FINAL
WATERSHED PLAN - ENVIRONMENTAL IMPACT STATEMENT

RATTLESNAKE CREEK WATERSHED

Lead Federal Agency:
Natural Resources Conservation Service

Cooperating Agencies:
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
Kansas Department of Health and Environment
Kansas Department of Agriculture

Project Sponsor:
Big Bend Groundwater Management District #5

December 2025

FINAL
Watershed Plan – Environmental Impact Statement
for
Rattlesnake Creek Watershed
Stafford County, Kansas

Prepared by:
U.S. Department of Agriculture, Natural Resources Conservation Service

In Cooperation with:
U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Kansas Department of Health and Environment, Kansas Department of Agriculture

AUTHORITY

The watershed plan and environmental impact statement was prepared under the authority of the Watershed Protection and Flood Prevention Act, Public Law (PL) 83-566, as amended (16 USC 1001-1008) and in accordance with Section 102 (2)(C) of the National Environmental Policy Act (NEPA) of 1969 (NEPA), Public Law 91-190, as amended (42 USC 4321 et seq.).

ABSTRACT

Surface water and groundwater are essential resources to the central Kansas economy and environment. Management of the Rattlesnake Creek subbasin (Figure 1.0) and its interrelated water resources (such as Quivira National Wildlife Refuge [NWR]) has been difficult and complex because it involves administration of multiple users of a limited resource. A predictable and consistent source of water is required to support the agricultural economy. Providing long-term agricultural water management for the region would help provide water resources for the agricultural economy and help remedy Quivira NWR's impaired senior water right. The proposed project consists of an augmentation wellfield located in the Gar-Peace Creek and North Fork Ninnescah watersheds, that provides 15-18 cubic feet per second (cfs) of water via pipeline to Rattlesnake Creek upstream of Quivira NWR in the Rattlesnake Creek Watershed. Additional Project components including water right retirements and adaptive management will assist in achieving the purpose of the project, which is to provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin of Big Bend Groundwater Management District #5 (GMD #5). Total installation costs range from $44,465,000 to $61,658,000 depending on the wellfield configuration (refer to Chapter 8 for a breakdown of costs). Annual operation, maintenance, and replacement costs are estimated to be $900,000.

COMMENTS

Comments and inquires must be received by 06-02-2025. Submit comments and inquiries to: Dean Krehbiel, Assistant State Conservationist, USDA/NRCS, 760 S. Broadway Boulevard Salina, Kansas 67401.

NON-DISCRIMINATION STATEMENT

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident. Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the State or local Agency that administers the program or contact USDA through the Telecommunications Relay Service at 711 (voice and TTY). Additionally, program information may be made available in languages other than English. To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at How to File a Program Discrimination Complaint and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Mail Stop 9410, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov. USDA is an equal opportunity provider, employer, and lender.

ANCESTRAL LAND ACKNOWLEDGMENT

The following tribes have ancestral land claims within the vicinity of the proposed project: Wichita and Affiliated Tribes, the Osage Nation of Oklahoma, the Kiowa Indian Tribe of Oklahoma, the Cheyenne and Arapaho Tribes of Oklahoma, and the Prairie Band Potawatomi Nation.

Watershed Agreement for the Rattlesnake Creek Watershed
between the

Big Bend Groundwater Management District #5
State of Kansas
(Referred to herein as Sponsor)

and the

Natural Resources Conservation Service,
U.S. Department of Agriculture
(Referred to herein as NRCS)

Whereas, application has heretofore been made to the Secretary of Agriculture by the sponsors for assistance in preparing a plan for works of improvement for the Rattlesnake Creek Watershed, State of Kansas, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 USC Sections 1001 to 1008, 1010, and 1012); and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, there has been developed through the cooperative efforts of the sponsors and NRCS a watershed project plan and environmental impact statement for works of improvement for the Rattlesnake Creek Watershed, State of Kansas, hereinafter referred to as the watershed project plan or plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the sponsors hereby agree on this watershed project plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this plan and including the following:

1. **Term**. The term of this agreement is for the installation period and evaluated life of the project (50 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.

2. **Costs**. The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be the actual costs incurred in the installation of works of improvement.

3. **Real Property**. The sponsors will acquire such real property as will be needed in connection with the works of improvement. The amounts and percentages of the real property acquisition costs to be borne by the sponsors and NRCS are as shown in the cost-share table in section 5 hereof.

   The sponsors agree that all land acquired for measures, other than land treatment practices, with financial or credit assistance under this agreement will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency that will continue to maintain and operate the development in accordance with the operation and maintenance agreement.

4. **Uniform Relocation Assistance and Real Property Acquisition Policies Act**. The sponsors hereby agree to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 USC Section 4601 et seq. as further implemented through regulations in 49 CFR Part 24 and 7 CFR Part 21) when acquiring real property interests for this federally assisted

project. If the sponsor is legally unable to comply with the real property acquisition requirements, it agrees that, before any Federal financial assistance is furnished, it will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.

5. **Cost-share for Watershed Project Plans**. The following table will be used to show cost-share percentages and amounts for watershed project plan implementation.

	Works of Improvement	NRCS		Sponsors		Total Cost
		%	Cost	%	Cost	
Augmentation Wellfield (Compact Configuration)	**Cost-Sharable Items**					
	Construction[1]	75	$20,335,000	25	$6,778,000	$27,113,000
	Water Right Retirements	75	$8,440,000	25	$2,813,000	$11,253,000
	Interest for Water Right Retirements	75	$232,000	25	$77,000	$309,000
	Interest for Engineering, Construction and Project Administration Costs	75	$1,736,000	25	$553,000	$2,289,000
	Subtotal: Cost-Shareable Costs		$30,743,000		$10,221,000	$40,964,000
	Non-Cost-Shareable Items[2]					
	NRCS Technical Assistance/ Engineering[3]	100	$1,936,000	0	$0	$1,936,000
	Real Property Rights[4]	0	$0	100	$558,000	$558,000
	Project Administration[5]	NA	$645,000	NA	$212,000	$857,000
	Permits	0	$0	100	$150,000	$150,000
	Subtotal: Non-Cost-Shareable Costs		$2,581,000		$920,000	$3,501,000
	Total:		**$33,324,000**		**$11,141,000**	**$44,465,000**

	Works of Improvement	NRCS		Sponsors		Total Cost
		%	Cost	%	Cost	
Augmentation Wellfield (Expanded Configuration)	**Cost-Sharable Items**					
	Construction[1]	75	$31,285,000	25	$10,428,000	$41,713,000
	Water Right Retirements	75	$8,440,000	25	$2,813,000	$11,253,000
	Interest for Water Right Retirements	75	$232,000	25	$77,000	$309,000
	Interest for Engineering, Construction and Project Administration Costs	75	$2,659,000	25	$820,000	$3,479,000
	Subtotal: Cost-Shareable Costs		$42,616,000		$14,138,000	$56,754,000
	Non-Cost-Shareable Items[2]					
	NRCS Technical Assistance/ Engineering[3]	100	$2,958,000	0	$0	$2,958,000
	Real Property Rights[4]	0	$0	100	$614,000	$614,000
	Project Administration[5]	NA	$893,000	NA	$289,000	$1,182,000
	Permits	0	$0	100	$150,000	$150,000
	Subtotal: Non-Cost-Shareable Costs		$3,851,000		$1,053,000	$4,904,000
	Total:		**$46,467,000**		**$15,191,000**	**$61,658,000**

1 Includes wellfield construction, construction observation, mitigation, and monitoring equipment.

2 If actual non-cost-shareable item expenditures vary from these figures, the responsible party will bear the change.

3 Includes design, surveys, and geotechnical investigations.

4 The sponsors will acquire with other than Watershed Protection and Flood Prevention Act funds, such real property as will be needed in connection with the works of improvement. The value of real property is eligible as in-kind contributions toward the sponsors' share of the works of improvement costs. In no case will the amount of an in-kind contribution exceed the sponsors' share of the cost for the works of improvement. The maximum cost eligible for in-kind credit is the same as that for cost sharing.

5 The sponsor and NRCS will each bear the costs of project administration that each incurs.

6. **Land Treatment Agreements.** The sponsors will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater-retarding structure. These agreements must provide that the owners will carry out farm or ranch conservation plans on their land. The sponsors will ensure that 50 percent of the land upstream of any retention reservoir site is adequately protected before construction of the dam. The sponsors will provide assistance to landowners and operators to ensure the installation of the land treatment measures shown in the watershed project plan. The sponsors will encourage landowners and operators to

continue to operate and maintain the land treatment measures after the long-term contracts expire, for the protection and improvement of the watershed.

7. **Floodplain Management**. Before construction of any project for flood prevention, the sponsors must agree to participate in and comply with applicable Federal floodplain management and flood insurance programs. For plans approved as of the date of this revised manual the sponsor is required to have development controls in place below low and significant hazard dams prior to NRCS or the sponsor entering into a construction contract.
8. **Water and Mineral Rights**. The sponsors will acquire or provide assurance that landowners or resource users have acquired such water, mineral, or other natural resources rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
9. **Permits**. The sponsors will obtain and bear the cost for all necessary Federal, State, and local permits required by law, ordinance, or regulation for installation of the works of improvement.
10. **NRCS Assistance**. This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.
11. **Additional Agreements**. A separate agreement will be entered into between NRCS and the sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
12. **Amendments**. This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the sponsors have failed to comply with the conditions of this agreement or when the program funding or authority expires. In this case, NRCS must promptly notify the sponsors in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the sponsors or recoveries by NRCS must be in accordance with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the sponsors having specific responsibilities for the measure involved.
13. **Prohibitions**. No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan or to any benefit that may arise therefrom; but this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.
14. **Operation and Maintenance (O&M)**. The sponsors will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M agreement. An O&M agreement will be entered into before Federal funds are obligated and will continue for the project life (50 years). Although the sponsors' responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the

agreement, the sponsors acknowledge that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.

15. **Emergency Action Plan**. Prior to construction, the sponsors must prepare an emergency action plan (EAP) for each dam or similar structure where failure may cause loss of life or as required by state and local regulations. The EAP must meet the minimum content specified in NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure. EAPs must be reviewed and updated by the sponsors annually.
16. **Nondiscrimination Provisions**. The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW., Washington, DC 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD).

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    By signing this agreement the recipient assures the Department of Agriculture that the program or activities provided for under this agreement will be conducted in compliance with all applicable Federal civil rights laws, rules, regulations, and policies.

17. **Certification Regarding Drug-Free Workplace Requirements (7 CFR Part 3021).** By signing this Watershed Agreement, the sponsors are providing the certification set out below. If it is later determined that the sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

    Controlled substance means a controlled substance in Schedules I through V of the Controlled Substances Act (21 USC Section 812) and as further defined by regulation (21 CFR Sections 1308.11 through 1308.15);

    Conviction means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes;

    Criminal drug statute means a Federal or non-Federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance;

    Employee means the employee of a grantee directly engaged in the performance of work under a grant, including: (i) all direct charge employees; (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of

the grant; and, (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement; consultants or independent contractors not on the grantees' payroll; or employees of sub-recipients or sub-contractors in covered workplaces).

Certification:

A. The sponsors certify that they will or will continue to provide a drug-free workplace by—

(1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition.

(2) Establishing an ongoing drug-free awareness program to inform employees about—

(a) The danger of drug abuse in the workplace.

(b) The grantee's policy of maintaining a drug-free workplace.

(c) Any available drug counseling, rehabilitation, and employee assistance programs.

(d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

(3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1).

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee must—

(a) Abide by the terms of the statement; and

(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than 5 calendar days after such conviction.

(5) Notifying the NRCS in writing, within 10 calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice must include the identification numbers of each affected grant.

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4)(b), with respect to any employee who is so convicted—

(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

18. **Certification Regarding Lobbying (7 CFR Part 3018) (*for projects > $100,000*)**

A. The sponsors certify to the best of their knowledge and belief, that—

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned must complete and submit Standard Form LLL, “Disclosure Form to Report Lobbying,” in accordance with its instructions.

(3) The sponsors must require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients must certify and disclose accordingly.

B. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 USC Section 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

19. **Certification Regarding Debarment, Suspension, and Other Responsibility Matters—Primary Covered Transactions (7 CFR Part 3017)**.

A. The sponsors certify to the best of their knowledge and belief, that they and their principals—

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(2) Have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph A(2) of this certification; and

(4) Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

B. Where the primary sponsors are unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

20. **Clean Air and Water Certification**.

(Applicable if this agreement exceeds $100,000, or a facility to be used has been subject of a conviction under the Clean Air Act (42 USC Section 7413(c)) or the Federal Water Pollution Control Act (33 USC Section 1319(c)) and is listed by EPA or is not otherwise exempt.)

A. The project sponsoring organizations signatory to this agreement certify as follows:

(1) Any facility to be utilized in the performance of this proposed agreement is (____), is not (_X_) listed on the Environmental Protection Agency List of Violating Facilities.

(2) To promptly notify the NRCS-State administrative officer prior to the signing of this agreement by NRCS, of the receipt of any communication from the Director, Office of Federal Activities, U.S. Environmental Protection Agency, indicating that any facility which is proposed for use under this agreement is under consideration to be listed on the Environmental Protection Agency List of Violating Facilities.

(3) To include substantially this certification, including this subparagraph, in every nonexempt subagreement.

B. The project sponsoring organizations signatory to this agreement agree as follows:

(1) To comply with all the requirements of section 114 of the Clean Air Act as amended (42 USC Section 7414) and section 308 of the Federal Water Pollution Control Act (33 USC Section 1318), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, issued there under before the signing of this agreement by NRCS.

(2) That no portion of the work required by this agreement will be performed in facilities listed on the EPA List of Violating Facilities on the date when this agreement was signed by NRCS unless and until the EPA eliminates the name of such facility or facilities from such listing.

(3) To use their best efforts to comply with clean air standards and clean water standards at the facilities in which the agreement is being performed.

(4) To insert the substance of the provisions of this clause in any nonexempt subagreement.

C. The terms used in this clause have the following meanings:

(1) The term “Air Act” means the Clean Air Act, as amended (42 USC Section 7401 et seq.).

(2) The term “Water Act” means Federal Water Pollution Control Act, as amended (33 USC Section 1251 et seq.).

(3) The term “clean air standards” means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 of the Air Act (42 USC Section 7414) or an approved implementation procedure under section 112 of the Air Act (42 USC Section 7412).

(4) The term “clean water standards” means any enforceable limitation, control, condition, prohibition, standards, or other requirement which is promulgated pursuant to the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 USC Section 1342), or by a local government to assure compliance with pretreatment regulations as required by section 307 of the Water Act (33 USC Section 1317).

(5) The term “facility” means any building, plan, installation, structure, mine, vessel, or other floating craft, location or site of operations, owned, leased, or supervised by a sponsor, to be utilized in the performance of an agreement or subagreement. Where a location or site of operations contains or includes more than one building, plan, installation, or structure, the entire location will be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are collocated in one geographical area.

21. **Assurances and Compliance**.

As a condition of the grant or cooperative agreement, the sponsor assures and certifies that it is in compliance with and will comply in the course of the agreement with all applicable laws, regulations, Executive orders and other generally applicable requirements, including those set out below which are hereby incorporated in this agreement by reference, and such other statutory provisions as a specifically set forth herein.

State, Local, and Indian Tribal Governments: OMB Circular Nos. A-87, A-102, A-129, and A-133; and 7 CFR Parts 3015, 3016, 3017, 3018, 3021, and 3052.

Nonprofit Organizations, Hospitals, Institutions of Higher Learning: OMB Circular Nos. A-110, A-122, A-129, and A-133; and 7 CFR Parts 3015, 3017, 3018, 3019, 3021 and 3052.

22. **Examination of Records**.

The sponsors must give the NRCS or the Comptroller General, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to this agreement, and retain all records related to this agreement for a period of three years after completion of the terms of this agreement in accordance with the applicable OMB Circular.

23. **Signatures**

Big Bend Groundwater Management District #5

Sponsor

125 S. Main Street
Stafford, KS 67578

Address

By _____

[Type name below signature]
Tom C Taylor

Title President

Date 1-15-2026

The signing of this plan was authorized by a resolution of the governing body of Big Bend Groundwater Management District #5 adopted at a meeting held on January 15, 2026

_____
[Type name below signature]
Secretary [or other title]
MARLYN E SPARE

125 S. Main Street
Stafford, KS 67578

Address

Date 1-15-26

Natural Resources Conservation Service
U.S. Department of Agriculture

Approved by _____ Acting For

David Doctorian
State Conservationist

Date 1/15/2026

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APPENDICES

Appendix A – Public Participation, Agency Coordination
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ACRONYMS AND ABBREVIATIONS

ACHP ..... Advisory Council on Historic Preservation
ACS ..... American Community Survey
AFY ..... acre-feet per year
AMC ..... Adaptive Management Committee
AMP ..... Adaptive Management Plan
APE ..... Area of Potential Effect
BA ..... Biological Assessment
BGEPA ..... Bald and Golden Eagle Protection Act
bgs ..... below ground surface
BMP ..... Best Management Practice
BTU ..... British Thermal Unit
bu/ac ..... bushels per acre
CAMP ..... Compensated Allocation Management Program
CCP ..... comprehensive conservation plan
CEQ ..... Council of Environmental Quality
CFR ..... Code of Federal Regulations
cfs ..... cubic feet per second
CREP ..... Conservation Reserve Enhancement Program
CRP ..... Conservation Reserve Program
DPS ..... Distinct Population Segments
DR ..... Departmental Regulation
EA ..... Environmental Assessment
EFA ..... ecological focus area
EIS ..... Environmental Impact Statement
EO ..... Executive Order
EPA ..... Environmental Protection Agency
ESA ..... Endangered Species Act
FEMA ..... Federal Emergency Management Agency
FPPA ..... Farmland Protection Policy Act
FWCA ..... Fish and Wildlife Coordination Act
FWOFI ..... future without federal investment
FWOP ..... future without project
GHG ..... greenhouse gas
GHGRP ..... Greenhouse Gas Reporting Program
GIS ..... geographic information systems
GM ..... General Manual
GMD #5 ..... Big Bend Groundwater Management District Number 5

gpm ..... gallons per minute
HUC ..... Hydrologic Unit Code
IGUCA ..... Intensive Groundwater Use Control Area
IMPLAN ..... impact analysis for planning
IPaC ..... Information for Planning and Consultation
K.A.R. ..... Kansas Administrative Regulations
KDA ..... Kansas Department of Agriculture
KDA-DWR ..... Kansas Department of Agriculture-Division of Water Resources
KDHE ..... Kansas Department of Health and Environment
KDOT ..... Kansas Department of Transportation
KDWP ..... Kansas Department of Wildlife and Parks
KGMDA ..... Kansas Groundwater Management District Act
KGS ..... Kansas Geological Survey
K.S.A. ..... Kansas Statutes Annotated
KWA ..... Kansas Water Authority
LEMA ..... Local Enhanced Management Area
MBTA ..... Migratory Bird Treaty Act
MDS ..... minimum desirable streamflow
mg/L ..... milligrams per liter
MISIN ..... Midwest Invasive Species Information Network
MLRA ..... Major Land Resource Area
MOA ..... Memorandum of Agreement
MSAT ..... Mobile Source Air Toxics
MT ..... metric tons
mya ..... million years ago
NED ..... National Economic Development
NEPA ..... National Environmental Policy Act
NFHL ..... National Flood Hazard Layer
NHCP ..... National Handbook of Conservation Practices
NHD ..... National Hydrography Dataset
NHPA ..... National Historic Preservation Act
NLCD ..... National Landcover Database
NOA ..... Notice of Availability
NOAA ..... National Oceanic and Atmospheric Administration
NOI ..... Notice of Intent
NPDES ..... National Pollutant Discharge Elimination System
NPS ..... National Park Service
NRCS ..... Natural Resources Conservation Service
NRHP ..... National Register of Historic Places

NRI ..... Nationwide Rivers Inventory
NWI ..... National Wetland Inventory
NWR ..... National Wildlife Refuge
O&M ..... operations and maintenance
OMB ..... Office of Management and Budget
ONRW ..... Outstanding Natural Resource Waters
PA ..... Programmatic Agreement
PL ..... Public Law
Plan – EA ..... Watershed Plan Environmental Assessment
Plan – EIS ..... Watershed Plan Environmental Impact Statement
PM ..... Presidential Memorandum
PR&G ..... Principles, Requirements, and Guidelines for Federal Investments in Water Resources
PWS ..... Public Water Supply
RAC ..... Regional Advisor Committee
ROD ..... Record of Decision
ROW ..... right-of-way
RPA ..... Regional Planning Area
SALU ..... Special Aquatic Life Use
SGCN ..... Species of Greatest Concern
SHPO ..... State Historic Preservation Office
SO ..... Secretarial Order
SOI ..... Secretary of the Interior
SSA ..... Sole Source Aquifers
SWPPP ..... Stormwater Pollution Prevention Plan
SWQUA ..... Special Water Quality Use Area
TDS ..... Total Dissolved Solids
TMDL ..... total maximum daily load
USACE ..... U.S. Army Corps of Engineers
USC ..... U.S. Code
USCB ..... U.S. Census Bureau
USDA ..... U.S. Department of Agriculture
USFWS ..... U.S. Fish and Wildlife Service
USGS ..... U.S. Geological Survey
WCA ..... Water Conservation Area
WIMAS ..... Water Information Management Analysis System
WOTUS ..... waters of the U.S.
WMA ..... Wildlife Management Area
WTAP ..... Water Transition Assistance Program
Zone A ..... Streamflow Response Region

Summary of Watershed Plan – Environmental Impact Statement
for
Rattlesnake Creek Watershed

Stafford County, Kansas
First Congressional District

Authorization: Watershed Protection and Flood Prevention Act, Public Law (PL) 83-566, as amended (16 USC 1001-1008); NEPA, Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969, Public Law 91-190, as amended (42 U.S.C. 4321 et seq.).

Sponsor: Big Bend Groundwater Management District #5 (GMD #5)

Proposed Action: The proposed action consists of construction of an augmentation wellfield and implementation of a water right retirement program. In addition, the proposed project includes implementation of a multistakeholder adaptive management approach that would evaluate the success of the wellfield and water right retirements on an annual basis.

Purpose and Need for Action: Within the PL 83-566 authorization, the purpose of the Rattlesnake Creek Watershed Plan Environmental Impact Statement (Plan – EIS) is to provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin of GMD #5. The need for developing the Plan – EIS is twofold: Quivira National Wildlife Refuge (NWR) water supply needs and the importance of groundwater to the agricultural economy.

Description of the Proposed Action Alternative: The Proposed Action Alternative consists of construction of an augmentation wellfield that will provide 15-18 cubic feet per second (cfs) of water to Rattlesnake Creek upstream of Quivira NWR. Additionally, 2,500 acre-feet of water rights would be retired, and an adaptive management strategy (further developed following the NEPA process) would be used to adjust augmentation and/or water right retirements as needed.

Resource Information:

Latitude and longitude: 38.086088º -98.509466º

Eight-digit hydrologic unit code (HUC) number: 11030009, 11030010, 11030014

Climate and topography: The average annual rainfall is 28.57 inches, and the average annual temperature is 57.45 degrees Fahrenheit. The proposed project is in the Arkansas River Lowlands and High Plains regions. Both regions are generally flat to rolling with gentle slopes and sand dunes present periodically.

Watershed size: Rattlesnake Creek Subbasin is approximately 796,709 acres.

Land uses (acres) within project area: According to the National Land Cover Database (NLCD), farmed cropland covers a total of 448,494 acres of land within the project area (63 percent). Herbaceous and hay and pasture cover types, including grasslands, forbs, and hayed or grazed pasture, comprise 214,529 acres of land (30 percent). Developed land accounts for approximately 28,973 (4 percent), and woody wetlands, emergent herbaceous wetlands, and open water

account for 23,663 acres (3 percent). Approximately 1,567 acres (less than 1 percent) of deciduous/mixed forest, barren land, and scrub/shrub lie within the project area.

Land ownership: Private (97.1 percent), State/Local (0.2 percent) Federal (2.7 percent)

Population and demographics: Populations include 17 percent who identify as minority or nonwhite. Notable, the population of Macksville is 38.2 percent minority or nonwhite. Three communities have a higher poverty rate (percentage of people living below the federal poverty level) than the state poverty rate: Hudson (13.3 percent), St. John (12.5 percent), and Belpre (32.7 percent).

Threatened and Endangered Species: Four federally endangered species (northern long-eared bat [*Myotis septentrionalis*], Eskimo curlew [*Numenius borealis*], whooping crane [*Grus americana*], and peppered chub [*Macrhybopsis tetranema*]); four federally threatened species (eastern black rail [*Laterallus jamaicensis ssp. jamaicensis*], piping plover [*Charadrius melodus*], and red knot [*Calidris canutus rufa*], Arkansas river shiner [*Notropis girardi*]; two proposed threatened species (monarch butterfly [*Danaus plexippus*] and western regal fritillary [*Argynnis idalia occidentalis*]); one proposed endangered species (tricolored bat [*Perimyotis subflavus*]); five federal candidate species (little brown bat [*Myotis lucifugus*], Iowa skipper [*Atrytone arogos iowa*], American bumble bee [*Bombus pensylvanicus*], southern plains bumble bee [*Bombus fraternus*]), and variable cuckoo bumble bee [*Bombus variabilis*];, and two species identified for discretionary review (hoary bat [*Lasiurus cinereus*], and cave myotis [*Myotis velifer*]) were identified for analysis.

Wetlands and Streams: There are a total of approximately 53,425 acres of wetlands and approximately 558 miles of perennial streams and 2,647 miles of intermittent and ephemeral streams within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds. Specifically, Rattlesnake Creek Watershed includes approximately 21,045 acres of wetlands, 140 miles of perennial streams, and 838 miles of intermittent and ephemeral streams.

Other Alternative Plans Considered:

No Action Alternative: Junior water rights curtailment within Zone B would be completed initially and then the Kansas Department of Agriculture-Division of Water Resources (KDA-DWR) would annually evaluate the effectiveness in securing the U.S. Fish and Wildlife Service's (USFWS's) water right. The junior water rights curtailment would result in all water rights within Zone B that are junior to Water Right File Number 7,571 to cease groundwater pumping. Adjustments in the level of regulation would occur based on the annual evaluation.

Groundwater Use Reduction Alternative: Groundwater use in Zone A, which is a larger area than Zone B, would be modified to reduce water use from a larger number

of water rights. This will avoid complete curtailment from any one water right holder by spreading reductions in water use over a larger area. However, because the Rattlesnake Creek response from Zone A is 10 percent versus 20 percent in Zone B, an increased reduction in water use is required compared to the No Action Alternative.

Proposed Project Costs (Compact Wellfield Configuration).

Compact Wellfield Configuration	Public Law (PL) 83-566 Funds: 75%	Other Funds: 25%	Total: 100%
Engineering/Technical Assistance	$1,936,000	$0	$1,936,000
Construction	$20,335,000	$6,778,000	$27,113,000
Project Administration	$645,000	$212,000	$857,000
Real Property Rights	$0	$558,000	$558,000
Permits	$0	$150,000	$150,000
Relocation	$0	$0	$0
Water Right Retirements	$8,440,000	$2,813,000	$11,253,000
Interest for Water Right Retirements	$232,000	$77,000	$309,000
Interest for Engineering, Construction and Project Administration Costs	$1,736,000	$553,000	$2,289,000
Total	**$33,324,000**	**$11,141,000**	**$44,465,000**

Proposed Project Costs (Expanded Wellfield Configuration).

Expanded Wellfield Configuration	Public Law (PL) 83-566 Funds: 75%	Other Funds: 25%	Total: 100%
Engineering/Technical Assistance	$2,958,000	$0	$2,958,000
Construction	$31,285,000	$10,428,000	$41,713,000
Project Administration	$893,000	$289,000	$1,182,000
Real Property Rights	$0	$614,000	$614,000
Permits	$0	$150,000	$150,000
Relocation	$0	$0	$0
Water Right Retirements	$8,440,000	$2,813,000	$11,253,000
Interest for Water Right Retirements	$232,000	$77,000	$309,000
Interest for Engineering, Construction and Project Administration Costs	$2,659,000	$820,000	$3,479,000
Total	**$46,467,000**	**$15,191,000**	**$61,658,000**

Proposed Project Benefits:

Estimated Average Annual Watershed Protection Damage Reduction Benefits.

Item	Damage Reduction Benefit, Average Annual[1]
On-site	
Maintaining Productivity	$4,499,000
Groundwater Retirements[2]	$0
Subtotal	$4,499,000
Off-site/Public	$0
Total	$4,499,000

[1]Price Base: 2023

[2]Benefits of groundwater retirements are included with maintaining productivity.

Comparison of National Economic Development (NED) Benefits and Costs; Rattlesnake Creek Watershed, Kansas (dollars[1]).

Works of Improvement	Agricultural-Related	Average Annual Benefits	Average Annual Costs	Benefit-cost Ratio
Compact Configuration	Maintain Productivity	$4,499,000	$2,342,000	1.92
Expanded Configuration	Maintain Productivity	$4,499,000	$2,885,000	1.56

[1]Price Base: 2023

Number of direct beneficiaries (On-site – Off-site): 876 water right holders

Other beneficial effects in physical terms: Providing long-term agricultural water management for the region would help provide water resources for the agricultural economy and help meaningfully address Quivira NWR's impaired senior water right. Implementation of the project will result in streamflow increases to downstream Rattlesnake Creek and Quivira NWR.

Benefit to cost ratio (2.75 percent discount rate):

- Compact Configuration – 1.92
- Expanded Configuration – 1.56

Annual Average Net beneficial effects (NED):

- Compact Configuration – $2,157,000
- Expanded Configuration – $1,615,000

Funding schedule (budget year plus 5):

Compact Wellfield Configuration:

Year	Funds	Water Right Retirements	Interest on Water Rights Retirements[1]	Engineering/ Technical Assistance	Project Admin	Construction	Real Property Rights	Permits	Interest for Engineering, Construction and Admin Costs[1]	Total
1	PL 83-566	$1,688,000	$46,400	$968,000	$129,000				$159,000	**$2,990,400**
1	Other	$562,600	$15,400		$42,400			$75,000	$17,000	**$712,400**
2	PL 83-566	$1,688,000	$46,400	$968,000	$129,000				$126,000	**$2,957,400**
2	Other	$562,600	$15,400		$42,400			$75,000	$13,000	**$708,400**
3	PL 83-566	$1,688,000	$46,400		$129,000	$10,167,500			$873,000	**$12,903,900**
3	Other	$562,600	$15,400		$42,400	$3,389,000	$279,000		$315,000	**$4,603,400**
4	PL 83-566	$1,688,000	$46,400		$129,000	$10,167,500			$574,000	**$12,604,900**
4	Other	$562,600	$15,400		$42,400	$3,389,000	$279,000		$207,000	**$4,495,400**
5	PL 83-566	$1,688,000	$46,400		$129,000				$4,000	**$1,867,400**
5	Other	$562,600	$15,400		$42,400				$1,000	**$621,400**
	TOTAL	**$11,253,000**	**$309,000**	**$1,936,000**	**$857,000**	**$27,113,000**	**$558,000**	**$150,000**	**$2,289,000**	**$44,465,000**

[1] Calculated using a 2.75 percent discount rate.

