high-density sections and, therefore, increase the potential for impacts on locations, sacred sites, resources, and settings within these areas. More COAs would be applied in low-density sections and designated sensitive areas, which would reduce the potential for impacts in these areas. For low-density sections, a COA specifies buffers that would be applied for protecting cultural sites. This would reduce ground disturbance and potential for other impacts. In low-density sections, impacts on locations, sacred sites, resources, and settings would likely be less than under Alternative 1 (No Action). In high-density sections, impacts would be greater than under Alternative 1 (No Action), because there are fewer protective COAs applied.

4.18.6 Alternative 4

Under Alternative 4, management actions include increased use of COAs and a policy of not approving new ground-disturbing oil and gas development in specified sensitive areas and would result in increased requirements for lessees. Economic contributions from production to the Osage Nation and headright owners could be reduced compared with Alternative 1 (No Action). The actual level of development and production and related economic effects would continue to be affected by oil and gas market conditions.

Preventing new ground disturbance from oil and gas development in some sensitive areas and applying additional COAs to protect sensitive cultural and environmental resources would reduce the potential for impacts on locations, sacred sites, resources, and settings that are traditionally important. Buffers applied as COAs for protecting cultural sites throughout the planning area could further reduce the potential for impacts.

4.18.7 Cumulative Impacts

The cumulative impact analysis area for trust assets and Osage Nation interests is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impact analysis area that have affected and will likely continue to affect trust resources and Osage Nation traditional practices are those described under current conditions in **Section 3.18**.

Oil and gas operations in the county will continue to provide income to those with headrights, supported by existing pipelines. The Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the ABB in Oklahoma (USFWS 2014a) could affect development timing or siting on a site-specific basis. This may affect the timing of subsequent economic contributions from this industry.

The Osage Nation retains trust status on a relatively small amount of land surface (approximately 1,600 acres) in the county. It has purchased 43,000 acres of the former reservation lands. The intention is to bring it into trust status to prevent future sales, promote economic development, protect natural resources, and preserve cultural values (Indian Country Today 2016).

The Osage Nation is also participating in the Land Buyback Program for Tribal Nations, which facilitates the purchase of individual fractionated interests and returns them to communal Tribal trust ownership (DOI 2015). These actions to recover control over surface lands assist the Osage Nation in economic development and promoting and preserving nonmarket cultural values.

Proposed projects that could affect access to and continued use of locations, sacred sites, resources, and settings that are traditionally important to the Osage Nation are wind farms, transportation routes, road and bridge improvements, and the continued oil and gas development proposed under all alternatives.

Alternatives Analysis

Under Alternative 1 (No Action), COAs for oil and gas development could result in site-specific limitations on development; however, drilling in the planning area should remain economically feasible, and contributions to jobs and economic output would continue. Sensitive area closures and COAs may reduce cumulative contributions from disturbance and development. This would include impacts on quality of life and nonmarket values of clean air and water and the visual landscape.

Contributions to cumulative impacts from development on the quality of life, nonmarket values, and other land uses would be increased under Alternative 2.

Alternative 3 may encourage development in specific portions of the planning area; however, overall contributions are likely to remain similar to those under Alternative 1 (No Action). Under Alternative 4, impacts on quality of life, nonmarket values, and other land uses would decrease.

The exact level of impact would depend on market conditions, the technology used, and site-specific restrictions implemented under any alternative.

Chapter 5.
Consultation and Coordination

5.1 INTRODUCTION

In accordance with requirements set forth in NEPA, Title 40 CFR, Section 1506.3(c), and the CEQ, the BIA conducted consultation and coordination when preparing this EIS. This was done to ensure that appropriate members of the public, Tribes, and federal, state, and local agencies were contacted, consulted, and given an adequate opportunity to be involved in the process.

This chapter describes the internal and public scoping process, Tribal consultation, cooperating agency involvement, and additional consultations and public involvement activities.

5.2 PUBLIC SCOPING

The BIA held two formal scoping periods to involve the public in identifying significant issues related to its potential land use management actions. The first public scoping period was completed as part of the OKT Joint EIS/BLM RMP/BIA IRMP scoping period. Osage County is in the planning area for this joint document.

The subject of the Osage County Oil and Gas EIS—oil and gas development in Osage County—was part of the OKT Joint EIS/BLM RMP/BIA IRMP scoping. The scoping period began on July 26, 2013, with the publication of a NOI in the *Federal Register*, and concluded on January 31, 2014. As part of the scoping period, the BIA held a public meeting in Pawhuska, Oklahoma, on January 15, 2014. The final scoping report for this first public scoping period is available at the public website for the OKT Joint EIS/BLM RMP/BIA IRMP, https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=renderDefaultPlanOrProjectSite&projectId=72142.

Following the first public scoping period, the Osage Nation requested that the analysis of oil and gas development in Osage County be expedited. As a result, the BIA removed the Osage County Oil & Gas EIS from the OKT Joint EIS/BLM

RMP/BIA IRMP and prepared the EIS as a separate document. In November 2015, the BIA published the Osage County Oil and Gas Draft EIS. Following the public comment period, the BIA determined that the 2015 Draft EIS should be revised in order to address comments received and to take additional information into consideration.

On April 11, 2016, the BIA published the NOI to revise the 2015 Draft EIS. This initiated the second formal scoping period, which concluded on May 8, 2016. During this scoping period, a public scoping meeting was held in Pawhuska, Oklahoma, on April 28, 2016. Meeting materials and the final scoping report for this second public scoping period are available at the project website, https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis.

The scoping periods provided an opportunity for individuals from federal, state, and local agencies, tribes, interest groups, and the general public to express their comments and to provide meaningful input via email, letters, and participation in the public scoping meetings. The BIA used the information collected during the second scoping period to formulate the alternatives for this EIS. Issues addressed in the Osage County Oil and Gas EIS through the scoping periods are presented in **Section 1.8.2**, Issues.

5.3 COLLABORATION

Federal laws require the BIA to consult with certain federal and state agencies and entities and Native American tribes (40 CFR, Subsection 1502.25) during the NEPA decision-making process. The BIA is also directed to integrate NEPA requirements with other environmental review and consultation requirements to reduce paperwork and delays (40 CFR, Subsection 1500.4-5).

The BIA will also hold a Draft EIS meeting with the public and cooperating agencies. The BIA will continue to meet with interested agencies and organizations throughout the planning process, as appropriate, and will continue coordinating closely with cooperating agencies.

5.3.1 Tribal Consultation

The BIA sent the Osage Nation a written invitation on January 2, 2015, to participate in the EIS on a government-to-government basis. The Osage were invited to participate on a variety of issues related to the EIS, including mineral development and cultural concerns. Government-to-government consultation between the BIA and the Osage Nation has been ongoing since November of 2014.

5.3.2 Cooperating Agency Involvement

In March 2014, the BLM and BIA wrote to appropriate local, state, federal, and tribal representatives, inviting them to participate as cooperating agencies and entities for the OKT Joint EIS/BLM RMP/BIA IRMP. At the time these invitations were sent, oil and gas leasing and development in Osage County was within the scope of the joint document.

After deciding to separate and accelerate the Osage County Oil and Gas EIS, the BIA sent separate written invitations to seven eligible federal agencies, state and local governments, the Osage Nation, and the Osage Minerals Council to participate as cooperating agencies and entities during the development of the EIS. These invitations were sent on January 2, 2015. Those who accepted cooperating agency or entity status for this EIS are the following:

- EPA Region 6
- The Osage Minerals Council
- The Osage Nation
- The US Geological Survey

Cooperating agencies and entities are engaged throughout the planning process, including participating in alternatives development and reviewing and commenting on draft sections of this Draft EIS. They were invited to attend all public meetings, as described in **Section 5.4.1**, Public Meetings.

5.3.3 National Historic Preservation Act Section 106 Consultation

The BIA is also engaging in NHPA Section 106 consultation with the SHPO and the Osage Nation THPO.

On January 15, 2015, the BIA notified by mail the Osage Nation THPO, Deputy SHPO, and the State Archeologist (at the Oklahoma Archeology Survey) of the EIS. This letter invited comment on the potential for historic properties and sensitive cultural properties that may be affected by planning decisions in the EIS.

In addition, on March 9, 2015, and at the suggestion of the SHPO, the BIA contacted Preservation Oklahoma, Inc., and the Osage County Historical Museum to notify them of the EIS and request information.

Consultation continued and information was requested throughout the development of the Draft EIS, including input on planning actions and alternatives and assessment of the potential effects. The BIA will continue consultation as needed through the completion of the EIS. In accordance with the NHPA, the BIA will make a determination of effect for the planning actions considered in the EIS and will notify the SHPO and Osage Nation THPO for review.

5.3.4 Endangered Species Act Section 7 Consultation

To comply with Section 7(c) of the ESA, the BIA is conducting ESA Section 7 consultation with the USFWS through the development of a BA. The BIA submitted a BA to the USFWS in July 2017, and the USFWS issued a BO and letter of concurrence with the BIA's effects determinations in July 2018 (see **Appendix B**).

5.4 Additional Public Involvement and Scoping

5.4.1 Public Meetings

In addition to the scoping meetings described in **Section 5.2**, Public Scoping, the BIA hosted additional public meetings to offer the public the opportunity to provide input throughout the EIS process.

As part of the 2015 Draft EIS, the BIA hosted a public listening session on March 9, 2015, at the Wah-Zha-Zhi Cultural Center (1449 W. Main, Pawhuska, Oklahoma). As part of the process to prepare a new EIS, the BIA held a second alternatives listening session on April 6, 2017, at the same location. The listening session began with a short presentation providing background information on the EIS process and additional detail on the COAs that were being considered under each alternative. Following the presentation, the BIA invited written comment and verbal input on the draft alternatives from members of the public.

The BIA will also host a public meeting following publication of this Draft EIS to provide information on the EIS, to collect written comments, and to answer questions about the process.

5.4.2 Project Website and Email Address

The BIA maintains an interactive website to provide the public with the latest information about the EIS process (https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis). The website provides background information about the project, a public comment card, information on involvement opportunities, and copies of public information documents, such as the NOI and newsletter.

The BIA also created a project email address (osagecountyoilandgaseis@bia.gov) for the public to use to offer comments and subscribe to the project mailing list.

5.4.3 Mailing List

The BIA maintains a mailing list that includes individuals who attend public meetings, those who request to be on the mailing list, and relevant agencies and organizations, including those that were contacted for possible cooperating agency status. Requests to be added to or to remain on the mailing list will continue to be accepted throughout the EIS process.

Appendix A

Reasonably Foreseeable Development Scenario

Reasonably Foreseeable Development Scenario

Osage County, Oklahoma

Photo by Nate Billings, The Oklahoman

Prepared By:

Craig Williamson
Petroleum Engineer
Indian Energy Service Center

Sue Mehlhoff
Branch Chief, Engineering
Indian Energy Service Center

Contents

Figures

Tables

I. Summary

The subsurface mineral estate in Osage County, Oklahoma (“Osage Mineral Estate”) is held in trust by the United States for the benefit of the Osage Nation. Act of June 28, 1906, 34 Stat. 539, as amended. The planning area for the Osage County Oil and Gas Environmental Impact Statement (EIS) includes the entire Osage Mineral Estate, which is approximately 1,474,500 acres.

This Reasonably Foreseeable Development Scenario (“RFD”) for Osage County analyzes historical oil and gas well activity and prices to project drilling activity and surface disturbance in the planning area for the next 20 years (2018-2037). Oil and gas price data for Osage County is available through 2015. The data indicates that since 2011, there has been a decline in new well activity in Osage County, despite the fact that oil prices continued to rise through 2014. This decline roughly coincides with an increase in environmental protections resulting from the identification of endangered species habitat in Osage County, regulatory uncertainty, a rise in litigation relating to oil and gas operations, and a significant drop in oil prices nationwide. Other external factors may have also contributed to this decline. For these reasons, the RFD does not analyze the correlation between well activity and pricing beyond the year 2010.

Assuming that the oil and gas markets normalize and that external factors are neutral, it is reasonably foreseeable that 4,761 new wells could be drilled in Osage County between 2018 and 2037. With an estimated surface disturbance of 2 acres per well, the county can expect a gross disturbance of 9,522 acres during this time frame. Taking into account potential interim reclamation, the net surface disturbance is estimated to be approximately 3,571 acres.

Though Osage County has historically been dominated by oil fields, newer gas fields have provided a significant contribution to the county’s development. Historically, oil wells accounted for over 80 percent of the total wells drilled in Osage County, while gas wells made up less than 10 percent. Injection, disposal and service wells accounted for the remaining wells drilled. Since 2000, the number of gas wells drilled has increased due to the development of coal-bed methane and shale gas formations. Gas wells have accounted for 32 percent of the total wells drilled in Osage County from 2000 through 2016, while oil wells have accounted for just over 61 percent. Though not as dominant in recent years, oil wells remain the majority of new wells drilled as development continues in the same formations that have been major producers for the past century.

While activity has declined in Osage County, oil and gas resources remain in the ground and approximately 823,301 acres remain available for lease. Although recent drilling rates are below the anticipated RFD projection, operators continue to negotiate leases of the Osage Mineral Estate. It is expected that activity will gradually resume and approach the projected figures as commodity prices increase and regulatory processes become more efficient.

II. Introduction

A. Background

In July 2013, the Bureau of Land Management (BLM) issued a Notice of Intent to partner with the Bureau of Indian Affairs (BIA) in preparation of a joint Environmental Impact Statement for the Oklahoma, Kansas, and Texas planning area ("OKT Joint EIS"). When scoping for the OKT Joint EIS began, analysis of the Osage County oil and gas program was contemplated as part of the project. However, in response to issues raised during scoping, and at the request of the Osage Nation, in 2014, BIA decided to prepare the Osage County Oil and Gas EIS separate from the OKT Joint EIS, on an expedited basis.

In November 2015, the BIA published the Draft Osage County Oil and Gas EIS ("2015 DEIS"). Thereafter, the BIA determined that the 2015 DEIS needed to be re-scoped and revised to address public comments received and take additional information into consideration. The BIA reinitiated public scoping for the Osage County Oil and Gas EIS in April 2016. This RFD was prepared at the request of the BIA to provide analysis in support of the new Draft Osage County Oil and Gas EIS.

B. Purpose and Scope of the RFD

The RFD is a long-term, reasonable projection of anticipated oil and gas development and surface disturbance expected to occur on lands within the planning area over a specific period of time. These projections are technical approximations based on the best available information regarding geology and past and present development in the planning area. The RFD provides basic technical information that is used to perform a thorough environmental analysis of the direct, indirect, and cumulative effects that could reasonably be expected as a result of the Osage oil and gas program. The baseline information presented in the RFD will facilitate consideration of the potential effect of various management alternatives set forth in the Osage County Oil and Gas EIS.

Since the majority of the Osage Agency's oil and gas records have not been digitized, the primary source of historical well and producing formation data for the RFD analysis was the IHS Enerdeq (IHS) online oil and gas database. IHS provides a variety of information and analytics solutions across numerous industries, and is a well-known source for oil and gas information. The Osage Agency provided internally verified geographic information system (GIS) well location data, which was used to cross check and verify the IHS well data.

Prior to comparing the IHS and Osage Agency well data, both data sets were reviewed to identify and remove wells that were not actually drilled. As a result of this review, abandoned locations, canceled permits, and permitted wells lacking spud dates were removed from the IHS data. In addition, wells with the status indicating location only and that showed zero well depth were removed from the Osage Agency data. When comparing the two data sets, the numbers of total wells were within 1.6 percent of one another.

The number of oil wells and gas wells in the IHS and Osage Agency data sets was also similar, though an accurate comparison ratio could not be determined due to differences in the way each data set reports well status, particularly with respect to abandoned wells. Osage Agency data has a larger number of abandoned wells than IHS data. Further, the Osage Agency data has more abandoned wells that have not been segregated and identified as either oil or gas wells. This discrepancy between the two data sets does not affect the analysis and projections set forth in the RFD however. The similarity in well production types and small difference in the number of total wells between each data set provides confidence in the overall trends derived from the IHS data. Accordingly, it is reasonable to assume that if all abandoned wells were segregated, both oil wells and gas wells would correlate closely between the two data sets, as was the case with the total number of wells.

The well locations from each data set were then plotted to visually compare the distribution of wells across the county. The two maps showed very similar concentrations, which reinforced the confidence in the IHS data. The maps can be seen in Figure 10 and 11 in the Appendix. Some variation between the maps may be due to differences in the size of well location symbols and their order of overlay.

All price data used throughout the RFD was pulled from the U.S. Energy Information Administration (EIA) website. Annual historical data includes the Cushing, Oklahoma West Texas Intermediate (WTI) Spot Price Free On Board (FOB) and the Henry Hub Natural Gas Spot Price. FOB refers to the shipment of goods, in which the seller is responsible for the costs of transporting the goods to the port of shipment and loading. The buyer is responsible for costs from that point on. Both the WTI oil price and Henry Hub natural gas price are linked to the New York Mercantile Exchange, Inc. (NYMEX), the world's largest physical commodity futures exchange. Price projections for oil and natural gas came from EIA's, Annual Energy Outlook 2017.

III. Description of Geology

The Cherokee Basin or Cherokee Platform Province is located in the Mid-Continent region, stretching from southeastern Kansas and part of southwestern Missouri down into northeastern Oklahoma. The Province is 235 miles long by 210 miles wide, and consists of 37 counties with an area of 26,500 square miles (Charpentier et al., 1995). Osage County, which consists of 2,303.8 square miles, or roughly 1.5 million acres, lies in the lower half of the Province, located in northeastern Oklahoma. Figure 1 from the Oklahoma Geological Survey (Northcutt, Campbell, 1998) shows the location of Osage County within the state of Oklahoma and within the lower portion of the Cherokee Platform Province.

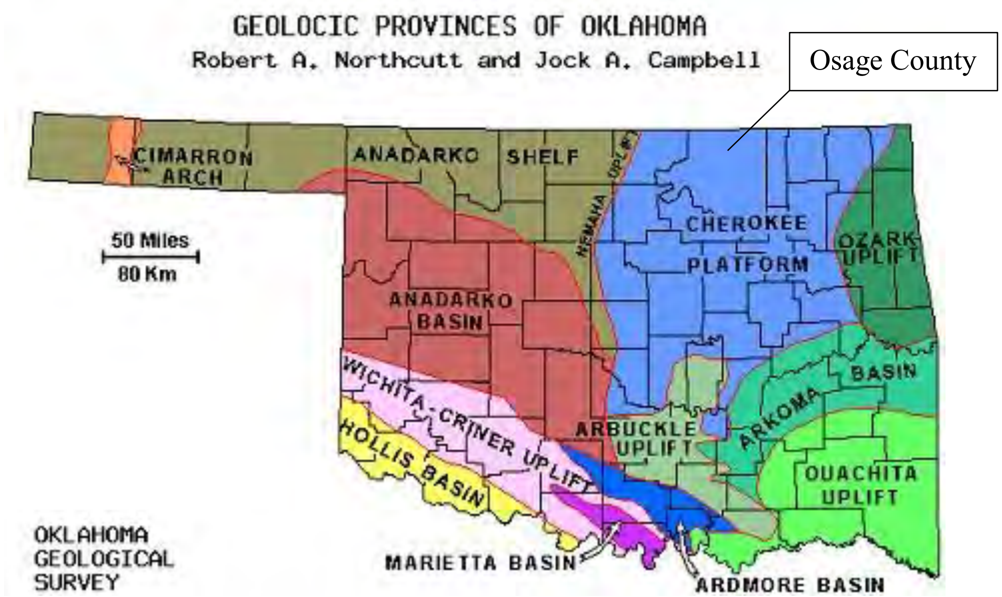


Figure 1. Map of Oklahoma Showing Oil and Gas Basins and County Outlines.

The United States Geological Survey (USGS) published an assessment of the Cherokee Platform Province Area in September 2015 (Drake II et al., 2015). Within that area, three total petroleum systems (TPS) were defined: Paleozoic Composite TPS, Woodford/Chattanooga TPS, and Desmoinesian Coal TPS. The Paleozoic Composite TPS contains conventional hydrocarbon resources and draws most of those hydrocarbons from the Woodford/Chattanooga Shale. Minor sources also include the Middle Ordovician shale and limestone, and Middle and Upper Pennsylvanian marine black shale. The Woodford/Chattanooga Shale TPS and Desmoinesian Coal TPS both contain continuous or unconventional resources.

Within the three TPS's the USGS identified four assessment units (AUs): Paleozoic Conventional AU, Woodford Biogenic AU, Woodford Shale Oil AU and Desmoinesian Coalbed Gas AU. All of Osage County lies within the Paleozoic Conventional and Woodford Shale Oil AUs. Other than a small portion in the northwest, the majority of Osage County falls within the Desmoinesian Coalbed Gas AU. The Woodford Biogenic AU lies east of the county, containing no Osage minerals. Figure 2, from the USGS Cherokee Platform Assessment, shows the AU boundaries relative to Osage County.

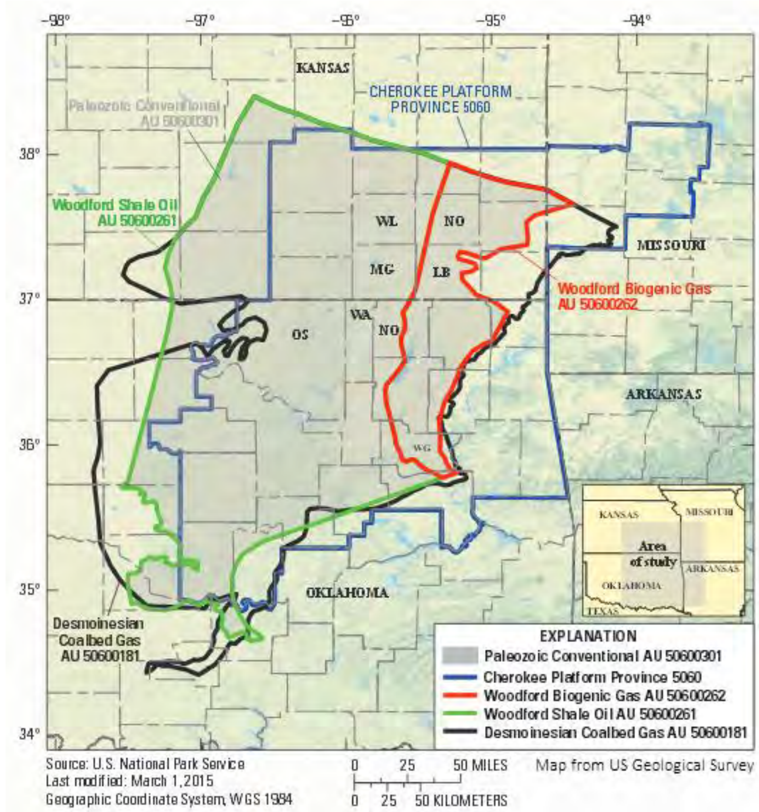


Figure 2. Location of the Cherokee Platform Province and the USGS Oil and Gas Assessment Unit Boundaries. Osage County is marked, OS.

The primary discussion for activity and development will focus on the Pennsylvanian, Mississippian and Ordovician systems. These systems represent geologic periods, which are subdivisions of the Paleozoic era. Systems are further subdivided into series. The Ordovician period dates from over 485 million years to over 440 million years ago (Cohen et al., 2017). From the Oklahoma Geological Survey's Stratigraphic Guide to Oklahoma Oil and Gas Reservoirs (stratigraphy chart), the system primarily contains sections of sandstone with thinner carbonate formations above and below (Boyd, 2008). The Arbuckle, a carbonate formation that sits at the very bottom of the Ordovician, has been the largest producing formation within that system for Osage County. Most of the formation is Ordovician, Canadian series, though the lower portion falls within the Croixan series of the Cambrian system.

The Mississippian and Pennsylvanian systems are within the Carboniferous period, beginning nearly 359 million years ago and lasting 60 million years (Cohen et al., 2017). The Mississippian system contains mostly carbonate formations as well as a couple of shales. The Mississippian formations, which include the Mississippian, Mississippian Lime, Mississippian Solid, Mississippian Chat, Mississippian Chert, and Chat fall within the Meramecian and Osagean series and have been among the most targeted and produced formations in the county. Though this is not a comprehensive list of all formations within the Mississippian system, for purposes of this RFD, this list will be referred to as the Mississippian formations.

The Pennsylvanian system sits above the Mississippian and consists of many alternating layers of sandstone, carbonate, shale and coal bed formations. Similar to the Mississippian, some of these formations have been among the most targeted and produced in the county throughout the last century. The most active of these formations lie within the Desmoinesian series and include the Bartlesville, Burbank and Wayside formations. The depths of these formations vary widely throughout Osage County.

A comparison of each well's drilled total depth (TD) to the formation at TD in the IHS well data indicated that the Arbuckle had depths ranging from nearly 1,700 feet to over 6,000 feet, with most TDs occurring in the 2,000 to 3,000 feet range. Mississippian system TDs varied from less than 1,000 feet to more than 8,000 feet, with most TDs falling between 1,000 and 3,000 feet. Pennsylvanian system TDs varied from the low hundreds to over 5,000 feet. Similar to the Mississippian system, most TDs in the Pennsylvanian system were between 1,000 and 3,000 feet.

IV. Past and Present Oil and Gas Exploration Activity

Osage County exploration began in the late 1890's, and major producing formations continued to be discovered through the first half of the twentieth century. The height of activity came in 1920 with 2,044 well spuds during the Burbank discovery. Drilling activity spiked again in 1956 with 1,586 well spuds. The last major spike occurred in 1980 when 1,116 wells were spudded. Over the years, exploration slowed as operator activity focused more on developing the county's proven formations.

Success rates in Osage County have been good historically and have improved over time. The historical success rate from the late 1890's through 2016 is approximately 78 percent. However, the success rate from 2000 through 2016 is over 95 percent. To calculate success rates, the number of wells intended to produce but listed in the IHS data as "drilled and abandoned," was subtracted from the total number of wells intended to produce, for the relevant time period. The resulting ratio of those wells to the total wells intended to produce was used to calculate a percentage of successful wells.

Relatively recent exploration of gas producing formations occurred primarily in the southern part of the county beginning in the mid-to-late 1990's. Most of these formations have been Pennsylvanian Desmoinesian coal beds producing methane gas. Notable formations include the Bluejacket, Dawson, Mulky, Iron Post, and Weir-Pittsburgh coal beds. The story is very similar for each of these formations in that activity began in the mid-to-late 1990's and increased during the 2000's until natural gas prices fell in 2008. There has been little to no new activity in any of these formations since.

One notable non-coal bed target has been the Nuyaka Creek black shale bed. The Nuyaka is also a gas producing formation, often produced along with the coal beds discussed above. It is also within the Pennsylvanian system, just above the Desmoinesian series in the Missourian series. Nuyaka activity began in 2004 and increased over the next few years until 2008 when natural gas prices fell. There has been no new activity in the shale formation since.

The most recent significant development in Oklahoma has been the Woodford Shale play. Though the Woodford Shale was first produced in 1939 in southeast Oklahoma, historically, it was a very rarely targeted formation (Vulgamore et al., 2007). New completion techniques and increased gas prices in the early 2000's made the Woodford Shale a much more attractive play. While the Woodford has been a major gas play in other parts of Oklahoma, it also produces oil depending on location. This can be seen in neighboring counties to the southwest. The thermal maturity of the Woodford under Osage County makes it more suited for producing oil than gas. Unfortunately, Osage County is located in an area where the Woodford is thin and lacks necessary biogenic silica. The silica makes the shale brittle and creates natural fractures crucial for oil extraction (Cardot, 2015). As a result, there has been very little Woodford exploration in the county.

V. Past and Present Oil and Gas Development Activity

A. Leasing Activity and Spacing

Currently, according to Osage Agency data, approximately 651,199 acres are leased for oil and/or gas development, or otherwise held by concession agreements, with 823,301 acres still available for leasing. The BIA does not have specific spacing orders in Osage County. However, pursuant to 25 C.F.R. § 226.33, drilling is not permitted within 300 feet of the lease boundary, and no wells or tanks can be sited within 200 feet of a public highway, established watering place, or any building used as a dwelling, granary or barn, except with written permission of the Osage Agency Superintendent.

B. Concession Agreements

Through the years, the Osage Tribal Council, and later the Osage Minerals Council, entered into a number of oil and gas concession agreements. These written agreements provide exclusive rights for a company to conduct exploration and development activities including geophysical surveys, leasing, and drilling within the designated concession area for the life of the agreement. The terms and conditions in concession agreements were previously negotiated by the Osage Tribal Council and are currently negotiated by the Osage Minerals Council, which may amend and modify all existing concession agreements and grant extensions of the original terms thereof. There are presently six active concession agreements in Osage County. Due to multiple extensions of the original terms, these six concession agreements have been in effect for an average of 13 years. The net effect of these agreements is a significant reduction in the acreage available for leasing through open competition among oil and gas operators. As seen in Figure 9 in the Appendix, Osage Agency data indicates that the six active concession agreements cover approximately half of Osage County's total acreage.

C. Drilling Activity by Well Type

Based on IHS data, between the late 1890's and 2016, over 42,000 wells have been drilled and completed in Osage County. Drilling activity was divided into three separate categories for the purpose of analysis and discussion in the RFD: (1) well type; (2) producing formations; and (3) hole direction. To facilitate this analysis, the wells were plotted on separate county maps for each of these three categories. These maps are included in the Appendix and will be referenced in the following discussion.

Well types were divided into wells reported as oil wells, gas wells, both oil and gas wells, injection/disposal/service (IDS) wells, abandoned wells and unknown/unreported wells. Oil wells dominate the county accounting for over 62 percent of all drilled wells. Gas wells account for just over 7 percent, and IDS wells for 6.5 percent. These percentages do not include abandoned wells, which were not divided by original well type for the purpose of this section, or unknown/unreported wells, for which information regarding original well type is not available.

To account for the well type distribution within the abandoned and unknown/unreported wells groups, the ratios of oil, gas, and IDS wells listed above were applied to the total numbers of abandoned and unknown/unreported wells. With the addition of abandoned and unknown/unreported wells to the calculation of total well type distribution in Osage County, oil wells account for nearly 82 percent of all wells drilled, gas wells for over 9 percent, and IDS wells for approximately 8.5 percent. Wells listed as both oil and gas accounted for less than half a percent of the total wells.

Figure 10 in the Appendix shows a map of all wells drilled in the county by well type. The geographical distribution shows the historical dominance of oil focused activity throughout the county. The high concentration of IDS wells in the northwest is mainly due to injection wells being used to flood the Burbank formation as part of secondary and enhanced oil recovery (EOR) projects. Phillips Petroleum Corp. used water injection wells in the late 1950's, and Chaparral Energy, Inc. began using CO_2 injection wells in 2013 to recover additional oil trapped in the ground (Wilmoth, 2013).

Focusing on recent activity, though the majority of new wells drilled in Osage County are oil wells, the ratio of new oil wells to total wells drilled has dropped. Oil wells make up just over 61 percent of all wells drilled since 2000, while gas wells have increased to over 32 percent and IDS wells account for less than 6 percent. The higher number of new gas wells is likely due to an increase in natural gas prices between 2000 and 2008, and exploration and development of the coal-bed methane (CBM) and shale gas formations previously discussed. It should be noted that while there was a decline in the number of new oil wells drilled in Osage County beginning in 2010, oil prices remained high into 2014. Accordingly, it is possible that in the absence of the external factors that influenced drilling during that time, oil wells would account for a higher percentage of wells drilled. Figures 3 and 4 show the trends of new drilling activity in relation to commodity prices.

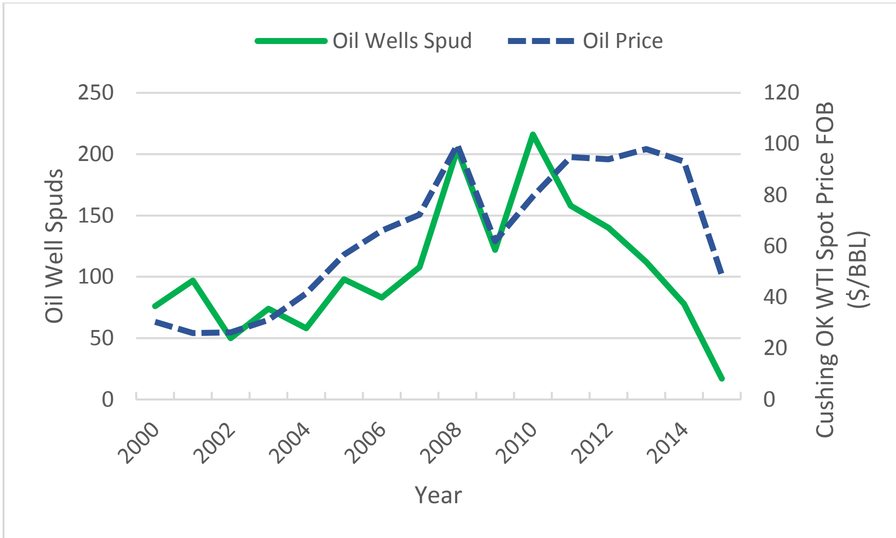


Figure 3. Oil Well Spuds compared to WTI Oil Price from 2000 through 2015.

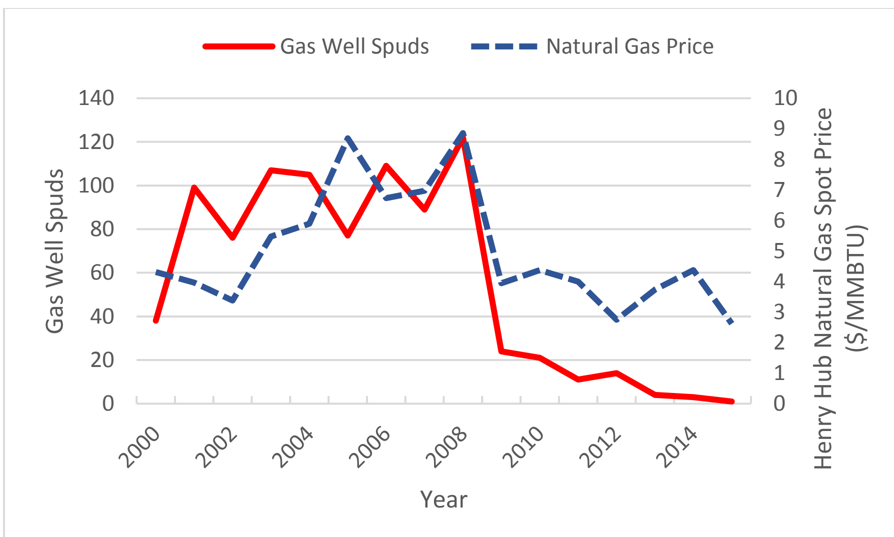


Figure 4. Gas Well Spuds compared to Henry Hub Natural Gas Price from 2000 through 2015.

D. Drilling Activity by Formation

Consistent with well type data, producing formations in Osage County have historically been primarily oil producing. The ranking of formations varies whether looking at production zone or initial production (IP) formation data. These two categories were pulled from two different data reports within the IHS database, and while both are valuable, there is significantly more data available for IP formation. Therefore, the RFD relies primarily on IP formation to assess formation activity. Regardless of the exact rank, the same formations are among the top of the lists in both reports.

The most targeted formations have clearly been Pennsylvanian, Desmoinesian sandstones, and Mississippian, Meramecian and Osagean carbonates. The Bartlesville has been by far the most targeted formation in Osage County with over 3.5 times the activity of the next most active Pennsylvanian formation, the Burbank, and over 1.5 times the Mississippian formations combined. The Mississippian Chert, listed second to the Bartlesville, has been the most targeted Mississippian formation.

Figure 12 in the Appendix shows a map of well spuds for the top five formations in terms of initial production formation. Though the lithology, reservoir characteristics and trapping mechanisms for each Mississippian formation may differ, they have been grouped together for simplicity. The stratigraphy chart referenced in this RFD groups them together as well. While IP formation data was not available for all wells, the map effectively shows the bigger picture development trend for the most targeted formations as well as the dominance of those formations in different parts of Osage County. While activity in the Bartlesville and Mississippian formations has been spread out over large areas of the county, the Burbank has a much tighter, denser concentration of activity.

Though Pennsylvanian and Mississippian wells have been drilled throughout the county, many have been concentrated in a couple of major fields. The Burbank and the Domes-Pond Creek fields have each had more than three times the activity of any other fields in the county. The Burbank field, located in the northwestern quarter of the county, has been a major field for the Burbank formation, as the name would suggest. The Domes-Creek field in the northeast has been a productive area for the Bartlesville and Mississippian formations in particular.

Many of the county's most targeted formations historically have remained heavily targeted in recent years. From IP formation data, the top five remain Pennsylvanian and Mississippian formations. While there is more variation in formation rankings between production zone and IP formation data after 2000, looking at the top 10 to 15 formations on each list, there is a consistent trend in the overall recent development. As with well type, higher gas prices and new gas exploration had a significant impact on the development picture in Osage County.

CBM and shale development made the Osage City field the most active field in Osage County since 2000. The Osage City field is located on the southeastern edge of the county. Further demonstrating the recent significance of gas production, both the Arbuckle and Bartlesville, traditionally more focused on oil production, have shown much higher ratios of gas wells to total wells since 2000. While the CBM and shale formations have played a vital role in the county's oil and gas development, they have not eclipsed the dominance of the top Pennsylvanian and Mississippian oil formations that have continued to produce over the course of the last century.

E. Drilling Activity by Hole Direction

Horizontal and directional wells are typically used to reach minerals where the surface above is inaccessible, in order to reduce the surface footprint while developing a larger producible area, or to take advantage of geological features such as natural fractures and faults. Horizontal and directional drilling methods did not gain prominence until the early to mid-2000's, although such methods existed well before that time. As would be expected due to the age of the oil fields in Osage County, vertical wells make up the vast majority of wells drilled in the county. Figure 13 in the Appendix shows a map of wells in Osage County represented by drilled hole direction.

Looking more recently, from 2000 through 2016, vertical wells account for the majority of the 2,753 new well spuds. Over 91 percent of wells spudded since 2000 have been vertical, with just over 7 percent horizontal, and just under 1.4 percent directional. Potential reasons for the low numbers of horizontal wells include lack of available unconventional resource plays, and higher drilling and completion costs for horizontal wells.

The Woodford Shale is an example of a popular unconventional resource play in other parts of Oklahoma, where horizontal drilling has been an economic way of exploiting that resource. Noble County is a neighboring county to the southwest where the Woodford is thicker, making it more producible, and horizontal drilling has been used almost exclusively to develop it. Since 2000, 77 of 79 Noble County Woodford wells have been horizontal. As discussed in Section IV, geologic conditions in Osage County make it very difficult to produce the Woodford and provide little incentive to drill horizontal wells.

Horizontal wells in Osage County have typically targeted the Mississippian formations, followed by shale gas and CBM formations. According to the Osage Agency, horizontal wells in Osage County have had little success. As reported by Osage News, two large operators, Encana Corporation and Chaparral Energy, LLC, shut down their expensive horizontal well operations in Osage County due to poor returns. The article further noted that drilling and completion of horizontal wells can cost up to $2.8 million (Shaw Duty, 2013).

A 2012 drilling program presentation by Constellation Energy Partners estimated their vertical wells targeting Pennsylvanian and Mississippian formations in the Cherokee Basin would cost between $175,000 and $375,000 each (Constellation, 2012). Given these dollar figures, horizontal well costs could be up to 16 times the vertical well costs. Vertical wells have proven capable of producing Osage minerals for more than a century. Accordingly, the high drilling costs associated with horizontal wells, when coupled with the low success rates of such wells in Osage County, provide little incentive for new horizontal drilling operations absent future discoveries, technological advancements, or other catalysts.

F. Production

Analyzing production for Osage County is difficult due to the lack of data in a useable digital format. In addition, production is reported by lease rather than by well in Osage County, making it impractical to generate well or formation specific decline curves. If a decline curve could be generated, it would be difficult to know how representative of the field it was. For these reasons, it is not practical to calculate estimated ultimate recoveries for the various targeted formations. The Osage Agency did have countywide useable monthly data from 2007 through 2015 for oil, and from 2007 through March 2016 for gas and natural gas liquids. That data is plotted below in Figure 5.

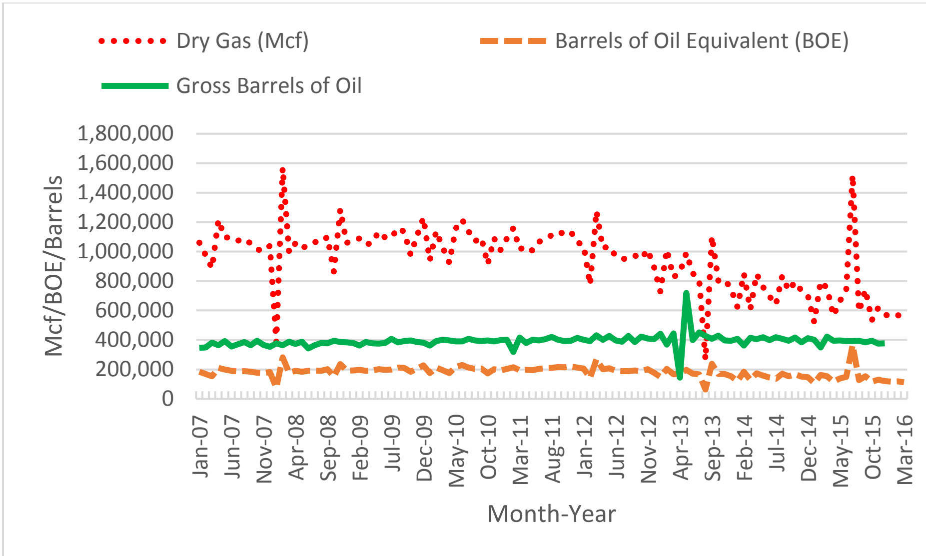


Figure 5. Monthly Production for Oil and Gas in Osage County.

Oil production has remained consistent through 2015, staying close to 400,000 barrels per month despite the drop off in new activity since 2010. Dry gas production has been in a downtrend since 2010, falling from a peak of over 1,000,000 Mcf per month to less than 600,000 Mcf per month. This trend is expected given the fall in natural gas price in 2008. A conversion to barrels of oil equivalent (BOE) is a way to combine more than one product type (e.g. oil, gas and natural gas liquids) into one equivalent measurement. In Figure 5, BOE is representative of dry gas combined with natural gas liquids. This is in a downtrend as well since late 2012, falling from around 200,000 BOE per month to less than 125,000 BOE per month. The large fluctuation spikes may be due to reporting discrepancies and subsequent corrections.

G. Infrastructure

With the long history of development in Osage County, there is an existing network of oil and gas pipelines and infrastructure. Today, virtually all oil purchased in Osage County is transported by truck to nearby Oklahoma and Kansas refineries or to pipeline facilities located within the county. In light of Osage County's proximity to major oil refineries, lack of transport capability is not expected to be an obstacle to future oil development. Osage County gas infrastructure is more complicated however.

While there are existing gas pipelines in Osage County, as seen in Figure 14 of the Appendix, much of this infrastructure is currently owned by one operator. Osage County gas producers and the Osage Minerals Council have expressed concern that the existing gas pipeline infrastructure is insufficient and that producers have experienced difficulty negotiating contracts with pipeline operators due to the small number of such operators present in Osage County, prohibitive infrastructure costs, and low production volumes, among other things. Despite these longstanding issues, gas development in Osage County has continued to increase over time. Accordingly, since this RFD does not project that future development will exceed historical levels, these issues are not expected to pose a significant barrier to future development.

VI. Oil and Gas Occurrence and Development Potential

Occurrence potential is the potential for oil and gas resources to be present in a certain area. Development potential is the potential for economic development of those resources. To demonstrate the difference, oil and gas may exist in an area where, due to various economic and/or geologic factors, the resources are not recoverable. If this were the case, occurrence potential may be high while development potential would be low. Development potential can change over time with the advent of new technology and increased commodity prices. Owing to extensive oil and gas exploration and development over the past century, occurrence and development potential in Osage County are well known and highly correlated. Therefore, this section will focus solely on development potential.

The BLM Oklahoma Field Office prepared a RFD for all of Oklahoma, Kansas, and Texas ("OKT RFD") as part of the OKT Joint EIS discussed in Section II.A. (Stong, 2015). In the OKT RFD, the BLM classified areas throughout the three states based on their oil and gas development potential. The methodology used to classify the different levels of potential was as follows: identify and map all wells drilled in the planning area, select wells that have been tested or have produced, select wells currently producing, and establish buffer areas around the selected wells, identifying them either as "hydrocarbon potential emplacement footprint" or "currently producing." Areas were then classified in a range from "no potential" to "high potential" based on where they fell in relation to the wells and their buffer areas.

Figure 15 in the Appendix, taken from the OKT RFD, shows a map of oil and gas development potential in Oklahoma, Kansas and Texas. Looking specifically at Osage County, the entire county is within the "moderate potential" to "high potential" range, with most of the county in the "high potential" range. A band stretching vertically through the middle of the county represents "moderate to high potential." "Moderate potential" has some scattered sections with the highest concentration in the northwest. However, much of that northwest "moderate potential" area is held by concession agreement or heavily populated by Burbank IDS wells.

Minerals in the northwest may have more potential than previously realized. According to an online article on Oil & Gas 360, Petro River Oil Company, a publicly traded oil company, has plans to continue drilling in Osage County (Enercom, 2016). The company has conducted 3D seismic analysis, which it believes shows abundant oil potential in the Pennsylvanian and Mississippian systems in the northwestern part of the county. There are currently plans to drill four initial wells with a potential 60-well conventional drilling program to follow. There are also plans to permit additional acreage for further seismic testing. Petro River estimates around 2.8 million barrels of oil could be recovered from the targeted formations.

As the previous example shows, there are resources remaining in the ground and companies willing to extract those resources. Horizontal wells may not have much current potential in Osage County, but cheaper conventional plays are still available. The county will likely see continued development in its existing major producing formations, as well as the newer CBM and shale gas formations.

VII. RFD Baseline Scenario

The RFD baseline scenario assumes all potentially productive areas in Osage County are open under standard lease terms and conditions, except those areas designated as closed to leasing by law, regulation, or executive order. According to the Osage Agency, no areas are currently closed to leasing, and approximately 823,301 acres are available for new leasing. For the RFD, commodity prices and well spud activity were analyzed from 2000 to 2010. As previously noted, the RFD does not analyze the correlation between well activity and pricing beyond the year 2010 due to the known divergence between well activity and pricing from 2011-2014. That divergence can be seen in Figure 3, which shows that the overall oil well spud trend follows oil price until 2010, when it declines.

The RFD also assumes the Osage County Oil and Gas EIS will be completed and ready to implement by the beginning of 2018, and furthermore, that operators will increase activity following implementation. Delayed implementation of the EIS, depressed commodity prices, or other negative external forces have the potential to result in less well spuds than this scenario projects.

It is difficult to say how factors such as technological and political developments will shape future oil and gas activity. Price, however, has been a fairly consistent indicator of activity in the past and is assumed to continue to be an indicator over the next 20 years. The activity projections in this RFD cover a 20-year period from 2018 through 2037. Figures 6 and 7 plot IHS-reported oil and gas well spuds versus commodity price data between 2000 and 2010. The data plotted was used to generate a linear trend-line, which provided a slope equation that could then be used to estimate future well spuds based on future price estimates. Oil wells and gas wells were plotted separately to more accurately evaluate activity based on the associated commodity prices. Wells listed as both "oil and gas" were categorized by assigning the most commonly produced commodity from the listed target formation.

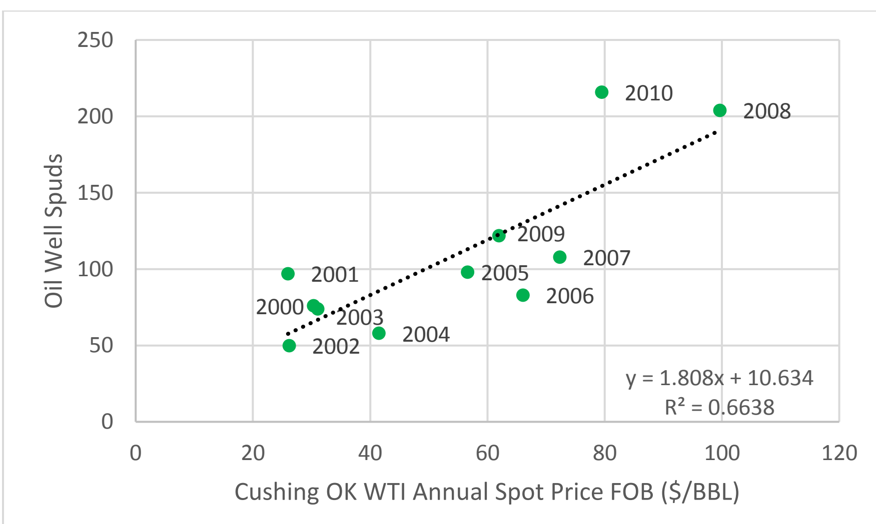


Figure 6. Oil Well Spuds versus WTI Oil Price from 2000 through 2010.

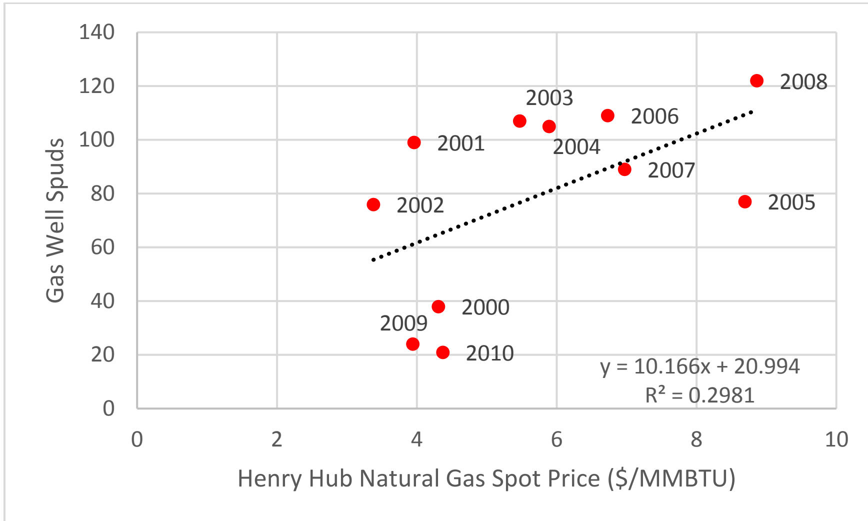


Figure 7. Gas Well Spuds versus Henry Hub Natural Gas Price from 2000 through 2010.

Figure 8 shows oil and gas well-spud projections compared to actual spuds beginning in 2000. Though well spuds for 2017 were not included in the final cumulative projections, they are shown in the graph for continuity. Actual future well spuds will likely deviate from the graphed projections below. There may be more spuds than projected in some years, and less than projected in other years. The potential well spuds are based on current EIA reference or baseline price projections. Future projections will vary with the development of new techniques and technology, and changes in the national and global political climates. Actual well spuds may vary based on a variety of factors. The goal is to provide an overall estimate of new activity over several years.

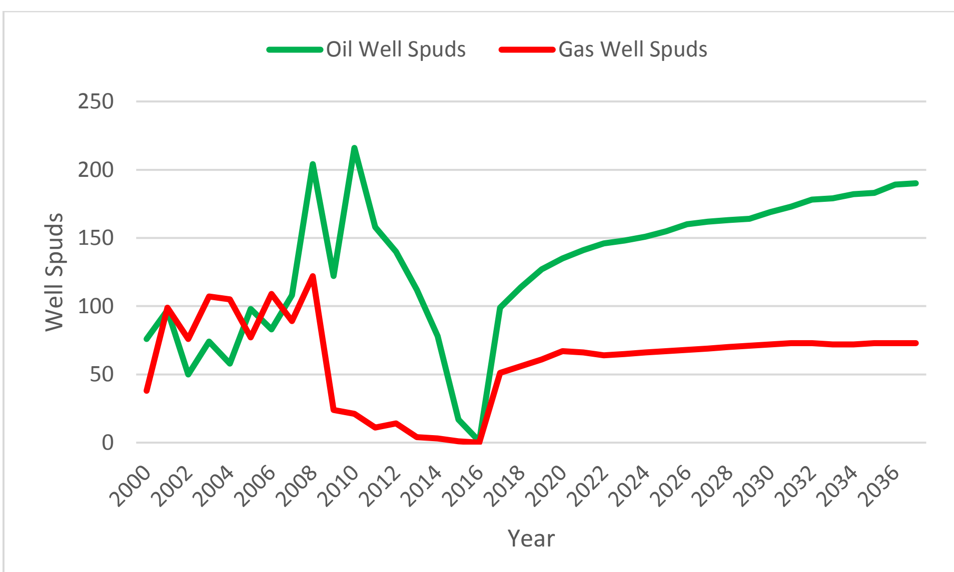


Figure 8. Actual Past and Potential Future Oil and Gas Well Spuds.

The potential new oil and gas well spuds between 2018 and 2037 are estimated to be 3,208 oil wells and 1,369 gas wells for a total of 4,577 producing wells. IDS wells made up about 4 percent of the total wells drilled from 2000 through 2010. Though new IDS well activity may not directly correlate with new well spuds, it is reasonable to assume new well activity would increase production and lead to further potential need for IDS wells. All IDS well types were grouped together for simplicity since they account for a small fraction of overall activity. However, the amount was large enough to justify its inclusion in an overall well count. Therefore, the percentage of IDS well spuds to total well spuds was used to calculate a future estimate of 184 IDS well spuds. This brought the total number of projected well spuds to 4,761 wells. Table 1 summarizes the results for projected well spuds.

Table 1. Potential Well Spuds in Osage County between 2018 and 2037.

Oil Wells	Gas Wells	IDS Wells	Total Wells
3,208	1,369	184	4,761

VIII. Surface Disturbance Due to Oil and Gas Activity

It is extremely difficult to estimate the current surface disturbance in Osage County given the limited data available. For many years the Osage Tribal Council, and later the Osage Minerals Council, considered every wellbore an asset, advancing a policy of leaving orphaned and abandoned wells unplugged with the expectation that they may later be returned to production. Accordingly, there are many wells in Osage County that have not been plugged, nor have all of the well sites and brine scars been reclaimed. Formal records regarding historical reclamation activity in Osage County are not available. In addition, oil and gas exploration in Osage County began before 1900, prior to the enactment of modern environmental laws and regulations.

The current regulations governing oil and gas development of the Osage Mineral Estate do not allow well pad disturbance to exceed 1.5 acres unless authorized by the Superintendent. *See* 25 C.F.R. § 226.19(b). With the inclusion of roads and other infrastructure, the Osage Agency estimates 2 acres of total gross surface disturbance per well. While the regulations have allowed only 1.5 acres of well pad disturbance for over the past 75 years, accurate historical data regarding gross surface disturbance is limited. It is, however, possible to provide a reasonable estimate of the future surface disturbance, given the current regulations and the projected well spuds estimate.

Applying 2 acres of disturbance for 4,761 wells, the gross surface disturbance totals 9,522 acres. With gross disturbance determined, interim surface reclamation was considered to estimate the net surface disturbance. Final reclamation was not factored in because it is not required in Osage County until all production on a lease has ceased, rather than after each individual well is plugged. According to the Osage Agency, though their regulations do not specify a set acreage or time frame for completion, interim reclamation is now a common practice in the county. The agency estimates, based on field observation, that an average of 1.25 acres are reclaimed per well. Subtracting the reclaimed acreage from the gross disturbance provides a net long term surface disturbance of approximately 3,571 acres. Table 2 summarizes the results for potential gross and net surface disturbance.

Table 2. Potential gross and net surface disturbance for total potential well spuds in Osage County between 2018 and 2037.

Total Wells	Gross Surface Disturbance (acres)	Net Surface Disturbance (acres)
4,761	9,522	3,571

IX. Conclusion

This RFD is limited to providing oil and gas development projections for the Osage Mineral Estate. These projections are based on the best available data and information; however actual future activity may vary based on any number of factors. Additional analysis regarding surface disturbance and the potential impacts associated with development is provided in the Osage County Oil and Gas EIS.

X. References

Boyd, Dan T. (2008). Oklahoma Geological Survey Stratigraphic Guide to Oklahoma Oil and Gas Reservoirs. Retrieved from http://www.ogs.ou.edu/fossilfuels/pdf/StratChartfr.pdf

Cardot, Brian J. (2015, November 5). Woodford Shale Thermal Anomaly in Osage County, Oklahoma. *Oklahoma Geological Survey Presentation for Osage Oil & Gas Summit*.

Charpentier, Ronald R., Rice, Dudley D., Finn, Tom (1995). Cherokee Platform Province. Retrieved from https://certmapper.cr.usgs.gov/data/noga95/prov60/text/prov60.pdf

Cohen, K.M., Harper, D.A.T., Gibbard, P.L., (2017, February; updated) The International Commission on Statigraphy International Chronostratigraphic Chart. Retrieved from http://www.stratigraphy.org/ICSchart/ChronostratChart2017-02.pdf

Constellation Energy Partners LLC (2012, July). 2012 Drilling Update.

Cuzella, Jerome., Lloyd, Ron., McLean, Janelle., Frazier, Fionna., Knight, Roger. (2016, November). Draft Osage Mineral Assessment. Prepared by Division of Energy and Mineral Development.

Drake II, Ronald M., Hatch, Joseph R., Schenk, Christopher J., Charpentier, Ronald R., Klett, Timothy R., Le, Phuong A., Leathers, Heidi M., Brownfield, Michael E., Gaswirth, Stephanie B., Marra, Kristen R., Pitman, Janet K., Potter, Christopher J., and Tennyson, Marilyn E. (2015). Assessment of Undiscovered Oil and Gas Resources in the Cherokee Platform Province Area of Kansas, Oklahoma, and Missouri, 2015. U.S. Geological Survey Fact Sheet 2015-3054. Retrieved from https://pubs.usgs.gov/fs/2015/3054/fs20153054.pdf

Enercom, (2016, December 15). Oklahoma's Osage Nation wants Oil & Gas Development to Hit the Accelerator-Now. *Oil & Gas 360.* Retrieved from http://www.oilandgas360.com/oklahomas-osage-nation-wants-oil-gas-development-to-hit-the-accelerator-now/

IHS Enerdeq Browser. (2017, March). *Osage County Well and Production Data.* Retrieved from IHS Website https://my.ihs.com/Energy/Products

Northcutt, Robert A., Campbell, Jock A. (1998). Geologic Provinces of Oklahoma. Hogan, John P., Gilbert, M.C. (Ed.). *Basement Techtonics 12.* (Vol 6 pp.29-37). Kluwer Academic Publishers. Retrieved from https://www.sec.gov/Archives/edgar/data/1514994/000109690612000417/ex99-1.htm

National Pipeline Mapping System Public Viewer. Map of Osage County Oil and Gas Pipelines. Retrieved May 2017 from https://pvnpms.phmsa.dot.gov/PublicCiewer/

Shaw Duty, Shannon (2013, July 25). Horizontal wells too costly for two companies in Osage County. *Osage News*. Retrieved from http://osagenews.org/en/article/2013/07/25/horizontal-wells-too-costly-two-companies-osage-county/

Stong, Patrick (2015, December 28). *Reasonable Foreseeable Development Scenario Kansas Oklahoma, & Texas*. Bureau of Land Management Oklahoma Field Office prepared Document.

U.S. Energy Information Administration. (2017). Annual Historical Cushing, OK WTI Spot Price FOB. Retrieved March 2017 from https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=rwtc&f=a. Annual Historical Henry Hub Natural Gas Spot Price. Retrieved March 2017 from https://www.eia.gov/dnav/ng/hist/rngwhhdA.htm. Annual Energy Outlook 2017. Retrieved March 2017 from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=1-AEO2017&region=0-0&cases=ref2017~ref_no_cpp&start=2015&end=2035&f=A&linechart=~~~~~~ref2017-d120816a.44-1-AEO2017~ref2017-d120816a.42-1-AEO2017&ctype=linechart&sid=~&sourcekey=0

Vulgamore, Travis B., Clawson, Timothy D., Pope, Charles D., Wolhart, Stephen L., Mayerhofer, Michael J., Machovoe, Sean R., Waltman, Charles K. (2007). Applying Hydraulic Fracture Diagnostics to Optimize Stimulations in the Woodford Shale. Society of Petroleum Engineers. https://doi.org/10.2118/110029-MS. *Paper presented at SPE Annual Technical Conference and Exhibition*. 11-14 November, Anaheim, CA.

Wilmoth, Adam (2013, June 25). Back to the Future: Chaparral hopes to recover 77 million barrels of oil from one of Oklahoma's oldest oil fields. *NewsOK*. Retrieved from http://newsok.com/article/3855899

XI. Appendix

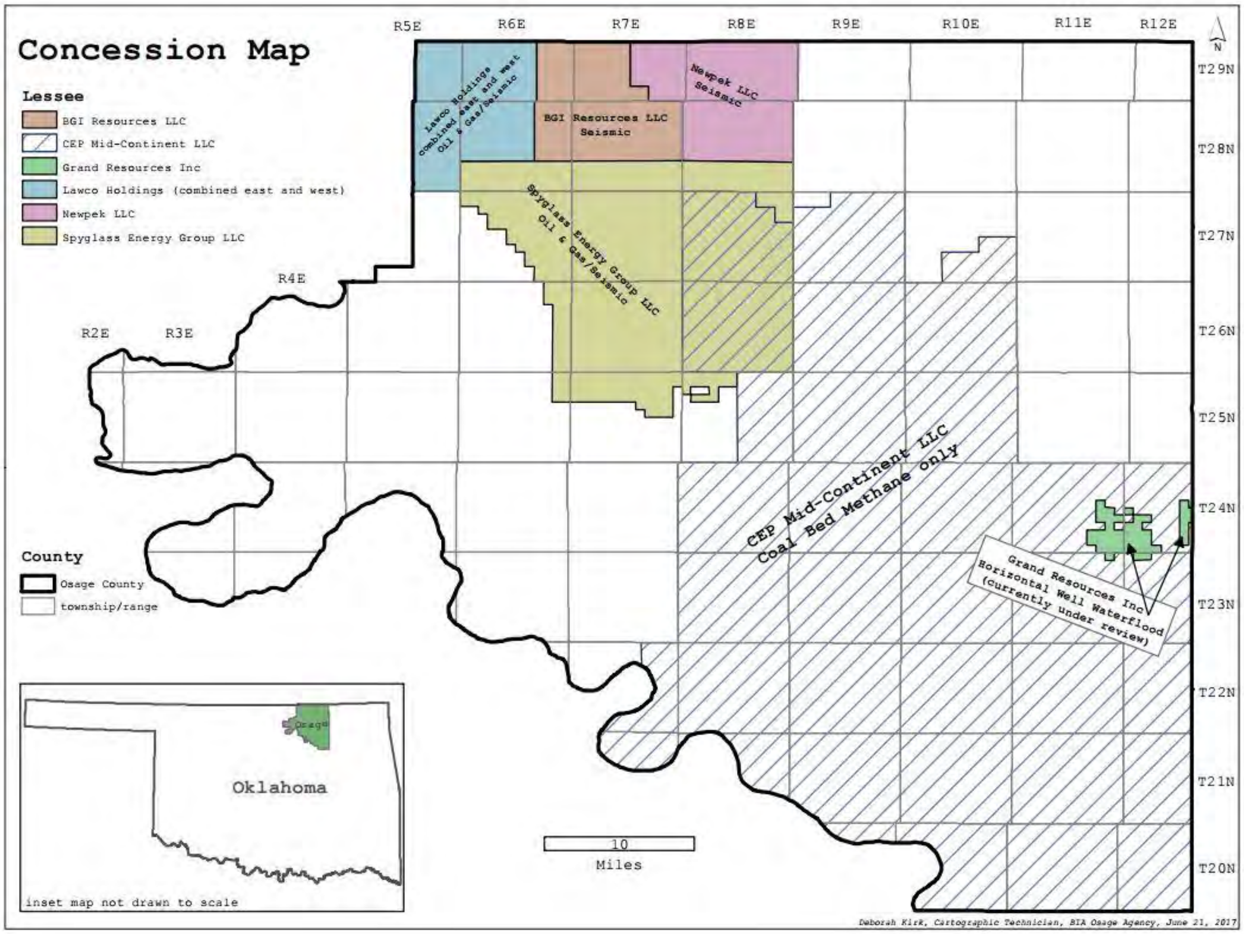


Figure 9. Map of Osage County Concession Agreements. Map courtesy of the BIA Osage Agency.

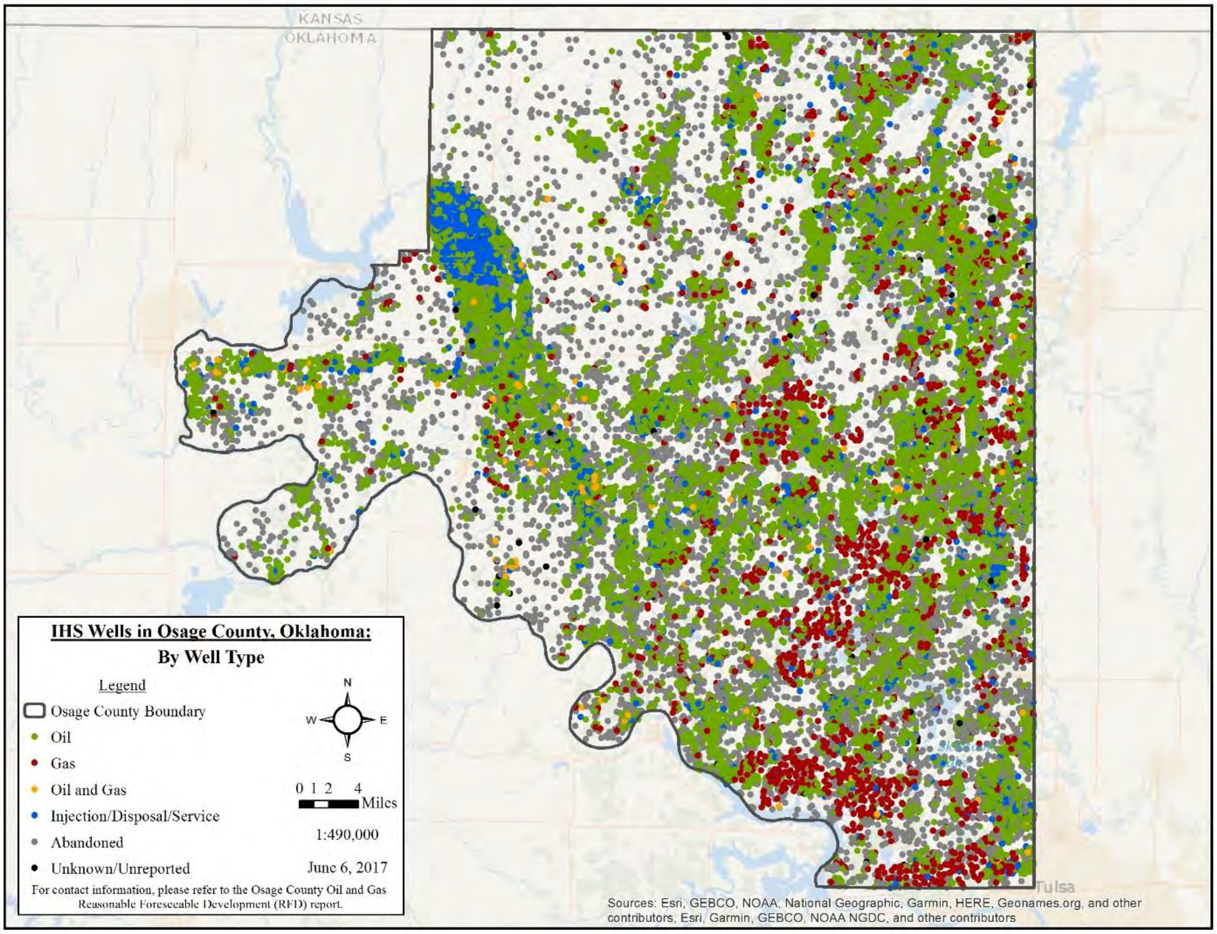


Figure 10. Map of Osage County Wells by Well Type (Oil, Gas, Oil and Gas, Injection/Disposal/Service, Abandoned, Unknown/Unreported). Map courtesy of the Bureau of Land Management (BLM) National Operations Center (NOC).