Expanded Wellfield Configuration

Year	Funds	Water Right Retirements	Interest on Water Rights Retirements[1]	Engineering/ Technical Assistance	Project Admin	Construction	Real Property Rights	Permits	Interest for Engineering, Construction and Admin Costs[1]	Total
1	PL 83-566	$1,688,000	$46,400	$1,479,000	$178,600				$241,000	**$3,633,000**
1	Other	$562,600	$15,400		$57,800			$75,000	$19,000	**$729,800**
2	PL 83-566	$1,688,000	$46,400	$1,479,000	$178,600				$190,000	**$3,582,000**
2	Other	$562,600	$15,400		$57,800			$75,000	$15,000	**$725,800**
3	PL 83-566	$1,688,000	$46,400		$178,600	$15,642,500			$1,341,000	**$18,896,500**
3	Other	$562,600	$15,400		$57,800	$5,214,000	$307,000		$473,000	**$6,629,800**
4	PL 83-566	$1,688,000	$46,400		$178,600	$15,642,500			$882,000	**$18,437,500**
4	Other	$562,600	$15,400		$57,800	$5,214,000	$307,000		$311,000	**$6,467,800**
5	PL 83-566	$1,688,000	$46,400		$178,600				$5,000	**$1,918,000**
5	Other	$562,600	$15,400		$57,800				$2,000	**$637,800**
	TOTAL	**$11,253,000**	**$309,000**	**$2,958,000**	**$1,182,000**	**$41,713,000**	**$614,000**	**$150,000**	**$3,479,000**	**$61,658,000**

[1] Calculated using a 2.75 percent discount rate.

Federal funds:

- Compact Configuration – $33,324,000
- Expanded Configuration – $46,467,000

Nonfederal funds:

- Compact Configuration – $11,141,000
- Expanded Configuration – $15,191,000

Period of Analysis: 50 years

Proposed Project Life: The proposed project life is planned for 50 years.

Environmental Effects, Impacts: These include changes in hydrology that provide beneficial impacts to wetlands and wildlife at the Quivira NWR. Negative impacts would occur as a result of aquifer impacts that would reduce available water in areas around the augmentation wellfield and downstream in the Gar-Peace Creek and North Fork Ninnescah River watersheds. Effects to the human environment would include a reduction in irrigated acres that support the regional economy, but to a lesser degree than the No Action and Groundwater Use Reduction alternatives. Hydrology benefits realized with the No Action Alternative may not be present with the proposed alternative.

Major Conclusions: The proposed project provides water to Quivira NWR to support management activities and its established water right while minimizing the economic impacts on the region.

Areas of Controversy and Issues to be Resolved: The USFWS holds Water Right File Number 7,571 for the management of Quivira NWR. This water right, which is senior in priority to approximately 95 percent of all other water rights in the Rattlesnake Creek subbasin, has been impaired frequently over the past 25 years as determined by the Kansas Department of Agriculture (KDA) Chief Engineer.

Evidence of Unusual Congressional or Local Interest: On August 29, 2018, U.S. Senators Pat Roberts and Jerry Moran and members of Congress Ron Estes and Roger Marshall sent a letter to USFWS requesting technical assistance with the augmentation engineering. Additionally, Audubon of Kansas has expressed interest and has participated in legal proceedings.

Is this report in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects? Yes ☒ No ☐

1. INTRODUCTION AND BACKGROUND

Surface water and groundwater are essential resources to the central Kansas economy and environment. Management of the Rattlesnake Creek subbasin (Figure 1.0) and its interrelated water resources (including Quivira National Wildlife Refuge [NWR]) has been difficult and complex because it involves administration of multiple users of a limited resource. This resource is relied on principally for ecosystem sustainability (through management of surface water at the Quivira NWR; recreational use) and for irrigated agriculture (through groundwater pumping); all types of uses are of equal importance in Kansas. To regulate water use, the state of Kansas uses a system of water rights, which dictates when and how much water may be diverted by users. The Big Bend Groundwater Management District #5 (GMD #5) was formed in 1976 for the conservation of groundwater within multiple hydrologic units, including the Rattlesnake Creek subbasin. GMD #5 can assist the state of Kansas with the management of groundwater through various statutory and incentive-based options. Quivira NWR and GMD #5 have been working on a solution to these complex water issues for many years. Surface water flows have been insufficient to support management practices at Quivira NWR during certain years and periods within those years because of the reductions in streamflow caused by groundwater use. Finding an agreeable solution that balances the needs of the Quivira NWR while limiting impacts to agriculture has been challenging. Table 1.0 shows a timeline of significant events that have occurred in the buildup to the Rattlesnake Creek Watershed Plan Environmental Impact Statement (Plan – EIS).

Extensive background information including emails, reports, studies and analyses, and engineering and regulatory documents related to the Plan – EIS are publicly available at the following websites:

- GMD #5 Website – Quivira NWR Resolution
  https://gmd5.org/quivira-nwr
- Quivira NWR – Comprehensive Conservation Plan
  https://ecos.fws.gov/ServCat/DownloadFile/44658
- Kansas Department of Agriculture-Division of Water Resources (KDA-DWR) Website – GMD #5 Rattlesnake/Quivira Local Enhanced Management Area (LEMA)
  https://www.agriculture.ks.gov/divisions-programs/division-of-water-resources/managing-kansas-water-resources/local-enhanced-management-areas/gmd-5-rattlesnake-quivira-lema
- KDA-DWR Website – Quivira NWR Impairment Complaint
  https://www.agriculture.ks.gov/divisions-programs/division-of-water-resources/water-appropriation/impairment-complaints/quivira-national-wildlife-refuge

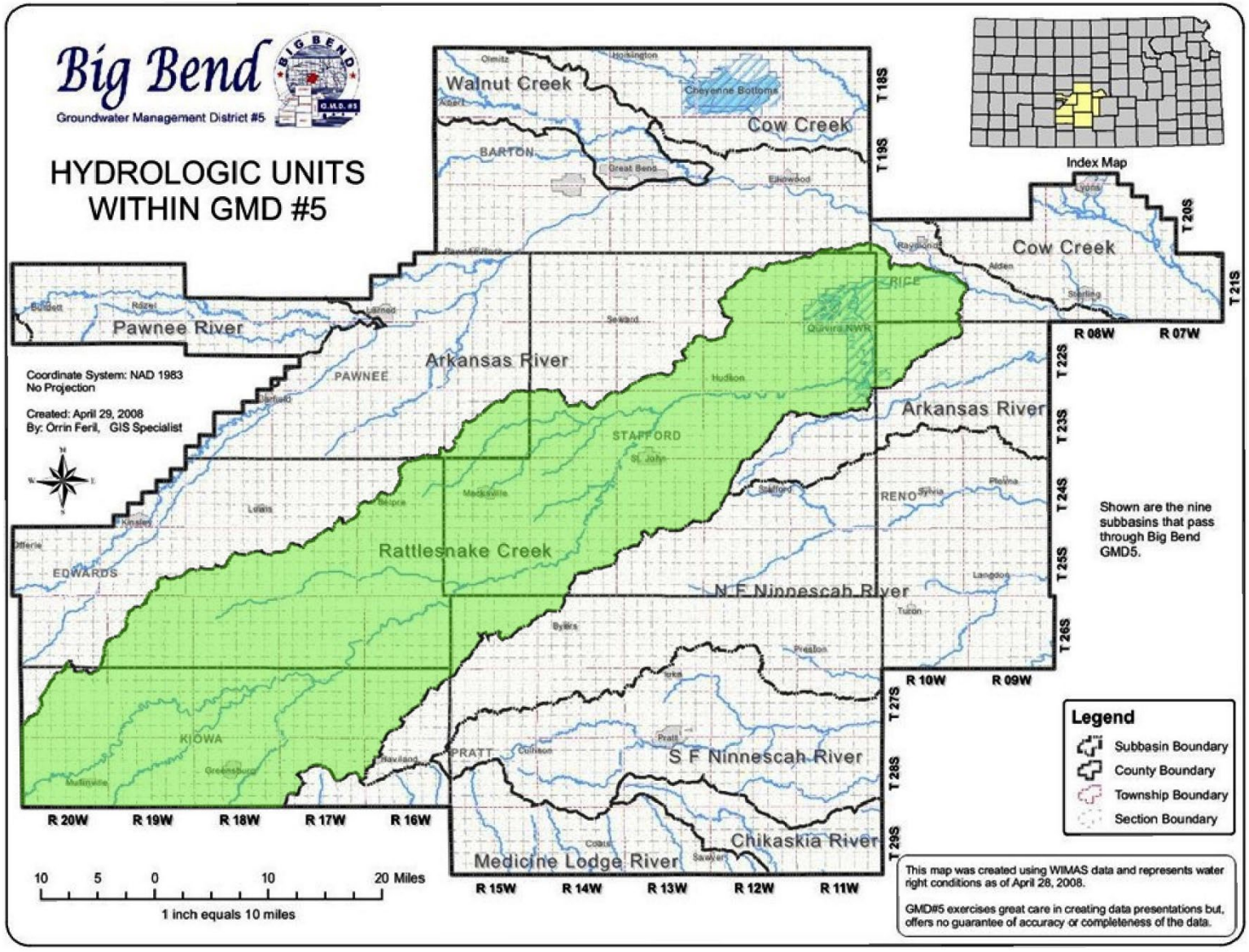

Figure 1.0. Big Bend Groundwater Management District #5 (GMD #5) Boundary Map (GMD #5 2022a).

Table 1.0. Timeline of Significant Events in Rattlesnake Creek.

Date	Significant Event
1955	Quivira National Wildlife Refuge (NWR) is established
1957	U.S. Fish and Wildlife Service (USFWS) files for a water right
1976	Big Bend Groundwater Management District #5 (GMD #5) is established
1984	Kansas legislature passed the minimum instream flow statute (Kansas Statutes Annotated [K.S.A.] 82a-703), which requires that minimum desirable streamflows be maintained in different streams in Kansas, including Rattlesnake Creek
1992	Kansas Geological Survey (KGS), in cooperation with GMD #5, implemented a multiyear investigation of factors related to groundwater and streamflow declines and concerns of water quality relating to the mineral intrusion area.
1993	GMD #5 is closed to new water right appropriations (Kansas Administrative Regulations [K.A.R.] 5-25-4), and Rattlesnake Creek/Quivira Partnership is formed to develop and implement solutions to water resource issues in the subbasin
1996	Kansas Department of Agriculture-Division of Water Resources (KDA-DWR) certifies the USFWS water right for diversion of 14,632 acre-feet of water per year from Rattlesnake Creek
2000	Rattlesnake Creek Management Program is initiated by Rattlesnake Creek/Quivira Partnership to resolve surface water declines in the subbasin and includes Water Protection Association of Central Kansas, GMD #5, USFWS, and KDA-DWR
2010	Balleau Groundwater Inc. (Balleau) produces hydrologic model of GMD #5
2012	Rattlesnake Creek Management Program ends without achieving the stated water use reductions
2013	USFWS files impairment claim on Water Right File Number 7,571
2016	KDA-DWR Chief Engineer submits the final report on the USFWS impairment claim
2018	USFWS files request to secure water
2018	Memorandum of understanding is signed between GMD #5 and KDA-DWR
2018	GMD #5 submits Rattlesnake Creek/Quivira NWR Local Enhanced Management Area (LEMA) plan
2019	KDA-DWR rejects LEMA plan proposed by GMD #5
2019	USFWS files request to secure water
2020	Memorandum of agreement (MOA) is signed between GMD #5 and USFWS

Date	Significant Event
2021	GMD #5 produces the Rattlesnake Creek Streamflow Augmentation Proposal
2021	Watershed Plan Environmental Assessment (Plan – EA) is initiated
2022	Watershed Plan – EA hold scoping meetings (public and interested agency)
2022	Augmentation Wellfield Technical Assessment and Technical Committee Coordination occurs
2022	NRCS accepts review/comment of Watershed Plan – EA chapters 1-5
2023	Augmentation wellfield modeling is completed
2023	USFWS files request to secure water
2023	Section 7 Biological Assessment is initiated
2023	GMD #5 makes decision to change Watershed Plan document from an EA to an Environmental Impact Statement (EIS)
2023	Notice of Intent (NOI) published in the Federal Register
2024	State-led Rattlesnake Working Group is formed
2024	USFWS withdraws request to secure water
2025	Draft Plan – EIS is completed
2025	Section 106 Programmatic Agreement accepted by ACHP
2025	Draft Plan-EIS is published in the Federal Register
2025	Section 7 Biological Assessment completed

1.1 Quivira National Wildlife Refuge

Quivira NWR is located within GMD #5 and within the Rattlesnake Creek hydrologic unit code (HUC) 10 watershed in south-central Kansas. The refuge encompasses approximately 22,135 acres of diverse habitat for migratory birds and federally threatened and endangered species. The refuge was established by the Migratory Bird Conservation Commission in 1955 and is recognized nationally and internationally for its conservation value. The refuge was established under the authority of the Migratory Bird Conservation Act and the Fish and Wildlife Act of 1956. The refuge is a Ramsar Wetland of International Importance, a Western Hemisphere Shorebird Reserve Network site, and a Globally Important Bird Area (USFWS 2013a). Surface and groundwater resources provide the water supply for the wetland complex that includes Big Salt Marsh and Little Salt Marsh. Rattlesnake Creek flows through Quivira NWR and is a main source of water for the wetland complex.

The NWR system, including Quivira NWR, was established under the concepts and guidance of the National Wildlife Refuge System Administration Act of 1966 (Administration Act), Title 50 of the Code of Federal Regulations (CFR). The National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) amended the Administration Act by providing (1) a unifying mission for the Refuge System; (2) a new process for determining compatible public uses on refuges; and (3) a need for each refuge to be managed under a comprehensive conservation plan (CCP). The Improvement Act states that wildlife conservation is the priority of Refuge System lands and that the Secretary of the Department of the Interior will make sure that the biological integrity, diversity, and environmental health of refuge lands are kept (USFWS 2013a). In 2013, the U.S. Fish and Wildlife Service (USFWS) published its CCP for Quivira NWR, which outlined the following goals for the refuge (USFWS 2013a):

- Landscape Conservation
- Native Ecological Community Conservation
- Visitor Services
- Public Outreach
- Cultural Resources and Historic Properties
- Visitor and Employee Safety and Resource Protection
- Administration

Quivira NWR's resources include sand prairies, sand dunes, salt flats, and salt and freshwater wetland types managed to "provide migration, nesting, resting, and feeding habitat for migratory birds and to develop, advance, manage, conserve, and protect fish and wildlife resources" (USFWS 2013a). The refuge supports more than 100 wetland-associated species. More than 35 species of shorebirds use the refuge, and many have declining populations (USFWS 2013a; Smith et al. 2020). The unique habitat of the refuge attracts hundreds of thousands of migratory birds each year, including federally protected species such as the whooping crane (*Grus americana*). Wetland habitat also provides benefits (e.g., shelter, food resources) to numerous upland-associated wildlife.

The refuge's salt marshes form a wetland complex that is hydrologically connected to area groundwater and Rattlesnake Creek (USFWS 2013a). Water salinity levels throughout most of the refuge are commonly brackish (contains greater dissolved solid content than freshwater, but less than seawater) and support a rare abundance of salt-tolerant vegetation such as alkali sacaton (*Sporobolus airoides*) and inland salt grass (*Distichlis spicata*). Freshwater sources, such as inputs to Rattlesnake Creek, precipitation, and springs on the refuge, are critical for maintaining a natural range of salinities that support species with different water quality tolerances.

To facilitate the refuge's purpose and management objectives, Quivira NWR draws water from Rattlesnake Creek and diverts the water through a combination of water control structures and a

wetland complex. The use of water control structures allows for seasonal fluctuation of water levels throughout the wetland complex to provide habitat (food, cover, and water) for a diversity of waterbirds that occur throughout the year (USFWS 2013a). USFWS holds Water Right File Number 7,571, which allows for up to 14,632 AFY of water diversion at a maximum rate of 300 cfs (USFWS 2013a). This water right permit has a priority date of August 15, 1957, which is senior in priority to most agricultural uses of water in the region. More than 30 years ago, flows in Rattlesnake Creek began to diminish as other water users (primarily agricultural irrigation) within the subbasin began diverting more water (KDA-DWR 2016). This reduction in flow in Rattlesnake Creek has contributed to shortages of water available to Quivira NWR during certain years and periods of those years, making it more difficult for the refuge to fulfill its purpose and management objectives (USFWS 2013a).

1.2 Big Bend Groundwater Management District #5

GMD #5 was formed in March 1976 under the authority of Kansas Statutes Annotated (K.S.A.) 82a-1020 et seq. GMD #5 was formed for the conservation of groundwater and established the following purposes for the district (GMD #5 2022a):

- Establish a data-gathering bank including the measurement of water withdrawal, measurement of aquifer recharge, and other pertinent information.
- Establish a water quality monitoring program.
- Discourage waste of water.
- Develop an educational program on optimum water use.
- Develop well spacing criteria.
- Encourage accurate production measurements.
- Promote tail-water pits.
- Exert action to prevent water pollution.
- Review replacement wells.
- Review and authorize annual appropriation of water usage.
- Investigate alternate points of diversion.
- Explore and develop artificial recharge.
- Provide advice and assistance in the management of drainage problems and surface water.

GMD #5 encompasses approximately 2.5 million acres, including 569,725 authorized irrigated acres, and manages 4,523 water rights with 5,459 points of diversion. The total authorized quantity that these water rights can produce is 768,784 acre-feet of water annually. Within GMD #5's boundary, there are also two notable wetland complexes: Cheyenne Bottoms Wildlife Refuge (state) and Quivira NWR (federal). There are also nine 8-digit hydrologic units that are included within GMD #5's boundary, as follows (GMD #5 2022a):

1. Walnut Creek subbasin

2. Pawnee River subbasin
3. Cow Creek subbasin
4. Arkansas River (Gar-Peace Creek) subbasin
5. Rattlesnake Creek subbasin
6. North Fork of the Ninnescah River subbasin
7. South Fork of the Ninnescah River subbasin
8. Medicine Lodge River subbasin
9. Chikaskia River subbasin

The Rattlesnake Creek subbasin, which includes Quivira NWR, is approximately 800,000 acres in size and located in the Arkansas River Lowlands and High Plains regions. Both regions are generally flat to rolling with gentle slopes and sand dunes present periodically. The landscape is primarily dominated by agriculture, where on average 160,000 acres are irrigated per year (KDA-DWR 2016). Agricultural groundwater irrigation makes up approximately 89 percent of total active groundwater rights in the subbasin (see Figure 1.2-1). Municipal, industrial, and recreational uses also occur but on a relatively smaller scale (GMD #5 2018).

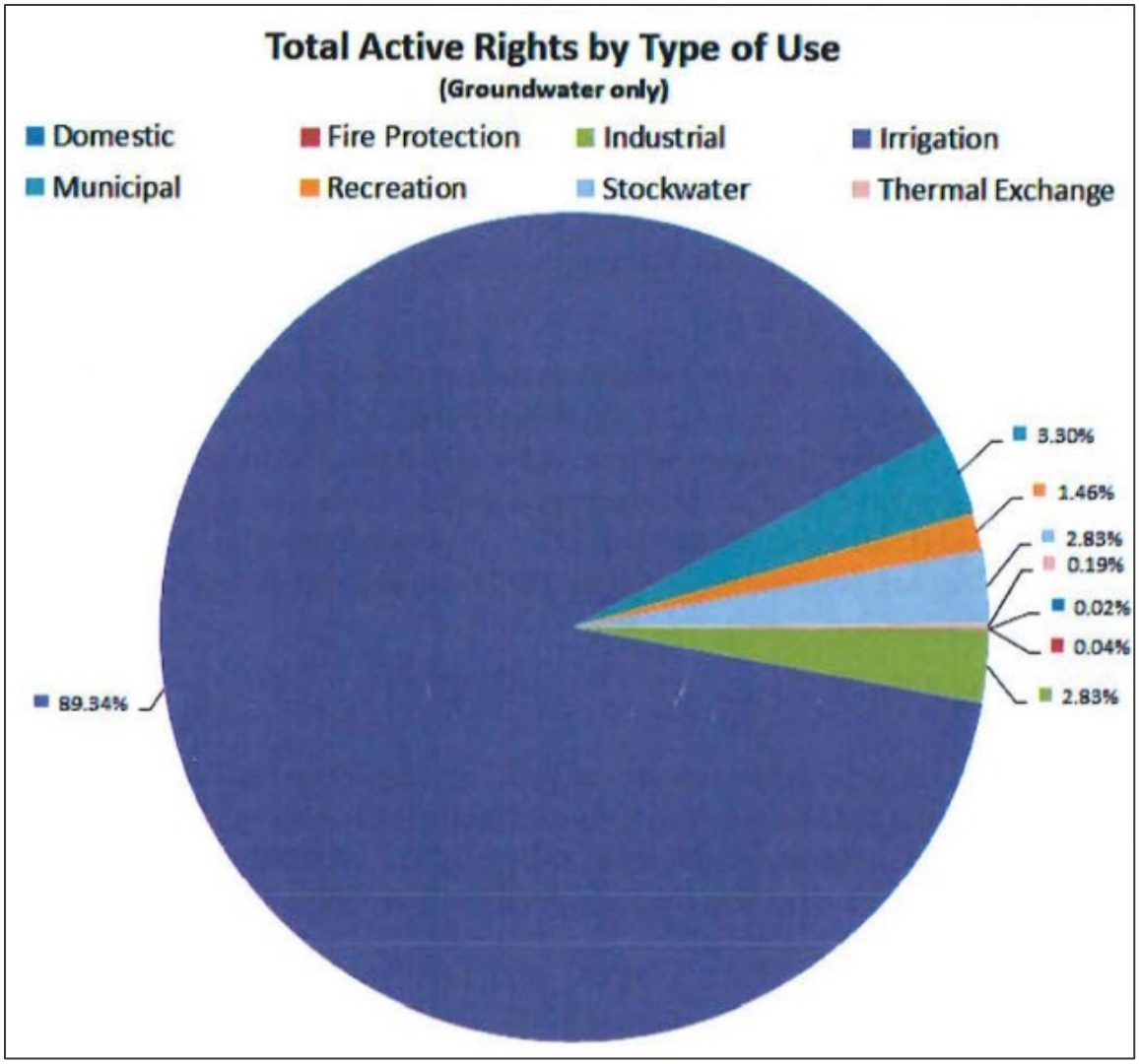

Figure 1.2-1. Active Groundwater Rights in Groundwater Management District #5 (GMD #5) by Type of Use (GMD #5 2018).

Most irrigation wells are installed into the Great Bend Prairie component of the High Plains Aquifer (Figure 4.3-2), which consists of Quaternary age sediments. Water right development began in the GMD #5 region during the 1940s and significantly expanded between 1970 and 1980, with the adoption of the center pivot irrigation system (see figures 1.2-2 and 1.2-3). After the 1980s, water right development slowed considerably until GMD #5 formally closed to new appropriations in 1993 (K.A.R. 5-25-4). The KDA-DWR maintains a record of all nondomestic water use information in its online database called the Water Information Management Analysis System (WIMAS). According to WIMAS, the number of groundwater rights in the Rattlesnake Creek subbasin totals 1,680; about 1,370 of those water rights have reported use since 2003 (KDA-DWR 2016).

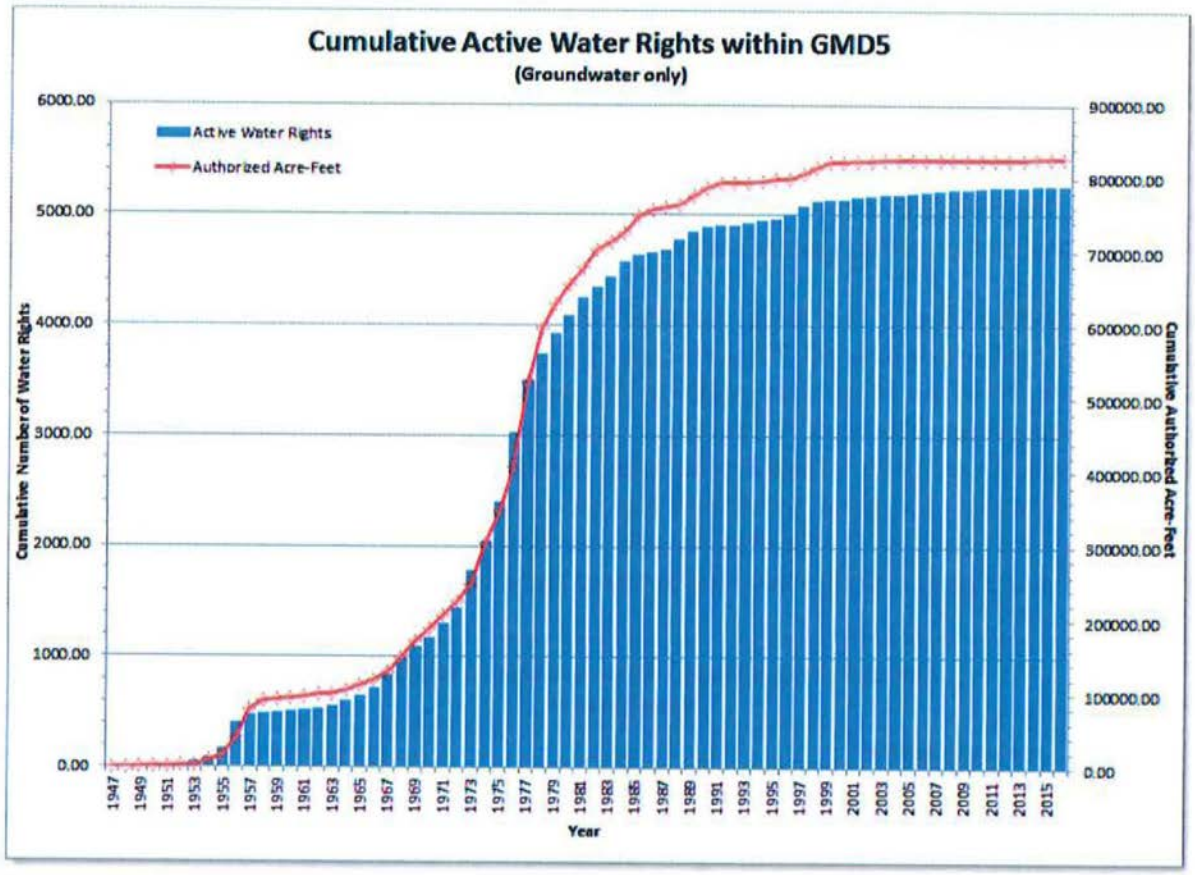

Figure 1.2-2. Cumulative Active Water Rights Within Groundwater Management District #5 (GMD #5; GMD #5 2018).

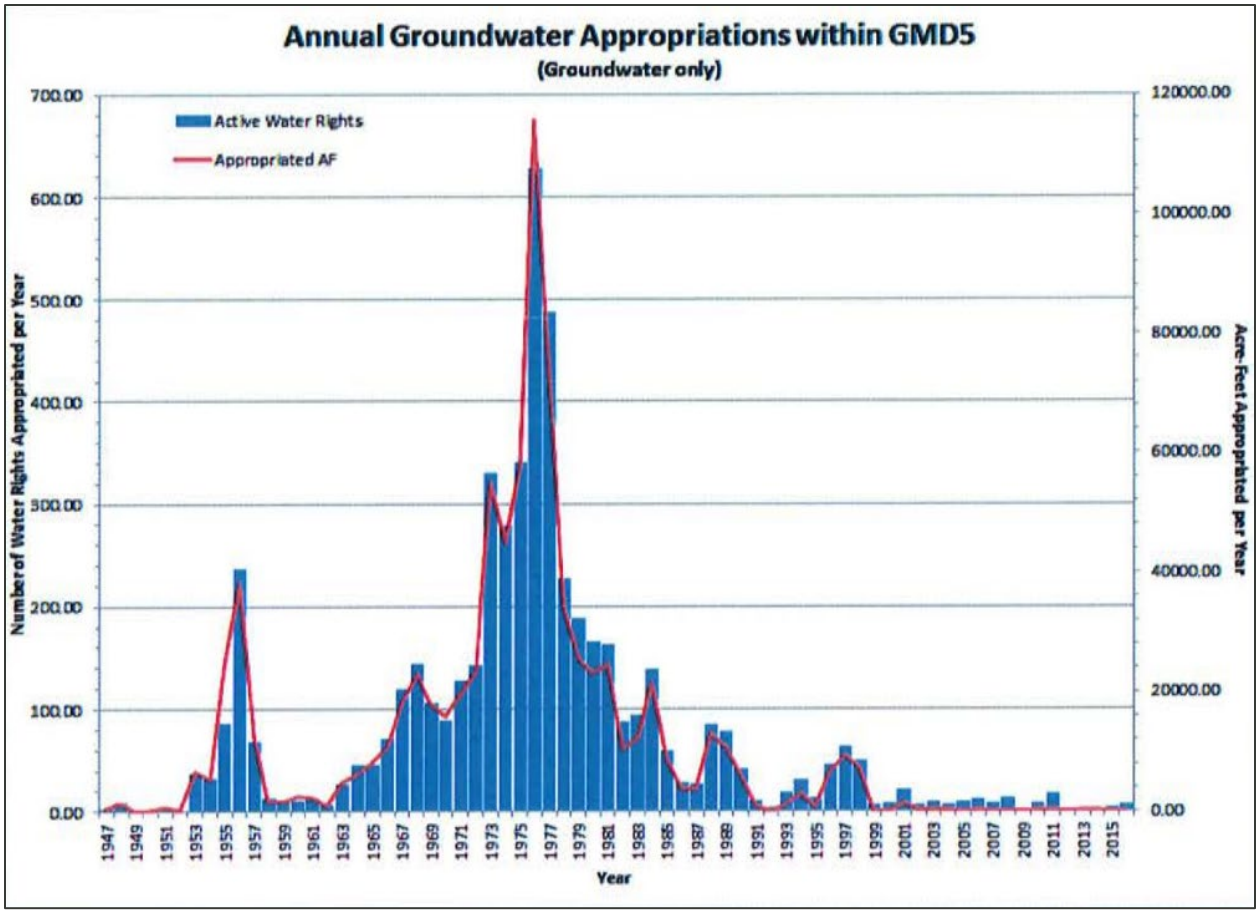

Figure 1.2-3. Groundwater Rights Issued in Groundwater Management District #5 (GMD #5) from 1947 to 2015 (GMD #5 2018).