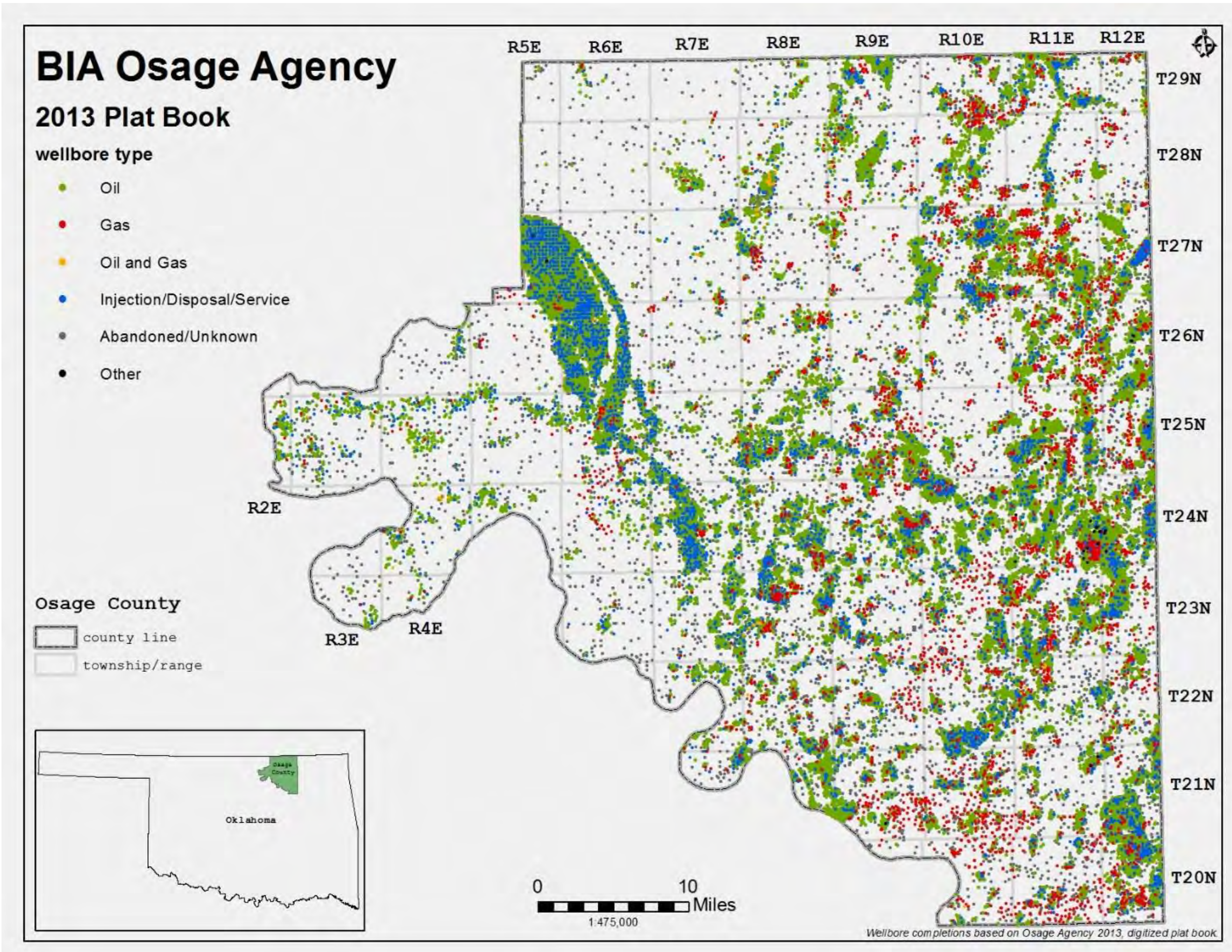


Figure 11. Map of Osage County Wells by Well Type According to BIA Osage Agency Data. Map courtesy of the BIA Osage Agency.

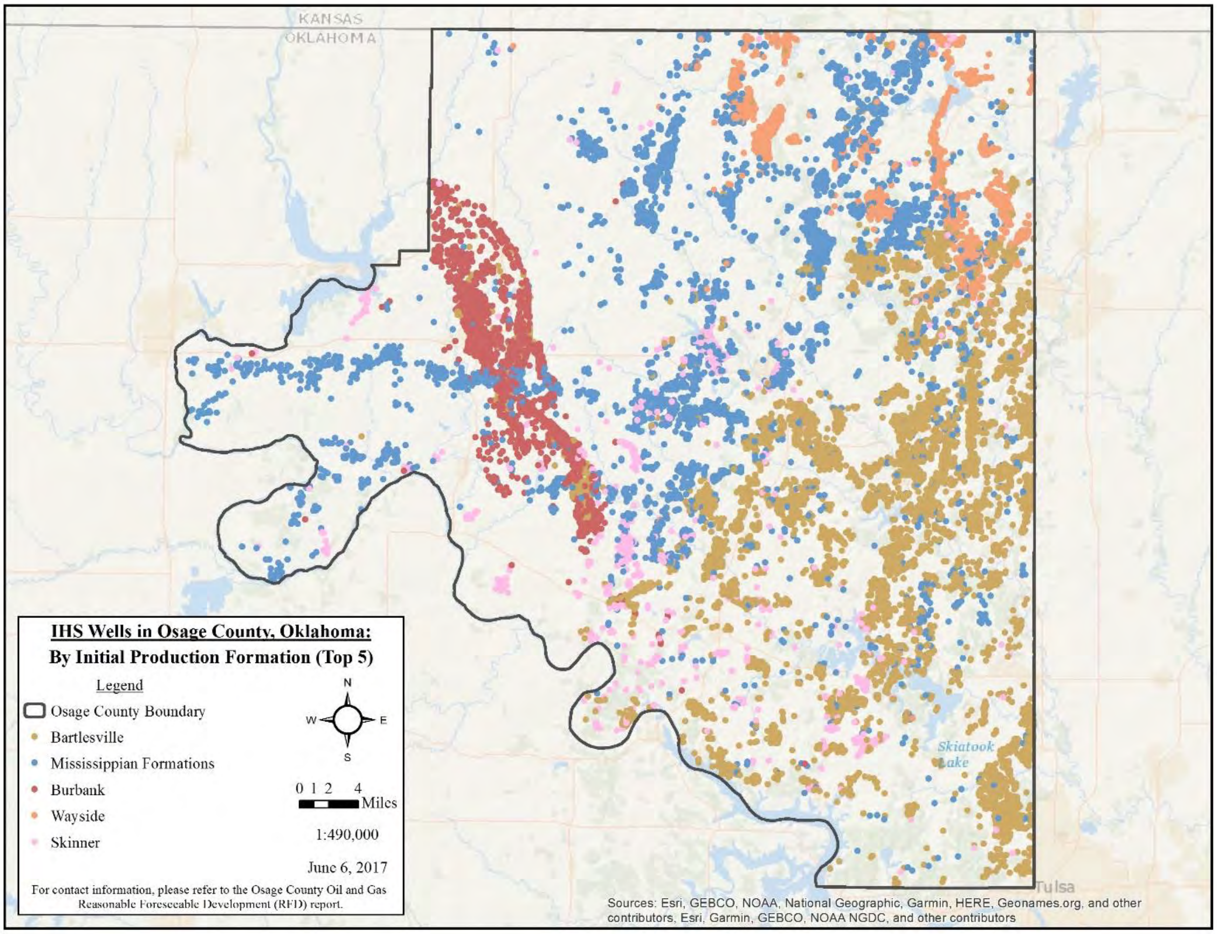


Figure 12. Map of Osage County Wells by Top 5 Initial Production Formation Activity (Bartlesville, Mississippian Formations, Burbank, Wayside, Skinner). Map courtesy of the BLM NOC.

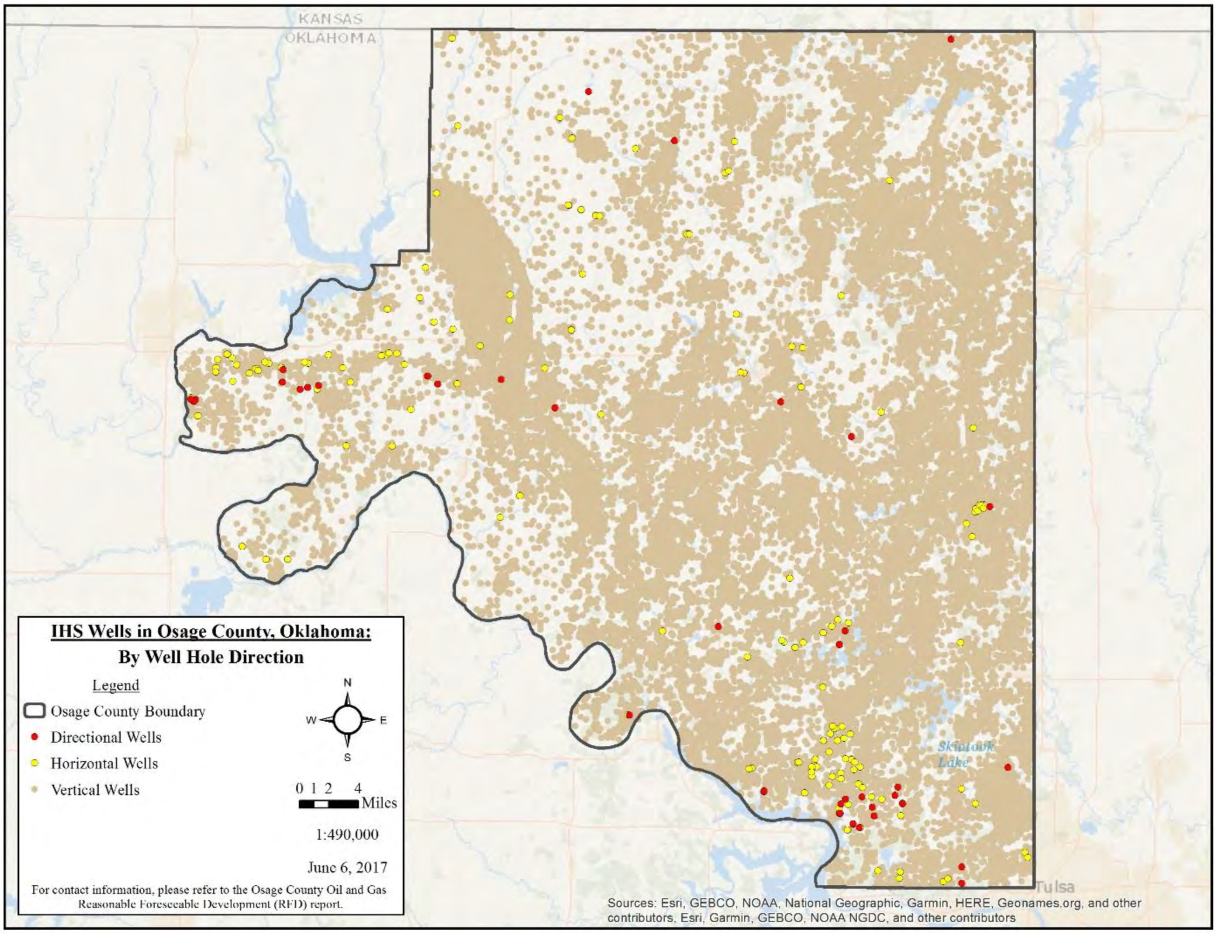


Figure 13. Map of Osage County Wells by Hole Direction (Vertical, Horizontal, Directional). Map courtesy of the BLM NOC.

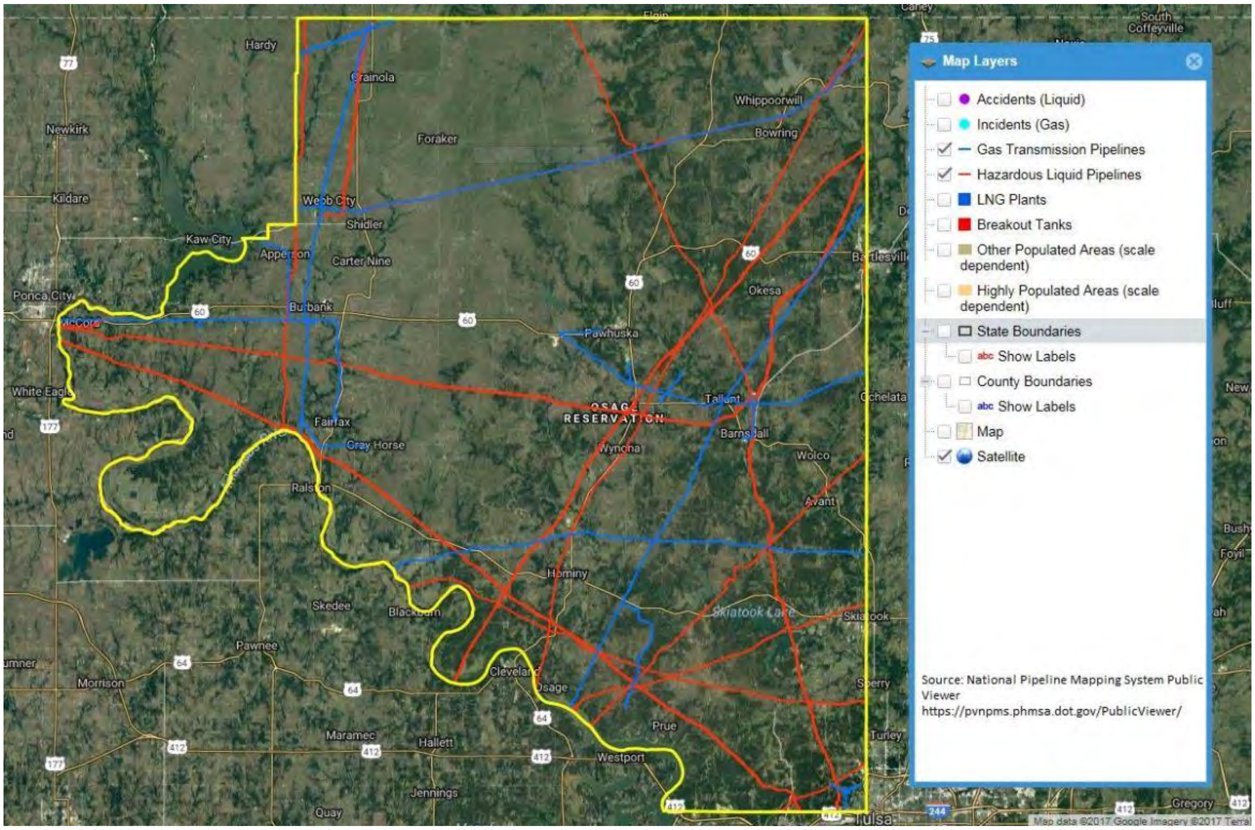


Figure 14. Map of Osage County Pipeline Infrastructure. Map courtesy of National Pipeline Mapping System Public Viewer.

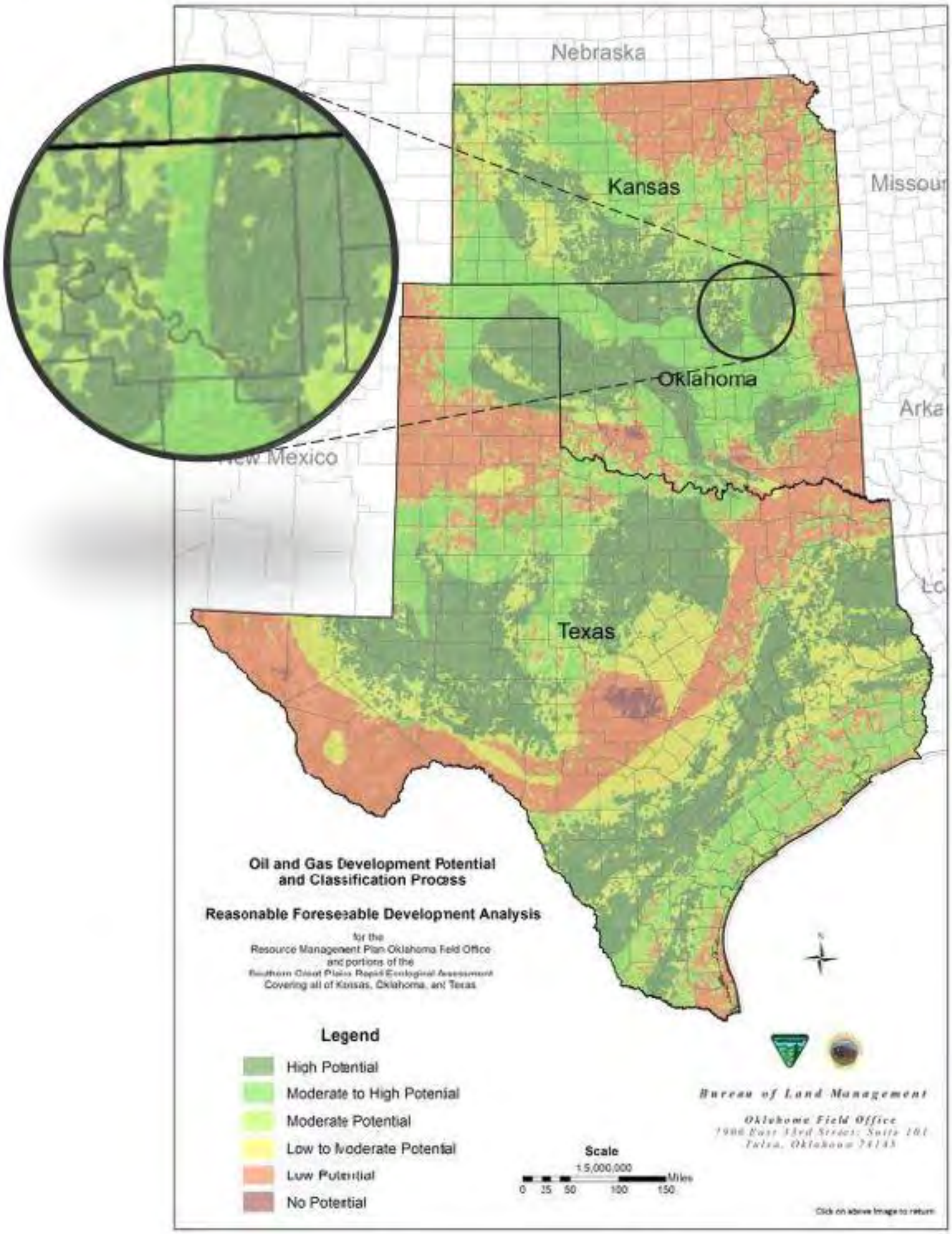


Figure 15. Map of Oil and Gas Development Potential for Kansas, Oklahoma and Texas. Map courtesy of the BLM Oklahoma Field Office. Enhancement shows Osage County's location on the map along with a zoomed-in view of the county.

Appendix B

Osage County Oil and Gas Biological Opinion and Biological Assessment

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Division of Ecological Services
9014 East 21st Street
Tulsa, Oklahoma 74129
918/581-7458 / (FAX) 918/581-7467

In Reply Refer To:
FWS/R2/OKES/
2017-F-2338

July 12, 2018

Memorandum

To: Director, Division of Environmental and Cultural Resources Management, Bureau of Indian Affairs Eastern Oklahoma Region Office, Muskogee, Oklahoma

From: Field Supervisor, FWS, Tulsa, Oklahoma J. Polk

Subject: Programmatic Consultation Relating to the Osage Agency Oil and Gas Program Impacts to the American Burying Beetle (ABB) in Osage County, Oklahoma (Attached)

Attached is the U.S. Fish and Wildlife Service's (Service) amended biological opinion (Opinion) pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*), on effects of the Bureau of Indian Affairs-Osage Agency (Osage Agency) Oil and Gas Program in Osage County, Oklahoma for years 2018-2026. The Osage Agency determined that the American burying beetle (*Nicrophorus americanus*-ABB) is likely to be adversely affected by the proposed action. The Service concurs with that determination and effects of the proposed action on the ABB are addressed in our Opinion. The Osage Agency also determined that the proposed action may affect, but not likely to adversely affect the whooping crane (*Grus Americana*), interior least tern (*Sterna antillarum athalassos*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and Neosho mucket (*Lampsilis rafinesqueana*). The Service concurs with these determinations based upon the avoidance and minimization measures for these species set forth by the Osage Agency in the biological assessment.

Our Opinion is based on information provided in the July 13, 2017, Biological Assessment (Assessment), e-mail communications between the Service, Bureau of Indian Affairs, Osage Agency, scientific literature, and other sources of information. A complete record of this consultation is on file at the Service's Oklahoma Ecological Services Field Office, in Tulsa, Oklahoma. The attached Opinion addresses effects of the proposed action on the ABB and its habitat.

The Assessment and this Opinion include conservation measures for avoiding, minimizing and offsetting any unavoidable impacts from Osage Agency's Oil and Gas Program to the ABB for years 2018 through 2026. For each project within the ABB's range in Osage County, Oklahoma, the Osage Agency will determine the proposed project's potential impacts to ABB. Impacts will be minimized by using acceptable conservation and minimization measures, and unavoidable impacts will be mitigated through conservation funded by oil and gas proponents that will result in direct habitat uplift for the ABB. The Osage Agency will perform section 7 consultations for other federally listed species in Oklahoma that are impacted by these projects separate from this Opinion and these consultations must be completed with the Service before individual project implementation, as needed.

Questions or comments should be referred to Laurence Levesque at 918-382-4509.

Attachment

FINAL BIOLOGICAL OPINION

U.S. Fish and Wildlife Service
Endangered Species Act Section 7 Consultation

U.S Fish and Wildlife Service Reference: FWS/R2/OKES/21440-2017-F-2338

Biological Opinion for the Bureau of Indian Affairs, Osage Agency, Osage County Oil and Gas Program for Years 2018-2026

Consulting Agency:
Bureau of Indian Affairs

Biological Opinion Conducted By:
U.S. Fish and Wildlife Service
Oklahoma Ecological Services Field Office
Tulsa, Oklahoma

Approved:

Jonna E. Polk

Jonna Polk, Field Supervisor
Oklahoma Ecological Services Field Office

July 27, 2018
Date

INTRODUCTION

This document provides the U.S. Fish and Wildlife Service's (Service) programmatic Biological Opinion (Opinion) addressing the anticipated impacts of oil and gas development projects over the next eight years (2017-2025) for the Bureau of Indian Affairs Osage Agency (Osage Agency) in Osage County, Oklahoma. The projects and their effects on the Federally- listed American burying beetle (*Nicrophorus americanus* – ABB) are evaluated in accordance with section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*). The Osage Agency provides federal oversight on Osage Nation oil and gas development projects in Osage County, Oklahoma. This Opinion will provide a predictable and streamlined process, which the Osage Agency will utilize when permitting oil and gas activities within the ABB's range in Osage County. The Osage Agency proposes to minimize and mitigate, to the maximum extent practicable, adverse effects of incidental take from activities affecting ABB.

CONSULTATION HISTORY

The process of developing the Opinion was initiated when Osage Agency submitted their original draft biological assessment (assessment), on July 12, 2016, for review and comment. On October 7, 2016, comments were submitted to the Osage Agency for incorporation in the draft assessment. On January 11, 2017, a meeting was held between the Service, Bureau of Indian Affairs Eastern Oklahoma Regional Office, and the Osage Agency to further discuss the programmatic assessment. On April 18, 2017, a second draft of the assessment was submitted by the Osage Agency for comment by the Service. On May 23, 2017, the Service submitted comments to the Osage Agency on the second draft. On July 13, 2017, a final version of the assessment was submitted to the Service by the Osage Agency. The Service contacted Osage Agency via phone on September 1, 2017, requesting clarification on the proposed term the assessment covered. The Osage Agency responded via email on September 12, 2017. On September 15, 2017, a letter from the Service initiating formal consultation was sent to the Osage Agency.

DESCRIPTION OF THE PROPOSED ACTION

Overview and Scope

Section 7 of the Act requires that, through consultation with the Service, federal actions do not jeopardize the continued existence of threatened, endangered, or proposed species or result in the destruction or adverse modification of critical habitat. Oil and gas development projects in Osage County, Oklahoma have a federal nexus, because they are authorized by the Osage Agency. The oil and gas activities permitted by Osage Agency have the potential to adversely impact both the ABB and its habitat, therefore, the Osage Agency needs to address incidental take of listed species through consultation with the Service under section 7 of the Act. The Osage Agency currently consults with the Service on a project-by-project basis for oil and gas operations in Osage County, Oklahoma. This programmatic consultation will allow for projects to be covered under an overall consultation, thereby streamlining the review process for the Osage Agency and Service, resulting in better conservation of the ABB.

All anticipated oil and gas development activities authorized or permitted by the Osage Agency in Osage County, Oklahoma are addressed in this Opinion. The Osage Agency estimates that about 300 wells will be permitted annually over the next eight years, through 2025, within the ABB's historic and current range in Osage County, Oklahoma. Project types range from geophysical exploration; oil and gas drilling and workover operations, drilling pad and access road construction; pipeline construction, and other such oil and gas development activities. The type and amount of temporary habitat impacts, permanent cover change, and permanent habitat loss that could occur from any of the proposed activities varies considerably, but typically would not exceed any proposed limits of disturbance in the permit application submitted to the Osage Agency. Not all projects will affect ABBs or their habitat (*e.g.*, workover operations on existing pads). The Osage Agency will ensure that the conditions set forth in this Opinion are implemented for all oil and gas development projects where ABBs or their habitat will be affected in Osage County, Oklahoma.

Action Area

The action area encompasses the known and potential range of the ABB and its habitat in Osage County, Oklahoma (Figure 1). The Osage Agency's conservation program (minimization and mitigation measures) associated with this Opinion and outlined in the assessment only applies in occupied (or assumed to be occupied) ABB habitat within the ABB range. The total project area occupies approximately 1,419,669 acres (574,520 hectares) and includes portions of five ecoregions, as defined by Woods *et al.* (2005). The current range of the ABB in Osage County is dominated by the Osage Cuestas of the Central Irregular Plains, the Northern Cross Timbers of the Cross Timbers, the Flint Hills, and the Cross Timbers Transition and the Prairie Tablelands of the Central Great Plains ecoregions. The natural vegetation varies and consists of natural communities encompassing areas of tall grass prairie, oak woodland, and scrubby oak forest. Many of these plant communities provide suitable habitat for the ABB.

Project Details

The following types of oil and gas development activities authorized by the Osage Agency may affect the ABB.

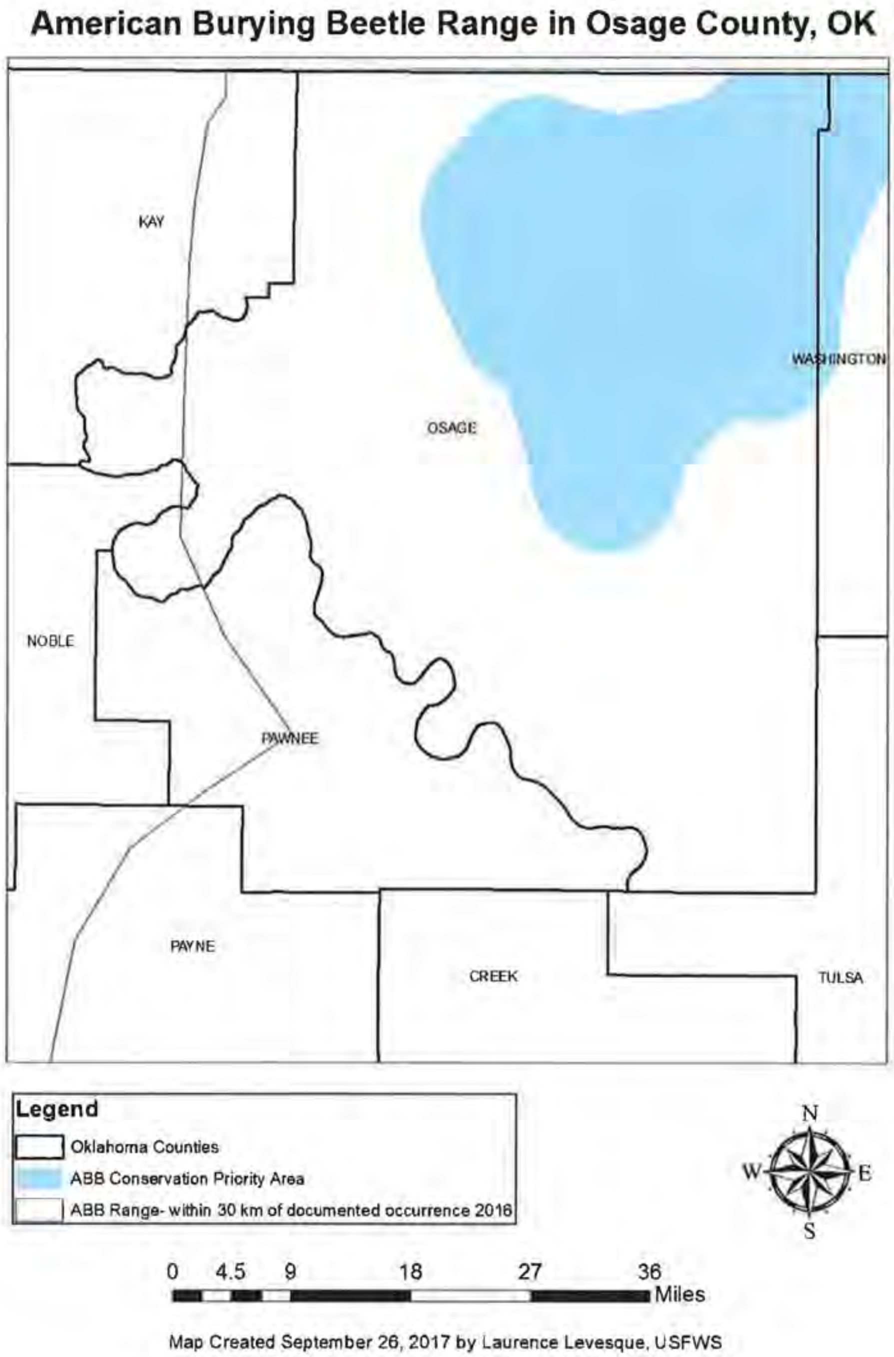
<u>Workover Operations</u>

Potential workover activities (Bureau of Indian Affairs 2015) associated with operation and maintenance of wells generally do not include new ground disturbance. These activities include acid fracturing, drilling or modification of bores on existing well pads, well conversions (gas to oil or oil to gas), plugging and abandonment, re-drilling a previously plugged well, and other activities. A full description of workover activities can be found in the Bureau of Indian Affairs' (2015) Programmatic Environmental Assessment for Approving Workover Operations.

Over the past three years, 512 permits for workover operations have been approved by the Osage Agency. Although most workover operations are confined to the existing well pad area, occasionally there is need to expand the work area beyond the existing pad. There have been approximately 20 permits issued by the Osage Agency over the last three years for projects involving work outside of the existing well pad area, impacting approximately 13 acres in total.

Over the next eight years, the Osage Agency anticipates an increase of about 50 acres per year (400 acres total) in workover and plugging operations that cause disturbance beyond the existing pad. These impacts are temporary in nature and are remediated once the work has been completed.

Figure 1. Current American burying beetle (ABB) range in Osage County, Oklahoma. For the most recent range information please refer to the Service's American burying beetle webpage <*https://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm*>.



Well Pads and Access Roads

Well pads include all structures and equipment necessary for recovering crude oil or natural gas, obtaining water for oil and gas recovery, or fluid disposal following production. Typical well pad construction requires vegetation clearing, grading to level the pad, constructing storm water and erosion control structures, laying shale, gravel, and/or rock over the well pad, and constructing pits, trenches, and sumps. Constructing an impoundment outside of the existing well pad is sometimes needed to maintain a water source for hydraulic fracturing operations.

Development of well sites may use existing roadways or may require constructing new lease roads. Newly constructed roads are first cleared of vegetation with a bulldozer and leveled with a road grader. Shale, rock, or gravel is applied to stabilize the length of the road.

Following construction of access roads and well pads, drilling rigs and associated equipment are transported to the well pad and installed. All drilling activities occur within the previously disturbed (cleared and graded) well pad. After drilling is completed, the rig is removed and hydraulic fracturing equipment may be brought onto the well pad to facilitate production. All activities associated with drilling and well completion occur on previously disturbed areas. After drilling and completion, typically 75 percent of the well pad and associated disturbances (*i.e.* rights-of-way, roads, utility lines, etc.) are re-vegetated. The remaining 25 percent is typically maintained in a developed state to facilitate oil and gas development activities.

Over the next eight years, approximately 300 new well pads and access roads are expected to be built related to new oil and gas development within the Action Area. Each well pad and access road impacts an average of 2.0 acres, with 0.5 acres being permanent and 1.5 acres being temporary impacts. These projects are anticipated to result in 3,600 acres (1,457 hectares) of temporary habitat loss, and 1,200 acres (486 hectares) of permanent habitat loss. No permanent land cover change is anticipated.

Summary

Over the next eight years (2017-2025), it is anticipated that proposed oil and gas development projects in Osage County, Oklahoma will impact a total of 5,200 acres (2,104 hectares) within the ABB's current range (Table 1).

Impacts will result from workover operations, well pad construction, well pad access road construction, and pipeline activities which will include the use of vehicles, trucks or heavy equipment.

Table 1. Total anticipated ABB habitat disturbance by Osage Agency activity type (acres).

	Temporary Habitat Loss	Permanent Land Cover Change	Permanent Habitat Loss	Total Habitat Disturbance
Workover Operations	400	0	0	400
Well Pads and Access Road Construction	3,600	0	1,200	4,800
TOTAL Acres				5,200

AMERICAN BURYING BEETLE PROCEDURES UNDER THE PROPOSED ACTION

Under the existing consultation process, lessees proposing oil and gas development activities having the potential to disturb suitable ABB habitat may conduct surveys for the presence of ABBs or assume presence and apply for an incidental take coverage through section(s) 7 and/or 10 of the Act. Currently, in the case of a positive ABB survey, the lessee has the following options: 1) obtain an incidental take permit through the Service's ABB Industry Conservation Plan (ICP) process under section 10 of the Act; 2) obtain an incidental take permit through an individual habitat conservation plan under section 10 of the Act; or 3) through a formal consultation between the Osage Agency and the Service (this would be a site-specific or batched section 7 consultation).

The ICP is a general conservation plan developed by the Service with oil and gas industry input. The ICP offers project proponents a streamlined permitting process that results in the same assurances and protections as a Habitat Conservation Plan. Within its 45-county planning area in Oklahoma, the ICP provides the oil and gas industry with a mechanism for incidental take authorization during construction, operation, maintenance, repair, and decommissioning of oil and gas projects. The ICP also describes measures to minimize and mitigate take of the ABB and impacts on its habitat.

The Osage Agency is proposing to adopt certain provisions of the Service's ICP, as outlined in the Osage Agency's assessment. These provisions will apply to lessees who have a positive ABB survey or wish to presume that the ABB is present. Currently, if there is a negative survey result, unless the Osage Agency makes a "no effect" determination, the Osage Agency must submit an individual consultation package and wait up to 45 days for a response from the Service. American burying beetle surveys conducted in the early season may need to be duplicated, due to processing time for the agencies and the requirement of a 30-day posting of the Notice of Availability for the site-specific Environmental Assessment before permits can be approved. Projects that would impact ABB habitat during the inactive season (usually late September to mid- May) must have ABB surveys conducted after July 28. Late season surveys may be necessary to extend the window for drilling permits to be issued, and allow the project to be initiated during the ABB inactive/dormant season.

The Osage Agency is proposing that the Service eliminate the requirements of individual consultation package submittal and the 45-day processing period in instances where there is a negative survey or determination (with supporting documentation) that no ABB habitat exists in the area of proposed activities. In such instances, the Osage Agency would still require appropriate best management practices as permit conditions, and would include any necessary site-specific permit conditions based upon review of project plans and National Environmental Policy Act documents. The Osage Agency would also report annually to the Service acreages of temporary or permanent impacts and any permanent cover change. All negative surveys must be valid for the appropriate timeframe for which ground disturbing activities are anticipated to occur (surveys conducted prior to July 28 are only valid until the end of the same year's active season and surveys conducted after July 28 are valid until the beginning of the following year's active season).

Additionally, the Osage Agency is consulting with the Service on the Osage Oil and Gas Program (the proposed action) on a programmatic level to have Service authorize incidental take through a programmatic biological opinion for oil and gas activities that may impact the ABB. The programmatic Opinion will allow for streamlining and make the consultation process more efficient. The Opinion would authorize incidental take for the Osage Agency based on the estimated acres of suitable ABB habitat ("occupied habitat") disturbed annually by oil and gas activities. This is a maximum of approximately 600 acres, comprised of 450 acres of temporary disturbance and 150 acres of permanent disturbance. The Osage Agency would report annually to the Service the number of acres disturbed under its programmatic incidental take statement and specify the number of projects with negative surveys with a may affect, not likely to adversely affect determination. If annual acres of disturbance exceed the limit defined in the incidental take statement, the Osage Agency would re-initiate consultation with the Service.

An ABB presence/absence survey would need to be conducted before ground-disturbing oil and gas activities begin within the ABB's range in the planning area, (see Figure 1, American Burying Beetle Range in Osage County, OK), unless the habitat is characterized as an area unfavorable for the ABB (Service 2016). Surveys would be necessary for well drilling and workover operations that result in ground disturbance beyond the extent of an existing well pad, road, or other disturbed area. Surveys would be based on the most recent Service survey guidance for Oklahoma. Lessees also may assume presence of ABBs and proceed with actions through section 7 or 10 of the Act. For workover operations tiered to the Programmatic Environmental Assessment for Approving Workover Operations, the Osage Agency requires that these activities not disturb the ground beyond the extent of the existing disturbance. Therefore, workover operations tiered to the Programmatic Environmental Assessment for Approving Workover Operations (or any superseding National Environmental Policy Act document that encompasses the Programmatic Environmental Assessment for Approving Workover Operations) would not require ABB surveys.

Applicants for workover permits must provide photographic documentation of vegetation height on the well pad where work is proposed. If well pad vegetation height is below eight inches (20.3 centimeters), the Osage Agency would assume that habitat for ABB is not present. In these cases, the Osage Agency will likely make a "no effect" determination, and therefore, site-specific consultation with the Service is not necessary.

If photographic documentation accompanying a workover application shows vegetation height is above eight inches, the Osage Agency would visit the site to determine extent and suitability of any ABB habitat present. If well pad soils are conducive to ABB burrowing or burying carrion then it would be considered suitable ABB habitat for reproduction. If well pad soils are compacted or contain a high percentage of rock or gravel, and there is excessive vegetation height, that would indicate potential foraging habitat for ABB exists. Vegetation may be removed from areas suitable as foraging habitat for the ABB only during the inactive season. The lessee must commit through conditions of approval of the permit, to maintain the vegetation height of the project area at a height of 8 inches or less until the proposed workover or plugging action has been implemented or until the permit expires (2 years). The proposed activity may commence immediately after vegetation removal has been completed within the inactive season without the need of a presence/absence survey.

Vegetation may also be removed during the inactive season in situations where the well pad has suitable reproduction habitat for the ABB; however, the lessee must commit to only removing the vegetation through the use of hand tools (*e.g.*, weed eaters, manual weed cutter, etc.) and will not be able to utilize heavy machinery such as riding mowers or tractors/brush hogs to remove vegetation.

Where suitable habitat for reproduction exists, the lessee must also commit to delaying the implementation of the proposed activity until after the beginning of the ABB active season (approximately May 15th of each year). The proposed activity may not commence during the inactive season after the vegetation removal because the ABB may still be dormant in the ground within the perimeter of the well pad. After the active season has begun then the proposed activity may commence without the need for an ABB presence/absence survey. In both situations the Osage Agency will require that the lessee maintain the vegetation below eight inches until the project is either implemented or the permit expires.

Under the circumstances described above, the Osage Agency would make a "no effect" determination due to the fact that no suitable habitat will exist within the project area at the time of project implementation. Workover permits are generally valid for a term of two years; however, an order of the Superintendent, Notice to Lessees (NTL), or special permit condition may be utilized, when justified, to reduce the period of potential disturbance to ABB habitat from maintaining vegetation height below eight inches (20.3 centimeters).

However, under circumstances where vegetation was proposed to be removed during the ABB active season, an ABB survey would be required prior to project implementation. If the survey results are negative, vegetation removal could begin provided the procedure outlined below for valid negative ABB survey results is followed. Alternatively, if the negative survey was conducted after July 28th, then the lessee could wait until the ABB's inactive season to begin vegetation removal as described above.

When surveys are completed, and survey results are negative, lessees would report the results to the Service and the Osage Agency. For lessees relying on negative early season survey results, the early season survey results would remain valid until the end of the ABB active season. Late season negative survey results would remain valid until the beginning of the next active season. Development activities with valid negative ABB surveys would receive a "may affect, not likely to adversely affect" determination or a "no effect" determination from the Osage Agency. Under the current process, this would require site-specific consultation with the Service for concurrence on the determination.

Under the proposed action, the Osage Agency requests that the Service issue a blanket concurrence for the Osage Agency's determination that development, with valid negative ABB surveys, "may affect, not likely to adversely affect" or would have "no effect" on ABB. In these circumstances, site-specific consultation with the Service would no longer be necessary, thus eliminating the need to submit individual project packages to the Service and eliminating the 45-day processing period for the proposed action. Lessees would have approval to proceed after the Osage Agency confirms that survey results have been submitted to the Service for review. This will enhance the efficiency of the Osage Agency's permitting process. As stated above, the Osage Agency would annually report to Service the acreages of disturbance for activities authorized in unoccupied ABB habitat, and Osage Agency would also include appropriate permit conditions to avoid significant environmental impacts identified through the review of project plans and the National Environmental Policy Act process.

When ABB surveys are positive, or when ABB presence is assumed, lessees would be required to minimize or mitigate the proposed disturbance, in accordance with the procedures detailed in the assessment and this Opinion. Osage Agency is adopting the minimization and mitigation measures listed below.

Conservation Measures Proposed by the Osage Agency

Several conservation measures have been proposed by the Osage Agency in their biological assessment to conserve the ABB, as described below. The following conservation measures have been proposed and will be implemented by the Osage Agency:

1. Avoid or minimize soil and vegetation disturbance. Avoid removal of or damage to trees, shrubs, and groundcover to the extent possible. Avoid or minimize alteration of the natural topography, and limit activities on steep slopes.

2. Erosion control measures are required for the duration of the construction, drilling, and completion phases of the project. Erosion control measures must minimize the impact of soil, debris, or contaminants moving from the well site to adjacent lands and waterways.

3. All vehicles and equipment must utilize and stay confined to existing and new roads described in the approved National Environmental Policy Act document. These roads must be maintained and upgraded as needed according to Osage Agency direction and agreements between the operator and surface owners.

4. Tank batteries must have a Spill Prevention and Control and Countermeasure Plan (SPCC) in compliance with EPA Regulations under 40 CFR, Part 112. A fluid impermeable secondary containment dike/berm must be constructed around any tank battery and facilities according to 40 CFR, Section 112.7. The dike/berm and entire containment area must be graveled. No water collected within the secondary containment shall be discharged. In accordance with the SPCC plan and the Osage Agency regulations, the lessee will immediately notify the Osage Agency of all spill incidents.

5. No venting or flaring of gas is allowed unless prior written approval of the Osage Agency Superintendent has been obtained.

6. Store and label chemicals properly (including secondary containment). Do not store equipment or chemicals onsite if they are not being used onsite. Do not leave open containers of chemicals or wastes onsite.

7. Keep sites clean and free of any litter, trash, old equipment, contaminated soil, or unused containers. Promptly dispose of any wastes at an appropriate recycling facility, approved landfill, or other approved location. Remove any unused equipment not necessary to the operation of the lease after drilling activities have been completed.

8. All pits (including tank batteries contained within a dike/berm) must be enclosed with a fence of at least four strands of barbed wire, or approved substitute. All earthen pits to be used for storage of salt water or other deleterious substances must be lined with an impermeable layer to prevent contamination of soils and groundwater. Temporary pits must be filled and leveled immediately upon completion of the activity.

9. To the extent possible, minimize disturbance to land owners, wildlife, and natural resources due to noise, excessive traffic, dust, or other impacts associated with operations.

10. Do not conduct activities within stream channels or wetlands without proper authorization. Avoid any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally approved water-quality standards.

11. Return disturbed area to original contour or as directed by the surface owner. If needed, add clean soil to disturbed areas. Restore disturbed areas by reestablishing vegetation using seed, sod, or other approved method. Restore with native species unless otherwise directed by the surface owner in writing and approved by the BIA. No noxious or invasive species may be used in revegetation and reclamation activities.

12. If well drilling, completion, and development are successful, all areas of the surface disturbance (*i.e.,* well pad, access road, pipeline, etc.) that are not needed or used in the production or operation of the well shall be promptly reclaimed as described in the approved National Environmental Policy Act document. If well drilling, completion,

and development are not successful, reclamation of the entire area will begin promptly. After a producing well is no longer in production, reclamation of the site will begin promptly. Reclamation shall be completed not later than ninety (90) days from rig removal, well abandonment, or final plugging of a well, unless otherwise approved by the Osage Agency.

13. The lessee shall conduct activities in a manner that avoids any potential incidental take or harm to federally-listed threatened and endangered species, or in a manner that complies with any permit or authorization issued by the Service. Lessee must follow guidance in the Service "Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects" (April 2014), found at the following website: http://www.fws.gov/southwest/es/oklahoma/documents/abb/abb_icp/migbird%20and%20eagle%20avoidance%20measures%20april2014.pdf

14. Lessee must follow the Service's established protocol regarding areas where the American burying beetle (ABB) is known or suspected to exist. See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm. If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that suitable habitat for the ABB does not exist. If proposed operations will impact suitable habitat for the ABB, it will be the responsibility of the lessee to obtain authorization from the Service to proceed with that portion of the project.

Minimization Measures

The following minimization measures will be implemented for all projects that are within the range of the ABB and may impact ABB habitat.

1. Reduce motor vehicle, machinery, or heavy equipment use. Motor vehicles, machinery, and heavy equipment can generate take of American burying beetles by crushing and collisions when individuals of the species are above-ground or by soil compaction when the species is underground. Reducing the number and use of motor vehicles and heavy equipment in occupied ABB habitat can minimize impacts from these activities. Lessees will minimize the number and use of motor vehicles and heavy equipment necessary in occupied ABB habitat to meet the objectives of the activity. If heavy equipment, machinery, or motor vehicle use is required in occupied ABB habitat for an activity, these vehicles will be allowed only in the areas that are necessary. All motor vehicles, machinery, and heavy equipment shall be parked within areas already impacted, areas where disturbance is planned to occur, or areas where occupied ABB habitat impacts and mitigation, as appropriate, have been assessed.

2. Reduce risk of motor vehicles sparking wildfire. Vehicle use or improper maintenance of vehicles and machinery could ignite fires during dry conditions or in areas with dry vegetation, which may cause take of ABBs. Motor vehicles, machinery, and heavy equipment should not be parked where dry grass or vegetation could be ignited. All

vehicles will be maintained per the respective service manuals. In dry conditions, grass and debris will be cleaned away from machinery exhaust systems and bearings on a weekly basis. All bearings will be lubricated and all spark arrestors will be serviced as necessary to reduce risk of sparking a fire. Fire mitigation equipment necessary at each project includes: a shovel, water, and working fire extinguisher in case of accidental ignition of a wildfire.

3. Increase safety during operation fluid use and storage. Operations fluids (fuel, oil, or other fluids for maintenance of equipment) may cause take of ABBs if spilled. Lessees must follow all applicable state and federal laws regarding fuel use and storage. Additionally, all operational fluids (fuel and motor vehicle oil) will be stored and all equipment must be fueled within areas already impacted, areas where disturbance is planned to occur, or areas where occupied ABB habitat impacts and mitigation, as appropriate, have been assessed.

4. Reduce erosion and increase soil stability. Land erosion can directly impact ABB habitat and cause take of ABBs. To prevent topsoil loss, gully formation, or other negative impacts to ABB habitat, lessees will implement erosion control techniques in accordance with prudent industry standards for sediment and erosion control. Examples of prudent industry standards are described in the Independent Petroleum Association of America's Reasonable and Prudent Practices for Stabilization of Oil and Natural Gas Exploration and Production Sites found at: http://www.ipaa.org/governmentrelations/reasonable-and-prudentpractices-for-stabilizationrapps-for-oil-and-natural-gas-explorationand-production-sites/. Lessees must comply with all state and federal laws regarding erosion control and soil stabilization.

5. Provide educational program for construction personnel. Human presence and movement within ABB habitat may cause take of ABBs. All workers operating in the project area will be trained about ABB habitat, biology, reasons for ABB decline, and the responsibility of all workers to protect the ABB. Standardized ABB educational information is provided on the Service website: www.fws.gov/southwest/es/oklahoma/ABBICP. Lessees will provide each worker with a full color Endangered Species Card with a picture of the ABB and a summary of information about the ABB before conducting soil disturbing activities. Lessees will post signs at all access points to the project area highlighting the areas as occupied ABB habitat and reminding workers to follow special restrictions in the area. All workers are required to report any ABB sightings to the project manager or environmental inspector, remove all food wastes from the work area each day, and prohibit dogs or cats on the work area (workers may not bring animals or pets to the job site). Additionally, all workers must park their vehicles within already impacted areas, areas where disturbance is planned to occur, or areas where impacts and mitigation, as appropriate, have been assessed.

6. Limit use of artificial lighting. Artificial lighting (*i.e.*, from construction or operations at night) can cause take of ABBs by interfering with normal behavior patterns. Therefore, activities occurring during the ABB active season within occupied ABB habitat will be

limited to daylight hours, other than situations described below. Necessary lighting associated with operations or in limited instances where it is necessary to extend construction activities beyond daylight hours (*e.g.*, to maintain the integrity of a bore hole during horizontal directional drill activities when installing a pipeline) must be down-shielded to minimize the effect on ABBs. Additionally, sodium vapor lights are required, rather than ultraviolet or mercury vapor lights near occupied ABB habitat, because they have been shown to be the least attractive to ABBs (Anschutz *et al.* 2007). Drilling rigs used during production, communication towers, or emergency response situations that require lighting are not required to use sodium vapor lighting or down shield lighting.

7. Limit use of gas flares. Light sources can cause take of ABBs by interfering with the species' normal behavior patterns and increasing energetic demands. Current technology allows for enclosure of the flame for some types of flares, thus minimizing or eliminating emitted light. Projects requiring small, constantly burning flares throughout the life of the project will cover the flame to eliminate the visibility of all natural gas flares to minimize artificial light sources that are attractive to ABBs.

8. Limit disturbance from mechanical vegetation maintenance. Vegetation maintenance following construction in areas already restored to ABB habitat (areas with temporary and permanent cover change impacts) may disturb individuals of the species and alter their normal behavior. Vegetation maintenance frequency and duration should be restricted to that necessary to allow for visual surveys and prevent hazards (e.g., fire). Vegetation must be maintained at a height of eight inches (20.3 centimeters) or more to maintain soil moisture. Vegetation maintenance activities will be completed during the ABB inactive season (approximately late September –early May) because these activities may cause take of ABBs during the active season. Given the implementation of this minimization measure, the Service believes that no additional mitigation is necessary for post-construction, intermittent non-soil disturbing operations and maintenance (e.g., mowing using tractor equipment or vehicle traffic along right-of-way) within ABB habitat.

9. Limit herbicide use. Removal of vegetation within ABB habitat may cause take of ABBs. Herbicides necessary for vegetation maintenance or removal in areas already restored to ABB habitat (areas with temporary and permanent cover change impacts) must be applied by licensed applicators in accordance with label directions. Herbicides must be applied using methods that minimize spray drift. If broadcast application of herbicides is necessary for effective right-of-way vegetation control (*e.g.*, in areas with dense stands of target woody plants and/or invasive forbs or grasses), application equipment must be equipped with spray nozzles designed to produce an herbicide spray pattern of uniform water droplet size and apply herbicides at a calibrated rate and at a set pattern on the right-of-way, thus ensuring precise application. Aerial broadcast application of herbicides cannot be used. Following complete restoration of ABB habitat, herbicides used for vegetation maintenance following construction may only be applied if vegetation can be maintained at a height of eight inches or more (to maintain soil moisture). Large equipment and vehicles necessary for application of herbicides may only be used once in a given area during the ABB active season. Any additional use of herbicide during the

ABB active season must be done by hand application instead of large equipment and vehicles.

10. Set aside topsoil for replacement following construction. Projects with temporary or permanent cover change impacts that require removal of top soil within occupied ABB habitat will set aside the top soil during construction activities for restoration following construction.

Post-construction Restoration

1. Replace topsoil. During restoration of project areas within occupied ABB habitat that required top soil removal during project activities (as described under Minimization Measures above), top soil will be replaced at the original location.

2. Relieve soil compaction. Immediately following Covered Activities that removed vegetation and compacted soil by heavy equipment or other means, and prior to vegetation re-establishment, the impacted area will be ripped to a depth of 24 inches(61 centimeters; or to rock, if present, whichever is less), to relieve soil compaction at depths used by ABBs. This effort will improve or enhance ABB habitat by making soils easier for ABBs to bury carrion or themselves. This measure is not required for small project areas (such as maintenance work on a pipeline) where the use of tractors and ripping equipment would result in increasing the impact area.

3. Re-establish vegetation. Following vegetation removal within a project area containing occupied ABB habitat prior to impacts, vegetation will be re-established with a native species composition similar to the surrounding area or, if requested by the landowner, the same vegetation type that existed prior to impacts. Preference should be given to the establishment of native vegetation if the landowner does not have specific requests and restoration of native vegetation is feasible. If construction/soil disturbance ends during the dormant vegetation season, bare soil will be temporarily stabilized if necessary to prevent erosion. At the beginning of the next growing season (preferably prior to the start of the ABB active season in mid-late May), these areas will be re-established with vegetation. Seeds used during vegetation reestablishment must be free of invasive species seeds. Invasive species to be avoided are listed at http://ok-invasive-plant-council.org/images/OKinvasivespp.pdf. For an impact to be considered temporary, vegetation must be re-established to the original density (based on visual comparison of before/after photographs of the project area and comparison to adjacent undisturbed areas) within five years of the initial impact. Vegetation reestablished for permanent cover change impacts should be restored to the density of the grasslands or pastures nearest to the project area, preferably restored with native species.

4. Inspection for invasive plant species. Because vegetation composition may change the carrion base (small mammal and bird composition) of an area, lessees will monitor project sites with temporary or permanent cover change impacts following post-construction restoration and document any invasive species (as listed at http://okinvasive-

plant-council.org/images/OKinvasivespp.pdf) in their annual reports during the 5-year restoration period.

Mitigation

Verification of Mitigation and Reporting

Lessees in cooperation with the Osage Agency will estimate which type of habitat impact will occur on each portion of the project area and mitigate appropriately, with Osage Agency approval, prior to any ground-disturbing activities likely to result in take of ABBs in occupied ABB habitat. Proof of purchase of mitigation credits at an approved bank, or proof of other mitigation method acceptable to Service, must be provided to the Osage Agency prior to issuance of a permit or other approval of ground-disturbing activity. All offsite mitigation provided for the ABB must be within a location approved by the Service.

Lessees estimating temporary or permanent habitat loss impacts within all or part of their project area will mitigate with appropriate ratios prior to impacts and document the impact start date (the date impacts to occupied ABB habitat began). All areas mitigated as temporary or permanent cover change impacts must implement post-construction restoration measures described below and these areas must be restored to a condition suitable for ABB use within 5 years of the impact start date. Lessees will include information about restoration methods within their annual reports submitted to the Osage Agency. When a Lessee has restored these areas, they will submit their restoration report to the Osage Agency.

Unless there is a positive ABB survey result, applicants for Osage Agency drilling permits, workover approvals, and other approvals would not need to be assigned acres pursuant to the Osage Agency's incidental take statement and no acres will be deducted from the total acreage for ABB.

For all oil and gas operations that require soil disturbance, regardless of survey results, lessees must report to the Osage Agency the number of acres temporarily disturbed and the number of acres permanently disturbed. The Osage Agency will report to the Service annually the acres of suitable ABB habitat disturbed, under the programmatic Opinion and incidental take statement. The Osage Agency's reports will include total acres disturbed, compiled from lessee reports and other available information such as maps and site inspection data.

For oil and gas operations outside of ABB range delineated by the Service, the action would not affect ABB and consultation with the Service for the ABB would not be required.

Offsite Habitat Mitigation through Mitigation Lands

This section describes how impacts to occupied ABB habitat will be offset through conservation and management of ABB habitat in perpetuity. All mitigation proposals must, to the maximum extent practicable, meet the minimum standards and other requirements described in *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP.

1. Individual- or Lessee-responsible mitigation lands. These consist of mitigation lands established by the lessee. Such mitigation tracts must be described in detail and included in the project description. Such lands must, to the maximum extent practicable, meet the minimum standards and other requirements described in Service guidelines, *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP. Also described in Service guidelines, conservation easements and agreements must be approved by the Service prior to any habitat impacts that could result in take of ABBs. The lessee or their designee is responsible for ensuring the success of and managing the mitigation land in perpetuity, even if the project is finite in duration (refer to Service guidelines).

2. Conservation Banks. Conservation banks are mitigation lands that are established by a Bank Sponsor. These sites are usually established to mitigate for the effects of multiple projects. A Service-approved conservation bank meets the minimum standards and other requirements described in Service guidelines (*American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands and Guidance for the Establishment, Use, and Operation of Conservation Banks*, found at: http://www.fws.gov/southwest/es/oklahoma/ABBICP). Conservation banks are established through a conservation bank agreement with the Service and conservation easements for the bank must be approved by the Service. When a lessee chooses to mitigate through the purchase of credits in an approved conservation bank, the bank sponsor is responsible for ensuring the success of and managing the mitigation land in perpetuity upon sale of the credits. If a lessee chooses this option, lessee must purchase appropriate credits prior to any habitat impacts that could result in take of the ABB. Lessees can visit http://ribits.usace.army.mil/, the Regulatory In-lieu Fee and Bank Information and Tracking System (RIBITS) for information on Service approved conservation banks with available ABB credits.

3. Third party mitigation lands. These mitigation lands are usually established for a single project or project proponent rather than multiple projects or proponents as are conservation banks. Such lands and agreements must, to the maximum extent practicable, meet the minimum standards and other requirements described in Service guidelines, *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP. Conservation easements and agreements must be approved by the Service prior to any habitat impacts that could result in take of ABB. The mitigation land sponsor (landowner or easement holder) is responsible for and assumes liability for the success of and management of the approved mitigation land in perpetuity.

The following ABB mitigation ratios will be implemented by Osage Agency in accordance with the Service's Mitigation Recommendations for the ABB in Oklahoma (Table 2).

Table 2. Mitigation Ratios for ABB Impacts. Ratio = acres of impact: acres of offset

	Areas Where Impacts Occur		
Impact Period	ABB Range (but not within CPA)	Conservation Priority Area (CPA)	Mitigation Land*
Temporary	1:0.25	1:0.5	1:1.5
Permanent Cover Change	1:0.5	1:1	1:2
Permanent	1:1	1:2	1:3
*Mitigation Land ratio is equal to the CPA ratio plus the mitigation acre(s) lost.			

STATUS OF THE SPECIES

The ABB is the largest silphid (carrion beetle) in North America, reaching 1.0 to 1.8 inches (2.5 to 4.75 cm) in length (Wilson 1971, Anderson 1982, Backlund and Marrone 1997). The most diagnostic feature of the ABB is the large orange-red marking on the raised portion of the pronotum, a feature shared with no other members of the genus in North America (Service 1991). The ABB is a nocturnal species that lives only for one year. The beetles are active in the summer months and bury themselves in the soil for the duration of the winter. Immature beetles (tenerals) emerge in late summer, over-winter as adults, and comprise the breeding population the following summer (Kozol 1990). Adults and larvae are dependent on carrion for food and reproduction. They must compete for carrion with other invertebrate species, as well as vertebrate species.

American burying beetles are strong fliers and have been reported moving distances ranging from 0.10 to 2.6 miles (0.16 to 4.18 km) in various parts of their range (Bedick *et al.* 1999, Creighton and Schnell 1998, Jurzenski *et al.* 2011, Schnell *et al.* 2011). When not involved with brood rearing, carrion selection by adult ABBs for food can include an array of available carrion species and size (Trumbo 1992). American burying beetles also capture and consume live insects. Immediately upon emergence from their winter hibernation, ABBs begin searching for a mate and a proper carcass for reproduction. Once a carcass has been found, inter-specific as well as intra-specific competition occurs until usually only a single dominant male and female burying beetle remain (Scott and Traniello 1987).

Suitable ABB habitat must have soil conditions that are conducive to excavation by ABBs (Anderson 1982; Lomolino and Creighton 1996). Level topography and a well formed detritus layer at the ground surface are common (Service 1991). American burying beetles are considered feeding habitat generalists and have been successfully live-trapped in several vegetation types including native grasslands, grazed pastures, riparian zones, and a variety of forest types including coniferous forests, deciduous forest with little undergrowth, and oak-hickory forest, as well as on a variety of soil types (Creighton *et al.* 1993; Lomolino and Creighton 1996; Lomolino *et al.* 1995; Service 1991 and 2008, Walker 1957). American burying beetles are widely believed to depend on landscape-level heterogeneity of habitat that supports the small mammals, birds and other sources of carrion necessary for their life cycle. A diverse landscape consisting of patches of woodland, shrubland, and herbaceous areas are believed to be a key component of good ABB habitat. Interspersion of the various vegetative cover types creates the discontinuity of habitat needed to support carrion species preferred by the ABB.

American burying beetles are relatively easy to capture, yet population estimates of ABB are problematic and precise estimates of absolute or even relative densities remain a challenge (Service 2008). The ABB experiences a relatively rapid turnover rate in the trappable ABB population due to factors such as natural mortality, dispersal, burrowing underground and while attending carrion/broods (Creighton and Schnell 1998). Because the ABB completes its lifecycle in one year, each year's population size is highly dependent on the reproductive success of the previous year. Therefore, populations may fluctuate (due to weather, disease, *etc*.), with high numbers and abundance in one year, followed by a decline in numbers the succeeding year. However, these short-term stochastic events are not expected have long-term effects on robust populations (Service 2008).

Habitat fragmentation causes increased vertebrate scavenger pressure, which decreases availability of carrion of the appropriate size, and increases competition between burying beetles (Creighton *et al*. 2007). There is little doubt that habitat loss and alteration affect this species at local or even regional levels, and could account for the extirpation of populations once they become isolated from others (Kozol 1995, Ratcliffe 1996, Amaral *et al*. 1997, Bedick *et al*. 1999). It is unclear if an extirpated ABB population can successfully be re-established. Protection of large areas of appropriate native habitat appears to be the best known method for enhancing the conservation of the ABB. Relatively large areas of native habitat tend to support the highest known ABB populations.

The American Burying Beetle Recovery Plan (Service 1991) and the 5-year status review of the species (Service 2008) identify the following factors as potential threats to the ABB: disease/pathogens, pesticides such as DDT, direct habitat loss and alteration, interspecific competition, increase in competition for prey, increase in edge habitat, decrease in abundance of prey, loss of genetic diversity in isolated populations, agricultural and grazing practices, and invasive species. None of these theories alone adequately explain why the ABB declined while congeneric species are still relatively common rangewide. There are eight sympatric congeners which are not in peril (Sikes and Raithel 2002).

The prevailing theory regarding the ABBs' decline is habitat fragmentation (Service 1991) which: (1) reduced the carrion prey base of the appropriate size for ABB reproduction, and (2) led to increased competition by vertebrate scavengers for this prey (Kozol 1995, Ratcliffe 1996, Amaral *et al*. 1997, Bedick *et al*. 1999) due to the ABBs relatively large size and specialized breeding behavior which require larger carcass sizes (Creighton *et al*. 2007). Although much of the evidence suggesting the reduction of carrion resources as a primary mechanism driving the decline of the ABB is circumstantial, this hypothesis fits the temporal and geographical pattern of the disappearance of ABBs; and, is sufficient to explain why ABBs declined while related species did not. In a fragmented ecosystem, larger species have been shown to be negatively affected before smaller species, a phenomenon that has been well-documented with carrion and dung beetles in South America (Klein 1989).

Since the middle of the 19th century, certain animal species in the favored weight range for ABBs have either been eliminated from North America or significantly reduced over their historic range (Service 1991), including the passenger pigeon (*Ectopistes migratorius),* greater prairie-chicken (*Tympanchus cupido)* and wild turkey *(Meleagris gallopavo)*. Fragmentation of large contiguous habitats into smaller pieces or patches of habitat may increase animal species richness, but the species composition usually changes. Correspondingly, historically large expanses of natural habitat that once supported high abundance of indigenous species are now artificially fragmented, supporting fewer numbers or lower densities of indigenous species that once supported ABB populations. Fragmentation also facilitated increased competition for limited carrion resources among the "new" predator/scavenger community.

Climate change is another factor that has the potential to impact the ABB. Although the impact of climate change on the ABB has not been thoroughly evaluated, the ABB appears to be sensitive to air and soil temperatures, particularly during the summer months. However, it is difficult to anticipate the exact impact that implementation of this proposed action will have on increasing factors that exacerbate climate change.

Kozol *et al*. (1994) examined ABB genetic variation within and between the Block Island, Rhode Island population and the eastern Oklahoma and western Arkansas population. Both populations have low levels of genetic variation, and most of the variation occurs within a single population. There were no unique diagnostic bands within either population, but they found the Oklahoma-Arkansas population to be somewhat more genetically diverse. Reduced genetic variation is often a result of founder effect, genetic drift, and inbreeding.

Numerous ABB surveys have been conducted throughout eastern Oklahoma. The majority of these surveys are associated with projects such as road construction, oil and gas projects, and similar development activities that may result in soil disturbance and impacts to ABB habitat. To determine whether ABBs may occur within these project areas, project proponents use permitted surveyors to conduct surveys for ABB. Because these surveys are associated with development projects that limit their temporal and spatial distribution, only limited conclusions can be drawn. The known ABB range in Oklahoma has expanded over time, but this could be explained by increased survey effort and area. American burying beetle captures typically fluctuate annually and between years, but in general ABB numbers appear stable to increasing within the action area. Critical habitat has not been designated for the ABB.

A more detailed life history account of the American burying beetle can be found on our website: *http://www.fws.gov/southwest/es/Oklahoma/ABB_Add_Info.htm.*

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all federal, state, or private actions in the action area; the anticipated impacts of all proposed federal actions in the action area that have undergone formal or early section 7 consultation; and the impact of state and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Status of the Species in the Action Area

The most current information for ABBs in Oklahoma can be found at the Service website: *http://www.fws.gov/southwest/es/Oklahoma/ABB_Add_Info.htm.*

Oklahoma counties with confirmed ABB sightings since 1992 include Atoka, Bryan, Cherokee, Choctaw, Coal, Craig, Creek, Haskell, Hughes, Johnston, Latimer, Le Flore, Marshall, Mayes, McCurtain, McIntosh, Muskogee, Okfuskee, Okmulgee, Osage, Pittsburg, Pontotoc, Pushmataha, Rogers, Seminole, Sequoyah, Tulsa, Wagoner, and Washington (29 counties). Additional counties with ABB habitat and potential occurrence due the proximity to the above counties include: Adair, Carter, Delaware, Garvin, Kay, Lincoln, Love, McClain, Murray, Nowata, Ottawa, Pawnee, Payne, and Pottawatomie.

The Oklahoma ABB range in Osage County includes 1,419,669 acres (574,520 hectares) with 1,282,247 acres (518,907 hectares) of potential habitat. Within the Osage County is a Conservation Priority Area (CPA), where ABB capture rates are higher than in the overall range, which encompasses 498,037 acres (201,549 hectares) centered around The Nature Conservancy's Tallgrass Prairie. Osage County supports the largest area of known occupied ABB habitat in the northern portion (Flint Hills) of the ABB range in Oklahoma.

The Osage County ABB area includes diverse land cover types and habitats that includes the Flint Hills, Northern Cross Timbers, Cross Timbers Transition, Osage Cuestas, and Prairie Tableland. Most of these cover types have at least some positive ABB surveys, but they are not all equal in suitability for ABBs. The two main ecoregions are the Northern Cross Timbers and the Flint Hills, which account for 59 percent and 36 percent, respectively, of the ABB range in Osage County. The Northern Cross Timbers encompass 835,851 acres (338,257 hectares) in the ABB range in Osage County. The Northern Cross Timbers are forest habitats interspersed with prairie habitat comprised primarily of post oak *Quercus stellata* and blackjack oak *Q. marilandica*, interspersed with big bluestem *Andropogon gerardii*, little bluestem *Schizachyrium scoparium*, switchgrass *Panicum virgatum*, and Indiangrass *Sorghastrum nutans*. The Flint Hills encompass 507,680 acres (205,451 hectares) of the ABB range in Osage county. The Flint Hills are characterized as prairie habitat dominated by tall grasses such as big bluestem, little bluestem, switchgrass, and Indiangrass, as well as such as short grasses including blue grama *Bouteloua gracilis*, sideoats grama *B. curtipendula*, and hairy grama *B. hirsuta*.

Oil and gas activity is high throughout the analysis area, as well as agricultural land uses, primarily cattle ranching. In Oklahoma, an Industry Conservation Plan (ICP) was developed to streamline ESA compliance for the oil and gas Industry. Current risk factors in the action area include habitat loss/alteration due to agricultural land uses (mostly grazing with some areas of row crops), commercial forestry, energy related projects, and some areas of urban expansion. Urban expansion near Tulsa, Oklahoma has reduced habitat suitability and connectivity. Some portions of the analysis area are more affected by habitat loss and alteration than others, which may explain why many areas of potential habitat have few or no positive ABB surveys.