In a hydrologically connected surface and groundwater system like the Rattlesnake Creek subbasin, depletions to streamflow because of groundwater pumping can occur in two ways: (1) intercepting groundwater that would otherwise become baseflow, or (2) intercepting streamflow directly by drawing the water table down below the stream, which induces water to flow from the stream into the aquifer. Figure 1.2-4 shows how over-pumping groundwater near a stream can lower the water table, forming a cone of depression that reduces or reverses natural groundwater flow into the stream. As pumping increases, the well can intercept water that would have sustained streamflow, and at high rates, may even draw water from the stream into the well. This disrupts the hydrologic balance and can lead to reduced streamflow, which can affect ecosystems and the availability of water downstream. Over time, this can lead to decreases in aquifer levels once streamflow has been depleted.

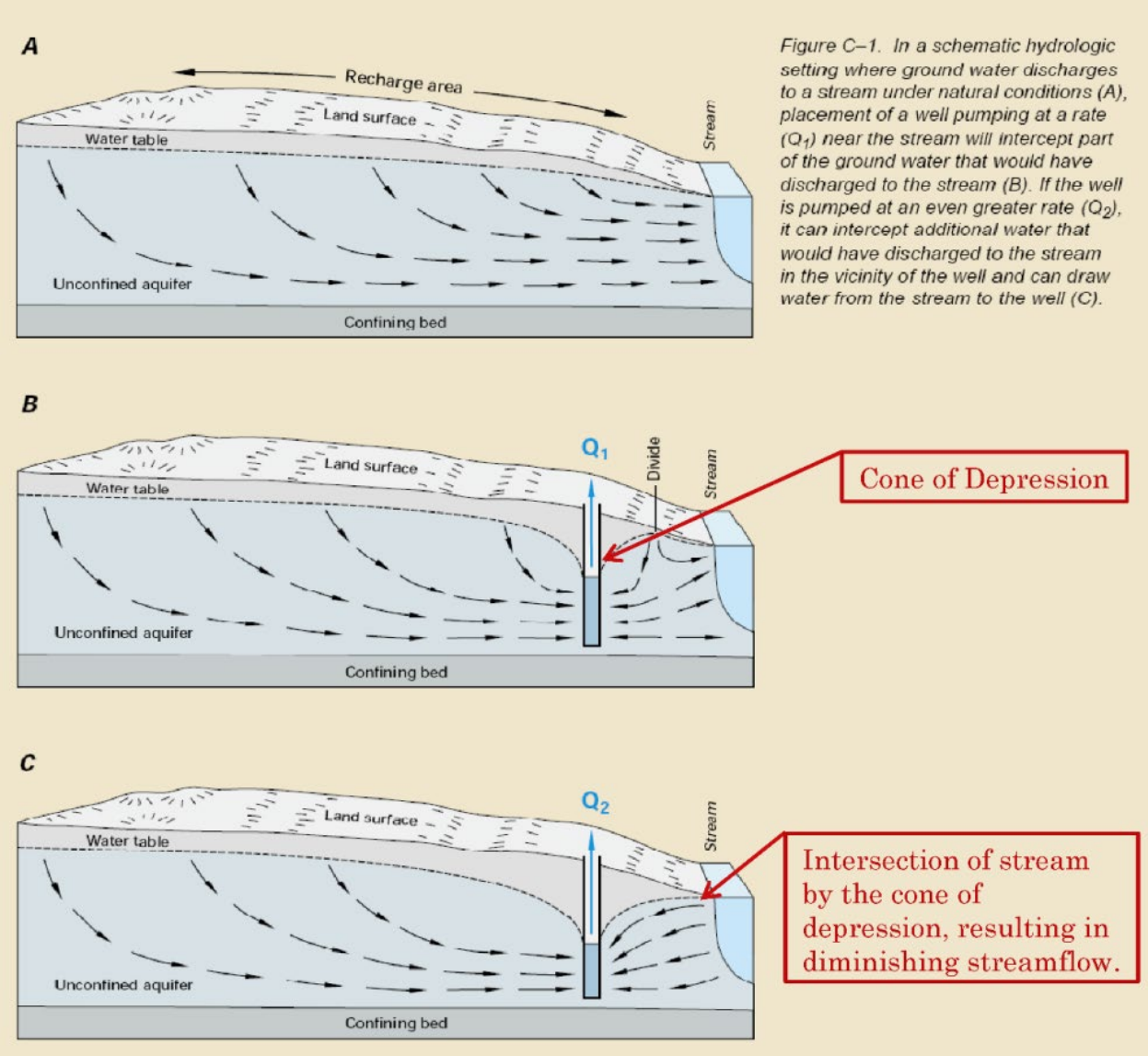

Figure C–1. In a schematic hydrologic setting where ground water discharges to a stream under natural conditions (A), placement of a well pumping at a rate (Q_1) near the stream will intercept part of the ground water that would have discharged to the stream (B). If the well is pumped at an even greater rate (Q_2), it can intercept additional water that would have discharged to the stream in the vicinity of the well and can draw water from the stream to the well (C).

Figure 1.2-4. Schematic Showing the Hydrologic Connection Between a Well, the Aquifer, and the Stream Under Three Different Conditions (KDA-DWR 2016).

The U.S. Geological Survey's (USGS) Zenith gage is located on Rattlesnake Creek near its intersection with Northeast 110th Avenue (Figure 1.2-5). Depletions are calculated by determining the difference between streamflow that would have occurred if the well was not pumped and the streamflow that occurs when a well is pumped. To quantify and predict streamflow depletions, groundwater models must be used. Figure 1.2-6 shows the KDA-DWR refinement of Balleau Groundwater Inc. (Balleau) modeled annual baseflow at Zenith gage from 1940 and 2075 (Balleau 2010).

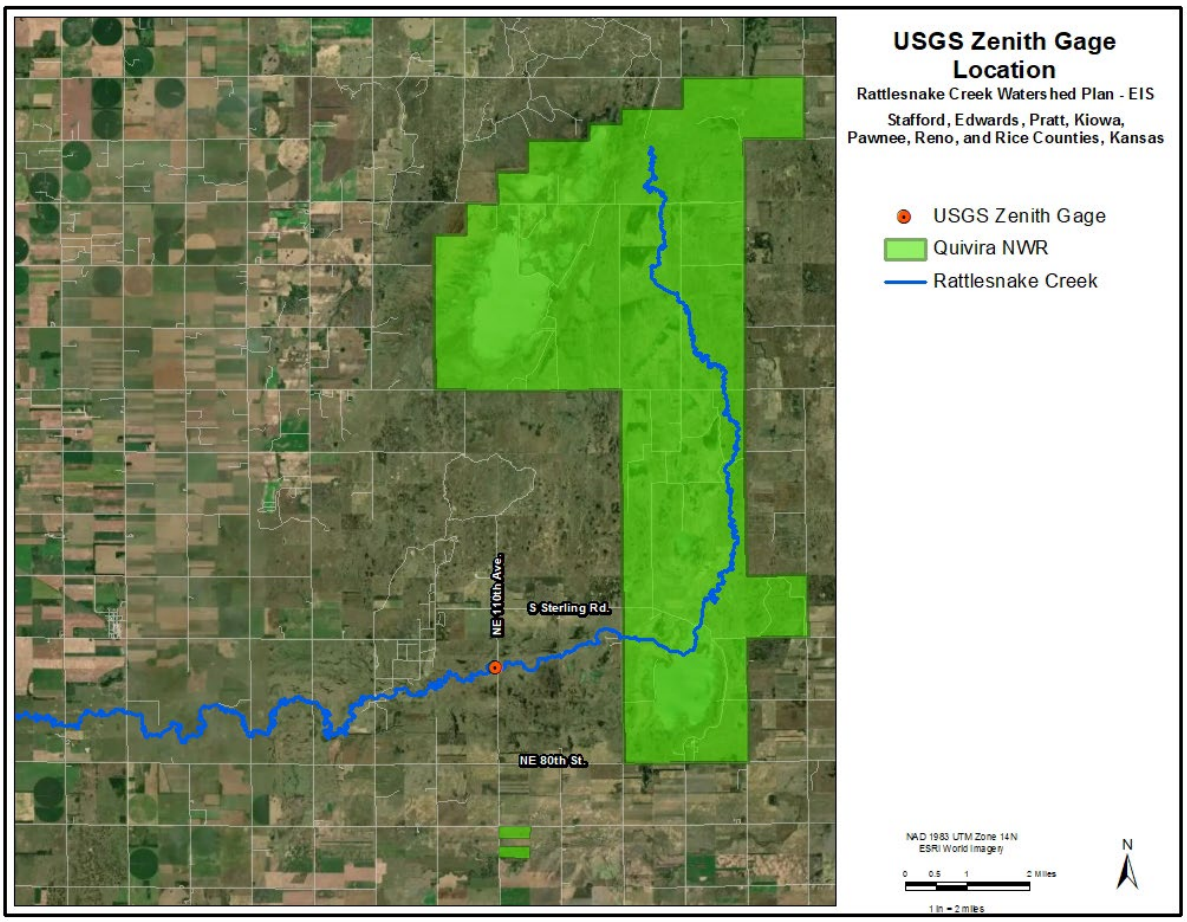

Figure 1.2-5. Location of the U.S. Geological Survey (USGS) Zenith Gage.

Based on the Balleau model (Balleau 2010), annual flow in Rattlesnake Creek was generally between 30 and 60 cubic feet per second (cfs) in the 1940s and 1950s, prior to the increase in active water rights in GMD #5 that occurred in the 1970s and 1980s. By 2020, the modeled baseflow is significantly reduced and by 2075, the modeled baseflow would be reduced to near zero cfs (KDA-DWR 2019a).

Based on the KDA-DWR refinement of the Balleau baseflow estimate at Zenith gage, (Figure 1.2-6), the subsequent simulated impairment, or streamflow depletions as a result of upstream, junior groundwater pumping, was modeled (Figure 1.2-7). Figure 1.2-7 shows significant variability in the model that is based on historical climate events. The modeled data shown in Figure 1.2-7 is based on historical climate trends that have occurred in the past and may occur in the future.

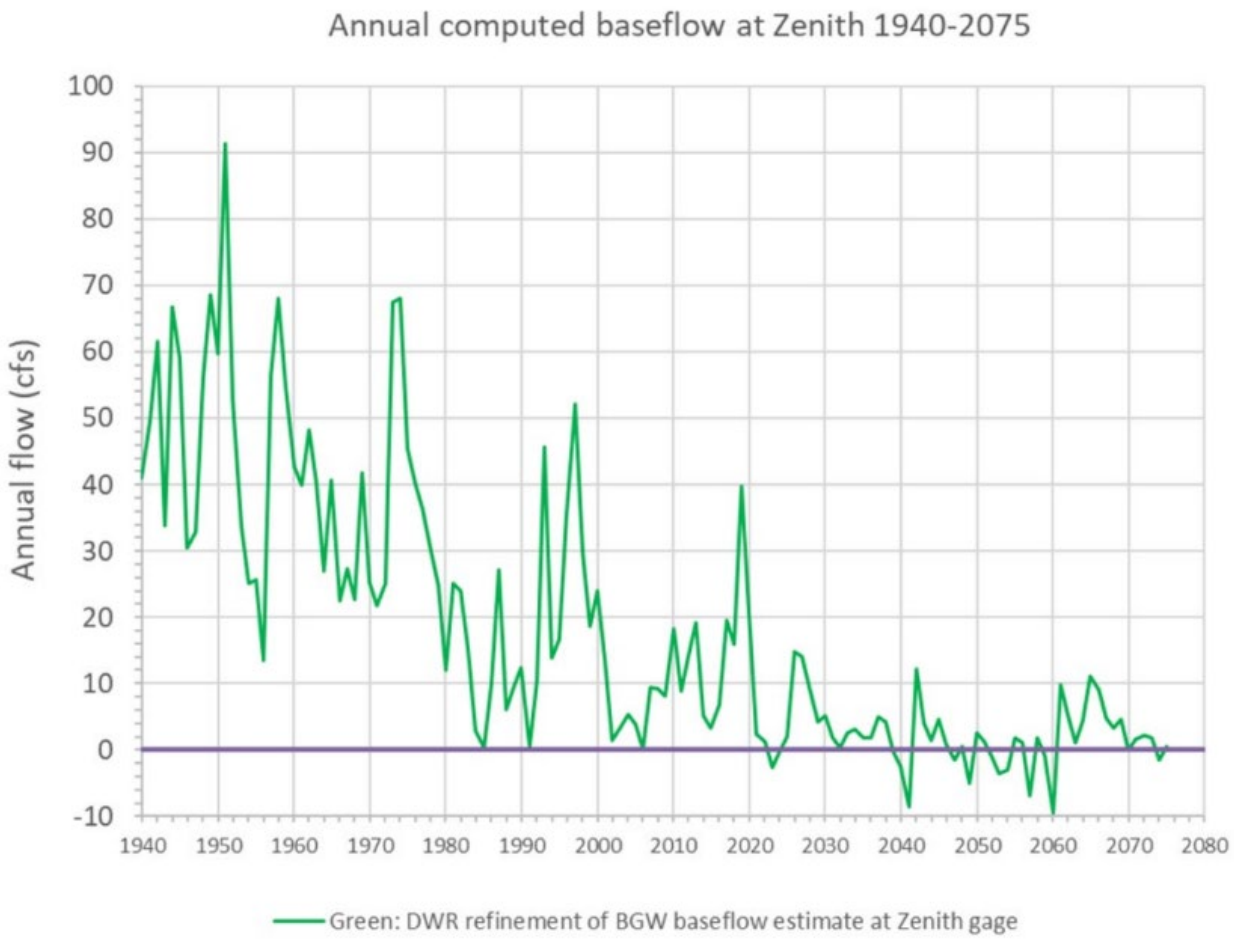

Figure 1.2-6. Rattlesnake Creek Modeled Baseflow Estimate at U.S. Geological Survey (USGS) Zenith Gage Between 1940 and 2075 (KDA-DWR 2019a).

On average, the modeled impairment from 1976 to 2018 was approximately 3,000 acre-feet per year (AFY). Over this time frame, there are years with no impairment and years with approximately 8,000 acre-feet of impairment. From 2020 to 2074, the average impairment is estimated to be approximately 6,000 to 7,000 AFY (KDA-DWR 2019b). The modeled data shows there may be years in the future with no impairment and years in the future with more than 14,000 acre-feet of impairment, which is based on climate variability. Based on KDA-DWR's analysis, a 30 percent reduction in water use in Zone A would be needed to stop additional, long-term depletions to Rattlesnake Creek streamflow (KDA-DWR 2019b).

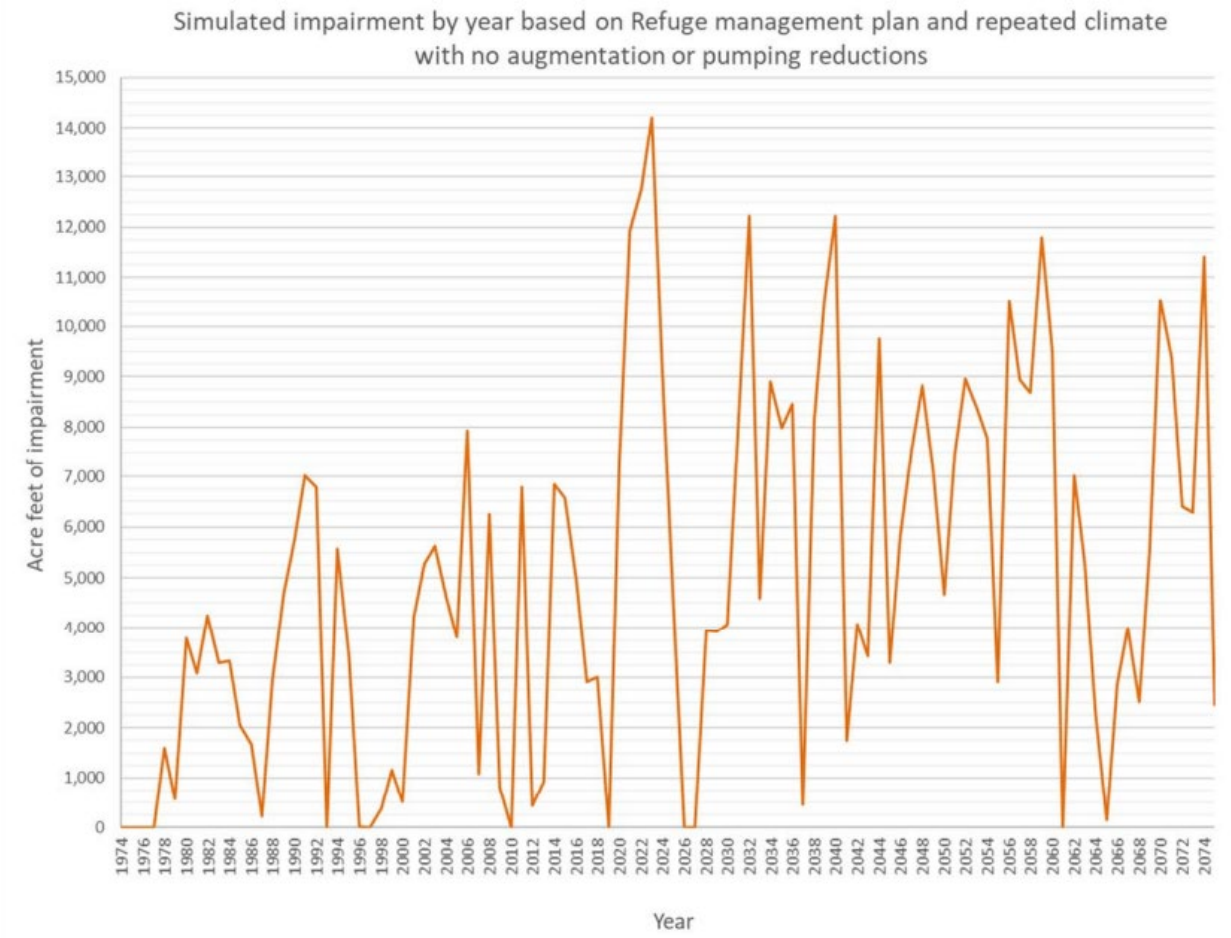

Figure 1.2-7. Estimated Quivira National Wildlife Refuge Impairment Between 1974 and 2074 (KDA-DWR 2019b).

Irrigated farmland has a substantial impact on the economy in GMD #5 (Table 1.2-1). Irrigation increases crop production, which has a direct economic benefit to the producer and has an indirect benefit to livestock production and agribusinesses (Hendricks et al. 2018). Based on the 2012 Census of Agriculture (Hendricks et al. 2018), agriculture in the GMD #5 boundary provides a total annual economic value of more than $2 billion, primarily from farm operating expenditures and animal sales (Table 1.2-1).

Table 1.2-1. Big Bend Groundwater Management District #5 (GMD #5) 2012 Census of Agriculture Values (Hendricks et al. 2018).

Livestock and Agribusiness	Value in millions
Sales from Animals	$817.2
Hog Sales	$96.2
Milk Sales	$2.4
Fertilizer Expenditures	$112.9
Chemical Expenditures	$70.5
Farm Operating Expenditures	$1,286.2

Economic impacts are an important consideration within GMD #5 because the population has a higher percentage of people in poverty and lower median household income than the state and national averages. The population in GMD #5 has 2 percent greater persons in poverty than the national average and a median household income of more than 25 percent below the national average. Table 1.2-2 provides information from the U.S. Census Bureau (USCB) 2019 census (USCB 2019).

Table 1.2-2. USCB 2019 Census Income Data.

Geographic Area	Persons in Poverty (percent)	Median Household Income	Per Capita Income in the Past 12 Months
Big Bend Groundwater Management District #5 (GMD #5)	12.6	$51,059	$26,961
State of Kansas	11.4	$59,597	$31,814
United States	10.5	$69,560	$42,065

1.3 Kansas Water Law

In Kansas, the use of water is monitored and regulated by KDA-DWR. Anyone intending to use Kansas waters for any purpose other than domestic use is required to obtain a permit, or "water right." Water right holders may include municipalities, farmers, commercial businesses, state wildlife management areas, or NWRs. Kansas regulates water use under the prior appropriation doctrine, which means those with older (or senior) water rights have priority access to water relative to newer (or junior) water right holders in times of water shortages (KDA 2021). Kansas water law provides protections for senior water right holders from being impaired by junior water right users, according to priority date. Kansas water rights do not guarantee the availability of any certain amount of water. The water right holder is entitled to the authorized amount while considering seniority and the natural availability of water. The Kansas water right holder is also entitled to divert water at times when it is most beneficial (KDA-DWR 2016). Thus, impairment could still occur because sufficient water is unavailable when the water is most beneficial, even though it is available on an annual basis.

In 1984, minimum desirable streamflow (MDS) requirements were established as an amendment to the Water Appropriation Act (K.S.A. 82a-703a-c). The purpose of MDS requirements is to assure baseflows in certain streams, including Rattlesnake Creek, to protect existing water rights and to meet stream water uses related to water quality, fish, wildlife, aquatic life, recreation, general aesthetics, and domestic uses (Young et al. 2000; K.S.A. 82a-928[i]). MDS are enforceable by KDA-DWR through regulated releases from state-owned reservoirs to supplement flows (where applicable) and through administration of junior water rights. The MDS statute further allows for streamflow augmentation as an option for replacement of diverted flows, specifically within the Rattlesnake Creek subbasin, if augmentation is feasible and voluntary (K.S.A. 82a-706b).

The USFWS holds Water Right File Number 7,571, which was filed on August 15, 1957, and approved in 1963, for the management of Quivira NWR. This water right, which is senior in priority to approximately 95 percent of all other water rights in the Rattlesnake Creek subbasin (Figure 1.3), entitles Quivira NWR to divert up to 14,632 AFY of surface water from Rattlesnake Creek. A final Certificate of Appropriation was issued by KDA-DWR on April 10, 1996 (KDA-DWR 2016).

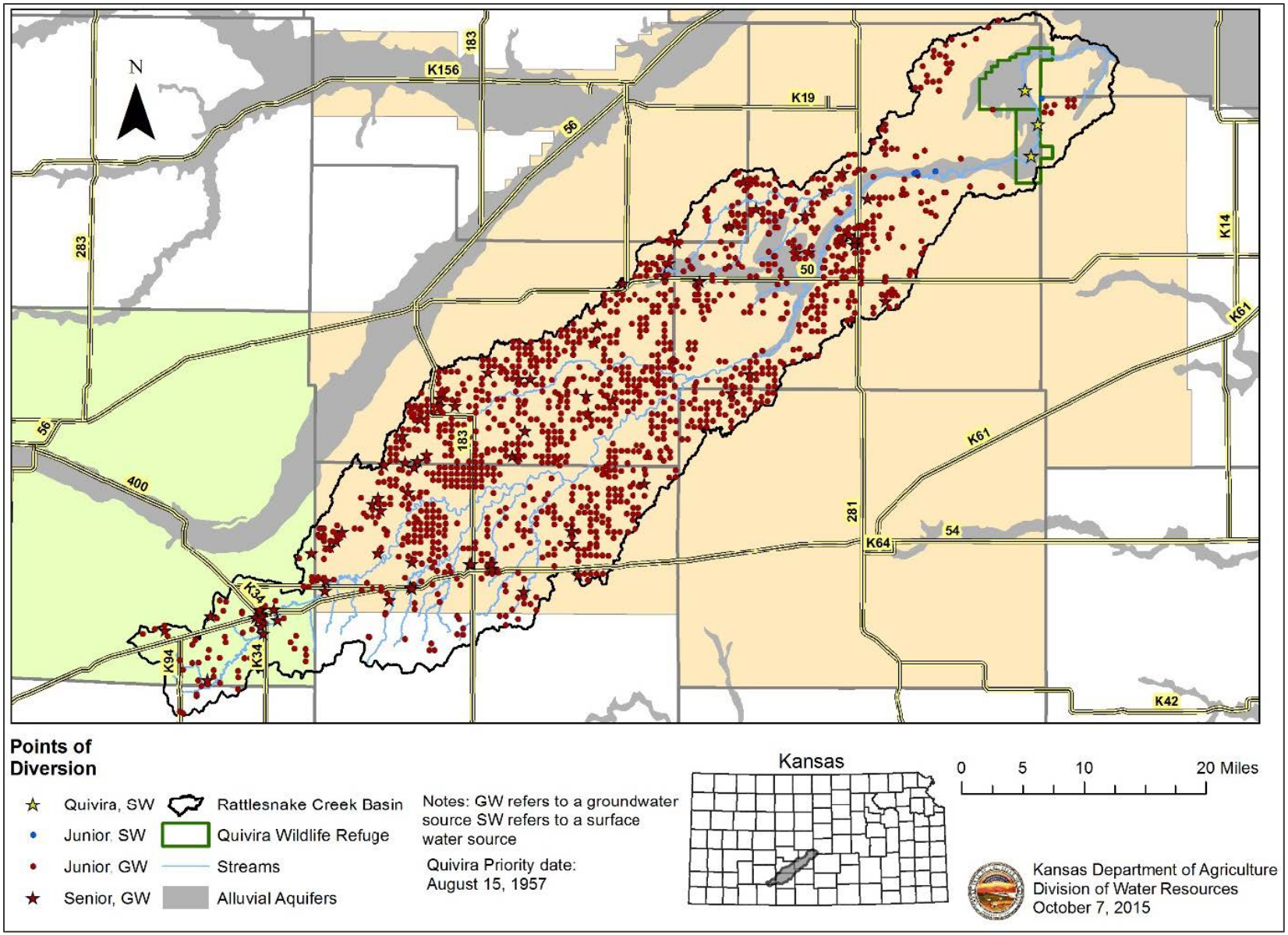

Figure 1.3. Points of Diversion Within the Rattlesnake Creek Subbasin (KDA-DWR 2016).

1.4 Current and Past Solutions

2000 to 2013 Rattlesnake Creek/Quivira Partnership

In 2000, the Rattlesnake Creek/Quivira Partnership comprised of the Water Protection Association of Central Kansas, GMD #5, USFWS, Quivira NWR, and KDA-DWR produced the Rattlesnake Creek Management Program Proposal in an attempt to address water shortages in Rattlesnake Creek. The goal of this program was to reduce water use by junior water right holders through incentive-based programs and community outreach. Local farmers were given the opportunity to enroll in programs such as the Water Transition Assistance Program, where cash incentives were offered to irrigators for permanent retirement of their water rights. Voluntary removal of irrigator end guns was also incentivized; participants who removed their end guns would receive credit toward any reduction required by alternative management actions (Rattlesnake Creek/Quivira Partnership 2000). After 12 years of implementation, it was determined that the Rattlesnake Creek Management Program was unsuccessful at significantly lowering water use rates by junior water right holders because of low community participation, resulting in unmet goals of the Rattlesnake Creek/Quivira Partnership (Rattlesnake Creek Partnership 2012).

2010 Balleau Groundwater Model

In 2010, under contract with the GMD #5 and as part of a technical advisory committee that included GMD #5, KDA-DWR, and USFWS, Balleau developed a regional groundwater model to assist with management of the groundwater in GMD #5, including in the Rattlesnake Creek subbasin. The hydrogeological model included both surface and groundwater considerations and was designed to simulate changes in the aquifer and streams that result from management actions. The model uses historical data from the study area to predict the future hydrologic results of management actions (Balleau 2010). The model was peer reviewed by S.S. Papadopulos and Associates under contract with KDA-DWR.

2013 USFWS Water Impairment Claim

In 2013, following the end of the Rattlesnake Creek/Quivira Partnership, the USFWS filed a water impairment claim that asserted agricultural irrigation infringed on its senior water right (KDA-DWR 2016). USFWS stated that its senior water right had been impaired by junior water right users and that water from Rattlesnake Creek and groundwater discharge are critical to the ecology of the Quivira NWR. USFWS noted the need for surface water from Rattlesnake Creek and groundwater from shallow, saline Permian bedrock. USFWS said that water is needed during critical periods, including the spring and fall migration periods and that water shortages are typically occurring during July, August, and September (USFWS 2013b). The impairment complaint stated that the Quivira NWR's water needs sustain wetlands that support migratory and resident bird species that include federally listed species and make the refuge regionally, nationally, and globally known.

2016 KDA-DWR Impairment Report

KDA-DWR reviewed the Quivira NWR impairment claim, completed an investigation lasting until 2016, and issued a final report from the Chief Engineer. The final report determined that the USFWS Quivira NWR Water Right File Number 7,571 had been impaired by junior water right holders who divert water (KDA-DWR 2016). The KDA-DWR Chief Engineer stated, “I find that the Refuge’s water supply has been regularly and substantially affected by junior groundwater pumping” (KDA-DWR 2016).

KDA-DWR used the Balleau model to evaluate the effects of irrigation pumping on groundwater levels based on historical pumping records. On November 4, 2014, in St. John, Kansas, KDA-DWR presented that the model shows that junior water right holders caused a significant reduction in the amount of groundwater that discharges to Rattlesnake Creek (Figure 1.4-1). KDA-DWR stated that the depletions between 1995 and 2007 were on the order of 30,000 to 60,000 acre-feet (KDA-DWR 2016). A different model titled “Scenario 1” showed that if junior water right holders were not pumping from 1958 onward, additional water would have been available in Rattlesnake Creek at times when Quivira NWR could have made use of the water. The Rattlesnake Creek reductions in flow still resulted in an impairment to USFWS’ water right that exceeded 3,000 AFY 18 times between 1974 and 2007 (Figure 1.4-2). The 2016 impairment report stated that to relieve the Quivira NWR’s impairment, “reductions and/or augmentation will be needed to increase available streamflow at the Refuge by 3,000-5,000 acre-feet on a regular basis” (KDA-DWR 2016). Additionally, KDA-DWR determined that unless changes in groundwater pumping occur, future Quivira NWR impairments can reasonably be assumed (KDA-DWR 2016).