ABB Habitat within the Action Area

Some areas within the Action Area are unsuitable for ABB use (*i.e.*, areas that are developed, have unsuitable soils, or contain water). To determine how many acres within the Action Area may be impacted by the Covered Activities in areas that are habitat for the ABB, the Service estimated the ratio of ABB habitat to areas unsuitable for the ABB using GIS and the 2006 National Land Cover Database (NLCD) (Fry *et al.* 2011). The Osage Agency or its permittees will likely delineate potential habitat for the ABB within their project areas at a smaller scale than the NLCD data, using different methods (for example, ground-truthing or satellite aerial photography). However, for the purpose of roughly estimating the total habitat within the Action Area, the Service elected to use the NLCD data. Definitions for each of the land cover categories are in Table 3. Areas selected as ABB habitat included the land cover categories of Deciduous Forest, Evergreen Forest, Mixed Forest, Shrub/Scrub, Herbaceous, Woody Wetlands, Emergent Wetlands, and Hay/Pasture (Table 3). Although portions of the Woody Wetlands and Emergent Wetlands are likely unsuitable for the ABB, portions of those areas are likely suitable, especially during dry periods. Therefore, the entire category was included as habitat for this analysis. Areas unsuitable for the ABB (areas where take is not expected to occur) included the land cover categories of Open Water, Developed Open Space, Developed Low Intensity, Developed Medium Intensity, Developed High Intensity, Barren Land, and Cultivated Crops. Approximately 91.0 percent (1,141,753 acres; 462,051 hectares) of the Action Area was considered ABB habitat according to NLCD data, and approximately 9.0 percent (112,830 acres; 45,661 hectares) was not considered ABB habitat.

There may be some additional lands within the Action Area are not suitable for the ABB (based on vegetation type and land management practices). However, the Service does not currently have the data necessary to determine the potential suitability of the entire Action Area using these additional factors. Therefore, for the purpose of this analysis, the Service assumes that 91.0 percent of the Action Area may be habitat for the ABB.

Table 3. Total Acres of ABB habitat within ABB Range in Osage County, Oklahoma.

Land Cover	NLCD Land Cover Description	Habitat (Acres)	Non-Habitat (Acres)
Open Water	Areas of open water, generally with less than 25% cover of vegetation or soil.	0	35,611
Developed, Open Space	Areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.	0	65,706

Land Cover	NLCD Land Cover Description	Habitat (Acres)	Non-Habitat (Acres)
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.	0	6,020
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.	0	1,370
Developed, High Intensity	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/ industrial. Impervious surfaces account for 80% to 100% of the total cover.	0	508
Barren Land	Areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, stripmines, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total cover.	0	1,176
Deciduous Forest	Areas dominated by trees generally greater than 16.5 feet (5 meters) tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.	367,993	0
Evergreen Forest	Areas dominated by trees generally greater than 16.5 feet (5 meters) tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.	1,084	0
Mixed Forest	Areas dominated by trees generally greater than 16.5 feet (5 meters) tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.	4	0

Land Cover	NLCD Land Cover Description	Habitat (Acres)	Non-Habitat (Acres)
Scrub/Shrub	Areas dominated by shrubs; less than 16.5 feet (5 meters) tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.	2,659	0
Grassland/Herbaceous	Areas dominated by gramanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.	781,268	0
Hay/Pasture	Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation.	114,267	0
Cultivated Crops	Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.	0	27,031
Woody Wetlands	Areas where forest or shrubland vegetation accounts for greater than 20% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	11,899	0
Emergent Wetlands	Areas where perennial herbaceous vegetation accounts for greater than 80% of vegetative cover and the soil or substrate is periodically saturated with or covered with water.	3,073	0
Total Acres		1,282,247	137,422

- Metric conversion: 1 acre = 0.4 hectares

Factors Affecting Species Environment within the Action Area

Adequately evaluating the effects of this Opinion's implementation on the ABB requires that the Service consider not only the impacts from the proposed Project, but the context in which they would likely occur. This context includes ongoing effects to ABB from current activities as well as anticipated effects from projects likely to occur in the foreseeable future.

Research and Recovery Permits

Currently, more than 100 entities or individuals in Oklahoma possess valid Section 10(a)(1)(A) scientific research permits under which some authorized take of ABBs may occur. Most of these permits authorize surveys, which contribute to our understanding of where ABBs occur. All research conducted under these permits must further conservation efforts for the species. The loss of some individual ABBs over the short-term from research is allowed as the research, when applied to conservation efforts, should provide long-term benefits. The Service requires that every available precaution be implemented to reduce and/or eliminate authorized take associated with research activities.

Habitat Conservation Plans

An Oil and Gas ICP was finalized in May of 2014 to provide a mechanism to meet statutory and regulatory requirements by proponents engaged in geophysical exploration (seismic), development, extraction, transport, and/or distribution of crude oil, natural gas, and/or other petroleum products and maintenance, operation, repair, and decommissioning of oil and gas pipelines and well field infrastructure within the current range of the ABB in Oklahoma. The ICP is intended cover construction actions over a two year period and maintenance for up to 20 years. Additional information on the ICP was provided in the previous section.

ESA Section 7 Consultations

History of consultations within the action area is largely dependent on the number and scale of potential projects within an area. The Service has consulted on many other proposed actions with the potential to impact the ABB in Oklahoma. Project types evaluated included pipelines, roads, quarries, communication towers, residential housing development, bridges, mining, petroleum exploration/extraction/production, commercial development, recreational development, transmission lines, and water and waste water treatment facilities. Impacts from these activities vary in size and duration, with projects such as quarries being hundreds of acres and having permanent impacts, to water treatment facilities of a few acres with both permanent and temporary impacts. Most of these consultations are informal, result in no take of the ABB, and thus do not provide for incidental take. However, there are several existing and at least eight pending formal consultations that include some level of incidental take of ABBs. Most take is related to temporary actions with soil disturbance.

There are several biological opinions with incidental take statements issued for the ABB in Oklahoma that are currently in effect:

- Natural Resources Conservation Service for the Oklahoma Healthy Forests Reserve Program; issued September 14, 2010; 5,000 acres (2,023 hectares) of habitat;
- Bureau of Land Management for Wild Horse and Burro Program; April 1, 2010; 200,000 acres (80,937 hectares) of habitat;
- Rural Utility Service (RUS) for a KAMO Power transmission project; June 9, 2011; 28 acres (11 hectares) of habitat;
- RUS for Broadband Initiative Program; July 7, 2011; 1,500 acres (607 hectares);
- U.S. Army Corps of Engineers regarding operation of multiple reservoir and navigation projects in Kansas, Oklahoma, and Texas; April 2013, 106,990 acres (43,297 hectares) of habitat, 1,100 acres (445 hectares) potentially permanent and 105, 890 acres (42,852 hectares) of temporary or periodic (flood pool acres) habitat loss;
- U.S. Army Corps of Engineers and Bureau of Indian Affairs for the construction stage on the Flanagan South Pipeline Project; July 24, 2013; a nearly 600-mile (966-kilometer), 36-inch (91 cm) diameter interstate crude oil pipeline that would originate in Pontiac, Illinois, and terminate in Cushing, Oklahoma; 205.5 acres (83.2 hectares) of ABB habitat:115.5 acres (46.7 hectares) during construction, and 90 acres (36.4 hectares) during operation and maintenance activities;
- Muddy Boggy Conservation Bank regarding establishment, management and operation of a Conservation Bank for ABB, September 25, 2013, up to 1,180 acres (478 hectares)of temporary impacts that will result in overall beneficial effects;
- ABB Conservation Bank (ABBCB) regarding establishment, management and operation of a Conservation Bank for ABB, March 17, 2014, up to 289.6 acres (117 hectares) annually during the management that will result in overall beneficial effects;
- Southwestern Power Administration programmatic consultation for powerline maintenance, 2008, 4,855 acres (1,965 hectares) in process of reinitiation;
- Department of Energy, Clean Line Transmission Project, approximately 700 mile (1126 km) transmission line from Texas County, Oklahoma to Shelby County, Tennessee, in planning phase, proposed to cross several counties within the known range of the ABB. Formal consultation issued on November 20, 2015. Anticipated take estimated to be approximately 14,545.5 acres (5,886.4 hectares) of habitat loss.
- Oil and Gas Industry Conservation Plan Biological Opinion; issued May 21, 2014; no more than 32,234 acres (13,044 hectares) of ABB habitat impacted over a two year period, for which mitigation will be implemented.
- U.S. Army Corps of Engineers and Southern Power Administration Programmatic Biological Opinion, issued July 12, 2016, no more than 297,151 acres (120,253 hectares) of ABB habitat impacted at multiple reservoirs and the impacts will be temporary.
- Federal Highway Administration for Oklahoma Department of Transportation and Oklahoma Turnpike Authority activities; June 15, 2017; 6,349.5 acres (2,569.6 hectares) of habitat;
- Natural Resources Conservation Service for conservation practices in Oklahoma, August 29, 2017; 190,050 acres (76,911 hectares).

Effects of the Action

The following section includes an evaluation of direct, indirect and cumulative effects for the ABB, from oil and gas projects included in the proposed action.

Direct Effects

Direct effects are those that are direct or immediate effects of the project on the species or its habitat (Service 1998). Construction activities related to oil and gas projects frequently disturb soils and have the potential to harm individual ABBs. Direct impacts to ABBs during their inactive or active periods may result from clearing vegetation, heavy equipment operation, fuel and chemical contamination of the soil, grading, soil excavation and filling, and re-vegetation of disturbed areas.

Vegetation Removal

Activities that include removal of vegetation may cause habitat degradation, a reduction of habitat connectivity, a loss of breeding and sheltering habitat by removing vegetation and altering soil moisture (loss of vegetation decreases soil moisture), and cause a species composition change within the small community that ABBs rely on for reproduction (Grant *et al.* 1982). The ABB is sensitive to soil moisture and die quickly when desiccated (Bedick *et a*l. 2006). Additionally, these activities may increase the potential for introduction of non-native or invasive species due to the removal of existing vegetation. American burying beetles occurring within the leaf litter or uncovered during the removal of vegetation may be wounded or killed from exposure to adverse weather conditions or crushed by vegetation removal equipment.

Use of Vehicles and Heavy Equipment

Activities requiring off-road vehicles, trucks, or heavy equipment may cause a loss of breeding and sheltering habitat (suitable soil for excavation and burial) from soil compaction, vegetation crushing and trampling, and alteration of soil moisture. Equipment causing soil compaction may crush ABBs within the area, either above ground (during active season) or below ground (during active or inactive season). During the ABB active season, equipment may crush brood chambers containing ABB adults, larvae, and eggs. Direct physical injury or mortality may result when individuals collide with equipment. In dry conditions, equipment could increase the risk of ignition of wildfire. Wildfire may cause loss of breeding, feeding, and sheltering habitat, alter the small mammal community (for a period of time) to a less appropriate size class for optimal ABB reproduction, and injury or mortality for individuals exposed to fire. Operation fluids (e.g., fuel and oil) required for equipment maintenance may cause take of ABBs if individuals or habitat are exposed to them during the active or inactive season.

Disturbance and Movement of Soil

Movement and physical disturbance of soil during construction activities such as grading, soil excavation, and topsoil stripping may crush or expose ABBs (adults, larvae, and/or eggs during the active season; adults during the inactive season) causing injury or mortality through direct impact or exposure to desiccation.

Soil erosion occurring during construction or following installation of project facilities may bury ABB adults or broods (during active season) or overwintering adults (during inactive season) too deep for them to emerge. Additionally, it may expose ABBs to adverse environmental conditions if soils (or individuals/broods) are washed away.

Human Presence and Movement

Introducing or increasing human presence and movement within or adjacent to ABB habitat may increase the amount of crushing or trampling of vegetation, leading to habitat degradation and potential displacement of ABBs in the area.

Light

Artificial lighting used during the active season may attract ABBs, which could result in take through collision or crushing by equipment and/or increasing energetic demands. Light used during nighttime construction can disrupt ABB foraging behavior and increase predation on ABBs (Service 1991). Additionally, light associated with the flame of gas flares used in drilling and production of natural gas may attract ABBs if they are not shielded. Light sources are not expected to affect ABBs during the inactive season, as ABBs are not above ground during that time period.

Vegetation Maintenance

Regular vegetation maintenance within project areas may cause injury or mortality of ABBs. During the active season, ABBs exposed to mowing/vegetation maintenance equipment may be crushed or exposed to desiccation. If vegetation maintenance reduces vegetation height to less than eight inches, the soil may dry to the point that: 1) ABBs have difficulty burying carcasses, 2) soil may not structurally support reproductive chambers, or 3) adult or larval ABBs become desiccated (Bedick *et al.* 2006). Maintaining grass and vegetation at less than eight inches tall could affect ABB reproduction (during the active season) and survival when ABBs are underground (during active or inactive season). If widespread application of herbicides are used to maintain the right-of-way (killing all vegetation within the right-of-way), instead of mechanical vegetation removal (*i.e.*, mowing) or spot-treatment of herbicides, soil may also dry causing the same impacts described above. Large mowing equipment operated within ABB habitat may cause soil compaction, resulting in take of buried ABBs during the active or inactive season. Vegetation maintenance may result in temporary habitat loss, temporary habitat fragmentation, and/or alteration of ABB habitat.

Impacts Analysis and Estimated Incidental Take

The Service anticipates impacts to ABBs will result from proposed action. Such impacts to ABBs are is expected to occur in the form of injury or death of adults, larvae, and eggs from by crushing or collision, or from limiting available resources, resulting in the loss of breeding, feeding, and sheltering habitat. Impacts to ABBs are expected to result from ground disturbance associated with construction and installation of well pads, pipelines, access roads, electrical distribution lines and substations, and off-site reservoirs. Activities related to operation and maintenance, reclamation, and decommissioning are also expected to result in take of the ABB.

Because quantification of the number of ABBs impacted incidental to Covered Activities is not possible given available data, the Service believes that relying on impacts to occupied ABB habitat is a suitable surrogate to estimate the amount of take that is likely to occur. Within the Opinion, "occupied ABB habitat" is defined as areas:

1. suitable for ABB use (containing ABB habitat), AND
2. Within the effective survey radius of a valid ABB survey where ABBs were identified *or* ABBs are assumed present (no surveys have been conducted).

Temporary Habitat Impacts, Permanent Cover Change, and Permanent Impacts

Impacts to ABB habitat are categorized as follows:

Temporary Habitat Impacts

Temporary habitat impacts include areas of ground disturbance resulting from project activities restored to a condition suitable for ABB use within five years of the impact with similar vegetative cover. The restoration timeframe of five years is based on the amount of time in which the Service expects most grass and shrub dominated cover types could be re-established to their previously undisturbed state based on the climate and vegetation types within the Action Area. The ABB is a habitat generalist and specific vegetation types required for the ABB have not been identified, but they have been documented within grassland cover types and native grasses and shrubs are a component of most areas that support ABBs in Oklahoma. Native warm season grasses can take several years to become established, but previous research suggests that five years is a realistic timeframe for restoration of these areas within the Action Area (USDA 2009).

Permanent Cover Change Impacts

Permanent cover change impacts are defined here as changing a vegetation cover type to a different vegetation cover type (*e.g.*, forest or shrubland to grassland), resulting in increased fragmentation of habitat (Oxley *et al.* 1974, Kozol 1995, Ratcliffe 1996, Amaral *et al.* 1997, Bedick *et al.* 1999, Trumbo and Bloch 2000, Marvier *et al.* 2004). Similar to temporary impacts, these areas are to be restored to a condition suitable for ABB use within five years. If these areas will be purposefully maintained (through vegetation control) as a different land cover type than existed prior to project implementation, the Service considers the vegetation cover of the area to have a permanent cover change.

Man-made changes to land cover types can create intense, sudden contrast between land cover types (*i.e.*, a grassland right-of-way fragmenting a contiguous stand of forest habitat), compared to natural patchy landscapes. These cover type conversions often occur within the right-of-ways of linear infrastructure, including road widening or new alignments.

To determine whether a project's cover change type will be permanently altered based on the proposed vegetation maintenance activities, project proponents should determine current land cover type using standard techniques (*i.e.*, ground truthing; analysis of recent aerial or satellite imagery; as described in Table 2, or the latest version of the Multi-Resolution Land Characteristics Consortium's National Land Cover Database, available at *http://www.mrlc.gov/*). The land cover type prior to impacts should be compared to the expected land cover type following the action (including any proposed maintenance/vegetation management activities and requests by the landowner). If the land cover type within the action area will be different (for example, prior to impact, NLCD classified the area at forest; following the impact, the land cover type will fit in the NLCD land cover description for herbaceous) than the original cover type 5 years after the action, the area will have a "permanent cover change." By definition, a permanent cover change does not eliminate ABB habitat.

Evidence suggests that permanent change in cover types, even if the original and resulting cover types are both native to the area, can increase threats to ABBs (Trumbo and Bloch 2000) by increasing the number of invasive plant species present (Marvier *et al.* 2004), reducing the carrion prey base of the appropriate size for ABB reproduction (Oxley *et al.* 1974), or increasing the scavenger competition for carrion (Kozol 1995, Ratcliffe 1996, Amaral *et al.* 1997, Bedick *et al.* 1999) necessary for ABB reproduction. Additionally, changing the vegetation cover type from forest to grassland provides access, which may increase human use and presence (including use of vehicles) in the area.

Impacts within new right-of-ways that have a permanent change in cover and are immediately adjacent and parallel to existing right-of-ways, may be considered temporary impacts because they do not increase habitat fragmentation. Co-locating right-of-ways along existing right-of-ways, roads, or other interruptions in habitat does not contribute to further fragmentation or edge effect and is preferable to crossing previously undisturbed areas.

Permanent Impacts

Permanent impacts are those that eliminate ABB habitat (*i.e.*, buildings, roads, new right-of-way not adjacent to existing right-of-ways), as well as any impact to habitat that takes more than five years to restore to ABB habitat. Permanent impacts to ABB habitat are expected to result in the greatest amount of take of individuals of the species.

Total ABB Impact Estimates within Action Area

Although it is difficult to accurately predict the total impact of Osage Agency oil and gas projects in the Action Area over the next eight years on ABB, the Service developed an estimate of total impacts within the Action Area based on a review of the assessment submitted by Osage Agency and detailed in *Description of the Proposed Action* above. A summary is provided in Table 4.

Given our estimate that 91.0 percent of the Action Area could potentially be ABB habitat and the total estimated disturbance associated with proposed action is 5,200 acres (2,104 hectares), the Service's estimated total impact of proposed action to the ABB habitat is 4,732 acres (1,915 hectares) (91.0 percent of the proposed action estimate, Table 3). That is approximately 0.41 percent of the 1,141,753 acres (462,051 hectares) of suitable ABB habitat within the Planning Area that may be impacted over the duration of the Opinion. The Service believes that not all ABB habitat impacts will occur in areas occupied by the ABB (determined through surveys or assuming presence). However, without knowing the specific locations of the impacts, the Service cannot estimate the exact amount of occupied ABB habitat that will be impacted. Therefore, assuming that all ABB habitat that will be impacted may be occupied (for the purpose of estimating take), we have determined that a maximum of 4,732 acres of occupied ABB habitat would be impacted.

Table 4. Summary of BIA proposed Action Area, ABB habitat, and potential impacts (acres)

	Acres
BIA Action Area Size	1,474,560
ABB Habitat within Action Area	1,141,753
Total estimated habitat disturbance within Action Area (from Table 1)	5,200
Anticipated impacts to ABB habitat (total ground disturbance x 0.91)	4,732

Metric conversion: 1 acre = 0.4 hectares

Cumulative Effects

Cumulative effects are those effects of future, non-federal state, tribal, local government, and private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. In addition to those projects with a Federal nexus that undergo consultation, there are numerous actions that do not require Federal funding, permitting, or authorization and consequently do not require consultation with the Service. Any of several private development projects may occur in Oklahoma.

Portions of the Action Area have undergone urban or industrial development, while other portions are primarily agricultural and have experienced little development. Major developments have included conversion of native vegetation to agricultural crops or grazing land, urban or rural development, transportation projects, rights-of-way clearing for utilities, and development of industrial facilities. Examples include tree management and harvest on private holdings and private conversion of native prairie rangeland to cropland in Oklahoma. Construction of houses, industrial manufacturing sites, power lines and roads are also examples of private projects that could impact ABBs. When large areas of native woodland and native grasslands are affected, loss and fragmentation of these habitats incrementally reduce the recovery potential of ABBs by damaging the functionality of these supporting ecosystems.

The Action Area encompasses a portion of Indian Nation Council of Governments State Planning Region in Oklahoma. The Census Bureau information shows that between 2000 and

2010, Osage County grew in population by approximately 6.8 percent (U.S. Census Bureau 2010). Osage County is projected to grow in population between 2010 and 2075 at an annual average of 0.79 percent (Oklahoma Department of Commerce 2012).

Residential and commercial developments are associated with population growth and are being constructed outside city limits or in previously undeveloped or rural areas. The specific numbers of new or anticipated projects and associated acres of disturbance are difficult if not impossible to quantify. However, it is clear that there are numerous, continuing, and expanding impacts to ABBs and their habitat from projects without a federal nexus. All of the above activities cause loss and further fragmentation of ABB habitat in Oklahoma, reducing incrementally the ability of the species to recover in the state. Construction activities that disturb soils within the current range of ABBs may cause mortality of ABB adults, and (potentially) ABB larvae and eggs. Although direct mortality of ABBs from individual construction activities is local and constitutes a short-term adverse effect, the cumulative loss of ABBs from multiple development projects in a larger area may eventually reduce the ability of a given population to survive in a fragmented landscape. Lighting associated with construction of new roads (*i.e.*, not associated with the proposed Project) and new residential developments can result in harassment and disruption of normal feeding behavior when ABBs are attracted to lights. Future construction and developments of this type by state or private entities may impact ABBs and interfere with feeding or breeding by distracting the ABB.

The IPCC (2007) concluded that warming of the climate system is unequivocal and most of the observed increases in average temperatures globally is likely due to man-made greenhouse gas concentrations. The use/combustion of fossil fuels, such as oil and gas, produces greenhouse gas emissions that contribute to global climate change. Emissions from consumer vehicles in particular, may occur as a result of production and use of oil and gas but typically occur later in time and are difficult to predict. Consequently, the Service assumes there will be greenhouse gas emissions that result from field production at full development of the anticipated leases in Osage County. However, the incremental contribution of these emissions on climate change globally cannot be estimated with any certainty but the Service expects the net impacts to be small.

Conclusion

Less than 0.4 percent of Osage Agency's individual oil and gas projects proposed within the ABBs range in Osage County over the next eight years are expected to have an adverse effect on the species, and could result in take of ABBs. Over the next eight years, direct impacts to 4,732 acres (1,915 hectares) of potential ABB habitat are expected; 3,549 acres (1,436 hectares) of temporary habitat loss, and 1,183 acres (479 hectares) of permanent habitat loss.

After reviewing the current status of the ABB, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's Opinion that implementation of the proposed actions are not likely to jeopardize the continued existence of the ABB. No critical habitat has been designated for this species; therefore, none would be affected.

The Service's determination is based on the following primary factors:

- Since the Recovery Plan was developed in 1991, numerous other ABB populations have been discovered, and the recovery objective of reducing the immediate threat of extinction through discovery or establishment of new populations has been met (Service 2008).

- Although the small population in Texas, on the periphery of the range, may be declining, available evidence indicates that populations of ABB are relatively stable in Nebraska, South Dakota, Oklahoma, Arkansas, Kansas, and Rhode Island.

- The Osage Agency's activities covered under this Opinion likely would cause take of ABBs in the form of killing, harm, and harassment within Oklahoma. However, some of these losses constitute a one-time or short-duration pulse effect to the ABB populations in Osage County, Oklahoma, so they are unlikely to affect ABB populations long-term.

- Anticipated habitat loss is relatively minor (less than one percent) considering that approximately 1,141,753 acres (462,051 hectares) of ABB habitat exists within the ABB range in Osage County, Oklahoma. A maximum of 4,732 acres (1,915 hectares) (0.41 percent) is expected to be impacted. Because permanently lost acres of ABB habitat will be mitigated at a 1:1 ratio or higher, temporarily lost acres of ABB habitat will be restored and mitigated at a 1:0.25 ratio or higher, and newly fragmented acres of ABB habitat will be mitigated at a 1:0.5 ratio or higher, the protection and management in perpetuity of ABB conservation areas is expected to fully mitigate for the effects of the habitat loss during oil and gas operations.

- Methods used to determine the amount of ABB habitat within the action area in Oklahoma has not been applied to other states within the ABB range. However, given that the ABB range expands well beyond Oklahoma, the Service anticipates that the overall percentage of range wide ABB habitat that may be impacted by proposed actions in this Opinion is likely much smaller than 0.41 percent (the percentage of Osage County, Oklahoma ABB habitat in that may be impacted by the proposed oil and gas projects).

- American burying beetle mortality that occurs as a result of project implementation would constitute a short-term effect to populations, which would have minimal impact on the species as a whole and the mitigation is anticipated to provide secure areas for ABB and mitigate for these short-term effects.

The proposed action would not appreciably reduce the likelihood of survival and recovery of the ABB because conservation measures in the Opinion will minimize impacts to the species, reduce the level of take, and result in long-term mitigation for impacts by preserving ABB habitat in perpetuity.

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 attempt to engage in any such conduct. Harm is further defined by FWS 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 by FWS 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 Osage Agency so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Osage Agency has a continuing duty to regulate the activity covered by this incidental take statement. If the Osage Agency (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions 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 Osage Agency must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

The Opinion and associated supporting documentation clearly identify anticipated effects to the ABB likely to result from the proposed Osage Agency oil and gas activities and the measures that are necessary and appropriate to minimize those effects. All avoidance, minimization and mitigation measures described in this Opinion are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR sec. 402.14(i). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the Act to apply. If the Osage Agency or their permittees fail to adhere to these terms and conditions, the take authorization provided under the section 7(o)(2) may lapse. The amount or extent of incidental take anticipated under the Opinion, associated reporting requirements, and provisions for disposition of dead or injured animals are described in the Opinion.

Amount or Extent of Take Anticipated

The Service anticipates incidental take of ABBs will occur as a result of the proposed action in the form of harm, harass, and/or killing. Estimating the number of ABBs that will be taken is difficult because there is no estimate of population density for the action area. Take of the ABB is also difficult to quantify because: 1) individuals of the species are small in size, making them difficult to locate, which makes encountering dead or injured individuals unlikely; 2) ABB losses may be masked by temporal fluctuations in numbers; 3) ABBs spend a substantial portion of their lifespan underground; and 4) the species is primarily active at night. These factors make it difficult to detect the amount of take that will occur. Although we cannot estimate the number of individual ABBs that will be incidentally taken, the Service is providing a mechanism to quantify take levels and define when take would be considered to be exceeded. For purposes of this Opinion, the Service defines incidental take in terms of the number of occupied acres disturbed.

Use of Impacts to Habitat as a Proxy for Take

The use of habitat as a proxy for take of individuals of a species is consistent with existing case law. Courts have recognized that as a general matter "Congress wanted incidental take to be stated in numbers of animals, where practical, not in terms of habitat markers" (*Miccosukee Tribe of Indians or Florida v. US*, 566 F.3d 1257 [11th Cir. 2009]). However, courts have also explained that "While Congress indicated its preference for a numerical value; it anticipated situations in which impact could not be contemplated in terms of a precise number. In the absence of a specific numerical value, however, the Fish and Wildlife Service must establish that no such numerical value could be practically obtained" (see *Arizona Cattle Growers' Association v. U.S. Fish and Wildlife Service*, 273 F.3d 1229, 1249-50 [9th Cir. 2001]). See also *Oregon Natural Resources Council v. Allen*, 476 F.3.d 1031, 1037 [9th Cir. 2007] in which the Service was directed to explain why it was unable to numerically quantify the level of take.

Based upon estimates detailed in Osage Agency's assessment and reiterated in this Opinion, information exchange between Bureau of Indian Affairs representatives and Service staff, and a review of publicly available information and scientific literature, it is anticipated that incidental take may occur within a maximum of 4,732 acres (1,915 hectares) of occupied ABB habitat within the action area, in the form of harm, harassment, and/or mortality. Therefore, the following amount of incidental take will be authorized by this Opinion:

- Individuals will be taken on no more than 4,732 acres (1,915 hectares) of ABB habitat that occurs within the action area.

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 of the ABB due to the small extent of expected habitat losses (less than one percent) in comparison to the total occupied range of the ABB and the long-term beneficial effects associated with the action, most importantly the permanent minimization of take and the effects of conservation of large blocks of habitat in the form of mitigation banks. No critical habitat has been designated for the ABB; therefore, none will be affected.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of ABBs. The Osage Agency shall:

1. Ensure oil and gas project proponents fully implement the proposed action as described in this Opinion, including their proposed Conservation Measures, Minimization Measures, and Mitigation.

2. Ensure that oil and gas project proponents fully adhere to the time frames for which a negative ABB survey is valid and a May Affect-Not Likely to Adversely Affect determination has been reached. For example, a negative ABB survey that is conducted prior to July 28th of a given year is only valid until the end of the same year's active season. Conversely, a negative ABB survey is conducted after July 28th until the end of the active season are only valid until the beginning of the following years' active season. If ground disturbing activities must be completed prior to the end of the time frame the survey is valid, otherwise, consultation may have to be re-initiated or the project proponent may assume presence and utilize either the ICP or this programmatic Opinion.

The reasonable and prudent measure, with its implementing terms and conditions, is designed to minimize the impacts of incidental take that might otherwise result from Opinion implementation. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring re-initiation of consultation and review of the reasonable and prudent measures.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Service must ensure the following terms and conditions that implement the reasonable and prudent measure described above. The terms and conditions are non-discretionary.

1.1 The Osage Agency will ensure that project proponents calculate and purchase Credits from Service approved ABB Conservation Banks to offset acres of ABB impact prior to the start of the project (or impact occurrence).

1.2 The Osage Agency will ensure that all Minimization Measures, as described in the *Conservation Measures Proposed by Osage Agency* section above, will be implemented for all projects within the ABB's range that will impact ABB habitat.

1.3 The Osage Agency will track each project's mitigation offset on a spread sheet and will submit this to the Service's Oklahoma Ecological Service Field Office on a yearly basis.

1.4 The Osage Agency will ensure that time frames of negative surveys are adhered to properly as outline in Reasonable and Prudent Measure Number 2 and are accurately tracked and reported to the Service.

1.5 The Osage Agency will ensure that if vegetation is managed to make it unsuitable as ABB habitat, either after a valid negative survey for the appropriate timeframe has been conducted or by use of hand tools (weed eaters, manual vegetation cutters), that vegetation is maintained below 8" in height until ground disturbing activities have concluded.

The Service believes that no more than 4,732 acres of ABB habitat will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Procedures of Handling and Disposing of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the nearest Service Law Enforcement Officer [Oklahoma: (405) 715-0617]. Secondarily, the Oklahoma Ecological Services Field Office should be contacted within three working days of its findings at (918) 581-7458. Written notification must be made within seven 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 with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care and in handling dead specimens to preserve biological material in the best possible condition.

All dead or moribund individuals will be frozen and the date and location of collection recorded. These specimens should then be furnished to the Sam Noble Museum of Natural History located at the University of Oklahoma.

Reinitiation Notice

This concludes formal consultation on the action outlined in the Opinion. As provided in 50 CFR §402.16, reinitiation of formal 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 shows that the action may affect listed species in a manner or to an extent not considered in this Opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species not considered in this Opinion; 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.

We appreciate the opportunity to work with you on this project. If you have any questions please contact Laurence Levesque at 918-382-4509 or laurence_levesque@fws.gov.

LITERATURE CITED

Amaral, M., A. J. Kozol, and T. French. 1997. Conservation strategy and reintroduction of the endangered American burying beetle. Northeastern Naturalist 4(3): 121–132.

Anderson, R.L. 1982. On the decreasing abundance of *Nicrophorus americanus* Olivier (Coleoptera: Silphidae) in eastern North America. *Coleopterists Bulletin* 36:362–65.

Anschutz, R. M., W. J. Allgeier, D.G. Snethen, W.W. Hoback. 2007. The impacts of light and light types on nocturnal carrion beetles, including the American Burying Beetle. Poster Presentation as North Central Branch Entomology Meeting, Winnipeg, Manitoba, Canada.

Backlund, D.C., and G.M. Marrone. 1997. New Records of the endangered American burying beetle, *Nicrophorus americanus* Olivier, (Coleoptera:Silphidae) in South Dakota. The Coleopterists Bulletin, 51(1):53–58.

Bedick, J.C., B.C. Ratcliffe, W.W. Hoback, and L.G. Higley. 1999. Distribution, ecology and population dynamics of the American burying beetle *Nicrophorus americanus* Olivier (Coleoptera, Silphidae)] in South-central Nebraska, USA. Journal of Insect Conservation 3(3): 171–181.

Bedick, J.C., W.W. Hoback, and M.C. Albrecht. 2006. High water-loss rates and rapid dehydration in the burying beetle, *Nicrophorus marginatus*. Physiologcal Entomology 31:23–29.

Bureau of Indian Affairs (BIA). 2015. Programmatic Envirornmental Assessment for Approving Workover Operations. BIA Osage Agency. Pawhuska, Oklahoma.

Creighton, J.C., R. Bastarache, M.V. Lomolino, M.C. Belk. 2007. Effect of forest removal on the abundance of the endangered American burying beetle, Nicrophorus americanus. Journal of Insect Conservation, Published online: 16 October 2007.

Creighton, J.C. and G. Schnell. 1998. Short-term movement patterns of the endangeredAmerican burying beetle *Nicrophorus americanus*. Biological Conservation 86: 281-–287.

Creighton, J.C., C.C. Vaughn, and B.R. Chapman. 1993. Habitat preference of the endangered American burying beetle (*Nicrophorus americanus*) in Oklahoma. The Southwestern Naturalist 38:275–277.

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United

States, PEandRS, Vol. 77(9):858-864.

Grant, W.E., E.C. Birney, N.R. French, and D.M. Swift. 1982. Structure and productivity of grassland small mammal communities related to grazing-induced changes in vegetative cover. Journal of Mammalogy 63(2):248–260.

IPCC 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Pachauri, R.K. and Reisinger, A. (Eds.) IPCC, Geneva, Switzerland. pp 104.

Jurzenski, J., D.G. Snethen, M.L. Brust, and W.W. Hoback. 2011. New records of carrion beetles in Nebraska reveal increased presence of the American burying beetle, *Nicophorus americanus* Olivier (Coleoptera: Silphidae). Great Plains Research 21:131–143.

Klein, B.C. 1989. Effects of forest fragmentation on dung and carrion beetle communities in Central Amazonia. Ecology 70: 1715-1725.

Kozol, A.J. 1990. The natural history and reproductive strategies of the American burying beetle, *Nicrophorus americanus*. Unpublished report prepared for the U.S. Fish and Wildlife Service 15pp.

Kozol, A.J. 1995. Ecology and Population genetics of the endangered American burying beetle, *Nicrophorus americanus*. Ph.D. Dissertation, Boston University, USA.

Kozol, A.J., J.F.A. Traniello, and S.M. Wouldiams. 1994. Genetic variation in the endangered burying beetle *Nicrophorus americanus* (Coleoptera: Silphidae). Annals of the Entomological Society of America 6:928-935.

Lomolino, M. V. and J. C. Creighton. 1996. Habitat selection, breeding success and conservation of the endangered American burying beetle, *Nicrophorus americanus*. Biological Conservation 77:235–241.

Lomolino, M. V., J. C. Creighton, G.D. Schnell, and D. L. Certain. 1995. Ecology and conservation of the endangered American burying beetle, *Nicrophorus americanus*. Conservation Biology 9:605–614.

Marvier, M., P. Kareiva, M.G. Neubert. 2004. Habitat Destruction, Fragmentation, and Disturbance Promote Invasion by Habitat Generalists in a Multispecies Metapopulation. Risk Analysis 24, 869–878.

Oklahoma Department of Commerce. 2012 Demographic State of the State Report. Oklahoma State and County Population Projections through 2075. Found at: http://okcommerce.gov/wp-content/uploads/2015/06/Population_Projections_Report-2012.pdf

Oxley, D.J., M.B. Fenton, and G.R. Carmody. 1974. The effects of roads on populations of small mammals. J. Appl. Ecol. 11: 51-59.

Ratcliffe, B.C. 1996. The carrion beetles (Coleoptera: Silphidae) of Nebraska. Bulletin of the Nebraska State Museum Vol. 13. 100pp.

Schnell, G. D., A.H. Hiott and V. Smyth. 2011. Evaluation of American burying beetles on the Weyerhaeuser Habitat Conservation Plan Area 10 year Assessment Report 1997-2006.

Scott, M.P. and J.F.A. Traniello. 1987. Behavioral cues trigger ovarian development in the burying beetle *Nicrophorus tomentosus*. Journal of Insect Physiology 33: 693–696.

Sikes, D.S., and Christopher J. Raithel. 2002. A review of hypotheses of decline of the endangered American burying beetle (Silphidae: *Nicrophorus americanus* Olivier). Journal of Insect Conservation 6: 103–113.

Trumbo, S.T. 1992. Monogamy to communal breeding: exploitation of a broad resource base by burying beetles (*Nicrophorus*). Ecological Entomology 17:289-298.

Trumbo, S.T. and P.L. Bloch. 2000. Habitat fragmentation and burying beetle abundance and success. Jour. of Insect Conservation 4(4): 245-252.

United States Census Bureau. 2010. Osage County, Oklahoma Quick Facts. Found at: https://www.census.gov/quickfacts/fact/table/osagecountyoklahoma/PST045216

United States Department of Agriculture (USDA) – NRCS. 2009. Natural Resources Conservation Service. Establishing Native Warm Season Grass Mixtures. April 2009 Fact Sheet.

United States Fish and Wildlife Service (Service). 1991. American Burying Beetle (*Nicrophorus americanus*) Recovery Plan. Newton Corner, Massachusetts. 80 pp.

United States Fish and Wildlife Service (Service). 2008. Five-year review of the status of the American Burying Beetle. June 16, 2008. Southwest Regional Office, Albuquerque, New Mexico.

United States Fish and Wildlife Service (Service). 2016. American Burying Beetle Impact Assessment for Project Reviews. Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. 19 pages.

Walker, T. J. 1957. Ecological studies of the arthropods associated with certain decaying materials in four habitats. Ecology 38(2) 262-276.

Wilson, E.O. 1971. The Insect Societies. Harvard University Press, Cambridge, MA.

Woods, A. J., J. M. Omernik, D. R. Butler, J. G. Ford, J. E. Henley, B. W. Hoagland, D. S. Arndt, and B.C. Moran. 2005. Ecoregions of Oklahoma (color poster with map, descriptive text, summary tables, and photographs): Reston, VA, US Geological Survey (map scale 1:1,250,000).

United States Department of the Interior
Bureau of Indian Affairs
Eastern Oklahoma Region
Osage Agency

OSAGE COUNTY OIL AND GAS BIOLOGICAL ASSESSMENT
JULY 2017

TABLE OF CONTENTS

Section | Page

TABLES

Page

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

	Full Phrase
ABB	American burying beetle
APD	application for permit to drill
APLIC	Avian Power Line Interaction Committee
BA	biological assessment
BIA	United States Department of the Interior, Bureau of Indian Affairs
BMP	best management practice
BO	biological opinion
°C	degrees Celsius
CFR	Code of Federal Regulations
COAs	conditions of approval
CPA	USFWS American burying beetle Conservation Priority Area
CWA	Clean Water Act
CWS	Canadian Wildlife Service
DOI	United States Department of the Interior
EIS	environmental impact statement
ESA	Endangered Species Act of 1973
°F	degrees Fahrenheit
FR	*Federal Register*
HCP	habitat conservation plan
ICP	American Burying Beetle Industry Conservation Plan
IPaC	USFWS Information Planning and Conservation system
MBTA	Migratory Bird Treaty Act of 1918
NEPA	National Environmental Policy Act of 1969
NTL	notice to lessee
NWR	USFWS National Wildlife Refuge
ODWC	Oklahoma Department of Wildlife Conservation
PEA	Programmatic Environmental Assessment
ROW	right of way
SPCC	spill prevention and control and countermeasure plan
T&E	threatened and endangered
US	United States
USACE	United States Army Corps of Engineers

USC	United States Code
USFWS	United States Department of the Interior, Fish and Wildlife Service

SECTION 1
INTRODUCTION

1.1 BACKGROUND

Under provisions of the United States (US) Endangered Species Act (ESA) of 1973, as amended (16 USC, Section 1531 et seq.), federal agencies are directed to conserve threatened and endangered (T&E) species and their habitats. Section 7(a) (1) states that all federal agencies shall "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species…." Thus, the conservation and recovery of T&E species is not simply the responsibility of the US Fish and Wildlife Service (USFWS) but of all federal agencies.

The US Department of Interior (DOI) Bureau of Indian Affairs (BIA) Osage Agency is responsible for managing the Osage Mineral Estate in Osage County, Oklahoma, for the benefit of the Osage. The Osage Oil and Gas Program is governed by the 1906 Osage Allotment Act and regulations set forth in 25 CFR, Part 226. In addition, the Osage Agency Superintendent has issued various directives and policies, and the agency has developed best management practices (BMPs), which are incorporated into permits to drill and approvals for workover operations.

The purpose of this biological assessment (BA) is to evaluate the extent to which the existing Osage Oil and Gas Program (The Proposed Action; see **Section 2**) may affect T&E species.

Section 7(a) (2) of the ESA requires agencies such as the BIA to consult or confer with the USFWS when there is discretionary federal involvement or control over the proposed action. The ESA requires agencies to determine the impacts of the proposed action on listed species, and to ensure that listed species are afforded adequate consideration and protection. Informal consultation occurs when the federal agency, after discussion with the USFWS, determines that the proposed action is not likely to affect any listed species in the action area, and the USFWS concurs. Formal consultation occurs after the agency determines that the proposed action is likely to adversely affect listed species or critical habitat, or when the USFWS does not concur with the agency's finding (USFWS 1998).

This BA provides documentation and analysis for the proposed action. It addresses federally listed T&E species and has been prepared under the 1973 ESA Section 7 regulations, in accordance with the 1998 procedures set forth by the USFWS.

The BIA requests formal consultation leading to a programmatic biological opinion (BO) and incidental take statement for the American burying beetle (ABB). The BIA is proposing to, in coordination with the USFWS, assume certain responsibilities in order to effectively address covered oil and gas activities in Osage County, in occupied habitat within the USFWS ABB Planning Area. In addition, the BIA proposes to streamline processing time for oil and gas activities where there is a negative ABB survey or absence of suitable ABB habitat, as described in **Section 2.3**, American Burying Beetle Activities Under the Proposed Action.

The BIA also requests informal consultation and concurrence for the impacts of the proposed action on five additional T&E species and their critical habitat (see **Table 1-1**).

Table 1-1
List of Threatened and Endangered Species

Common Name	Species Name	Federal Status[1]	Critical Habitat[2]
Listed Species for Potential Consultation			
Invertebrates			
American burying beetle	*Nicrophorus americanus*	E	
Neosho mucket mussel	*Lampsilis rafinesqueana*	E	Designated
Birds			
Whooping crane	*Grus americana*	E	Designated
Red knot	*Calidris canutus rufa*	T	
Interior least tern	*Sternula antillarum athalassos*	E	
Piping plover	*Charadrius melodus*	T	Designated

Sources: USFWS 2015a; BIA 2015b
[1]Status: E = Endangered; T = Threatened
[2]Critical habitat: The planning area does not contain designated or proposed critical habitat.

1.2 SPECIES ADDRESSED

The species addressed in this BA are all listed T&E species or candidate species that are known to occur in the planning area (**Table 1-1**); the planning area does not contain designated or proposed critical habitat for any listed T&E species. In addition to the listed species in **Table 1-1**, the BA addresses one candidate species; rattlesnake-master borer moth (*Papaipema eryngii*). The planning area is described in detail in **Section 1.4**, Description of the Planning Area.

1.3 CONSULTATION HISTORY

The BIA has developed several BMPs during the preparation of NEPA documents, including but not limited to the Programmatic Environmental Assessment for Workover Operations (BIA 2015a) and the Draft Osage County Oil and Gas Environmental Impact Statement (EIS) (Draft Osage EIS; BIA 2015b). Although the USFWS is not a cooperating agency for the Draft Osage EIS, the BIA has met with the USFWS and described the resulting BMPs, several of which should help avoid, minimize, or mitigate wildlife-related impacts. The BMPs are summarized in **Section 2.4**, Best Management Practices.

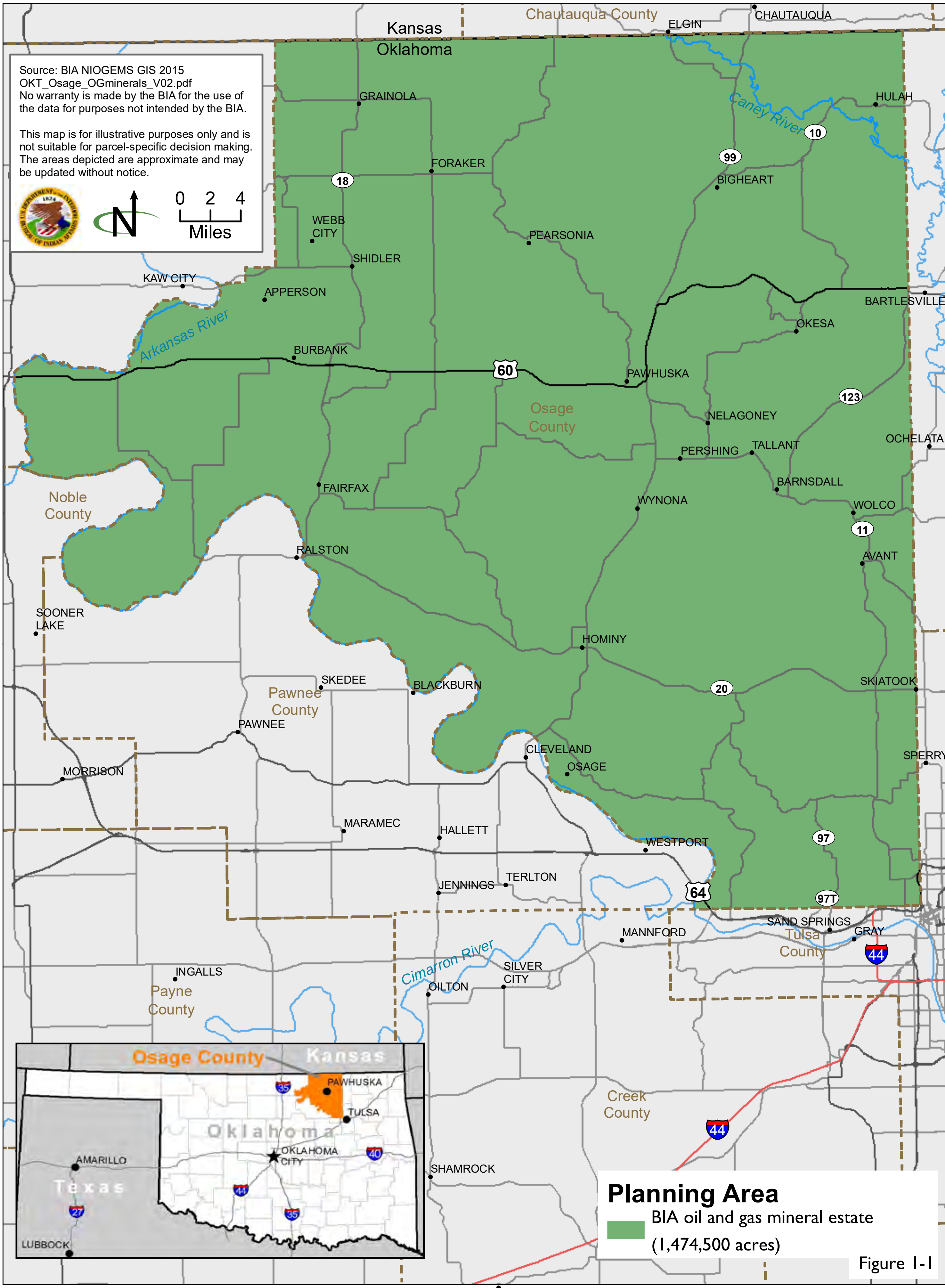
1.4 DESCRIPTION OF THE PLANNING AREA

Figure 1-1, Planning Area, represents the area subject to analysis in this BA (action area). The planning area covers all of the subsurface mineral estate in Osage County, approximately 1,474,500 acres. Osage County is in northeast Oklahoma, bordering Kansas. The BIA's Eastern Oklahoma Regional Office, Osage Agency manages all of the subsurface mineral estate in the county. **Table 1-2**, Planning Area Surface Ownership, and **Figure 1-2**, Surface Administration, show the acreage in each type of surface ownership in the planning area.

Table 1-2
Planning Area Surface Ownership

Landowner/Surface Management Agency[1]	Acres	Percentage of Total
Allotted	121,500	8
Private or other (not including The Nature Conservancy)	1,231,000	83
State	14,500	1
The Nature Conservancy	35,200	2
Tribal[2]	1,600	<1
US Army Corps of Engineers (includes open water)	70,700	5
Total	**1,474,500**	**100**

Sources: BIA NIOGEMS GIS 2015; OK GAP GIS 2008
[1]Land not identified as state, allotted, or tribal land was assumed to be privately owned.
[2]Tribal trust and allotted acreage is likely larger than that shown. The Osage Nation is working to determine the correct acreage of tribal lands in the planning area based on the historic reservation boundaries. The Tribe also owns lands in fee simple, and fee lands are not included in Table 1-2; for example, Osage Nation holds the "Bluestem Ranch" tract (approximately 43,000 acres) in fee.



Source: BIA NIOGEMS GIS 2015
OKT_Osage_OGminerals_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
FAIRFAX
BARNSDALL
Noble County
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
Cimarron River
INGALLS
SILVER CITY
OILTON
Payne County
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Planning Area
BIA oil and gas mineral estate (1,474,500 acres)

Figure 1-1

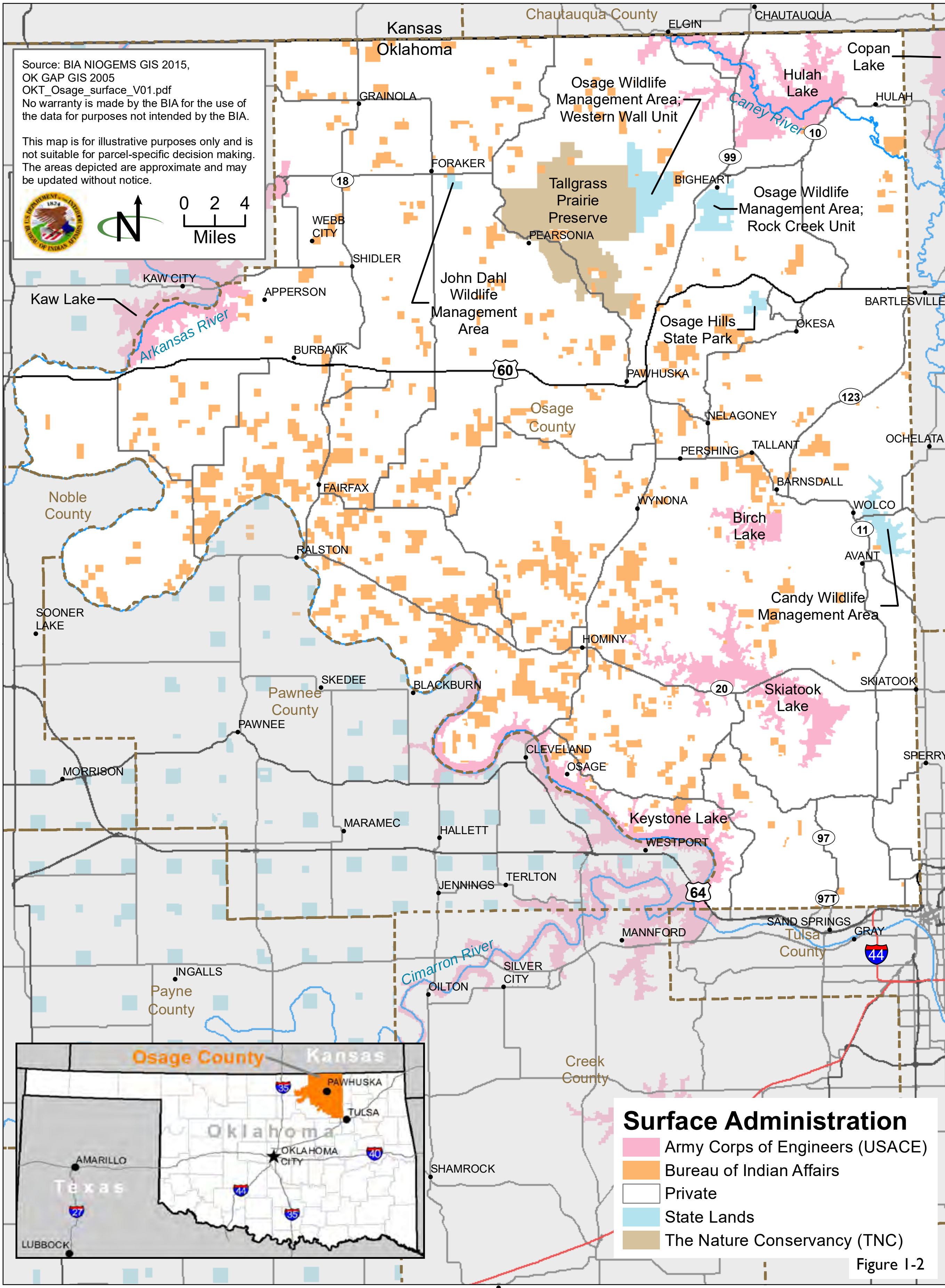

Source: BIA NIOGEMS GIS 2015,
OK GAP GIS 2005
OKT_Osage_surface_V01.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
N
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
Copan Lake
Hulah Lake
HULAH
Caney River
Osage Wildlife Management Area; Western Wall Unit
Tallgrass Prairie Preserve
BIGHEART
Osage Wildlife Management Area; Rock Creek Unit
PEARSONIA
GRAINOLA
FORAKER
WEBB CITY
SHIDLER
John Dahl Wildlife Management Area
KAW CITY
Kaw Lake
APPERSON
Arkansas River
BURBANK
Osage Hills State Park
OKESA
BARTLESVILLE
PAWHUSKA
Osage County
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
FAIRFAX
WYNONA
WOLCO
Noble County
Birch Lake
RALSTON
AVANT
Candy Wildlife Management Area
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
Pawnee County
PAWNEE
Skiatook Lake
SKIATOOK
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
Keystone Lake
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
INGALLS
Payne County
Cimarron River
SILVER CITY
OILTON
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Surface Administration
Army Corps of Engineers (USACE)
Bureau of Indian Affairs
Private
State Lands
The Nature Conservancy (TNC)

Figure 1-2

This page intentionally left blank.

SECTION 2
PROPOSED ACTION

2.1 PROPOSED ACTION

The proposed action is summarized in this section. The objective of the proposed action is to promote oil and gas production and, to the extent possible, to minimize potential adverse environmental impacts on landowners, wildlife, and natural and cultural resources from noise, traffic, excavations, dust, and other disturbance associated with construction and operations under oil and gas leases. To achieve this objective, the BIA would continue to apply BMPs (see **Section 2.4**, Best Management Practices) to the following types of activities under oil and gas leases, which are described in more detail in **Section 2.2**, Oil and Gas Activities under the Proposed Action:

- Activities within the scope of the BIA's (2015a) Workover Programmatic Environmental Assessment (PEA; workover activities)
- Applications for permit to drill (APDs) and other permitted and non-permitted lease activities

Under the proposed action, lessees must comply with and obtain any necessary permits or authorizations required under 25 CFR, Part 226, and other federal laws, including the ESA (1973), Clean Water Act (1972), Clean Air Act (1963), Safe Drinking Water Act (1974), and National Historic Preservation Act (1966).

All lessees must comply with the requirements of 25 CFR, Part 226, an approved lease, and the terms and conditions of any BIA-issued permit or approval. The BIA is authorized to apply requirements in the form of notices to lessees (NTLs) or Orders of the Superintendent to ensure that all operations are conducted in a manner that protects natural resources, environmental quality, and life and property. Through a combination of permit terms and conditions of approval (COAs), as well as NTLs and orders, the BIA may specify applicable requirements and practices that are interpreted as necessary or considered to be appropriate measures to protect natural resources in compliance with the regulations. The BIA would generally not apply measures that would prohibit development of an approved lease, but would first seek to impose reasonable measures for avoidance, minimization and mitigation of impacts from oil and gas activities.

2.2 OIL AND GAS ACTIVITIES UNDER THE PROPOSED ACTION

Typical oil and gas activities included in the proposed action are summarized in this section. The term "Covered Activities" under the BIA's proposed action and this BA includes all of the described facilities and activities for which BIA has jurisdiction and regulatory authority.

Geophysical exploration is the process of locating oil and gas deposits beneath the earth's surface. This involves generating seismic waves and measuring their reflectance through differing geologic structures. Ground disturbance associated with geophysical exploration may include clearing vegetation or road construction.

Non-permitted lease activities include those activities on a lease that are not associated with issuance of a drilling permit or performance of a workover review. These can include some ground-disturbing activities such as changes to established access roads or burial or rerouting of existing flow lines. Appropriate conservation measures may be imposed in this instance by standard lease or permit conditions, or a site-specific NTL or order issued by the Superintendent. The BIA may initiate consultation with USFWS under Section 7(c) of the ESA for species other than the ABB at any time it becomes necessary, for activities which require BIA approval or that are within the scope of standard permit conditions.

Potential workover activities (BIA 2015a) associated with operation and maintenance of wells generally do not include new ground disturbance. These activities include acid fracturing, new drilling or modification of bores on existing well pads, well conversions (gas to oil or oil to gas), plugging and abandonment, re-drilling a previously plugged well and other activities. A full description of workover activities can be found in the BIA's (2015a) Workover PEA.

Permits to drill and other BIA-authorized activities may include construction, operation, and maintenance of new and existing well field infrastructure and decommissioning of obsolete facilities. Activities may include geophysical exploration, well pad, road, and other infrastructure construction, as well as operation and maintenance of infrastructure.

Well pads include all structures and equipment necessary for recovering crude oil or natural gas, obtaining water for oil and gas recovery, or fluid disposal following production. Typical well pad construction requires vegetation clearing, grading to level the pad, constructing storm water and erosion control structures, laying shale, gravel, and/or rock over the well pad, and constructing pits, trenches, and sumps. Constructing an impoundment outside of the existing well pad is sometimes needed to maintain a water source for hydraulic fracturing operations.

Development of well fields relies on existing roadways or may require constructing new roads. Newly constructed roads are first cleared of vegetation with a bulldozer and leveled with a road grader. Shale, rock, or gravel is used to stabilize the length of the road.

Following construction of access roads and well pads, drilling rigs and associated equipment are transported to the well pad and installed. All drilling activities occur within the previously disturbed (cleared and graded) well pad. After drilling is completed, the rig is removed and hydraulic fracturing equipment may be brought onto the well pad to facilitate production. All activities associated with drilling and well completion occurs on previously disturbed areas. After drilling and completion, typically 75 percent of the well pad and associated activities (i.e. rights-of-way, roads, utility lines, etc.) is re-vegetated. The remaining 25 percent is typically maintained for oil/gas development activities.

Oil and gas pipeline construction involves land clearing activity where pipeline rights-of-way (ROWs) are cleared and graded. Pipeline construction ROWs are typically divided into four areas of activity: trenching, spoil piles (excavated materials consisting of topsoil or sub-soils that have been removed and temporarily stored during the construction activity), pipeline assembly, and vehicle traffic areas. Pipeline ROW widths are determined by the pipeline diameter and material, as well as terrain and site-specific conditions. After pipeline installation and backfilling the trench, work areas are graded and restored as closely as possible to preconstruction contours, and previously segregated topsoil is spread across the construction ROW. Pipe installation by conventional or directional boring, also known as horizontal direction drilling, may be utilized at roads, railroad crossings, water crossings, or in other sensitive areas to minimize disturbance.

Surface facilities associated with crude oil, natural gas, and petroleum product pipelines may include access roads, booster stations, pump stations, compressor stations, valve sites, meter stations, pig (a device used to clean and/or inspect pipelines) launchers and receivers (locations where pigs are inserted into or removed from a pipeline), processing/treatment plants, communication towers, electric distribution lines and other utilities, electric substations, and others.

2.3 AMERICAN BURYING BEETLE ACTIVITIES UNDER THE PROPOSED ACTION

Under the current process, lessees proposing oil and gas activities with potential to disturb suitable ABB habitat may conduct surveys for the presence of ABBs or assume presence and apply for an incidental take permit through Section 7 and/or 10 of the ESA. Currently, in the case of a positive ABB survey, the lessee has the following options: 1) obtain an incidental take permit through the USFWS' ICP process under Section 10 of the ESA, 2) obtain an incidental take permit through an individual habitat conservation plan (HCP) under Section 10 of the ESA, or 3) obtain an incidental take permit through a formal consultation between the BIA and the USFWS (this would be a site-specific or batched Section 7 consultation, not a programmatic one).

The ABB ICP is a general conservation plan developed by the USFWS with oil and gas industry input. It offers project proponents a streamlined permitting process that results in the same assurances and protections as an HCP. Within its 45-county planning area in Oklahoma, it provides the oil and gas industry with a mechanism for incidental take authorization during construction, operation, maintenance, repair, and decommissioning of oil and gas projects and it also describes measures to minimize and mitigate take of the ABB and impacts on its habitat.

The BIA is proposing to adopt certain provisions of the USFWS' ABB ICP, as outlined in this BA. These provisions will apply to lessees who have a positive ABB survey or wish to presume that the ABB is present.

Currently, if there is a negative survey result, unless the BIA makes a "no effect" determination, then the BIA must submit an individual consultation package and wait up to 45 days for a response from the USFWS. ABB surveys conducted in the early season may have to be duplicated, due to processing time for the agencies and the requirement of a 30-day posting of the Notice of Availability for the site-specific EA before permits can be approved. Projects that would impact ABB habitat during the inactive season (usually late September to mid-May) must have ABB surveys conducted after July 28. Late season surveys may be necessary to extend the window for drilling permits to be issued, and allow the project to be initiated during the ABB inactive/dormant season.

BIA is proposing that USFWS eliminate the requirement for individual package submittal and the 45-day processing period, in cases where there is a negative survey or determination (with supporting documentation) that no ABB habitat exists in the area of proposed activities. In this situation, the BIA would still require appropriate BMPs as permit conditions, and would include any necessary site-specific permit conditions based upon review of project plans and NEPA documents. BIA would also report annually to the USFWS acreages of temporary, permanent cover change, and permanent impacts.

The BIA is also consulting with the USFWS on the Osage Oil and Gas Program (the proposed action) on a programmatic level to have USFWS authorize incidental take through a programmatic BO for oil and gas activities that may impact the ABB. The programmatic BO will allow for streamlining and efficiencies in the process.

The programmatic BO would authorize incidental take for the BIA based on the estimated acres of suitable ABB habitat ("occupied habitat") disturbed by oil and gas activities annually. This is approximately a maximum of 600 acres, comprised of 450 acres of temporary disturbance and 150 acres of permanent disturbance (see *Assumptions and Methods* of analysis for ABB in **Section 4.2.1**, American Burying Beetle). The BIA would report annually to the USFWS the number of acres disturbed under its programmatic incidental take statement. If annual acres of disturbance exceed the limit defined in the incidental take statement, the BIA would re-initiate consultation with the USFWS.

Before ground-disturbing oil and gas activities begin within the ABB's range in the planning area, (see **Figure 3-1**, American Burying Beetle) and not within the list of Areas Unfavorable for the ABB (USFWS 2015b), a presence/absence survey would be conducted. Surveys would be necessary for well drilling and workover operations that result in ground disturbance beyond the extent of an existing well pad, road, or other disturbed area. Surveys would be based on the most recent USFWS Oklahoma survey guidance. Lessees also may assume presence of ABBs and proceed with actions through section 7 or 10 of the ESA.

For workover operations tiered to the Workover PEA, the BIA requires that these activities not disturb the ground beyond the extent of the existing disturbance. Therefore, workover operations tiered to the Workover PEA (or any superseding NEPA document that encompasses the Workover PEA) may not require ABB surveys.

Applicants for workover permits must provide photographic documentation of vegetation height on the well pad where work is proposed. If well pad vegetation height is below 8 inches, the BIA would assume that habitat for ABB is not present. In these cases, the BIA makes a "no effect" determination, and site-specific consultation with the USFWS is not necessary.

If photographic documentation accompanying a workover application shows vegetation height is above 8 inches, the BIA would visit the site to determine what type of ABB habitat is present. If well pad soils are compacted or contain a high percentage of rock or gravel, and there is excessive vegetation height, that would indicate potential foraging habitat for ABB. If well pad soils are conducive to ABB burrowing or burying carrion that would be considered suitable ABB habitat for reproduction

Vegetation may be removed from areas suitable as foraging habitat for the ABB only during the inactive season. The lessee must commit through conditions of approval of the permit, to maintain the vegetation height of the project area at a height of 8 inches or less until the proposed workover or plugging action has been implemented or until the permit expires in 2 years. The proposed activity may commence immediately after vegetation removal has been completed within the inactive season without the need of a presence/absence survey.

Vegetation may also be removed during the inactive season in situations where the well pad has suitable reproduction habitat for the ABB; however, the lessee must commit to only removing the vegetation through the use of hand tools (e.g., weed eaters, manual weed cutter, etc.) and will not be able to utilize heavy machinery such as riding mowers or tractors/brush hogs to remove vegetation. The lessee must also commit to delaying the implementation of the proposed activity until after the beginning of the ABB active season (approximately May 15th of each year). The proposed activity may not commence during the inactive season after the vegetation removal due to the fact that the ABB may still be dormant in the ground within the perimeter of the well pad. Delaying project implementation will allow for the temperatures to become high enough for the ABB to become active, emerge from the ground and leave the project area. After the active season has begun then the proposed activity may commence without the need for an ABB presence/absence survey.

In both situations the BIA will require that the lessee maintain the vegetation below 8 inches until the project is either implemented or the permit expires. The BIA would make a “no effect” determination due to the fact that no suitable habitat will exist within the project area at the time of project implementation.

Well workover and plugging permits on leases are generally valid for a term of 2 years; however, an order of the Superintendent, NTL or special permit condition may be utilized, when justified, to reduce the period of potential disturbance to ABB habitat from maintaining vegetation height below 8 inches.

If vegetation were to be removed during the ABB active season, an ABB survey would be required. If the survey results are negative, vegetation removal could begin according to the procedure outlined below for valid negative ABB survey results. Alternatively, the lessee could wait until the ABB’s inactive season to begin vegetation removal as described above.

When surveys are required, and survey results are negative, lessees would report them to the USFWS and the BIA. For lessees relying on negative early season survey results, the early season survey results would remain valid until the end of the ABB active season. Late season negative survey results would remain valid until the beginning of the next active season. Development activities with valid negative ABB surveys would receive a “may affect, not likely to adversely affect” determination or a “no effect” determination from the BIA. Under the current system, this would require site-specific consultation with the USFWS for concurrence on the determination.

Under the proposed action, the BIA requests that the USFWS issue a blanket concurrence for the BIA’s determination that development, with valid negative ABB surveys, “may affect, not likely to adversely affect” or would have “no effect” on ABB. In these circumstances, site-specific consultation with the USFWS would no longer be necessary, thus eliminating the need to submit individual project packages to USFWS and eliminating the 45-day processing period. Lessees would have approval to proceed after the BIA confirms that survey results have been submitted to USFWS for review. This will enhance the efficiency of the BIA permitting process. As stated above, the BIA would annually report to USFWS the acreages of disturbance for activities authorized in unoccupied ABB habitat, and BIA would also include appropriate permit conditions to avoid significant environmental impacts identified through the review of project plans and the NEPA process.

When ABB surveys are positive, or when presence is assumed, lessees would be required to minimize or mitigate the proposed disturbance, in accordance with the procedures detailed in this BA and the programmatic biological opinion. BIA is adopting the minimization and mitigation measures listed in **Attachment A.**

Lessees with positive ABB surveys would be required to follow the minimization and mitigation measures listed in Attachment A. BIA will calculate the acreages and require appropriate documentation and reporting for the following types of impacts:

Temporary Impacts
Temporary impacts include areas of ground disturbance resulting from covered activities restored to a condition suitable for ABB use within 5 years of the impact with similar vegetative cover.

Permanent Cover Change Impacts
Permanent cover change impacts are defined here as changing a vegetation cover type to a different vegetation cover type (e.g., forest or scrubland to grassland), resulting in increased fragmentation of habitat. Similar to temporary impacts, these areas will need to be restored to a condition suitable for ABB use within 5 years. If these areas will be purposefully maintained (through vegetation control) as a different land cover type than prior to project implementation, it will be considered a permanent cover change. Impacts within ROWs (for projects such as pipeline and electric distribution lines) that have a permanent change in cover and are immediately adjacent and parallel to existing ROWs, may be considered temporary because they do not increase habitat fragmentation. Co-locating ROWs along existing ROWs, roads, or other interruptions in habitat does not contribute to further fragmentation or edge effect and is preferable to crossing previously undisturbed areas.

Permanent Impacts
Permanent impacts are those that eliminate ABB habitat (i.e., buildings, roads, quarries, strip mines), as well as any impact to habitat that takes more than 5 years to restore to ABB habitat. Permanent impacts to ABB habitat are expected to result in the greatest amount of take of individuals of the species.

2.3.1 Mitigation Ratios

BIA will utilize mitigation ratios established by the USFWS. These mitigation ratios are set forth in **Table 2-1**.

Table 2-1
Mitigation Ratios[1]

Impact Period	ABB Range Outside Conservation Priority Area	Conservation Priority Area	Mitigation Land[2]
Temporary	1:0.25	1:0.5	1:1.5
Permanent Cover	1:0.5	1:1	1:2
Permanent	1:1	1:2	1:3

[1] Mitigation Ratios are acres of impact: acres of mitigation
[2] Mitigation land ratio is equal to the CPA ratio plus the mitigation acres impacted

Each acre of *temporary impact* (≤5 years)[1] occurring within the ABB range (but not within a CPA), would require 0.25 acres of mitigation (1:0.25 ratio). The ABB Conservation Priority Areas (CPAs) contribute more towards ABB conservation compared to other areas within the species range, and therefore the ratio for each acre of temporary impact within a CPA is one-half acre of mitigation (1:0.5). To mitigate for each acre of temporary impact within a conservation bank or on mitigation lands the mitigation ratio is 1:1.5.

For *permanent cover change* impacts occurring within the ABB range, 0.5 acres of mitigation will be required (1:0.5 ratio) for each acre of impact. The ratio for each acre of these impacts within a CPA is 1 acre of mitigation (1:1). To mitigate for each acre of permanent cover change impact on mitigation lands, the mitigation ratio is 1:2, which is the same as the ratio for impacts in a CPA, plus replacement for the acre of mitigation from prior projects that would be impacted by the action.

Permanent impacts to occupied ABB habitat have higher mitigation ratios because they are expected to result in the highest level of effects over the longest period of time. For permanent impacts (>5 years) occurring within the ABB range, 1 acre of mitigation will be required for each acre of impact (1:1 ratio). The ratio for each acre of permanent impact within a CPA is 2 acres of mitigation (1:2), and on mitigation lands, the mitigation ratio is 1:3, which is the same as the ratio for impacts in a CPA, plus replacement for the acre of mitigation from prior projects that would be impacted by the action.

2.3.2 Verification of Mitigation and Reporting

Lessees in cooperation with BIA will estimate which type of habitat impact will occur on each portion of the project area and mitigate appropriately, with BIA approval, prior to any ground-disturbing activities likely to result in take of ABBs

[1] If the area has not become suitable for ABB use within 5 years following the temporary or permanent cover change impact start date, Lessees must provide additional mitigation prior to the end of the 5 year period, since the impact was actually permanent instead of temporary or permanent cover change. The amount of additional mitigation required is the difference between the amount of mitigation required for a permanent impact and the amount of mitigation previously secured as a temporary or a permanent cover change impact.

in occupied ABB habitat. Proof of purchase of mitigation credits at an approved bank, or proof of other mitigation method acceptable to USFWS, must be provided to the BIA Osage Agency prior to issuance of a permit or other approval of ground-disturbing activity. All offsite mitigation provided for the ABB must be within a location approved by the USFWS.

Lessees estimating temporary or permanent cover change impacts within all or part of their project area will mitigate with appropriate ratios prior to impacts and document the impact start date (the date impacts to occupied ABB habitat began). All areas mitigated as temporary or permanent cover change impacts must implement post-construction restoration measures described in Attachment A and these areas must be restored to a condition suitable for ABB use within 5 years of the impact start date. Lessees will include information about restoration methods within their annual reports submitted to BIA. When a Lessee has restored these areas, they will submit their restoration report to the BIA.

Unless there is a positive ABB survey result, applicants for BIA drilling permits, workover approvals, and other approvals would not need to be assigned acres pursuant to the BIA's incidental take statement and no acres will be deducted from the total acreage for ABB.

For all oil and gas operations that require soil disturbance, regardless of survey results, lessees must report to the BIA the number of acres temporarily disturbed and the number of acres permanently disturbed. The BIA will report to the USFWS annually the acres of suitable ABB habitat disturbed, under the programmatic BO and incidental take statement. The BIA's reports will include total acres disturbed, compiled from lessee reports and other available information such as maps and site inspection data.

For oil and gas operations outside of ABB range delineated by the USFWS, the action would not affect ABB and consultation with the USFWS for the ABB would not be required.

2.4 Best Management Practices

The BIA is consulting with the USFWS to confirm that the proposed action and mitigation ratios described in **Section 2.3** and Attachment A, Minimization and Mitigation Measures, along with the BMPs listed in **Table 2-2**, implemented as described through the Osage Oil and Gas Program, are appropriate and adequate to comply with requirements of the ESA for the ABB. In addition, BIA requests USFWS concur that the implementation of the BMPs (**Table 2-2**) and specific measures described in **Section 5** for other T&E species included in this BA, are appropriate. If there is a significant change in the BMPs or the Osage Oil and Gas Program due to ongoing NEPA activities and/or rulemaking, BIA will notify USFWS and reinitiate discussions if appropriate.

Table 2-2
Best Management Practices

	Best Management Practice	Is the BMP Included in Standard Drilling BMPs[1]	Is the BMP Included in Workover PEA BMPs[2]	Is the BMP Wildlife Related
1	Avoid impacts on National Register-eligible or unevaluated cultural resources on well sites and access roads. If cultural resources are discovered during construction or operation, stop work immediately, secure the affected site, and notify the BIA and Tribal Historic Preservation Officer. In the event of a discovery, work in that area shall halt and not resume until written authorization to proceed has been received from the BIA. All surface disturbances must be kept within the proposed ground disturbance area described in the NEPA document. Expansion or relocation of the well pads, access roads, or other implementation of additional activities not included in the approved NEPA document is prohibited unless an appropriate cultural resources survey has been submitted and determined adequate——approved by the BIA Osage Agency—and all appropriate permits have been obtained.	X	X	
2	Avoid or minimize soil and vegetation disturbance. Avoid removal of or damage to trees, shrubs, and groundcover to the extent possible. Avoid or minimize alteration of the natural topography, and limit activities on steep slopes.	X	X	X
3	Erosion control measures are required for the duration of the construction, drilling, and completion phases of the project. Erosion control measures must minimize the impact of soil, debris, or contaminants moving from the well site to adjacent lands and waterways.	X	X	X
4	All vehicles and equipment must utilize and stay confined to existing and new roads described in the approved NEPA document. These roads must be maintained and upgraded as needed according to BIA direction and agreements between the operator and surface owners.	X	X	X
5	Tank batteries must have a Spill Prevention and Control and Countermeasure Plan (SPCC) in compliance with EPA Regulations under 40 CFR, Part 112. A fluid impermeable secondary containment dike/berm must be constructed around any tank battery and facilities according to 40 CFR, Subpart 112.7. The dike/berm and entire containment area must be graveled. No water collected within the secondary containment shall be discharged. In accordance with the SPCC plan and the BIA regulations, the lessee will immediately notify the BIA of all spill incidents.	X	X	X

Table 2-2
Best Management Practices

	Best Management Practice	Is the BMP: Included in Standard Drilling BMPs[1]	Included in Workover PEA BMPs[2]	Wildlife Related
6	No venting or flaring of gas is allowed unless prior written approval of the BIA Osage Agency Superintendent has been obtained.	X	X	X (where applicable)
7	Store and label chemicals properly (including secondary containment). Do not store equipment or chemicals on-site if they are not being used on-site. Do not leave open containers of chemicals or wastes on-site.	X	X	X
8	Keep sites clean and free of any litter, trash, old equipment, contaminated soil, or unused containers. Promptly dispose of any wastes at an appropriate recycling facility, approved landfill, or other approved location. Remove any unused equipment not necessary to the operation of the lease after drilling activities have been completed.	X	X	X
9	If the well is successful, all production equipment, facilities, and tanks, including well-head and aboveground piping/equipment, shall be properly enclosed to exclude livestock if present.	X	X	—
10	All pits (including tank batteries contained within a dike/berm) must be enclosed with a fence of at least four strands of barbed wire, or approved substitute. All earthen pits to be used for storage of salt water or other deleterious substances must be lined with an impermeable layer to prevent contamination of soils and groundwater. Temporary pits must be filled and leveled immediately upon completion of the activity.	X	X	X[2]
11	To the extent possible, minimize disturbance to land owners, wildlife, and natural resources due to noise, excessive traffic, dust, or other impacts associated with operations.	X	X	X
12	Do not conduct activities within stream channels or wetlands without proper authorization. Avoid any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally approved water-quality standards.	X	X	X[3]

[2] BIA agrees to modify this BMP/permit condition to include the requirement of netting for open pits and tanks, as required by USFWS, to protect migratory birds.
[3] Authorization must be obtained from BIA and the USACE.

Table 2-2
Best Management Practices

	Best Management Practice	Is the BMP Included in Standard Drilling BMPs[1]	Included in Workover PEA BMPs[2]	Wildlife Related
13	Return disturbed area to original contour or as directed by the surface owner. If needed, add clean soil to disturbed areas. Restore disturbed areas by reestablishing vegetation using seed, sod, or other approved method. Restore with native species unless otherwise directed by the surface owner in writing and approved by the BIA. No noxious or invasive species may be used in revegetation and reclamation activities.	X	X	X
14	If well drilling, completion, and development are successful, all areas of the surface disturbance (i.e. well pad, access road, pipeline, etc.) that are not needed or used in the production or operation of the well shall be promptly reclaimed as described in the approved NEPA document. If well drilling, completion, and development are not successful, reclamation of the entire area will begin promptly. After a producing well is no longer in production, reclamation of the site will begin promptly. Reclamation shall be completed not later than ninety (90) days from rig removal, well abandonment, or final plugging of a well, unless otherwise approved by the BIA.	X	X	X
15	The lessee shall conduct activities in a manner that avoids any potential take or harm to federally listed T&E species, or in a manner that complies with any permit or authorization issued by the USFWS. Lessee must follow guidance in the USFWS "Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects" (April 2014), found at the following website: http://www.fws.gov/southwest/es/oklahoma/documents/abb/abb_icp/migbird%20and%20eagle%20avoidance%20measures%20april2014.pdf	X	X	X
16	Lessee must follow the USFWS's established protocol regarding areas where the American burying beetle (ABB) is known or suspected to exist. See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm. If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that	X	X	X[4]

[4] Once the Programmatic BO is issued, this BMP will be superseded by the process and requirements outlined in the BA and Programmatic BO.

Table 2-2
Best Management Practices

	Best Management Practice	Is the BMP Included in Standard Drilling BMPs[1]	Is the BMP Included in Workover PEA BMPs[2]	Is the BMP Wildlife Related
	suitable habitat for the ABB does not exist. If proposed operations will impact suitable habitat for the ABB, it will be the responsibility of the lessee to obtain authorization from the USFWS to proceed with that portion of the project.			
17	Approval must be obtained from the Environmental Protection Agency prior to the commencement of workover operations related to underground injection, construction, or conversion of saltwater injection/disposal wells.	—	X	—

Notes:
[1] BMPs as detailed in the BIA's Workover Programmatic Environmental Assessment (BIA 2015a)
[2] BMPs as detailed in the BIA's standardized list of drilling BMPs to be applied to permitted activities

Because applicants would be required to comply with appropriate permit conditions and BMPs described for that species, individual Section 7 consultations would no longer be required for valid negative ABB results or for other T&E species where the BIA makes and documents a "no effect" or "may affect, not likely to adversely affect" determination. This determination would be based on the absence of habitat, valid negative ABB surveys, or minimization/mitigation measures and applied BMPs.

The BMPs in **Table 2-2** are tailored to planning area-specific conditions and issues; therefore, as a general rule, these measures could be applied through COAs to all new permitted activities and workovers in the action area. The BIA would have flexibility to tailor COAs or to allow exceptions based on site-specific circumstances. Exceptions could be granted where a BMP was not applicable, where the goal is achieved through regulation or another mechanism, or where another measure proposed by the lessee would achieve the goals of the BMP, given site-specific conditions.

The BIA would ensure compliance with the Migratory Bird Treaty Act of 1918 (MBTA; 16 USC, Sections 703-712) through use of BMP 15 and/or COAs, NTLs or orders of the Superintendent, as appropriate. Compliance would continue to be ensured through site-specific NEPA analysis, permit conditions, and inspections by federal agencies. The BIA would continue to require lessees to implement measures to protect migratory birds, including by installing netting over pits and tank batteries, as part of conducting activities in a workmanlike manner under 25 CFR, Part 226.19.

Table 2-2 describes the BMPs included as part of the proposed action. Also see **Attachment A**, USFWS American Burying Beetle Minimization and Mitigation Measures, and **Attachment B**, Standardized BMPs for Workovers and Drilling Permits.

SECTION 3
EVALUATED SPECIES

3.1 INTRODUCTION

Six listed T&E species and their critical habitat are addressed in this BA (see **Table 1-1**). This section describes the following for each species:

- Species description
- Life history
- Status and distribution
- Environmental baseline
- Critical habitat
- Threats

The environmental baseline is defined by the regulations implementing the ESA (50 CFR, Part 402.02) as the following:

- Past and present impacts of all federal, state, and private actions and other human activities in the action area
- The anticipated impacts of all proposed state or federal projects in the action area that have already undergone formal or early Section 7 consultation
- The impact of state or private actions that are contemporaneous with the consultation process

The action area is defined at 50 CFR, Part 402, to mean "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." For the purposes of this consultation, the action area includes lands and subsurface mineral estate in Osage County, and those areas nearby that could be affected by the proposed action.

3.2 LISTED SPECIES

3.2.1 American Burying Beetle (*Nicrophorus americanus*)

Species Description

The ABB is the largest carrion beetle in North America, reaching 1.0 to 1.8 inches (2.5 to 4.6 centimeters) in length (Wilson 1971; Anderson 1982; Backlund and Marrone 1997, in USFWS 2014c). ABBs are black, with the most diagnostic feature being a large orange-red marking on the raised portion of the pronotum;[5] this is a feature shared with no other members of the genus in North America (USFWS 1991). The ABB also has orange-red frons[6] and a single orange-red marking on the clypeus.[7] Antennae are large, with notable orange club-shaped tips (USFWS 2014c).

Life History

The ABB is a nocturnal species active in the summer, when ambient nighttime air temperatures consistently exceed 60 degrees Fahrenheit (°F; 15.5 degrees Celsius [°C]; USFWS 1991). During the daytime, ABBs likely bury themselves in vegetation litter (USFWS 2014c). Adult ABBs bury into the soil during the inactive season when ambient nighttime air temperatures consistently fall below 60 °F (15.5 °C; USFWS 1991). In Oklahoma, this typically occurs for approximately 8 to 9 months, from late September until mid-May (USFWS 2014b), depending on temperatures (USFWS 2014c). Reported inactive season burying depths vary from 0 to 27 inches (0 to 68.6 centimeters; Schnell et al. 2007; Hoback 2011, in USFWS 2014c).

ABBs are scavengers, and feed upon carrion prey. Adults locate carcasses using chemoreceptors on their antennae. Beetles are capable of finding carrion at a distance of up to 18.6 miles (30 kilometers; Jurzenski et al. 2011, in USFWS 2014c).

The ABB is considered a habitat generalist when searching for food items. It has been successfully live-trapped in native grasslands, grazed pasture, riparian zones, coniferous forests, mature forest, and oak-hickory forest, as well as on a variety of soil types (Creighton et al. 1993; Lomolino and Creighton 1996; Lomolino et al. 1995, in USFWS 2014c; USFWS 1991). In Oklahoma, ABB habitat consists of fragmented grassland/woodland matrices (USFWS 2014c).

Adult ABBs seek a mate soon after emerging from the inactive season. Typically, both male and female ABBs bury an entire carcass. Once underground, both adults remove the fur or feathers, roll the carcass into a ball, and treat it with secretions that retard the growth of mold and bacteria. The female ABB lays

[5] The upper surface of the first segment of the body that lies between the head and the abdomen
[6] The upper anterior part of the head
[7] The lower face located just above the mandibles

eggs in the soil near the carcass, which the larvae use as a food source. Individuals usually live for only one year (USFWS 2014c).

While studies indicate that the ABB is a habitat generalist in terms of feeding, it is likely more restricted when selecting burial sites for reproduction. Soil conditions must be conducive to excavation (Anderson 1982; Lomolino and Creighton 1996, in USFWS 2014c). Soil moisture is also a factor because ABBs die quickly when desiccated (Bedick et al. 2006, in USFWS 2014c). Burial soils are well drained and include sandy loam and silt loam, with a clay component noted at most sites. Level topography and a well-formed detritus layer at the ground surface are common (USFWS 1991).

Status and Distribution

The ABB was proposed for federal listing in October 1988 (53 *Federal Register* [FR] 39617). It was designated as an endangered species on July 13, 1989 (54 FR 29652), and retains this status. On March 16, 2016, the USFWS announced it will publish a substantial 90-day finding in response to an August 18, 2015, petition to delist the ABB (USFWS 2016a).

Critical habitat has not been designated. The American Burying Beetle Final Recovery Plan was signed on September 27, 1991 (USFWS 1991). At that time only two disjunct natural populations were known: one population found in four counties in Oklahoma and one population from an island off the coast of Rhode Island, at the extremities of the species' historic range (USFWS 2008).

Additional populations of ABB have been discovered since the recovery plan was completed in 1991. The USFWS's most recent five-year review found that the ABB remains endangered throughout its current range due to ongoing threats to known populations and the failure to discover or establish viable populations in the remaining recovery areas (USFWS 2008).

The historic range of the ABB included over 150 counties in 35 states, including most of temperate eastern North America and the southern portions of three eastern Canadian provinces (USFWS 1991). Documentation confirming the species' presence is not uniform throughout this broad historical range; more records exist from the Midwest into Canada and in the northeast of the United States than from the southeast and Gulf of Mexico region.

The ABB is known to occur in nine states: Rhode Island, Massachusetts, Oklahoma, Arkansas, Nebraska, Kansas, South Dakota, Texas, and Missouri (USFWS 2014c). Those in Missouri are part of a nonessential experimental population (under Section 10[j] of the ESA) that was reintroduced in 2012. In Oklahoma, 29 counties, including Osage County, currently have had confirmed ABB sightings (USFWS 2014c).

The USFWS updated the known range of the ABB in Oklahoma in 2016. The update is a result of positive survey findings in 2015 along the eastern and western edges of the species' range. The update represents a 2.3 percent expansion of the ABB's range in Oklahoma (approximately 410,900 acres). Since 2014, the known range in Oklahoma has increased by 5.3 percent (approximately 999,500 acres; USFWS 2016b).

Environmental Baseline

Occurrence in the Action Area

Most of the 1,474,500-acre planning area is within the potential range of ABB, and suitable habitat is widespread in the planning area. Most of northeastern Osage County is considered an ABB conservation priority area (CPA; USFWS GIS 2016). ABB range and CPAs are depicted in **Figure 3-1**, American Burying Beetle. The USFWS believes these CPAs are likely to contain important elements for beetle conservation, such as documented presence over multiple years, relatively high density populations, suitable breeding, feeding, and sheltering habitat, and carrion resources (USFWS 2015b). **Table 3-1**, Acres of ABB Habitat Classifications in the Planning Area, summarizes acreages of CPAs and potential range in the planning area.

Table 3-1
Acres of ABB Habitat Classifications in the Planning Area

Habitat Classification	Acres
CPA	495,700
Potential range	1,415,900

Source: USFWS GIS 2016

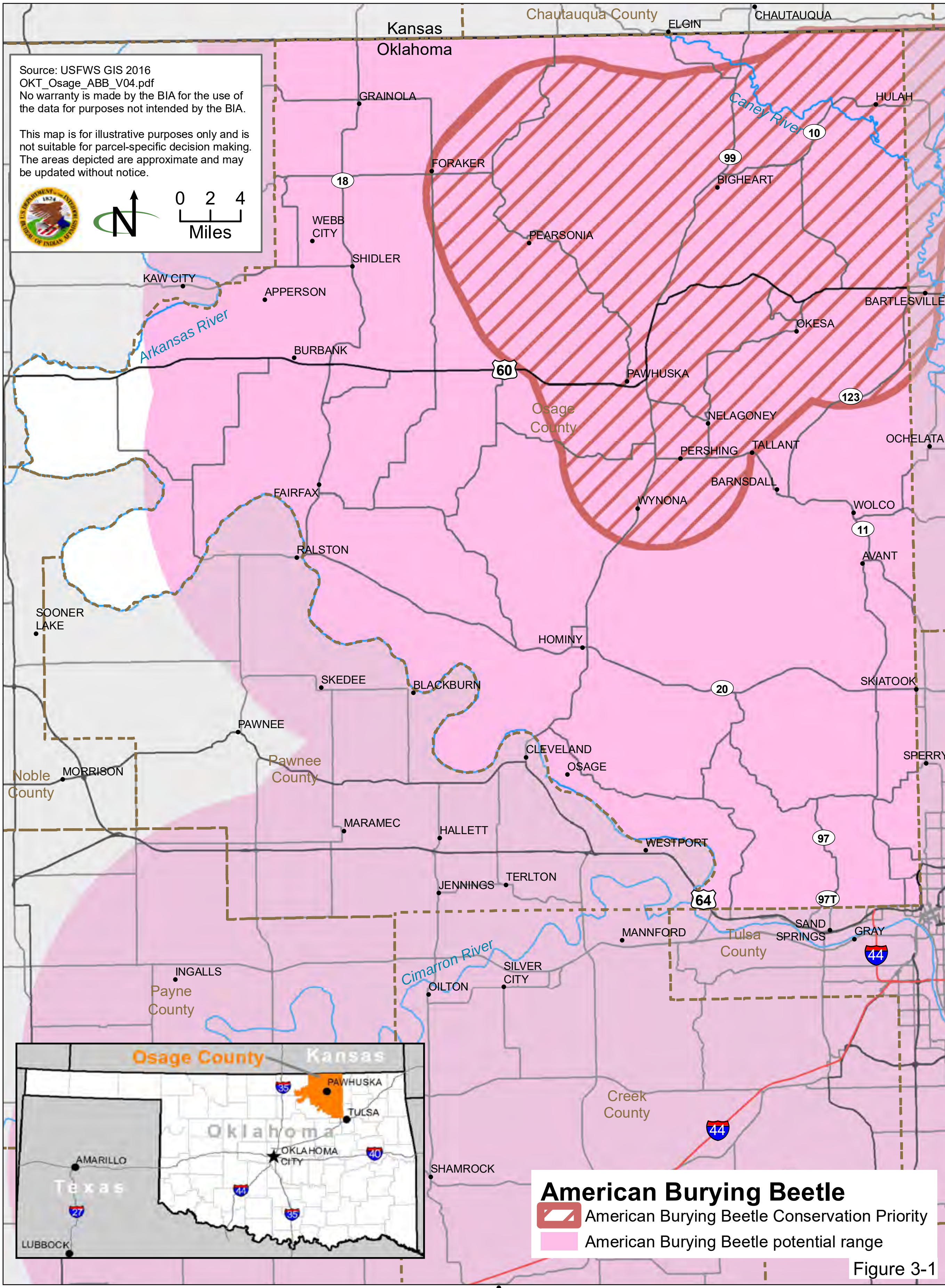
Past and Present Impacts

The following factors may have contributed to the ABB's decline (USFWS 2014c):

- Decline or extinction of preferred carrion species, including greater prairie-chicken (*Tympanchus cupido*), wild turkey (*Meleagris gallopavo*), and passenger pigeon (*Ectopistes migratorius*)
- Habitat loss and land use changes that result in fragmented habitat and increased edge habitat
- Reduction in the carrion prey base of the appropriate size for ABB reproduction and increases in vertebrate scavengers (e.g., raccoon [*Procyon lotor*] and striped skunk [*Mephitis mephitis*]) that are competition for this carrion prey

Critical Habitat

No critical habitat has been proposed or designated for the ABB.


Source: USFWS GIS 2016
OKT_Osage_ABB_V04.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
Arkansas River
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
Pawnee County
CLEVELAND
OSAGE
SPERRY
Noble County
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
INGALLS
Payne County
Cimarron River
SILVER CITY
OILTON
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
American Burying Beetle
American Burying Beetle Conservation Priority
American Burying Beetle potential range
Figure 3-1

Threats

The ABB recovery plan (USFWS 1991) and five-year review (USFWS 2008) identify potential threats, as follows:

- Disease and pathogens
- Pesticides
- Direct habitat loss or alteration
- Increase in edge habitat[8]
- Genetic diversity loss in isolated populations
- Increase in competition for carrion prey, including competition with other species, such as the imported red fire ant (*Solenopsis invicta*)
- Decrease in preferred carrion prey abundance
- Agricultural and grazing practices
- Noxious weeds and invasive plant species

3.2.2 Whooping Crane (*Grus americana*)

Species Description

Adult whooping cranes are white with a red crown and a long, dark, pointed bill. Immature whooping cranes are cinnamon brown. While in flight, their long necks are kept straight and their long dark legs trail behind. Adult whooping cranes' black wing tips are visible during flight. As the tallest North American bird, males approach 5 feet (1.5 meters) when standing erect. Males are generally larger than females (CWS and USFWS 2007).

Life History

Whooping cranes are monogamous but will re-pair following the death of a mate. Whooping cranes may start breeding as early as three years of age, but the average is five years. Most whooping cranes breed at Wood Buffalo National Park, Alberta, Canada, where they begin to arrive in April to begin nest construction. Generally, two olive-buff eggs are laid in late April or May, and they hatch approximately one month later. However, most breeding pairs, when successful, arrive at the winter range with one chick (CWS and USFWS 2007).

Whooping cranes winter at Aransas National Wildlife Refuge (NWR) in Texas, generally arriving between late October and mid-November. Migration occurs during the day, and cranes make regular stops to rest and feed at stopover locations during the two-week migration (CWS and USFWS 2007). Spring migration generally begins in late March to mid-April, when whooping cranes depart Aransas NWR for breeding grounds at Wood Buffalo National Park.

[8] The boundary of two intact habitats, e.g., the boundary between a forest and an agricultural field

Parents separate from young of the previous season when they depart for spring migration. The Salt Plains NWR in Oklahoma is a major migratory stopover for the crane population.

Whooping cranes are omnivorous and feed by probing the soil subsurface with their bills and taking foods from the soil surface or vegetation. Young chicks are fed by their parents. Summer foods include nymphal or larval forms of insects; frogs, rodents, and small birds; minnows; and berries. Migration foods are agricultural grains, frogs, fish, and insects. Winter foods are foraged from brackish bays, marshes, and salt flats and include crabs and clams and wolfberry (*Lycium carolinianum*; CWS and USFWS 2007).

Whooping crane is a long-lived species. Current estimates suggest a lifespan of up to 30 years in the wild (Mirande et al. 1993, in CWS and USFWS 2007); captive individuals have been recorded to live 35 to 40 years (Moody 1931; McNulty 1966, in CWS and USFWS 2007).

Status and Distribution

The whooping crane was originally listed as an endangered species on March 11, 1967, following establishment of the Endangered Species Preservation Act on October 15, 1966. It is currently listed as endangered under the Endangered Species Act of 1973, as amended. The current International Recovery Plan for the Whooping Crane, Third Revision (CWS and USFWS 2007) was approved on May 29, 2007 (72 FR 29544).

Critical habitat in the United States was designated in 1978 (43 FR 20938-942) and is in five sites in four states. No critical habitat is in the planning area; the nearest critical habitat unit is the Salt Plains National Wildlife Preserve, approximately 60 miles west of Osage County.

The whooping crane's historic range extended from the Arctic coast south to central Mexico, and from Utah east to New Jersey, South Carolina, Georgia, and Florida (Allen 1952; Nesbitt 1982, in CWS and USFWS 2007). The major nesting area during the nineteenth and twentieth centuries extended from central Illinois, northwestern Iowa, northwestern Minnesota, and northeastern North Dakota, northwesterly through southwestern Manitoba, southern Saskatchewan, and into east-central Alberta (Allen 1952, in CWS and USFWS 2007). The historic principal wintering range was the tall grass prairies, in southwestern Louisiana, along the Gulf Coast of Texas, and in northeastern Mexico near the Rio Grande Delta.

Currently, whooping cranes occur only in Canada and the United States. Approximately 83 percent of wild nesting sites are in Canada and 17 percent are in Florida and Wisconsin. The 2005-2006 population was estimated at 343 (CWS and USFWS 2007).

Environmental Baseline

Occurrence in the Action Area

Whooping crane migrating between winter and summer ranges likely pass through the planning area, though there are no nesting areas there. The nearest critical habitat unit is the Salt Plains NWR, approximately 60 miles west of Osage County. Salt Plains NWR is a major migration stopover area (CWS and USFWS 2007). The 200-mile-wide migration path for whooping crane is depicted in **Figure 3-2**, Whooping Crane Migration Path, which is adapted from the 2007 recovery plan (CWS and USFWS 2007). This migration path is approximately equivalent to the 95 percent sighting corridor used by the USFWS (2015d).

Important stopover or roosting habitat for whooping crane, as defined by the USFWS (2015d), occurs in the planning area and is used by whooping cranes during migration. Important stopover or roosting habitat is defined as the Cimarron, Red, Washita, South Canadian, and Arkansas Rivers and all reservoirs or emergent (not forested) wetlands larger than 10 acres.

Past and Current Impacts

The following factors have contributed to the whooping crane's decline (CWS and USFWS 2007):

- Habitat alteration or destruction from human population growth in North America, including conversion of much of historic nesting habitat to agricultural production, and alterations in freshwater inflows to wintering grounds
- Hunting was a primary reason for historical decline; though now illegal, birds are occasionally mistakenly shot by hunters or purposefully shot by vandals
- Adult whooping cranes are generally not susceptible to predation, but eggs and chicks are predated on breeding grounds by black bear (*Ursus americanus*), wolverine (*Gulo luscus*), gray wolf (*Canis lupus*), and other predators. In wintering grounds, predation by bobcat (*Lynx rufus*) and alligator (*Alligator mississippiensis*) are significant in introduced populations in Florida. Eagles also prey on juvenile whooping cranes during their migration.

Critical Habitat

Critical habitat in the United States was designated in 1978 (43 FR 20938-942) in four states and five sites, including Aransas NWR and several migratory stopover sites (see **Table 3-2**, Primary Constituent Elements of Whooping Crane Critical Habitat).

Figure 3-2
Whooping Crane Migration Path

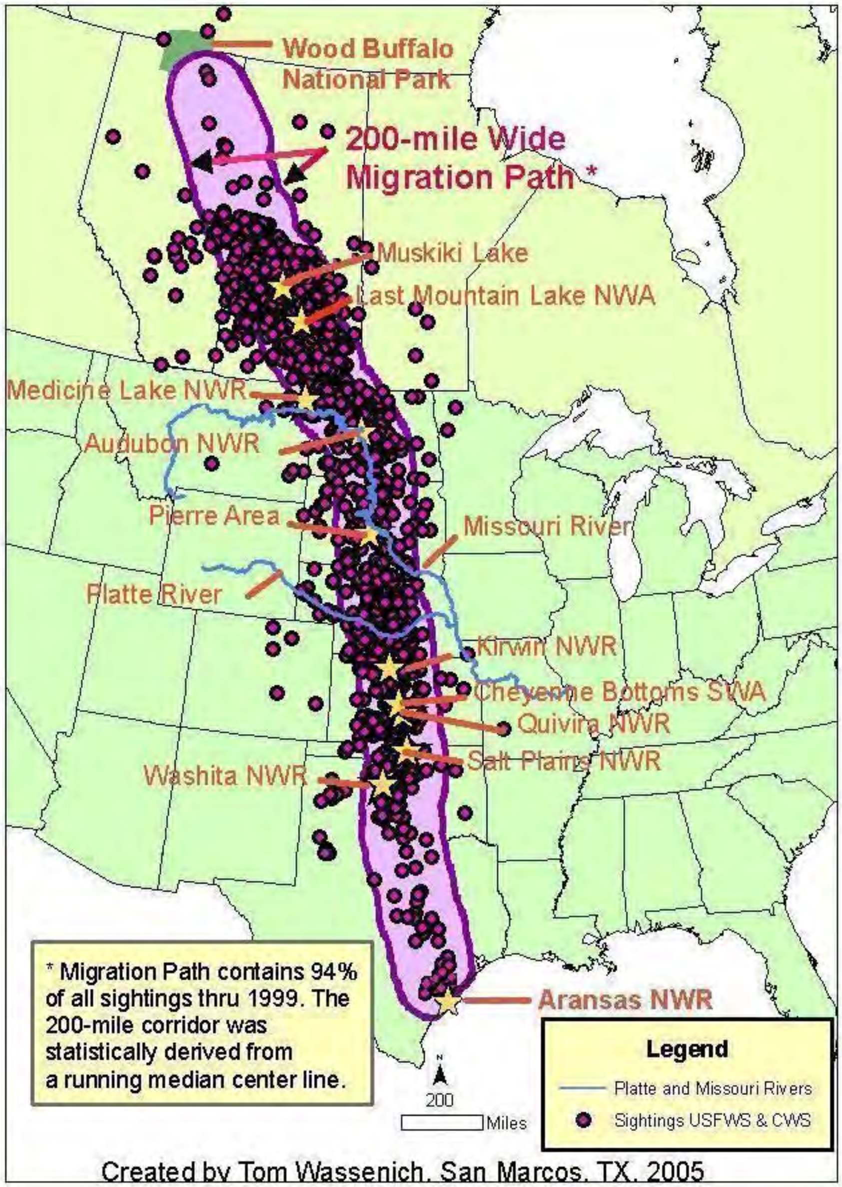


Table 3-2
Primary Constituent Elements of Whooping Crane Critical Habitat

Element	Description
Space for individuals and population growth and for normal behavior	• Whooping cranes are territorial. Each pair requires several hundred acres of undisturbed wetlands in and around Aransas NWR. Unmated subadults must also have some suitable habitat that is not regularly defended by the paired cranes. • The population wintering in the vicinity of Aransas NWR has been expanding. Although maximum density of the habitat has not yet been reached, some cranes are now moving up and down the coastal marshes from the refuge to establish wintering territories. • The four refuges in Idaho, Colorado, and New Mexico will offer further space for individual and population growth, as this separate flock becomes established in the wild.
Food, water, air, light, minerals, or other nutritional or physiological requirements	• All areas that are designated under this rule provide food, water, and other nutritional or physiological needs of the whooping crane.
Cover or shelter	• As do most other cranes in the world, whooping cranes generally require an open expanse for nightly roosting. This habit of using sand or gravel bars in rivers and lakes for nightly roosting appears to be one of the major factors in crane habitat selection. • Feeding cranes in migration are frequently found within short flight distances of reservoirs, lakes, and large rivers that offer bare islands for nightly roosting.
Sites for breeding, reproduction, or rearing	• Under this rule, only the Grays Lake area offers potential nesting habitat for the whooping crane. • The rearing of young cranes extends for approximately ten months; that is, until the young cranes are driven out of the family unit by their parents on the spring migration. All the areas under this rule constitute habitats essential to the rearing of these young whooping cranes by providing the cranes with sites for training, protection, feeding, and other normal behaviors.
Habitats that are protected from disturbances or are representative of the geographical distribution of the species	• Whooping cranes do not readily tolerate disturbances to themselves or their habitat. A human on foot can quickly put a whooping crane to flight at distances of over one quarter of a mile. • The one common feature uniting the vast majority of confirmed sightings of this crane in migration is the proximity to wetlands that provide undisturbed roosting sites.

Source: USFWS 1978

The designated critical habitat nearest to the planning area is the Salt Plains NWR in Oklahoma, approximately 60 miles to the west.

Threats

The whooping crane recovery plan (CWS and USFWS 2007) and five-year review (USFWS 2012a) identify potential threats to whooping crane, as follows:

- Wetland loss from agricultural and other development and river flow alterations from water diversion projects
- Development, including roads, buildings, power lines, and wind turbines, and collision with infrastructure and vertical structures
- Increasing human disturbance to whooping crane wintering grounds
- Disease or pathogens, including West Nile virus and red tide phytoplankton blooms, can be made worse by loss of wetlands and resulting concentrations of birds in smaller areas and by climate change
- Drought, altered hydrology, and increasing sea levels and coastal flooding due to climate change
- Chemical spills in the wintering grounds

3.2.3 Red Knot (*Calidris canutus rufa*)

Species Description

The red knot is a sandpiper, distinguishable among other shorebirds by its colorful breeding plumage, which is where its name derives from. Other distinguishing characteristics are the bill, which is black year-round, and the legs, which are dark gray to black (Harrington 1996, 2001, in American Bird Conservancy et al. 2005). Males in breeding plumage have a dark red or salmon breast, throat, and flanks, with a white belly. The crown and back are flecked with gray and salmon (Harrington 1996, 2001; Paulson 1993, in American Bird Conservancy et al. 2005). Female coloration is similar to that of males but is typically less intense. Nonbreeding plumage is a plain gray on the head and back, with light fringes of gray and white along the wings, giving an appearance of a white line running the length of the wing when in flight. The breast is white mottled with gray; the belly is dull white.

Life History

The average clutch size is four eggs, which have an incubation period of 21 to 22 days; pairs have only one clutch per season. Fledging is estimated at 18 days (American Bird Conservancy et al. 2005). Fledged chicks move with the male to wetland habitats, while the female abandons the brood.

Populations of red knots, including the subspecies *rufa*, migrate to the high Arctic in large flocks, through the contiguous United States, mainly in March to early June (Harrington 2001, in NatureServe 2015). Flocks generally arrive at breeding grounds in early June.

Most flocks depart breeding areas by mid-August (NatureServe 2015) and undertake an annual 18,600-mile (30,000-kilometer) hemispheric migration to wintering grounds in Patagonia and Tierra del Fuego in southern South America (American Bird Conservancy et al. 2005).

The red knot principally uses marine habitats in both North and South America for rest stopovers during migration. It prefers coastal habitats along the mouths of bays and estuaries, providing sandy beaches to forage for benthic invertebrates or horseshoe crab (*Limulus* spp.) eggs (Harrington et al. 1986; Harrington 1996, 2001; Tsipoura and Burger 1999, in American Bird Conservancy et al. 2005).

Status and Distribution

Red knot was listed as threatened under the ESA under a final rule published on December 11, 2014 (79 FR 73705). No recovery plan has been drafted.

Red knot nesting range centers in Canada, north of the Arctic Circle. Wintering range primarily is in southern South America; the species appears to be most abundant in northeastern Tierra del Fuego and Bahía Lomas in Chile, near the eastern end of the Strait of Magellan (NatureServe 2015). Population estimates for the subspecies *rufa* up to the early 1990s were 100,000 to 150,000. During the 1990s this fell to around 80,000, and by the early 2000s the population may have dropped to 35,000 to 40,000. Current estimates place the population at between 18,000 and 33,000 (NatureServe 2015).

Environmental Baseline

Occurrence in the Action Area

Red knots do not nest or winter in the planning area but have been observed there during migration (NatureServe 2015). Red knot may occasionally use wetland habitats in the planning area for resting or foraging during migration.

Past and Current Impacts

Past impacts are increased commercial harvest and overutilization of horseshoe crabs (for use as bait in eel and conch fisheries; especially in the Delaware Bay region in the 1990s [NatureServe 2015]). The subsequent reduction in horseshoe crab populations and their eggs have impacted red knot body condition and fitness during spring migration and annual survival (NatureServe 2015). Most of the *rufa* population migrates through Delaware Bay during northward migration (NatureServe 2015).

Past impacts have also included hunting. Red knot was historically heavily hunted for market and sport (American Bird Conservancy 2005)

Critical Habitat

No critical habitat has been designated for red knot.

Threats

The primary threats to red knot are as follows (American Bird Conservancy 2005, NatureServe 2015):

- Reduced availability of horseshoe crab eggs during spring migration

- Increased disease and pathogen susceptibility from reduced fitness during migration
- Oil pollution at wintering grounds and migration stopover habitats
- Human disturbance
- Habitat loss via reclamation of wetlands and waters for development
- Climate change may impact breeding, wintering, and migration habitats, including through sea level rise and loss of wetland habitat

3.2.4 Interior Least Tern (*Sternula antillarum athalassos*)

Species Description

Least terns (all currently recognized subspecies and populations) are the smallest members of the gull and tern family (Laridae). They measure about 8.3 to 9.5 inches (21 to 24 centimeters) long with a 20-inch (51-centimeter) wingspread. Sexes are alike, characterized by a black-capped crown, white forehead, grayish back and dorsal wing surfaces, snowy white undersurfaces, legs of various orange and yellow colors depending on the sex, and a black-tipped bill whose color also varies depending on sex (Watson 1966; Davis 1968; Boyd and Thompson 1985, in USFWS 1990). Immature birds have darker plumage than adults, a dark bill, and dark eye stripes on their white foreheads (USFWS 1990).

Life History

Interior least terns spend about four to five months at their breeding sites. They arrive at breeding areas from late April to early June from wintering habitat along the Central American coast and the northern coast of South America, from Venezuela to northeastern Brazil. Least terns nest in colonies, or terneries, on exposed gravel bars in rivers or in sand and gravel pits and other similar artificial nesting habitats. Nests can be as close as just a few yards apart or widely scattered up to hundreds of yards.

By late May, interior least terns lay two to three eggs, which are pale to olive buff and speckled or streaked with dark purplish-brown, chocolate, or blue-gray markings. Incubation is 20 to 25 days. Chicks hatch within one day of each other, are brooded for about one week, and usually remain within the nesting territory as they mature. Chicks fledge after three weeks, although parental attention continues until fall migration. Departure from colonies by both adults and fledglings varies but is usually complete by early September (USFWS 1990).

The riverine nesting areas of interior least terns are sparsely vegetated sand and gravel bars within a wide unobstructed river channel or salt flats along lake shorelines. Nesting locations usually are at the higher elevations and away from the water's edge because nesting starts when the river flows are high and small amounts of sand are exposed. Breeding site fidelity of coastal and California least terns (*S. a. browni*) is very high, and this may also be true for the interior least tern in its riverine environment. Least terns also nest on artificial habitats, such as sand and gravel pits and dredge islands, and even gravel rooftops (USFWS 1990).

The fish-eating interior least tern feeds in shallow waters of rivers, streams, and lakes, usually near nesting sites. Terns nesting at sand and gravel pits and other artificial habitats may fly up to one mile (3.2 kilometers) to fish. Fishing behavior involves hovering and diving over standing or flowing water (USFWS 1990).

Status and Distribution

The interior least tern was listed as endangered under the ESA in a final rule published on May 28, 1985 (50 FR 21784). The interior least tern recovery plan was approved in September 1990 (USFWS 1990). Critical habitat for interior least tern has not been designated.

The interior least tern is migratory and historically bred along the Mississippi, Red, and Rio Grande River systems and the rivers of central Texas. The breeding range extended from Texas to Montana and from eastern Colorado and New Mexico to southern Indiana. It included the Red, Missouri, Arkansas, Mississippi, Ohio, and Rio Grande River systems.

Currently, interior least terns continue to breed in most of the aforementioned river systems, although the species' distribution generally is restricted to less altered river segments (USFWS 1990). Interior least terns currently breed from the lower Ohio River in Indiana and Kentucky in the east, as far west as the Upper Missouri River in Montana; they breed as far north as Montana and as far south as southern Texas (USFWS 2013).

Reported numbers of nesting interior least tern have expanded by almost an order of magnitude (from less than 2,000 to about 18,000) since the species was listed, and the range has increased significantly. Currently, multiple colonies are known to occur in all major drainages where the species historically nested, and available monitoring data indicate most of these drainage populations are stable or increasing (USFWS 2013).

Environmental Baseline

Occurrence in the Unit

Interior least terns breed along portions of the Arkansas River in Osage County (USFWS 1990, 2013).

Past and Current Impacts

The following factors have contributed to the interior least tern's decline (USFWS 1990, 2013):

- Habitat alteration and destruction; regulated river flows, channelization, irrigation, and the construction of reservoirs and pools have contributed to the elimination of much of the tern's sandbar nesting habitat.
- Human disturbance reduces reproductive success; recreation is often concentrated in river systems where interior least terns breed.

Critical Habitat

No critical habitat has been designated for the interior least tern.

Threats

The primary threats to interior least terns are random floods and droughts, which can affect river flow and quantity and quality of nesting habitat (USFWS 2013).

3.2.5 Piping Plover (*Charadrius melodus*)

Species Description

Adult piping plovers have yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the neck. This chest band is usually thicker in males during the breeding season, and it is the only reliable way to tell the sexes apart. Piping plovers have a body length of 6.5 inches (17 centimeters), and wing span of 4.3 to 5 inches (11 to 12.7 centimeters; USFWS 1988).

Life History

Piping plovers are migratory shorebirds that spend approximately three to four months at their breeding grounds. Arrival time at breeding grounds varies by location but is generally in mid-April. Nest cups are shallow depressions lined with small pebbles or shell fragments. Eggs are laid in May; clutch size is four eggs. Incubation lasts 25 to 31 days, and fledging time varies from 21 to 35 days, depending on location. Adults depart breeding grounds by early August, with the juveniles departing a few weeks later (USFWS 1988).

Piping plovers breed in open, sparsely vegetated habitats, including barren sand and gravel, lake and river shorelines, and sandbars. The beach width, amount and distribution of vegetation, and substrate composition may affect nest site selection. Piping plovers have been observed nesting in interior least tern colonies at a number of Great Plains river sandbars, sand pits, and Atlantic coast beaches (USFWS 1988).

Wintering habitat consists of beaches, sandflats, and sand dunes along the Gulf of Mexico coastal beaches and adjacent off-shore islands. Spoil islands in the Intercoastal Waterway are also used (USFWS 1988).

Piping plovers eat marine worms, insects (fly larvae and beetles), crustaceans, mollusks, and other small marine animals. They forage on exposed beach substrates near the water's edge (USFWS 1988).

Status and Distribution

In 1986, the Great Lakes population of piping plovers was listed as endangered and all other populations were listed as threatened (50 FR 50726). The USFWS published a recovery plan for the northern Great Plains and Great Lake populations 1988, and later recovery plans updated information for the Atlantic Coast and Great Lakes breeding populations. Critical habitat for wintering piping plovers was designated on July 10, 2001 (66 FR 36038) and for the Northern Great Plains population on September 11, 2002 (67 FR 57637).

In the final listing rule (50 FR 50726), effective January 10, 1986, the USFWS did not use subspecies to distinguish breeding populations of piping plovers. Subsequent ESA actions have consistently recognized three separate breeding populations: on the Atlantic Coast (threatened), the Great Lakes (endangered), and the Northern Great Plains (threatened).

Historically, piping plovers bred across three geographic regions: The United States and Canadian Northern Great Plains, from Alberta to Manitoba and south to Nebraska, on Great Lakes beaches, and on Atlantic coastal beaches, from Newfoundland to North Carolina. Historic wintering sites are not well described, but the species was generally observed along the Gulf of Mexico, on the southern US Atlantic coastal beaches, from North Carolina to Florida, in eastern Mexico, and on scattered Caribbean islands (USFWS 1988). The species' current range is similar to its historic range (USFWS 1988).

Environmental Baseline

Occurrence in the Action Area

Although piping plovers have been observed migrating in Osage County, they do not nest or winter in the vicinity of the planning area (USFWS 1988, 2009).

Past and Present Impacts

The following factors may have contributed to the piping plover's decline (USFWS 1988):

- Habitat alteration and destruction, including loss of sandy beaches and other breeding and wintering habitat, due to recreational and commercial development and dune stabilization
- Human disturbance, including vehicular and foot traffic within breeding areas; disturbance inhibits incubation and other breeding behavior, reducing reproductive success

- Elimination of nesting habitat due to construction of reservoirs, river channelization, and flow modification
- Historical hunting

Critical Habitat

Critical habitat for the Northern Great Plains population of piping plover was designated in 2002 (67 FR 57638). It affects 18 population units in Minnesota, Montana, North Dakota, South Dakota, and Nebraska.

Primary constituent elements of piping plover critical habitat are described in **Table 3-3**, Primary Constituent Elements of Piping Plover Critical Habitat.

The designated critical habitat nearest to the planning area is the Platte River in central Nebraska, several hundred miles north of the planning area.

Table 3-3
Primary Constituent Elements of Piping Plover Critical Habitat

Location	Elements
On prairie alkali lakes and wetlands	• Shallow, seasonally to permanently flooded, saline to hypersaline wetlands, with sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, or gravelly salt flats • Springs and fens along edges of alkali lakes and wetlands • Adjacent uplands 200 feet (61 meters) above the high water mark of the alkali lake or wetland
On rivers	• Sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river
On reservoirs	• Sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, gravel, or shale, and their interface with the water bodies
On inland lakes	• Sparsely vegetated and windswept sandy to gravelly islands, beaches, and peninsulas, and their interface with the water body

Source: USFWS 2002

Threats

The most recent five-year review (USFWS 2009) identified potential threats to piping plovers, as follows:

- Habitat loss and degradation on winter and migration grounds from shoreline and inlet stabilization
- Recreational disturbance from pedestrians, dogs, motorized vehicles, and boats
- Predation on wintering and migration grounds
- Contamination, including oil spills

- Impacts of climate change, including habitat loss from sea level rise and storms
- Minor threat from West Nile virus and avian influenza on wintering and migration grounds

3.2.6 Neosho Mucket Mussel (*Lampsilis rafinesqueana*)

Species Description

The Neosho mucket is a medium to large freshwater mussel. Its shell is relatively oblong, and the umbones[9] are low and project only slightly or not at all above the curvature of the shell (Shiver 2002).

Life History

The Neosho mucket is associated with shallow riffles and runs, with gravel substrate and moderate to swift currents. Channel stability is an important factor determining the location of Neosho muckets. They need substrate loose enough to allow burrowing, and typically they are embedded in the substrate in a variety of habitats in large streams and small rivers.

Like other freshwater mussels, Neosho muckets live embedded in the bottom of rivers and streams. They siphon water into their shells and across gills that are specialized for respiration and food collection. Food items include algae, bacteria, detritus, and microscopic animals (USFWS 2012b). Adults are filter feeders and generally orient themselves partially on or near the substrate surface to take in food and oxygen from the water column. Juveniles typically burrow completely beneath the substrate surface and are pedal feeders[10] until the structures for filter feeding are more fully developed.

The Neosho mucket spawns in late April and May and broods larvae from May through August (Shiver 2002). Males release sperm into the water column, and females draw it in through their siphons during feeding and respiration. Fertilization takes place inside the shell, and success is apparently influenced by mussel density and water flow conditions. The eggs are retained in the gills of the female until they develop into mature larvae called glochidia. The glochidia have a parasitic stage during which they must attach to the gills, fins, or skin of a fish to transform into a juvenile mussel. When the transformation is complete, the juvenile mussels drop from their fish host and sink to the stream bottom where, given suitable conditions, they grow and mature into adults (USFWS 2012b).

[9] The oldest, highest part of each shell valve
[10] Taking in food particles that adhere to the foot while it is extended outside the shell

Status and Distribution

In 2012, the USFWS proposed the Neosho mucket mussel for federal listing (77 FR 63440) and designated it as endangered with critical habitat in 2015 (80 FR 24692). No recovery plan has been developed.

Historically, populations existed in the Neosho, Illinois, and Verdigris River Basins. Over half of these populations are now extirpated, and the remainder are in decline, with one exception (USFWS 2012b). The Neosho mucket mussel is estimated to have been extirpated from 62 percent of its historic range.

Environmental Baseline

Occurrence in the Action Area

According to the Oklahoma Department of Wildlife Conservation (ODWC), the Neosho mucket mussel has been observed in the Caney River, both upstream and downstream of Hulah Lake in northeast Osage County (ODWC 2015). According to the proposed listing rule (USFWS 2012b), the Caney River population is considered extirpated, but suitable habitat is present. It is possible that suitable habitat may also be found in other Osage County streams.

Past and Present Impacts

The following factors may have contributed to the Neosho mucket mussel's decline (USFWS 2012b, 2015c):

- Water quality degradation from human settlement and modern industrial activities, such as mining and oil and gas extraction
- Habitat modification by stream channel alteration and land use changes, resulting in increased erosion and siltation into waterways
- Introduction of invasive fish species and loss of native host fish species

Critical Habitat

The USFWS designated critical habitat for the Neosho mucket mussel on April 30, 2015 (80 FR 24691). No critical habitat is in the planning area; it is generally located to the east and northeast of the planning area, in eastern Oklahoma, southeastern Kansas, southwestern Missouri, and northwestern Arkansas. No critical habitat unit is downstream of any stream or river in the planning area. The critical habitat nearest to the planning area is Unit NM6 (Fall and Verdigris Rivers, Kansas). It is in Montgomery and other counties in southeast Kansas, approximately 25 miles northeast of the planning area (USFWS 2015c). **Table 3-4**, Primary Constituent Elements of Neosho Mucket Mussel Critical Habitat, lists the primary constituent elements for Neosho mucket mussel critical habitat.

Table 3-4
Primary Constituent Elements of Neosho Mucket Mussel Critical Habitat

Element	Details
Stable river channels and banks with habitats that support a diversity of freshwater mussels and native fish	• Channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without changing bed elevation • Stable riffles, sometimes with runs, and mid-channel island habitats that provide flow refuges consisting of gravel and sand substrates, with low to moderate amounts of fine sediment and attached filamentous algae
Hydrologic flow regime necessary to maintain benthic habitats where the species are found and to maintain connectivity of rivers with the floodplain	• Allowing for the exchange of nutrients and sediment for maintaining the mussel host's habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats
Water and sediment quality necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages	• Water quality features, such as conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents
Occurrence of natural fish assemblages for each inhabited river or creek that will serve as an indication of appropriate presence and abundance of fish hosts necessary for recruitment	• Suitable fish hosts include smallmouth bass (*Micropterus dolomieu*), largemouth bass (*M. salmoides*), and spotted bass (*M. punctulatus*).
Competitive or predaceous invasive species in quantities low enough to have minimal impact on survival of freshwater mussels	• No details given in USFWS (2015c)

Source: USFWS 2015c

Threats

The *Federal Register* listing (USFWS 2015c) for Neosho mucket mussel lists the following threats:

- Impoundments
- Channelization
- Sedimentation
- Chemical contaminants
- Mining
- Oil and natural gas development
- Invasive, nonnative species
- Temperature

3.3 CANDIDATE SPECIES

3.3.1 Rattlesnake-Master Borer Moth (*Papaipema eryngii*)

Species Description

Rattlesnake-master borer moth is a large chocolate-colored moth with bold white disk markings on the wings. Nearly all the larvae in the genus are purplish brown and have a pattern of longitudinal white stripes (Forbes 1954, in USFWS 2013b).

Life History

Moth larvae rely on the plant, rattlesnake master (*Eryngium yuccifolium*), which is the sole host plant for this species; a population of 100 to 1,000 rattlesnake master plants are needed for the moth to persist. The host plant is generally sparsely distributed and has been found to have relative frequencies in restored and relict prairies of less than 1 percent (Danderson and Molano-Flores 2010; Molano-Flores 2001, in USFWS 2013b).

Rattlesnake-master borer moths emerge as adults from mid-September to mid-October, flying through mid- to late October. Their nocturnal habits make them hard to observe. Based on their short adult flight span, their underdeveloped mouth parts, and the large amount of stored fat, researchers postulate that they likely use dew or oozing sap for imbibing moisture (USFWS 2013b). Adults are believed to spend their days attached to host plants or on the bottom of leaves, where their presence is camouflaged.

Mating and egg laying are strictly nocturnal. Females deposit 200 or more eggs in the duff (ground litter) on or near host plants, where eggs overwinter. Larvae emerge from overwintered eggs in late May and immediately begin to bore into the rattlesnake master host. Larvae enter stems near the ground and slowly eat their way into the root of the plant. They continue to feed through early August, at which time mature larvae cease all activity and lie dormant for approximately one week. Pupation appears to take place either in the root of the host plant or in the soil and lasts from two to three weeks. The boring activities of the moth generally result in failed reproduction or death of the host plant.

Rattlesnake-master borer moths are considered relatively sedentary and do not disperse widely (USFWS 2013b).

Status and Distribution

In August 2013, the USFWS (78 FR 49422) found that listing the rattlesnake-master borer moth under the ESA was warranted but precluded by actions on higher priority species (USFWS 2013b).

Rattlesnake-master borer moths are obligate residents of undisturbed prairie and woodland openings that contain their only food plant, rattlesnake master.

The moths occur in low density over a range that includes most of the eastern United States, from Minnesota to Texas and east to Florida. An estimated 82 to 99 percent of tallgrass prairie habitat in that area has been lost, and most remnants are small and discontinuous. Currently, populations are known to occur in Illinois, Arkansas, Kentucky, North Carolina, and Oklahoma. Suitable habitat is found across 26 states for the host plant.

Environmental Baseline

Occurrence in the Action Area

In Oklahoma, the rattlesnake-master borer moth is known only from The Nature Conservancy's Tallgrass Prairie Preserve in Osage County, near Pawhuska (ODWC 2015). During surveys conducted between 2000 and 2005, three populations of between 50 and 200 individual moths were found, approximately 2 to 4 miles (3 to 6 kilometers) apart (USFWS 2013b). The prairie community on the entire site is managed with grazing bison (*Bison* spp.) and a randomized prescribed fire regime designed to mimic the natural forces found on the site before European-American settlement. Although no surveys have been conducted on-site since 2005, the management of the area is unchanged, so this population is considered extant (USFWS 2013b).

Past and Present Impacts

The following factors may have contributed to the moth's decline (USFWS 2013b):

- Conversion of tallgrass prairie habitat, where obligate host plant rattlesnake master occurs, for agricultural or nonagricultural purposes
- Alteration of the natural fire regime, which sustains tallgrass prairie ecosystems, through fire suppression

Critical Habitat

No critical habitat has been proposed or designated for the rattlesnake-master borer moth.

Threats

The *Federal Register* listing of "warranted but precluded" (USFWS 2013b), identifies the following threats to the rattlesnake-master borer moth:

- Pesticide application
- Habitat loss or alteration
- Flooding
- Agricultural and grazing practices
- Noxious weeds and invasive plant species

SECTION 4
IMPACTS OF THE PROPOSED ACTION

4.1 INTRODUCTION

This BA analyzes the impacts of a proposed discretionary federal action. A federal action is defined as anything authorized, funded, or carried out by a federal agency. The proposed action, described in **Section 2** is programmatic, meaning that oil and gas activities under a lease that could affect threatened or endangered species would be subject to Section 7 ESA consultation with the USFWS. The BIA could tier to this BA to streamline the consultation.

4.1.1 Definitions

The impacts of implementing the proposed action can be categorized into direct, indirect, and cumulative impacts:

- **Direct impacts** are those that are caused by the proposed action and occur at the time of the action.
- **Indirect impacts** are those that are caused by the proposed action and occur later in time but are reasonably certain to occur.
- **Cumulative impacts** are those of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BA. Future federal actions that are unrelated to the proposed action are not considered in a cumulative analysis. This is because they will be subject to separate consultation, in accordance with Section 7 of the ESA.

The following definitions are used for impact determinations:

- **No effect—**This is the appropriate conclusion when the BIA determines that its proposed action would not affect listed species. The principal factor in this determination is that the species and its suitable habitat do not exist in the analysis area or that the proposed action would involve no surface disturbances or other species disruption. In this situation, no further contact with the USFWS is required.

- **May affect, is not likely to adversely affect—**This is the appropriate conclusion when the BIA determines that impacts on listed species under the proposed action are expected to be discountable, insignificant, or completely beneficial. This type of impact requires informal Section 7 consultation with the USFWS and concurrence with the determination.
- **May affect, is likely to adversely affect—**This is the appropriate conclusion when the BIA determines that any adverse impact on listed species may occur as a direct or indirect result of the proposed action, and the impact would not be discountable, insignificant, or beneficial. If the overall impact of the proposed action were beneficial to the listed species but also would be likely to cause some adverse impacts, the proper impact determination for the proposed action would be "likely to adversely affect" the listed species. Such determination requires formal Section 7 consultation with the USFWS.

4.1.2 Methods of Analysis

Although some data on known species locations and habitats in the planning area are available, they are neither complete nor comprehensive. The BIA considered known and potential species and habitat locations in the analysis but also considered the potential for species to occur outside these areas. Impacts were quantified when possible. In the absence of quantitative data, the BIA used best professional judgment, based on scientific reasoning.

No decision would be authorized on BIA-administered lands (including mineral estate) that would jeopardize the continued existence of species that are listed or proposed for listing as threatened or endangered.

The analysis is based on the following assumptions:

- Impacts on T&E or proposed species can occur from actions that result in direct mortality, loss of habitat, or modifications to habitat suitability and actions that displace individuals or disrupt behavior. Because T&E and proposed species have specific habitat requirements, and their habitats are often diminishing, the species or their habitat disturbance could result in population declines, which could adversely affect the viability of local populations.
- Since T&E and proposed species populations are, by their nature, generally small and localized, the total area affected by other activities or restrictions is less important than where the activities or restrictions occur in relation to special status species and their habitat.

- The health of T&E and proposed species populations is directly related to the overall health and functional capabilities of upland, aquatic, riparian, and wetland resources, which in turn are a reflection of overall watershed health.
- Ground-disturbing activities generally lead to negative modification of habitat and loss of individuals. The extent of the impact depends on the nature of the activity, the intensity of the surface disturbance, the amount of area disturbed, the location of the disturbance, and the species affected.
- Species' health, population levels, and habitat conditions fluctuate in response to natural factors. Periods of drought or excessive moisture and outbreaks of diseases or pests that directly affect species or impact habitat (e.g., fire ant infestation) would likely impact T&E and proposed species' population levels.
- As the proposed action analyzed in this BA is programmatic, site-specific surveys for listed T&E or proposed species would be conducted before individual projects involving new ground disturbance were authorized, unless a "no effect" determination is made by the agency on the basis of species range, lack of suitable habitat, or other data. Survey results would indicate what BMPs and other minimization measures would be necessary to protect species and habitat.
- Any covered activities that could affect T&E or proposed species would, unless otherwise covered by a blanket concurrence or agreement or methodology outlined by the BA/BO, be required to undergo ESA Section 7 or Section 10 consultation with the USFWS. The BIA could tier to this BA to streamline the consultation. The activities would need to be mitigated to ensure that T&E species would not be jeopardized on a project-specific basis or at a cumulative level.
- Oil and gas activities are and would continue to be concentrated in areas of high potential for oil and gas development, as identified by BLM GIS (2015). Where listed T&E species or critical habitat occur in these areas, the potential for impacts from oil and gas activities is increased.

Cumulative Impacts

Cumulative impacts under the ESA are those of future state, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in the cumulative analysis because they would be subject to separate consultation, in accordance with Section 7 of the ESA. Cumulative impacts address the impact of implementing the proposed action, in combination with other future nonfederal actions outside the scope of the proposed action.

4.2 LISTED SPECIES

4.2.1 American Burying Beetle

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.1.2**. Additional assumptions are as follows:

- In order to estimate the acres of annual ground disturbance associated with oil and gas activities in the planning area, the BIA estimated the acres of disturbance associated with a typical drilling permit development. According to 25 CFR, Subpart 226.19(b), the maximum allowable disturbance per well pad is 1.5 acres without special permission from the Superintendent. Because this does not include ancillary disturbance (e.g., from roads or tank batteries), the BIA estimated an additional 0.5 acre for ancillary disturbance. This results in a total of 2 acres of disturbance, on average, for a typical oil and gas permit development.

  The BIA estimates that 1.5 of the 2 acres of disturbance is comprised of temporarily disturbed areas and 0.5 acres is permanently disturbed. The BIA estimated 300 permits per year would be issued. This would result in approximately 600 acres of disturbance associated with oil and gas development activities annually; 450 acres of these acres would be temporary disturbance and 150 acres would be permanent disturbance.

- Impacts on ABB habitat would be concentrated in areas of high to moderate oil and gas potential. This is because these areas are more likely to see continued or increased oil and gas development and associated ground disturbance or vegetation removal.

- Activities conducted entirely outside of the potential ABB range, as determined by the USFWS (see **Figure 3-1**), would have no effect on ABB (USFWS 2015b). Up-to-date ABB range is available on the USFWS Information Planning and Conservation (IPaC) system (https://ecos.fws.gov/ipac/).

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit ABB. Lessees would be required to follow the USFWS's established protocol regarding areas where the ABB is known to occur or suspected to occur.

Unless the project will have no new ground disturbance, lessees will have to obtain approval from the BIA under the programmatic incidental take permit or comply with the ICP (see **Section 2.3**).

Further, lessees would be required to conduct activities in a manner that would avoid any potential take of federal T&E species, including ABB, or in a manner that complies with any permit or authorization issued by the USFWS. Additional BMPs as they relate to specific direct and indirect impacts are described in the analysis below.

USFWS American Buying Beetle Industry Conservation Plan

The USFWS ICP for the ABB (USFWS 2014c) provides a mechanism to meet statutory and regulatory requirements by proponents engaged in oil and gas activities while promoting conservation of the ABB. The BIA has incorporated provisions similar to the ICP in this BA, including those found in Attachment A. After the BO is issued, these minimization and mitigation measures will be implemented as part of BIAs obligation under Section 7(a)(1) of the ESA.

In areas where the ABB is known or suspected to occur, based on existing records or suitable habitat, oil and gas project proponents would be required to conduct presence/absence surveys for the beetle following USFWS protocols, or assume presence. In occupied habitat, or where presence is presumed, project proponents would be required to implement minimization and mitigation measures listed in Attachment A. A summary of minimization measures adopted by BIA (see Attachment A) follows:

- Reduce motor vehicle, machinery, and heavy equipment use
- Reduce risk of motor vehicles sparking wildfire
- Increase safety during operation fluid use and storage
- Reduce erosion and increase soil stability
- Train construction personnel
- Limit the use of artificial lighting
- Limit the use of gas flares
- Limit disturbance from mechanical vegetation maintenance
- Limit herbicide use
- Set aside topsoil for replacement following construction

Attachment A lists mitigation measures to employ when projects temporarily or permanently impact ABB habitat or result in other forms of take of the species. On-site measures are to replace topsoil, to remediate topsoil compaction, to reestablish vegetation, and to manage invasive plant species. Off-site measures are to establish mitigation lands under conservation easements or to purchase mitigation bank credits.

Direct and Indirect Impacts

As described in *Assumptions*, the potential impacts on the ABB would be highest in those areas with high or moderate-to-high oil and gas potential. This is because oil and gas development would be concentrated in these areas. **Table 4-1**, Acres of ABB Habitat Classifications in Areas of High or Moderate-to-High Oil and Gas Potential, summarizes the acres of ABB potential range and CPAs (USFWS 2015b; CPAs are discussed in **Section 3.2.1**) in areas of high or moderate-to-high oil and gas potential in the planning area. **Figure 3-1** depicts CPAs, as well as ABB potential range, in the planning area.

Table 4-1
Acres of ABB Habitat Classifications in Areas of High or Moderate-to-High Oil and Gas Potential

Habitat Classification	Acres	Percent of Habitat Classification
CPA	445,700	90
Potential range	1,144,300	84

Source: BLM GIS 2015; USFWS GIS 2016

As shown in **Table 4-1**, approximately 90 percent of ABB CPAs and 84 percent of potential range in the planning area are in areas of high or moderate-to-high oil and gas potential. This indicates that potential impacts on ABB from ongoing and future oil and gas development concentrated in these areas are likely.

The direct and indirect impacts on ABB occur from typical activities associated with oil and gas development, including vegetation removal and maintenance, habitat fragmentation, vehicle and heavy equipment use, soil disturbance and movement, and artificial lighting (USFWS 2014c, 2014d). In general, construction-related, ground-disturbing activities have a higher potential to impact ABB than do exploration and pre- and post-construction activities (USFWS 2014d). Where there is a positive ABB survey or presumed presence, the BIA would implement the minimization and mitigation measures in Attachment A to reduce direct and indirect impacts on the beetle. The BIA would implement BMPs (**Table 2-2**), or other site-specific conditions, to further avoid or minimize impacts. Where there is a negative survey for ABB, BIA may still include appropriate BMPs and site specific conditions in order to avoid unnecessary soil or vegetation disturbance. Together, these measures would reduce adverse direct and indirect impacts on the ABB from activities covered by the proposed action.