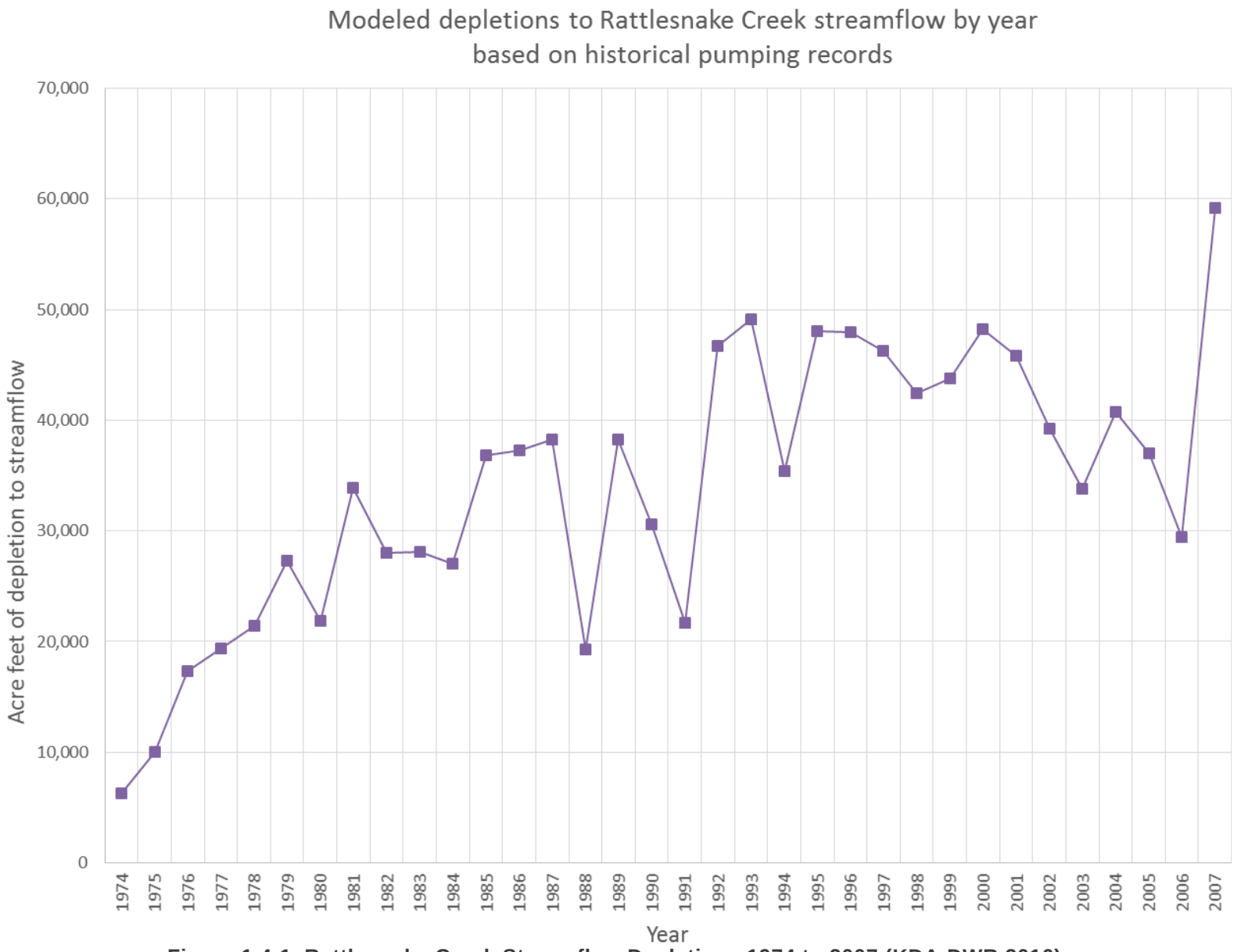

Figure 1.4-1. Rattlesnake Creek Streamflow Depletions 1974 to 2007 (KDA-DWR 2016).

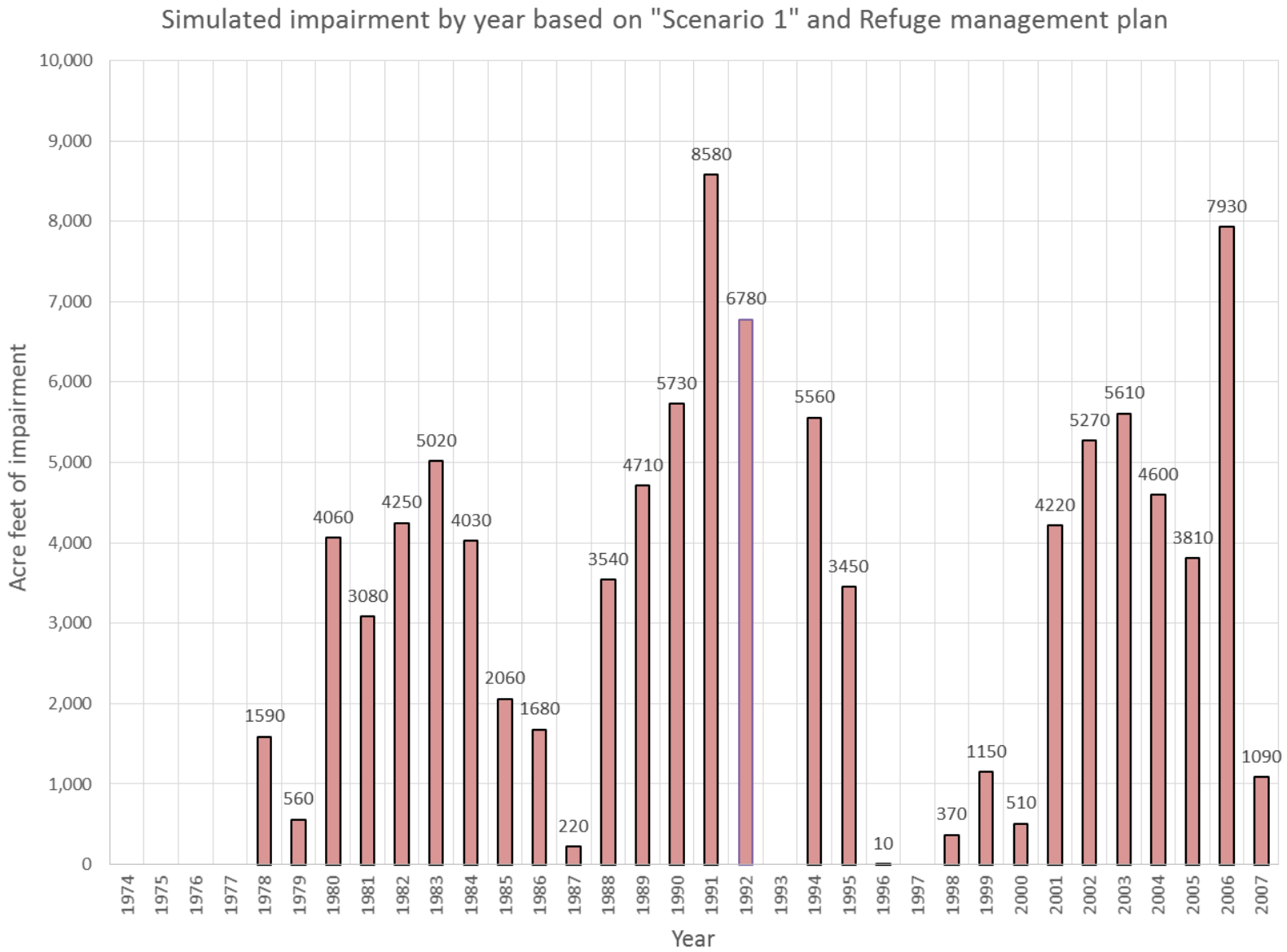

Figure 1.4-2. Quivira National Wildlife Refuge Simulated Impairment "Scenario 1" 1974 to 2007 (KDA-DWR 2016).

KDA-DWR used the Balleau groundwater model to test the sensitivity of Rattlesnake Creek streamflow to pumping throughout the Rattlesnake Creek subbasin. As a result, KDA-DWR developed a series of response zones based on the range of sensitivity of Rattlesnake Creek baseflows to pumping in each zone (Figure 1.4-3). These zones were defined as follows:

- Zone A: The area where pumping groundwater affected Rattlesnake Creek baseflows by **10 percent** or greater of the amount pumped (includes Zones B, C, D).
- Zone B: The area where pumping groundwater affected Rattlesnake Creek baseflows by **20 percent** or greater of the amount pumped (includes Zones C, D).
- Zone C: The area where pumping groundwater affected Rattlesnake Creek baseflows by **30 percent** or greater of the amount pumped (includes Zone D).
- Zone D: The area where pumping groundwater affected Rattlesnake Creek baseflows by **40 percent** or greater of the amount pumped. This zone has also been referred to as the high-impact zone.

Because these areas define the groundwater pumping that predominantly affects baseflows in Rattlesnake Creek, they have been used in various ways in proposals to manage groundwater use. The response zones are based on historical flows at the Zenith gage and modeled depletions above the Zenith gage. KDA-DWR developed these zones for the purpose of water administration, and they are based on the Zenith gage, which provides the best available data for this modeling effort. Though a small number of wells are located downstream of the Zenith gage, which may affect the refuge, most groundwater pumping that affects the refuge occurs from well users upstream of the Zenith gage.

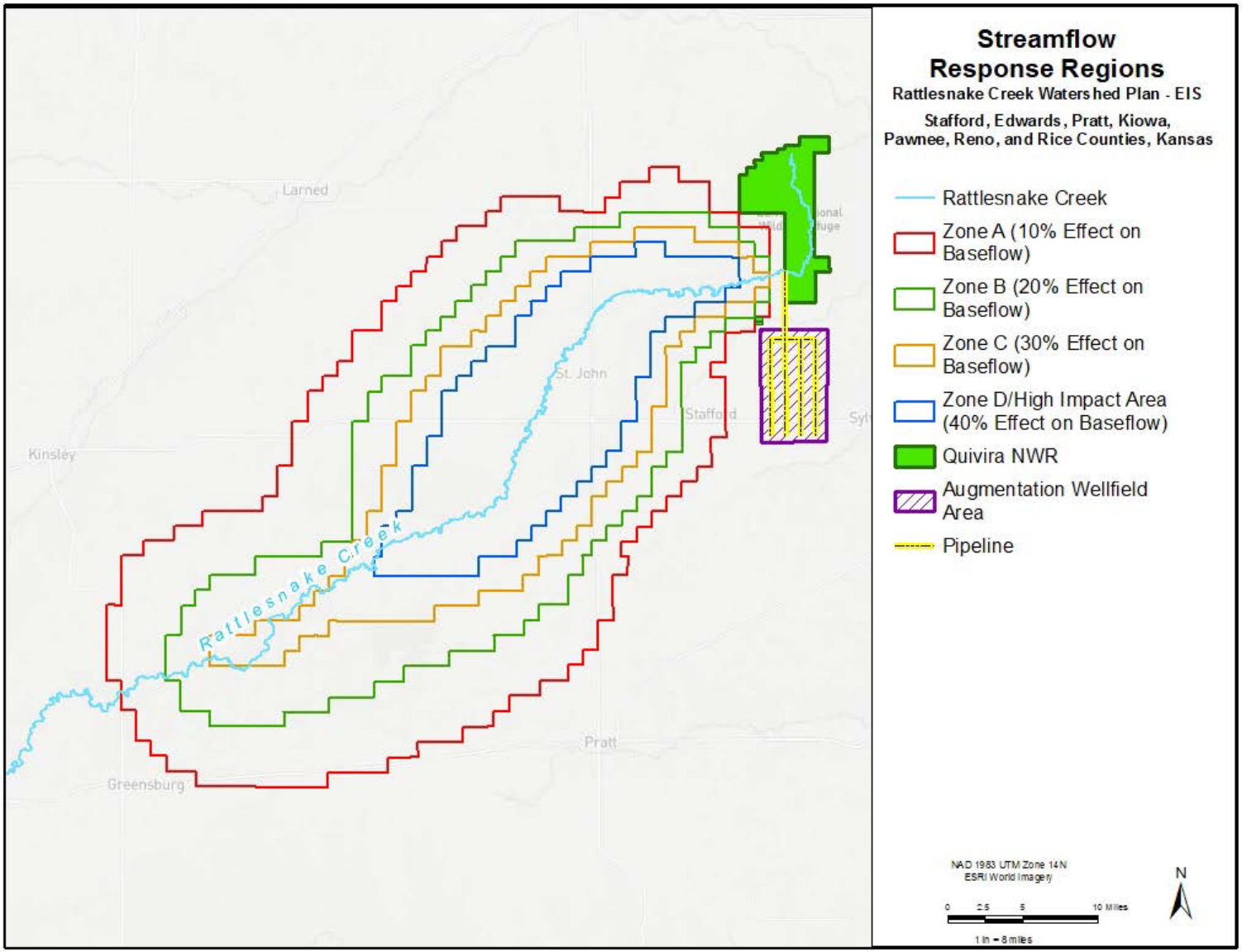

Figure 1.4-3. Streamflow Response Zones to Rattlesnake Creek at U.S. Geological Survey (USGS) Zenith Gage.

2016 and 2017 GMD #5 Proposals

Following the 2016 impairment report, on September 8, 2016, GMD #5 submitted a proposal to the USFWS that described a framework for a solution intended to achieve enhanced water management at Quivira NWR. The proposal included development, construction, and operation of a 15 cfs wellfield at or near Quivira NWR that would provide 1,500 AFY of groundwater per year for use on the refuge to meet or exceed the management objectives for maintaining forage and habitat (GMD #5 2016). In a response dated December 1, 2017, the USFWS rejected the proposal because it would not provide the amount of water needed by the refuge described in the impairment report (3,000-5,000 AFY). The USFWS also cited significant legal obstacles and concerns about the quantity, timing, quality, and location of water delivery (USFWS 2016). On February 15, 2017, GMD #5 submitted a second proposal to the USFWS that offered two options for augmentation, one that proposed an annual water quantity of 2,500 acre-feet and a second option that proposed an annual water quantity of 5,000 acre-feet (GMD #5 2017). The USFWS rejected both proposals on April 14, 2017, stating that neither proposal provided sufficient water quantity to remedy impairment, the proposals risked introducing poor quality water, and the proposals did not provide a sustainable remedy over the long term (USFWS 2017a).

2018 and 2019 GMD #5 LEMA Proposals

Following the two proposals prepared by GMD #5 in 2016 and 2017, efforts shifted toward establishing a LEMA. The GMD #5 submitted a LEMA proposal to the KDA-DWR Chief Engineer on December 20, 2018 (KDA-DWR 2018a). Per the KDA-DWR Chief Engineer's response (KDA-DWR 2018a), the LEMA proposal lacked the following requirements pursuant to K.S.A. 82a-1041: "proposes goals and corrective control provisions as provided in K.S.A. 82a-1041(f) adequate to meet the state goal" and "gives due consideration to water users who already have implemented reductions in water use resulting in voluntary conservation measures." Additionally, the LEMA was "unclear which condition contained in K.S.A. 82a-1036(a-d) the management is supposed to address" (KDA-DWR 2018a).

GMD #5 proposed an updated LEMA in February 2019 with the goal to "provide a satisfactory remedy to the impairment complaint at the Refuge" and the intent to "reduce the hydrologic stress from irrigation operations on the aquifer and the interrelated stream systems" (GMD #5 2019). The LEMA objectives were to "reduce water use in the LEMA area to a degree that will temper the growth and future streamflow losses…" (GMD #5 2019). The LEMA boundary included Zone A (Figure 1.4-3) and the LEMA proposal included the following core elements:

- Reduced hydrologic stress and augmented depleted flows (augmentation wellfield)
- Central Kansas Water Bank Association
- Violations
- Meters
- Advisory Committee

- LEMA Order Reviews
- Corrective Controls
- Impairment Complaints
- Water Level Monitoring
- Coordination

To provide a reduction in hydrologic stress, the following elements were included in the 2019 LEMA proposal (GMD #5 2019):

- Permanent retirement of water rights through the expansion of the Conservation Reserve Enhancement Program (CREP) and the Water Transition Assistance Program (WTAP)
- Permanent purchase and retirement of water rights by the district or other third parties
- Permanent movement of water from hydrologically sensitive areas to less sensitive areas
- Temporary water leases through the Central Kansas Water Bank Association
- Temporary set-aside and rotation programs
- Enrollment in water conservation areas
- Removal of invasive tree species (e.g., Russian olive [*Elaeagnus angustifolia*], salt cedar [*Tamarix ramosissima*])
- Any combination of these programs that have a positive hydrologic effect to the region as confirmed using the Balleau hydrologic model.

Additionally, the 2019 LEMA proposal included end gun removal and water right retirements as mechanisms to decrease irrigation.

The proposed augmentation wellfield, an element of Core Goal No. 1 of the 2019 LEMA proposal, was proposed to be located south of the Quivira NWR. The augmentation wellfield was proposed to provide 15 cfs of groundwater when needed by Quivira NWR. The proposed location was in Township 23 South, Range 11 West, south of Peace Creek and west of Salt Marsh Road. Groundwater from the augmentation wellfield would be delivered to Rattlesnake Creek directly upstream of the Quivira NWR. The LEMA proposed that Quivira NWR had one week of available storage and that during rain, high flow, or when Rattlesnake Creek flowed through Quivira NWR, the augmentation wellfield would not operate.

In August 2019, the KDA-DWR Chief Engineer rejected the LEMA because it was missing the following core requirements aimed at solving the impairment (KDA-DWR 2019c).

- A stated goal of reducing upstream junior groundwater pumping which halves the growth rate of depletions at the Zenith gage on Rattlesnake Creek.
- An overall limitation for total withdrawals within the boundaries of the LEMA.
- Specific limitations for withdrawals within the areas considered Zone A, Zone D, and/or the area within Zone A that is outside Zone D, as needed.

- Specific individual five-year allocations for each water right within the LEMA boundaries consistent with the goal and limitations stated above.
- A method to adjust limitations and individual allocations based on the amount of water retired from Zone D or moved to areas that have lesser impact on Rattlesnake Creek.
- If an augmentation project able to deliver up to 5,000 acre-feet of water at a rate of 15 cfs of acceptable water quality is not operational by January 1, 2023, then the following will occur:
    - Authority to limit total withdrawals within Zone A to an average use of 150,000 AFY for 2023-2025 with specific allocations for each water right within the LEMA to achieve a withdrawal goal of 150,000 acre-feet.
    - A specific request granting the Chief Engineer authority to initiate an Intensive Groundwater Use Control Areas (IGUCA) process to determine the appropriate pumping limitations necessary to resolve the impairment without augmentation and a requirement that such limitations be implemented by January 1, 2026, if augmentation continues to be unavailable.
- A requirement that limitations and allocations be measured by annual water use reports.

2018, 2019, and 2023 USFWS Requests to Secure Water

USFWS submitted requests to secure water to KDA-DWR Chief Engineer David Barfield in 2018 and 2019 (USFWS 2018; USFWS 2019b). Both requests stated that USFWS has had injury from junior water right users. The 2018 request to secure water noted that the request to secure water does not preclude USFWS from working with GMD #5 to find a mutual solution. USFWS submitted a request to secure water to KDA-DWR Chief Engineer Earl Lewis in 2023 (USFWS 2023f).

2019 KDA-DWR Plan for Administration

KDA-DWR presented a plan for administration to the public at an October 21, 2019, meeting in St. John, Kansas. The plan included phasing in water allocations by response zone over the course of three years with the higher impacts to streamflow reduced first. The plan was based on GMD #5 developing an augmentation project with an agreed-on capacity and voluntary action to provide relief to increasing stream depletions caused by groundwater pumping. The augmentation project could be implemented by a local or state entity without federal funding or federal implementation. The 2019 KDA-DWR plan for administration is based on the construction of an augmentation wellfield, which is an alternative described in Chapter 5.

2020 KDA-DWR Planned Administration Orders

Following the 2018 and 2019 USFWS requests to secure water, and in anticipation of a 2020 request to secure water, KDA-DWR planned administration orders to secure the Quivira NWR water right through a sample notice mailing (KDA-DWR 2019d). The sample notice mailing described a three-pronged approach to securing the water right: (1) reductions in water

withdrawals, (2) development of an augmentation project proposed by GMD #5, and (3) the retirement or reduction of 4,400 acre-feet of water right use near Rattlesnake Creek in Zone D.

The reductions in annual withdrawals of water were based on water right priority and would occur in Zone D in 2020, Zone B in 2021, and Zone A in 2022. The water withdrawal reductions would be phased in over three years and would begin with water rights closest to Rattlesnake Creek (KDA-DWR 2019d). The sample notice detailed that the augmentation project and 4,400 AFY of water right retirement in Zone D would be needed by 2023 or additional reductions in water use would be administered.

2020 GMD #5 and USFWS Memorandum of Agreement (MOA)

Following the rejection of the 2018 and 2019 LEMA proposals, continuing efforts to address the impairment claim resulted in a MOA on July 25, 2020 (MOA 2020), between the USFWS and GMD #5. As agreed, the USFWS did not submit a request to secure water during the MOA. The timelines from the MOA expired in 2021.

2021 GMD #5 and Kansas Natural Resources Conservation Service (NRCS) Secures Public Law (PL) 83-566 Funding

GMD #5, through the Kansas NRCS, applied for and secured PL 83-566 funding with support from several agencies and nongovernmental organizations to develop solutions to the limited agricultural water in the GMD #5 subbasin through the development of a Plan – EIS.

2023 KDA-DWR Supplement to Impairment Report

In August 2023, KDA-DWR issued a draft of a supplement to the 2016 impairment report using newly available data from Balleau's update to the 2010 GMD #5 model. The purpose of the supplement was to extend the analysis presented in the 2016 report to include data from the years 2008-2020; data used in the 2016 report ended in 2007. Based on the updated analysis, KDA-DWR concluded that Quivira NWR's water right was impaired in nine of the 13 additional years, ranging from 8,711 acre-feet of impairment in 2012 to 2,250 acre-feet in 2020 (Figure 1.4-4). The average annual impairment between 2008-2020 was 4,039 acre-feet (6 cfs), and the average annual impairment between 2011-2018 was 6,282 acre-feet (9 cfs). The supplemental analysis reached the same conclusion as the 2016 analysis, that Quivira NWR's water right has been significantly impaired by upstream, junior groundwater pumping (KDA-DWR 2023).

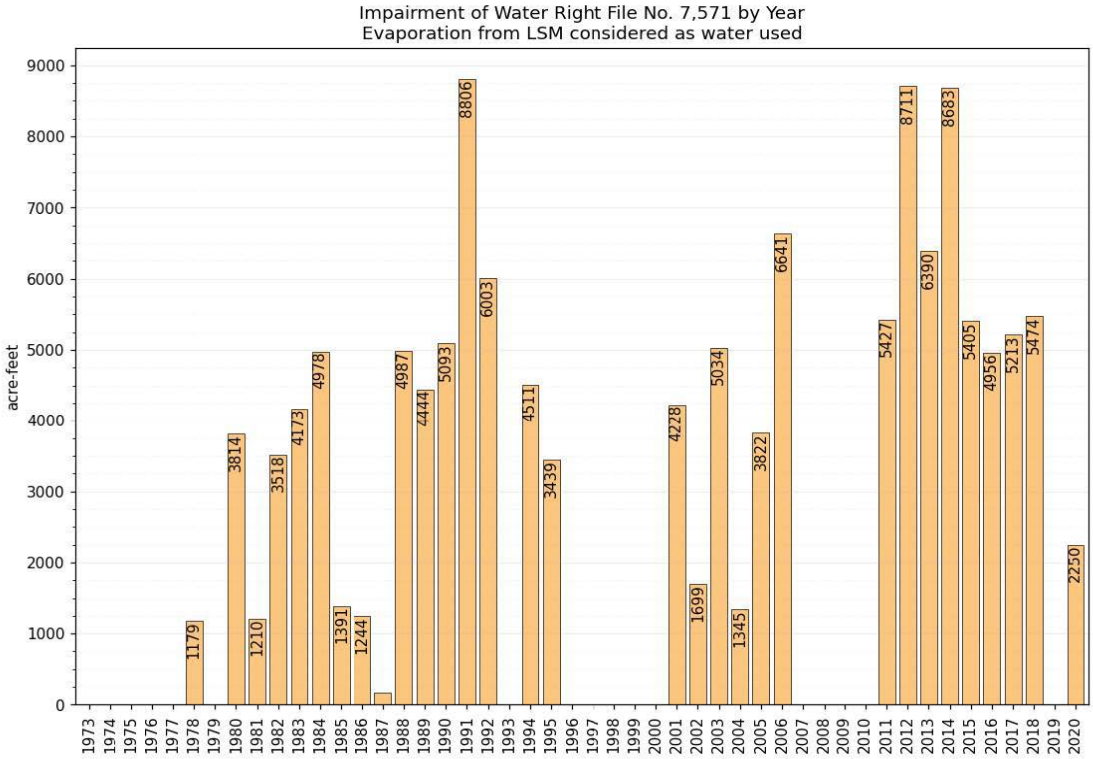

Figure 1.4-4. Impairment of Water Right File No. 7,571 by Year.

January 2024 KDA-DWR Plan for Administration

On January 25, 2024, KDA-DWR notified water right holders via mail of a proposed plan to administer water rights beginning January 1, 2025, pursuant to K.S.A. 82a-706b. This mailing was informational in nature, nondeterminative, and is not an official order. Prior to implementation, this plan may be further modified based on new information, public input, or legal challenge. The mailing information and plan for administration is included in Appendix A.

The proposed plan for administration would include similar baseline conditions as the current No Action Alternative. A key difference between the two scenarios would be potentially reduced economic impacts that may occur by spreading the water rights administration over a larger group of water right holders and allocating water rights over a longer duration compared to the current No Action Alternative.

2024 Rattlesnake Creek Workgroup

Following the USFWS February 2023 request to secure water, KDA-DWR formed the Rattlesnake Creek Workgroup (Workgroup) to address the Chief Engineer's water right impairment finding at Quivira National Wildlife Refuge. With the support of the USFWS, the Chief Engineer convened the Workgroup beginning in January 2024 to allow for full participation of affected stakeholders and the pursuit of a collaborative remedy in lieu of KDA-DWR issuing administration orders in 2024 (USFWS 2023f). Several notable participating stakeholders include USFWS, NRCS, GMD #5, representatives from Senator Marshall's office, Senator Moran's office, Governor Kelly's office, Audubon of Kansas, Kansas Water User's Association, Central Kansas Water Bank Association, Kansas Corn, The Nature Conservancy, WaterPACK, Kansas Farm Bureau, Kansas Livestock Association, and Kansas Agribusiness Retailers Association. The Workgroup met monthly from January to July 2024, with additional technical subcommittee meetings held periodically outside of the larger Workgroup meetings. The Workgroup and subcommittee focused on identifying pending issues and concerns, learning about existing and planned conservation efforts in the region, reviewing modeling and available data, and developing short-term methods to be used before the proposed augmentation wellfield would be put into operation following completion of the Plan – EIS process. Funding from KDA-DWR was secured for one year and the Workgroup's goal is to develop methods to implement in the beginning of 2025 as a short-term remedy to the impairment.

As a result of this stakeholder involvement, several short-term initiatives are now under development, including: (1) voluntary water conservation agreements through a Compensated Allocation Management Program (CAMP) designed by the Central Kansas Water Bank Association, (2) a voluntary Water Conservation Area (WCA) designed by several industry groups, (3) a small-scale pilot streamflow augmentation project to be implemented through the Chief Engineer and funded by the state of Kansas, and (4) minimum desirable streamflow administered and implemented by KDA-DWR. Because of the progress made by the Workgroup, the USFWS issued a statement indicating it does not believe it is necessary for Chief Engineer Lewis to administer water rights in the Rattlesnake Creek region in 2025 and that it is committed to continued participation through the Workgroup (USFWS 2024). The collaborative Workgroup remains active to further develop these programs.

2. PURPOSE AND NEED FOR ACTION

This section provides a description of the Rattlesnake Creek Watershed Plan – EIS purpose and need. Also included is a summary of authorized project purposes associated with PL 83-566 and background information.

2.1 Project Purpose

The purpose of the Rattlesnake Creek Watershed Plan – EIS is to provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin of GMD #5, including project components, to meaningfully address the impairment at Quivira NWR. For the purposes of this Plan – EIS, "long-term" is defined as a period of 50 years, recognizing that changes in water use may take years to affect Rattlesnake Creek and the Great Bend Prairie Aquifer. A 50-year period allows for sufficient simulation time to model the impacts from implementation options, evaluate the long-term sustainability of water management, and apply adaptive management where needed. For the purposes of the Plan – EIS, "sustainable agricultural water management" is defined as surface and groundwater use that can be maintained consistent with water rights and the economic viability of the region's agriculture.

Authorized Project Purposes Under PL 83-566

The PL 83-566 statute establishes eligible project purposes. PL 83-566 projects must meet one of three general purposes, or as characterized in the statute, "works of improvements" (16 U.S. Code [USC] 1001-1008 [Watershed Protection and Flood Prevention Act 1954]) as follows:

- Flood prevention (including structural and land treatment measures)
- The conservation, development, utilization, and disposal of water
- The conservation and proper use of land

Additionally, the statute states that, "Each project must contain benefits directly related to agriculture, including rural communities, that account for at least 20 percent of the total benefits of the project" (16 USC 1001-1008).

Once the above requirements on works of improvements and agricultural benefits have been met, sections 3 and 4 of PL 83-566 specifically authorize the following project components (16 USC 1001-1008):

- Flood prevention (flood damage reduction)
- Watershed protection
- Public recreation
- Public fish and wildlife
- Agricultural water management
- Municipal and industrial water supply
- Water quality management
- Watershed structure rehabilitation

This Plan – EIS meets the general purpose of conservation, development, utilization, and disposal of water and the project component of agricultural water management.