Vegetation removal can have direct impacts on the ABB through injury or death. Beetles uncovered during vegetation removal may be wounded or killed from exposure to adverse weather conditions or crushed by vegetation removal equipment. ABBs are sensitive to soil moisture and die quickly when desiccated (Bedick et al. 2006, in USFWS 2014c); therefore, vegetation removal that exposes the soil surface to drying may kill inactive adult beetles in the soil.

Where there are unavoidable impacts on the ABB from vegetation removal, adhering to mitigation measures in Attachment A would mitigate these impacts.

Vegetation removal on undisturbed soils in suitable habitat can also have indirect impacts on the ABB. It could result in breeding, foraging, or sheltering habitat degradation and reduced habitat connectivity, which may limit the reproductive success of the species. Vegetation removal or habitat fragmentation may change wildlife use, resulting in altered carrion prey availability for the beetle (Grant et al. 1982, in USFWS 2014c; USFWS 2014d).

Activities that would reduce leaf litter, including the conversion of forest to grassland habitat, may indirectly impact ABB by removing overnight shelter and overwintering habitat, or increasing potential for mortality via desiccation (USFWS 2014d). Introduction of nonnative, weedy, or invasive plant species, including mat-forming grasses, could reduce ABB's ability to bury carrion, resulting in reduced reproductive success (USFWS 2014d). BMPs 1, 2, and 4 would minimize vegetation disturbance. Minimization measures in Attachment A, along with appropriate BMPs, would ensure that habitat connectivity is maintained to the maximum extent practicable and that changes in wildlife use and carrion prey availability are temporary.

Vegetation maintenance may also have direct impacts on ABBs through injury or death, if it were to occur in suitable habitat on undisturbed soils. Adults, larvae, or eggs may be injured or crushed by mowing or vegetation equipment in the active season; in the inactive season, adults may be crushed or exposed to desiccation. Large mowing equipment being operated in suitable habitat may compact the soil, resulting in the take of buried beetles during the active or inactive season (Hoback et al. 2012; Hoback 2013, in USFWS 2014c). Soil compaction could reduce or eliminate ABB's ability to bury carrion, remove existing burrows that may facilitate carrion burial and reproduction, and eliminate overwintering habitat (USFWS 2014d). BMPs to minimize direct impacts on ABB from vegetation removal would also minimize direct impacts from vegetation maintenance.

If vegetation maintenance in suitable habitat on undisturbed soils were to reduce vegetation height to less than 8 inches, the soil may dry to the point that beetles have difficulty burying carcasses, soil may not structurally support reproductive chambers, or adult or larval beetles may become desiccated (Bedick et al. 2006, in USFWS 2014c). Vegetation maintenance in these areas may result in indirect impacts, including temporary habitat loss or fragmentation or beetle habitat alteration. USFWS minimization measures in Attachment A, along with appropriate BMPs or COAs, would be implemented to minimize the impacts from vegetation maintenance.

Vegetation maintenance as part of workover operations or other operations on existing well pads would be less likely to result in direct and indirect impacts on ABBs. Well pad soils are not conducive to ABB burrowing or burying carrion.

This is because these soils are dry and compacted, with high gravel or rock content.

Unmaintained, volunteer vegetation growing on well pads may provide some foraging habitat for adult beetles but would not provide suitable burial sites for reproduction. Therefore, impacts may be restricted to individual foraging beetles, as opposed to impacts on brood chambers or inactive, overwintering beetles. On well pads where vegetation is consistently mown or otherwise maintained below 8 inches, suitable foraging habitat is not likely present. No effects on ABB would be expected in these areas.

Vehicle, trucks, or heavy equipment use can result in direct impacts on ABBs through injury or death. In the active season, adults can collide with or be struck by vehicles or equipment. Because adult ABBs are winged and moderately mobile, above-ground adults during the active season may avoid some impacts of oil and gas activities (USFWS 2014d). However, brood chambers containing adults, larvae, and eggs can be crushed by off-road vehicles or equipment. In the inactive season, adults in leaf litter or soil can be similarly crushed.

During dry periods, vehicles and equipment may increase the risk of wildfire ignitions, which can injure or kill any exposed beetles in the burned area. Wildfires can have indirect impacts by causing habitat loss, and can temporarily alter the small mammal community and thus available carrion prey (Grant et al. 1982; Kirchner et al. 2011, in USFWS 2014c). Vehicles, trucks, or heavy equipment can also result in indirect impacts. Off-road vehicles can compact soils, rendering them unsuitable for carrion prey burial, and can crush vegetation, degrading breeding, foraging, and sheltering habitat. In order to avoid or minimize these impacts, BMPs 1 and 4 require that vehicles and equipment must remain on approved existing and new roads. Because off-road vehicle use is prohibited, the risk of unintentional wildfire ignition is reduced.

Spills of deleterious materials can have direct impacts on any ABBs in the work area. Spills may injure or kill exposed beetles during the active or inactive season. BMP 5 requires preparation and implementation of an SPCC plan for tank batteries, which would minimize the impacts from spills. BMP 7 mandates that chemicals are labeled and stored properly, further reducing chances of spill impacts on ABBs.

Soil grading can result in direct impacts on ABBs through injury or death. In the active season, brood chambers can be crushed, and in the inactive season adults in the leaf litter or soil can be crushed or exposed to desiccation or adverse weather. Soil erosion occurring during construction or following installation of project facilities may bury adults or broods (during the active season) or overwintering adults (during the inactive season) too deep for them to emerge. To avoid impacts, BMPs 2 and 3 require minimizing soil disturbance and implementation of erosion control measures for soil-moving activities and soil erosion prevention, which would minimize the potential impacts from soil erosion.

Artificial light used during oil and gas operations (including gas flares) may indirectly affect ABB. During the active season, artificial light sources may attract adult beetles (Longcore and Rich 2004), which could injure or destroy them through collision with structures or equipment or exposure to gas flares. This would adversely affect foraging success, increase predation on beetles (USFWS 1991), and cause artificially increased energetic demands on beetles, leading to reduced fitness or breeding success.

Since ABBs are not aboveground during the inactive season, they would not be affected by artificial light sources during this time (USFWS 2014c). Minimization measures in Attachment A and BMP 16 would limit the use of artificial lights and gas flares in the active season in order to minimize or avoid potential impacts on the beetle. For projects that require constantly burning flares throughout the life of the project (i.e., during the active season), the flares should be covered to eliminate or minimize flare visibility to ABBs. BMP 6 (venting of flare gas) would also limit this practice without express permission from the BIA Osage Agency Superintendent.

For the potential impacts described above, regulatory approval would be provided by the programmatic incidental take statement issued to the BIA as a result of formal consultation (see **Section 2.3**). As described in **Section 2.3**, when activities are proposed in suitable ABB habitat, lessees would conduct presence/absence surveys, or assume presence, and would report the findings and acres disturbed to the BIA. For negative findings, lessees would proceed with work and would report the acres disturbed to the BIA. For positive survey results, lessees would be required to mitigate ABB take in accordance with the BIA permit and biological opinion.

Where activities occur outside of the ABB potential range, as delineated by the USFWS (see **Figure 3-1**), no effect on the ABB is expected (USFWS 2015b).

Cumulative Impacts

The cumulative impacts analysis area for ABB is the potential range of the species. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect ABB and its habitat are the following:

- Oil and gas leasing and development
- Agriculture, livestock grazing, and similar forest/woodland conversion
- Renewable energy and infrastructure development
- Conservation planning,

Generally, impacts on the ABB and its habitat from the actions described above could occur due to the following:

- Loss or modification of vegetation communities
- Altered species composition and vegetation structure, resulting in alterations to the carrion prey base, including from agricultural pesticide use
- Habitat fragmentation that limits dispersal
- Establishment and spread of noxious weeds and invasive species
- Soil disturbance, including compaction, erosion, and topsoil removal

Alternatively, vegetation conservation and habitat restoration actions would have beneficial impacts on the ABB and its habitat by relieving soil compaction, restoring suitable vegetation for breeding, foraging, and sheltering habitat, and managing weed establishment and spread.

Oil and gas leasing and development, in combination with conversion of tallgrass prairie and other wooded habitats to agriculture, is likely to continue to affect ABBs that use these habitats for breeding, foraging, and sheltering. As described in the Draft Osage EIS, approximately 95 percent of the county is in agricultural use (BIA 2015b), and further conversion of native habitats to agriculture would result in long-term habitat loss or fragmentation.

Land use changes that fragment native forest and prairie habitats, create edge habitats, and remove top-level carnivores have created conditions in which vertebrate scavenger species (e.g., raccoon and striped skunk) have thrived in the action area. With the rise of these species and the local extinction or extirpation of some native species, the availability of preferred carrion prey species including greater prairie-chicken (*Tympanchus cupido*), wild turkey (*Meleagris gallopavo*), and the extinct passenger pigeon (*Ectopistes migratorius*) has decreased substantially. This is because carrion is a widely-scattered but finite resource (Karr 1982; Pimm et al.1988; Peck and Kaulbars 1987, in USFWS 2014c).

Further reductions in carrion prey availability would further limit the beetle's reproductive potential. The imported red fire ant has become a formidable competitor for carrion and a potential source of death for burying beetles when they are collocated at a food source (Warriner 2004; Godwin and Minich 2005, in USFWS 2014c). Of the states with ABB populations, the imported red fire ant now occurs in all or parts of Arkansas**,** Oklahoma, and Texas (USDA 2003, in USFWS 2014c).

It is likely that impacts from climate change will affect vegetation in the planning area within the cumulative impacts horizon, and as a result, will affect ABB breeding, foraging, and sheltering habitat. Current climate change models are projecting a range of potential shifts in climate, including increasing temperatures and more intense rainfall. This is despite a decrease in average amounts of total annual precipitation (Karl et al. 2009). Altered climatic patterns would likely influence species distribution within vegetation communities in the planning area. This may be particularly true in those communities that are sensitive to impacts from drought or altered fire regimes or that are susceptible to weed establishment and spread.

Under the proposed action, the impacts on the ABB and its habitat from oil and gas development in the planning area would cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing minimization and mitigation measures in Attachment A or as identified in the Biological Opinion, would ensure that contributions to cumulative impacts from the proposed action are minor or negligible. Where appropriate, implementing mitigation measures such as permanent conservation of lands within CPAs and other suitable habitat, would have beneficial cumulative impacts in the long term.

4.2.2 Whooping Crane

Assumptions and Methods of Analysis

The assumptions and methods of analysis are similar to those described in **Section 4.1.2.** Also, because whooping cranes do not breed in the planning area, no impacts on whooping crane breeding habitat would occur from implementing the proposed action.

Important stopover or roosting habitat for whooping crane, as defined by the USFWS (2015d), occurs in the planning area. The USFWS provides guidance to avoid impacts on whooping crane from oil and gas projects within the ABB range in Oklahoma (USFWS 2015d). Potential impacts from the proposed action, incorporating USFWS avoidance measures, are analyzed in this section.

Additionally, under the proposed action, water bodies would be protected by a 200-foot-wide buffer protecting established watering places in, accordance with 25 CFR, Subpart 226.33. The regulations do allow for a lessee to submit a request and justification to the Superintendent for an exception to the 200-foot-wide buffer, which may be granted with appropriate protective measures. This should be noted for all future references to this regulation.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive; new measures may be developed as necessary following the BIA's site-specific review of applications for drilling or other permits or approvals.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit whooping crane. These are detailed below.

Under BMP 15, lessees would be required to follow the USFWS's Oklahoma Ecological Services Field Office guidance for migratory birds and eagles (USFWS 2014b). The guidance lists measures to avoid or minimize impacts on migratory birds and eagles associated with oil and gas projects in Oklahoma. Lessees would be required to implement these avoidance measures for projects authorized under the proposed action. Impact avoidance measures mostly are those to avoid impacts on breeding birds.

Whooping cranes do not breed in the planning area, but may use wetland and other habitat there for stopovers during migration. Therefore, measures for conserving whooping crane are general. However, under the guidance, surveys to determine potential nesting habitat for migratory birds would also document potential whooping crane migratory stopover habitat, and subsequent avoidance measures would be implemented if necessary.

Multiple BMPs would protect wetlands, waters, and water quality in the planning area by prohibiting activities in wetlands and streams without USACE approval (BMP 12), by requiring spill prevention planning (BMPs 5 and 7), and by controlling soil erosion (BMPs 2 and 3). These BMPs would protect whooping crane migratory stopover habitat in the planning area.

Additional measures benefiting whooping cranes are as follows:

- BMP 15 directs lessees to conduct activities to avoid any potential incidental take or harm to federal T&E species
- BMP 11 directs lessees—to the extent possible—to minimize disturbance to wildlife and natural resources from noise, traffic, or other operations

USFWS Avoidance Measures

The USFWS provides guidance to avoid impacts on whooping crane from oil and gas projects within the ABB range in Oklahoma (USFWS 2015d). To comply with this guidance, the BIA will implement the following measures within the 95 percent sighting corridor:

- New overhead power lines within one mile of important stopover or roosting habitat in the 95 percent sighting corridor should be marked according to the guidance in Reducing Avian Collisions with Power Lines (Avian Power Line Interaction Committee [APLIC] 2012).
- Within 200 yards of important stopover or roosting habitat in the 95 percent sighting corridor, new overhead power lines should be

avoided or buried. Lines in forested or wooded habitat can be marked and not buried if the height of the line is equal to or lower than nearby trees.

Direct and Indirect Impacts

As discussed in **Section 3.2.2**, whooping cranes do not breed in the planning area, though they likely pass through the planning area when migrating between winter and summer ranges. No nesting areas occur in the planning area. The Salt Plains National Wildlife Preserve is a major migration stopover area (USFWS and CWS 2007), approximately 60 miles west of the planning area. Important stopover or roosting habitat, as defined by the USFWS, occurs in the planning area.

Despite the lack of breeding habitat in the planning area, limited numbers of whooping cranes may use its wetland habitats as short-term stopover sites. Whooping cranes may also use adjacent grassland or agricultural habitats during migratory stopovers (USFWS and CWA 2007). Osage county is partially within the 200-mile-wide migration path described in the whooping crane recovery plan (USFWS and CWA 2007); crane observations have been recorded outside of this pathway in eastern Oklahoma, as depicted in **Figure 3-2**.

Potential direct impacts could occur from whooping crane interaction with oil and gas project components or infrastructure, including overhead transmission lines, especially where these features are close to important stopover or roosting habitat. To avoid potential direct impacts, the USFWS avoidance measures would be implemented within the 95 percent sighting corridor, as BIA permit conditions or COAs. These measures include marking new overhead lines within one mile of important stopover or roosting habitat, according to APLIC (2012) guidelines. New overhead lines within 200 yards of important stopover or roosting habitat in the 95 percent sighting corridor would be avoided or buried, unless surrounding vegetation is taller than the new lines. In such a case, new lines would be marked according to APLIC (2012) guidelines. If the lessee chooses not to implement USFWS avoidance measures, additional coordination with the USFWS may be required to avoid impacts.

Implementing BMP 15 requires lessees to follow the minimization measures in the USFWS Oklahoma Ecological Services Field Office guidance for migratory birds and eagles (USFWS 2014b). Measures applicable to migrating whooping cranes in this guidance are general. However, under the guidance, surveys to determine potential nesting habitat for other migratory birds would also document potential whooping crane stopover habitat. As discussed, suitable migratory stopover habitat may also include grasslands and agricultural lands next to wetlands. Where such habitat exists close to proposed oil and gas projects, guidance in APLIC (2012) for reducing collision should be implemented where collision risk exists. Implementing these measures would minimize or avoid potential direct impacts on migrating whooping cranes.

Additional indirect impacts on whooping cranes from oil and gas activities are migratory stopover habitat degradation and visual or noise disturbance to whooping cranes from humans (Lewis and Slack 2008). This could result in flight response and unnecessary energy expenditure and elevated stress.

In order to minimize or avoid these indirect impacts, multiple BMPs would protect wetlands, waters, and water quality in the planning area by prohibiting activities in wetlands and streams without USACE approval (BMP 12), by requiring spill prevention planning (BMPs 5 and 7), and by controlling soil erosion (BMPs 2 and 3). These BMPs would protect whooping crane migratory stopover habitat in the planning area, avoiding potential indirect impacts.

Additionally, BMP 11 directs lessees to reduce potential noise and other disturbances to wildlife from oil and gas projects to the extent possible, further reducing impacts on whooping crane from operations.

Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. The 200-foot buffer would further protect migratory habitat and reduce the potential for indirect impacts on whooping crane from the proposed action.

Cumulative Impacts

The cumulative analysis impacts area for whooping crane is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect whooping crane and its habitat are as follows:

- Loss of wetland habitat due to agricultural conversion, oil and gas development, renewable energy, infrastructure, and other development
- Installation of tall structures, including wind farms and transmission lines
- Implementing the USFWS avoidance measures within the 95 percent sighting corridor, as BIA permit conditions or COAs

Whooping cranes do not breed or winter in the planning area, so no cumulative impacts on breeding or wintering habitat under the proposed action are anticipated.

Whooping cranes have lost much of their historic migratory stopover habitat due to development, agricultural conversion, and other human encroachment (CWS and USFWS 2007), including within the planning area. As described under *Direct and Indirect Impacts*, important stopover or roosting habitat is present in the planning area. Therefore, it is likely that whooping cranes using wetland habitat for migratory stopover have been and will continue to be affected by oil and gas development in the planning area. Potential impacts include chances of collision with oil and gas or other infrastructure near wetlands habitats (e.g., transmission lines and tall drill rigs) and visual or noise disturbance. Impacts from oil and gas activities would be reduced or avoided by implementing the USFWS's avoidance measures in the 95 percent sighting corridor, as described.

Other actions in the planning area could similarly affect whooping cranes. Renewable energy development infrastructure may pose collision risks to migrating whooping cranes. Cranes can collide with transmission lines and wind turbines. The potential for collision increases where these structures are in migratory corridors or next to high-use areas, like migratory stopover sites (APLIC 2012).

Under the proposed action, impacts on whooping cranes from oil and gas development in the planning area would cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs and USFWS avoidance measures, as necessary, would ensure that contributions to cumulative impacts from the proposed action are minor or negligible.

4.2.3 Red Knot

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.2.2**, Whooping Crane. Additionally, under the proposed action, water bodies would be protected by a 200-foot-wide buffer protecting established watering places, in accordance with 25 CFR, Subpart 226.33. If oil and gas activities under the proposed action occur within the 200-foot buffer, direct and indirect impacts on red knots may occur.

When oil and gas activities covered under the proposed action occur outside of the 200-foot buffer from established watering places, no impacts on red knot are anticipated due to the distance from suitable habitat.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit red knots. They are the same as those described under **Section 4.2.2**.

Direct and Indirect Impacts

As discussed in **Section 3.2.3**, red knots do not breed in the planning area, though individuals migrating between winter and summer ranges likely pass through. Despite the lack of breeding habitat in the planning area, red knots may use wetland habitats in the planning area as short-term stopover sites during migration.

Wetlands suitable for red knot stopover habitat are a relatively small amount of the land surface in the planning area. As described in the Draft Osage EIS (BIA 2015b), approximately 9,000 acres of emergent herbaceous wetlands and freshwater ponds (excluding forested wetlands, lakes, and river habitats) occur in the planning area. This is less than one percent of the planning area's total land area. However, approximately 7,400 acres (82 percent) of these wetlands occur in areas of high or moderate-to-high oil and gas potential (NWI GIS 2015; BLM GIS 2015). This suggests most wetlands in the planning area could be near existing or future oil and gas activities. Therefore, red knots using wetlands in Osage County as migratory stopover habitat have a high chance of being affected by current and future oil and gas activities.

Potential direct and indirect impacts on red knots from oil and gas activities would be largely the same as those described for whooping cranes in **Section 4.2.2**. This is because neither migratory species breeds nor winters in the planning area but may occasionally use its wetland habitats for migratory stopovers. Potential direct impacts could occur from collisions with oil and gas infrastructure, such as drill rigs or transmission lines. Potential indirect impacts are from degraded water quality in wetland habitats that are suitable migratory stopover areas and from visual or noise disturbances in these habitats.

Under the proposed action, BMPs would be implemented to avoid or minimize these potential direct and indirect impacts, as described in **Section 4.2.2**.

Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. When oil and gas activities covered under the proposed action occur entirely outside of the 200-foot buffer, no direct or indirect impacts on red knot are anticipated due to the distance from suitable migratory stopover habitat.

Cumulative Impacts

The cumulative analysis impacts area for red knots is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect red knots are similar to those described in **Section 4.2.2**.

As described above under *Direct and Indirect Impacts*, red knots do not breed or winter in the planning area but may use wetlands as migratory stopovers. These stopover habitats are similar to those used by whooping cranes; therefore, the potential cumulative impacts on red knots would be similar to those described for whooping crane.

Under the proposed action, impacts on red knot from oil and gas development in the planning area would cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs would ensure that contributions to cumulative impacts from the proposed action are minor or negligible.

4.2.4 Interior Least Tern

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.1.2**. The USFWS provides guidance to avoid impacts on interior least tern from oil and gas projects within the ABB range in Oklahoma (USFWS 2015d). Potential impacts from the proposed action, incorporating USFWS avoidance measures, are analyzed in this section. Additionally, under the proposed action, water bodies (including the Arkansas River) would be protected by a 200-foot-wide buffer protecting established watering places, in accordance with 25 CFR, Subpart 226.33.

When oil and gas activities covered under the proposed action occur outside of the USFWS avoidance buffers, no impacts on interior least tern are anticipated due to the distance from suitable habitat.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes BMPs, described below, that would directly and indirectly benefit interior least tern.

Under BMP 15, lessees would be required to follow the USFWS's Oklahoma Ecological Services Field Office guidance for migratory birds and eagles (USFWS 2014b). The guidance lists impact avoidance measures to avoid or minimize impacts on migratory birds and eagles from oil and gas projects in Oklahoma. Lessees would be required to implement avoidance measures within the guidance as part of projects authorized under the proposed action. This would include conducting surveys for suitable habitat for breeding bird species and taking appropriate avoidance measures if breeding birds are observed.

Multiple BMPs would protect wetlands, waters, and water quality within the planning area by prohibiting activities in wetlands and streams without USACE approval (BMP 12), by requiring spill prevention planning (BMPs 5 and 7), and by controlling soil erosion (BMPs 2 and 3). Since interior least terns breed in the Arkansas River floodplain in the planning area, these BMPs would indirectly benefit breeding habitat by protecting upstream water quality.

Additional measures benefiting interior least terns are as follows:

- BMP 15 directs lessees to conduct activities in a manner that avoids any potential incidental take of or harm to federal T&E species.

USFWS Avoidance Measures
The USFWS provides guidance to avoid impacts on interior least tern from oil and gas projects within the ABB range in Oklahoma (USFWS 2015d). To comply with this guidance, project activities will avoid interior least tern nesting areas during the nesting season. New overhead power lines within one mile of suitable habitat (Arkansas River) will be marked according to the guidance in APLIC (2012). Overhead lines, tall drilling rigs, or other tall vertical structures will be avoided within 200 yards of nesting areas and pipelines will be bored under the river in these areas.

Direct and Indirect Impacts
As discussed in **Section 3.2.4**, interior least terns are known to breed along portions of the Arkansas River in Osage County. Breeding habitat is on sand and gravel bars in the river floodplain.

While unlikely, a potential direct impact could occur from interior least terns colliding with oil and gas project components or infrastructure, especially if such infrastructure is installed near breeding colonies. While small agile birds like interior least terns are generally at lower risk of collision (APLIC 2012), interior least tern deaths from power line collisions have been observed near breeding colonies (Dinan et al. 2012). Dinan et al. (2012) noted that size and flight agility may not be the only factors that influence a species' susceptibility to power line collisions; behavior, habitat, time of day, weather, and age may play a role, and interior least terns may be at increased susceptibility due to their courting and pair-bonding behavior.

To avoid potential direct impacts, USFWS avoidance measures would be implemented, including avoiding nesting areas during the breeding season, and marking new overhead lines within one mile of suitable habitat (Arkansas River) according to APLIC (2012) guidelines. New overhead lines, tall drilling rigs or other tall vertical structures will be avoided within 200 yards of nesting areas unless tall vertical structures already exist within the 200-yard buffer. Pipelines will be bored under the river in these areas. Implementing these measures would avoid this potential direct impact on interior least terns from colliding with oil and gas project infrastructure. If the lessee chooses not to implement USFWS avoidance measures, additional coordination with the USFWS may be required to avoid impacts.

Additionally, BMPs (**Table 2-2**) and other measures under the proposed action would avoid and reduce direct and indirect impacts on interior least terns and habitat. BMPs under the proposed action protect interior least tern habitat.

BMP 15 directs lessees to conduct activities in a manner that avoids any potential incidental take of or harm to federal T&E species, including mandating adherence to the USFWS migratory bird and eagle protocol (USFWS 2014b). This includes conducting surveys for breeding birds and habitat before construction and implementing appropriate measures to avoid breeding birds, if present.

Because interior least terns breed and forage in riverine habitat, changes to water quality may indirectly affect the species. Excessive silt deposition resulting from soil erosion and runoff could degrade nesting habitat; water quality alterations marked enough to kill fish species may reduce prey for interior least terns. To avoid such indirect impacts, multiple BMPs in **Table 2-2** would protect water quality by implementing spill prevention planning (BMPs 5 and 7) and soil erosion control (BMPs 2 and 3). These BMPs would indirectly benefit breeding habitat by protecting upstream water quality from both soil erosion and runoff and introduction of deleterious materials (e.g., petroleum products and production fluids) into waterways.

Additional indirect impacts on interior least terns from oil and gas activities are visual or noise disturbance from humans, potentially resulting in flight response and unnecessary energy expenditure and elevated stress. BMP 11 directs lessees to reduce potential noise and other disturbances to wildlife from oil and gas projects. Implementing these measures would minimize or avoid potential indirect impacts on interior least terns.

Under the proposed action, water bodies (including the Arkansas River where interior least terns are known to breed) would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. The 200-foot buffer would further protect habitat and reduce potential for indirect impacts on interior least tern from the proposed action.

When oil and gas activities covered under the proposed action occur entirely outside of the USFWS avoidance measure buffers around suitable breeding habitat, no direct or indirect impacts on interior least terns are anticipated due to the distance from suitable breeding habitat.

Cumulative Impacts

The cumulative analysis impacts area for interior least terns is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect interior least terns and their habitat are as follows:

- Habitat alteration and destruction, including regulated river flows, channelization, irrigation, and the construction of reservoirs
- Human disturbance, including recreation in river systems where interior least terns breed

Past actions, such as river channel engineering, reservoirs, channelization, channel training structures, and bank stabilization, have reduced available breeding habitat for interior least terns. Recreation has also affected and will likely continue to affect interior least terns. Recreation concentrated in river systems can disturb interior least terns' breeding activity and result in reduced reproductive success.

Under the proposed action, impacts on interior least terns from oil and gas development in the planning area would be unlikely to cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing the USFWS avoidance measures and BMPs suggests that contributions to cumulative impacts from the proposed action are unlikely.

4.2.5 Piping Plover

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.2.4** for interior least tern. Piping plover is not known to breed in the planning area but may pass through it during migration.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit piping plovers. BMPs that would directly and indirectly benefit piping plovers are the same as those described under **Section 4.2.4**.

Direct and Indirect Impacts

As discussed in **Section 3.2.5**, piping plovers are not known to breed in the planning area but may pass through the planning area during migration. Additionally, potentially suitable breeding habitat, consisting of sparsely vegetated sandbars, lake and reservoir shorelines, and similar areas, are present in the planning area. Further, piping plovers and interior least terns are known to breed in the same discrete locations in the Missouri River system (USFWS 1990); interior least terns are known to breed along portions of the Arkansas River, as described in **Section 3.2.4**. Therefore, it is reasonable to assume that there is a potential for piping plovers to breed in the planning area.

Potential direct and indirect impacts on piping plovers from oil and gas activities would be largely the same as those described for interior least terns in **Section 4.2.4**. This is because both species use similar habitat for breeding and foraging. Potential direct impacts could occur from colliding with oil and gas infrastructure, such as drill rigs or transmission lines, though this may be unlikely

(Dinan et al. 2012). Potential indirect impacts are degradation of water quality in riverine habitats, associated degradation of nesting habitat from excessive siltation, and potential noise or visual disturbance to individual piping plovers.

Under the proposed action, BMPs would be implemented to avoid or minimize these potential direct and indirect impacts, as described in **Section 4.2.4**. Additionally, water bodies, including the Arkansas River, with potential breeding habitat for piping plovers would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33.

Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. When oil and gas activities covered under the proposed action occur entirely outside of the 200-foot buffer, no direct or indirect impacts on piping plovers are anticipated due to the distance from suitable foraging and potential breeding habitat.

Cumulative Impacts

The cumulative analysis impacts area for piping plovers is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect piping plovers are similar to those described in **Section 4.2.4**, for interior least tern. As described under *Direct and Indirect Impacts*, above, piping plovers are not known to breed in the planning area, but suitable breeding habitat may exist. Piping plovers have been documented in the planning area during migration. Therefore, the potential cumulative impacts on piping plover would be similar to those described for interior least terns.

Under the proposed action, the impacts on piping plovers from oil and gas development in the planning area would be unlikely to cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs suggest that contributions to cumulative impacts from the proposed action are unlikely.

4.2.6 Neosho Mucket Mussel

Assumptions and Methods of Analysis

Assumptions and methods of analysis are similar to those described in **Section 4.1.2**. An additional assumption is that, under the proposed action, water bodies would be protected by a 200-foot-wide buffer protecting established watering places, in accordance with 25 CFR, Subpart 226.33. When oil and gas activities covered under the proposed action occur outside of the 200-foot buffer from established watering place, no direct or indirect impacts on Neosho mucket mussel are anticipated.

If oil and gas activities occur within the 200-foot buffer from occupied habitat, indirect impacts may still occur resulting primarily from water quality impacts, as described below.

Conservation Planning (As It Relates to Section 7[a][1] of the ESA)

The proposed action is summarized in **Section 2** of this BA and incorporates the BMPs described below. Since the proposed action is programmatic, measures described below may not be comprehensive. New measures may be developed as necessary following BIA APD review.

Best Management Practices

Table 2-2 includes a number of BMPs that would directly and indirectly benefit Neosho mucket mussel. These are discussed below.

Multiple BMPs would protect wetlands, waters, and water quality in the planning area by prohibiting activities in wetlands and streams without USACE approval (BMP 12), by requiring spill prevention planning (BMPs 5 and 7), and by controlling soil erosion (BMPs 2 and 3). Since Neosho mucket mussels occur in large streams and small rivers in the planning area, these BMPs would indirectly benefit breeding habitat by protecting water quality.

An additional measure benefiting Neosho mucket mussels is BMP 15, which directs lessees to conduct activities in a manner that avoids any potential incidental take of or harm to federal T&E species.

Direct and Indirect Impacts

As discussed in **Section 3.2.7**, Neosho mucket mussels have been observed in large streams and small rivers in Osage County, in shallow riffle-run complexes with swift currents. Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33. This would prevent potential direct impacts and would limit potential indirect impacts from oil and gas activities on Neosho mucket mussel habitat.

Indirect impacts on Neosho mucket mussel habitat could occur from oil and gas activities next to river and stream habitat. Indirect impacts are those on water quality from erosion, runoff, and sedimentation and from deleterious substances from unintentional spills.

BMPs (**Table 2-2**) would be sufficient to avoid indirect impacts on Neosho mucket mussel habitat. BMPs under the proposed action prohibit activities in wetlands and streams without USACE approval (BMP 12). Multiple BMPs would protect water quality by implementing spill prevention planning (BMPs 5 and 7) and soil erosion control (BMPs 2 and 3). These BMPs would indirectly benefit Neosho mucket mussel habitat by protecting upstream water quality from both soil erosion and runoff and the introduction into waterways of deleterious materials, such as petroleum products and production fluids.

Under the proposed action, water bodies would be protected by a 200-foot-wide buffer, in accordance with 25 CFR, Subpart 226.33, further minimizing chances for indirect impacts on Neosho mucket mussel from water quality changes associated with oil and gas activities.

Finally, BMP 15 mandates that lessees avoid any potential incidental take of or harm to federally T&E species and to comply with any permit or authorization issued by the USFWS.

Cumulative Impacts

The cumulative impacts analysis area for Neosho mucket mussels is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the cumulative impacts analysis area that have affected and will continue to affect Neosho mucket mussel and its habitat are as follows:

- Surface-disturbing activities that affect water quality, including oil and gas, residential, commercial, infrastructure, and other development
- Habitat alteration and destruction, including regulated river flows, channelization, irrigation, and the construction of reservoirs

Past river channel engineering and reservoir construction have likely reduced available Neosho mucket mussel habitat. As discussed in **Section 3.2.7**, Neosho mucket occurs both upstream and downstream of Hulah Lake (a constructed reservoir) in the Caney River (ODWC 2015). Because Neosho mucket mussels are not known from other rivers in the planning area, this suggests that reservoir construction may have removed much of the suitable habitat there.

Past and current land uses including agriculture, oil and gas development, residential, commercial, infrastructure, and other development have resulted in cumulative impacts on watersheds that support or may support Neosho mucket mussel. Impacts are those on water quality, including increases in sediment and turbidity. Water quality requirements for Neosho mucket are not well understood; however, environmental contamination is a contributing factor to the decline in mussel populations, and excessive sediments can be detrimental to the survival of juvenile mussels and may affect food availability (USFWS 2015c).

Impacts on Neosho mucket mussel as a result of oil and gas development in the planning area would be unlikely to cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs suggests that contributions to cumulative impacts from the proposed action are unlikely.

4.3 CANDIDATE SPECIES

4.3.1 Rattlesnake-Master Borer Moth

Assumptions and Methods of Analysis

Assumption and methods of analysis are similar to those described in **Section 4.1.2**. Additional assumptions are as follows:

- Impacts on the rattlesnake-master borer moth's host plant, rattlesnake master, were used as a proxy to analyze impacts on rattlesnake-master borer moth.
- Impacts would be concentrated in suitable habitat, in areas of high to moderate oil and gas potential. This is because these areas are more likely to see continued or increased oil and gas development and associated ground disturbance or vegetation removal.
- Surveys would not be conducted for the host plant in suitable prairie habitat, except in the event that the applicable RCM requiring surveys is selected during the Osage EIS process.
- Oil and gas activities outside of suitable prairie habitat would have no effect on the rattlesnake-master borer moth, as the host plant does not occur there.

Conservation Planning (as It Relates to Section 7[a][1] of the ESA)
The proposed action is summarized in **Section 2** of this BA and incorporates the conservation measures described below. Since the proposed action is programmatic, standard best management practices described in Attachment B may not be comprehensive. New conditions of approval may be developed as necessary following BIA APD review.

Conservation Measures
Attachment B includes a number of measures that would directly and indirectly benefit rattlesnake-master borer moth.

In general, oil and gas operators must conduct activities in a workman like manner as stated in 25 CFR 226.19. Attachment B best management practices provide more specific guidelines which may be included in permit conditions.

Standard BMP 5 directs lessees to avoid or minimize soil and vegetation disturbance, and avoid removal or damage to trees, shrubs and groundcover to the extent possible. BMP 6 requires erosion control measures to avoid debris or contaminants off the well site to adjacent lands. BMP 7 states that all vehicles and equipment must utilize and stay confined to existing and approved new roads. Where oil and gas projects are in appropriate habitat, such as wet or mesic prairie soils or open woods, these BMPs would minimize potential impacts on the host plant, rattlesnake master, as well as individual moths. BMP 16 provides that disturbed areas should be restored to original contour with clean soil and vegetation should be re-established with native species unless otherwise approved. No noxious or invasive species may be used in revegetation and reclamation activities.

These measures would indirectly benefit habitat for the host plant. An additional measure benefiting rattlesnake-master borer moth is BMP 18, which directs lessees to conduct activities in a manner that avoids any potential incidental take of or harm to federal T&E species.

Direct and Indirect Effects

As discussed in **Section 3.3.1**, in Oklahoma, rattlesnake-master borer moth is known only from The Nature Conservancy's Tallgrass Prairie Preserve, near Pawhuska. However, suitable habitat for the host plant likely occurs in other areas of the planning area in tallgrass prairie. For this reason, undiscovered populations of rattlesnake-master borer moth may occur in these areas.

As described in *Assumptions*, potential impacts on rattlesnake-master borer moth were analyzed by assessing potential impacts on its host plant, rattlesnake-master, including potential impacts on tallgrass prairie, which is habitat for the host plant. The potential for impacts on tallgrass prairie and the host plant would be highest where this habitat occurred in areas of high or moderate-to-high oil and gas potential. This is because oil and gas development will likely continue to be concentrated in these areas.

Table 4-2 summarizes acres of tallgrass prairie habitats in the planning area in areas of high or moderate-to-high oil and gas potential.

Table 4-2
Acres of Tallgrass Prairie in Areas of High or Moderate-to-high Oil and Gas Potential

Habitat Classification	Acres with Oil and Gas Potential	Total Acres in Planning Area	Percent of Habitat Classification
Tallgrass prairie	502,700	656,700	77

Sources: Oklahoma Biological Survey GIS 1943; BLM GIS 2015

As shown in **Table 4-2**, approximately 77 percent of tallgrass prairie in the planning area is in high or moderate-to-high oil and gas potential areas. This suggests that most tallgrass prairie habitat in the planning area could be near existing or future oil and gas activities. Therefore, the potential for effects of current or future oil and gas activities on the rattlesnake-master borer moth may be greater. Further, oil and gas development is found in TNC's Tallgrass Prairie Preserve, with approximately 220 active wells operating there in 2013[11] (TNC 2013).

Potential direct impacts on rattlesnake-master borer moth can include injury or death. During the moth's flight period, adult moths may collide with or be struck by vehicles or equipment, resulting in injury or death. Depending on the season, vegetation removal, soil grading, and off-road vehicle and equipment can

[11] R. G. Hamilton, Director Tallgrass Prairie Preserve, The Nature Conservancy, personal communication with E. Streater, Acting Deputy Regional Director – Trust Services, Eastern Oklahoma Region, BIA, January 25, 2013.

crush eggs in the duff surrounding the host plant or crush or injure burrowed larvae or adults in or on the host plant. During dry periods, vehicle and equipment use may increase the risk of wildfire ignitions, which can injure or kill adults or larvae.

Several BMPs listed in Appendix B, as described above, can work to avoid or minimize these impacts. Additionally, because off-road vehicle and equipment use is prohibited, the risk of unintentional wildfire ignition, and associated impacts on the moth, are reduced.

Vegetation removal can also have indirect effects on the rattlesnake-master borer moth. Vegetation removal may result in breeding, foraging, or sheltering habitat degradation and reduced habitat connectivity, which may limit reproductive success. To minimize or avoid impacts, BMP 5 would minimize vegetation disturbance, as discussed above. Revegetating temporarily disturbed areas, will make recolonization by the host plant more likely in the long term.

Vegetation maintenance may also have direct and indirect effects on rattlesnake-master borer moth. Mowing may injure or kill individual larvae or adults, and mowing equipment may crush eggs in the duff surrounding host plants. Herbicide application can kill the host plant, effectively leaving individuals without a means of forage or reproduction, eventually resulting in death or decreased reproductive success.

Artificial light used during oil and gas operations (including gas flares) may indirectly or directly affect rattlesnake-master borer moth during its flight period. Artificial light sources may attract the moth, resulting in injury or death through collision with structures or equipment or exposure to the gas flare. Artificial lights may adversely affect reproductive success and increase predation on the moth. Artificial lights may artificially increase energetic demands on the moth, leading to reduced fitness or breeding success.

BMP 18 mandates that lessees conduct activities to avoid incidental take or harm to listed species. This BMP may be added as a condition of approval to a permit issued by BIA in appropriate situations, and additional site-specific COAs can also be developed. If listed as a T & E species, BIA may require surveys to determine the presence of the host plant, and specify measures to avoid detrimental impacts on rattlesnake-master borer moth following results of the survey, if necessary.

When oil and gas activities are completely outside of suitable habitat for the host plant, no effects on rattlesnake-master borer moth are anticipated.

Cumulative Effects

The cumulative effects analysis area for rattlesnake-master borer moth is the planning area. Past, present, and reasonably foreseeable future actions and conditions in the area that have affected and will continue to affect rattlesnake-master borer moth and its habitat are as follows:

- Fragmentation and loss of native tallgrass prairie habitat due to various types of development
- Establishment and spread of noxious weeds and nonnative invasive species in tallgrass prairie habitat
- Vegetation management plans, including the Osage Nation Integrated Resource Management Plan (ONENRD 2006)

Tallgrass prairie has declined greatly in acreage due to agricultural conversion throughout the region; however, large expanses of this vegetation type still occur in the planning area (Hoagland 2008). The historical use of tallgrass prairie for pasture (Duck and Fletcher 1943) led to its conversion to exotic pasture grasses and is an ongoing threat in tallgrass prairie in the region.

The frequency and extent of fire in these systems has dramatically declined as a result of fire suppression and reduction in fuels due to grazing. This can give rise to changes in the plant community and invasion of native or nonnative species, potentially reducing suitable habitat for the host plant, rattlesnake master.

Invasive plants are generally spreading or increasing in density in some parts of the planning area. This is especially true in oil and gas fields, along roadways, transmission lines, and other rights-of-way. At the margins of agricultural operations, ground disturbance is concentrated and human activities have increased the number of potential invasive plant introductions (Smith and Knapp 2001).

Invasive plants may outcompete native species, including the host plant, for nutrients and light, eventually reducing the density and distribution of native species. Typically, as ground disturbance increases in areas of weed populations, the likelihood that invasive plants would move into these areas increases. Linear development, such as transmission lines, pipelines, roads, and fences, can facilitate long-distance weed dispersal (Sheley 1996; Forest Service 2012).

It is likely that impacts from climate change will affect vegetation in the planning area within the cumulative impacts planning horizon. Current climate change models are projecting a range of potential shifts in climate, including increasing temperatures and more intense rainfall. This is despite a decrease in average amounts of total annual precipitation (Karl et al. 2009). Altered climatic patterns would likely influence species distribution within vegetation communities in the planning area, potentially affecting density and distribution of the host plant. This may be particularly true in those communities that are sensitive to impacts from drought or altered fire regimes or that are susceptible to weed establishment and spread.

Under the proposed action, impacts on rattlesnake-master borer moth from oil and gas development in the planning area would cumulatively contribute to the impacts from past, present, and reasonably foreseeable actions. Implementing BMPs and appropriate COAs should ensure that contributions to cumulative impacts from the proposed action would be minor. These BMPS are as follows:

- Conducting activities in a manner that avoids incidental take of T&E species or complies with any USFWS permit or authorization
- Avoiding or minimizing vegetation disturbance
- Revegetating temporarily disturbed areas using native seed unless otherwise approved, and
- Prohibiting the use of noxious or invasive species for revegetation

SECTION 5
IMPACTS DETERMINATION

5.1 AMERICAN BURYING BEETLE

Implementing the proposed action **may affect, and is likely to adversely affect**, ABB when oil and gas activities occur within the potential range of ABB. When oil and gas activities under the proposed action occur outside of the potential range of ABB, these activities would have **no effect** on ABB.

5.1.1 Rationale

Direct and indirect impacts on ABB and its habitat can occur from typical activities associated with oil and gas development (USFWS 2014c). To minimize direct and indirect impacts, the BIA would implement and adhere to protocols incorporated into this BA and its Attachments, including but not limited to Attachment A. The BIA may implement additional standardized BMPs from **Table 2-2** or include site-specific COAs to further minimize impacts. Where unavoidable impacts on the ABB remain after measures in Attachment A, standard BMPs and site-specific COAs are implemented, adverse impacts would be mitigated in accordance with Attachment A and this BA.

Under the proposed action, before oil and gas activities begin within the ABB's range in the planning area, a presence/absence survey would be conducted or presence would be assumed. When survey results are negative, lessees would report them to the BIA. After the BIA determines that the results of a valid survey have been submitted to the USFWS, lessees would have approval to proceed. For workover operations that would not require a survey, maintaining vegetation below 8 inches on well pads until operations are complete would minimize potential impacts on any ABBs. The vegetation removal process is described in greater detail in **Section 2.3** above.

When ABB surveys are positive, lessees would be required to minimize or mitigate the proposed disturbance, in accordance with the procedures detailed in this BA, including but not limited to Attachment A.

The BIA would report to the USFWS annually the acres of suitable ABB habitat disturbed, under the programmatic incidental take statement.

The USFWS (2015b) has stated that projects outside of the ABB's potential range would have no effect on ABB. This includes all areas with the potential to be both directly and indirectly affected by oil and gas activities.

5.2 WHOOPING CRANE

Implementing the proposed action outside of the 95 percent sighting corridor will have **no effect** on whooping cranes. Implementing the proposed action within the 95 percent sighting corridor **may affect but is not likely to adversely affect** whooping cranes. Implementing the proposed action would have **no effect** on designated critical habitat for whooping cranes. BIA will utilize geographical information provided by the USFWS to confirm the location of the 95 percent sighting corridor.

5.2.1 Rationale

Whooping cranes do not breed or winter in the planning area, and no nesting habitat occurs there. However, important stopover or roosting habitat within the 95 percent sighting corridor occurs in the planning area. Despite the lack of breeding habitat in the planning area, limited numbers of whooping cranes may use wetland and adjacent agricultural habitats in the planning area as short-term stopover sites during migration. Because most of these habitats in the planning area are in areas with high or moderate-to-high potential for oil and gas activities, the potential for impacts of current or future oil and gas activities on whooping cranes may be greater.

To avoid and minimize direct impacts, the BIA would implement USFWS avoidance measures (USFWS 2015d) for whooping cranes within the 95 percent sighting corridor as described in **Section 4.2.2**. If the lessee chooses not to implement USFWS avoidance measures, additional coordination with the USFWS may be required to avoid impacts.

To avoid and minimize direct and indirect impacts, the BIA would also implement BMPs (**Table 2-2**), as follows:

- Following USFWS guidance on avoiding impacts on migratory birds
- Reducing noise and other project impacts
- Implementing appropriate BMPs to protect wetlands, waters, and water quality in the planning area

When oil and gas activities covered under the proposed action occur outside of the 95 percent sighting corridor, no impacts on whooping cranes are anticipated due to the distance from suitable migratory stopover habitat.

There is no designated critical habitat for whooping cranes in the planning area. The nearest designated critical habitat is the Salt Plains NWR, approximately 60 miles west of the planning area.

5.3 Red Knot

Implementing the proposed action outside of the 200-foot buffer around established watering places under 25 CFR, Subpart 226.33 will have **no effect** on red knots. Implementing the proposed action within the 200-foot buffer around established watering places **may affect but is not likely to adversely affect** red knots.

5.3.1 Rationale

Red knots do not breed or winter in the planning area, and no nesting or major migratory stopover habitat occurs there. Despite the lack of breeding and major stopover habitat, limited numbers of red knots may use wetland habitats in the planning area as short-term stopover sites during migration. Because most of these habitats are in areas with high or moderate-to-high potential for oil and gas activities, the potential for impacts of current or future oil and gas activities on red knots may be greater.

When oil and gas development activities under the proposed action occur within the 200-foot buffer under 25 CFR, Subpart 226.33, this could expose individuals in these areas to direct and indirect impacts from activities under the proposed action.

The BIA would implement the following BMPs (**Table 2-2**) to avoid or minimize impacts:

- Following USFWS guidance on avoiding impacts on migratory birds
- Taking measures to reduce noise and other project impacts
- Implementing a suite of BMPs to protect wetlands, waters, and water quality within the planning area

When oil and gas activities covered under the proposed action occur outside of the 200-foot buffer from established watering places, no impacts on red knots are anticipated due to the distance from suitable migratory stopover habitat.

5.4 Interior Least Tern

Implementing the proposed action outside of the USFWS avoidance measure buffers around breeding habitat will have **no effect** on interior least terns. Implementing the proposed action within the USFWS avoidance buffers **may affect but is not likely to adversely affect** interior least terns.

5.4.1 Rationale

Interior least terns are known to breed along sparsely vegetated sand and gravel bars in the Arkansas River in the planning area. To avoid direct impacts, the BIA would implement USFWS avoidance measures (USFWS 2015d) for interior least terns within the buffer areas described in **Section 4.2.4**. If the lessee chooses not to implement the USFWS avoidance measures, additional coordination with the USFWS may be required to avoid impacts.

These areas would also be protected by a 200-foot-wide buffer under 25 CFR, Subpart 226.33. While direct impacts on least tern breeding habitat would not occur, other potential direct and indirect impacts may occur from current and future oil and gas activities in uplands adjacent to least tern breeding habitat (see **Section 4.2.4**).

Potential direct and indirect impacts on interior least terns would further be minimized or avoided by implementing the following BMPs (**Table 2-2**) throughout the planning area:

- Following USFWS guidance on avoiding impacts on migratory birds
- Taking measures to reduce noise and other project impacts
- Implementing a suite of BMPs to protect wetlands, waters, and water quality in the planning area

When oil and gas activities covered under the proposed action occur outside of the USFWS avoidance buffers, no impacts on interior least terns are anticipated due to the distance from suitable breeding and foraging habitat.

5.5 Piping Plover

Implementing the proposed action outside of the 200-foot buffer around established watering places under 25 CFR, Subpart 226.33 will have **no effect** on piping plover. Implementing the proposed action within the 200-foot buffer around established watering places **may affect but is not likely to adversely affect** piping plover. Implementing the proposed action would have **no effect** on their designated critical habitat.

5.5.1 Rationale

Piping plovers are not known to breed in the planning area; however, they generally use the same breeding habitats as interior least terns, which do breed there. As piping plovers have been observed in the planning area, the assumption is that potential breeding habitat exists. These areas would be protected by a 200-foot-wide buffer under 25 CFR, Subpart 226.33. While direct impacts on breeding habitat would not occur, other potential direct and indirect impacts as described in **Section 4.2.5** may occur from current and future oil and gas activities located adjacent to breeding habitat.

Potential direct and indirect impacts on piping plovers would be avoided by implementing the following BMPs (**Table 2-2**):

- Following USFWS guidance on avoiding impacts on migratory birds

- Taking measures to reduce noise and other project impacts
- Implementing a suite of BMPs to protect wetlands, waters, and water quality within the planning area

When oil and gas activities covered under the proposed action occur outside of the 200-foot buffer from established watering places, no effects on piping plovers are anticipated due to the distance from suitable habitat.

There is no designated critical habitat for piping plover in the planning area. The nearest designated critical habitat to the planning area is in the Platte River in central Nebraska, several hundred miles to the north.

5.6 Neosho Mucket Mussel

Implementing the proposed action outside of the 200-foot buffer around established watering places under 25 CFR, Subpart 226.33 will have **no effect** on Neosho mucket mussels. Implementing the proposed action within the 200-foot buffer around established watering places may affect but is not likely to adversely affect Neosho mucket mussels where suitable habitat for these mussels exists. Implementing the proposed action would have **no effect** on designated critical habitat for Neosho mucket mussel.

5.6.1 Rationale

Neosho mucket mussels are known from the Caney River in the planning area. These areas would be protected by a 200-foot-wide buffer under 25 CFR, Subpart 226.33.

Potential impacts on Neosho mucket mussels from oil and gas activities in adjacent areas would be avoided by implementing the 200-foot-wide buffer and by including additional BMPs (**Table 2-2**), including a suite of BMPs to prevent erosion and sedimentation, protect wetlands, waters, and water quality in the planning area.

There is no designated critical habitat for Neosho mucket mussel in the planning area. No critical habitat units are downstream of any streams or rivers in the planning area. The critical habitat nearest to the planning area is in the Fall and Verdigris Rivers, in southeast Kansas, approximately 25 miles to the northeast.

This page intentionally left blank.

SECTION 6
REFERENCES

American Bird Conservancy, Audubon Maryland-DC, Audubon New York, Citizens Campaign for the Environment, Defenders of Wildlife, Delaware Audubon Society, National Audubon Society, New Jersey Audubon Society, and Virginia Audubon Council. 2005. Emergency Petition for a Rule to List the Red Knot (*Calidris canutus rufa*) as Endangered under the Endangered Species Act, 16 USC, 1531 et seq. (1973 as amended) within the United States.

APLIC (Avian Power Line Interaction Committee). 2012. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, DC.

BIA (US Department of the Interior, Bureau of Indian Affairs). 1979. Environmental Assessment for the Oil and Gas Leasing Program of the Osage Indian Tribe, Osage County, Oklahoma. Muskogee Area Office. Muskogee, Oklahoma. May 1979.

______. 2015a. Programmatic Environmental Assessment for Approving Workover Operations. BIA Osage Agency. Pawhuska, Oklahoma.

______. 2015b. Draft Osage County Oil and Gas EIS. BIA Eastern Oklahoma Region, Muskogee, Oklahoma.

BIA NIOGEMS GIS. 2015. GIS data of BIA-administered tribal and allotted lands. Bureau of Indian Affairs, Southern Plains and Eastern Oklahoma Regions.

BLM (US Department of the Interior, Bureau of Land Management) GIS. 2015. Base GIS data on file with the BLM's eGIS Server used for calculations or figures; includes data prepared for the RFD. Bureau of Land Management, Oklahoma Field Office, Tulsa.

Brabander, J. J., R. E. Masters, and R. M. Short. 1985. Bottomland Hardwoods of Eastern Oklahoma—A Special Study of Their Status, Trends, and Values. US Fish and Wildlife Service, Tulsa, Oklahoma, and Oklahoma Department of Wildlife Conservation, Oklahoma City, Oklahoma. December 1985.

CWS and USFWS (Canadian Wildlife Service and US Fish and Wildlife Service). 2007. International Recovery Plan for the Whooping Crane (*Grus americana*), Third Revision. Ottawa: Recovery of Nationally Endangered Wildlife (RENEW), and USFWS, Albuquerque, New Mexico.

Dinan, L. R., J. G. Jorgensen, and M. B. Brown. 2012. "Interior least tern power line collision on the Lower Platte River." *The Prairie Naturalist* 44:109-110.

Duck, L. G., and J. B. Fletcher. 1943. The Game Types of Oklahoma. A Report to the Oklahoma Game and Fish Commission. Adapted by the Oklahoma Biological Survey. Internet website: http://www.biosurvey.ou.edu/duckflt/dfhome.html.

Forest Service (US Department of Agriculture, Forest Service). 2012. Noxious Weed Risk Assessment, Giant Sequoia National Monument Management Plan. Porterville, California. July 2012.

Hoagland, B. W. 2008. "Vegetation of Oklahoma." Poster for the Oklahoma Biological Survey. University of Oklahoma, Norman, Oklahoma.

Karl, T. R., J. M. Melillo, and T. C. Peterson (editors). 2009. *Global Climate Change Impacts in the United States*. US Global Change Research Program, Cambridge University Press, New York, New York.

Longcore, T., and C. Rich. 2004. "Ecological light pollution." *Front Ecol. Environ.* 2:191-198.

Lewis, T. E., and R. D. Slack. 2008. "Whooping cranes and human disturbance: An [sic] historical perspective and literature review." North American Crane Workshop Proceedings. Paper 182.

NatureServe. 2015. Comprehensive Species Report – *Calidris canutus rufa*. Internet website: http://explorer.natureserve.org/index.htm.

NWI (National Wetlands Inventory) GIS. 2015. National Wetlands Inventory. US Department of the Interior, Fish and Wildlife Service, Washington, DC. Internet website: http://www.fws.gov/wetlands/.

Oklahoma Biological Survey GIS. 1943. The Game Types of Oklahoma, map created in 1943 and digitized in 1995. Internet website: http://www.biosurvey.ou.edu/duckflt/dfhome.html.

ODWC (Oklahoma Department of Wildlife Conservation). 2015. An overview of the federally listed and candidate species in Oklahoma – May 2015. Internet website: http://www.wildlifedepartment.com/wildlifemgmt/515listed.pdf.

OK GAP GIS. 2008. USGS Gap Analysis Program (GAP) data symbolized for owner type as a proxy for land status. Internet website: http://gapanalysis.usgs.gov/padus/data/download/.

ONENRD (Osage Nation Environmental and Natural Resources Department). 2006. Osage Nation Integrated Resource Management Plan. Pawhuska, Oklahoma.

Sheley, R., M. Manoukian, and G. Marks. 1996. "Preventing noxious weed invasion." Rangelands 18(3).

Shiver, M. A. 2002. "Reproduction and propagation of the Neosho mucket, *Lampsilis rafinesqueana*." Dissertation, Southwest Missouri State University, Springfield, Missouri.

Smith, M. D., and A. K. Knapp. 2001. "Physiological and morphological traits of exotic, invasive exotic, and native plant species in tallgrass prairie." *Int. J. Plant Sci.* 162(4):785-792.

USFWS (US Fish and Wildlife Service). 1978. Determination of Critical Habitat for the Whooping Crane. 43 FR 20938-20942.

______. 1988. Great Lakes & Northern Great Plains Piping Plover (*Charadrius melodus*) Recovery Plan. Great Lakes/Northern Great Plains Piping Plover Recovery Team.

______. 1990. Recovery Plan for the Interior Population of the Least Tern (*Sterna antillarum*). USFWS, Twin Cities, Minnesota. September 1990.

______. 1991. American Burying Beetle (*Nicrophorus americanus*) Recovery Plan. Newton Corner, Massachusetts.

______. 1998. Final ESA Section 7 Consultation Handbook. USFWS and National Marine Fisheries Service.

______. 2002. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Northern Great Plains Breeding Population of the Piping Plover. 67 FR 57638.

______. 2008. American Burying Beetle (*Nicrophorus americanus*) 5-Year Review: Summary and Evaluation. USFWS New England Field Office, Concord, New Hampshire. March 2008.

______. 2009. Piping Plover (*Charadrius melodus*) 5-Year Review: Summary and Evaluation. USFWS Northeast Region, Hadley, Massachusetts, and the Midwest Region's East Lansing Field Office, Michigan. September 2009.

______. 2012a. Whooping Crane *(Grus americana)* 5-Year Review: Summary and Evaluation. USFWS, Aransas NWR, Austwell, Texas, and Corpus Christi Ecological Services Field Office, Texas.

______. 2012b. Proposed Endangered Status for the Neosho Mucket, Threatened Status for the Rabbitsfoot and Designation of Critical Habitat for Both Species; Proposed Rule. 77 FR 63440.

______. 2013. Interior Least Tern (*Sternula antillarum*) 5-Year Review: Summary and Evaluation. USFWS Southeast Region, Mississippi Field Office, Jackson.

______. 2014a. Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects. Oklahoma Ecological Services Field Office, Tulsa. April 2014.

______. 2014b. American Burying Beetle *Nicrophorus americanus* Oklahoma Presence/Absence Live-trapping Survey Guidance. Oklahoma Ecological Services Field Office, Tulsa. May 2014.

______. 2014c. Final Oil and Gas Industry Conservation Plan Associated with Issuance of ESA Section 10(a)(1)(B) Permits for the American Burying Beetle in Oklahoma. USFWS Oklahoma Ecological Services Field Office. Tulsa.

______. 2014d. Draft Environmental Assessment for the Oil and Gas Industry Conservation Plan for the American Burying Beetle in Oklahoma. USFWS, Tulsa, Oklahoma. April 2014.

______. 2015a. Information for Planning and Conservation (IPaC) Trust Resource Report for Osage County, Oklahoma. Generated October 24, 2015.

______. 2015b. American Burying Beetle Impact Assessment for Project Reviews. USFWS Southwest Region, Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. March 2015.

______. 2015c. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Neosho Mucket and Rabbitsfoot; Final Rule. 80 FR 24692-24774.

______. 2015d. US Fish and Wildlife Service Species Take Avoidance Measures for Non-Covered Species Related to Selected Oil and Gas Projects within the American Burying Beetle Range in Oklahoma. USFWS, Tulsa, Oklahoma. April 2015.

______. 2016a. News Release: US Fish and Wildlife Service Evaluating Status of the American Burying Beetle. USFWS Public Affairs Office, Albuquerque, New Mexico.

______. 2016b. American Burying Beetle: Additional Information. USFWS Oklahoma Ecological Services Field Office, Tulsa, Oklahoma. Internet website: http://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm.

USFWS GIS. 2016. Published GIS data of American Burying Beetle habitat. Internet website: http://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm.

SECTION 7
LIST OF PREPARERS

7.1 BUREAU OF INDIAN AFFAIRS, EASTERN OKLAHOMA REGION

Benjamin Daniels
Environmental Protection Specialist, Osage Agency

Jeannine Hale
Director, Division of Environmental & Cultural Resource Management

Sierra Mandelko
Archaeologist

Michael Miley
Environmental Protection Specialist, Eastern Oklahoma Region

7.2 CONTRACTOR, ENVIRONMENTAL MANAGEMENT AND PLANNING SOLUTIONS, INC.

Katie Patterson
JD, Environmental Law
BA, Environmental Policy
(Project Manager)

Meredith Zaccherio
MA, Biology
BS, Biology
(Quality Assurance/Quality Control)

Morgan Trieger
BS, Conservation and Resource Studies
(BA Author)

This page intentionally left blank.

ATTACHMENT A
AMERICAN BURYING BEETLE MINIMIZATION AND MITIGATION MEASURES

The following minimization and mitigation measures will be required by BIA in the event of a positive ABB survey:

MINIMIZATION MEASURES

1. Reduce motor vehicle, machinery, or heavy equipment use. Motor vehicles, machinery, and heavy equipment can generate take of American burying beetles (ABBs) by crushing and collisions when individuals of the species are above-ground or by soil compaction when the species is underground. Reducing the number and use of motor vehicles and heavy equipment in occupied ABB habitat can minimize impacts from these activities. Lessees will minimize the number and use of motor vehicles and heavy equipment necessary in occupied ABB habitat to meet the objectives of the activity. If heavy equipment, machinery, or motor vehicle use is required in occupied ABB habitat for an activity, these vehicles will be allowed only in the areas that are necessary. All motor vehicles, machinery, and heavy equipment shall be parked within areas already impacted, areas where disturbance is planned to occur, or areas where occupied ABB habitat impacts and mitigation, as appropriate, have been assessed.
2. Reduce risk of motor vehicles sparking wildfire. Vehicle use or improper maintenance of vehicles and machinery could ignite fires during dry conditions or in areas with dry vegetation, which may cause take of ABBs. Motor vehicles, machinery, and heavy equipment should not be parked where dry grass or vegetation could be ignited. All vehicles will be maintained per the respective service manuals. In dry conditions, grass and debris will be cleaned away from machinery exhaust systems and bearings on a weekly

basis. All bearings will be lubricated and all spark arrestors will be serviced as necessary to reduce risk of sparking a fire. Fire mitigation equipment necessary at each project includes: a shovel, water, and working fire extinguisher in case of accidental ignition of a wildfire.

3. Increase safety during operation fluid use and storage. Operations fluids (fuel, oil, or other fluids for maintenance of equipment) may cause take of ABBs. Lessees must follow all applicable state and federal laws regarding fuel use and storage. Additionally, all operational fluids (fuel and motor vehicle oil) will be stored and all equipment must be fueled within areas already impacted, areas where disturbance is planned to occur, or areas where occupied ABB habitat impacts and mitigation, as appropriate, have been assessed.

4. Reduce erosion and increase soil stability. Land erosion can directly impact ABB habitat and cause take of ABBs. To prevent topsoil loss, gully formation, or other negative impacts to ABB habitat, lessees will implement erosion control techniques in accordance with prudent industry standards for sediment and erosion control. Examples of prudent industry standards are described in the Independent Petroleum Association of America's Reasonable and Prudent Practices for Stabilization of Oil and Natural Gas Exploration and Production Sites found at: http://www.ipaa.org/governmentrelations/reasonable-and-prudent-practices-for-stabilizationrapps-for-oil-and-natural-gas-exploration-and-production-sites/. Lessees must comply with all state and federal laws regarding erosion control and soil stabilization.

5. Provide educational program for construction personnel. Human presence and movement within ABB habitat may cause take of ABBs. All workers operating in the project area will be trained about ABB habitat, biology, reasons for ABB decline, and the responsibility of all workers to protect the ABB. Standardized ABB educational information is provided on the USFWS website: www.fws.gov/southwest/es/oklahoma/ABBICP. Lessees will provide each worker with a full color Endangered Species Card with a picture of the ABB and a summary of information about the ABB before conducting soil disturbing activities. Lessees will post signs at all access points to the project area highlighting the areas as occupied ABB habitat and reminding workers to follow special restrictions in the area. All workers are required to report any ABB sightings to the project manager or environmental inspector, remove all food wastes from the work area each day, and prohibit dogs or cats on the work area (workers may not bring animals or pets to the job site). Additionally, all workers must park their vehicles within already impacted areas, areas where disturbance is

planned to occur, or areas where impacts and mitigation, as appropriate, have been assessed.

6. Limit use of artificial lighting. Artificial lighting (i.e., from construction or operations at night) can cause take of ABBs by interfering with normal behavior patterns. Therefore, activities occurring during the ABB active season within occupied ABB habitat will be limited to daylight hours, other than situations described below.

   Necessary lighting associated with operations or in limited instances where it is necessary to extend construction activities beyond daylight hours (e.g. to maintain the integrity of a bore hole during horizontal directional drill activities when installing a pipeline) must be down-shielded to minimize the effect on ABBs. Additionally, sodium vapor lights are required, rather than ultraviolet or mercury vapor lights near occupied ABB habitat, because they have been shown to be the least attractive to ABBs (Anshutz et al. 2007).

   Drilling rigs used during production, communication towers, or emergency response situations that require lighting are not required to use sodium vapor lighting or down shield lighting.

7. Limit use of gas flares. Light sources can cause take of ABBs by interfering with the species' normal behavior patterns and increasing energetic demands. Current technology allows for enclosure of the flame for some types of flares, thus minimizing or eliminating emitted light. Projects requiring small, constantly burning flares throughout the life of the project will cover the flame to eliminate the visibility of all natural gas flares to minimize artificial light sources that are attractive to ABBs.

8. Limit disturbance from mechanical vegetation maintenance. Vegetation maintenance following construction in areas already restored to ABB habitat (areas with temporary and permanent cover change impacts) may disturb individuals of the species and alter their normal behavior. Vegetation maintenance frequency and duration should be restricted to that necessary to allow for visual surveys and prevent hazards (e.g., fire). Vegetation must be maintained at a height of 8 inches or more to maintain soil moisture. Vegetation maintenance activities will be completed during the ABB inactive season (approximately late September – early May) because these activities may cause take of ABBs during the active season. Given the implementation of this minimization measure, USFWS believes that no additional mitigation is necessary for post-construction, intermittent non-soil disturbing operations and maintenance (e.g., mowing using tractor equipment or vehicle traffic along ROW) within ABB habitat.

9. Limit herbicide use. Removal of vegetation within ABB habitat may cause take of ABBs. Herbicides necessary for vegetation maintenance or removal in areas already restored to ABB habitat (areas with temporary and permanent cover change impacts) must be applied by licensed applicators in accordance with label directions. Herbicides must be applied using methods that minimize spray drift. If broadcast application of herbicides is necessary for effective ROW vegetation control (e.g., in areas with dense stands of target woody plants and/or invasive forbs or grasses), application equipment must be equipped with spray nozzles designed to produce an herbicide spray pattern of uniform water droplet size and apply herbicides at a calibrated rate and at a set pattern on the ROW, thus ensuring precise application. Aerial broadcast application of herbicides cannot be used. Following complete restoration of ABB habitat, herbicides used for vegetation maintenance following construction may only be applied if vegetation can be maintained at a height of 8 inches or more (to maintain soil moisture). Large equipment and vehicles necessary for application of herbicides may only be used once in a given area during the ABB active season. Any additional use of herbicide during the ABB active season must be done by hand application instead of large equipment and vehicles.

10. Set aside topsoil for replacement following construction. Projects with temporary or permanent cover change impacts that require removal of top soil within occupied ABB habitat will set aside the top soil during construction activities for restoration following construction.

MITIGATION MEASURES

Post-construction Restoration

1. Replace topsoil. During restoration of project areas within occupied ABB habitat that required top soil removal during project activities (as described under *Minimization Measures*), top soil will be replaced at the original location.

2. Relieve soil compaction. Immediately following Covered Activities that removed vegetation and compacted soil by heavy equipment or other means, and prior to vegetation re-establishment, the impacted area will be ripped to a depth of 24 inches (or to rock, if present, whichever is less), to relieve soil compaction at depths used by ABBs. This effort will improve or enhance ABB habitat by making soils easier for ABBs to bury carrion or themselves. This measure is not required for small project areas (such as maintenance work on a pipeline) where the use of tractors and ripping equipment would result in increasing the impact area.