2.2 Project Need

The Plan – EIS is necessary for two reasons: (1) Quivira NWR's ongoing senior water right impairment as described in KDA-DWR's 2016 impairment report, and (2) the importance of groundwater to the agricultural economy. The sustainability of Quivira NWR relies primarily on surface water diversions that have been impaired because of agricultural groundwater use (Section 1.1). However, a predictable and consistent source of water is required to support the agricultural economy (Section 1.2). Providing long-term agricultural water management for the region would help provide water resources for both the agricultural economy and meaningfully address Quivira NWR's impaired senior water right as described in KDA-DWR's 2016 impairment report. A project will be developed on approval of this Plan – EIS that would assure a water supply for Quivira NWR while considering and minimizing economic impacts to the surrounding agricultural economy.

3. SCOPE OF THE WATERSHED PLAN ENVIRONMENTAL IMPACT STATEMENT

GMD #5 has been awarded federal funding from the NRCS through the Watershed Protection and Flood Prevention Act, PL 83-566. Through PL 83-566, the NRCS provides assistance (both technical and financial) to local government sponsors that are planning and implementing watershed projects. Projects can include flood prevention (including structural and land treatment measures); the conservation, development, utilization, and disposal of water; or the conservation and proper use of land. Funding received by GMD #5 from NRCS through the PL 83-566 program is being used to develop a Plan – EIS for the project area shown in Figure 3.0.

NRCS requires that the scope of the Plan – EIS be completed in accordance with the *Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines (PR&G) for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments* (NRCS 2017) and 40 CFR Section 1501.7. Public and agency comments were solicited on January 13, 2022, as part of separate scoping meetings. The public and agency comments received related to the range of actions, alternatives, and impacts to be considered in the Plan – EIS. Additionally, public and agency comments were received that relate to impacts associated with direct and indirect effects and connected and cumulative actions. Public and agency comments are used to determine the issues and concerns related to the proposed project and to determine potential reasonable alternatives to be evaluated in the Plan – EIS. Public and agency comments are included in Appendix A. The NRCS *National Watershed Program Manual* (NRCS 2015) requires that the following (Table 3.0-1) concerns be addressed in the scoping process.

Table 3.0-1. Natural Resources Conservation Service (NRCS) National Watershed Program Manual – Resource Concerns and Applicable References.

Item / Concern	Associated Laws, Executive Orders, and Code of Federal Regulations (CFRs)
Air Quality	Clean Air Act (42 U.S. Code [USC] Sections 7401 -7671q); 40 CFR Section 70.2
Bald and Golden Eagles	Protection of Bald and Golden Eagles Act of 1990 (16 USC Sections 668(a)-(d)
Civil Rights	Civil Rights Act of 1964; 230 GM, Part 402 and Part 403
Coastal Zone Management Areas	Public Law (PL) 92-583, the Coastal Zone Management Act of 1972
Coral Reefs	Executive Order (EO) 13089, Coral Reef Protection; PL 92-500, the Clean Water Act
Cultural Resources/Historic Properties and Tribal Consultation	PL 89-665, the National Historic Preservation Act of 1966, as amended; 36 CFR Part 800, Protection of Historic Properties; PL 96-95, the Archaeological Resources Protection Act of 1979; and PL 101-601, the Native American Graves Protection and Repatriation Act; 7 CFR Section 650.3(a)(7); EO 13007, Indian Sacred Sites; EO 13175, Consultation and Coordination with Tribal Governments; EO 13287, Preserve America; Secretarial Order (SO) 3206, American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act; Presidential Memorandum (PM), Government-to-Government Relations with Native American Tribal Governments (April 29, 1994); PM, Tribal Consultation (November 5, 2009); 410-General Manual (GM), Part 405, American Indians and Alaska Natives; 420-GM, Part 401, Cultural Resources and Historic Properties; Departmental Regulation (DR) 1350-001, Tribal Consultation (2008); DR 1340-007, Policies on American Indians and Alaska Natives
Ecologically Critical Areas	No applicable law or regulation per Title 390-National Watershed Program Manual Part 500, Subpart C
Endangered and Threatened Species	PL 93-205, the Endangered Species Act of 1973; 7 CFR Section 650.3(b)(12)
Essential Fish Habitat	PL 95-265, Fishery Conservation and Management Act; 16 USC Section 1855(b)(2)
Fish and Wildlife (including coordination requirements)	PL 83,566 Section 12, Watershed Protection and Flood Prevention Act of 1654
Floodplain Management	EO 11988, Floodplain Management; 7 CFR Section 650.25
Forest Resources	PL 94-588, the National Forest Management Act of 1976
Invasive Species	EO 13112, Invasive Species (1999); EO 13751, Safeguarding the Nation from the Impacts of Invasive Species (2016)
Land Use	No applicable law or regulation per Title 390- National Watershed Program Manual Part 500, Subpart C
Migratory Birds	The Migratory Bird Treaty Act of 1918 (16 USC Sections 703 -712, 40 Stat. Section 755); EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds

Item / Concern	Associated Laws, Executive Orders, and Code of Federal Regulations (CFRs)
Natural Areas	7 CFR Section 650.23; PL 88-577 (16 USC 131-1136), Wilderness Act of 1964
Parklands (including National Parks, Monuments, and Historical Sites)	40 CFR Section 1508.27(b)(3)
Prime and Unique Farmland, and Farmland of Statewide or Local Importance	PL 97-98, the Farmland Protection Policy Act of 1981, as amended (7 USC Section 4201 et seq.); 7 CFR Section 650.3(b)(9); 7 CFR Section 658.5
Public Health and Safety	Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risk; 190 GM, Part 410
Regional Water Resource Plans (including coastal zone plans)	7 CFR Section 1506(d)
Riparian Areas	190 GM Section 411.3(D)
Scenic Beauty	190 GM, Part 410
Significant Scientific Resources	40 CFR Section 15808.27(b)(8)
Sole Source Aquifers	PL 93-523, the Safe Drinking Water Act of 1974, as amended
Social Issues	190 GM, Part 410
Soil Resources	PL 95-192, the Soil and Water Resources Conservation Act of 1977; PL 94-580, Resource Conservation and Recovery Act of 1976, as amended; PL 96-510, Comprehensive Environmental Response, Compensation, and Liability Act of 1980
Water Quality	PL 92-500, the Clean Water Act, as amended; PL 93-523, the Safe Drinking Water Act of 1974, as amended; 7 CFR Section 650.3(b)(14); 40 CFR Part 232; PL 94-580, Resource Conservation and Recovery Act of 1976, as amended; PL 96-510, Comprehensive Environmental Response, Compensation, and Liability Act of 1980
Water Resources	PL 92-500, the Clean Water Act, as amended; River and Harbors Act of 1899 (33 USC Section 403); PL 99-198, Food Security Act of 1985; EO11990, Protection of Wetlands; 33 USC Section 701b-11; 7 CFR Section 650.3(b)(12)
Waters of the U.S. (WOTUS), Wetlands, and Special Aquatic Sites	PL 92-500, the Clean Water Act, as amended; River and Harbors Act of 1899 (33 USC Section 403); PL 99-198, Food Security Act of 1985; EO11990, Protection of Wetlands; 33 USC Section 701b-11; 7 CFR Section 650.3(b)(12)
Wild and Scenic Rivers	PL 90-542, the Wild and Scenic Rivers Act of 1968
Ecosystem Services (Provisioning, Regulating, Supporting, Cultural)	Office of Management and Budget (OMB) Memorandum M-16-01, Incorporating Ecosystem Services into Federal Decision Making

A summary of scoping is provided in Table 3.0-2. Resources identified as relevant to the project are investigated in further detail within this document.

Table 3.0-2. Summary of Scoping.

Concern	Item	Relevant	Not Relevant	Rationale
Soil-Related Concern	Prime and Unique Farmland, and Farmland of Statewide or Local Importance	X		Approximately 97 percent of land within the project area is farmed, and 37 percent of farmed areas are classified by the Natural Resources Conservation Service (NRCS) as prime farmland. Conversion of farmland to nonagricultural uses could occur in portions of the project area where permanent disturbance or infrastructure may occur.
Soil-Related Concern	Soil Resources and Geology	X		Ground disturbance activities have the potential to disturb existing soils in the project area. Existing surficial and bedrock geology in the project area contributes to soil formation, groundwater movement, and groundwater availability.
Water-Related Concern	Aquifers and Sole Source Aquifers (SSA)	X		The project area is within the Great Bend Prairie and Equus Beds components of the High Plains Aquifer. Most artificial withdrawal from the High Plains Aquifer occurs from groundwater wells used for irrigation, which can alter streamflows in areas with shallow depths to water table. According to the Environmental Protection Agency (EPA) map of SSAs, the High Plains Aquifer is not an SSA.
Water-Related Concern	Surface Water Quality	X		Watersheds within the project contain impaired or potentially impaired waters listed under Section 303(d) by the Kansas Department of Health and Environment (KDHE) and approved by the Environmental Protection Agency (EPA). The primary water quality concern related to the project area is the prevalence and concentration of chlorides in surface waters.
Water-Related Concern	Surface Water Resources	X		Numerous streams, wetlands, and other surface waters are present within the project area based on the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) and U.S. Geological Survey (USGS) National Hydrography Dataset (NHD). Surface water resources within the project area are evaluated under Waters of the U.S. (WOTUS), wetlands, and special aquatic sites.

Concern	Item	Relevant	Not Relevant	Rationale
Water-Related Concern	Water Rights	X		Kansas water law provides protections for senior water right holders from being impaired by junior water right users, according to priority date. The USFWS holds Water Right File Number 7,571, which was filed on August 15, 1957, and approved in 1963, for the management of Quivira National Wildlife Refuge (NWR). This water right is senior to approximately 95 percent of all water rights in the Rattlesnake Creek subbasin. In 2013, USFWS filed a water impairment claim that asserted agricultural irrigation infringed on its senior water right. The impairment has not yet been resolved.
Water-Related Concern	Regional Water Management Plans	X		The project area is within Groundwater Management District #5 (GMD #5) and the Great Bend Prairie Regional Planning Area. GMD #5 is the proposed local sponsor associated with the project.
Water-Related Concern	Floodplain Management		X	The project area is not located with a 100-year floodplain or regulatory floodway based on a review of the Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL) geospatial database.
Water-Related Concern	Coastal Zone Management Areas		X	There are no Coastal Zone Management Areas within the project area. Kansas is not a coastal state, does not border the Great Lakes, and does not participate in the National Oceanic and Atmospheric Administration (NOAA) Coastal Zone Management Program.
Water-Related Concern	Coral Reefs		X	According to the USGS NHD, the project area is landlocked and unconnected to marine environments. There are no coral reefs in the state of Kansas.
Water-Related Concern	WOTUS, Wetlands, and Special Aquatic Sites	X		Wetlands, streams, and other WOTUS are present within the project area based on desktop resources including the USFWS National Wetland Inventory (NWI) and USGS NHD.
Water-Related Concern	Wild and Scenic Rivers		X	According to the National Park Service (NPS) Wild and Scenic Rivers map and NPS Nationwide Rivers Inventory (NRI) map, there are no Wild and Scenic Rivers or NRI segments in the project area.
Air-Related Concern	Air Quality		X	According to the EPA Green Book, no counties within the project area have nonattainment or maintenance statuses for criteria pollutants.

Concern	Item	Relevant	Not Relevant	Rationale
Plant- and Animal-Related Concern	Endangered and Threatened Species	X		The project area is within the known range of several species listed as threatened or endangered under the Endangered Species Act (ESA), species listed as threatened or endangered under the Kansas Nongame and Endangered Species Conservation Act, and special status (federally proposed, candidate, discretionary listed) species.
Plant- and Animal-Related Concern	Invasive Species	X		Invasive species, primarily invasive plant species, are known to occur within the project area and adjacent areas. Soil disturbance during construction activities could inadvertently facilitate the introduction or spread of invasive species.
Plant- and Animal-Related Concern	Riparian Areas	X		Riparian areas (both forested and nonforested) are present within the project area based on land cover and NHD data. These areas are sensitive to changes in streamflow and groundwater levels.
Plant- and Animal-Related Concern	Forest Resources		X	According to the National Land Cover Database (NLCD), less than 1 percent of the project area is classified as forested land cover. Forested areas are not present in areas where construction activities could occur.
Plant- and Animal-Related Concern	Fish and Wildlife Resources (including coordination requirements)	X		There are no recreational fisheries within the project area; however, there are various fish and wildlife species present throughout the project area and associated watersheds, including at Quivira NWR.
Plant- and Animal-Related Concern	Ecologically Critical Areas	X		Quivira NWR is within the project area and provides habitat for migratory and resident bird species in the Central Flyway. Quivira NWR could be affected by alterations in streamflow in Rattlesnake Creek. Quivira NWR and its ecological significance are evaluated under Significant Scientific Resources.
Plant- and Animal-Related Concern	Natural Areas	X		Quivira NWR is considered a natural area and is present within the project area. Quivira NWR could be affected by alterations in streamflow in Rattlesnake Creek. One additional natural area, Pratt Sandhills State Wildlife Management Area, is also located within the project area.

Concern	Item	Relevant	Not Relevant	Rationale
Plant- and Animal-Related Concern	Migratory Birds and Bald and Golden Eagles	X		Migratory birds are present within the project area and could be affected by land disturbance activities or changes to their habitats. Though forest resources are limited within the project area, bald eagles could be present.
Plant- and Animal-Related Concern	Essential Fish Habitat		X	According to the NOAA Essential Fish Habitat map, there are no designated essential fish habitats in the project area.
Human Use-Related Concern	Cultural Resources/Historic Properties and Tribal Coordination	X		Though there are no sites listed in the National Register of Historic Places (NRHP) within the project area, a cultural resources survey of the project area (including both historic properties and archaeological resources) has not yet been conducted. Historic properties are documented in the watershed and additional undocumented properties may be present. A Section 106 Programmatic Agreement (PA) was accepted by the ACHP on August 27, 2025.
Human Use-Related Concern	Civil Rights	X		According to data obtained from the United States Census Bureau, there are low-income populations, minority populations, and linguistically isolated populations within the project area.
Human Use-Related Concern	Local, Regional, and National Economy	X		Implementation of any of the evaluated alternatives could result in impacts to the local and regional economy resulting from changes in agricultural practices.
Human Use-Related Concern	Social Issues		X	There are no known social issues within the project area or raised during scoping aside from concerns expressed regarding the local and regional economy, which are addressed separately within this document.
Human Use-Related Concern	Public Health and Safety		X	No public health and safety concerns have been identified associated with any of the evaluated alternatives. There will be no increased exposure to natural hazards resulting from implementation of any alternative.
Human Use-Related Concern	Scenic Beauty		X	There are no federally designated National Scenic Areas within or near the project area. No areas of scenic beauty were further noted or identified during scoping.

Concern	Item	Relevant	Not Relevant	Rationale
Human Use-Related Concern	Significant Scientific Resources	X		Quivira NWR was identified as a significant scientific resource within the project area based on its unique habitat types, wildlife resources, and ongoing research and monitoring programs.
Human Use-Related Concern	Parklands (including National Parks, Monuments, and Historical Sites)	X		Three locally owned parks are present within the project area. There are no National Parks, National Monuments, or National Historic Sites within the project area according to NPS maps. Recreational areas managed by state or federal entities are evaluated under Natural Resources.
Risk and Uncertainty	Climate Change	X		Evaluation of climate change is required by Principles, Requirements, and Guidelines (PR&G) analysis. Climate change represents an inherent uncertainty related to future conditions.
Risk and Uncertainty	Land Use	X		Evaluation of land use is required by PR&G analysis. Land use within the project area, which is largely agricultural, could be altered based on implementation of alternatives.
Ecosystem Services	Provisioning	X		Provisioning ecosystem services within the project area include crop production, livestock production, and other agricultural practices.
Ecosystem Services	Regulating	X		Regulating ecosystem services within the project area include water quality and water filtration/purification in wetland areas.
Ecosystem Services	Supporting	X		Supporting ecosystem services within the project area include nutrient cycling and biodiversity resilience.
Ecosystem Services	Cultural	X		Cultural ecosystem services provided by the project area include educational values, recreation, and knowledge systems.

In addition to the relevant resources identified above, alternatives carried forward for detailed analysis in this document will also be evaluated according to the Federal Objective and Guiding Principles, as required under the PR&G.

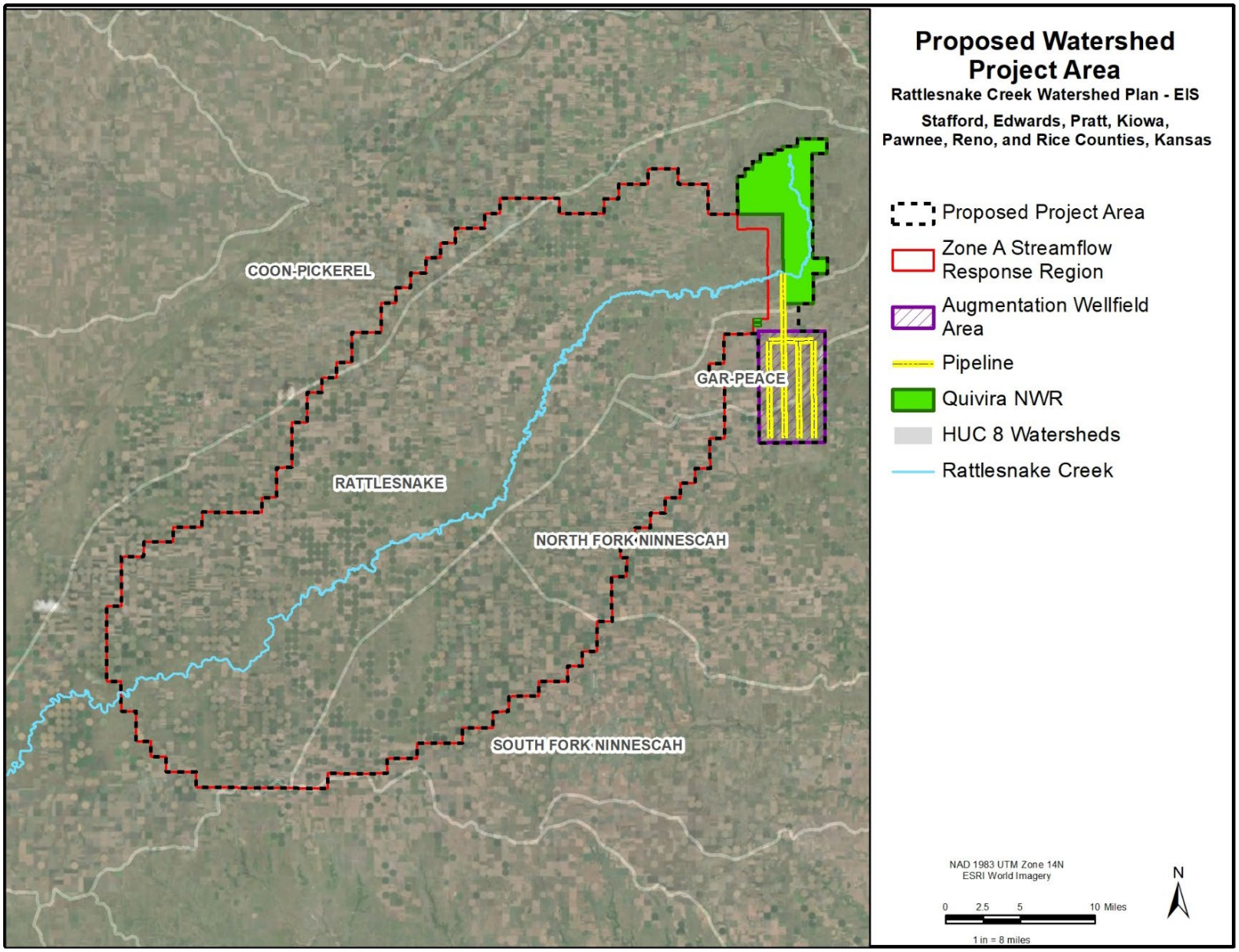

Figure 3.0. Watershed Plan Environmental Impact Statement (Plan – EIS) Project Area.

4. AFFECTED ENVIRONMENT

The existing physical, biological, social, and economic conditions that may be affected by implementation of the alternatives discussed in Section 5 are presented in this section. The geographic scope of analysis varies from a multicounty region to the project area (Figure 3.0) depending on available data and the potential extent of an alternative's impacts. The description of the affected environment is based primarily on desktop studies and on information obtained from published documents regarding nearby projects and interviews of resource agency personnel familiar with the area.

4.1 Ecosystem Services Framework

PR&G watershed planning assures that formulation, evaluation, and implementation of agency activities incorporates the Federal Objective, Guiding Principles, and General Requirements within the context of an ecosystem services framework. Ecosystem services are an analysis approach that traces the pathways of natural ecosystem processes to the benefits that they grant to society utilizing both quantitative and qualitative methods. As required for the PR&G analysis, an ecosystem services framework was identified and applied throughout the preliminary investigation and planning process. Ecosystem services include the following:

Provisioning Services

Provisioning services are tangible goods for human use such as food, clean air, fresh water, energy, fuel, forage, fiber, and minerals. In the Rattlesnake Creek Watershed, provisioning services include crop production, livestock production, and other agricultural practices. These provisioning services are impacted by land use (Section 4.8), prime and unique farmland (Section 4.9), groundwater use (Section 4.3), water quality (Section 4.10), and soil resources (Section 4.2).

Regulating Services

Regulating services maintain natural processes that provide buffers against environmental catastrophe such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood control; and disease regulation. Within the Rattlesnake Creek Watershed, regulating ecosystem services include water regulation from the aquifer (Section 4.3) and wetlands (Section 4.10), climate regulation including greenhouse gas (GHG) emissions (Section 4.4), and ecosystem effects including vegetation (Section 4.8), soils (Section 4.2), and riparian buffers (Section 4.12).

Supporting Services

Supporting services are the underlying processes maintaining conditions for life such as pollination, seed dispersal, soil formation, and nutrient cycling. In the Rattlesnake Creek

Watershed, supporting services include nutrient cycling in wetlands (Section 4.10), biodiversity resilience related to fish and wildlife species and their habitat (Section 4.13), threatened and endangered species (Section 4.15), migratory birds and eagles (Section 4.16), and significant scientific features present at Quivira NWR (Section 4.17).

Cultural Services

Cultural services are related to the cultural or spiritual needs of people such as educational, aesthetic, and spiritual resources. Within the Rattlesnake Creek Watershed, cultural resources include historic properties, tribal resources (Section 4.5), and the recreational and aesthetic value provided by Quivira NWR (sections 4.7 and 4.17).

4.2 Geology and Soils

The geographic scope of analysis for geology and soils includes the Rattlesnake Creek Watershed (HUC8 11030009), Gar-Peace Creek Watershed (HUC8 11030010), and North Fork Ninnescah River Watershed (HUC8 11030014), located in south-central Kansas (Figure 3.0). This section considers both the surficial and bedrock characteristics of geology underlying these watersheds.

4.2.1 Surficial Geology

Surficial geology refers to the unconsolidated materials overlying bedrock. The surficial geology in the Rattlesnake Creek primarily consists of Quaternary age deposits from the Cenozoic Era (approximately 2.5 million years ago [mya]). Gar-Peace Creek surficial geology is composed of Quaternary age deposits from the Cenozoic Era and Permian age rock from the Paleozoic Era, and the North Fork Ninnescah River Watershed contains deposits from the Quaternary and Tertiary/Neogene Period of the Cenozoic Era and Permian-age rock from the Paleozoic Era (KGS 2008). Cenozoic deposits cover extensive areas in Kansas. Locally, they attain considerable thickness, and this mantle of mainly unconsolidated material serves to mask the underlying stratigraphy and structure. The Cenozoic deposits are of great economic value, especially because the groundwater they contain supplies the state with a large percentage of its water (Merriam 1963).

The Rattlesnake Creek Watershed is located primarily (85 percent) within the Arkansas River Lowlands physiographic region, with a small portion (15 percent) of the watershed located within the High Plains physiographic region (KGS 1990). The Gar-Peace Creek Watershed is located primarily (90 percent) within the Arkansas River Lowlands physiographic region, with small percentages of the watershed in the High Plains (7 percent) and Wellington-McPherson Lowlands (3 percent) physiographic regions. The North Fork Ninnescah River Watershed is located within the Arkansas River Lowlands physiographic region (49 percent), the High Plains (39 percent), and the Wellington-McPherson Lowlands (12 percent). The physiographic regions are depicted in Figure 4.2.1-1 (KGS 2020).

The surficial geology of the Arkansas River Lowlands physiographic region is characterized by flat, alluvial plains with significant sand deposits (Buchanan and McCauley 2010). Sand deposits associated with the Arkansas River Lowlands region are the result of the northeasterly migration of the Arkansas River over time (Hathaway et al. 1978). Similarly, the High Plains physiographic region is a relatively flat alluvial plain, though the High Plains region contains more loess deposits than the Arkansas River Lowlands region. Wellington-McPherson Lowlands consists of a relatively flat to rolling alluvial plain made up of unconsolidated sand, silt, and gravel (Buchanan and McCauley 2010).

Surficial geology within the Rattlesnake Creek Watershed is dominated by dune sands (75 percent), with remaining areas overlain by loess (17 percent) and alluvium (8 percent; Ross 1992). Surficial geology within the Gar-Peace Creek Watershed is mostly alluvium (54 percent), along with dune sand (36 percent), loess (9 percent), and Sumner group (less than 1 percent; Ross 1992). Surficial geology within the North Fork Ninnescah River Watershed is dune sand (45 percent), alluvium (35 percent), Sumner group (10 percent), loess (5 percent), Nippewalla group (2 percent), water (2 percent), and Ogallala Formation (1 percent; Ross 1992). Figure 4.2.1-2 depicts the surficial geology within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds.

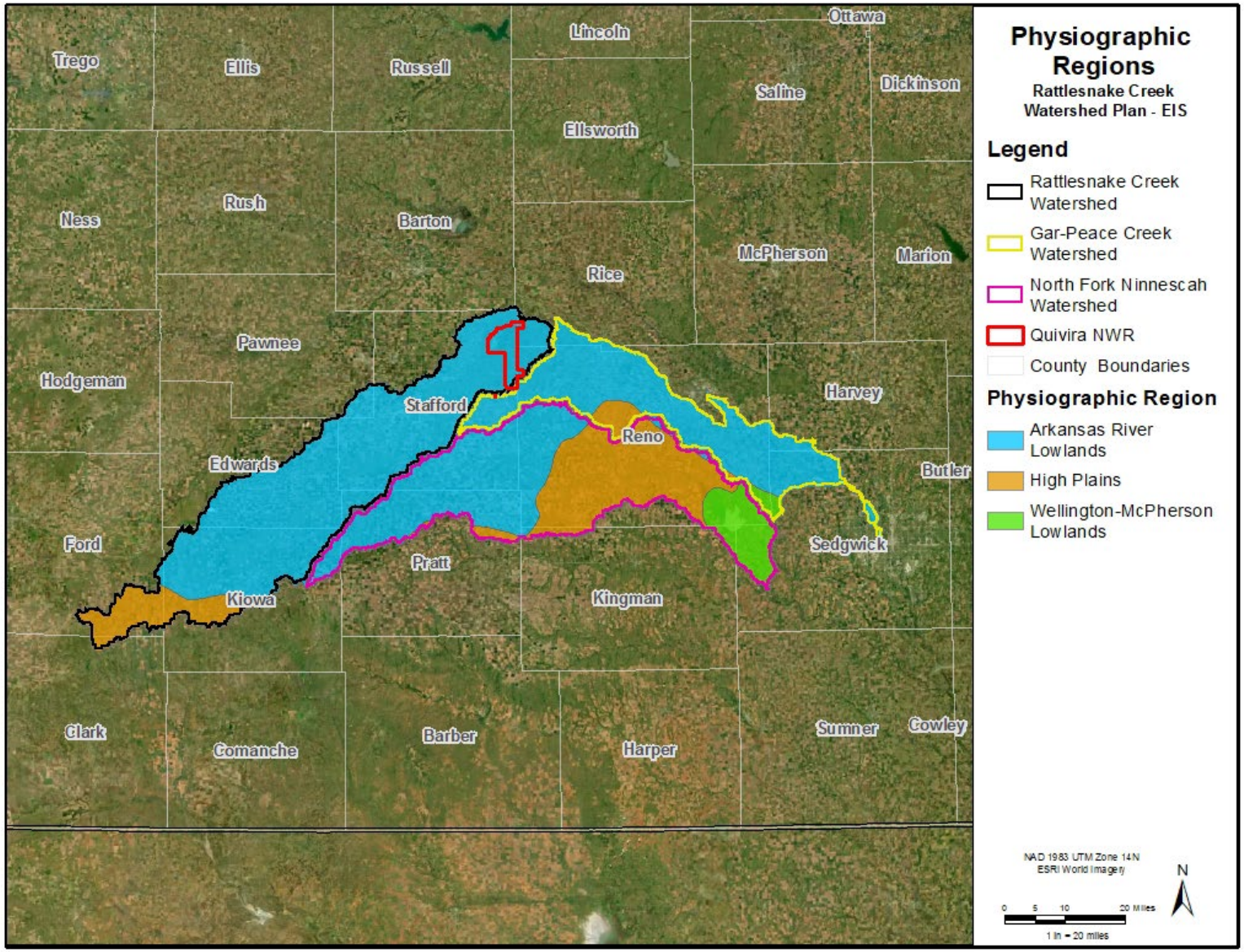

Figure 4.2.1-1. Physiographic Regions Within Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds (KGS 2020).