3. Re-establish vegetation. Following vegetation removal within a project area containing occupied ABB habitat prior to impacts, vegetation will be re-established with a native species composition like the surrounding area or, if requested by the landowner, the same vegetation type that existed prior to impacts. Preference should be given to the establishment of native vegetation if the landowner does not have specific requests and restoration of native vegetation is feasible. If construction/soil disturbance ends during the dormant vegetation season, bare soil will be temporarily stabilized if necessary to prevent erosion. At the beginning of the next growing season (preferably prior to the start of the ABB active season in mid-late May), these areas will be re-established with vegetation. Seeds used during vegetation reestablishment must be free of invasive species seeds. Invasive species to be avoided are listed at http://ok-invasive-plant-council.org/images/OKinvasivespp.pdf. For an impact to be considered temporary, vegetation must be re-established to the original density (based on visual comparison of before/after photographs of the project area and comparison to adjacent undisturbed areas) within 5 years of the initial impact. Vegetation reestablished for permanent cover change impacts should be restored to the density of the grasslands or pastures nearest to the project area, preferably restored with native species.

4. Inspection of invasive plant species. Because vegetation composition may change the carrion base (small mammal and bird composition) of an area, lessees will monitor project sites with temporary or permanent cover change impacts following post-construction restoration and document any invasive species (as listed at http://ok-invasive-plant-council.org/images/OKinvasivespp.pdf) in their annual reports during the 5-year restoration period.

Offsite Habitat Mitigation through Mitigation Lands

This section describes how impacts to occupied ABB habitat will be offset through conservation and management of ABB habitat in perpetuity.

All mitigation proposals must, to the maximum extent practicable, meet the minimum standards and other requirements described in *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP.

1. Individual- or Lessee-responsible for mitigation lands. These consist of mitigation lands established by the lessee. Such mitigation tracts must be described in detail and included in the project description. Such lands must, to the maximum extent practicable, meet the minimum standards and other requirements described in USFWS guidelines, *American Burying Beetle Conservation Strategy for the*

Establishment, Management, and Operations of Mitigation Lands found at http://www.fws.gov/southwest/es/oklahoma/ABBICP. Also described in USFWS guidelines, conservation easements and agreements must be approved by the USFWS prior to any habitat impacts that could result in take of ABBs. The lessee or their designee is responsible for ensuring the success of and managing the mitigation land in perpetuity, even if the project is finite in duration.

2. Conservation Banks. Conservation banks are mitigation lands that are established by a Bank Sponsor. These sites are usually established to mitigate for the effects of multiple projects. A USFWS-approved conservation bank meets the minimum standards and other requirements described in USFWS guidelines (*American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands and Guidance for the Establishment, Use, and Operation of Conservation Banks*, found at http://www.fws.gov/southwest/es/oklahoma/ABBICP). Conservation banks are established through a conservation bank agreement with the USFWS and conservation easements for the bank must be approved by the USFWS. When a lessee chooses to mitigate through the purchase of credits in an approved conservation bank, the bank sponsor is responsible for ensuring the success of and managing the mitigation land in perpetuity upon sale of the credits. If a lessee chooses this option, lessee must purchase appropriate credits prior to any habitat impacts that could result in take of the ABB. Lessees can visit http://geo.usace.army.mil/ribits/index.html, the Regulatory In-lieu Fee and Bank Information and Tracking System (RIBITS) for information on USFWS-approved conservation banks with available ABB credits.

3. Third party mitigation lands. These mitigation lands are usually established for a single project or project proponent rather than multiple projects or proponents as are conservation banks. Such lands and agreements must, to the maximum extent practicable, meet the minimum standards and other requirements described in USFWS guidelines, *American Burying Beetle Conservation Strategy for the Establishment, Management, and Operations of Mitigation Lands* found at http://www.fws.gov/southwest/es/oklahoma/ABBICP. Conservation easements and agreements must be approved by the USFWS prior to any habitat impacts that could result in take of ABB. The mitigation land sponsor (landowner or easement holder) is responsible for and assumes liability for the success of and management of the approved mitigation land in perpetuity.

ATTACHMENT B
STANDARD BMPS FOR WORKOVERS AND DRILLING PERMITS

DRILLING PERMIT BMPS – BIA OSAGE AGENCY

Applicant will comply with the requirements of 25 CFR 226, including but not limited to:

- §226.22 – Prohibition of Pollution
- §226.33 – Line Drilling – Prohibiting location of any well or tank battery within 200 feet of a public highway, established watering place, or building used as a dwelling, granary, or barn unless prior written permission is granted by the Superintendent.
- §226.19 – Use of Surface Lands – Lessee must conduct operations in a workman like manner, commit no waste and allow none to be committed upon the land, nor permit any unavoidable nuisance to be maintained on the premises under his/her control.

Standard BMPs

Applicants, their agents, operators, and contractors will follow the BMPs listed below.

1. Avoid impacts on National Register-eligible or unevaluated cultural resources on well sites and access roads. If cultural resources are discovered during construction or operation, stop work immediately, secure the affected site, and notify the BIA and Tribal Historic Preservation Officer. In the event of a discovery, work in that area shall halt and not resume until written authorization to proceed has been received from the BIA. All surface disturbances must be kept within the proposed ground disturbance area described in the EA. Expansion or relocation of the well pads, access roads, or other implementation of additional activities not

included in the approved EA is prohibited unless an appropriate cultural resources survey has been submitted and determined adequate, approve by the BIA Osage Agency and all appropriate permits have been obtained.

2. Avoid or minimize soil and vegetation disturbance. Avoid removal of or damage to trees, shrubs, and groundcover the extent possible. Avoid or minimize alteration of the natural topography, and limit activities on steep slopes.
3. Erosion control measures are required for the duration of the construction, drilling and completion phases of the project. Erosion control measures must minimize the impact of soil, debris, or contaminants moving from the well site to adjacent lands and waterways.
4. All vehicles and equipment must utilize and stay confined to existing and new roads described in the approved EA. These roads must be maintained and upgraded as needed according to the BIA's direction and agreements between the operator and surface owners.
5. Tank batteries must have a Spill Prevention and Control and Countermeasure Plan (SPCC) in compliance with EPA Regulations under 40 CFR Part 112. A fluid impermeable secondary containment dike/berm must be constructed around any tank battery and facilities according to 40 CFR 112.7. The dike/berm and entire containment area must be graveled. No water collected within the secondary containment shall be discharged. In accordance with the SPCC plan and the BIA regulations, the lessee will immediately notify the BIA of all spill incidents.
6. No venting or flaring of gas is allowed unless prior written approval of the BIA Osage Agency Superintendent has been obtained.
7. Store and label chemicals properly (including secondary containment). Do not store equipment or chemicals onsite if they are not being used on site. Do not leave open containers of chemicals or wastes on site.
8. Keep sites clean and free of any litter, trash, old equipment, contaminated soil or unused containers. Promptly dispose of any wastes at appropriate recycling facility, approved landfill or other approved location based on type of waste. Remove any unused equipment not necessary to the operation of the lease after drilling activities have been completed.
9. If the well is successful, all production equipment, facilities and tanks including well-head and above-ground piping/equipment shall be properly enclosed to exclude livestock if present.

10. All pits (including tank batteries contained within a dike/berm) must be enclosed with a fence of at least four strands of barbed wire, or approved substitute. Unlined earthen pits shall not be used for the continued storage of saltwater or other deleterious substances. Temporary pits must be filled and leveled upon completion of the activity.

11. To the extent possible, minimize disturbance to land owners, wildlife, and natural resources due to noise, excessive traffic, dust or other impacts associated with operations.

12. Do not conduct activities within stream channels or wetlands without proper authorization, and avoid any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally-approved water quality standards.

13. Return area to original contour or as directed by the surface owner. If needed, add clean soil to disturbed areas. Restore disturbed areas by re-establishing vegetation using seed, sod or other approved method. Restore with native species unless otherwise directed by the surface owner in writing and approved by the BIA. No noxious or invasive species may be used in revegetation and reclamation activities.

14. If well drilling, completion and development are successful; all areas of the surface disturbance (i.e. well pad, access road, pipeline, etc.) that are not needed or used in the production or operation of the well shall be promptly reclaimed as described in the approved EA. If well drilling, completion and development are not successful, reclamation of the entire area will begin promptly. After a completed well is no longer in production, reclamation of the site will begin promptly. Reclamation shall be completed not later than ninety (90) days from rig removal, well abandonment or final plugging of a well, unless otherwise approved by the BIA.

15. The applicant shall conduct activities in a manner that avoids any potential incidental take or harm to federally-listed threatened and endangered species, or in a manner that complies with any permit or authorization issued by the USFWS. Applicant will follow guidance in the USFWS's "Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects" (April 2014).

16. Applicant will follow the USFWS's established protocol regarding areas where the ABB is known or suspected to exist. (See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm.)

    If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that suitable habitat for the ABB does not exist. If proposed operations will impact suitable habitat for the ABB, it will be the responsibility of the lessee to obtain authorization from the USFWS to proceed with that portion of the project.

Air Quality BMPs

For proposed drilling operations in areas where formations will be penetrated which have zones suspected of containing H2S of 100 ppm in the gas stream, the Applicant will implement the following Air Quality BMPs in an effort to mitigate exposure to personnel and contractors, and to protect the public:

1. Conduct the appropriate H2S training and install H2S related safety equipment which is operational when drilling commences.
2. If H2S was not suspected, but is encountered in excess of 100 ppm in the gas stream, the following measures shall be taken:
   a. Operator shall immediately ensure control of the well, suspend drilling operations, and obtain materials and safety equipment in order to protect all personnel or individuals in risk of exposure.
   b. Operator shall notify the appropriate company personnel of the event and mitigating steps that have or are being taken as soon as possible.
3. The operator will ensure that all personnel who will be working at the well site once drilling operations resume, will be properly trained in H2S drilling procedures and use of applicable safety equipment including:
   a. Respiratory protection.
   b. H2S detection and monitoring equipment.
   c. Visible warning system:
      i. Wind direction indicators
      ii. Post appropriate warning signs.

In the event that the company anticipates the continued risk of exposure to H2S emissions during ongoing production operations, BMPs will be implemented that follow the guidelines listed in BLM Onshore Order 6.

Bureau of Indian Affairs, Osage Agency Conditions for Workover Operations

The following forms must be kept at the project site at all times during the workover operation(s): (1) the Osage Agency Form No. 139, (2) Attachment A for Osage Form No. 139 which identifies all of the COAs of workover operations in Osage County (listed below), and (3) the Workover Review form which will be provided to the Lessee/Operator upon confirmation of approval by the Agency.

General Requirements

All lessees must comply with the requirements of 25 CFR 226, including but not limited to:

- § 226.22 Prohibition of Pollution.
- § 226.19 Use of Surface Lands – Lessee must conduct operations in a workmanlike manner, commit no waste and not create any unavoidable nuisance on the premises under his/her control.

Workover operations must be contained to the historic well pad in order to minimize impacts on the affected environment. This must be documented through the submission to the Osage Agency of photographs taken before the proposed activities commence and after activities have ceased.

For each workover operation a minimum of seven (7) dated photographs must be submitted as supporting documentation with the Form 139 in order to depict the existing condition of the well pad and existing facilities as described below.

- 1 photo of the well sign
- 1 photo of the well head (well bore/pumping unit location
- 1 photo of the lease road, showing ingress and egress to the proposed workover location
- 4 photos taken in the following manner: stand at the center of the well pad and take 1 photo facing each direction (North, East, South and West)

All lessees must comply with, and obtain any necessary permits or authorizations required under the federal Clean Water Act, Clean Air Act, Safe Drinking Water Act, Endangered Species Act and other applicable federal laws.

In addition, the standard BIA Osage Agency Best Management Practices, listed below, will apply, unless the Superintendent has given prior written approval of either an exemption to a specific standard BIA Osage Agency BMP or an equivalent set of BMPs developed by the lessee.

Standard BMPs

1. Avoid impacts on National Register-eligible or unevaluated cultural resources on well sites and access roads. If cultural resources are discovered during construction or operation, stop work immediately, secure the affected site, and notify the BIA and Tribal Historic Preservation Officer. In the event of a discovery, work in

that area shall halt and not resume until written authorization to proceed has been received from the BIA. All surface disturbances must be kept within the confines of the historic well pad described in the application package. Expansion or relocation of the well pads, access roads, or other implementation of additional activities outside of the area specified in the application is prohibited unless an appropriate cultural resources survey has been submitted and determined adequate, approved by the BIA Osage Agency and all appropriate authorizations have been obtained.

2. Avoid or minimize soil and vegetation disturbance. Avoid removal of or damage to trees, shrubs, and groundcover to the extent possible. Avoid or minimize alteration of the natural topography, and limit activities on steep slopes.
3. Erosion control measures are required for the duration of all implementation phases of the proposed project. Erosion control measures must minimize the impact of soil, debris, or contaminants moving from the project site to adjacent lands and waterways.
4. All vehicles and equipment must utilize and stay confined to existing roads described in the approved EA. These roads must be maintained and upgraded as needed according to BIA direction and agreements between the operator and surface owners.
5. Tank batteries must have a Spill Prevention and Control and Countermeasure Plan (SPCC) in compliance with EPA Regulations under 40 CFR Part 112. A fluid impermeable secondary containment dike/berm must be constructed around any tank battery and facilities according to 40 CFR 112.7. The dike/berm and entire containment area must be graveled. No water collected within the secondary containment shall be discharged. In accordance with the SPCC plan and the BIA regulations, the lessee will immediately notify the BIA of all spill incidents.
6. No venting or flaring of gas is allowed unless prior written approval of the BIA Osage Agency Superintendent has been obtained.
7. Store and label chemicals properly (including secondary containment). Do not store equipment or chemicals onsite if they are not being used on site. Do not leave open containers of chemicals or wastes on site.
8. Keep sites clean and free of any litter, trash, old equipment, contaminated soil or unused containers. Promptly dispose of any wastes at appropriate recycling facility, approved landfill or other approved location. Remove any unused equipment not necessary to the operation of the lease after drilling activities have been completed.

9. All production equipment, facilities and tanks including well-head and above-ground piping/equipment shall be properly enclosed to exclude livestock if present.

10. All pits (including tank batteries contained within a dike/berm) must be enclosed with a fence of at least four strands of barbed wire, or approved substitute. All earthen pits to be used for storage of salt water or other deleterious substances must be lined with an impermeable layer to prevent contamination of soils and groundwater. Temporary pits must be filled and leveled immediately upon completion of the activity.

11. To the extent possible, minimize disturbance to land owners, wildlife, and natural resources due to noise, excessive traffic, dust or other impacts associated with operations.

12. Do not conduct activities within stream channels or wetlands without proper authorization, and avoid any discharge of soil or contaminants or removal of stream water that could result in a violation of applicable federally-approved water quality standards.

13. Restore disturbed areas by re-establishing vegetation using seed, sod or other approved method, and add clean soil to disturbed areas if necessary. Restore with native species unless otherwise directed by the surface owner in writing and approved by the BIA. No noxious or invasive species may be used in revegetation and reclamation activities.

14. Upon conclusion of workover operations all areas of the surface disturbance (i.e. well pad, access road, pipeline, etc.) shall be promptly reclaimed as described in the permit and approved Programmatic EA for workover operations. After a well is no longer in production, reclamation of the site will begin promptly. Reclamation shall be completed not later than ninety (90) days from rig removal, well abandonment, conclusion of workover operations or final plugging of a well, unless otherwise approved by the BIA.

15. The lessee shall conduct activities in a manner that avoids any potential incidental take or harm to federally-listed threatened and endangered species, or in a manner that complies with any permit or authorization issued by the US Fish and Wildlife Service (USFWS).

    Lessee must follow guidance in the USFWS "Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects (April 2014), found at the following website: http://www.fws.gov/southwest/es/oklahoma/documents/abb/abb_icp/migbird%20and%20eagle%20avoidance%20measures%20april2014.pdf

16. Lessee must follow the USFWS's established protocol regarding areas where the American burying beetle (ABB) is known or suspected to exist. (See http://www.fws.gov/southwest/es/oklahoma/ABBICP.htm.)

    If proposed operations require the construction of a drilling pit or other excavation activity by heavy equipment, then the lessee must ensure that suitable habitat for the ABB does not exist.

    If proposed operations will impact suitable habitat for the ABB, it will be the responsibility of the lessee to obtain authorization from the USFWS to proceed with that portion of the project.

17. Approval must be obtained from the Environmental Protection Agency prior to the commencement of workover operations related to underground injection, construction or conversion of saltwater injection/disposal wells.

Site-Specific BMPs and Special Instructions

1. Review of the proposed project location determined that suitable habitat for the endangered American Burying Beetle is present. Therefore, no ground disturbing activities may occur during implementation of the proposed workover operation. If a pit is needed to conduct the operation, then the lessee is advised to utilize a temporary above-ground storage tank, or other mitigating efforts approved by the Superintendent, and may not conduct any soil excavation in association with the workover. The temporary tank must be removed from the location after the operation is completed.

Appendix C
Acronyms and Abbreviations

Appendix C.
Acronyms and Abbreviations

ACRONYMS AND ABBREVIATIONS	Full Phrase
1906 Act	Osage Allotment Act of 1906
AADT	annual average daily traffic
ABB	American Burying Beetle
ACS	American Community Survey
AD	Anno Domini
APD	application for permit to drill
AQRV	air quality related values
ARPA	Archaeological Resources Protection Act of 1979
BA	biological assessment
BC	Before Christ
BIA	United States Department of the Interior, Bureau of Indian Affairs
BLM	United States Department of the Interior, Bureau of Land Management
BMP	best management practice
BO	biological opinion
CAA	Clean Air Act of 1963
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CO_2e	carbon dioxide equivalent
COA	condition of approval
CPTS	Cimarron Public Transit System
CWA	Clean Water Act of 1972
dB	decibel
dBA	A-weighted decibel scale
DIR	dividends, interest, and rent
DOI	United States Department of the Interior

EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	executive order
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
FMP	fire management plan
FONSI	Finding of No Significant Impact
GHG	greenhouse gas
GIS	geographic information system
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
INCOG	Indian Nations Council of Governments
IPCC	International Panel on Climate Change
IRMP	Integrated Resource Management Plan
Leasing PEA	Programmatic Environmental Assessment for Leasing Activities
Ma	millions of years ago
MBTA	Migratory Bird Treaty Act of 1918
mg/L	milligrams per liter
MMT	million metric tons
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NOI	Notice of Intent
NPMS	National Pipeline Mapping System
NRCS	United States Department of Agriculture Natural Resource Conservation Service
NTL	notice to lessees
OAS	Oklahoma Archeological Survey
OCC	Oklahoma Corporation Commission
ODM	Oklahoma Department of Mines
ODOT	Oklahoma Department of Transportation
ODWC	Oklahoma Department of Wildlife Conservation
OGS	Oklahoma Geological Survey
OkIPC	Oklahoma Invasive Plant Council
OKT	Oklahoma, Kansas, and Texas
Osage Mineral Estate	subsurface mineral estate in Osage County, Oklahoma
PEA	Programmatic Environmental Assessment
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
ppb	parts per billion

ppm	parts per million
PSD	prevention of significant deterioration
RCRA	Resource Conservation and Recovery Act of 1976
RFD	reasonably foreseeable development scenario
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
SHPO	State Historic Preservation Office(r)
SPCC	spill prevention, control, and countermeasure
THPO	Osage Nation Tribal Historic Preservation Office(r)
TNC	The Nature Conservancy
Tribe(s)	Federally-recognized Tribe(s)
TTP	Tribal Transportation Program
US	United States
USC	United States Code
USFWS	United States Department of the Interior, Fish and Wildlife Service
USFWS Impact Avoidance	United States Department of the Interior, Fish and Wildlife Service, Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects
VOC	volatile organic compound
VRI	visual resource inventory
WMA	wildlife management area
Workover PEA	Programmatic Environmental Assessment for Approving Workover Operations
WRI	World Resources Institute

This page intentionally left blank.

Appendix D

Table 2-4: Summary Comparison of Environmental Consequences of the Alternatives

Appendix D.
Table 2-4: Summary Comparison of Environmental Consequences of the Alternatives

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Topography, geology, paleontology, and soils	COAs would continue to limit surface disturbance by enforcing the confinement of work vehicles to existing roads. Limiting vehicle disturbance of areas beyond existing roads would continue to reduce the footprint of impacts on soils, which may result in lower compaction or erosion rates during exploration and production. Erosion-control measures would effectively minimize soil movement during workovers and result in less soil loss from these activities. Impacts on geology, paleontology and topography due to the installation of well pads, tank batteries, and other oil and	Applying an additional COA prohibiting land application of waste oil, wastewater, contaminated soil, and other contaminated substances would reduce the risk of soil contamination and salt scarring, compared with Alternative 1 (No Action). Removing requirements that lessees implement erosion-control measures and promptly reclaim areas of the site not needed for production after drilling would increase the possibility of erosion and soils damage. Not requiring that waste and old equipment be removed from sites would increase the risk of soil contamination and salt	In addition to COAs applied under Alternative 1 (No Action), this alternative would provide some additional protection of soil resources in low-density sections, compared with Alternative 1 (No Action). Requirements in low-density sections would include testing for hydrogen sulfide, mitigating, locating wells and pits away from streams and outside of areas prone to flooding, and salvaging topsoil for use in reclamation. This would protect soils from contamination, erosion, and loss of productivity in low-density sections. Under this alternative, COAs requiring returning land to its original contour	In addition to COAs applied under Alternative 1 (No Action), this alternative would provide some additional protection of soil resources in all areas. Requirements would include locating wells and pits away from streams and outside of areas prone to flooding and salvaging topsoil for use in reclamation. This would protect soils from contamination, erosion, and loss of productivity. Under this alternative, impacts on geology, paleontology and topography from installing well pads, tank batteries, and other oil and gas infrastructure would be reduced, compared with Alternatives 2 and 3 high-density due to COAs limiting surface disturbance.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Topography, geology, paleontology, and soils *(continued)*	gas infrastructure would continue. COAs requiring returning land to its original contour would minimize long-term impacts on topography.	scarring, compared with Alternative 1 (No Action). Waiving COAs that limit surface disturbance would also increase soil compaction and erosion, compared with all other alternatives. Overall, this alternative would result in the highest risk of impacts on soils out of all the alternatives. These impacts would be from erosion, soil compaction, and brine contamination and salt scarring. Under this alternative, impacts on geology, paleontology and topography from installing well pads, tank batteries, and other oil and gas infrastructure could increase, compared with other alternatives, by removing COAs to avoid or minimize altering topography, by returning land to its original contour, and by reclaiming unneeded	would minimize long-term impacts on topography in low-density sections. This would reduce impacts, compared with Alternative 2. In these areas, impacts would be the same as under Alternative 1 (No Action). Impacts on topography, geology, paleontology and soils in high-density sections would be the similar to those under Alternative 2. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. Topography, geology, paleontology, and soil resources would be protected in these areas.	Impacts would be the same as under Alternative 1 (No Action). COAs requiring that land be returned to its original contour would minimize long-term impacts on topography. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. Topography, geology, paleontology, and soil resources would be protected in these areas.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Topography, geology, paleontology, and soils *(continued)*	*(see above)*	areas following drilling or workover. Of all the alternatives, this one would result in the highest levels of impacts on topography, paleontology and geology.	*(see above)*	*(see above)*
Water resources	Applying the COAs under Alternative 1 (No Action) would continue to limit impacts from oil and gas activities on groundwater and surface water. COAs would protect water resources by preventing oil and gas activities within stream channels or wetlands without proper authorization and avoiding any discharge of soil or contaminants.	Alternative 2 requires the fewest COAs and would generally provide the least protection for surface water and groundwater. Less stringent requirements on leases may permanently adversely affect water resources by increasing the risk of erosion runoff and contamination; therefore, this alternative would have the greatest impacts on water resources.	Applying COAs based on the density of well development would result in location-specific water resource impacts; this is because fewer COAs would be applied in high-density sections and more COAs would be applied in low-density sections, compared with Alternative 1 (No Action). More COAs in low-density sections that limit surface disturbance, avoid stream crossings, and provide buffer zones from streams and waterways would protect surface water and groundwater, compared with Alternative 1 (No Action). In high-density sections, COAs would be applied in	More stringent COAs would protect water resources, compared with Alternative 1 (No Action). Additional COAs, such as buffer zones and restrictions on surface waste pits near water supply wells, applied to all oil and gas activities would make this alternative the most protective of water resources and would limit the location and type of new oil and gas development. This would in turn protect surface water and groundwater from contamination. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. Water resources would have a reduced risk of

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Water resources *(continued)*	*(see above)*	*(see above)*	the same way as under Alternative 2. This reduction in protective measures could have short-term and long-term impacts on both surface water and groundwater resources by increasing the risk of erosion runoff and contamination. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. Water resources would have a reduced risk of contamination in these areas.	contamination in these areas.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Air quality and climate	Oil and gas leasing would have no direct impact on air quality but would have indirect impacts from subsequent oil and gas development, such as emissions from equipment used in workovers, drilling, and production operations. Under Alternative 1 (No Action), certain COAs would continue to limit impacts of dust from workover activities on air quality in the planning area. Such requirements are those to keep all disturbance within the confines of the historic well pad (COA 2), to avoid or minimize soil and vegetation disturbance (COA 3), to keep vehicles and equipment confined to roads described in the approved APD (COA 6), and to promptly reclaim disturbed areas associated with workovers (COA 17).	Under Alternative 2, the BIA would apply fewer standardized COAs to oil and gas activities. The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would not apply under Alternative 2. This would increase localized fugitive dust, compared with Alternative 1 (No Action). Fugitive dust emissions would be the highest out of all alternatives under Alternative 2. Emissions from equipment used in workovers, drilling, and production operations would be similar to those under Alternative 1 (No Action).	Under Alternative 3, the BIA would apply COAs based on the density of well development. The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would not apply in high-density sections; this would increase localized fugitive dust in these areas, compared with Alternative 1 (No Action). The COAs related to limiting surface disturbance described under Alternative 1 (No Action) would apply in low-density sections; impacts in these areas would be the same as those under Alternative 1 (No Action). Overall, localized fugitive dust emissions may be higher in some areas, compared with Alternative 1 (No Action), while emissions from equipment used in workovers, drilling, and production operations would be similar to those under Alternative 1 (No Action).	Under Alternative 4, the BIA would apply the COAs described in Alternative 1 (No Action) as well as additional COAs to protect sensitive cultural and environmental resources. With one exception, the COAs to minimize impacts would be the same as those described for Alternative 1 (No Action); therefore, impacts on air quality from localized fugitive dust and emissions from workovers, drilling, and production would be the same as under Alternative 1 (No Action). Under Alternative 4, the BIA would apply the additional COA 29, which would require lessees to conduct an initial test of hydrogen sulfide in the gas stream for each well and production facility. This would provide additional protections to workers and the public related to potential public health hazards from hydrogen sulfide exposure, compared with all other alternatives.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Air quality and climate *(continued)*	*(see above)*	*(see above)*	Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. The approximately 16 percent reduction in the number of wells under this alternative would reduce air emissions by approximately the same percentage.	Emissions from equipment used in workovers, drilling, and production operations would be similar to those under Alternative 1 (No Action). Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. The approximately 35 percent reduction in the number of wells would reduce air emissions by approximately the same percentage.
Fish, wildlife, and migratory birds	In addition to the COAs applied under all alternatives, several COAs would be applied under Alternative 1 (No Action). These COAs would help reduce the extent of habitat disturbance or direct disturbance to fish, wildlife, and migratory birds from these activities, such as minimizing noise, excessive traffic, and dust and restricting the discharge of contaminants into waterways.	The BIA would apply fewer standardized COAs under Alternative 2. COAs 28 and 31 would limit audible or visual disturbance and would prohibit land application of wastewater, waste oil, and contaminated soil. Compared with all other Alternatives, Alternative 2 would have the greatest impact on fish, wildlife, and migratory birds.	COAs would be based on the density of well development and would result in location-specific impacts. Impacts on fish, wildlife, and migratory birds in high-density sections would be similar to those under Alternative 2. Additional COAs would be applied in low-density sections, so these areas would be more protected from impacts. Additional COAs emphasize protections for streams, lakes, wetlands, and areas	Impacts from applying additional COAs under Alternative 4 would make it the most protective of fish, wildlife, and migratory birds. Benefits under may also occur from non-wildlife-specific COAs, such as buffer zones around sensitive cultural sites and streams, rivers, ponds, reservoirs, lakes, and wetlands. In addition, avoiding new road and pipeline crossings of streams or wetlands,

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Fish, wildlife, and migratory birds *(continued)*	*(see above)*	*(see above)*	prone to flooding, lessening impacts on species found in these systems. Impacts on low-density sections would be similar to those under Alternative 4 and would offer more protections, compared with Alternative 1 (No Action) and 2. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. These areas would offer additional protections for water quality and wildlife habitat.	altering hydrology, and burying pipelines, to the extent practicable, would help to eliminate impacts on riparian and wetland species of fish, wildlife, and migratory birds. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. These areas would offer additional protections for water quality and wildlife habitat.
Special status species	COAs would reduce the extent of habitat disturbance or direct disturbance to special status species, such as minimizing noise, excessive traffic, and dust and restricting the discharge of contaminants into waterways. COAs to control noxious weeds and reduce drilling footprints for air quality and cultural resource protection	Under Alternative 2, applying fewer standardized COAs to all oil and gas activities would have the greatest impact on special status species. COAs aimed at preventing disturbance to vegetation, and degradation to wetlands may be waived; however, COAs 28 and 31 would reduce some impacts on special status species by	In high-density sections, the BIA would apply the COAs described in Alternative 2; however, additional COAs applied under Alternative 3 in low-density sections would make these sections more protective of special status species. Buffers around culturally sensitive areas, such as historic sites, sacred sites, and grave sites, would	Additional COAs applied under Alternative 4 would make this alternative the most protective of special status species. Lessees could not conduct operations that may constitute an audible or visual disturbance, which may prevent avoidance or nest abandonment. In addition, COAs prohibiting the land application of wastewater, waste oil, and

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Special status species *(continued)*	would also indirectly benefit the special status species in the vicinity. COAs would protect migratory birds by requiring screening or netting on open-top tanks and pits. For ABB compliance, the BIA prepared a BA, and the USFWS would issue a BO, describing the total amount of acreage in the county where incidental take of ABB can occur. If an area is being used by eagles, then installing power lines would be avoided, when possible, flared gas pipes would be fitted with anti-perching devices, existing poles would be marked, and new poles would be designed according to APLIC guidelines.	limiting audible or visual disturbances; this would prevent site avoidance or nest abandonment. Additionally, prohibiting land application of wastewater, waste oil, and contaminated soil would reduce the likelihood of direct mortality from chemical ingestion, potential drowning, cold stress from loss of insulation, and susceptibility to disease. ESA compliance would still be required under this alternative. Impacts on the ABB would be the same as those described under Alternative 1 (No Action).	preserve vegetation and habitat for the ABB and other special status species by reducing surface disturbance. Low-density sections would have specific COAs in place to reduce impacts on waterways, streams, and wetland habitats, as well as covering or netting open-top tanks and pits to reduce bird injury and mortality. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. The reduction in new surface disturbance in these areas would protect vegetation and habitat for the ABB and other special status species.	contaminated soil would likely keep injurious material out of important habitat, such as wetlands. Applying a buffer around culturally sensitive areas, such as historic sites, sacred sites, and grave sites, would preserve vegetation and habitat for the ABB and other special status species found in these areas by reducing surface disturbance. Lessees would avoid new road and pipeline crossings of streams, wetlands, or other alterations to hydrology, lessening habitat disturbance for special status species found in these systems. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. The reduction in new surface disturbance in these areas would protect vegetation and habitat for the ABB and other special status species.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Vegetation, wetlands, and noxious weeds	Applying the COAs under Alternative 1 (No Action) would continue to limit the extent of surface disturbance from oil and gas activities. COAs limiting surface disturbance would continue to limit direct and indirect impacts on native vegetation from vegetation removal. COAs prohibiting noxious weed use during revegetation and reclamation and requiring prompt site reclamation would limit the potential for the spread of noxious weeds. Prohibiting lessees from conducting activities within stream channels or wetlands without proper authorization would continue to protect wetlands and riparian vegetation communities from the impacts of surface disturbance.	Alternative 2 would apply fewer standardized COAs and would generally provide the least protection to wetlands and vegetation and would allow the most noxious weed spread. As a result, vegetation would become more fragmented, compared with other alternatives. Acres of ground-disturbing activity, the potential for erosion and sedimentation into waterways, and the potential for noxious weeds or invasive species introduction and spread would increase.	Under Alternative 3, the BIA would apply COAs based on the density of well development. This would result in location-specific vegetation, wetland, and noxious weed impacts. Applying more COAs in low-density sections would protect vegetation and wetlands and would reduce the spread of noxious weeds. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. Vegetation and wetlands in these areas would be protected from disturbance, and potential for the spread of noxious weeds would be reduced.	Applying the same COAs as Alternative 1 (No Action), plus additional COAs, under Alternative 4 would protect vegetation and wetlands and prevent the spread of noxious weeds to the greatest degree of all the alternatives. By salvaging topsoil for use in site reclamation, revegetation would be hastened by using native seed stock and organic soil components stored in topsoil. By avoiding wetlands with new roads and pipelines, there would be less obstruction to hydrology in the area, thereby maintaining the extent of wetland areas. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas. Vegetation and wetlands in these areas would be protected from disturbance, and potential for the spread of noxious weeds would be reduced.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Vegetation, wetlands, and noxious weeds *(continued)*	Requiring lessees to minimize excessive dust to the extent possible would continue to provide some level of protection from dust covering plants and impairing their respiration and photosynthesis.	*(see above)*	*(see above)*	*(see above)*
Agriculture	Applying the COAs under Alternative 1 (No Action) would continue to limit short- and long-term impacts on farmland through prompt reclamation of surface disturbance, off-road restrictions, and fencing, which would reduce the risk of injury to or mortality of livestock.	Alternative 2 would apply the fewest COAs to oil and gas activities. Such COAs are designed to minimize surface disturbance, require erosion control, minimize alterations to the natural topography, require restoring vegetation, require fencing, and require reclaiming land promptly. The risk of disturbance or loss of farmland and livestock injury or mortality would be greater than under the other alternatives.	Applying COAs based on the density of well development would result in concentrating development and effects on farmland and agricultural uses in specific areas, when compared with Alternative 1 (No Action). More COAs would be applied in low-density sections where prime farmland is and could protect farm and pastureland from conversion and other impacts. Prime farmland would be more likely to be converted or disturbed in high-density sections because COAs that are less protective would be applied and more oil and gas development and access facilities would be concentrated. There would	The COAs that would minimize impacts on farmland and agricultural uses would be similar to those under Alternative 1 (No Action), as would the impacts due to surface disturbance and livestock interaction. Buffers applied as COAs for protecting cultural sites could further reduce ground disturbance, farmland conversion, and impacts on agricultural uses, compared with Alternative 1 (No Action). Overall, Alternative 4 would result in the least impact on farmland and livestock out of all the alternatives. Under this alternative, the BIA would not approve new drilling permits in certain

Resource/ Resource Use	**Alternative 1 (No Action)**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Agriculture *(continued)*	*(see above)*	*(see above)*	likely be more fragmentation of productive land and pasture. Buffers applied as COAs for protecting cultural sites in low-density sections could reduce ground disturbance, farmland conversion, and impacts on agricultural uses. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. Farmland in these areas would be protected from new oil and gas-related disturbance.	sensitive areas. Farmland in these areas would be protected from new oil and gas-related disturbance.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Cultural resources	Resolving adverse impacts through the NHPA Section 106 process would mitigate any significant impacts under NEPA. The infrastructure and access roads remaining in place for operations and maintenance could lead to indirect impacts on cultural resources from increased access, trespass, vandalism, erosion, and changes to setting. Applying the COAs under Alternative 1 (No Action) would continue to reduce potential impacts on cultural resources through avoidance, minimized surface disturbance, discovery provisions, and the NHPA Section 106 process.	Many of the COAs applied under Alternative 1 (No Action) would not apply under Alternative 2; however, standard NHPA compliance procedures, as implemented at 36 CFR 800, would apply, and special COAs could be included to protect cultural resources. Resolving adverse impacts identified in NEPA analysis, through the NHPA Section 106 process would mitigate any significant impacts.	Under Alternative 3, COAs would concentrate new facilities and therefore increase the potential for impacts on cultural resources in specific areas where there is already oil and would be based on the density of well development. More COAs would be applied in low-density sections under Alternative 3. This could reduce the potential for impacts on cultural resources in those areas and possibly preserve their settings. For low-density sections, Alternative 3 would include proactive guidance on minimum, expected, no-drilling, buffer zones for cultural resource protection. This would have a beneficial impact on cultural resources by providing more predictable guidance and standards for siting facilities and avoiding impacts on cultural resources.	The COAs that would minimize the potential for impacts on cultural resources would be similar to those under Alternative 1 (No Action). Alternative 4 would include proactive guidance on minimum, expected, no-drilling, buffer zones. Applying these additional COAs would have a beneficial impact on cultural resources by providing more predictable guidance and standards for siting facilities and avoiding impacts on cultural resources; therefore, impacts on cultural resources are expected to be least frequent and least severe under this alternative. Standard NHPA compliance procedures would apply and special COAs can be included to protect cultural resources. Resolving adverse impacts identified in NEPA analysis through the NHPA Section 106 process would

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Cultural resources *(continued)*	*(see above)*	*(see above)*	In low-density sections, potential impacts from oil and gas development on cultural resources would likely be less than under Alternative 1 (No Action) and Alternative 2; however, standard NHPA compliance procedures would apply, and special COAs can be included to protect cultural resources. Resolving adverse impacts identified in NEPA analysis through the Section NHPA 106 process would mitigate any significant impacts. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. The possibility of damage to cultural resources would be reduced, as would the possibility of new discoveries in these areas.	mitigate any significant impacts. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas totaling approximately 36 percent of the county. The possibility of damage to cultural resources would be reduced, as would the possibility of new discoveries in these areas.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Socioeconomics and environmental justice	Applying the COAs under Alternative 1 (No Action) would continue to restrict operations and siting for development; however, COAs would not reduce the overall number of operations or result in substantially increased costs for developers. Economic contributions from drilling and production would continue or would increase, depending on market conditions. Applying COAs could minimize impacts from development on quality-of-life factors and on market values and could minimize impacts on other land uses and their economic contributions. Project activities would not result in disproportionate adverse impacts on identified minority or Tribal populations.	Under Alternative 2, management actions would emphasize oil and gas development to a greater extent than under Alternative 1 (No Action) by minimizing or waiving most COAs. Lessees would have a greater degree of flexibility in how to comply, reducing development costs. The time required for permitting and site preparation would be reduced, especially in areas where a CE could be approved, maximizing economic output; however, this alternative would increase regulatory uncertainty and open up lessees to liability and additional expense, compared with Alternative 1 (No Action). This would be the case if methods of compliance with applicable laws and regulations are judged to be inadequate. Impacts on quality of life and on other land uses would likely be increased.	In high-density sections, the impacts would be as described under Alternative 2. In low-density sections, additional protective COAs would be applied, and the impacts of restrictions on siting and timing of development may be increased, compared with Alternative 1 (No Action). Under Alternative 3, total development and economic output may be reduced. It is estimated that the total number of wells would be reduced by approximately 16 percent, which would result in a reduction in income and headright payments. Concentrating development could reduce the overall impacts on other land uses, nonmarket values, and quality-of-life factors. Potential impacts may be more likely in census tracts in high-density sections. Of those tracts with minority	Total development levels over the planning period under Alternative 4 may be reduced. It is estimated that the total number of wells would be reduced by approximately 35 percent, which would result in a reduction in income and headright payments. The surface area of long-term disturbance associated with oil and gas development could be reduced from Alternative 1 (No Action). This could increase the potential for economic contributions from other activities and reduce the impacts on nonmarket and quality of life factors. Project activities are not anticipated to result in disproportionate adverse impacts on low-income, minority, or Tribal populations.

Resource/ Resource Use	**Alternative 1 (No Action)**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Socioeconomics and environmental justice *(continued)*	*(see above)*	Because impacts would be spread throughout the planning area and the region, proposed oil and gas development is not anticipated to result in disproportionate adverse impacts on identified minority or Tribal populations.	populations, 42 percent of census tract 9400.2 and 55 percent of census tract 9400.6 are within high-density sections.	*(see above)*
Public health and safety	Current BMPs would continue to be required as COAs in order to protect public health and safety. COAs requiring secondary containment for tank batteries and prompt removal of waste and unused chemicals would reduce the risk of hazardous chemicals being released into the environment. COA 20 would protect workers and the general public from the impacts of hydrogen sulfide exposure in areas where hydrogen sulfide levels of 100 ppm or greater are expected in the gas stream. This would come about by requiring the air quality BMPs listed in the	This alternative would not allow the storage of flowback and produced water in unlined pits; however, it would otherwise not apply COAs for handling chemicals or potentially contaminated water. Applicable laws and regulations would still apply, but this alternative would provide fewer protections for public health and safety than all other alternatives.	In high-density sections, management would be the same as under Alternative 2. In low-density sections, additional COAs requiring secondary containment for tank batteries and prompt removal of waste and unused chemicals would be applied. This would reduce the risk of accidental releases of potentially contaminated water and hazardous chemicals. COAs 20 and 29, requiring hydrogen sulfide testing and mitigation, would protect workers and the general public from the impacts of hydrogen sulfide exposure. This alternative would provide additional protections to public health in some areas, when	Throughout the planning area, COAs would be applied requiring secondary containment for tank batteries and prompt removal of waste and unused chemicals. These COAs would reduce the risk of contaminated water and hazardous chemical releases. COAs 20 and 29 would require hydrogen sulfide testing and mitigation to protect workers and the general public from the impacts of hydrogen sulfide exposure. This alternative would provide the highest level of protection to public health and safety. Under this alternative, the BIA would not approve new drilling permits in certain

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Public health and safety *(continued)*	site-specific EA for the drilling permit.	*(see above)*	compared with Alternative 2. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities. The reduction in new drilling in these areas, especially municipalities, which tend to be population centers, would reduce the potential for human exposure to hazardous materials and fumes from oil and gas development activities.	sensitive areas totaling approximately 36 percent of the county. The reduction in new drilling in these areas would reduce the potential for human exposure to hazardous materials and fumes from oil and gas development activities.
Visual resources	Under this alternative, COAs that require lessees to minimize surface disturbance and topography alterations, reclaim promptly, and remove unused equipment would continue to limit impacts on visual resources.	Under this alternative, COA 28 would specifically prohibit adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors; however, other COAs that minimize surface disturbance and topography alterations would not be applied, so overall impacts on visual resources could increase the most under this alternative.	In low-density sections, COAs from Alternative 1 (No action) would be applied, as well as additional COAs that would require burying pipelines and avoiding cultural sites and wetlands. This alternative would provide additional protections to generally more pristine low-density sections. COA 28, which specifically prohibits adverse visual impacts that may constitute	COAs from Alternative 1 (No Action), as well as additional COAs that would require burying pipelines and avoiding cultural sites and wetlands, would be applied to all areas. COA 28, which specifically prohibits adverse visual impacts that may constitute a public nuisance that is harmful to people or sensitive environmental receptors would be applied to all areas under this

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Visual resources *(continued)*	*(see above)*	*(see above)*	a public nuisance that is harmful to people or sensitive environmental receptors, would be applied to all areas under this alternative. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities encompassing approximately 17 percent of the county. Visual impacts from new oil and gas development activities would be reduced in these areas.	alternative. This would result in the fewest impacts on visual resources out of all alternatives. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas totaling approximately 36 percent of the county. Visual impacts from new oil and gas development activities would be reduced in these areas.
Noise	The application of certain standardized COAs may indirectly limit noise impacts by confining operations to existing roads where possible COAs instructing lessees to minimize vegetation removal and disturbance to the surface owner could also help reduce noise impacts.	Under this alternative fewer COAs would be applied; however, COA 28, which specifically prohibits noise levels that may constitute a public nuisance considered harmful to people or sensitive environmental receptors, would be applied. Depending on how COA 28 is applied, this alternative could provide additional noise protections over Alternative 1 (No Action).	COA 28, which specifically prohibits noise levels that may constitute a public nuisance that is harmful to people or sensitive environmental receptors, would be applied in all areas. Additionally, the same COAs as Alternative 1 (No Action), which could incidentally reduce noise impacts, would be applied in low-density sections. This alternative would provide	COA 28, which specifically prohibits noise levels that may constitute a public nuisance that is harmful to people or sensitive environmental receptors would be applied in all areas. In addition, COAs instructing lessees to minimize vegetation removal and disturbance to the surface owner, which could incidentally reduce noise pollution, would be applied

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Noise *(continued)*	*(see above)*	*(see above)*	more protections in low-density sections, compared with Alternative 1 (No Action) and Alternative 2; however, it would provide fewer protections in the entire planning area, when compared with Alternative 4. Under this alternative, the BIA would not approve new drilling permits near certain sensitive waterbodies and in groundwater protection areas and municipalities encompassing approximately 17 percent of the county. Noise impacts from new oil and gas development activities would be reduced in these areas.	in all areas. This alternative would provide the greatest level of protection from noise impacts. Under this alternative, the BIA would not approve new drilling permits in certain sensitive areas totaling approximately 36 percent of the county. Noise impacts from new oil and gas development activities would be reduced in these areas.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Land use plans, utilities, and timber harvesting	Existing and proposed oil and gas development would continue to increase the need for new or expanded utilities, such as pipelines and electrical distribution and transmission lines. Such COAs to reclaim all areas of surface disturbance that are not needed or used in the production or operation of the well would continue to be implemented. This would ensure that lands are reclaimed for other land uses and developments in a timely manner. Impacts on Timber harvesting are expected to be minimal under all alternatives. As of 2018, Osage County has not had any timber sales in the last 10 years on BIA-managed lands.	Under Alternative 2, in addition to COAs applied under Alternative 1 (No Action), the BIA would apply COAs that would prohibit applying waste oil, wastewater, or contaminated soil to land. The exception would be if the lessee submits a written request for such application. The degree of this impact would be evaluated on a site-specific, case-by-case basis. Overall, this alternative would apply the fewest COAs, resulting in the fewest restrictions on land use authorizations of all alternatives.	In high-density sections, impacts on land use plans, utilities, and timber harvesting would be the same as those described under Alternative 2. In low-density sections, the BIA would apply additional COAs that limit the spatial extent of surface disturbance associated with oil and gas development more than under Alternative 1 (No Action). This management approach would impose more restrictions on land use authorizations for oil and gas development but would continue to provide opportunities for non-oil and gas activities outside of concentrated oil and gas development sections.	This alternative would apply the most COAs of all the alternatives. This would impose the most restrictions on land use authorizations for oil and gas development but would continue to provide opportunities for non-oil and gas development outside of concentrated oil and gas development areas.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Traffic and transportation	Applying COAs would limit impacts by requiring lessees to maintain and upgrade roads as needed. These COAs would facilitate current and anticipated traffic levels and reduce damage to public roads. Building roadways through riparian areas or over stream crossings could subject those roadways to inundation and excessive erosion, which would decrease roadway quality and access. Building roadways over streams and in riparian areas would require frequent maintenance.	Impacts would be the same as under Alternative 1 (No Action), with the exception that fewer COAs that require maintaining and upgrading roadways to support new oil and gas development would allow roadways to deteriorate over time, which would reduce access. An inability to meet desired levels of service would be inconsistent with long-range transportation plans.	There would be location-specific impacts depending on COAs applied in high- or low-density sections. Impacts from roadway maintenance on access would be the same as those under Alternative 1 (No Action) in low-density locations. Also, in low-density locations, precluding new road crossings of streams and through areas subject to inundation would avoid impacts from roadway flooding on access. In high-density locations, impacts would be the same as under Alternative 2. The reduction in oil and gas production and drilling that is expected due to the BIA not approving new drilling permits in certain areas would likely result in a reduction in oil and gas related traffic and associated impacts.	Impacts would be the same as under Alternative 1 (No Action), with the exception that preventing new roadway crossings of streams and other waterways would protect new roadways from flooding and deterioration. The reduction in oil and gas production and drilling that is expected due to the BIA not approving new drilling permits in certain areas would likely result in a reduction in oil and gas related traffic and associated impacts.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Mineral extraction	Mineral extraction would continue according to current trends. All standard BMPs would continue to be applied as COAs, with special conditions added if necessary, based on a site-specific EA. It is projected that 4,761 new wells would be drilled in Osage County in the 20 years following the publication of the ROD for this EIS.	Some COAs would be waived. The BIA could approve a CE for all wells in a quarter-section in some situations, potentially accelerating permit issuance. The BIA would determine cultural site setbacks on a case-by-case basis, with site-specific COAs applied as necessary for NHPA compliance. The level of mineral extraction under this alternative is expected to be approximately the same as under Alternative 1 (No Action).	High-density sections would be managed the same as under Alternative 2. Low-density sections would have the same COAs as under Alternative 1 (No Action), plus additional COAs stipulating required setbacks from certain sensitive and cultural resources. In high-density sections, the BIA would determine cultural site setbacks on a case-by-case basis, with site-specific COAs applied as necessary for NHPA compliance. This could require adjusting well placement in some high-density sections. Under this alternative, the BIA would not permit new oil and gas-related surface disturbing activities near certain sensitive waterbodies and in groundwater protection areas and municipalities encompassing approximately 17 percent of the county. It is estimated that the number of new wells would	Alternative 4 would apply the same COAs as those under Alternative 1 (No Action), plus additional protective COAs. These would require setbacks from cultural resources and other sensitive resources. This alternative could require adjusting well placement in some areas. Under this alternative the BIA would not permit new oil and gas-related surface disturbing activities in certain sensitive areas totaling approximately 36 percent of the county. It is estimated that the number of new wells would be reduced by 35 percent compared to Alternative 1 (No Action) and Alternative 2. Overall recovery of gas and oil would be reduced by a similar percentage.

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Mineral extraction *(continued)*	*(see above)*	*(see above)*	be reduced by 16 percent compared to Alternative 1 (No Action) and Alternative 2. Overall recovery of gas and oil would be reduced by a similar percentage.	*(see above)*
Recreation and special use areas	The BIA would continue to apply COAs that limit impacts on recreation and special use areas. Such COAs as prohibiting expansion or relocation of well pads and access roads not included in the approved EA for the APD would continue to limit surface-disturbance activities. This would protect the naturalness of the landscape and the recreation experience for those seeking solitude and semiprimitive, nonmotorized recreation.	In addition to the COAs that apply to all alternatives, the BIA would apply COAs 28 and 31. These COAs would limit noise levels, visual impacts, and land applications for waste oil, wastewater, and contaminated soil. Limiting these impacts would enhance recreation, such as viewing wildlife. Overall, Alternative 2 emphasizes oil and gas development and would apply the fewest COAs. This would result in the most potential for surface disturbance in areas used for recreation of all the alternatives.	In addition to the COAs that apply to all alternatives, the BIA would apply COAs based on well development density. In low-density sections, COAs would be applied to minimize soil and vegetation disturbance. This would reduce wildlife habitat fragmentation and impacts on recreation, such as hunting and wildlife viewing. In high-density sections, the impacts on recreation and special use areas would be the same as those under Alternative 2. In areas where BIA would not approve new drilling permits, impacts on recreation would be reduced compared to Alternative 1 (No Action).	Alternative 4 emphasizes enhanced resource protection. This would limit surface disturbance associated with oil and gas activities more than under Alternative 1 (No Action). Compared with the other alternatives, there would be fewer impacts on recreation and special use areas under Alternative 4. This is because more COAs, such as prohibiting nuisance from noise or adverse visual impacts, burying pipelines where appropriate, and avoiding disturbance in and near streams and waterways would be applied to the entire planning area. In areas where BIA would not approve new drilling permits, impacts on recreation would be

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Recreation and special use areas *(continued)*	*(see above)*	*(see above)*	*(see above)*	reduced compared to Alternative 1 (No Action).
Trust assets and Osage Nation interests	Under all alternatives, oil and gas production from the Osage Mineral Estate would result in royalties distributed to Osage headright owners, as well as a portion of royalties for the Osage Minerals Council's operation. Well development levels are not likely to be substantially affected by proposed management activities. COAs may represent site-specific restrictions, but drilling would not be made uneconomical, and royalties to Osage Nation and headright owners would continue or increase, depending on market conditions. Under all alternatives, the BIA would comply with the NHPA Section 106 process and would consult with the Osage Nation THPO and the SHPO, when applicable.	As under Alternative 1 (No Action) and depending on market conditions, Alternative 2 would continue or increase economic contributions from production royalties to Osage Nation and headright owners. The potential for increased surface disturbance from oil and gas development under Alternative 2 would increase the potential for oil and gas-related impacts on locations, sacred sites, resources, and settings that are traditionally important, culturally significant, or sacred to the Osage Nation. Many of the COAs that reduce or minimize surface disturbance would not apply under this alternative, and the potential for impacts on cultural properties that are considered significant and sacred to Tribes as established through	Under Alternative 3, management actions would support a varied level of development in high- and low-density sections. Management may result in preferential development in high-density sections; total development and economic output (royalty payments) would be reduced compared with Alternative 1 (No Action). Alternative 3 would concentrate facility development in high-density sections; therefore, the potential for impacts of surface disturbance on locations, sacred sites, resources, and settings could be greater in these areas. More COAs would be applied in low-density sections. This would reduce the potential for impacts from surface disturbance in these areas.	Under Alternative 4, increased use of COAs would increase restrictions for developers. Total development levels over the 20-year planning period ; and economic contributions from production royalties to Osage Nation and headright owners would be reduced compared with Alternative 1 (No Action).. The actual level of development and production and related economic impacts would continue to be affected by oil and gas market conditions. Applying more COAs to protect sensitive cultural and environmental resources would reduce the potential for impacts on locations, sacred sites, resources, and settings that are traditionally important, culturally significant, or sacred to the Osage Nation. Buffers

Resource/ Resource Use	Alternative 1 (No Action)	Alternative 2	Alternative 3	Alternative 4
Trust assets and Osage Nation interests *(continued)*	As part of that process, the THPO would review projects for impacts on locations, sacred sites, resources, and settings that are traditionally important, culturally significant, or sacred to the Osage Nation. All alternatives include COAs to avoid impacts on cultural sites and any other sensitive sites identified by the Osage Nation, and procedures addressing unanticipated discoveries. The reviews may reduce impacts on these resources by requiring that potential impacts are identified and mitigated.	consultation with the THPO would be greater than under Alternative 1 (No Action).	For low-density sections, a COA specifies buffers that would be applied for protecting cultural sites. This would reduce ground disturbance and the potential for other impacts. Also, in low-density sections, impacts on locations, sacred sites, resources, and settings would likely be less than under Alternative 1 (No Action) and Alternative 2. This is because the COAs would reduce impacts. In high-density sections, impacts would be greater than under Alternative 1 (No Action), because fewer protective COAs would be applied. In areas where BIA would not approve new drilling permits, impacts on locations, sacred sites, resources, and settings would likely be reduced compared to Alternative 1 (No Action) and Alternative 2.	applied as COAs for protecting cultural sites throughout the planning area could further reduce the potential for impacts. In areas where BIA would not approve new drilling permits, impacts on locations, sacred sites, resources, and settings would likely be reduced compared to Alternative 1 (No Action) and Alternative 2.

Appendix E

Figures

Figure 1-1
Current Leasing Process

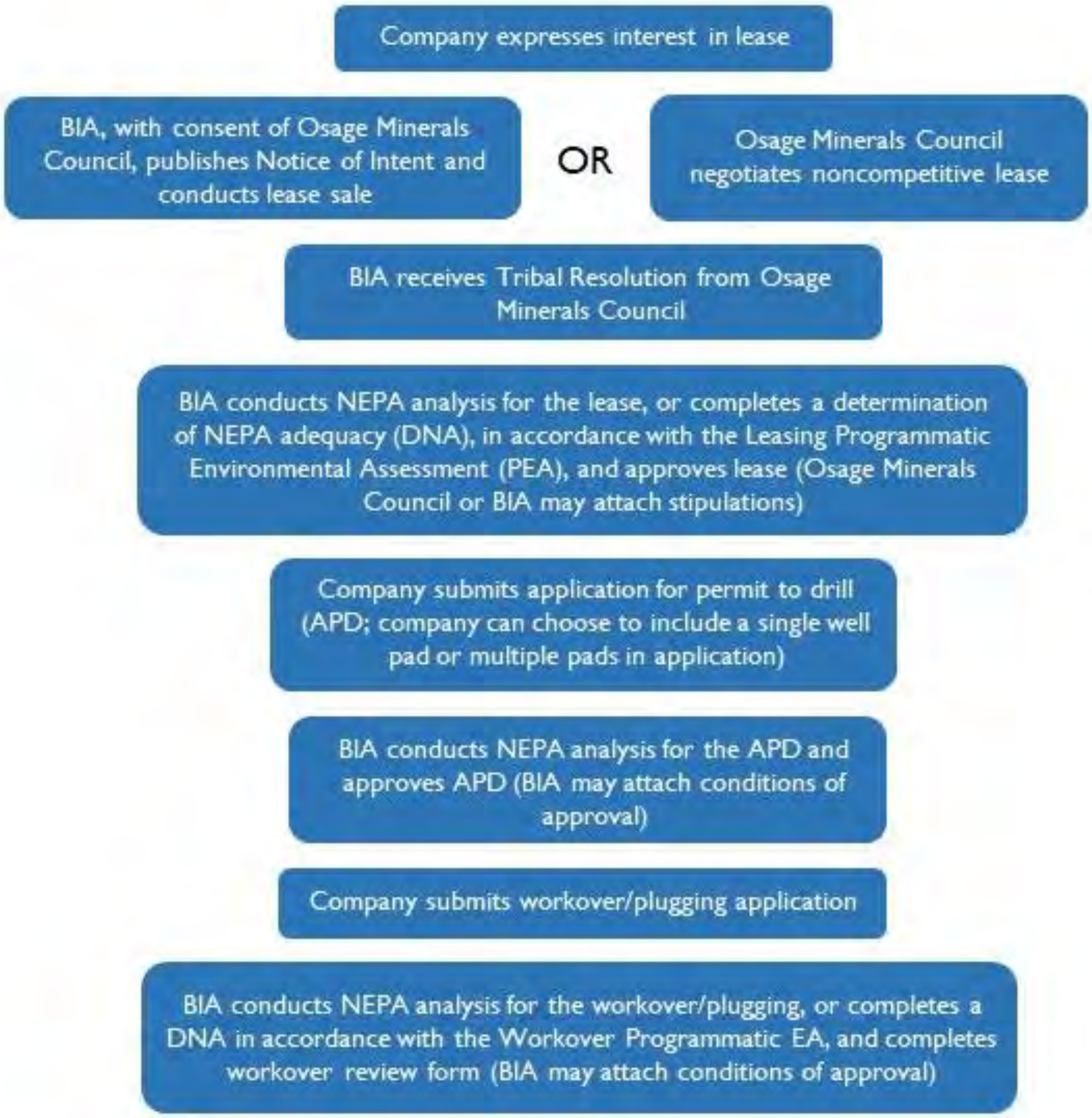
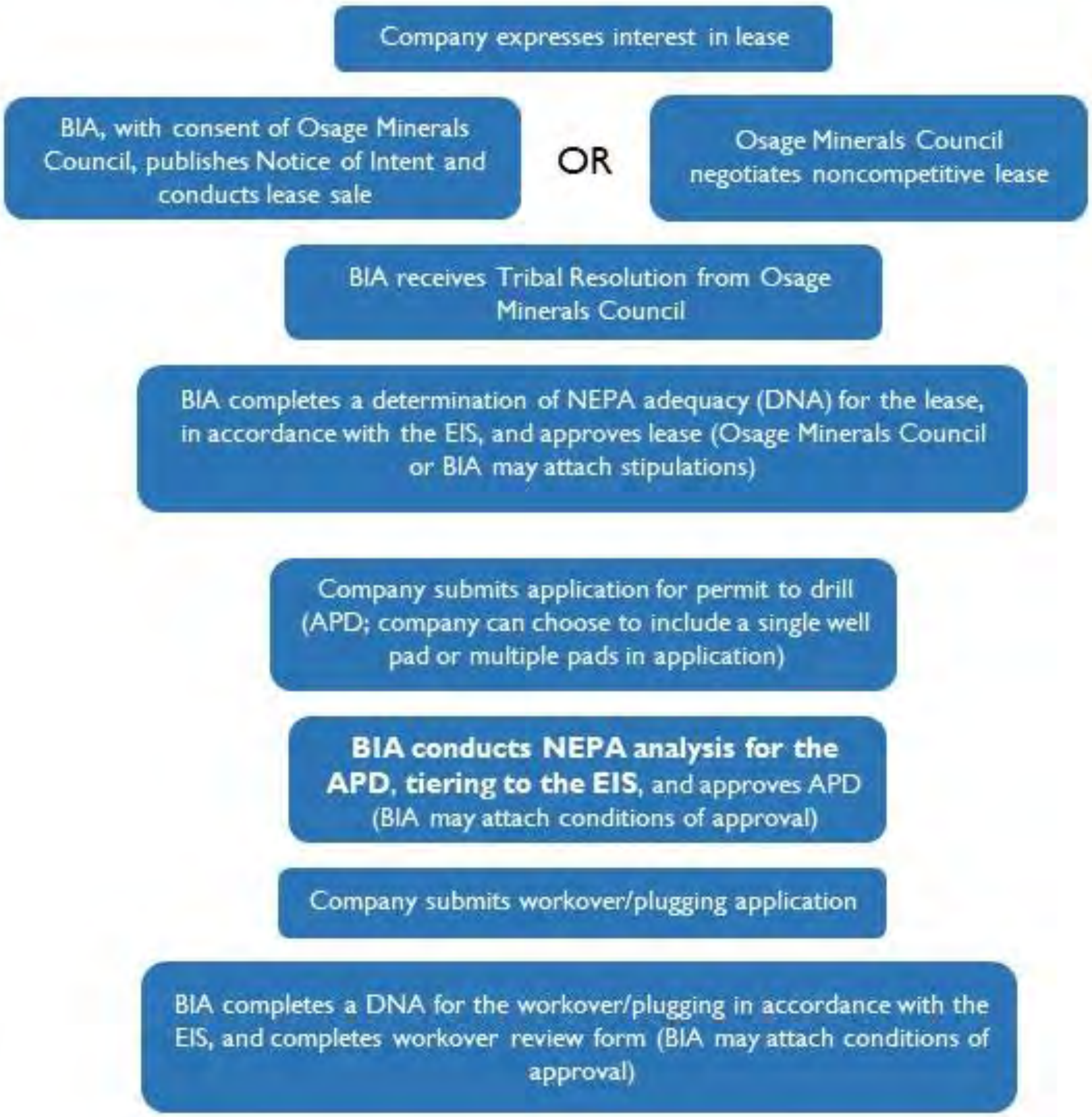


Figure 1-2
Streamlined Leasing Process



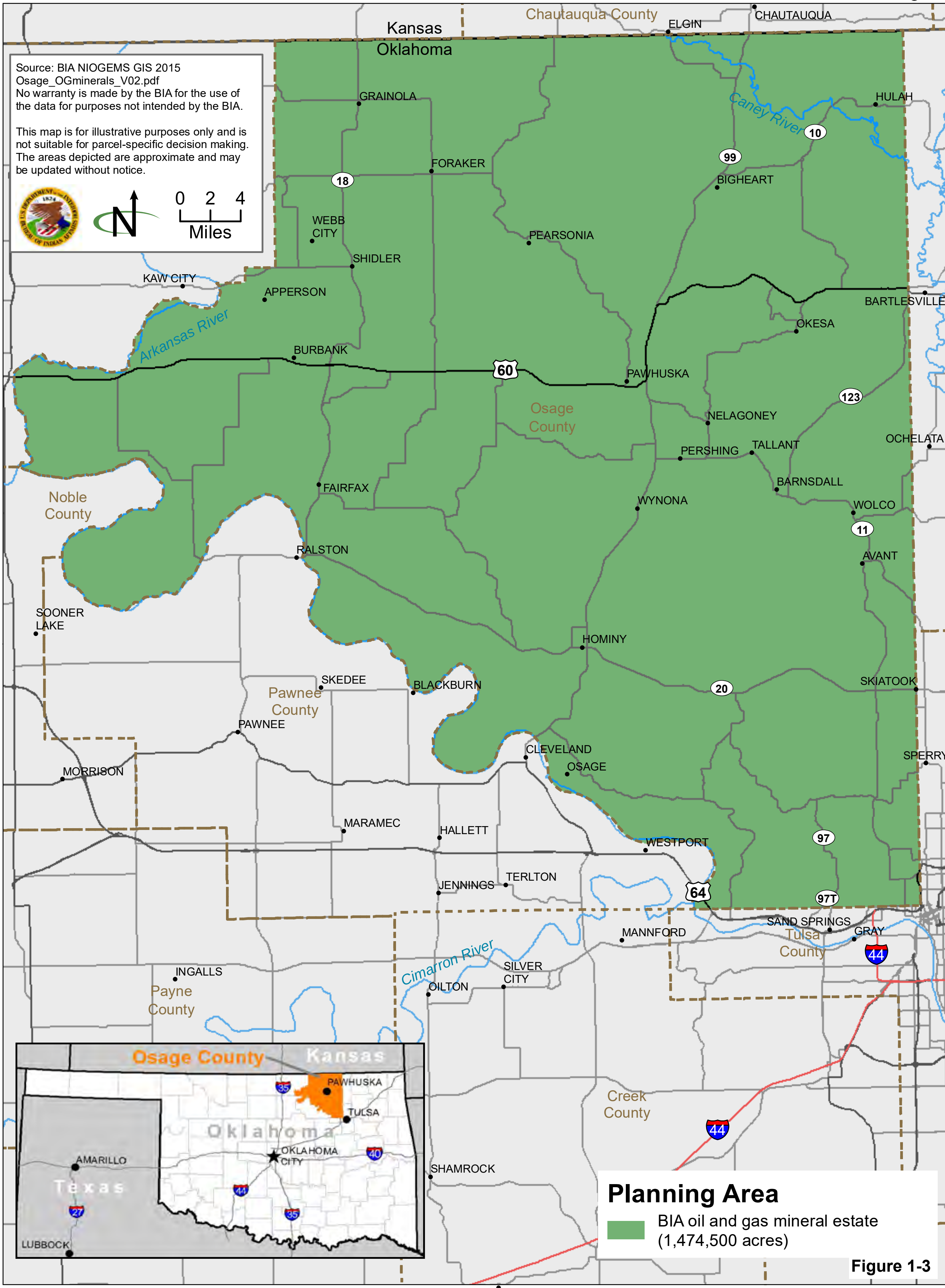

Source: BIA NIOGEMS GIS 2015
Osage_OGminerals_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
Osage County
Noble County
Pawnee County
Payne County
Creek County
Tulsa County
Arkansas River
Caney River
Cimarron River
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
NELAGONEY
OCHELATA
PERSHING
TALLANT
FAIRFAX
BARNSDALL
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
INGALLS
SILVER CITY
OILTON
SHAMROCK
Kansas
Oklahoma
Texas
AMARILLO
LUBBOCK
OKLAHOMA CITY
TULSA
Planning Area
BIA oil and gas mineral estate (1,474,500 acres)

Figure 1-3

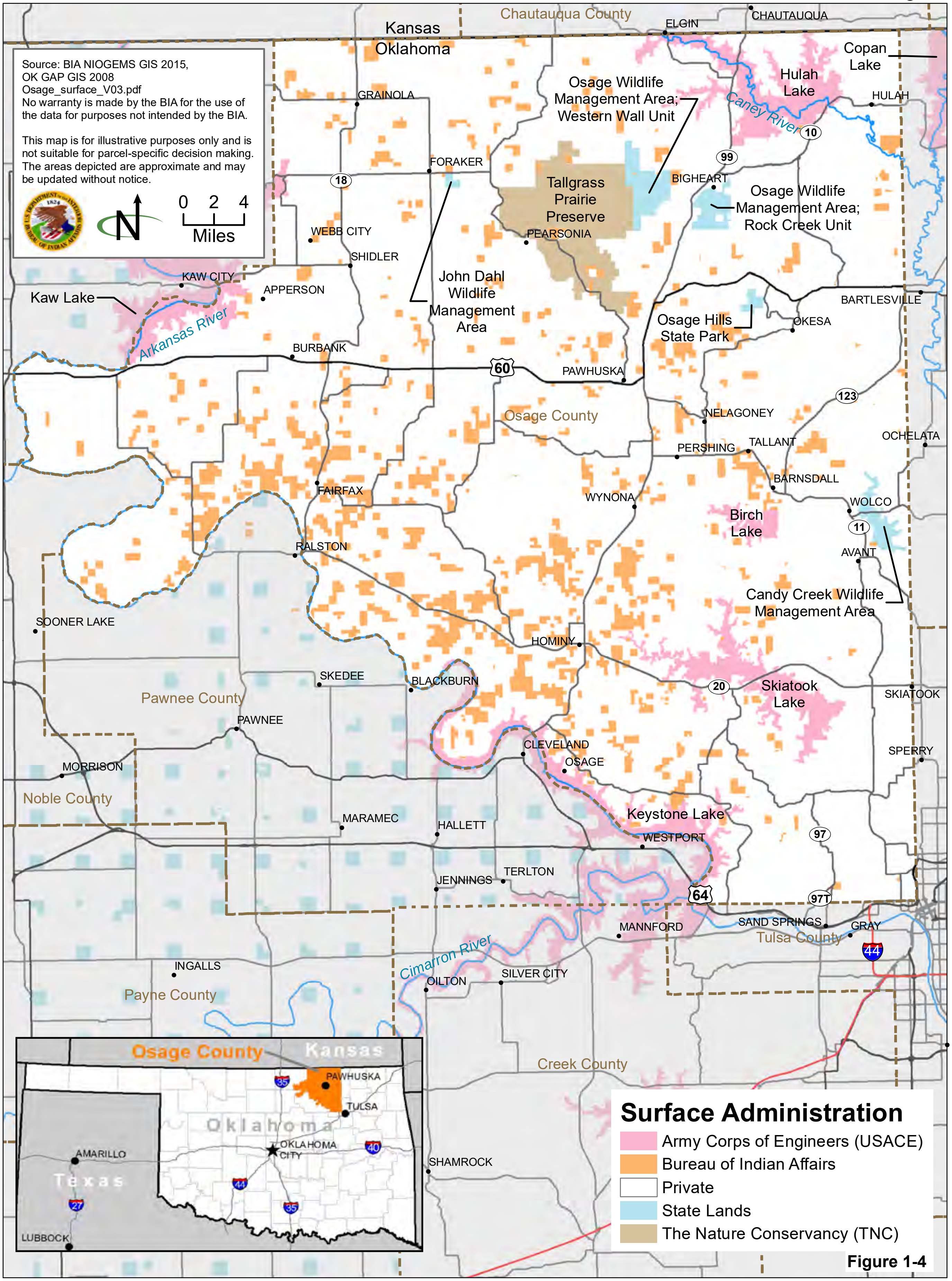
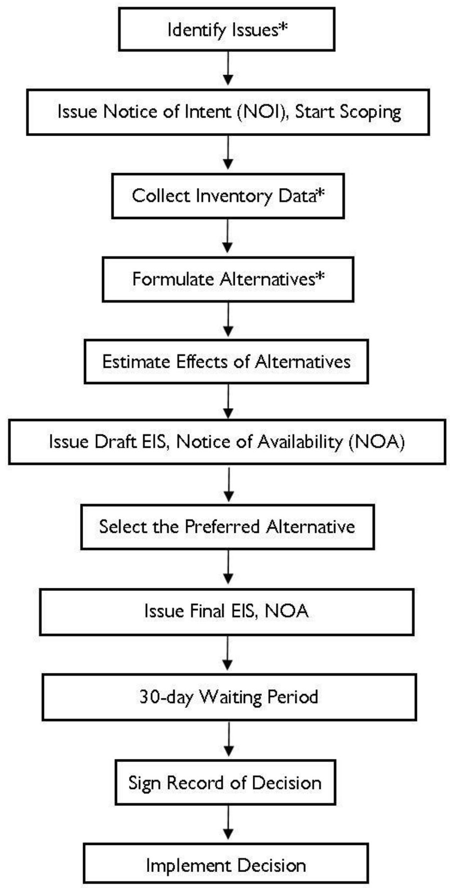

Source: BIA NIOGEMS GIS 2015,
OK GAP GIS 2008
Osage_surface_V03.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Creek County
Tulsa County
Osage Wildlife Management Area; Western Wall Unit
Osage Wildlife Management Area; Rock Creek Unit
Tallgrass Prairie Preserve
John Dahl Wildlife Management Area
Osage Hills State Park
Candy Creek Wildlife Management Area
Copan Lake
Hulah Lake
Kaw Lake
Birch Lake
Skiatook Lake
Keystone Lake
Arkansas River
Caney River
Cimarron River
Surface Administration
Army Corps of Engineers (USACE)
Bureau of Indian Affairs
Private
State Lands
The Nature Conservancy (TNC)
Figure 1-4

Figure 1-5
The BIA EIS Process



*These steps may be revised throughout the EIS process and may overlap other steps

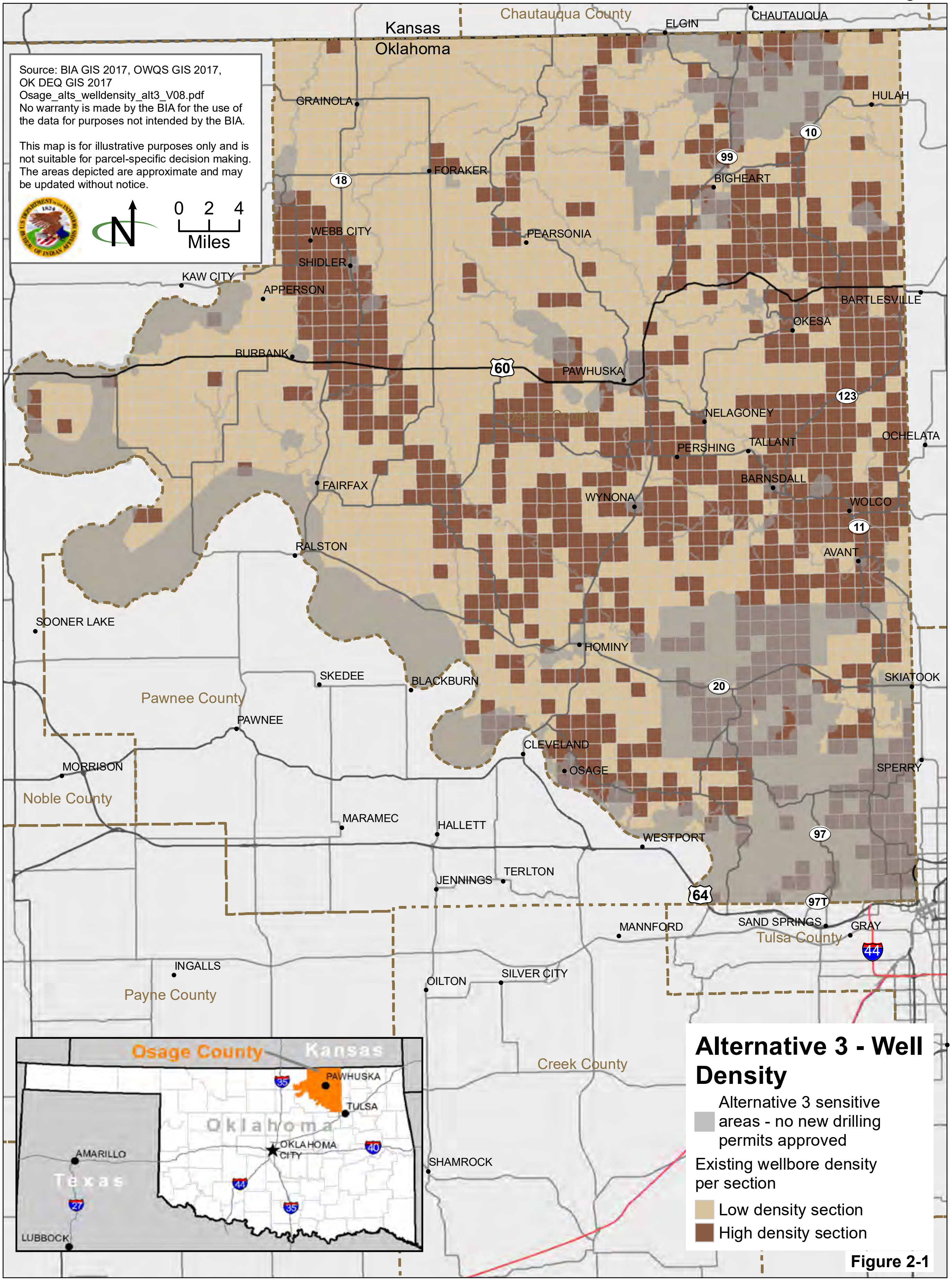

Source: BIA GIS 2017, OWQS GIS 2017, OK DEQ GIS 2017
Osage_alts_welldensity_alt3_V08.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
NELAGONEY
Osage County
OCHELATA
TALLANT
PERSHING
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
Noble County
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
INGALLS
Payne County
OILTON
SILVER CITY
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Alternative 3 - Well Density
Alternative 3 sensitive areas - no new drilling permits approved
Existing wellbore density per section
Low density section
High density section

Figure 2-1

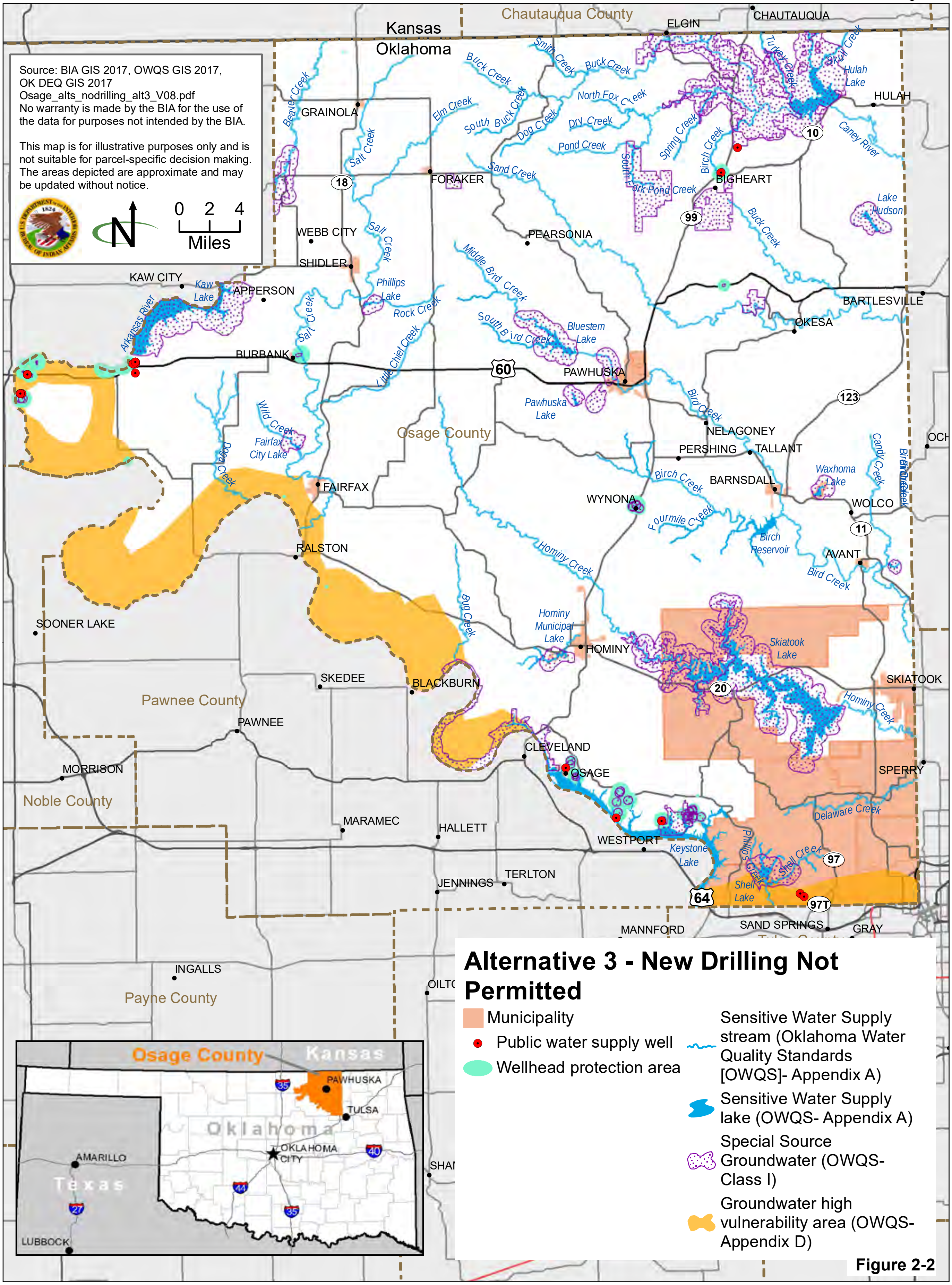

Source: BIA GIS 2017, OWQS GIS 2017, OK DEQ GIS 2017
Osage_alts_nodrilling_alt3_V08.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
N
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BURBANK
BARTLESVILLE
OKESA
PAWHUSKA
NELAGONEY
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
INGALLS
Kaw Lake
Arkansas River
Phillips Lake
Bluestem Lake
Pawhuska Lake
Fairfax City Lake
Hulah Lake
Lake Hudson
Waxhoma Lake
Birch Reservoir
Hominy Municipal Lake
Skiatook Lake
Keystone Lake
Shell Lake
18
10
99
60
123
11
20
97
97T
64
Alternative 3 - New Drilling Not Permitted
Municipality
Public water supply well
Wellhead protection area
Sensitive Water Supply stream (Oklahoma Water Quality Standards [OWQS]- Appendix A)
Sensitive Water Supply lake (OWQS- Appendix A)
Special Source Groundwater (OWQS- Class I)
Groundwater high vulnerability area (OWQS- Appendix D)
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK

Figure 2-2

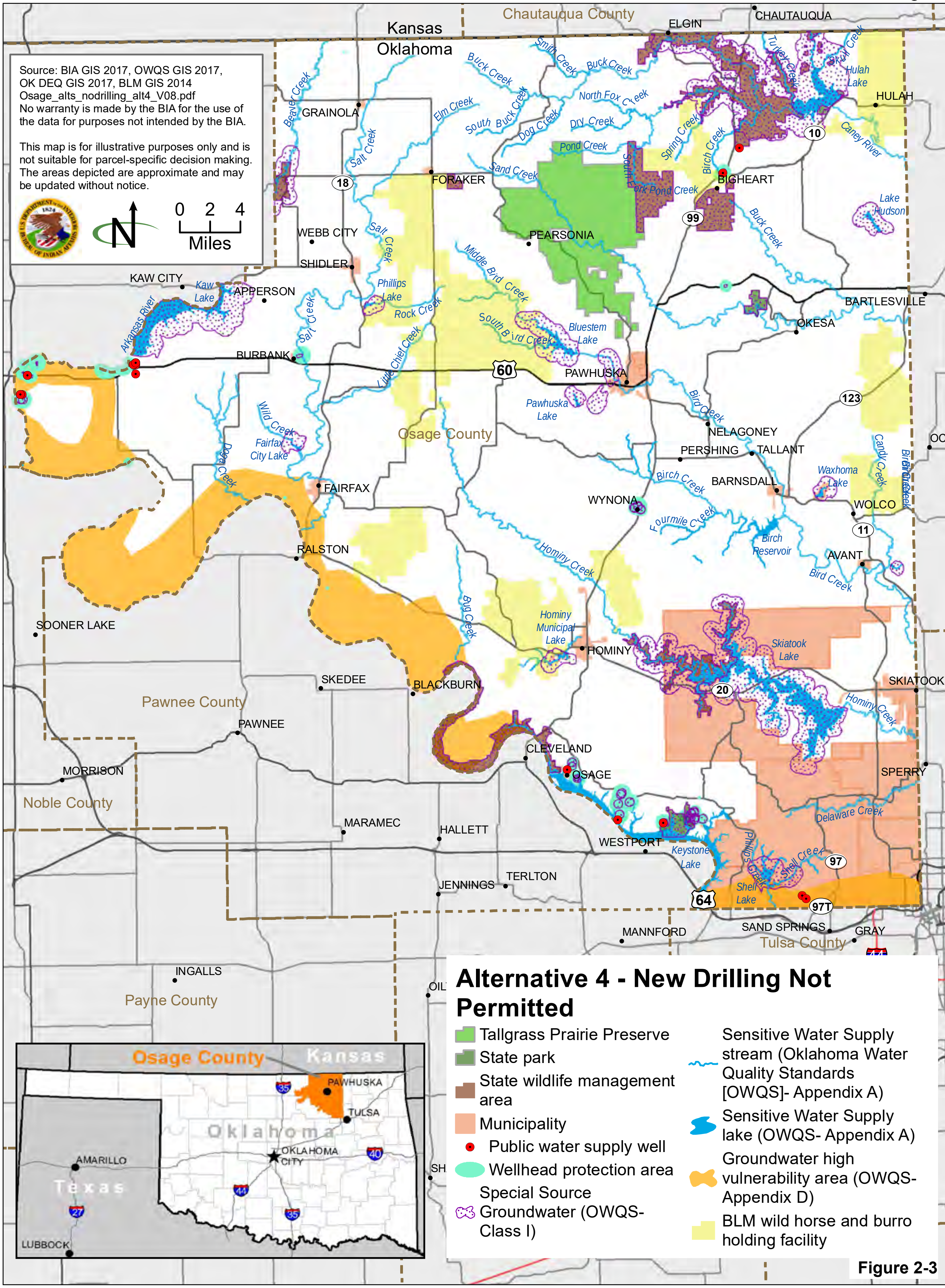

Source: BIA GIS 2017, OWQS GIS 2017, OK DEQ GIS 2017, BLM GIS 2014
Osage_alts_nodrilling_alt4_V08.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Tulsa County
ELGIN
CHAUTAUQUA
HULAH
BIGHEART
GRAINOLA
FORAKER
PEARSONIA
WEBB CITY
SHIDLER
KAW CITY
APPERSON
BURBANK
PAWHUSKA
OKESA
BARTLESVILLE
NELAGONEY
PERSHING
TALLANT
BARNSDALL
WOLCO
WYNONA
FAIRFAX
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
INGALLS
Alternative 4 - New Drilling Not Permitted
Tallgrass Prairie Preserve
State park
State wildlife management area
Municipality
Public water supply well
Wellhead protection area
Special Source Groundwater (OWQS-Class I)
Sensitive Water Supply stream (Oklahoma Water Quality Standards [OWQS]- Appendix A)
Sensitive Water Supply lake (OWQS- Appendix A)
Groundwater high vulnerability area (OWQS-Appendix D)
BLM wild horse and burro holding facility
Osage County
Kansas
Oklahoma
Texas
PAWHUSKA
TULSA
OKLAHOMA CITY
AMARILLO
LUBBOCK

Figure 2-3

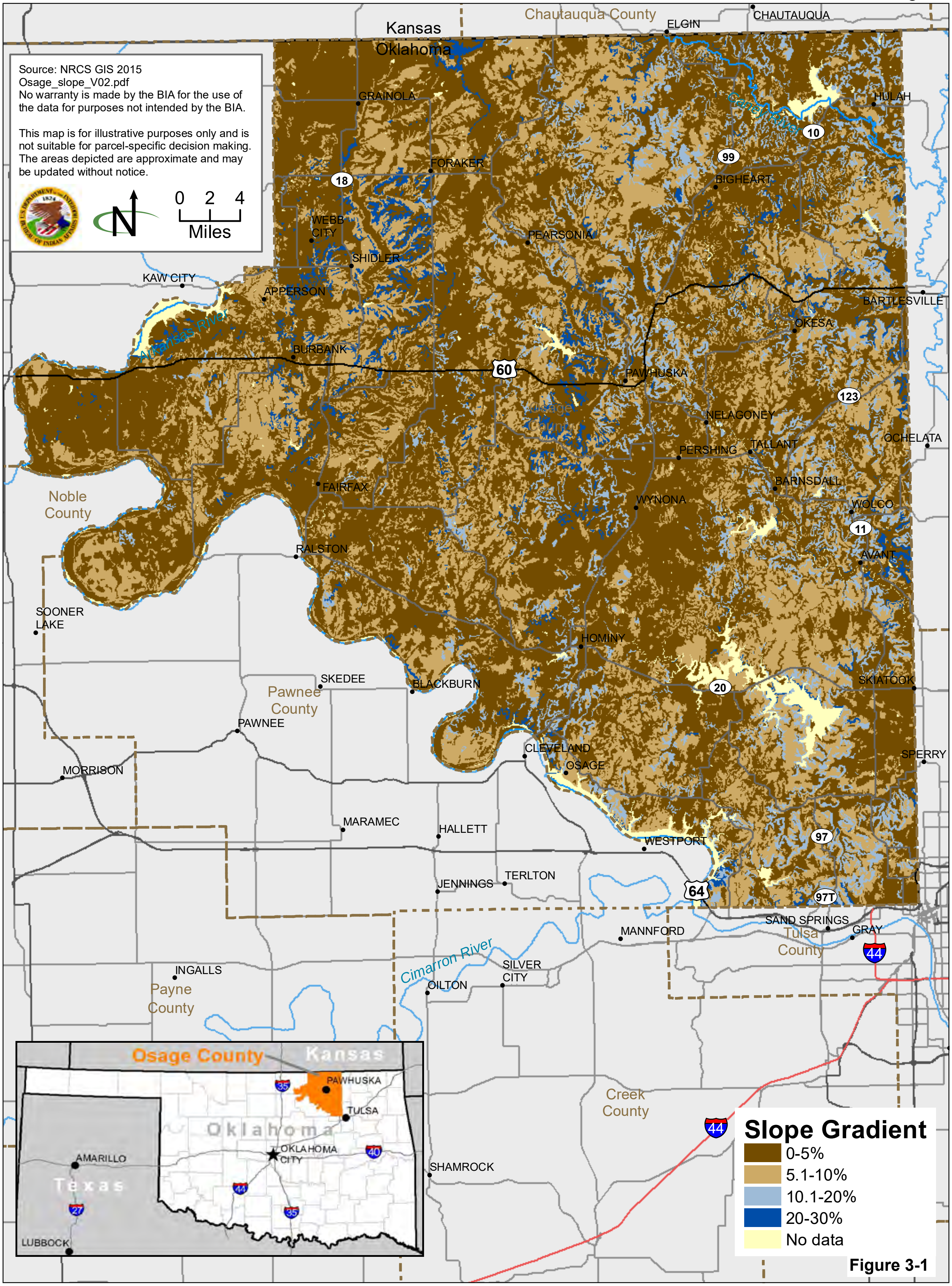
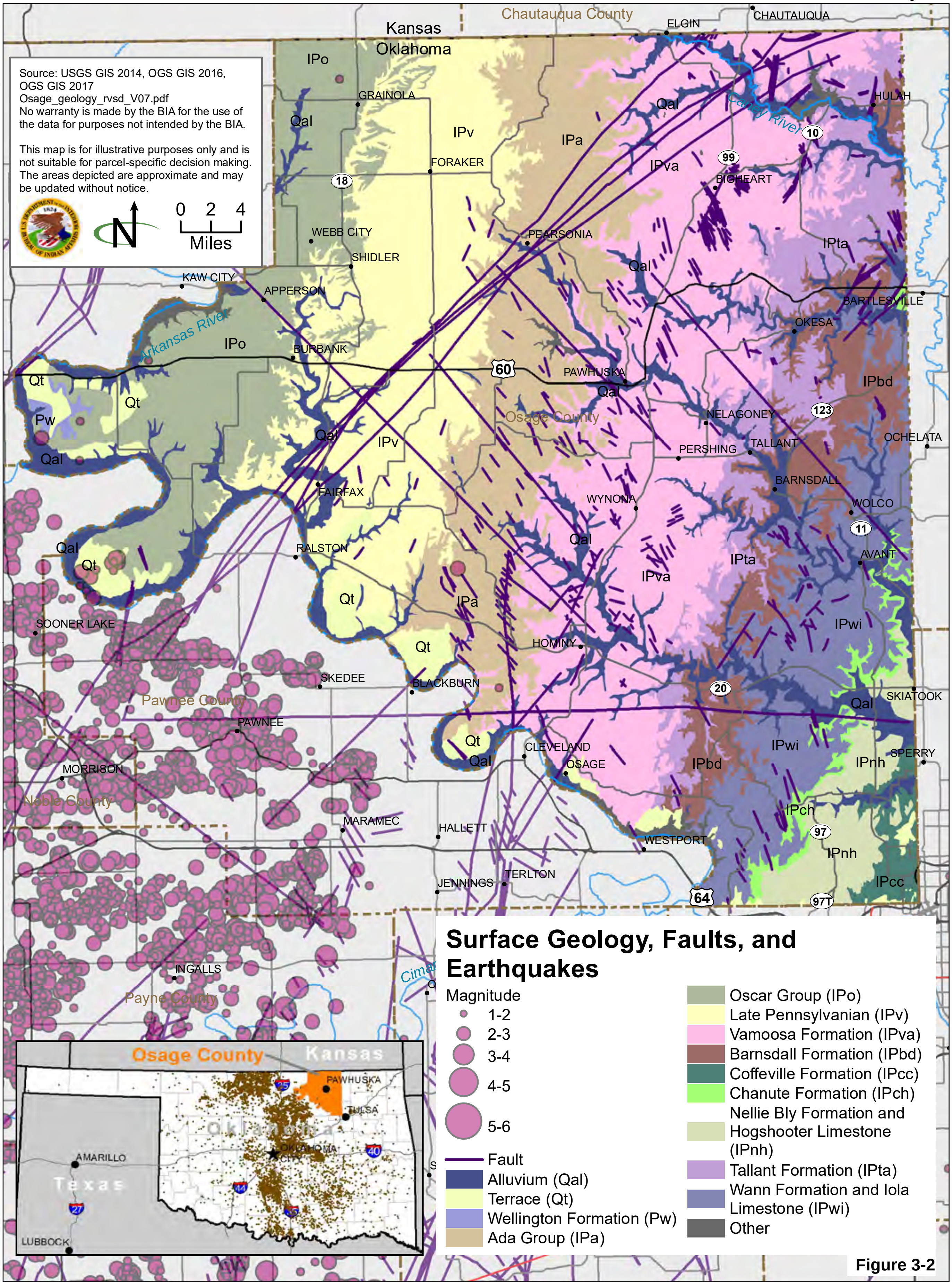

Source: NRCS GIS 2015
Osage_slope_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
Arkansas River
BARTLESVILLE
OKESA
BURBANK
PAWHUSKA
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
FAIRFAX
Noble County
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
Tulsa County
Cimarron River
INGALLS
SILVER CITY
OILTON
Payne County
Creek County
SHAMROCK
18
99
10
60
123
11
20
97
64
97T
44
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
35
40
44
27
Slope Gradient
0-5%
5.1-10%
10.1-20%
20-30%
No data

Figure 3-1



Surface Geology, Faults, and Earthquakes

Figure 3-2

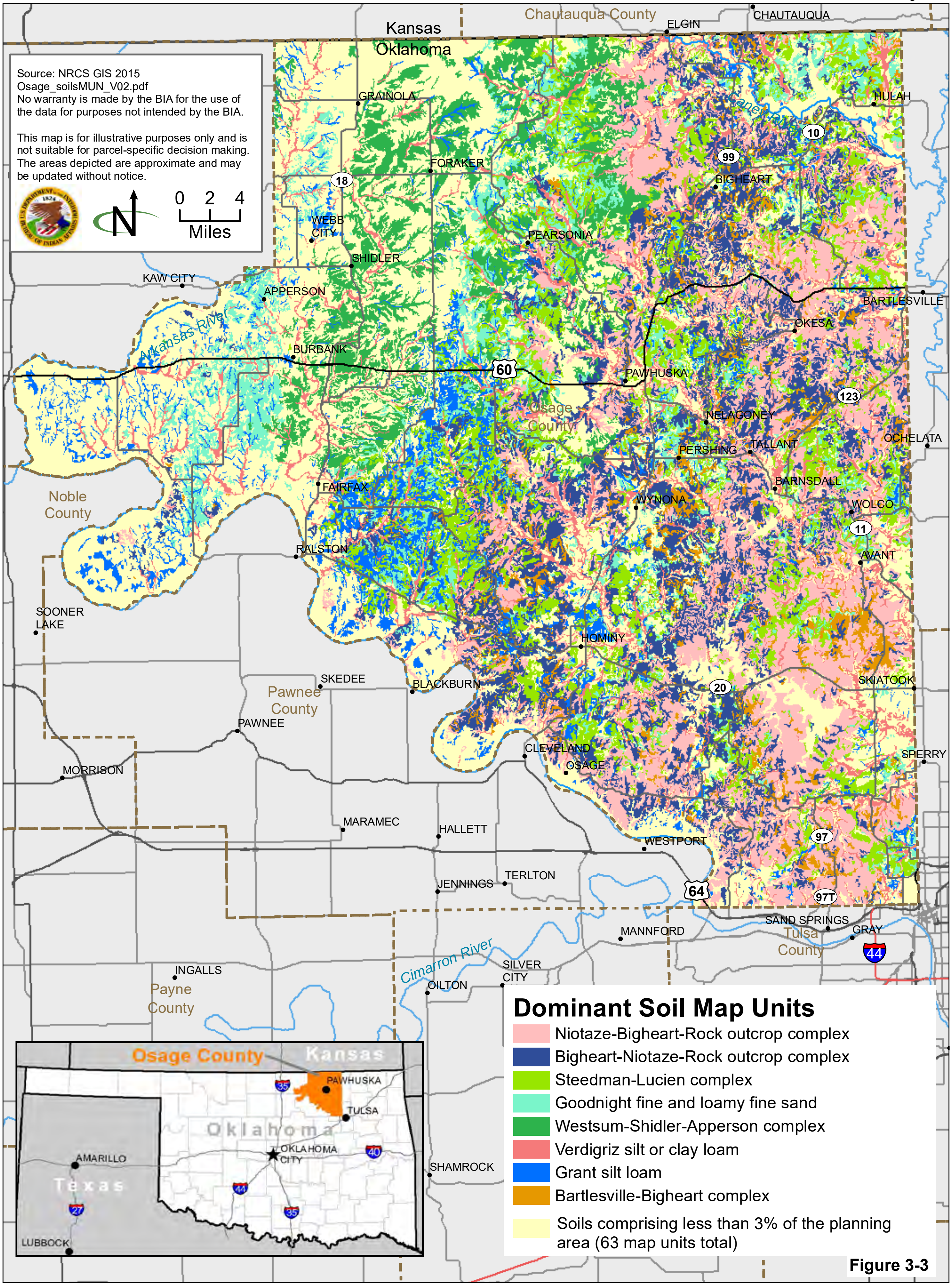
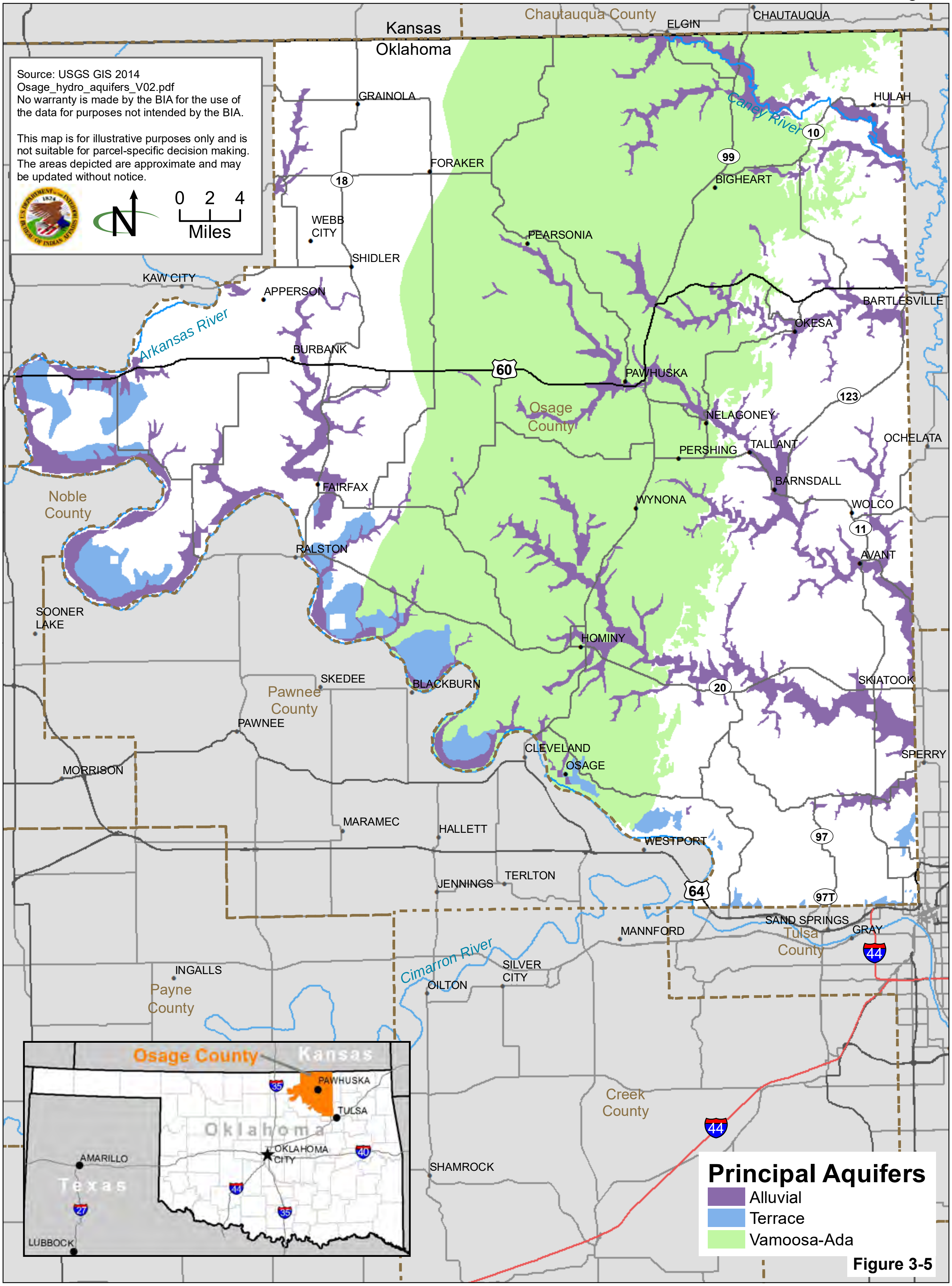
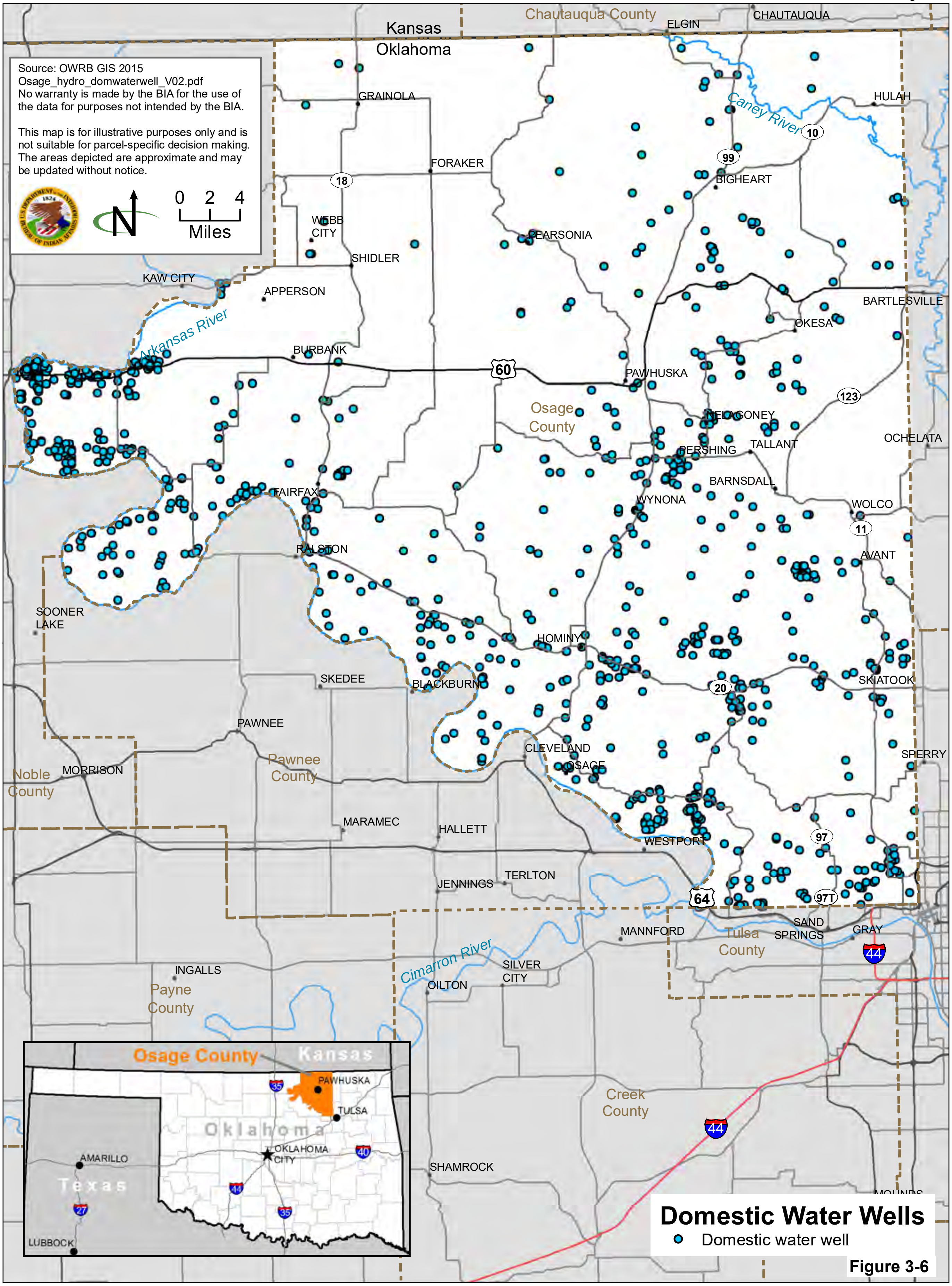

Source: NRCS GIS 2015
Osage_soilsMUN_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
FAIRFAX
BARNSDALL
WYNONA
WOLCO
Noble County
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
MANNFORD
GRAY
Tulsa County
Cimarron River
INGALLS
SILVER CITY
OILTON
Payne County
SHAMROCK
10
99
18
60
123
11
20
97
64
97T
44
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
35
40
44
27
Dominant Soil Map Units
Niotaze-Bigheart-Rock outcrop complex
Bigheart-Niotaze-Rock outcrop complex
Steedman-Lucien complex
Goodnight fine and loamy fine sand
Westsum-Shidler-Apperson complex
Verdigriz silt or clay loam
Grant silt loam
Bartlesville-Bigheart complex
Soils comprising less than 3% of the planning area (63 map units total)
Figure 3-3

Figure 3-4
Example Salt-scarred Site in the Planning Area

Source: USGS 2015b


Source: USGS GIS 2014
Osage_hydro_aquifers_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
10
99
18
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
Arkansas River
OKESA
BURBANK
60
PAWHUSKA
123
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
Noble County
FAIRFAX
WYNONA
WOLCO
11
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
20
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
SPERRY
OSAGE
MORRISON
MARAMEC
HALLETT
WESTPORT
97
JENNINGS
TERLTON
64
97T
SAND SPRINGS
MANNFORD
Tulsa County
GRAY
44
Cimarron River
SILVER CITY
OILTON
INGALLS
Payne County
Osage County
Kansas
PAWHUSKA
35
TULSA
Oklahoma
OKLAHOMA CITY
40
AMARILLO
Texas
44
27
35
LUBBOCK
Creek County
SHAMROCK
Principal Aquifers
Alluvial
Terrace
Vamoosa-Ada
Figure 3-5


Source: OWRB GIS 2015
Osage_hydro_domwaterwell_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
HULAH
Caney River
GRAINOLA
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
Arkansas River
BURBANK
PAWHUSKA
OKESA
BARTLESVILLE
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
Pawnee County
CLEVELAND
OSAGE
SPERRY
Noble County
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
Tulsa County
SAND SPRINGS
GRAY
INGALLS
Payne County
Cimarron River
SILVER CITY
OILTON
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Domestic Water Wells
Domestic water well
Figure 3-6

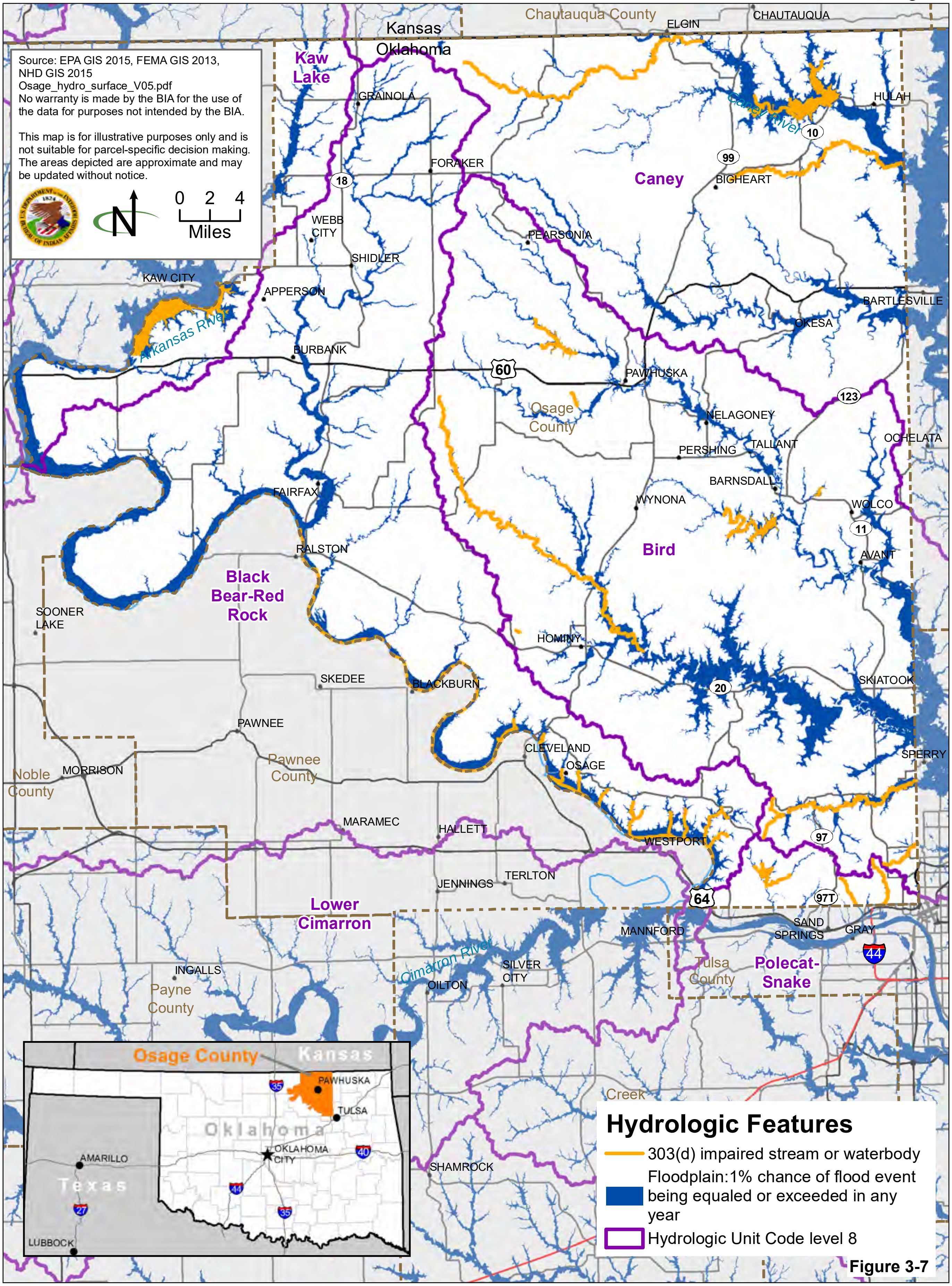
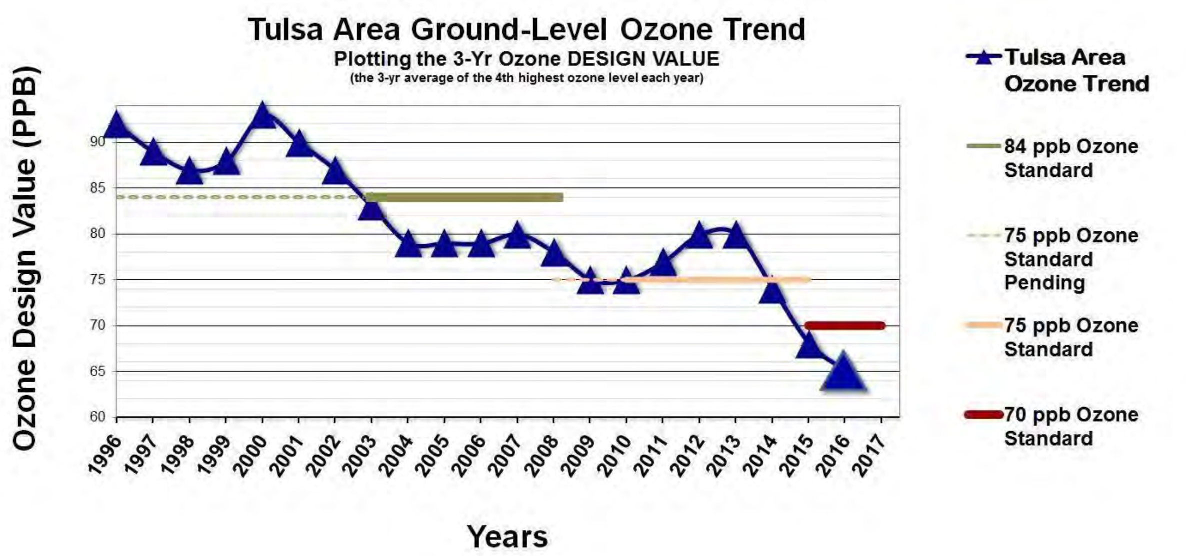
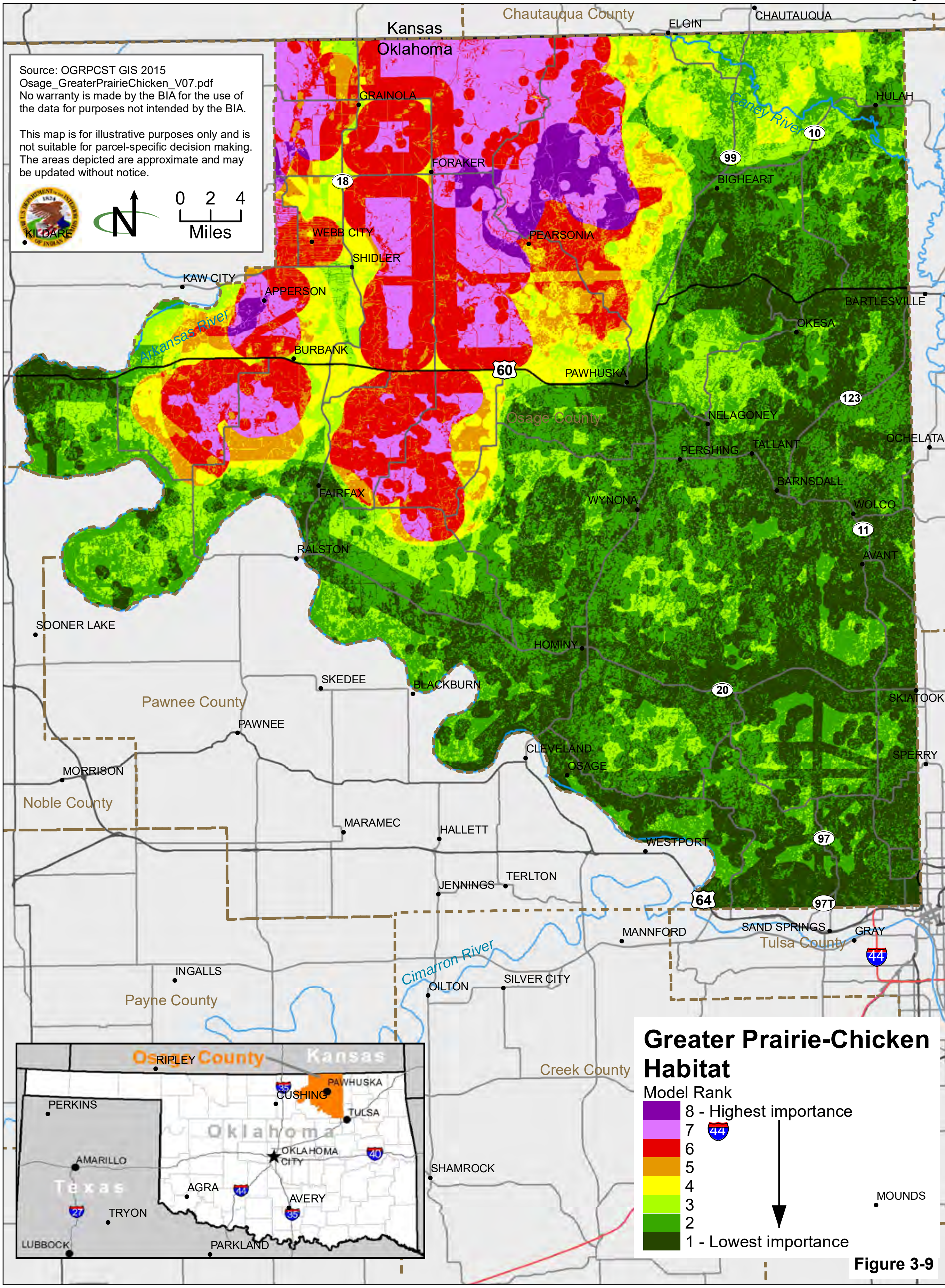

Source: EPA GIS 2015, FEMA GIS 2013, NHD GIS 2015
Osage_hydro_surface_V05.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
Kaw Lake
GRAINOLA
HULAH
Caney River
Caney
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
Arkansas River
BURBANK
BARTLESVILLE
OKESA
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
Bird
AVANT
Black Bear-Red Rock
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
Noble County
MORRISON
Pawnee County
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
Lower Cimarron
MANNFORD
SAND SPRINGS
GRAY
Cimarron River
SILVER CITY
INGALLS
OILTON
Tulsa County
Polecat-Snake
Payne County
Creek
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Hydrologic Features
303(d) impaired stream or waterbody
Floodplain:1% chance of flood event being equaled or exceeded in any year
Hydrologic Unit Code level 8

Figure 3-7

Figure 3-8
Ground Level Ozone Trend (1996–2016)



Source: INCOG and OK DEQ 2017



Source: OGRPCST GIS 2015
Osage_GreaterPrairieChicken_V07.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Greater Prairie-Chicken Habitat
Model Rank
8 - Highest importance
7
6
5
4
3
2
1 - Lowest importance
Kansas
Oklahoma
Chautauqua County
Osage County
Pawnee County
Noble County
Payne County
Creek County
Tulsa County
Arkansas River
Caney River
Cimarron River
ELGIN
CHAUTAUQUA
HULAH
GRAINOLA
FORAKER
BIGHEART
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
BURBANK
BARTLESVILLE
OKESA
PAWHUSKA
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
WOLCO
FAIRFAX
WYNONA
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
INGALLS
OILTON
SILVER CITY
RIPLEY
CUSHING
PERKINS
SHAMROCK
MOUNDS
KILDARE
Texas
Oklahoma
AMARILLO
TULSA
OKLAHOMA CITY
AGRA
AVERY
TRYON
LUBBOCK
PARKLAND

Figure 3-9

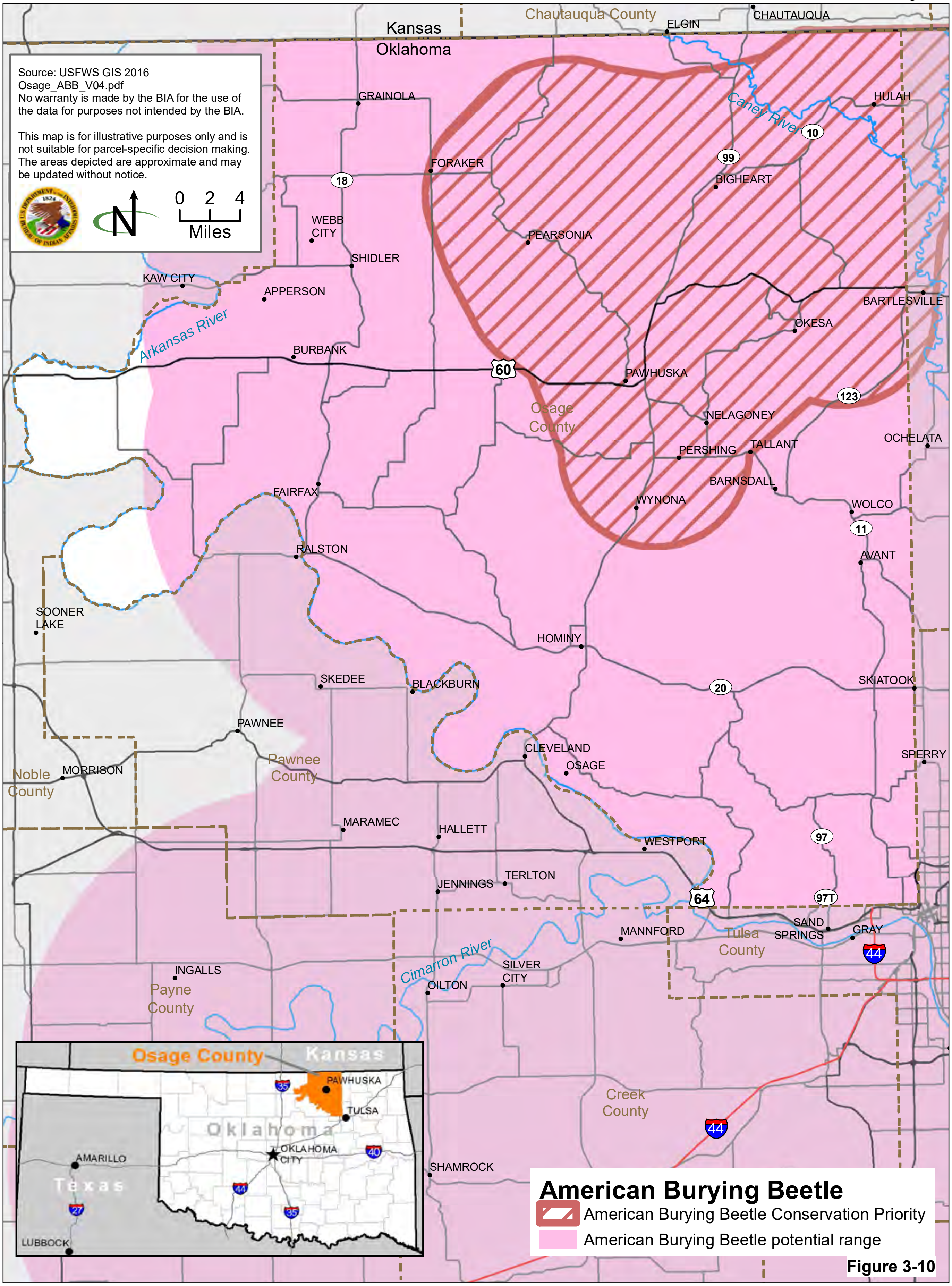

Source: USFWS GIS 2016
Osage_ABB_V04.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
PAWNEE
CLEVELAND
OSAGE
SPERRY
Pawnee County
Noble County
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
INGALLS
Cimarron River
SILVER CITY
Payne County
OILTON
Creek County
SHAMROCK
Osage County
Kansas
Oklahoma
Texas
TULSA
OKLAHOMA CITY
AMARILLO
LUBBOCK
American Burying Beetle
American Burying Beetle Conservation Priority
American Burying Beetle potential range

Figure 3-10

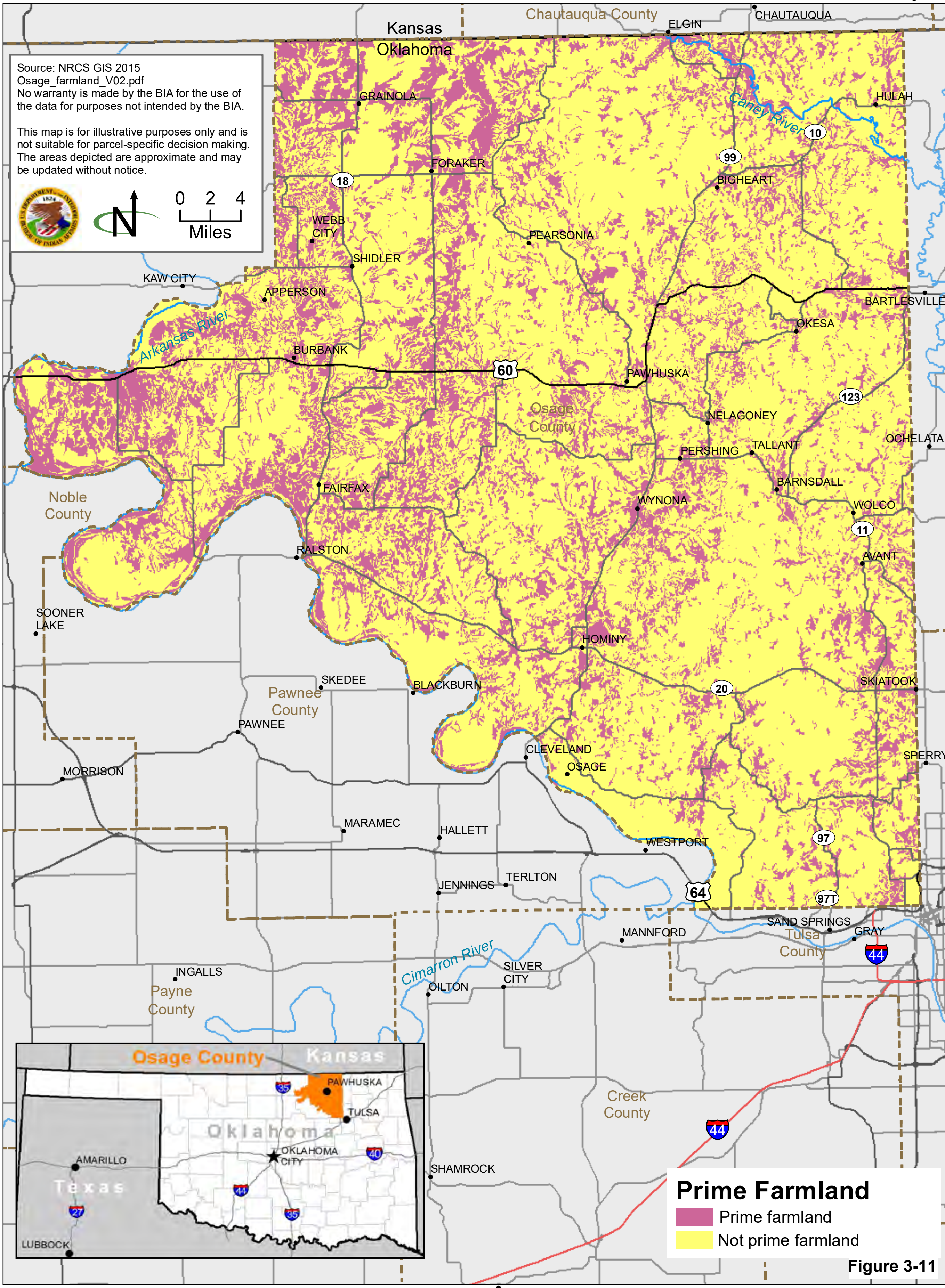

Source: NRCS GIS 2015
Osage_farmland_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
N
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
FORAKER
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
OKESA
Arkansas River
BURBANK
PAWHUSKA
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
FAIRFAX
BARNSDALL
Noble County
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
SKIATOOK
BLACKBURN
Pawnee County
PAWNEE
CLEVELAND
SPERRY
OSAGE
MORRISON
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
SAND SPRINGS
MANNFORD
Tulsa County
GRAY
Cimarron River
SILVER CITY
INGALLS
OILTON
Payne County
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Prime Farmland
Prime farmland
Not prime farmland

Figure 3-11

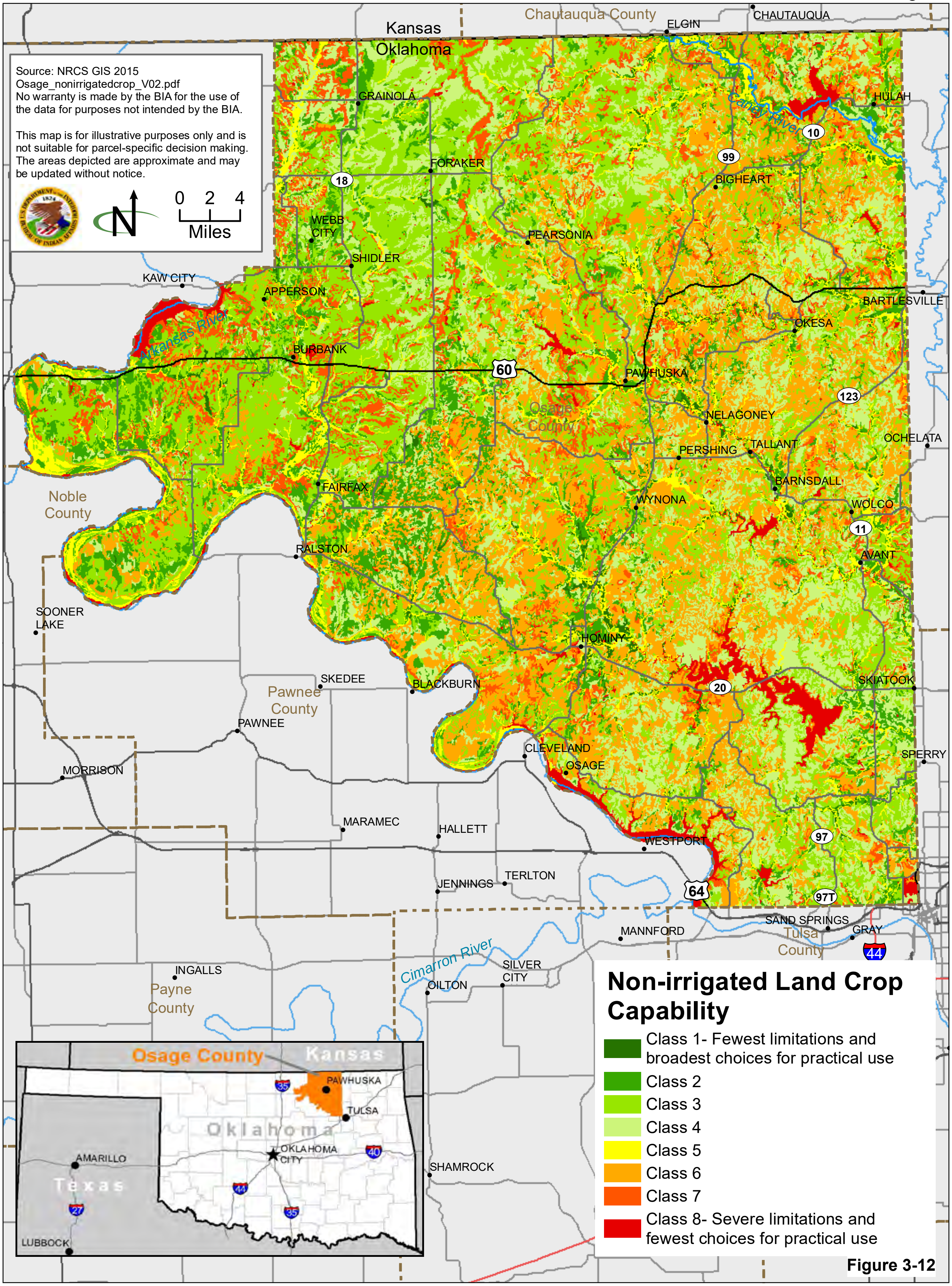
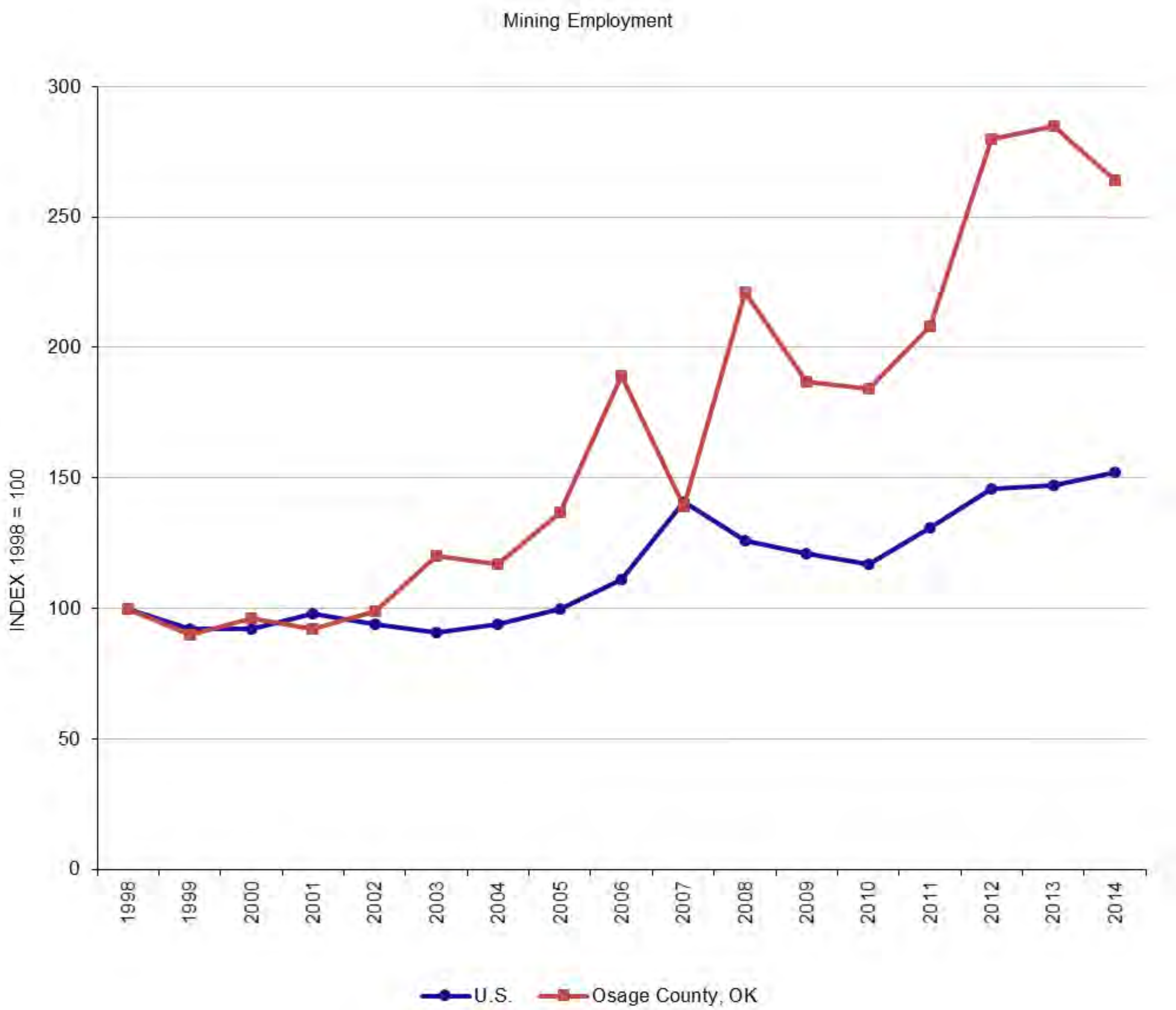
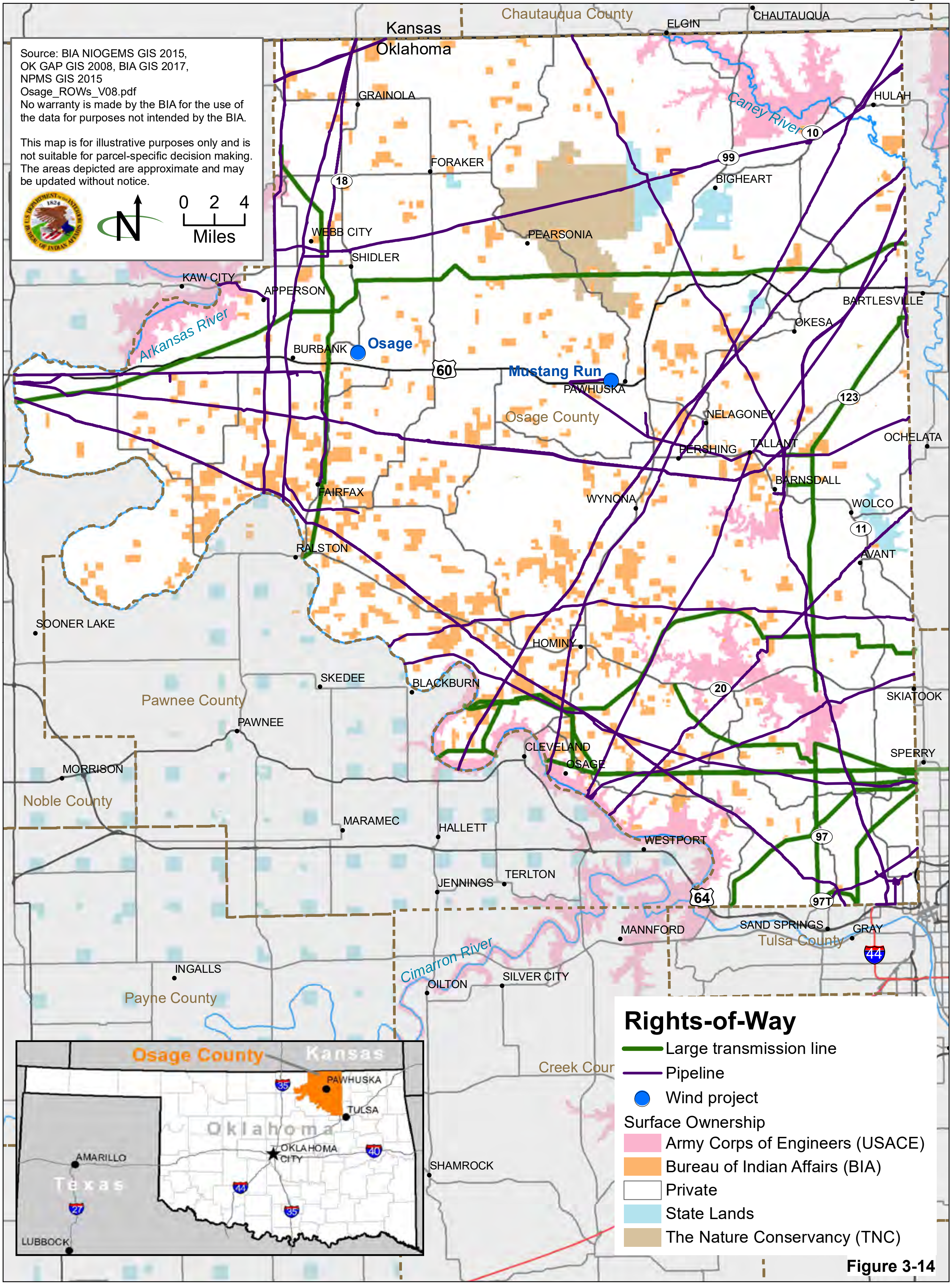

Source: NRCS GIS 2015
Osage_nonirrigatedcrop_V02.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
HULAH
Caney River
10
99
BIGHEART
GRAINOLA
FORAKER
18
WEBB CITY
SHIDLER
PEARSONIA
KAW CITY
APPERSON
Arkansas River
BURBANK
60
PAWHUSKA
BARTLESVILLE
OKESA
123
NELAGONEY
Osage County
OCHELATA
TALLANT
PERSHING
BARNSDALL
FAIRFAX
Noble County
WYNONA
WOLCO
11
AVANT
RALSTON
SOONER LAKE
HOMINY
SKIATOOK
SKEDEE
BLACKBURN
Pawnee County
20
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
MARAMEC
HALLETT
WESTPORT
97
JENNINGS
TERLTON
64
97T
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
44
Cimarron River
SILVER CITY
OILTON
INGALLS
Payne County
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
35
40
44
27
SHAMROCK
Non-irrigated Land Crop Capability
Class 1- Fewest limitations and broadest choices for practical use
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
Class 8- Severe limitations and fewest choices for practical use

Figure 3-12

Figure 3-13
Mining Employment 1998-2014

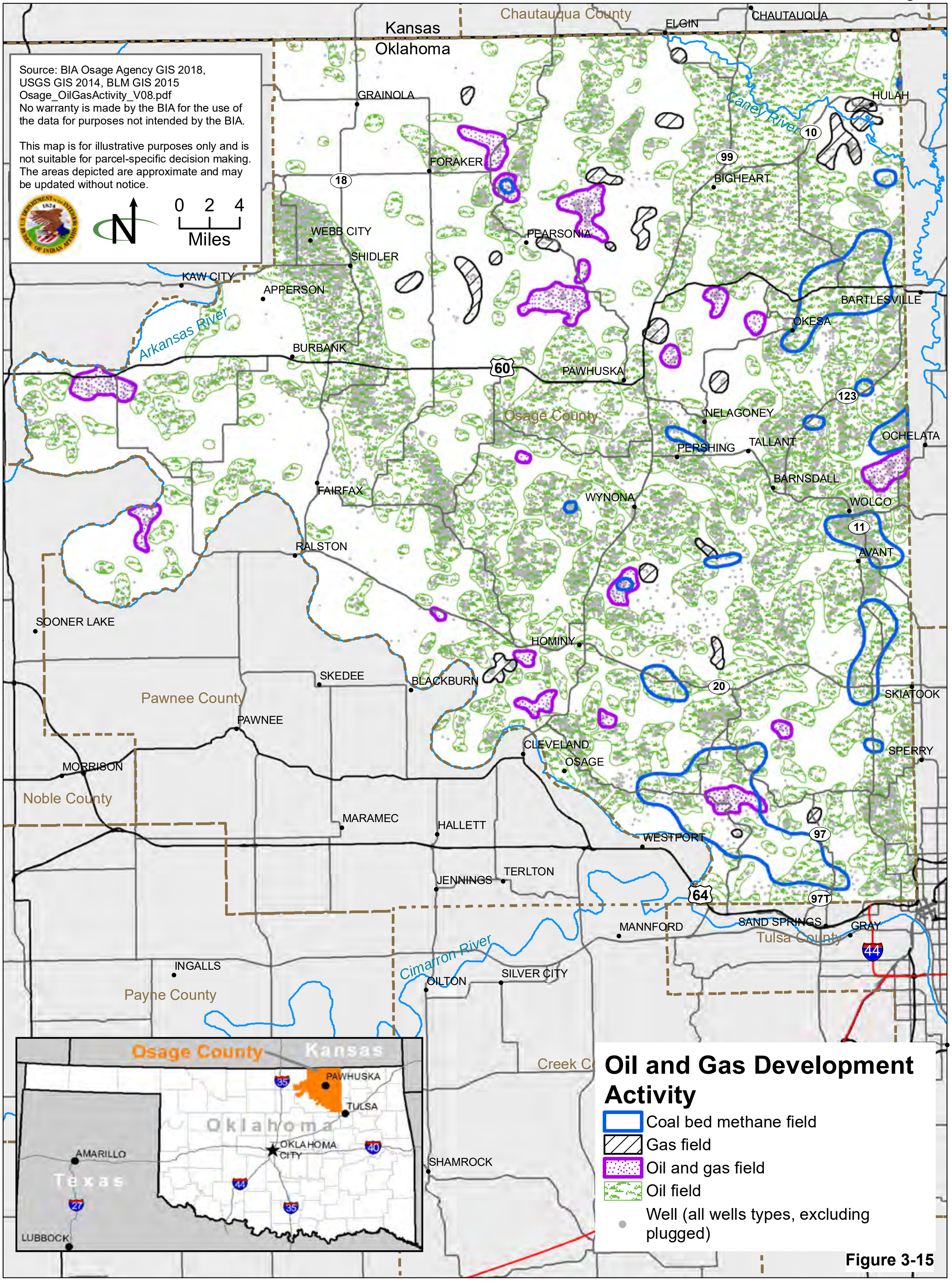


Source: US Census Bureau, as reported in Headwaters Economics 2017



Source: BIA NIOGEMS GIS 2015, OK GAP GIS 2008, BIA GIS 2017, NPMS GIS 2015
Osage_ROWs_V08.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
N
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
GRAINOLA
HULAH
Caney River
10
99
FORAKER
18
BIGHEART
WEBB CITY
PEARSONIA
SHIDLER
KAW CITY
APPERSON
BARTLESVILLE
Arkansas River
OKESA
Osage
BURBANK
60
Mustang Run
PAWHUSKA
123
Osage County
NELAGONEY
OCHELATA
PERSHING
TALLANT
BARNSDALL
FAIRFAX
WYNONA
WOLCO
11
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
Pawnee County
20
SKIATOOK
PAWNEE
CLEVELAND
SPERRY
MORRISON
OSAGE
Noble County
MARAMEC
HALLETT
WESTPORT
97
TERLTON
JENNINGS
64
97T
SAND SPRINGS
GRAY
MANNFORD
Tulsa County
44
Cimarron River
INGALLS
OILTON
SILVER CITY
Payne County
Creek County
SHAMROCK
Osage County
Kansas
PAWHUSKA
35
TULSA
Oklahoma
OKLAHOMA CITY
40
AMARILLO
Texas
44
27
35
LUBBOCK
Rights-of-Way
Large transmission line
Pipeline
Wind project
Surface Ownership
Army Corps of Engineers (USACE)
Bureau of Indian Affairs (BIA)
Private
State Lands
The Nature Conservancy (TNC)

Figure 3-14



Source: BIA Osage Agency GIS 2018, USGS GIS 2014, BLM GIS 2015
Osage_OilGasActivity_V08.pdf
No warranty is made by the BIA for the use of the data for purposes not intended by the BIA.
This map is for illustrative purposes only and is not suitable for parcel-specific decision making. The areas depicted are approximate and may be updated without notice.
0 2 4
Miles
Kansas
Oklahoma
Chautauqua County
ELGIN
CHAUTAUQUA
HULAH
Caney River
GRAINOLA
FORAKER
BIGHEART
PEARSONIA
WEBB CITY
SHIDLER
KAW CITY
APPERSON
Arkansas River
BURBANK
BARTLESVILLE
OKESA
PAWHUSKA
Osage County
NELAGONEY
PERSHING
TALLANT
OCHELATA
BARNSDALL
FAIRFAX
WYNONA
WOLCO
RALSTON
AVANT
SOONER LAKE
HOMINY
SKEDEE
BLACKBURN
SKIATOOK
Pawnee County
PAWNEE
CLEVELAND
OSAGE
SPERRY
MORRISON
Noble County
MARAMEC
HALLETT
WESTPORT
JENNINGS
TERLTON
MANNFORD
SAND SPRINGS
GRAY
Tulsa County
INGALLS
Payne County
Cimarron River
OILTON
SILVER CITY
Creek C
SHAMROCK
Osage County
Kansas
PAWHUSKA
TULSA
Oklahoma
OKLAHOMA CITY
AMARILLO
Texas
LUBBOCK
Oil and Gas Development Activity
Coal bed methane field
Gas field
Oil and gas field
Oil field
Well (all wells types, excluding plugged)

Figure 3-15

This page intentionally left blank.