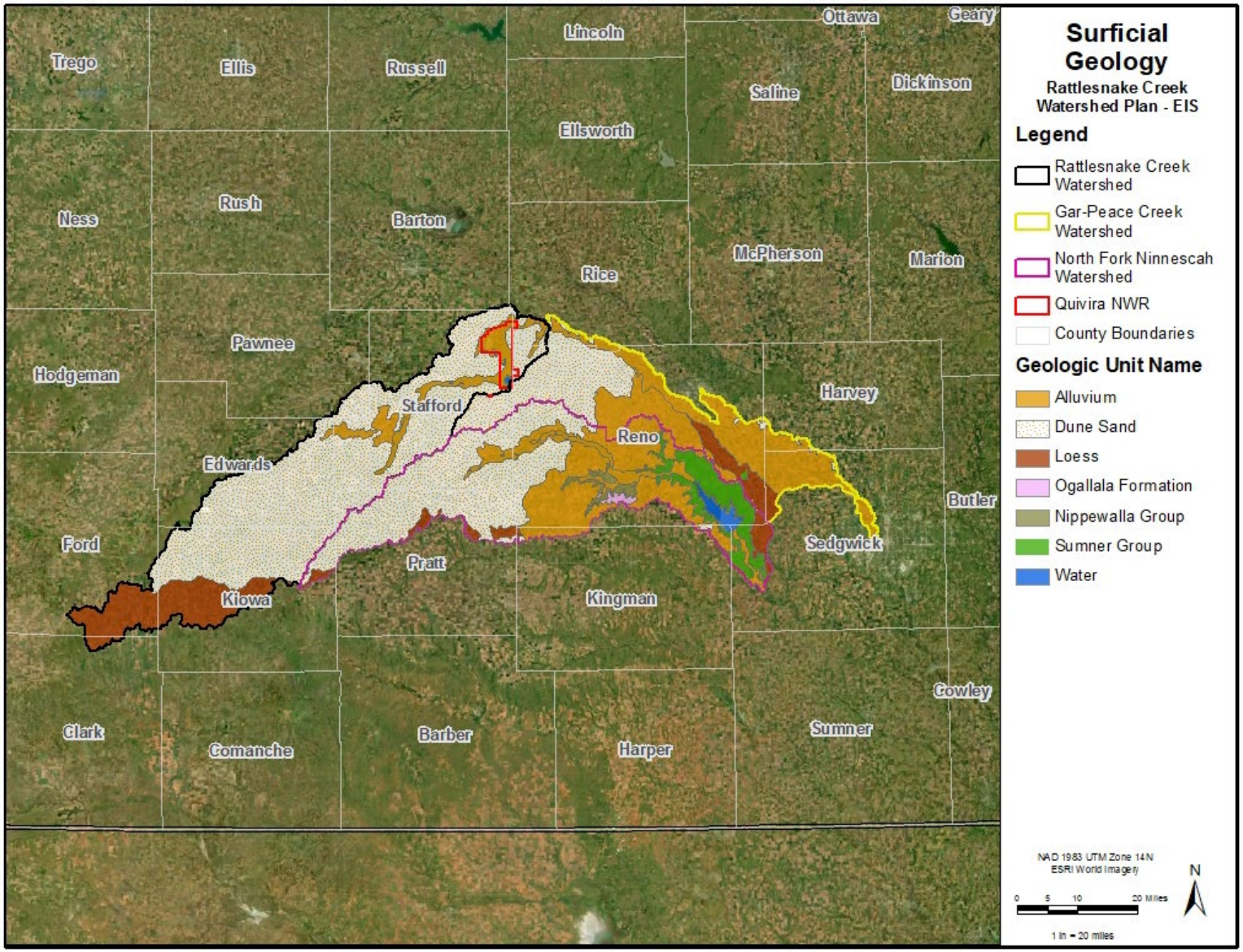

Figure 4.2.1-2. Surficial Geology of Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds (KGS 2020).

4.2.2 Bedrock Geology

The Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds are underlain by bedrock of the Cretaceous Period from the Mesozoic Era (145-66 mya) and bedrock of the Permian Period from the Paleozoic Era (538-251 mya; KGS 1990).

Rattlesnake Creek Watershed is primarily Cretaceous bedrock, specifically, Undifferentiated Lower Cretaceous bedrock, which is predominately comprised of shales (Zeller 1968). The upper unit of the Undifferentiated Lower Cretaceous bedrock, which is known as the Dakota Formation, is described as brown to gray fine- to medium-grained sandstone interbedded with gray sandy shale and varicolored shale (Young 1992). The Dakota Formation is generally considered a confining or leaking confining layer; it effectively separates the overlying Great Bend Prairie Aquifer and the underlying Permian water bearing units (KGS 1994). The extent of the Cretaceous bedrock is slightly east of Highway 281 and to the west of Quivira NWR, as shown on the lower half of Figure 4.2.2.

Rattlesnake Creek Watershed and the Gar-Peace Creek and North Fork Ninnescah River watersheds all transition west to east, from the Undifferentiated Lower Cretaceous bedrocks to Lower Permian Cedar Hills Sandstone, Salt Plain Formation, and Harper Sandstone Formation from the Nippewalla Group where Quivira NWR and the Big Salt Marsh are located (Figure 4.2.2). Cedar Hills Sandstone is characterized by predominantly red mudrocks that contain gypsum. Cedar Hills is separated from the underlying Salt Plain Formation by a thin, white sandstone. The Salt Plain Formation is described as a reddish-brown sandy siltstone and fine-grained sandstone (Young 1992). Below the Salt Plain Formation is the Harper Sandstone Formation, which consists of brownish-red siltstone and silty shale with a few thin beds of silty sandstone (Young 1992).

The Permian bedrock, specifically the Salt Plain Formation and Cedar Hills Sandstone, contains an ancient saltwater brine. There is no effective separation from the Great Bend Prairie Aquifer from the underlying Permian bedrock in the area near Quivira NWR (cross-section view of Figure 4.2.2). Because there is no effective separation between the aquifer and the Permian bedrock, saltwater is free to move upward into the freshwater aquifer, affecting the quality of groundwater. This is illustrated in the cross-section view of Figure 4.2.2 below with red arrows indicating diffusion of salt upward from the Permian bedrock into the Great Bend Prairie Aquifer in the vicinity of Quivira NWR.

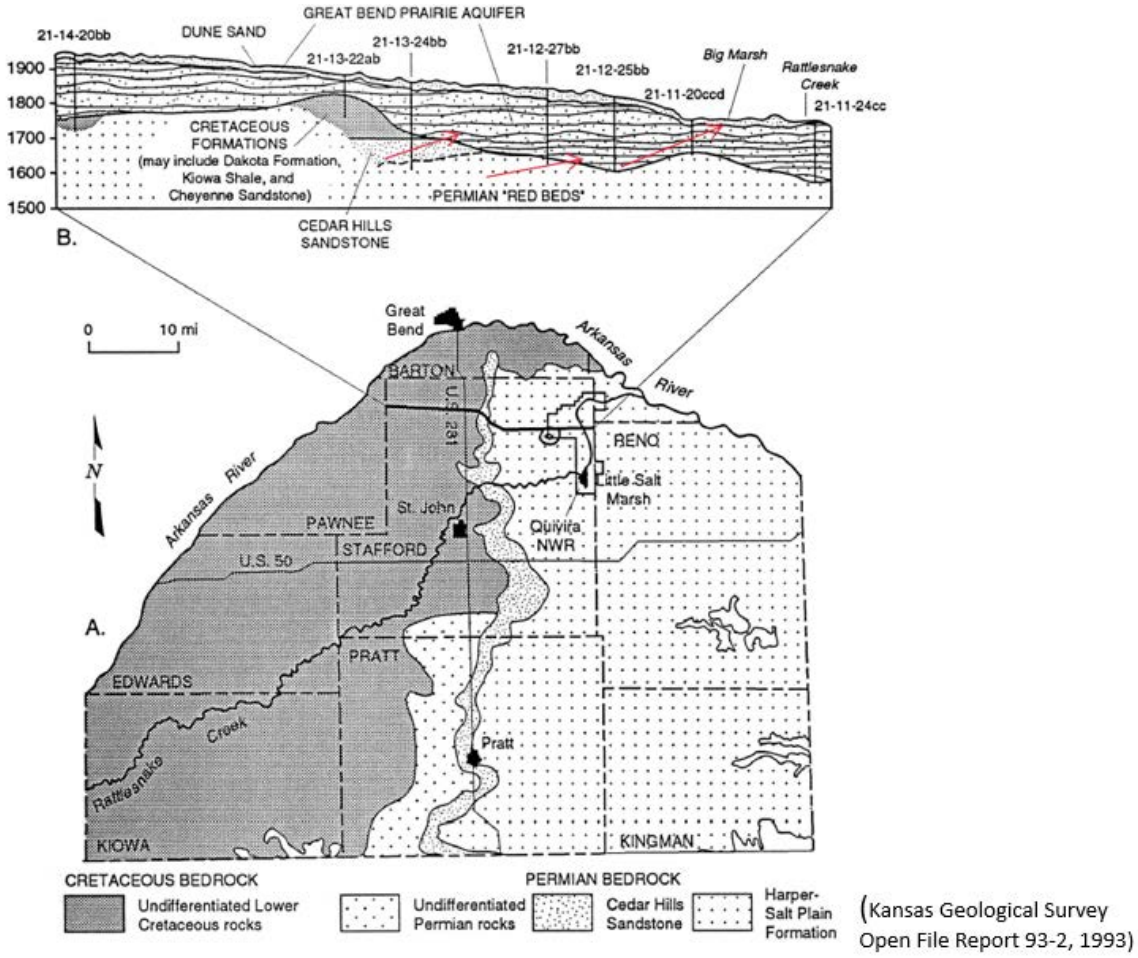

Figure 4.2.2. Bedrock Geology in the Vicinity of Rattlesnake Creek and Quivira National Wildlife Refuge (Whittemore 1993).

4.2.3 SOILS

Soil formation and stabilization contribute to regulating and supporting ecosystem services. Soils within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds reflect the underlying sand, loess, and alluvial parent materials. Within the Arkansas River Lowlands portion of the watersheds, soils are loamy and sandy, and they are often saline (Hathaway et al. 1978). Soils within the High Plains physiographic region of the watersheds are deep, well-drained, silty soils (Hathaway et al. 1978). Soils within the Wellington-McPherson Lowlands portion consist mainly of sand, silt, and gravel (Buchanan and McCauley 2010). Tables 4.2.1-1, 4.2.1-2, and 4.2.1-3 list the 10 most common soil types within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds, respectively.

Table 4.2.1-1. Ten Most Common Soils Within the Rattlesnake Creek Watershed.

Natural Resources Conservation Service Soil Map Unit Name	Percent of Soil Unit in Watershed
Pratt loamy fine sand, 5 to 10 percent slopes	14
Saltcreek and Naron fine sandy loams, 1 to 3 percent slopes	9
Pratt-Tivoli loamy fine sands, 5 to 15 percent slopes	8
Harney silt loam, 0 to 1 percent slopes	6
Harney silt loam, 1 to 3 percent slopes	6
Pratt loamy fine sand, 5 to 12 percent slopes	5
Solvay loamy fine sand, 0 to 2 percent slopes	5
Farnum and Funmar loams, 0 to 1 percent slopes	4
Attica fine sandy loam, 1 to 3 percent slopes	4
Hayes-Solvay loamy fine sand, 0 to 5 percent slopes	4

Consistent with characterizations described above (Hathaway et al. 1978; KGS 1990), the most prevalent soil types within the Rattlesnake Creek Watershed are loamy fine sands, sandy loams, and silt loams. Pratt soils, which make up approximately 27 percent of the soils in the watershed, were formed from weathering of eolian materials deposited during the Holocene. Harney silt loams, located in the High Plains portion of the watershed, were formed from weathering of underlying loess parent materials that were deposited during the late Pleistocene (KGS 1990).

Table 4.2.1-2. Ten Most Common Soils Within the Gar-Peace Creek Watershed.

Natural Resources Conservation Service Soil Map Unit Name	Percent of Soil Unit in Watershed
Farnum and Funmar loams, 0 to 1 percent slopes	8
Saltcreek and Naron fine sandy loams, 1 to 3 percent slopes	8
Taver loam, 0 to 1 percent slopes	6
Avans loam, 1 to 3 percent slopes	6
Avans loam, 0 to 1 percent slopes	5
Hayes-Solvay loamy fine sands, 0 to 5 percent slopes	4
Funmar-Taver loams, 0 to 2 percent slopes	4
Saltcreek and Naron fine sandy loams, 0 to 1 percent slopes	3
Darlow-Elmer complex, 0 to 2 percent slopes	3
Punkin-Taver complex, 0 to 1 percent slopes	3

The most prevalent soil types within the Gar-Peace Creek Watershed are loamy fine sands, sandy loams, and silt loams. The Funmar, Taver, and Avans series consist of very deep, well-

drained, moderately permeable soils that formed in loamy alluvium on paleoterraces in river valleys of the Great Bend Sand Plains, which is part of Major Land Resource Area (MLRA) 79 (NRCS 2022).

Table 4.2.1-3. Ten Most Common Soils Within the North Fork Ninnescah River Watershed.

Natural Resources Conservation Service Soil Map Unit Name	Percent of Soil Unit in Watershed
Solvay loamy fine sand, 0 to 2 percent slopes	21
Saltcreek and Naron fine sandy loams, 1 to 3 percent slopes	19
Taver loam, 0 to 1 percent slopes	13
Farnum and Funmar loams, 0 to 1 percent slopes	9
Pratt-Turon fine sands, 1 to 5 percent slopes	7
Hayes-Solvay loamy fine sands, 0 to 5 percent slopes	5
Langdon fine sand, 0 to 15 percent slopes	4
Hayes-Turon complex, 0 to 5 percent slopes	4
Pratt fine sand, 5 to 10 percent slopes	2
Turon-Carway complex, 0 to 5 percent slopes	2

Consistent with characterizations described above (Hathaway et al. 1978), the most prevalent soil types within the North Fork Ninnescah River Watershed are loamy fine sands, fine sandy loams, and loams. There are three significant soil types in this area of the watershed: (1) Solvay loamy fine sands, (2) Saltcreek and Naron fine sandy loams, and (3) Taver loam. Solvay loamy fine sands make up 21 percent of soils in this area of the watershed and consist of very deep, somewhat poorly drained, moderate or moderately slowly permeable soils that were formed in eolian deposits (USDA 1999). Saltcreek and Naron fine sandy loams make up 19 percent of soils in this area of the watershed and consist of very deep, well-drained soils that formed in eolian deposits (USDA 1999). Taver loam makes up 13 percent of soils in this area and consists of very deep, moderately well-drained soils (USDA 1999). All three soil types were formed on paleoterraces in river valleys of the Great Bend Sand Plains, which is part of MLRA 79 (NRCS 2022).

4.3 Aquifers and Sole Source Aquifers

The USGS defines aquifers as geologic formations or structures that store or transmit water (USGS 2011). Sole source aquifers are defined by the U.S. Environmental Protection Agency (EPA) as aquifers that supply at least 50 percent of the drinking water for an aquifer's service area where there are no other reasonable alternative drinking water sources should the aquifer become contaminated (EPA 2021). The geographic scope of analysis for aquifers and sole

source aquifers includes the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds.

High Plains Aquifer

The Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds are all located within the High Plains Aquifer (KDA 2017). The High Plains Aquifer spans portions of eight states and covers approximately 174,000 square miles of the central U.S. (Figure 4.3-1; KDA 2017). In Kansas, the High Plains Aquifer is divided into three components: Ogallala, Great Bend Prairie, and Equus Beds. The Rattlesnake Creek Watershed is located within the Great Bend Prairie component of the High Plains Aquifer, and the Gar-Peace Creek Watershed is split between the Great Bend Prairie component and the Equus Beds component (KDA 2017), which is shown in Figure 4.3-2. Most of the North Fork Ninnescah River Watershed is located in the Great Bend Prairie component, with a small portion of the downstream area of the watershed in the Equus Beds component. There are no sole source aquifers in any of the three watersheds (EPA 2021).

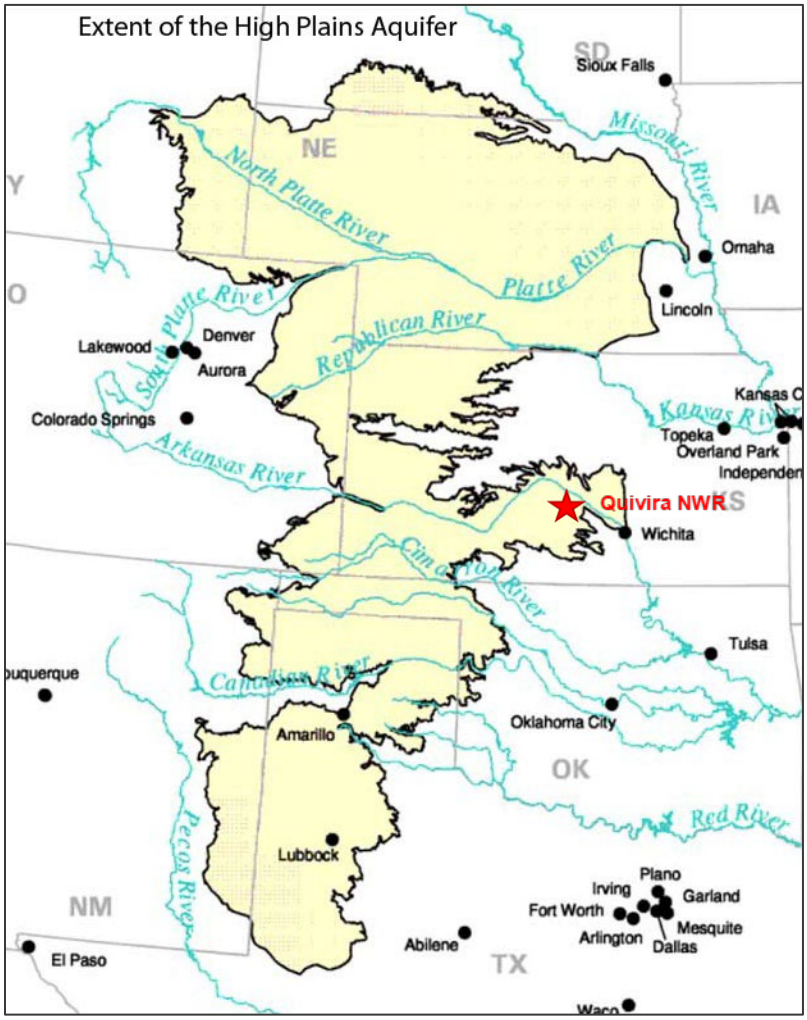

Figure 4.3-1. Extent of the High Plains Aquifer (KDA 2017).

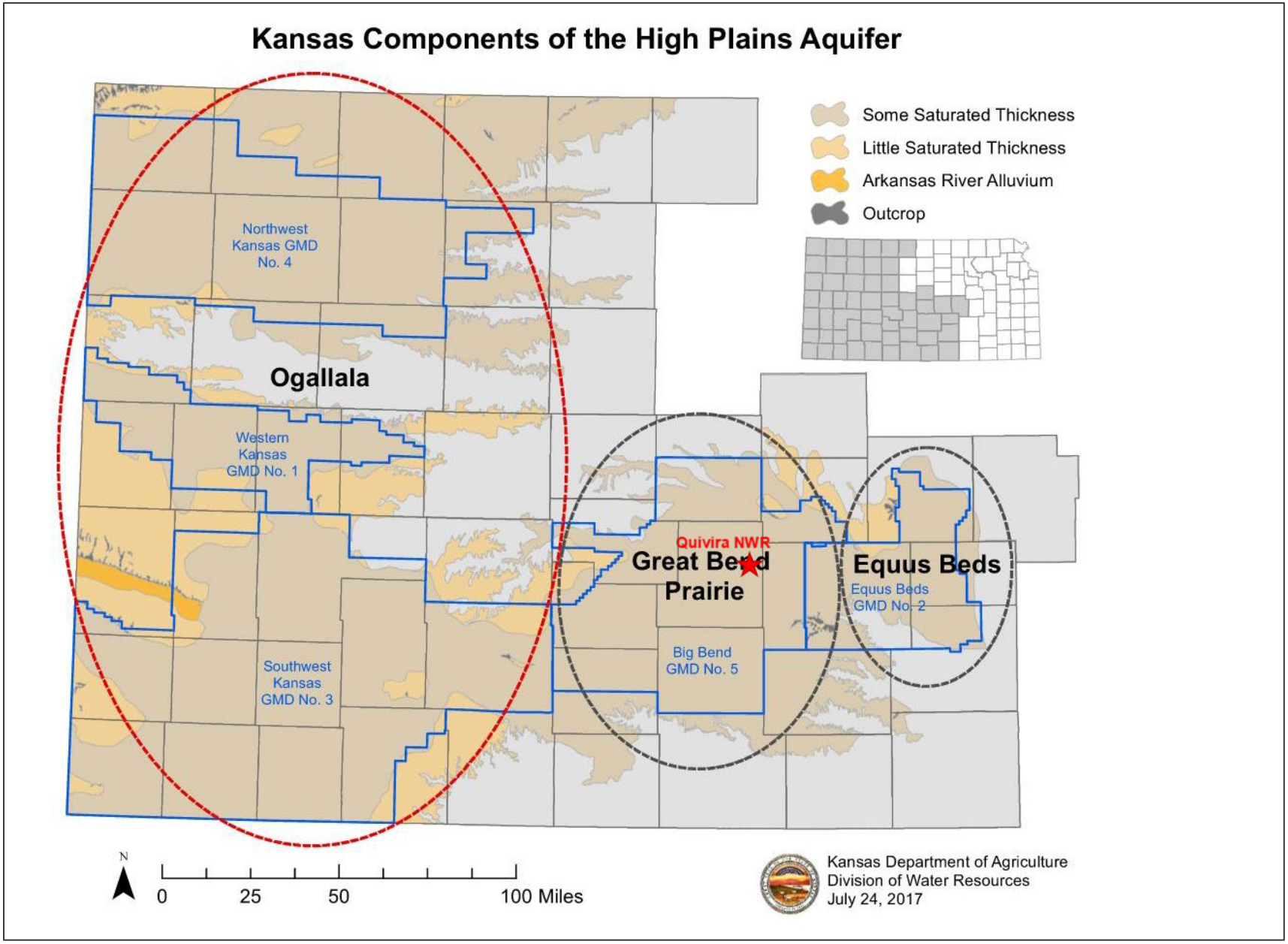

Figure 4.3-2. Kansas Components of the High Plains Aquifer (KDA 2017).

Current Aquifer Trends

Water levels within aquifers increase through recharge and decrease through discharge. Natural recharge to the aquifer occurs mainly from precipitation. The average yearly precipitation for the Great Bend Prairie and Equus Beds components of the High Plains Aquifer is approximately 23-35 inches per year (Whittemore et al. 2018; Klager 2016). Returns of water pumped for irrigation is also a source of aquifer recharge. Natural discharge from the aquifer occurs as discharge to streams and evapotranspiration where the depth-to-water is shallow and diffuses groundwater flow. Artificial discharge occurs as discharge to wells (Luckey and Becker 1999). In 2015, it was estimated that approximately 95 percent of withdrawal from the High Plains Aquifer was groundwater used for irrigation, with the remaining withdrawal for public and domestic water supply and other uses (Lovelace et al. 2020). The availability of fresh, clean water for public and domestic supply are both provisioning and regulating ecosystem services, where water availability and quality contribute meaningfully to the human way of life in the project area.

The amount of water stored in the High Plains Aquifer has decreased since predevelopment times (1950s). Total recoverable water in storage in the High Plains Aquifer in 2017 was approximately 2.91 billion acre-feet, which was a decline of about 291.8 million acre-feet since predevelopment and an increase of 0.1 million acre-feet from 2015 to 2017 (McGuire and Strauch 2022). Whittemore et al. (2018) reports that a roughly 1.9 to 6.3 percent reduction in pumping is needed to maintain groundwater levels in the short term (approximately 10 years) in the Great Bend Prairie Aquifer as a whole. Analysis of average annual water level change versus annual water use from 2005–2016 for the Equus Beds component of the High Plains Aquifer indicates that groundwater pumping is within 1 percent of that which would be sustainable; in this context, “sustainable” refers to zero water-level change in the aquifer (Whittemore et al. 2018).

Changes to groundwater quality within the High Plains Aquifer have occurred in the last 40 years (Lane et al. 2020). Though groundwater quality can be altered by a variety of factors, the primary driver of change within the High Plains Aquifer is widespread fertilizer use. Fertilizer use has resulted in degraded water quality in shallow portions of the aquifer because of the accumulation of nitrate. Evidence of degraded water quality was illustrated by an analysis of groundwater samples by Lane and others in 2020. Lane and others (2020) found that seven of 22 wells sampled for nitrate levels in the aquifer exceeded EPA standards for drinking water, and only one of those same 22 wells contained a nitrate concentration above EPA drinking water standards when sampled 30-40 years prior by Whittemore (1993).

Mineral Intrusion

Within the Rattlesnake Creek Watershed, the depth to the water table follows a southwest to northeast gradient. The depth to the water table is most shallow in the northeastern portion of the watershed (approximately 10-20 feet), near Quivira NWR, and deepens toward the southwest, where the depth to the water table reaches 100 feet (KGS 1990). Along Peace

Creek from Stafford to the Arkansas River, depth to groundwater is generally less than 30 feet deep (KGS 2002). Along the North Fork Ninnescah River Watershed, depth to groundwater ranges from less than 10 feet deep adjacent to the river to around 25 feet deep along the sides of the valley (KGS 1998).

In the northeastern part of the Rattlesnake Creek Watershed, dissolution of underlying Permian bedrock interfaces with the Great Bend Prairie Aquifer to create an area of mineral intrusion (KGS 1993). As discussed in Section 4.2, a mineral intrusion area is created because the lower Permian bedrock directly underlies the Great Bend Prairie Aquifer. There is no effective separation between the aquifer and the Permian bedrock; therefore, saltwater is free to move upward into the freshwater aquifer. The resulting brackish waters rise vertically and mix with surface waters (KGS 1990; Garneau and Buddemeier 1992). Some areas of the shallow aquifer are protected by intermittent clay layers. Clay is a relatively impermeable material, causing the saltwater to pass very slowly through the clay or not at all. The intermittent clay layers essentially force the saltwater to flow horizontally away from the freshwater aquifer. Because the groundwater flows to the east, the saltwater then flows southeast through portions of the Gar-Peace Creek Watershed and North Fork Ninnescah River Watershed and discharges into the Arkansas River (Figure 4.3-3).

Conductivity is a measure of the ability of water to pass an electrical current. Because dissolved salts and other inorganic chemicals conduct electrical current, conductivity increases as salinity increases (EPA 2022a). An indicator of mineral intrusion is an increase in specific conductivity of groundwater. High specific conductance values indicate poor groundwater quality and low specific conductance values indicate higher groundwater quality. The consequences of low groundwater quality are shown in both aquatic life and plant (both crops and naturally occurring) tolerances being exceeded and impacts to drinking water quality standards. The northeastern portion of the Rattlesnake Creek Watershed, particularly areas near Rattlesnake Creek, exhibits high groundwater conductivity, and therefore, low groundwater quality (Figure 4.3-3). High conductivity in this area is consistent with the known mineral intrusion from underlying Permian formations. Areas of higher groundwater quality (i.e., lower conductivity) are present in the south-central portion of the Rattlesnake Creek Watershed.

Trends in specific conductance across the Rattlesnake Creek Watershed have been well documented. According to data collected between 1980-1985, conductivity within the watershed exhibits a southwest to northeast trend, with low specific conductance levels (high water quality) in the south-central part of the watershed and high specific conductance levels (low water quality) in the northeastern part of the watershed (KGS 1990; Figure 4.3-4). The trend in specific conductance is the result of underlying bedrock. As previously discussed in Section 4.2 and shown on the following figures, the Cretaceous bedrock reaches an easternmost extent near U.S. Highway 281. Without the layer of Cretaceous bedrock creating a barrier between the

overlying Great Bend Prairie Aquifer and the Permian bedrock (that contains the salt), the salt mixes with the fresh water of the aquifer and creates the mineral intrusion zone.

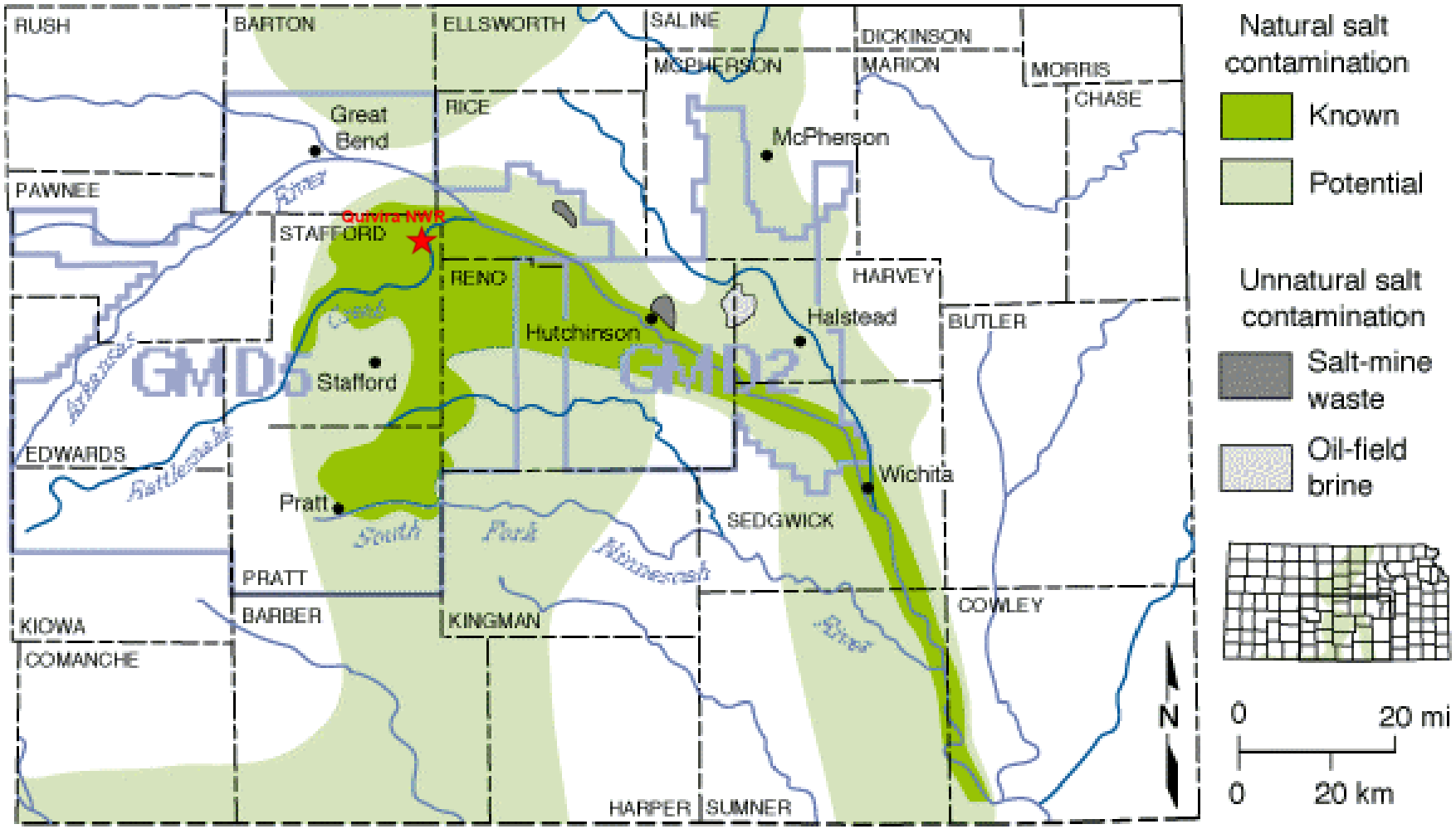

Figure 4.3-3. Natural Salt Contamination in Central Kansas (Buddemeier et al. 1995).