Appendix F
List of Preparers

Appendix F.
List of Preparers

Name	Role/Responsibility
BIA Interdisciplinary Team	
Lisa Atwell	Program Support Assistant, Division of Environmental and Cultural Resource Management, Eastern Oklahoma Region
Richard Beaty	Archaeologist, Osage Agency
Benjamin Daniels	Supervisory Environmental Protection Specialist, Osage Agency (Former)
Jeannine Hale	Regional Environmental Protection Specialist, Division of Environmental and Cultural Resource Management, Eastern Oklahoma Region (Retired)
Mosby Halterman	Project Lead; Regional Environmental Scientist, Division of Environmental and Cultural Resource Management, Eastern Oklahoma Region
Shelby Hanchera	Environmental Protection Specialist, Osage Agency
Deborah Kirk	GIS Specialist, Osage Agency
Sierra Mandelko	Archaeologist, Eastern Oklahoma Region (Former)
Michael Miley	Environmental Protection Specialist, Division of Environmental and Cultural Resource Management, Eastern Oklahoma Region
Robin Phillips	Superintendent, Osage Agency
Richard Winlock	Acting Deputy Superintendent, Osage Agency
Department of the Interior	
Kristen Kokinos	Attorney-Advisor, Office of the Solicitor
Stephen Simpson	Senior Attorney, Office of the Solicitor
EMPSi Interdisciplinary Team	
Jordan Adams	Topography, Geology, Paleontology, and Soils; Agriculture
David Batts	Program Manager
Amy Cordle	Air Quality and Climate
Sean Cottle	Land Use Plans, Utilities, and Timber Harvesting; Recreation and Special Use Areas
Francis Craig	Topography, Geology, Paleontology, and Soils; Public Health and Safety; Mineral Extraction
Annie Daly	Air Quality and Climate; Public Health and Safety

Name	Role/Responsibility
Kevin Doyle	Historical, Cultural, and Archaeological Resources; Agriculture
Zoe Ghali	Socioeconomics and Environmental Justice
Peter Gower	Land Use Plans, Utilities, and Timber Harvesting; Traffic and Transportation
Haley Holladay	Vegetation, Wetlands, and Noxious Weeds
Derek Holmgren	Water Resources; Noise
Jenna Jonker	GIS/eGIS Lead
Kate Krebs	Visual Resources
Molly McCarter	Deputy Project Manager; Visual Resources; Noise; Quality Assurance and Quality Control
Laura Patten	Water Resources
Katie Patterson	Project Manager; Water Resources; Mineral Extraction
Kevin Rice	Fish and Wildlife
Andy Spellmeyer	Fish and Wildlife; Special Status Species
Morgan Trieger	Vegetation, Wetlands, and Noxious Weeds
Drew Vankat	Public Health and Safety; Traffic and Transportation; Recreation, and Special Use Areas
Liza Wozniak	Special Status Species
Meredith Zaccherio	Fish and Wildlife; Vegetation, Wetlands, and Noxious Weeds; Special Status Species

Appendix G
References

Appendix G. References

Abbott, M. M. 2000. Water Quality of the Quaternary and Ada-Vamoosa Aquifers on the Osage Reservation, Osage County, Oklahoma, 1997: US Geological Survey Water-Resources Investigations Report 99-4231.

Aldridge, C. L., & Boyce, M. S. 2007. Linking Occurrence and Fitness to Persistence: Habitat-Based Approach for Endangered Greater Sage-Grouse. Ecological Applications, 17(2), 508-526.

Alley, William. 2014. Hydraulic fracturing: Meeting the nation's energy needs while protecting groundwater resources. National Groundwater Association Position Paper.

America's Scenic Byways. 2015. Osage Nation Heritage Trail Byway. Internet website: http://scenicbyways.info/byway/74113.html.

American Society of Mammalogists. 2015. State-specific lists of indigenous mammals. Internet website: http://www.mammalsociety.org/mammals-list.

American Speech-Language-Hearing Association. 2018. Loud Noise Dangers. Internet website: http://www.asha.org/content.aspx?id=10737441099.

Annie E. Casey Foundation. 2014. Kids Count. 2014 Data Book: trends in child well-being. Internet website: http://www.aecf.org/2014db.

APLIC (Avian Power Line Interaction Committee). 2012. Reducing Avian Collisions with Power Lines. The state of the Art in 2012. Edison Electric Institute. Internet website: http://www.aplic.org/uploads/files/11218/Reducing_Avian_Collisions_2012watermarkLR.pdf.

AWWA (American Water Works Association). 2013. Water and hydraulic fracturing: A white paper from the American Water Works Association. Internet website: http://www.awwa.org/portals/0/files/legreg/documents/awwafrackingreport.pdf.

Belnap, J., R. Prasse and K. T. Harper. 2001. Influence of Biological Soil Crusts on Soil Environments and Vascular Plants. Ecological Studies, 2001, Volume 150, Part IV, 281-300, DOI: 10.1007/978-3-642-56475-8_21.

BIA (United States Department of the Interior, Bureau of Indian Affairs). 1979. Environmental Assessment for the Oil and Gas Leasing Program of the Osage Indian Tribe, Osage County, Oklahoma. Muskogee Area Office. Muskogee, Oklahoma. May 1979.

______. 2009. Regional 10-Year Fire Management Plan 2010-2020. Eastern Oklahoma Regional Office, Division of Environmental, Safety, and Cultural Resources Management. Muskogee, Oklahoma.

______. 2012. Indian Affairs National Environmental Policy Act (NEPA) Guidebook. 59 IAM 3-H. Reston, Virginia. August 2012.

______. 2013. Environmental Assessment Report for the Flanagan South Pipeline Project. Prepared by URS. December 24, 2013.

______. 2014. Programmatic Environmental Assessment for Leasing Activities. BIA Osage Agency. Pawhuska, Oklahoma.

______. 2015a. Programmatic Environmental Assessment for Approving Workover Operations. BIA Osage Agency. Pawhuska, Oklahoma.

______. 2015b. BIA Production Report. Oil Report. Years 2010-2015.

______. 2015c. BIA Production Report. Dry Gas Report. Years 2006-2015.

______. 2016. Osage County Oil and Gas Scoping Summary Report. BIA Eastern Oklahoma Region, Osage Agency. September 2016. Internet website: https://www.bia.gov/cs/groups/xregeasternok/documents/text/idc2-048210.pdf/.

______. 2017a. Standard Best Management Practices (BMP) Drilling Permits and Standard Best Management Practices (BMP) Workover/Plugging Permits. Osage Oil and Gas Environmental Impact Statement. Internet website: https://www.bia.gov/regional-offices/eastern-oklahoma/osage-agency/osage-oil-and-gas-eis.

______. 2017b. BIA Production Report. Oil, Gas and 214 Minerals. Years 2015-2016.

BIA GIS. 2017. GIS data created by or for the use of the BIA for the completion of the Osage Oil and Gas EIS. Data used to support the alternatives, affected environment, impact analysis, or other document features. Data updated throughout the project life and available upon request.

BIA NIOGEMS GIS. 2015. GIS data of BIA-administered tribal and allotted lands. Bureau of Indian Affairs, Southern Plains and Eastern Oklahoma Regions.

BIA Osage Agency GIS. 2018. Osage Agency wellbore plat book and GIS data. Data received from BIA March 2018.

Bingham, R. H., and D. L. Bergman. 1980. Reconnaissance of the Water Resources of the Enid Quadrangle North-central Oklahoma: Oklahoma Geological Survey, Hydrologic Atlas 7.

BLM (United States Department of the Interior, Bureau of Land Management). 1984. Manual 8400—Visual Resource Management. Rel. 8-24. Washington, DC. April 5, 1984.

______. 1986. Handbook H-8410-1—Visual Resource Inventory. Rel. 8-28. BLM, Washington, DC. January 17, 1986.

______. 2016a. Air Resources Technical Report for Oil and Gas Development, New Mexico, Oklahoma, Texas, and Kansas. BLM, New Mexico State Office. January 2016.

______. 2016b. Reasonable Foreseeable Development (RFD) for Oil and Gas, Minerals, Geothermal, Wind and Solar Resources in Kansas, Oklahoma and Texas. BLM Oklahoma Field Office. December 5, 2016.

BLM and BIA (United States Department of the Interior, Bureau of Land Management and Bureau of Indian Affairs). 2014. Oklahoma Field Office Resource Management Plan Revision and Environmental Impact Statement Final Scoping Summary Report. BLM Oklahoma Field Office, Tulsa.

BLM and Forest Service (United Stated Department of the Interior, Bureau of Land Management, and United States Department of Agriculture, Forest Service). 2007. Surface operating standards and guidelines for oil and gas exploration and development: The Gold Book. Fourth edition.

BLM GIS. 2015. GIS data of oil and gas potential as provided by the BLM in the Reasonably Foreseeable Development Scenario. Bureau of Land Management, Oklahoma Field Office.

______. 2016. GIS data of Visual Resource Inventory and components. Bureau of Land Management, Oklahoma Field Office.

Bureau of Labor Statistics. 2016. CPI conversion calculator. Internet website: https://www.bls.gov/data/inflation_calculator.htm.

______. 2017. Local Area Unemployment Statistics. Osage County. Internet website: https://www.bls.gov/lau/.

Cameron Siler. 2017. Chytrid fungus found on amphibians in Oklahoma. Internet website: http://cameronsiler.com/chytrid-fungus-found-on-amphibians-in-oklahoma/.

CEQ (Council on Environmental Quality). 1997. Environmental Justice: Guidance Under the National Environmental Policy Act. Internet website: https://www.epa.gov/environmentaljustice/ceq-environmental-justice-guidance-under-national-environmental-policy-act.

______. 2010. Memorandum for Heads of Federal Departments and Agencies: Establishing, Applying, and Revising Categorical Exclusions under the National Environmental Policy Act. Washington, DC. November 23, 2010. Internet website: https://ceq.doe.gov/docs/ceq-regulations-andguidance/NEPA_CE_Guidance_Nov232010.pdf.

Ceres. 2014. Hydraulic Fracturing and Water Stress: Water Demand by the Numbers. Internet website: http://www.ceres.org/resources/reports/hydraulic-fracturing-water-stress-water-demand-by-the-numbers.

Clement, J. P., A. d'A. Belin, M. J. Bean, T. A. Boling, and J. R. Lyons. 2014. A strategy for improving the mitigation policies and practices of the Department of the Interior. A Report to the Secretary of the Interior from the Energy and Climate Change Task Force. April 2014.

Coleman, J. 2014. "White-nose syndrome the devastating disease of hibernating bats in North America." US Fish and Wildlife Publications. Paper 453.

Cosic, Biljana, and Krish Vijayaraghavan. 2016. GHG Emissions and Climate Change for the BLM-BIA Regional Management Plan/Environmental Impact Statement for Kansas-Oklahoma-Texas. Prepared for the BLM New Mexico State Office, Santa Fe, and the BLM National Operations Center, Denver, Colorado. September 2016.

Cowardin, L. M., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. US Department of the Interior, Fish and Wildlife Service, Washington, DC. Jamestown, North Dakota: Northern Prairie Wildlife Research Center Online. Internet website: http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm (Version 04DEC1998).

Crawford, P. H. 2012. Why Is the Interior Least Tern Endangered? Oklahoma Department of Wildlife Conservation and the US Fish and Wildlife Service, Section 6 Grant E-73-R-1. Internet website: http://faculty-staff.ou.edu/C/Priscilla.H.Crawford-1/images/TernPamphlet_2012.pdf.

D'Lugosz, J. J., R. G. McClaflin, and M. V. Marcher. 1986. Geohydrology of the Vamoosa-Ada Aquifer East-Central Oklahoma: Oklahoma Geological Survey Circular 87.

Daniels, Mike, Brian Haggard, and Andrew Sharpley. Undated. Arkansas Watersheds. University of Arkansas Division of Agriculture, Cooperative Extension Service.

DOI (United States Department of the Interior). 2015. Osage Nation Becomes 20th Tribe to Partner with Interior to Implement the Land Buy-Back Program, Press Release. May 28, 2015 Office of the Secretary, Internet Website: https://www.doi.gov/pressreleases/osage-nation-becomes-20th-tribe-to-partner-with-interior-to-implement-the-land-buy-back-program.

______. 2016. Visual Resource Inventory Report. Bureau of Land Management Oklahoma Field Office and Amarillo Field Office. Bureau of Indian Affairs Southern Plains Region and Eastern Oklahoma Region. April 2016. Tulsa, Oklahoma.

Duck, L. G., and J. B. Fletcher. 1943. The Game Types of Oklahoma. A Report to the Oklahoma Game and Fish Commission. Adapted by the Oklahoma Biological Survey. Internet website: http://www.biosurvey.ou.edu/duckflt/dfhome.html.

Earthworks. 2015. Oil and Gas Noise. Internet website: http://www.earthworksaction.org/issues/detail/oil_and_gas_noise#.VSVVVfnF_sY.

eBird. 2017. Tallgrass Prairie Preserve, First Sightings, 1994-2017. Internet website: http://ebird.org/ebird/sightings?locInfo.regionType=hotspot&locInfo.regionCode=L275551&locInfo.parentCode=US-OK&continuous=true&listType=first.

Energy Information Administration. 2014. Annual Energy Outlook 2014. pp. A-25 to A-27. Internet website: http://www.eia.gov/forecasts/aeo/pdf/appa.pdf.

Environmental Laboratory. 1987. 1987 Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, US Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. January 1987.

EPA (United States Environmental Protection Agency). 1978. Protective Noise Levels. Condensed Version of EPA Levels Document. EPA 550/9-79-100. US Environmental Protection Agency. Office of Noise Abatement and Control. Washington, DC.

______. 2000. EPA Office of Compliance Sector Notebook Project: Profile of the Oil and Gas Extraction Industry. EPA/310-R-99-006. Washington, DC.

______. 2012. Ecoregions in Oklahoma. Internet website: http://www.epa.gov/wed/pages/ecoregions/ok_eco.htm.

______. 2013. 12-Month Finding on a Petition to List the Rattlesnake-Master Borer Moth (*Papaipema eryngii*) as an Endangered or Threatened Species. 78 FR 49422 49440.

______. 2015a. The Process of Hydraulic Fracturing. Internet website: http://www.epa.gov/hydraulicfracturing/process-hydraulic-fracturing.

______. 2015b. About Private Water Wells. Internet website: https://www.epa.gov/privatewells/about-private-water-wells.

______. 2015c. Impaired Waters and Total Maximum Daily Loads. Internet website: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/.

______. 2015d. Watershed, Assessment, Tracking and Environmental Results, Oklahoma 303(d) Listed Waters for Reporting Year 2012. Internet website: http://iaspub.epa.gov/waters10/attains_impaired_waters.impaired_waters_list?p_state=OK&p_cycle=2012.

______. 2015e. Guidance on Considering Environmental Justice During the Development of Regulatory Actions. May 2015. Internet website: https://www.epa.gov/sites/production/files/2015-06/documents/considering-ej-in-rulemaking-guide-final.pdf.

______. 2015f. CERCLA Overview. Internet website: http://www.epa.gov/superfund/policy/cercla.htm.

______. 2015g. Analysis of Hydraulic Fracturing Fluid Data from the FracFocus Chemical Disclosure Registry 1.0. Internet website: https://www.epa.gov/sites/production/files/2015-03/documents/fracfocus_analysis_report_and_appendices_final_032015_508_0.pdf.

______. 2015h. Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources. Internet website: https://www.epa.gov/sites/production/files/2015-06/documents/hf_es_erd_jun2015.pdf.

______. 2016a. Nonpoint Source Success Story: Delaware Creek. Internet website: https://www.epa.gov/sites/production/files/2016-10/documents/ok_delaware_creek_508.pdf.

______. 2016b. Climate Change Science. Internet website: https://19january2017snapshot.epa.gov/climate-change-science/future-climate-change_.html.

______. 2016c. Glossary of Climate Change Terms. Internet website: https://www3.epa.gov/climatechange/glossary.html#G.

______. 2016d. What Climate Change Means for Oklahoma. Internet website: https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ok.pdf. August 2016.

______. 2016e. EPA's Study of Hydraulic Fracturing and Its Potential Impact on Drinking Water Resources. Internet website: https://www.epa.gov/hfstudy/hydraulic-fracturing-water-cycle.

______. 2017a. NAAQS Table. Internet website: https://www.epa.gov/criteria-air-pollutants/naaqs-table.

______. 2017b. Nonattainment Areas for Criteria Pollutants (Green Book). Internet website: https://www.epa.gov/green-book.

______. 2017c. Outdoor Air Quality, Monitor Values Report (Ozone Report in 2013-2015 for Tulsa County, Oklahoma). Internet website: https://www.epa.gov/outdoor-air-quality-data/monitor-values-report.

______. 2017d. Inventory of US Greenhouse Gas Inventory Report, 1990-2015. Internet website: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015.

EPA GIS. 2015. GIS data used to describe the 303d impaired waters. Environmental Protection Agency. Internet website: http://water.epa.gov/scitech/datait/tools/waters/data/downloads.cfm.

Fairfax Community Hospital. 2017. Information page. Internet website: http://www.fairfaxcommunityhospital.com/.

FEMA GIS. 2013. GIS data of areas of high risk to flooding. Federal Emergency Management Agency. Data received via disc on October 2013.

Forbes, W. T. 1954. Lepidoptera of New York and Neighboring State, Part II. Cornell University Agricultural Experiment Station, Ithaca, New York. (Cited in BIA 2017)

Forest Service (United States Department of Agriculture, Forest Service). 2012. Noxious Weed Risk Assessment, Giant Sequoia National Monument Management Plan. July 2012. 27 pp.

Gallegos, T. J., Brian A. Varela, Seth S. Haines, and Mark A. Engle. 2015. Hydraulic fracturing water use variability in the United States and potential environmental implications. Water Resources Research 51(7):5839–5845. July 2015.

GAO (United States Government Accountability Office). 2004. Natural Gas Flaring and Venting Opportunities to Improve Data and Reduce Emissions.

Getches-Wilkinson Center for Natural Resources, Energy, and the Environment. 2015. Water Quantity. University of Colorado Law School, Intermountain Oil and Gas BMP Project. Internet website: http://www.oilandgasbmps.org/resources/water_quantity.php.

Global Carbon Project. 2014. Carbon Budget 2014: An annual update of the global carbon budget and trends. Internet website: http://www.globalcarbonproject.org/index.htm.

GPNC (Great Plains Nature Center). 2012. American burying beetle *Nicrophorus americanus*. Internet website: http://www.gpnc.org/abbeetle.htm.

Grant, J., R. Parikh, K. Vijayaraghavan, and R. Morris. 2016a. Memorandum: Texas, Oklahoma, and Kansas Oil and Gas and Mining Sector Emissions. Prepared by Ramboll Environ, Novato, California. Developed for the BLM New Mexico State Office, Santa Fe. May 2016.

______. 2016b. Addendum to the Memorandum: Texas, Oklahoma, and Kansas Oil and Gas and Mining Sector Emissions. Developed by Ramboll Environ, Novato, California. Developed for Craig Nicholls, BLM National Operations Center. May 2016.

Hammerson, G.A. 2007. *Phrynosoma cornutum*. The IUCN Red List of Threatened Species 2007: e. T64072A12741535. http://dx.doi.org/10.2305/IUCN.UK.2007.RLTS.T64072A12741535.en.

Harrington, B. 2001. "Red knot (*Calidris canutus*)." In *The birds of North America*. No. 563 (A. Poole, editor). The Academy of Natural Sciences, Washington, DC, and the American Ornithologists' Union, Philadelphia, Pennsylvania; doi:10.2173/bna.563. (Cited in BIA 2017)

Headwaters Economics. 2017. Economic Profile System. Socioeconomic profiles for Oklahoma and Osage County. Produced using the Economic Profile System-Human Dimensions Toolkit. Internet website: http://headwaterseconomics.org/tools/eps-hdt.

Hedge, Allen. 2011. Acoustic Environment. DEA3500. Cornell University, Ithaca, New York. January 2011.

Hoagland, B. W. 2000. The Vegetation of Oklahoma: A Classification for Landscape Mapping and Conservation Planning. Oklahoma Natural Heritage Inventory and Department of Geography, University of Oklahoma, Norman. December 2000.

______. 2008. Vegetation of Oklahoma. Educational Publication 9: 2008. Vegetation, Pg. 17.

Hunter, Andrea A., James Munkres, and Barker Fariss. 2013. Supporting Documentation: Osage Nation NAGPRA Claim for Human Remains Removed from the Clarksville Mound Group (23PI6), Pike County, Missouri. Manuscript of file, Osage Nation Historic Preservation Office, Osage Nation, Pawhuska, Oklahoma.

Indian Country Today 2016. Osage Nation Takes Ownership of Ted Turner's 43,000-Acre Ranch. August 26, 2016. Indian Country Today, Indian Country Media Network, Verona, NY. Internet Website: https://indiancountrymedianetwork.com/news/business/osage-nation-takes-ownership-of-ted-turners-43000-acre-ranch/.

Information Handling Services, Inc. 2015. Information Handling Services Energy Database. Queried by the BLM in April 2015.

______. 2017. Information Handling Services Energy Database. Queried by the Indian Energy Service Center in March 2017.

INCOG and OK DEQ (Indian Nations Council of Governments and Oklahoma Department of Environmental Quality). 2017. Tulsa Area Ozone Advance Annual Update: 2016. Internet website: https://www.epa.gov/sites/production/files/2017-03/documents/tulsa_update.feb_2017.pdf.

IPAA (Independent Petroleum Association of America). 2015. The Mississippian Lime: Not New, but Reinvented. Independent Petroleum Association of America, Edward Cross, Stephen Trammel, Bill Grieser, Steve London, and Matt Wilcoxson. Internet website: http://oilindependents.org/the-mississippian-lime-not-new-but-reinvented/.

IPCC (International Panel on Climate Change). 2013. "Climate change 2013: The physical science basis." Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels et al., editors). Cambridge University Press, Cambridge, United Kingdom, and New York, New York.

______. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (R. K. Pachauri and L. A. Meyer, editors). Geneva, Switzerland.

Jackson, R. E., A. W. Gorody B. Mayer, J. W. Roy, M. C. Ryan, and D. R. Van Stempvoort. 2013. Groundwater protection and unconventional gas extraction: The critical need for field-based hydrogeological research. Groundwater 51(4):488-510. July-August 2013.

Johnson, Kenneth S. 2008. Oklahoma Geological Survey. Geologic History of Oklahoma. Education Publication 9:2008. Internet website: http://www.ogs.ou.edu/pubsscanned/EP9_2-8geol.pdf.

Jordan, Louise. 1957. Subsurface Stratigraphic Names of Oklahoma. Oklahoma Geological Survey Guide Book VI. Internet website http://www.ogs.ou.edu/pubsscanned/guidebooks/GB6.pdf.

Jung, Jaegun, Wei Chun Hsieh, Maria Zatko, John Grant, Tejas Shah, and Krish Vijayaraghavan. 2016. Air Quality Modeling with CAMx for the BLM-BIA Regional Management Plan/Environmental Impact Statement for Kansas-Oklahoma-Texas. Prepared for BLM New Mexico State Office, Santa Fe, New Mexico. December 2016.

Karl, T. R., J. M. Melillo, and T. C. Peterson (editors). 2009. Global Climate Change Impacts in the United States. US Global Change Research Program, Cambridge University Press, New York, New York.

KDWPT (Kansas Department of Wildlife, Parks and Tourism). 2011. American Burying Beetle (*Nicrophorus americanus*). Internet website: http://kdwpt.state.ks.us/news/Services/Threatened-and-Endangered-Wildlife/Threatened-and-Endangered-Species/Species-Information/AMERICAN-BURYING-BEETLE.

______. 2012. Neosho Mucket (*Lampsilis rafinesqueana*). Internet website: http://kdwpt.state.ks.us/news/Services/Threatened-and-Endangered-Wildlife/Threatened-and-Endangered-Species/Species-Information/NEOSHO-MUCKET-MUSSEL.

Keystone State Park. 2017. Internet website: http://www.stateparks.com/keystone_state_park_in_oklahoma.html.

King, G. E. 2012. Hydraulic fracturing 101: What every representative, environmentalist, regulator, reporter, investor, university researcher, neighbor and engineer should know about estimating frac risk and improving frac performance in unconventional oil and gas wells. Presentation at SPE Hydraulic Fracturing Technology Conference, The Woodlands, Texas, February 6-8, 2012. SPE 152596, Society of Petroleum Engineers.

Koplos, J., M. E. Tuccillo, and B. Ranalli. 2014. "Hydraulic fracturing overview: How, where, and its role in oil and gas." *Journal American Water Works Association* 106(11):38–46.

La Flesche, Francis. 1930. "The Osage Tribe: Rite of the Wa-xo'-be." Bulletin No. 45. Bureau of American Ethnology, Smithsonian Institution, Washington, DC.

______. 1939. "The war ceremony and peace ceremony of the Osage Indians." Bulletin No. 101. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

Lewis, M. B. 2013. "Roads and the reproductive ecology of *Hesperidanthus suffrutecens*, an endangered shrub." Master's thesis. Utah State University, Logan.

Mashburn, S. L., C. C. Cope, and M. M. Abbott. 2003. Aquifer Characteristics, Water Availability, and Water Quality of the Quaternary Aquifer, Osage County, Northeastern Oklahoma, 2001-2002: US Geological Survey Water-Resources Investigations Report 03-4235.

May, Jon D. 2009. "Osage County." Encyclopedia of Oklahoma History and Encyclopedia of Oklahoma History and Culture. Internet website: http://www.okhistory.org.

McDermott, John Francis (editor). 1940. Tixier's Travels on the Osage Prairies. Translated from the French by Albert J. Salvan. University of Oklahoma, Norman.

MDC (Missouri Department of Conservation). 2011. MDC Online: Interior Least Tern (*Sternula antillarum athalassos*). Internet website: http://mdc4.mdc.mo.gov/applications/mofwis/Mofwis_Detail.aspx?id=0400294.

Metz, N. E., T. Roach, and J. A. Williams. 2017. The cost of Induced Seismicity: A Hedonic Analysis. *Economic Letters*. Volume 160, November 2017, Pages 86-9.

Murray, K. E., 2013. "State-scale perspective on water use and production associated with oil and gas operations, Oklahoma." *US Environmental Science & Technology* 47:4918–4925. Internet website: https://www.ncbi.nlm.nih.gov/pubmed/23531128.

NASA (National Aeronautics and Space Administration). 2016. Global Climate Change. Vital Signs of the Planet. Internet website: http://climate.nasa.gov/scientific-consensus.

National Audubon Society. 2013. Developing a Management Model of the Effects of Future Climate Change on Species: A Tool for the Landscape Conservation Cooperatives. Unpublished report prepared for the US Fish and Wildlife Service.

National Climate Assessment. 2014. US Global Change Research Program. National Climate Assessment, Great Plains. Internet website: http://nca2014.globalchange.gov/report/regions/great-plains.

National Oceanic and Atmospheric Administration, National Climatic Data Center. 2015. Data Tools: 1981-2010 Normals. Internet website: http://www.ncdc.noaa.gov/cdo-web/datatools/normals.

National Park Service (US Department of the Interior, National Park Service). 2011. Class I area locations. Internet website: http://www.nature.nps.gov/air/maps/classiloc.cfm. Last updated on July 26, 2011.

National Research Council. 2002. "Riparian areas: Functions and strategies for management." National Academy of Science. Washington, DC.

National Weather Service, Norman, OK, Weather Forecast Office. 2017. Heavy Snow in Oklahoma – Where, When, and How Often? Internet website: https://www.weather.gov/oun/climate-heavysnow.

NatureServe. 2015. Explorer. An Online Encyclopedia of Life. Internet website: http://www.natureserve.org/explorer.

NETL (National Energy Technology Laboratory). 2013. Modern shale gas development in the United States: An update. U.S. Department of Energy. September 2013.

NGWA (National Groundwater Association). 2016. "Hydraulic fracturing: Meeting the nation's energy needs while protecting groundwater resources." Internet website: http://www.ngwa.org/Documents/PositionPapers/Hydraulic-Fracturing-Meeting-Needs.pdf.

NHD GIS. 2015. GIS data of hydrographic features, including HUC 8 boundaries. National Hydrography Dataset. Internet website: http://datagateway.nrcs.usda.gov.

Nicot, J.-P., and B. R. Scanlon. 2012. "Water use for shale-gas production in Texas." *US Environmental Science & Technology* 46:3580–3586. Internet website: http://www.beg.utexas.edu/staffinfo/Scanlon_pdf/Nicot+Scanlon_ES&T_12_SI.pdf.

Nicot, J-P., R. C. Reedy, R. A. Costley, and Y. Huang. 2012. Oil & gas water use in Texas: Update to the 2011 Mining Water Use Report. Prepared for Texas Oil & Gas Association, Austin, Texas. Bureau of Economic Geology, Austin, Texas. September 2012. Internet website: http://www.beg.utexas.edu/water-energy/docs/Final_Report_O&GWaterUse-2012_8.pdf.

Niles, L. J., H. P. Sitters, A. D. Dey, P. W. Atkinson, A. J. Baker, K. A. Bennett, R. Carmona, et al. 2008. "Status of the red knot, *Calidris canutus rufa*, in the western hemisphere." *Studies Avian Biol.* 36:1-185. (Cited in BIA 2017)

NPMS GIS. 2015. GIS data of pipelines in Osage County, Oklahoma. National Pipeline Mapping System, Pipeline and Hazardous Materials Safety Administration. Data received August 2015.

NRCS (United States Department of Agriculture, Natural Resources Conservation Service). 2012a. Oklahoma State-listed Noxious Weeds. OK state weed list. Internet website: http://plants.usda.gov/java/noxious?rptType=State&statefips=40.

______. 2012b. Supplement to the Soil Survey of Osage County Web Soil Survey. Internet website: http://websoilsurvey.sc.egov.usda.gov/.

______. 2017. Official Soil Series Descriptions (OSD) Fact Sheet. Internet website: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/data/?cid=nrcs142p2_053586.

NRCS GIS. 2015. gSSURGO GIS data of slopes, prime farmland, map unit names, and non-irrigated land crop capability. Natural Resources Consevation Service, United States Department of Agriculture. Data received from BLM April 2015.

NWI GIS. 2017. GIS data of wetland and riparian areas. National Wetlands Inventory, United States Fish and Wildlife Service. Internet website: https://www.fws.gov/wetlands/data/data-download.html.

OCC (Oklahoma Corporation Commission). 2014. Title 165, Corporation Commission, Chapter 10, Oil and Gas Conservation. The Oklahoma Register, volume 31, number 24. Published September 2, 2014. Internet website: https://www.occeweb.com/rules/Ch10eff08-2516searchable.pdf.

ODM (Oklahoma Department of Mines). 2015. Annual Report 2015. Internet website: https://www.ok.gov/mines/documents/AnnualReport2015.pdf.

ODWC (Oklahoma Department of Wildlife Conservation). 2005a. Tallgrass Prairie Region. Oklahoma Comprehensive Wildlife Conservation Strategy. Internet website: https://www.wildlifedepartment.com/cwcs/ApprovedOKCWCSTallgrassPrairie.pdf.

______. 2005b. Final Report: The Freshwater Mussels of Oklahoma. Federal Aid Grant No. T-14-P-1.

______. 2013a. Bats of Oklahoma Field Guide, Oklahoma Department of Wildlife Conservation. Internet website: https://www.wildlifedepartment.com/wildlifemgmt/Batfieldguide.pdf.

______. 2013b. 2013 Deer Kill by County, Season, and Sex. Internet website: http://www.wildlifedepartment.com/hunting/deertotals/13county.pdf.

______. 2015. An overview of the federally listed and candidate species in Oklahoma. Internet website: https://www.wildlifedepartment.com/wildlifemgmt/515listed.pdf.

______. 2016a. Upland urgency: the fight against bobwhite quail decline. Internet website: https://www.wildlifedepartment.com/hunting/quail/upland_urgency.pdf.

______. 2016b. Wildlife Management Area Profile for Osage. Internet website: https://www.wildlifedepartment.com/facts_maps/wma/osage.htm.

______. 2017a. Eastern Oklahoma Bat Tests Positive for White-nose Syndrome. Internet website: http://www.wildlifedepartment.com/outdoor-news/eastern-oklahoma-bat-tests-positive-white-nose-syndrome.

______. 2017b. Whooping crane species account. Internet website: https://www.wildlifedepartment.com/wildlifemgmt/endangered/crane.htm.

______. 2017c. Eagles in Oklahoma. Internet website: https://www.wildlifedepartment.com/wildlifemgmt/eaglesinok.htm.

OGRPCST GIS. 2015. Oklahoma Greater Prairie Chicken spatial planning tool. Oklahoma Department of Wildlife Conservation. Internet website: http://www.wildlifedepartment.com/grpcspatial_planning/grpcdevelopmentplanninggis.htm.

OGS (Oklahoma Geological Survey). 2015. Statement on Oklahoma Seismicity. Internet website: http://www.ogs.ou.edu/Documents/OGS_Statement-Earthquakes-21-April-2015.pdf.

OGS GIS. 2016. Comprehensive Fault Database and Interpretive Fault Map of Oklahoma, by Stephen Marsh and Austin Holland. OF2-2016. Internet website: http://www.ou.edu/content/ogs/data/fault.html.

______. 2017. Spatial data of earthquakes from 1882 through June 2017. Internet website: http://www.ou.edu/content/ogs/research/earthquakes/catalogs.html.

OHSP (Osage Hills State Park). 2017. Osage Hills State Park. Internet website: http://www.stateparks.com/osage_hills.html.

OIG (Office of Inspector general). 2014. BIA needs sweeping changes to manage the Osage Nation's energy resources. Report No. CR-EV -BIA-0002-2013, US Department of the Interior. Internet website: https://www.doioig.gov/reports/bia-needs-sweeping-changes-manage-osage-nations-energy-resources. October 2014.

OK Biological Survey GIS. 1943. The Game Types of Oklahoma, map created in 1943 and digitized in 1995. Internet website: http://www.biosurvey.ou.edu/duckflt/dfhome.html.

OK Department of Commerce. 2012. 2012 Demographic State of the State Report, Oklahoma State and County Population Projections through 2075. Steve Barker, MBA, Senior Research Analyst/Program Manager. Policy, Research, and Economic Analysis Division.

OK DEQ (Oklahoma Department of Environmental Quality). 2017. Point Source Emissions Inventory Data (2013-2015). Internet website: http://www.deq.state.ok.us/aqdnew/emissions/inventory_data.htm.

OK DEQ GIS. 2017. GIS data of public water supply wells and wellhead protection areas. Data provided by BIA.

OK GAP GIS. 2008. USGS Gap Analysis Project (GAP) data symbolized for owner type as a proxy for surface administration. Internet website: https://gapanalysis.usgs.gov/padus/data/download/.

OkIPC (Oklahoma Invasive Plant Council). 2014. Oklahoma Nonnative Invasive Plant Species. Developed by the Oklahoma Native Plant Society, Oklahoma Biological Survey, and Oklahoma State University Natural Resource Ecology and Management. Internet website: http://ok-invasive-plant-council.org/index.html.

Oklahoma Atlas Institute. 2015. Physiography, Fenneman Physiography Classification. Department of Cartography and Geography, East Central University. Ada, Oklahoma. Internet website: http://www.okatlas.org/okatlas/terrain/provinces.htm.

Oklahoma Climatological Survey. 2013. The Climate of Osage County: Oklahoma Climatological Survey. Internet website: http://climate.ok.gov/county_climate/Products/County_Climatologies/county_climate_osage.pdf.

ODOT (Oklahoma Department of Transportation). 2013. Annual Average Daily Traffic – Oklahoma Highway System. Strategic Asset and Performance Management Division.

______. 2015. Long Range Transportation Plan. August 2015. Internet website: http://www.oklongrangeplan.org/.

______. 2017. Cimarron Public Transit System. Internet website: http://www.okladot.state.ok.us/transit/s5311/cimarron.htm.

Oklahoma Historical Society. 2009. Osage Plains. Internet website: http://www.okhistory.org/publications/enc/entry.php?entry=OS007.

Oklahoma Indian Affairs Commission. 2011. 2011 Oklahoma Indian Nations. Internet website: https://web.archive.org/web/20120512040555/http://www.ok.gov/oiac/documents/2011.FINAL.WEB.pdf.

Oklahoma Office of the Secretary of Energy and Environment. 2017. Internet website: http://earthquakes.ok.gov/what-we-know/.

ONENRD (Osage Nation Environmental and Natural Resources Department). 2006. Integrated Resource Management Plan. Bureau of Indian Affairs Quarterly Report October – December 2005. January 2006.

Osage County. 2011. 2030 Osage County Comprehensive Plan. Internet website: http://www.incog.org/Transportation/OsageCo/aboutus.html. June 2011.

______. 2015. County 2015-2016 Estimate of Needs and Financial Statement for the Fiscal Year 2014-2015. County Commissioners of the County of Osage, State of Oklahoma. October 30, 2015.

Osage Nation. 2007. 25-Year Vision and Strategic Plan Summary Report. Oklahoma. September 2007.

______. 2012. The Osage Nation. Internet website: http://www.osagetribe.com/.

______. 2015. Auditor's Report and Financial Statements for 2015. September 30, 2015. Internet website: https://www.osagenation-nsn.gov/who-we-are/treasury.

______. 2016. Audited Financial Statements and Supplementary Information for 2016. September 30, 2016. Internet website: https://www.osagenation-nsn.gov/who-we-are/treasury.

______. 2017a. Osage Nation Emergency Management - OILFIELD DANGERS. Internet website: https://www.osagenation-nsn.gov/news-events/news/osage-nation-emergency-management-oilfield-dangers.

______. 2017b. Housing Department. Internet website: https://www.osagenation-nsn.gov/what-we-do/housing.

______. 2017c. Financial Assistance. Internet website: https://www.osagenation-nsn.gov/what-we-do/financial-assistance.

______. 2017d. Long Range Transportation Plan 2017–2036. Internet website: https://s3.amazonaws.com/osagenation-nsn.gov/files/departments/Roads/2017_Roads_Osage-LRTP-Final.pdf.

______. 2017e. Osage Headright Payments (Annual). Internet website: https://s3.amazonaws.com/osagenation-nsn.gov/files/departments/Minerals/2017-0504_3OMC_Headright-Payment-History-Per-Headright.pdf. Last updated February 2017.

______. 2017f. Law Enforcement. Internet website: https://www.osagenation-nsn.gov/what-we-do/law-enforcement-department.

______. 2018. Roads Department. Internet website: https://www.osagenation-nsn.gov/what-we-do/roads-department.

Osage Nation Congress. 2017. Bill Number ONCA 17-30. Osage Nation Wildlife Conservation Act. April 24, 2017. Internet website: https://www.osagenation-nsn.gov/who-we-are/congress-legislative-branch/legislation.

Osage Sheriff. 2015. Osage County Sheriff's Office. Internet website: http://www.ocso.net/sheriffs-office/sheriff/.

OSDA (Oklahoma State Department of Agriculture). 2000. Oklahoma Noxious Weed Laws and Rules. Effective May 11, 2000. Internet website: http://oces.okstate.edu/caddo/agriculture/Oklahoma%20Noxious%20Weed%20Law.pdf.

OSHA. 2017. Safety and Health Topics- Hydrogen Sulfide. Internet website: http://www.osha.gov/SLTC/hydrogensulfide/hazards.html.

OSU (Oklahoma State University). 1998. E-952 Riparian Area Management Handbook. Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources, Oklahoma State University.

______. 2012. EPP-7318 Integrated Management of Invasive Thistles in Oklahoma. Internet website: http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-2325/F-7318pod%20color.pdf.

OTRD (Oklahoma Tourism and Recreation Department). 2015. State Parks. Internet website: http://www.travelok.com/State_Parks.

OWQS GIS (Oklahoma Water Quality Standards). 2017. GIS data of Oklahoma Water Quality Standards. Data provided by BIA.

OWRB (Oklahoma Water Resources Board). 2016. Water Use Permitting. Internet website: http://www.owrb.ok.gov/supply/watuse/permitting.php.

OWRB GIS. 2015. GIS data for rivers and streams, and domestic water wells. Oklahoma Water Resources Board. Internet website: http://www.owrb.ok.gov/maps/pmg/owrbdata_SW.html.

Pardieck, K.L., D.J. Ziolkowski Jr., M.-A.R. Hudson, and K. Campbell. 2016. North American Breeding Bird Survey Dataset 1966 - 2015, version 2015.1. U.S. Geological Survey, Patuxent Wildlife Research Center. Internet website: http://www.pwrc.usgs.gov/BBS/RawData/.

Payne, Toni, Stevens, S., and W. Caire. 2015. Annotated checklist of the mammals of the Tallgrass Prairie Preserve, Osage County, Oklahoma." In Proceedings of the Oklahoma Academy of Science, vol. 81, pp. 41-51. 2015.

PHMSA (Pipeline and Hazardous Materials Safety Administration). 2017. U.S. Department of Transportation. Internet website: https://www.phmsa.dot.gov.

Pitman, J. C., Hagen, C. A., Robel, R. J., Loughin, T. M., & Applegate, R. D. 2005. Location and success of lesser prairie-chicken nests in relation to vegetation and human disturbance. *Journal of Wildlife Management*, *69*(3), 1259-1269.

Pruett, J. 2009. Invasive Species Audit for Oklahoma. The Nature Conservancy. July 8, 2009.

PWC (PricewaterhouseCoopers). 2011. The Economic Impacts of the Oil and Natural Gas Industry on the US Economy in 2009: Employment, Labor Income and Value Added. May 2011.

Region Track. 2017. Regional Economic Forecasting and Analysis. Economic Timeline of Drilling an Oil and Gas Well in Oklahoma. Internet website: http://okoga.com/wp-content/uploads/2017/05/OK-Oil-Gas-Well-Drilling-OKOGA.pdf.

Richter, C. F. 1958. Elementary Seismology. W. H. Freeman and Company, San Francisco. Internet website: http://resilience.abag.ca.gov/shaking/mmi/. Pp. 135-149, 650-653.

Riedle, J. D., P. A. Shipman, S. F. Fox, D. M. Leslie Jr. 2005. Status and distribution of the alligator snapping turtle, *Macrochelys temminckii* in Oklahoma. The Southwestern Naturalist. 50:1 79-84.

Rosgen, D. L. 1996. "A geomorphological approach to restoration of incised rivers." Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision, 1997.

Rubinstein, Justin L., and Alireza Babaie Mahani. 2015. Myths and Facts on Wastewater Injection, Hydraulic Fracturing, Enhanced Oil Recovery, and Induced Seismicity. Seismological Research letters, Volume 86, Number 4, DOI: 10.1785/0220150067. Internet website: https://profile.usgs.gov/myscience/upload_folder/ci2015Jun1012005755600Induced_EQs_Review.pdf. August 2015.

Sampson, F. and F. Knopf. 1994. Prairie conservation in North America. BioScience 44(6). June 1994.

Scanlon, B. R., R. C. Reedy, and J.-P. Nicot. 2014a. Comparison of water use for hydraulic fracturing for unconventional oil and gas versus conventional oil. Environmental Science & Technology 48(20):12386–12393. October 2014.

______. 2014b. Will water scarcity in semiarid regions limit hydraulic fracturing of shale plays? Environmental Research Letters 9(2014):124011.

Schlumberger. 2015. Oilfield Glossary. Internet website: http://www.glossary.oilfield.slb.com/.

Sheley, R., M. Manoukian, and G. Marks. 1996. Preventing Noxious Weed Invasion. Rangelands 18(3).

Shiver, M. A. 2002. "Reproduction and propagation of the Neosho mucket, *Lampsilis rafinesqueana*." Master's thesis. Southwest Missouri State University. (Cited in BIA 2017)

Shop Oklahoma. 2012. "Native American Culture." Internet website: http://www.shopoklahoma.com/native.htm.

Smith, M. D., and A. K. Knapp. 2001. Physiological and Morphological Traits of Exotic, Invasive Exotic, and Native Plant Species in Tallgrass Prairie. Int. J. Plant Sci. 162(4):785-792.

Snead, Mark, and Suzette Barta. 2008. The Economic Impact of Oil and Gas Production and Drilling on the Oklahoma Economy; Oklahoma State University. October 2008.

Spaulding, George F. (editor). 1968. On the Western Tour with Washington Irving; The Journal and Letters of Count de Pourtalès. Translated by Seymour Feiler. University of Oklahoma, Norman.

SRI (Statistical Research, Inc.). 2016. Class I Cultural Resources Survey of BLM and BIA Lands in Nebraska, Kansas, Oklahoma, and Texas. Edited by Christine Ward, with contributions by A. M. Hernandez, P. O. Leckman, T. M. Mills, M. L. Murrell, D. T. Unruh, C. Ward, and R. Wells. Confidential electronic supporting data. Prepared for the BLM Oklahoma Field Office, Tulsa, and (EMPSi) Environmental Management and Planning Solutions, Inc., Boulder, Colorado.

State of Oklahoma. 2015. Oklahoma Public School Directory. Internet website: https://data.ok.gov/en/Education/Oklahoma-Public-School-Site-Directory-Feb-2015-/3iv9-8xxn/1235. Last updated February 15, 2015.

Stephens, Daniel B., and Associates, Inc. 2016. Hydrological Assessment Report. Prepared in support of Oklahoma, Kansas, and Texas Joint Environmental Impact Statement. Albuquerque, New Mexico. January 26, 2016.

Stewart, J. G., F. P. Gelwick, W. J. Matthews, C. M. Taylor. 1991. An annotated checklist of the fishes of the tallgrass prairie preserve in Osage County, Oklahoma. Okla. Acad. Sci. 79:13-17.

Storer, Fred, T. Keener, and L. Burleson. Hydration Engineering PLLC. 2016. Oil and Gas Land Use in Osage County, Oklahoma. September 10, 2016.

Taylor, J. M., T. S., Seilheimer, and W. L. Fisher. 2014. "Downstream fish assemblage response to river impoundments varies with degree of hydrologic alteration." *Hydrobiologia* 728:23–39.

The Oklahoman. 2016a. "Pawnee earthquake upgraded to magnitude 5.8," by Adam Wilmoth, September 7, 2016. Internet website: http://newsok.com/article/5517153.

______. 2016b. "Oklahoma, federal regulators amend disposal well action in area around Pawnee quake," by Paul Monies. September 12, 2016. Internet website: http://newsok.com/article/5517814.

The Paleontology Portal. 2015. Interactive database. Internet website: http://www.paleoportal.org/index.php?globalnav=time_space&sectionnav=map.

Thorman, C. H., and M. H. Hibpshman. 1979. Status of Mineral Resource Information for the Osage Indian Reservation, Oklahoma. Administrative Report BIA-47.

TNC (The Nature Conservancy), Robert G. Hamilton. 2013. Letter to the Osage Negotiated Rulemaking Committee regarding concerns about minerals production in the Tallgrass Prairie Preserve. January 25, 2013. Internet website: http://www.bia.gov/cs/groups/xregeasternok/documents/text/idc-041324.pdf.

TNC (The Nature Conservancy). 2015. Oklahoma Tallgrass Prairie Preserve. Internet website: http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/oklahoma/placesweprotect/tallgrass-prairie-preserve.xml.

Tradewind Energy. 2016a. Osage Wind Project. Internet website: http://tradewindenergy.com/project/osage/.

______. 2016b. Osage Wind Project. Internet website: http://tradewindenergy.com/project/mustang-run-wind-project/.

Travel OK. 2015. Osage Nation Heritage Trail. Internet website: http://www.travelok.com/listings/view.profile/id.14855.

Tucker, Sara J. 1942. Indian Villages of the Illinois County. Scientific Papers Vol. 2, Part I Atlas. Illinois State Museum, Springfield, Illinois.

United Community Action Program, Inc. 2015. Annual Report: Activities and Results 2015. Internet website: http://www.ucapinc.org/uploads/Agency_Annual_Report_2015.pdf.

USACE (United States Army Corps of Engineers). 1996. Lakeshore Management Plan, Hulah Lake, Oklahoma and Kansas. Tulsa District. Tulsa, Oklahoma. January 19, 1996.

______. 2015. Welcome to Hulah Lake. Internet website: http://www.swt.usace.army.mil/Locations/TulsaDistrictLakes/Oklahoma/HulahLake.aspx.

______. 2017. Regulatory Program Overview. Internet website: http://www.swt.usace.army.mil/Missions/Regulatory.aspx.

US Census Bureau. 2010. American Fact Finder, Community Facts, 2010 Demographic Profile. Internet website: http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

______. 2015. 2015 Poverty Thresholds. Internet website: https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html.

______. 2016. QuickFacts Tulsa County, Oklahoma. Internet website: https://www.census.gov/quickfacts/table/BZA210214/40143.

US Census GIS. 2017. GIS data of cities and towns in Osage County, Oklahoma. Data provided by the BIA.

USDA (US Department of Agriculture). 2012a. 2012 Census of Agriculture, County Profile: Osage County, Oklahoma. National Agricultural Statistics Service. Internet website: https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/Oklahoma/cp40113.pdf.

______. 2012b. 2012 Census of Agriculture, Oklahoma Volume 1, Chapter 2: County Level Data. Internet website: https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Oklahoma/.

USFWS (United States Department of the Interior, Fish and Wildlife Service). 1990. Recovery Plan for the Interior Population of the Least Tern (Sterna antillarum). Grand Island, Nebraska.

______. 1991. American burying beetle (*Nicrophorus americanus*) recovery plan. Newton Corner, Massachusetts. Internet website: http://ecos.fws.gov/docs/recovery_plans/1991/910927.pdf.

______. 2000. "Wildlife mortality risk in oil field waste pits." US Fish and Wildlife Service Region 6 Contaminants Information Bulletin, December 2000.

______. 2008. Birds of Conservation Concern 2008. United States Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia.

______. 2010. Species Profile: Sprague's Pipit (*Anthus spragueii*). Internet website: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0GD.

______. 2011. Species Profile: Least Tern. Oklahoma Ecological Service Field Office. Internet website: http://www.fws.gov/southwest/es/Oklahoma/Documents/TE_Species/Species%20Profiles/Least%20Tern.pdf.

______. 2012a. US Counties in which the American burying beetle, entire is known to or is believed to occur. Internet website: http://ecos.fws.gov/speciesProfile/profile/countiesBySpecies?entityId=440.

______. 2012b. American Burying Beetle: Additional Information. Internet website: http://www.fws.gov/southwest/es/Oklahoma/ABB_Add_Info.htm.

______. 2012c. Species profile for Whooping crane (*Grus americana*). Internet website: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B003.

______. 2012d. Species profile for Piping Plover (*Charadrius melodus*). Internet website: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B079.

______. 2013. Endangered and Threatened Wildlife and Plants; 12-Month finding on a petition to list the rattlesnake-master borer moth (*Papaipema eryngii*) as an endangered or threatened species. Federal Register volume 78, no. 157. Internet website: https://www.gpo.gov/fdsys/pkg/FR-2013-08-14/pdf/2013-19632.pdf.

______. 2014a. Oil and Gas Industry Conservation Plan Associated with Issuance of Endangered Species Action Section 10(a)(1)(B) Permits for the American Burying Beetle in Oklahoma. Oklahoma Ecological Services Field Office. Tulsa, Oklahoma. May 21, 2014.

______. 2014b. Oklahoma Ecological Services Field Office Migratory Bird and Eagle Impact Avoidance Measures for Actions Associated with Oil and Gas Projects. Internet website: https://www.fws.gov/southwest/es/oklahoma/documents/abb/abb_icp/migbird%20and%20eagle%20avoidance%20measures%20april2014.pdf.

______. 2014c. All About the Piping Plovers. Internet website: http://www.fws.gov/plover/facts.html.

______. 2017. Northern long-eared bat range map. Internet website: https://www.fws.gov/Midwest/endangered.

USFWS GIS. 2016. American Burying Beetle Conservation Priority and potential range GIS data. Internet website: https://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm.

USGS (United States Geological Survey). 2002. Surface-Water Characteristics and Quality on the Osage Reservation, Osage County, Oklahoma, 1999. Reston, Virginia.

______. 2003a. A Digital Geologic Map Database of Oklahoma: USGS Open File Report 03-247.

______. 2003b. Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. USGS Open File Report 03-4260.

______. 2005. Environmental Impacts of Petroleum Production: Initial Results from the Osage-Skiatook Petroleum Environmental Research Sites, Osage County, Oklahoma. Water-Resources Investigations Report 03-4260. Internet website: https://pubs.usgs.gov/wri/wri03-4260/pdf/WRIR03-4260.pdf.

______. 2010. Volcano Hazards Program, Volcano Gases and Their Effects. Internet website: http://volcanoes.usgs.gov/hazards/gas/index.php.

______. 2013, Hydrogeology, distribution, and volume of saline groundwater in the southern midcontinent and adjacent areas of the United States: U.S. Geological Survey Scientific Investigations Report 2013–5017, 58.

______. 2014. Description of Landscape Features, Summary of Existing Hydrologic Data, and Identification of Data Gaps for the Osage Nation, Northeastern Oklahoma 1890-2012. Scientific Investigations Report 2014-5134.

______. 2015a. Mineral Resources On-Line Spatial Data. Internet website: http://mrdata.usgs.gov/geology/state/state.php?state=OK.

______. 2015b. Environmental Impacts Associated with Disposal of Saline Water Produced During Petroleum Production. Internet website: https://toxics.usgs.gov/photo_gallery/osage.html (image: https://toxics.usgs.gov/photo_gallery/photos/osage/site_b_salt_scar_l.jpg).

______. 2015c. Introduction to Hydraulic Fracturing. Internet website: https://www2.usgs.gov/hydraulic_fracturing/.

______. 2015d. Hydrologic Unit Maps. Internet website: http://water.usgs.gov/GIS/huc.html.

US News and World Report. 2014. Best Hospitals Survey. Internet website: http://health.usnews.com/best-hospitals/area/ok.

USGS GIS. 2014. Published report- Description of Landscape Features, Summary of Existing Hydrologic Data, and Identification of Data Gaps for the Osage Nation, Northeastern Oklahoma 1890-2012. GIS data of principal aquifers, oil, gas and CBM fields, and surface geology. Data received from USGS Jerrod Smith April 2015.

Weingarten, M., J. Ge, J. W. Godt, B. A. Bekins, and J. L. Rubinstein. 2015. "High-rate injection associated with increase in U.S. mid-continent seismicity." *Science* 348(6241):1336-1340. June 2015. Internet website: https://profile.usgs.gov/myscience/upload_folder/ci2015Jun1814143055600Weingarten_etal.pdf.

WRI (World Resources Institute). 2016. World Resources Institute Climate Analysis Indicators Tool (CAIT). Internet website: http://cait.wri.org.

______. 2017. CAIT Climate Data Explorer, Historic Emissions, Oklahoma (1990-2012). Internet website: http://cait.wri.org/profile/OK.

This page intentionally left blank.

Appendix H

Glossary

Appendix H. Glossary

Ad valorum taxes: Tax based on the assessed value of an item, such as real estate or personal property. The most common ad valorem taxes are property taxes levied on real estate.

Anoxia: Low oxygen levels.

Aquatic environment: Waters of the United States, including wetlands, that serve as habitat for interrelated and interacting communities and populations of plants and animals (40 CFR 230.3[b]).

Arbuckle formation: A deep sedimentary rock formation directly above continental basement rock; it was seen as ideal for injection due to its location far deeper than drinking water aquifers and its ability to accept large amounts of wastewater.

CO_2e: Carbon dioxide equivalent is the number of metric tons of CO_2 emissions with the same global warming potential as one metric ton of another greenhouse gas, It is calculated using Equation A-1 in 40 CFR Part 98.

Crinoidal limestone: Limestone with a high fossil content of the marine animals that make up the class Crinoida of the echinoderms.

Cuesta: A hill or ridge with a gentle slope on one side and a steep slope on the other.

Deciview: The unit of measurement of haze, or haze index.

Enhanced oil recovery: The implementation of various techniques for increasing the amount of crude oil that can be extracted from an oil field. Enhanced oil recovery is also called tertiary recovery (as opposed to primary and secondary recovery). There are three primary techniques for enhanced oil recovery – thermal recovery, gas injection, and chemical injection.

Eutrophic: Deprived of oxygen.

Flowback: A mix of water, mud, dissolved solids and petroleum returned from a well following hydraulic fracturing.

Headright: A prospective right to share in the periodic distributions of royalties derived from the Osage Mineral Estate, after certain authorized deductions have been made (Op. of the Solicitor General of the Department of the Interior, M-8370 [August 15, 1922]).

Historic properties: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.

Hydrostatic pressure: The pressure exerted by a fluid due to the force of gravity. Hydrostatic pressure increases in proportion to depth measured from the surface because of the increasing weight of fluid exerting downward force from above.

Muskeg: A North American swamp or bog, consisting of a mixture of water and dead vegetation, frequently covered by a layer of sphagnum or other mosses.

National Register of Historic Places: The official list of the nation's historic places considered worthy of preservation, maintained by the Secretary of the Interior, which is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archaeological resources.

Oil and gas field: A geographical area under which an oil or gas reservoir lies.

Oil and gas play: A set of known or postulated oil and or gas accumulations sharing similar geologic, geographic, and temporal properties, such as source rock, migration pathways, timing, trapping mechanism, and hydrocarbon type.

Pronotum: The plate covering all or part of the thorax of some insects.

Proppant: A solid material, typically sand, added to fracturing fluid to hold open the fractures created during hydraulic fracturing.

Radionuclide: An unstable form of a chemical element that radioactively decays, resulting in the emission of nuclear radiation.

Salt scarring: Bare soil with a reduced ability to support vegetation as a result of increased salinity, due to the release of brine or high salt concentrated water onto the landscape, generally from historic oil and gas exploration and production.

Section: According to the Public Land Survey System's method of subdividing and describing lands, a section is an area of one square mile (640 acres).

Section 106: A cultural resource compliance process under the National Historic Preservation Act, and implemented at 36 CR 800, that outlines the steps for identifying and evaluating historic properties, for assessing the effects of federal undertakings on historic properties, and for consulting to avoid, reduce, or minimize adverse effects.

Sundry Notice: Written request to perform work not covered by another type of permit, or to change operations in a previously approved permit.

Take: As used in the Endangered Species Act of 1973, is to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb" a listed species.

Transfer payment: Transfer payments are defined as those payments to persons for which no current services are performed; these are payments to individuals and to nonprofit institutions by federal, state, and local governments and by businesses.

Umbo: The highest point of a bivalve shell.

Workover: Additional work on an oil and gas lease post initial construction, such as removal or replacement of the production equipment.

Wellbore: The drilled hole of a well.

Well spud: Beginning the physical process of drilling a well.

This page intentionally left blank.

Appendix I

Index

Appendix I.
Index

This page intentionally left blank.