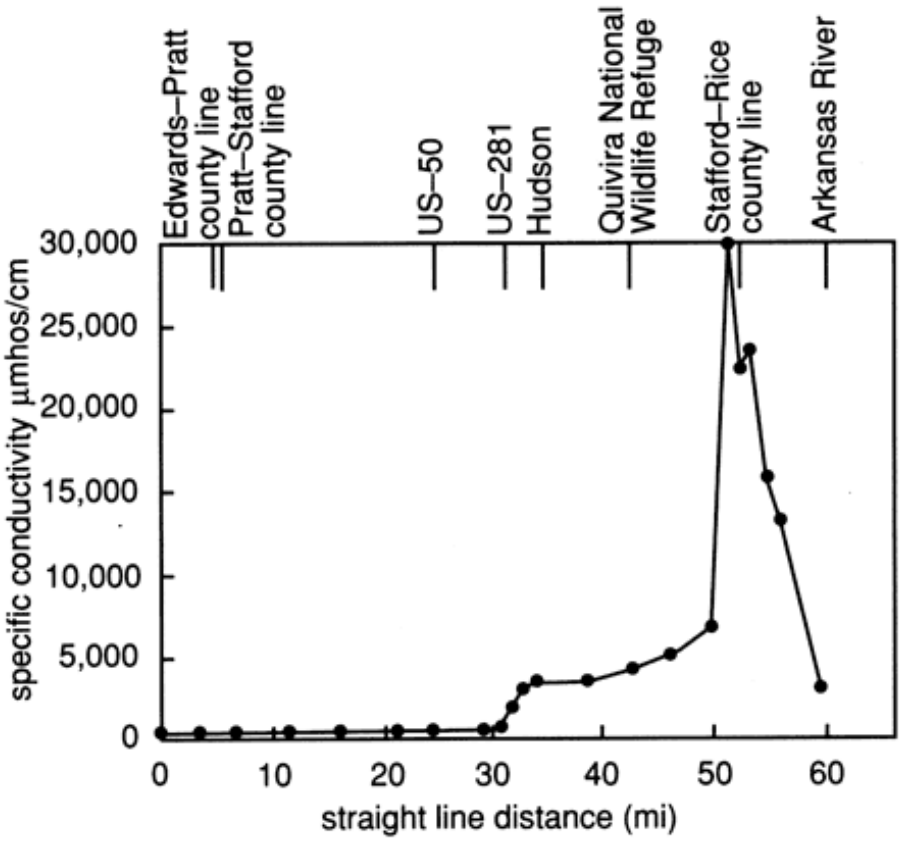

Figure 4.3-4. Specific Conductance Survey Along the Rattlesnake Creek Watershed (Sophocleous and Perkins 1992).

The bedrock below the Great Bend Prairie Aquifer contains paleochannels, where saltwater from Permian formations may penetrate the aquifer and possibly be conveyed over large distances (Figure 4.3-5). Paleochannels can be a major path for saltwater migration in instances where the paleochannel runs parallel to a natural stream course (Rubin and Buddemeier 2003). One of these instances takes place along the Rattlesnake Creek corridor where the paleochannel course, the Rattlesnake Creek course, and the groundwater streamlines are approximately parallel. The effect of the paleochannels on Rattlesnake Creek's ability to transmit salinity is less significant where its course is not parallel to the groundwater streamlines, but even in these cases, the course of the paleochannel may include locations of saltwater penetration into the aquifer because of proximity. Bedrock topography is shown below, indicating the suspected location of a paleochannel paralleling part of Rattlesnake Creek. The fact that it is oriented parallel to the groundwater flow direction means that it has the potential to serve as a conduit for relatively rapid, long-distance transport of high-salinity water (Rubin et al. 2001).

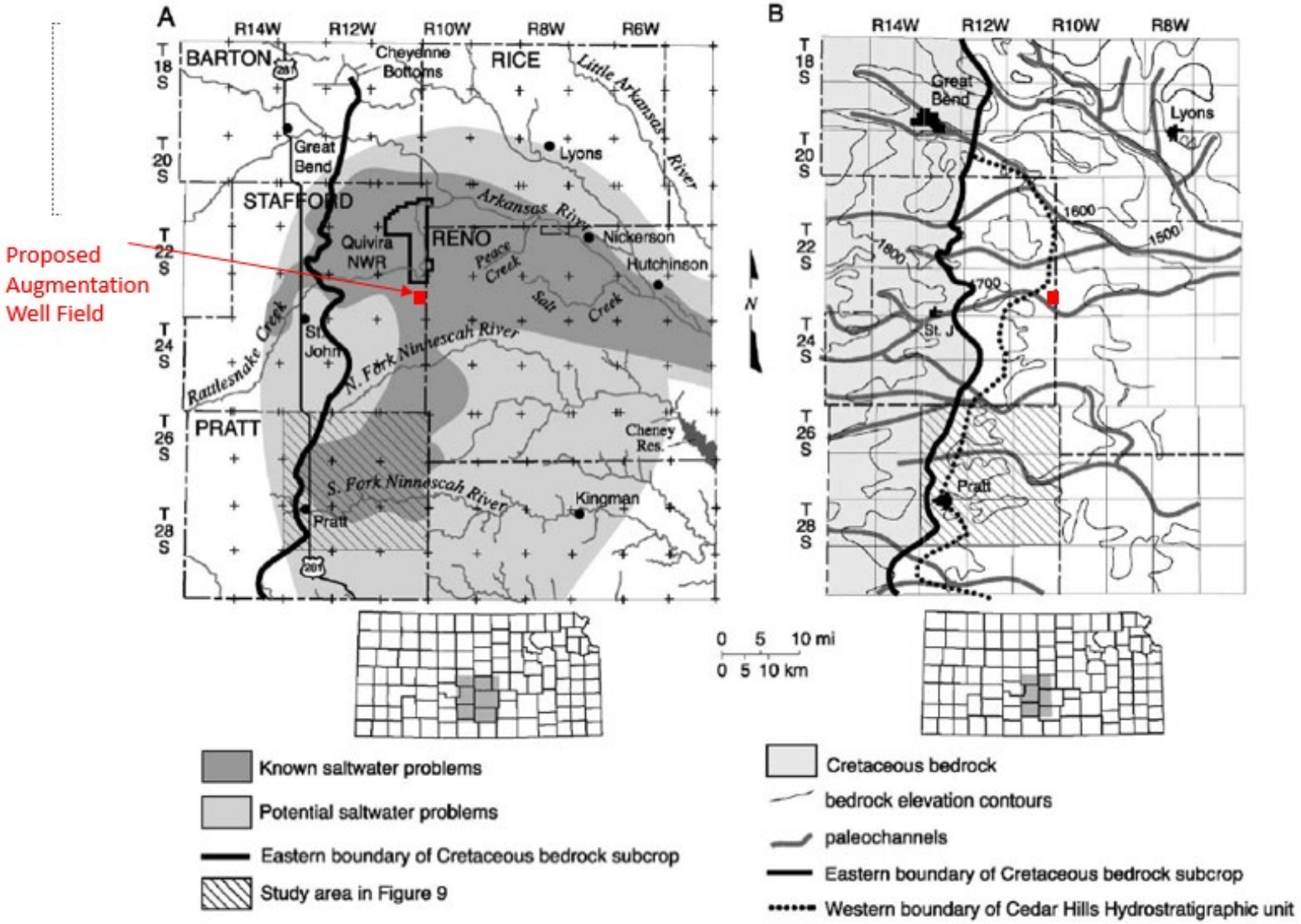

Figure 4.3-5. Groundwater Mineralization and Paleochannels in South-central Kansas (Rubin and Buddemeier 2003).

4.4 Climate

Climate is a regulating ecosystem service. The geographic scope of analysis for climate includes the region of south-central Kansas. The climate in this region includes hot summers, cold winters, moderate precipitation, and frequent high wind speeds. Snowfall in the winter is minimal, and water evaporation occurs rapidly in the summer. July is typically the hottest month of the year; January and February are generally the coldest months (NOAA 2022). Annual precipitation amounts in Kansas vary across an east-west gradient; lowest annual precipitation amounts occur in the western part of the state, and highest annual precipitation amounts occur in the eastern part of the state. Conversely, annual mean temperatures in Kansas vary along a north-south gradient; lower annual mean temperatures occur in the northern part of the state, and higher annual mean temperatures occur in the southern part of the state.

Table 4.4 provides temperature and precipitation data from the Hudson, Kansas, weather station for a 31-year period between 1991-2021 (USDA 2022). The Hudson, Kansas, weather station is located approximately 1 mile north of Rattlesnake Creek and approximately 8 miles west of Quivira NWR in Stafford County, Kansas. Between the years 1991-2021, the average annual rainfall was 28.57 inches; the lowest annual rainfall occurred in 1991 (15.25 inches), and the highest annual rainfall occurred in 2007 (42.38 inches). Conversely, the average annual temperature between 1991-2021 averaged 57.45 degrees Fahrenheit; the lowest average annual temperature was recorded in 2013 (54.7 degrees Fahrenheit), and the highest average annual temperature was recorded in 2006 (59.7 degrees Fahrenheit). The average annual temperature shows a slightly negative trend between 1991-2021, while total annual precipitation shows a slightly positive trend. Though these trends depict cooling temperatures and increasing precipitation over a 30-year period, important consideration should be given to the long-term timescales on which climate trends operate. Average annual temperature and average annual precipitation data are inversely correlated, with years of high temperatures generally corresponding to years of low annual precipitation.

Table 4.4. 1991 to 2021 Regional Climate Patterns from Hudson, Kansas, Weather Station (USDA 2022).

Year	Average Annual Temperature (Fahrenheit)	Annual Maximum Temperature (Fahrenheit)	Month(s) of Year Maximum Temperature	Annual Minimum Temperature (Fahrenheit)	Month(s) of Year Minimum Temperature	Total Annual Precipitation (inches)
1991	59.0	106	July	4	January	15.3
1992	57.3	102	July	7	December	31.5
1993	55.2	105	July, August	2	February	38.7
1994	58.5	107	June, August	0	February	17.0
1995	57.2	109	July	4	January	32.0
1996	56.4	105	July	-8	February	26.5
1997	56.5	106	July	-3	January	32.6
1998	58.8	107	June	-4	December	28.0
1999	58.3	105	August	0	January	29.9
2000	57.8	107	August, September	0	December	29.9
2001	58.6	106	July	0	February	25.5
2002	57.7	105	July	-3	March	30.1
2003	57.1	109	July	-3	February	24.3
2004	57.3	101	August	-2	January, February	33.4
2005	58.6	101	July, August	-8	December	28.8
2006	59.7	108	July	1	February	27.1
2007	57.5	103	August	-3	February	42.4
2008	56.4	105	August	2	December	33.7*
2009	57.0	105	July	-7	December	26.0
2010	59.0*	101*	June*	-5*	January*	23.4*
2011	57.7	113*	July*	9*	December*	15.09*
2012	59.6	110	June*	6	December	16.8

Year	Average Annual Temperature (Fahrenheit)	Annual Maximum Temperature (Fahrenheit)	Month(s) of Year Maximum Temperature	Annual Minimum Temperature (Fahrenheit)	Month(s) of Year Minimum Temperature	Total Annual Precipitation (inches)
2013	54.7	108	July	-1	December	33.6
2014	55.2	104	July	-6	March	28.6
2015	58.4	110	September	5	January	29.8
2016	59.0	105	July	-9	December	31.9
2017	58.3	105*	July*	-9*	December*	27.6
2018	56.2	102	September	-6	January	34.6
2019	55.4	105	August	0	March	30.7
2020	57.0	103	July	11	February	33.7
2021	57.6	105	August	-13	February	27.4

Note: *Missing data for one or more months.

Climate projections indicate that summer temperatures across the Great Plains region will increase over the next century, and although precipitation amounts will vary by location, wet areas will become wetter and dry areas will become drier (USGCRP 2023). In general, the northern Great Plains region is expected to experience the greatest increase in projected summer temperatures and greatest increase in spring precipitation amounts compared to the remainder of the Great Plains. The southern Great Plains region is expected to experience less severe increases in temperatures compared to northern states but experience a significantly drier climate. Specifically in southwestern and south-central Kansas, in the vicinity of the Rattlesnake Creek Watershed, summer temperatures are expected to increase, and spring precipitation amounts are expected to decrease. By midcentury, temperature levels are projected to exceed historical record levels regardless of emission pathways. In Kansas, precipitation levels are projected to increase as temperatures increase (USGCRP 2023). The wettest consecutive five-year period on record in Kansas was from 2015-2019 and the frequency of high precipitation events has shown a general increase (Frankson et. al. 2022).

According to the National Oceanic and Atmospheric Administration (NOAA), most of the state of Kansas has warmed by at least 1.5 degrees Fahrenheit in the last century (Frankson et. al. 2022). As a result of warming temperatures, soils have become drier and the demand for water has increased (EPA 2016). In Kansas, summer precipitation is projected to decrease in the range of 5 percent to 10 percent by 2050, while winter precipitation is expected to increase (Frankson et. al. 2022). These expected changes, and their impacts on Kansas' agricultural community, are complex and often interrelated. Irrigation, water conservation, and impacts to streamflow are affected by droughts, which means longer and more intense droughts may further the need for water conservation measures in the future.

4.5 Cultural Resources and Historic Properties

The National Historic Preservation Act (NHPA) of 1966 (16 USC 470f), as amended, sets forth national policy and procedures for historic properties, defined as districts, sites, buildings, structures, and objects included in or eligible for listing in the National Register of Historic Places (NRHP) that are important cultural ecosystem services.

Section 106 of the NHPA requires federal agencies to consider the effects of their undertakings on historic properties and to allow the Advisory Council on Historic Preservation (ACHP) the opportunity to comment on those undertakings, following regulations issued by the ACHP (36 CFR 800). If an undertaking will alter, damage, or destroy a historic property, the federal agency has a responsibility to avoid, minimize, or mitigate the adverse effect.

The geographic scope of analysis for historic properties includes the project area. A review was conducted of the NRHP listings in the watershed (NPS 2022) to determine the presence of historic properties within the project area. The NRHP identifies historic properties currently listed in the towns of Stafford, Sylvia, and St. John. Table 4.5 documents the name, address, resource type, and listing date of each of the NRHP-listed properties in the project area.

Table 4.5. National Register of Historic Places Properties Within the Vicinity of the Project.

Resource Name	Address	Resource Type	Date Listed in National Register of Historic Places
Sarah L. Henderson House	518 W. Stafford Street Stafford, KS	Building	7-19-1996
Joseph L. Spickard House	201 N. Green Street Stafford, KS	Building	6-8-2005
Covenanter Church	113 N. Green Street Stafford, KS	Building	6-8-2005
First Methodist Episcopal Church	219 W. Stafford Street Stafford, KS	Building	10-31-2002
Farmers National Bank	100 N. Main Stafford, KS	Building	5-17-2006
Sylvia Rural High School	203 Old Kansas 50 Sylvia, KS	Building	11-17-2005
William R. Gray Photography Studio and Residence	116 N. Main St. John, KS	Building	1-2-2013

No archaeological surveys have been completed for any of the alternatives proposed in this Plan – EIS. Archaeological surveys will be planned and executed during the design phase of the project after the Plan – EIS has been completed and authorized. Pursuant to § 800.4(b)(2), NRCS has executed a Programmatic Agreement (PA) that outlines the procedures for phased identification of historic properties in accordance with 36 CFR 800.14(b) (Appendix A). The Area of Potential Effect (APE) has been defined for the alternatives and is limited to areas where ground-disturbing activities will occur. The APE will be refined during the design process prior to the commencement of archaeological surveys.

Additional undocumented historic properties or archaeological resources may be present that are not shown on the NRHP because there are no documented records or because the specific type of archaeological resource is not maintained by the NRHP. These resources may be identified through the tribal consultation process and identification of historic properties through a Class III cultural resource survey in accordance with Secretary of Interior (SOI) *Standards and Guidelines for Archaeology and Historic Preservation* (48 FR 44716-4742) and *Standard for Identification* (48 FR 44720-44723) and NRHP criteria of significance (36 CFR 60.4).

4.6 Socioeconomics

The USCB's American Community Survey (ACS) Five-year Estimates (USCB 2019) was used to describe the population demographics of the geographic scope of analysis in Table 4.6-1. The geographic scope of analysis includes the project area (Figure 3.0).

The geographic scope of analysis includes a population of approximately 5,140 people. The largest communities within the geographic scope of analysis are St. John, with a population of 1,377, and Haviland, with a population of 796. Populations in the geographic scope of analysis include 17 percent who identify as minority or nonwhite, compared with 25 percent who identify as minority or nonwhite in the state of Kansas. Notably, the segment of the population of Macksville who identifies as minority or nonwhite is 38.2 percent (USCB 2019).

The median household income for all counties and communities in the geographic scope of analysis is below both the Kansas and national median household income of $61,091 and $64,994, respectively (USCB 2019). Populations living below the federal poverty level within the communities in the geographic scope of analysis range from 4.7 percent in Byers to 32.7 percent in Belpre. Three communities (Hudson, St. John, and Belpre) in the geographic scope of analysis have a higher poverty rate (percentage of people living below the federal poverty level) than the state poverty rate of 11.4 percent.

Table 4.6-1. Population and Demographics for the Project Area.

Geographic Area	Total Population	Minority Percentage	Median-Household Income (2020$)	Percentage in Poverty
Stafford County	4,125	16.7	$51,857	12.5
Hudson	105	0.0	$47,500	13.3
St. John	1,377	23.4	$54,962	12.5
Macksville	471	38.2	$48,125	5.7
Pratt County	9,324	14.0	$54,664	10.5
Byers	22	22.7	$55,560	4.7
Kiowa County	2,460	12.3	$53,107	6.3
Haviland	769	22.4	$53,625	7.6
Pawnee County	6,253	12.2	$46,599	9.2
Edwards County	2,907	26.4	$50,028	9.5
Belpre	109	22.9	$27,083	32.7
Geographic Scope of Analysis	5,140	17.0	NA	NA
Kansas	2,937,880	24.7	$61,091	11.4
United States	331,449,281	42.2	$64,994	12.8

Source**:** USCB 2019

Local and Regional Economy

Quivira NWR provides added value to the local and regional economy in various ways. Added value includes substantial funding and investments in conservation efforts to enhance wetland and stream improvements both on and off Quivira NWR that collectively involve many different government agencies, private organizations, and individuals (e.g., Ducks Unlimited, The Nature Conservancy, private landowners, USFWS). These investments have increased the importance of the region for waterfowl and other hunting opportunities, and the region is visited by many for birding observation and photography. The investments have resulted in valuable recreational resources for residents and nonresidents that generate important economic benefits to local communities and revenue sources for businesses.

Though it is difficult to estimate all the visitation to the area that can be attributed to Quivira NWR, it has been estimated that local visitors within 50 miles of the refuge typically made day trips and spent an average of $45 per day. Nonlocal visitors outside of 50 miles of the refuge stayed on average two days and spent $55 per person per day (USFWS 2013a). Activities performed at the Quivira NWR include birdwatching, hunting, fishing, photography, and wildlife observation. Each of these activities have additional economic benefits for equipment, licenses, etc. (USFWS 2013a).

A combination of employment at the refuge and visitor spending totals $1 million in added value (USFWS 2013a). Quivira NWR employs 11 full-time staff members, one part-time staff member, three temporary employees, and two regional employees. In addition, management of the refuge involves cattle grazing in cooperation with local landowners and occasional haying and other contract work. Refuge management activities support an estimated 20 jobs with five jobs generated through secondary effects.

Table 4.6-2 shows gross domestic product by industry for the geographic scope of analysis (REAP-KS 2023). For 2016 through 2021, the top three industries include agriculture, forestry, fishing and hunting (23 percent), government and government enterprises (17 percent), and finance, insurance, real estate, and rental and leasing (12 percent). Agriculture is important in the local economy, driven primarily by crops, livestock, and associated agricultural businesses. The dominant crops grown within the area are wheat, corn, soybeans, and sorghum, with a smaller percentage dedicated to hay and haylage. Average net farm income for Stafford County is approximately $34.4 million per year (USDA 2024). The U.S. Department of Agriculture (USDA) Census of Agriculture collects county-level data on agricultural economics including the amount of land used for farming, the demographics of farm operators, and average sales and income from farming. Table 4.6-3 presents the 2022 Census of Agriculture data for Pratt, Stafford, Kiowa, Edwards, and Pawnee counties and the state of Kansas (USDA 2024).

Table 4.6-2. Gross Domestic Product by Industry for the Geographic Scope of Analysis[1] (1,000 of Current Dollars).

Year	2016	2017	2018	2019	2020	2021
All industry total	1,385,374	1,289,047	1,293,701	1,384,237	1,345,895	1,341,104
Private industries	1,093,311	920,243	939,910	1,029,735	1,041,942	1,074,460
Agriculture, forestry, fishing, and hunting	430,018	275,306	205,725	288,478	254,519	303,691
Mining, quarrying, and oil and gas extraction	40,303	47,053	50,816	41,989	32,524	48,453
Utilities	24,408	94,772	90,731	127,696	128,370	119,366
Construction	61,729	29,290	24,156	25,960	23,994	24,099
Manufacturing	33,567	34,481	39,207	38,012	31,463	33,271
Wholesale trade	81,359	83,069	86,852	99,328	96,823	96,764
Retail trade	75,921	76,700	79,528	78,845	76,271	81,279
Transportation and warehousing	20,326	11,302	13,935	29,250	53,342	35,250
Information	112	2,576	2,302	2,283	2,560	2,425
Finance, insurance, real estate, rental, and leasing	150,948	142,483	158,535	141,692	170,317	163,838
Professional and business services	49,640	42,630	48,170	19,705	46,046	42,520
Educational services, health care, and social assistance	90,015	35,177	91,475	95,079	87,225	81,184
Arts, entertainment, recreation, accommodation, and food services	23,296	22,653	25,353	24,174	23,787	27,146
Other services (except government and government enterprises)	11,669	22,751	23,125	17,244	14,701	15,174
Government and government enterprises	233,520	228,560	228,236	234,167	251,675	227,760

[1]Includes Kiowa, Edwards, Pawnee, Pratt and Stafford counties in Kansas. Source: REAP-KS 2023

Table 4.6-3. Agricultural Statistics for Counties Included in the Project Area (USDA 2024).

Item	Unit	Pratt County	Stafford County	Kiowa County	Edwards County	Pawnee County	Kansas
Number of Farms	Number	517	489	352	233	337	55,734
Land in Farms	Acres	463,932	405,396	367,358	396,962	412,958	44,794,702
Croplands	Acres	397,451	306,067	170,763	271,996	350,434	28,340827
Harvested Cropland	Acres	302,605	233,482	104,597	189,077	232,877	20,314,273
Irrigated Land	Acres	90,651	48,003	34,045	64,820	44,473	2,344,782
Agricultural Land Value/Acre, Including Buildings	Dollars	$2,390	$2,086	$1,601	$1,957	$1,931	$2,324
Cattle and Calves	Number	53,279	41,320	23,806	61,957	70,093	6,126,402
Tenure of Operations							
Full Owners	Number	342	323	229	140	211	34,206
Part Owners	Number	126	130	85	80	96	17,312
Tenants	Number	48	36	38	13	30	4,216
Average Years on Present Farm	Number	20.4	23.5	24.0	25.1	22.0	22.3
Operator Work On/Off Farm							
No work off Farms	Number	443	349	272	212	248	39,765
Any work off Farms	Number	554	562	349	209	354	60,890
Ethnicity of Operators							
Hispanic, Latino, or Spanish Origin Producers	Number	4	5	0	10	5	1,302
American Indian or Alaska Native Producers	Number	19	0	0	0	10	594
Asian Producers	Number	0	0	0	0	0	201
Black or African American Producers	Number	0	9	0	0	0	160
Native Hawaiian or Other Pacific Islander	Number	0	0	0	0	0	29
White Producers	Number	973	902	614	420	583	98,924
Farm Sales							
Market Value of Agricultural Products Sold/Farm	Dollars	$635,693	$486,953	$214,205	$1,365,066	$1,037,869	$430,350
Average Net Cash Farm Income/Farm	Dollars	$99,834	$70,402	$48,859	$194,627	$112,547	$73,058
Total Net Cash Farm Income	$1,000	$51,614	$34,426	$17,198	$45,348	$37,928	$4,071,834
Value of Crop Sales	$1,000	$144,215	$99,631	$45,837	$116,221	D	$8,416,015

D: Information withheld to avoid disclosing data for individual farms. Source: USDA 2024

Total net farm income (gross farm income minus expenses) ranged from $17.2 million in Kiowa County to $45.3 million in Edwards County. Much of the farm income can be attributed to crop sales, which range from $45.8 million in Kiowa County to $144.2 million in Pratt County. Water for irrigated crops is important throughout the study area where the percentage of croplands that are irrigated range from 9 percent in Kiowa County to 20 percent in Pratt County (USDA 2024).

The largest communities within the rural geographic scope of analysis are St. John in Stafford County and Haviland in Kiowa County. The other communities dispersed throughout the area have populations of less than 500. As shown in Table 4.6-3, these communities have businesses that contribute to the local economy, many of which are agricultural in nature. The remaining businesses, though not directly agricultural, are still dependent on a healthy agricultural sector.

The largest percentage of the project area sits within Stafford County, with the largest town and county seat in St. John. The county is highly dependent on the agricultural industry for jobs and income (Table 4.6-3), including some large industrial operations such as the Stafford County Flour Mills in Hudson and the Dillwyn Feed Lot near Macksville. As shown in Table 4.6-4, the top three industries for employment in the county include agriculture, government (federal, state, and local), and oil and gas production.

Table 4.6-4. Top Three Industries in Percent of Employments.

Industry Rank	Pratt County	Stafford County	Kiowa County	Edwards County	Pawnee County
Industry 1	Government (16%)	Agriculture (20%)	Government (21%)	Agriculture (19%)	Government (34%)
Industry 2	Retail Trade (12%)	Government (20%)	Agriculture (18%)	Government (14%)	Agriculture (12%)
Industry 3	Health care and social assistance (12%)	Mining (including oil and gas development) (14%)	Construction (8%)	Health care and social assistance (8%)	Health care and social assistance (9%)

Source: Headwaters Economics 2022

4.7 Parklands and Natural Areas

Parklands and natural areas are properties owned by federal, state, county, or municipal entities that are available to the public for recreational activities. In Kansas, less than 3 percent of land is publicly owned (KDWP 2015a). The geographic scope of analysis for parklands and natural areas is the project area. Five recreational resources are located within the project area, including Quivira NWR. Quivira NWR contributes to cultural ecosystem services and offers the public many recreational activities including hunting, fishing, hiking, birdwatching, and

photography (USFWS 2022a). Additional information regarding Quivira NWR can be found in Section 1.1 of this document. One state-owned property, the Pratt Sandhills State Wildlife Management Area (WMA), is located in the southern portion of the project area, in Pratt County. This WMA is a popular hunting area, particularly for upland game birds (KDWP 2022a). Other parks within the region include Brown Memorial Park and Cornwell Park in St. John and the city park in Hudson (City of St. John 2013; Kansas Wetlands and Wildlife National Scenic Byway 2022). These parks are generally small and contain sports fields and playgrounds for use by the local communities.

4.8 Land Cover and Land Use

Land cover describes the surface components of land or water that are physically present and visible. Land cover can include classifications such as cropland, pasture, forest, or urban areas (EPA 2024a). Land use is how people use an area (e.g., developed, open space, etc.; NOAA 2021). The geographic scope of the analysis is the project area, which totals 717,227 acres. The National Landcover Database (NLCD; 30-meter resolution) map (Figure 4.8) shows that the project area is predominantly composed of agricultural land, specifically, cultivated crops (Homer et al. 2012) that contribute to important provisioning ecosystem services in the project area. Farmed cropland covers a total of 448,494 acres of land within the project area (63 percent). Herbaceous and hay and pasture cover types, including grasslands, forbs, and hayed or grazed pasture, comprise 214,529 acres of land (30 percent). Approximately 28,973 acres (4 percent) of developed land lie within the project area; most are classified as “Developed, Open Space.” Woody wetlands, emergent herbaceous wetlands, and open water account for 23,663 acres (3 percent); the most abundant type of wetland is emergent herbaceous (12,498 acres [2 percent]). Less than 1 percent of the project area (1,567 acres) accounts for deciduous/mixed forest, barren land, and scrub/shrub (Homer et al. 2012).

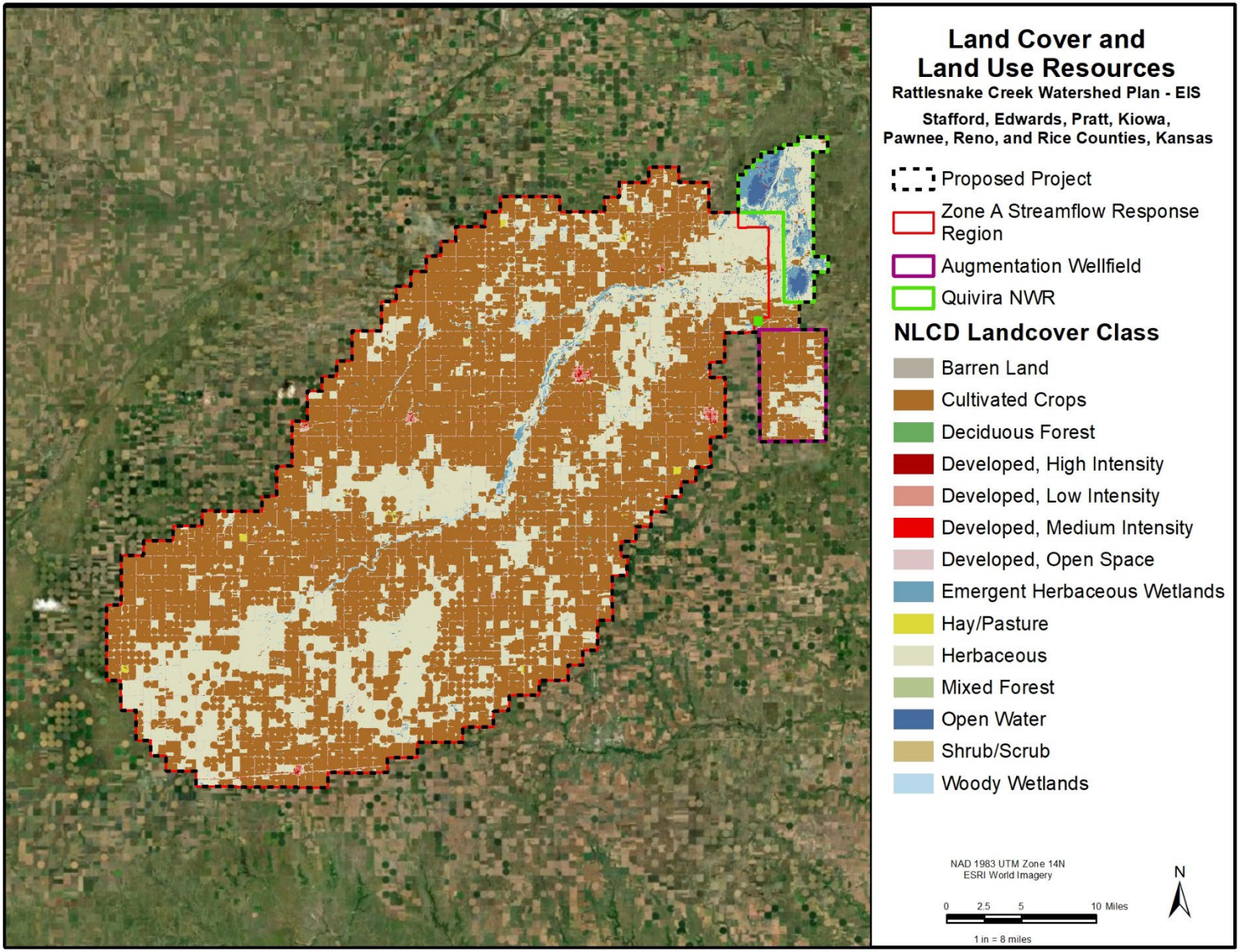

Figure 4.8. National Land Cover Database (NLCD) Land Cover and Land Use Map (Homer et al. 2012).

4.9 Prime Farmland

Under the USDA's Farmland Protection Policy Act (FPPA), federal agencies must identify and consider the adverse effects of federal programs on the preservation of prime or unique farmland. The purpose of the FPPA is to minimize the extent to which federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses and to assure that federal programs are compatible with state and local policies to protect farmland as an important provisioning ecosystem service (NRCS 2012a).

The geographic scope of analysis for prime farmland is the project area, located in seven counties in south-central Kansas (Edwards, Kiowa, Pawnee, Pratt, Rice, Reno, and Stafford). On average, 88.8 percent of land within the seven counties in the project area is farmed; an average of approximately 11.6 percent of existing farmland is irrigated (USDA 2024). Table 4.9 details the acreage of farmland and acres of irrigated farmland for each of the seven counties within the project area.

Table 4.9. 2022 Census of Agriculture Farmland Data for Counties Within the Project Area (USDA 2024).

County	Acres Farmed	Percent of County Farmed	Irrigated Acres	Percent Farmland Irrigated
Edwards	396,962	99.7	64,820	16.3
Kiowa	367,358	79.5	34,045	9.3
Pawnee	412,958	85.6	44,473	10.8
Pratt	463,932	98.5	90,651	19.5
Reno	779,043	95.7	67,441	8.7
Rice	384,753	82.6	19,208	5.0
Stafford	405,396	79.7	48,003	11.8

Prime farmland and farmland of statewide importance are identified by NRCS soil map units. Prime farmland is defined by the USDA as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops (USDA 2017a). Prime farmland has soil quality, growing season, and moisture supply to produce high yields of crops and is not excessively erodible or saturated for long periods of time (USDA 2017a). An adequate and dependable water supply, either through precipitation or irrigation, is a defining feature of prime farmland areas. Farmland of statewide importance is land (in addition to prime or unique farmland) important for production of food, feed, fiber, forage, biofuels, and oilseed crops. In general, farmlands of statewide importance are areas with soils that nearly meet the criteria for prime farmland and produce high yields of crops. Criteria for defining and delineating farmland of statewide importance is determined by appropriate state agencies (7 CFR 1491.3).

Prime farmland and farmland of statewide importance were identified using the Web Soil Survey mapping application (Figure 4.9; NRCS 2019). According to Web Soil Survey data, prime farmland constitutes approximately 37 percent of the project area (267,729 acres), and farmland of statewide importance occupies approximately 51 percent of the project area (362,484 acres). Areas of prime farmland are located abutting Rattlesnake Creek. Areas of farmland of statewide importance are located in areas generally adjacent to Rattlesnake Creek in areas not occupied by prime farmland. The remaining 12 percent of the project area (87,014 acres) is not prime farmland. The use of prime farmland contributes to the dominant provisioning ecosystem services for crop production, livestock production, and other agricultural practices in the project area.

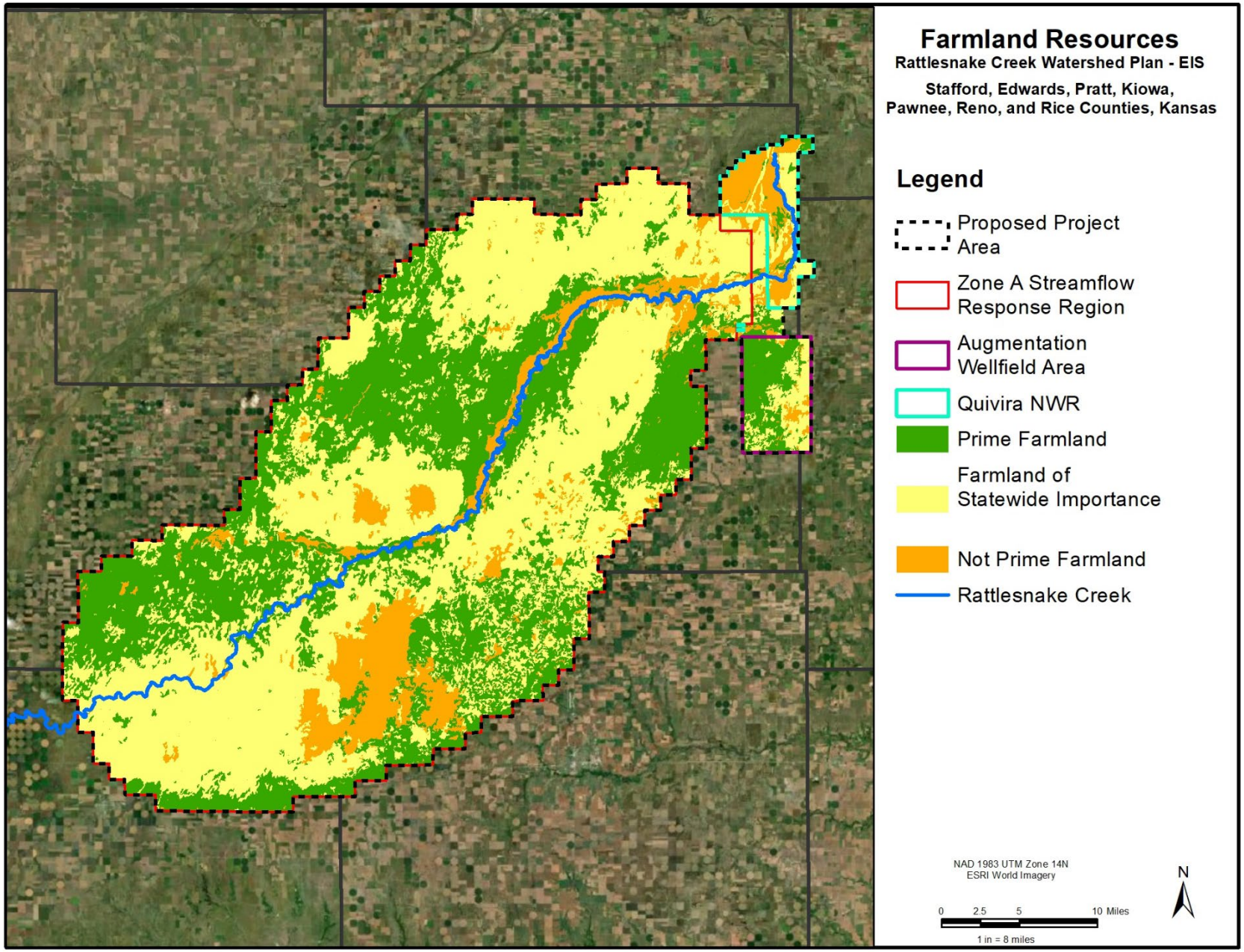

Figure 4.9. Farmland Resources (NRCS 2019).

4.10 Surface Water Resources and Water Quality

Watersheds, or drainage basins, are areas of land that drain surface water to a common outflow point, such as a stream or reservoir (USGS 2019b). The project area is situated within the Arkansas River drainage basin, which spans from central Colorado to southeastern Arkansas. The headwaters of the Arkansas River originate from snowmelt in the Collegiate Range on the eastern slope of the Rocky Mountains near Leadville, Colorado (Naeser and Smith 1995). From its headwaters, the Arkansas River continues through Kansas and Oklahoma before ultimately discharging into the Mississippi River in southeastern Arkansas (Naeser and Smith 1995; Miller et al. 2010). Within the Arkansas River basin, the project area is located within three smaller watersheds – the Rattlesnake Creek Watershed, the Gar-Peace Creek Watershed, and the North Fork Ninnescah River Watershed. The geographic scope of analysis for surface water resources and water quality includes the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds.

4.10.1 Surface Hydrology of Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds

The project area spans the Rattlesnake Creek, Gar-Peace Creek, and the North Fork Ninnescah River watersheds, which all discharge into the Arkansas River (Figure 3, Figure 4.10.1-1). Most of the project area, including Quivira NWR, is located within the Rattlesnake Creek Watershed. The Gar-Peace Creek and the North Fork Ninnescah River watersheds are included because alternatives considered may have project components located in and have the potential to impact these watersheds.

The Rattlesnake Creek Watershed covers approximately 1,232 square miles across 10 counties in south-central Kansas (KDA-DWR 2008). The watershed, which is drained by Rattlesnake Creek, is approximately 95 miles long with an average width of 10 miles and spans from the Rattlesnake Creek headwaters in northern Kiowa County to the stream's confluence with the Arkansas River in Rice County, just east of Quivira NWR (KDA-DWR 2008). Rattlesnake Creek is designated as a perennial stream from just north of St. John to its northerly bend near Little Salt Marsh in Quivira NWR, and the remainder of Rattlesnake Creek within the watershed is classified as an intermittent stream (KGS 1990; KDA-DWR 2008). Though the watershed contains a significant drainage area, only 519 square miles of the watershed contribute surface runoff to Rattlesnake Creek and ultimately Quivira NWR; over half of the Rattlesnake Creek Watershed does not contribute surface runoff to Rattlesnake Creek, highlighting the limited availability of surface water resources within the watershed (USGS 2022). Figure 4.10.1-2 shows the contributing and noncontributing areas of the Rattlesnake Creek Watershed.

The Gar-Peace Creek Watershed covers approximately 639 square miles across five counties in south-central Kansas. The watershed includes the Arkansas River and begins at the confluence of the Arkansas River with Rattlesnake Creek in southwestern Rice County (Whittemore 2004). The watershed stretches northwest to southeast, terminating at the

confluence of the Arkansas River with the Little Arkansas River in Sedgwick County (Whittemore 2004). A portion of Peace Creek, a contributing tributary of the Arkansas River within the watershed, is present within the footprint of the project area.

The North Fork Ninnescah River Watershed covers approximately 1,063 square miles across six counties in south-central Kansas. The watershed is approximately 96 miles long with an average width of 10 miles and spans from the North Fork Ninnescah headwaters in Kiowa County to the stream's confluence with the Ninnescah River in Sedgwick County. The North Fork Ninnescah is designated as a perennial stream beginning near the Pratt-Stafford County line and continuing to the confluence of the Ninnescah River near Cheney (KDA-DWR 2010). Cheney Reservoir, a U.S. Bureau of Reclamation water storage facility, is situated on the North Fork Ninnescah River near the intersection of Reno, Kingman, and Sedgwick counties. Water released from Cheney Reservoir flows into the Ninnescah River before draining to the Arkansas River. Part of the alternatives' footprint is located in the North Fork Ninnescah River Watershed. Additional information about project components can be found in Chapter 5 and potential impacts to surface hydrology based on each alternative can be found in Section 6.9.

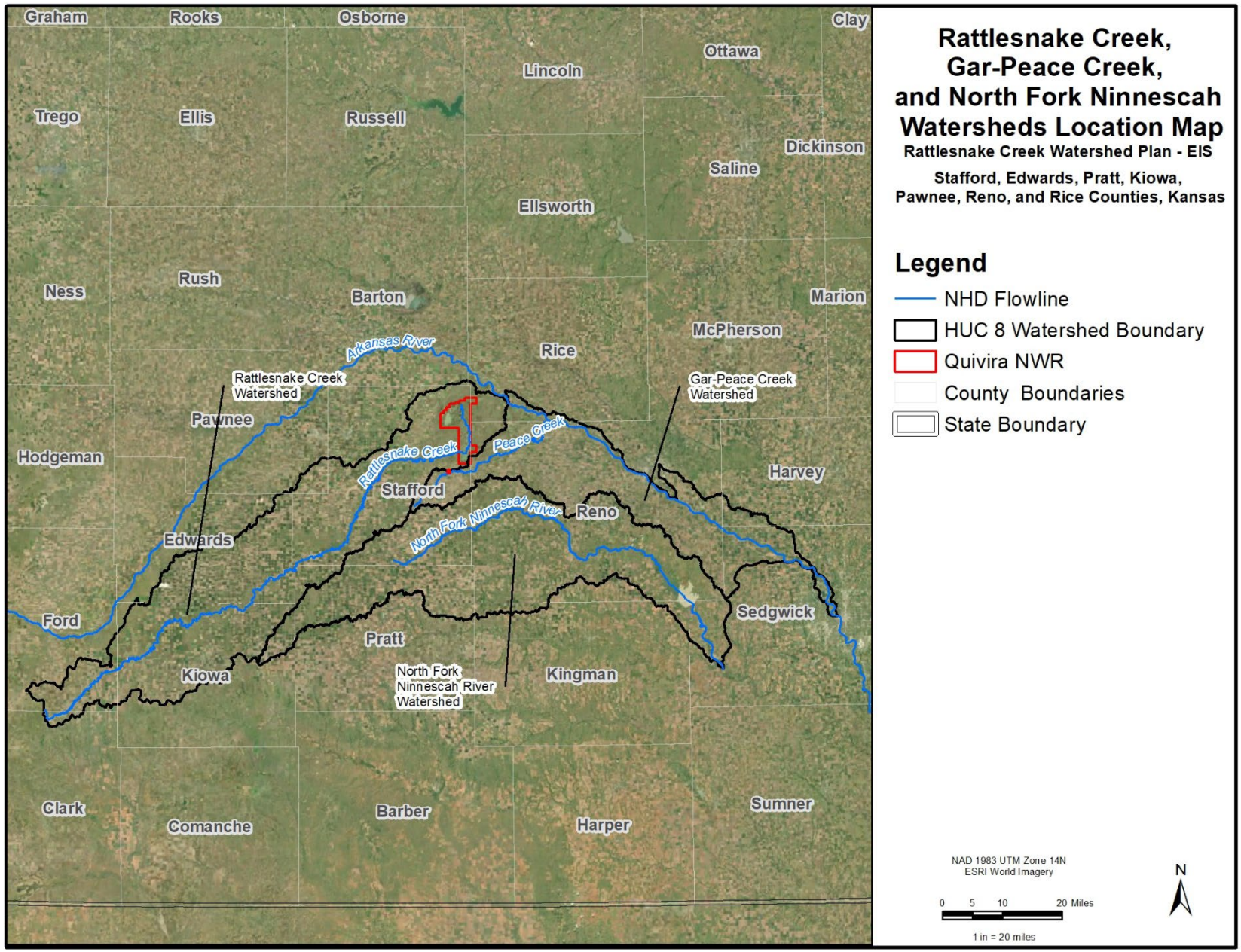

Figure 4.10.1-1. Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds Location Map.

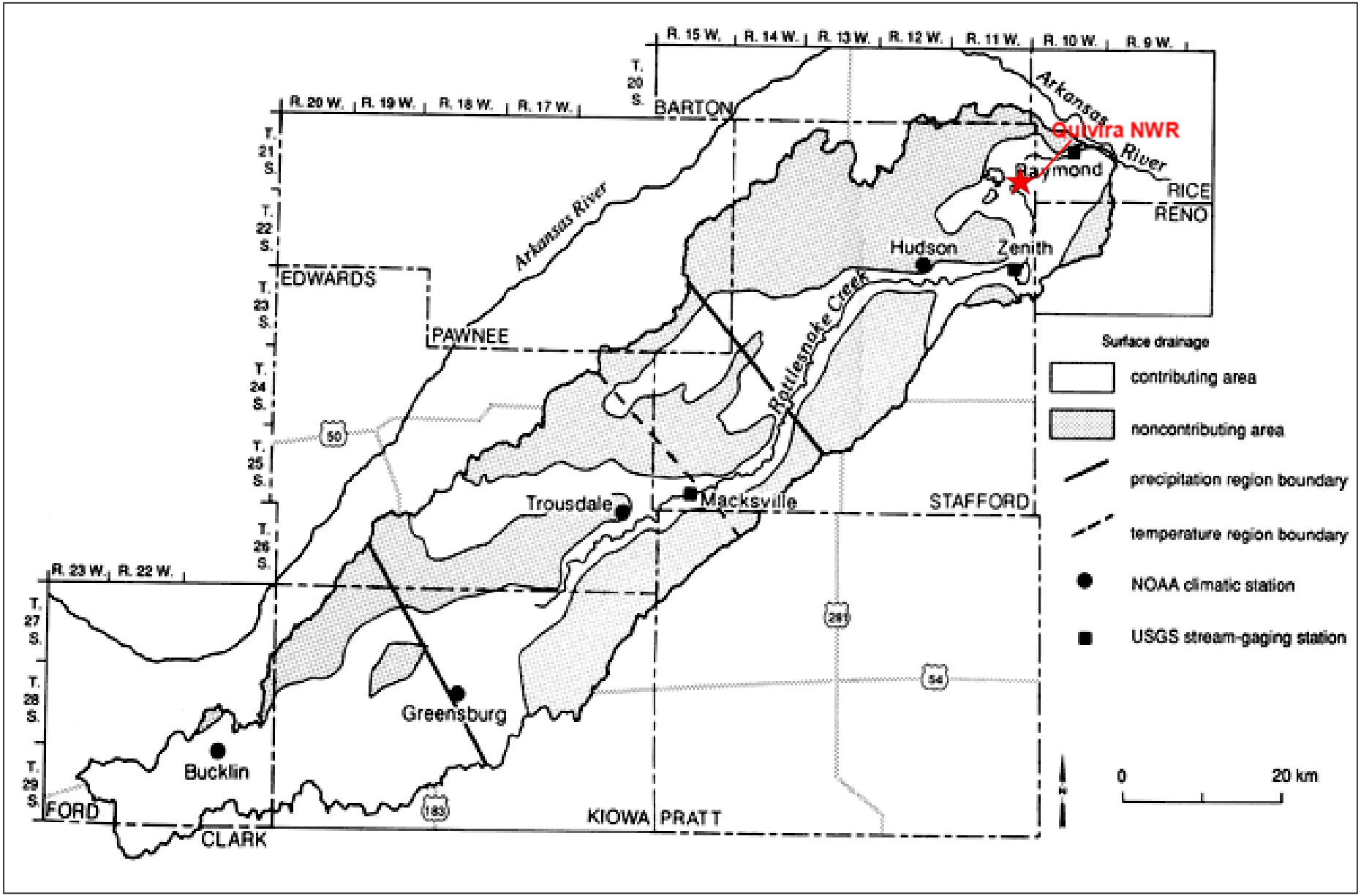

Figure 4.10.1-2. Contributing and Noncontributing Areas of Rattlesnake Creek Watershed (KGS 1990).

4.10.2 Surface Water Quality

The Kansas Department of Health and Environment (KDHE) designates Rattlesnake Creek and Peace Creek as Special Aquatic Life Use (SALU) waters. SALU are surface waters that contain combinations of habitat types and indigenous biota not found commonly in the state or surface waters that contain representative populations of threatened or endangered species (KDHE 2007). The Quivira NWR salt marshes are designated by KDHE as Outstanding National Resource Waters (ONRW). ONRW are surface waters or surface water segments of extraordinary recreational or ecological significance afforded the highest level of water quality protection (Tier 3) under the antidegradation and mixing zone provisions (KDHE 2007). Fresh, clean water is important to maintain provisioning ecosystem services. Wetlands can provide regulating ecosystem services for water quality by filtering and purifying water as well as supporting ecosystem services with nutrient cycling in wetlands.

Section 303(d) of the Clean Water Act requires states to identify waters within their boundaries that are impaired or are in danger of becoming impaired. Under Section 303(d), waters are assessed as impaired when an applicable water quality standard is not being attained. Impaired waters require states to establish a total maximum daily load (TMDL) or alternative restoration plan to reduce pollutant loadings and restore the waterbody (EPA 2023a). TMDLs submitted by states and approved by the EPA are ultimately incorporated into state water quality management plans and National Pollutant Discharge Elimination System (NPDES) permits (KDHE 2022). Federal regulations related to the 303(d) process are detailed in 40 CFR 130.7. Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds contain impaired or potentially impaired waters listed under Section 303(d) by KDHE and approved by the EPA (KDHE 2022). A summary of impaired uses and pollutants for each watershed is provided in Table 4.10.2.

The primary water quality concern related to water supply within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds is the prevalence and concentration of chlorides (salts) in surface waters (KDHE 2022). All three watersheds have impairments for chloride and established TMDLs (250 milligrams per liter [mg/L] for domestic water supply and 860 mg/L for aquatic life). Though chlorides within surface waters can originate from anthropogenic nonpoint sources, the primary chloride input in the three watersheds is from natural mineral intrusion from underlying Permian bedrock formations (Sophocleous and Perkins 1992; Whittemore 2004; Hathaway et al. 1978). As discussed in Section 4.3, salt concentrations within the Rattlesnake Creek Watershed are lowest near the stream's headwaters and highest in the northeastern portion of the watershed, within Quivira NWR, where the depth of the water table is most shallow. In the northeastern portion of the Rattlesnake Creek Watershed, waters underlying the Late Permian "red bed" deposits rise upward and interface with the shallow freshwater aquifer, discharging water that is high in chloride concentrations that then discharges into the lower reaches of Rattlesnake Creek (KGS

1990). In general, surface water chloride concentrations decrease with increased streamflow within these watersheds (Whittemore 2004).

Water quality in the upper portion of the Rattlesnake Creek Watershed influences surface water quality within Quivira NWR located within the lower part of the watershed. Upstream nonpoint inputs to Rattlesnake Creek include salts and minerals generated through agricultural practices and oil and gas production activities (Sophocleous and Perkins 1992). During high-intensity precipitation events, chlorides associated with cultivated cropland are washed into streams within the watershed through runoff and are ultimately transported downstream (KDHE 2023). Additional chloride loads from nonpoint sources can disrupt the natural range of water quality conditions in the watershed.

Table 4.10.2. Section 303(d) Streams in the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds (KDHE 2022).

Stream/Lake Resource	Impaired Use	Impairment	County	Total Maximum Daily Load Established
Rattlesnake Creek	Water Supply	Chloride	Stafford, Edwards, Kiowa	Yes
Big Salt Marsh (Quivira National Wildlife Refuge [NWR])	Aquatic Life	Ammonia	Stafford	No
Big Salt Marsh (Quivira NWR)	Aquatic Life	pH	Stafford	Yes
Big Salt Marsh (Quivira NWR)	Aquatic Life	Eutrophication	Stafford	Yes
Big Salt Marsh (Quivira NWR)	Water Supply	Chloride	Stafford	Yes
Little Salt Marsh (Quivira NWR)	Aquatic Life	Eutrophication	Stafford	Yes
Little Salt Marsh (Quivira NWR)	Aquatic Life	pH	Stafford	Yes
Little Salt Marsh (Quivira NWR)	Water Supply	Chloride	Stafford	Yes
Little Salt Marsh (Quivira NWR)	Water Supply	Siltation	Stafford	Yes
Arkansas River at Wichita	Water Supply	Chloride	Sedgwick	Yes
Arkansas River at Wichita	Aquatic Life	Phosphorus	Sedgwick	Yes
Arkansas River at near Hutchinson	Aquatic Life	Selenium	Rice, Reno	No
Arkansas River near Hutchinson	Aquatic Life	Biology	Rice, Reno	Yes
Arkansas River near Hutchinson	Water Supply	Chloride	Rice, Reno	Yes
Arkansas River near Maize	Aquatic Life	Phosphorus	Reno, Sedgwick	Yes
Arkansas River near Yoder	Aquatic Life	Selenium	Reno	No
Arkansas River near Yoder	Aquatic Life	Biology	Reno	Yes
Arkansas River near Yoder	Water Supply	Chloride	Reno	Yes
Arkansas River near Yoder	Aquatic Life	Phosphorus	Reno	Yes
Carey Park Lake	Aquatic Life	Eutrophication	Reno	Yes
Peace Creek near Sterling	Water Supply	Chloride	Stafford, Reno, Pratt	Yes
Peace Creek near Sterling	Recreation	E. coli	Stafford, Reno, Pratt	Yes
Peace Creek near Sterling	Aquatic Life	pH	Stafford, Reno, Pratt	Yes
Salt Creek near Hutchinson	Recreation	E. coli	Reno	No
Salt Creek near Hutchinson	Aquatic Life	Lead	Reno	No
Salt Creek near Hutchinson	Water Supply	Chloride	Reno	Yes

Stream/Lake Resource	Impaired Use	Impairment	County	Total Maximum Daily Load Established
Salt Creek near Hutchinson	Aquatic Life	pH	Reno	Yes
Cheney Lake	Water Supply	Eutrophication	Kingman, Reno, Sedgwick	Yes
Cheney Lake	Water Supply	Siltation	Kingman, Reno, Sedgwick	Yes
Cheney Lake	Aquatic Life	Eutrophication	Kingman, Reno, Sedgwick	Yes
Cheney Lake	Recreation	Eutrophication	Kingman, Reno, Sedgwick	Yes
Rock Creek	Water Supply	Chloride	Reno, Sedgwick	Yes
Unnamed Stream near Cheney	Water Supply	Chloride	Kingman, Sedgwick	Yes
Spring Creek near Cheney	Water Supply	Chloride	Reno, Sedgwick	Yes
North Fork Ninnescah River near Cheney	Water Supply	Chloride	Sedgwick	Yes

4.10.3 WETLANDS AND STREAMS

Executive Order 11990 states that agencies should provide leadership and take actions that minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands. Federal agencies provide guidance and leadership for the following:

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities

Executive Order 11990 does not apply to the issuance by federal agencies of permits, licenses, or allocations to private parties for activities involving wetlands on nonfederal property.

Section 404 of the Clean Water Act regulates the discharge of dredged or fill material into waters of the U.S. (WOTUS), including wetlands, streams, and other water bodies. Section 404 is administered by the U.S. Army Corps of Engineers (USACE) with oversight from the EPA. Section 404 requires a permit be obtained prior to discharge of material into WOTUS, unless such activity is exempt from Section 404 regulations. Regulations promulgated by the EPA regarding Section 404 are outlined in the Clean Water Act Section 404(b)(1) Guidelines at 40 CFR 230.

Streams

The USGS National Hydrography Dataset (NHD; high resolution 1:24,000/12,000) indicates the presence of approximately 558 miles of perennial streams and 2,647 miles of intermittent and ephemeral streams within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds (Figure 4.10.3-1; USGS 2019a). Of the mapped streams, approximately 19 miles of perennial stream (Rattlesnake Creek) and 79 miles of unnamed intermittent and ephemeral streams are located within Quivira NWR. All mapped perennial streams generally flow west to east toward the Arkansas River, which ultimately drains to the Mississippi River. Three named perennial streams are mapped within the Rattlesnake Creek Watershed, five named perennial streams are mapped within the Gar-Peace Creek Watershed, and 10 named perennial streams are mapped within the North Fork Ninnescah River Watershed. Stream segments classified as perennial, but without names in the NHD dataset, occur in all three watersheds. Remaining features, which comprise most of the NHD-mapped streams within the three watersheds, include intermittent and ephemeral tributaries to mapped perennial streams. A summary of features mapped by the NHD within the three watersheds is provided in Table 4.10.3-1.

Table 4.10.3-1. National Hydrography Dataset (NHD) Streams Within Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds.

Stream Name	Watershed	Miles of Stream in Watershed*
Rattlesnake Creek	Rattlesnake	121**
Salt Creek	Rattlesnake	15**
Spring Creek	Rattlesnake	3**
Arkansas River	Gar-Peace	80
Peace Creek	Gar-Peace	19**
Gar Creek	Gar-Peace	8**
Salt Creek	Gar-Peace	37**
Sand Creek	Gar-Peace	2**
North Fork Ninnescah River	North Fork Ninnescah	105
Silver Creek	North Fork Ninnescah	32**
Goose Creek	North Fork Ninnescah	15**
Red Rock Creek	North Fork Ninnescah	10**
Spring Creek	North Fork Ninnescah	8**
Wolf Creek	North Fork Ninnescah	7**
Irish Creek	North Fork Ninnescah	6**
Crow Creek	North Fork Ninnescah	3**
Rock Creek	North Fork Ninnescah	2**
Zenithscah	North Fork Ninnescah	1**
Other Perennial (Unnamed in NHD)	North Fork Ninnescah	84
Intermittent/Ephemeral	Rattlesnake/Gar-Peace	2,647

* Rounded to nearest whole number; ** Miles includes only those portions of the feature mapped as perennial (intermittent segments of named streams are included in ‘Intermittent/Ephemeral’ totals). Source: USGS 2019a

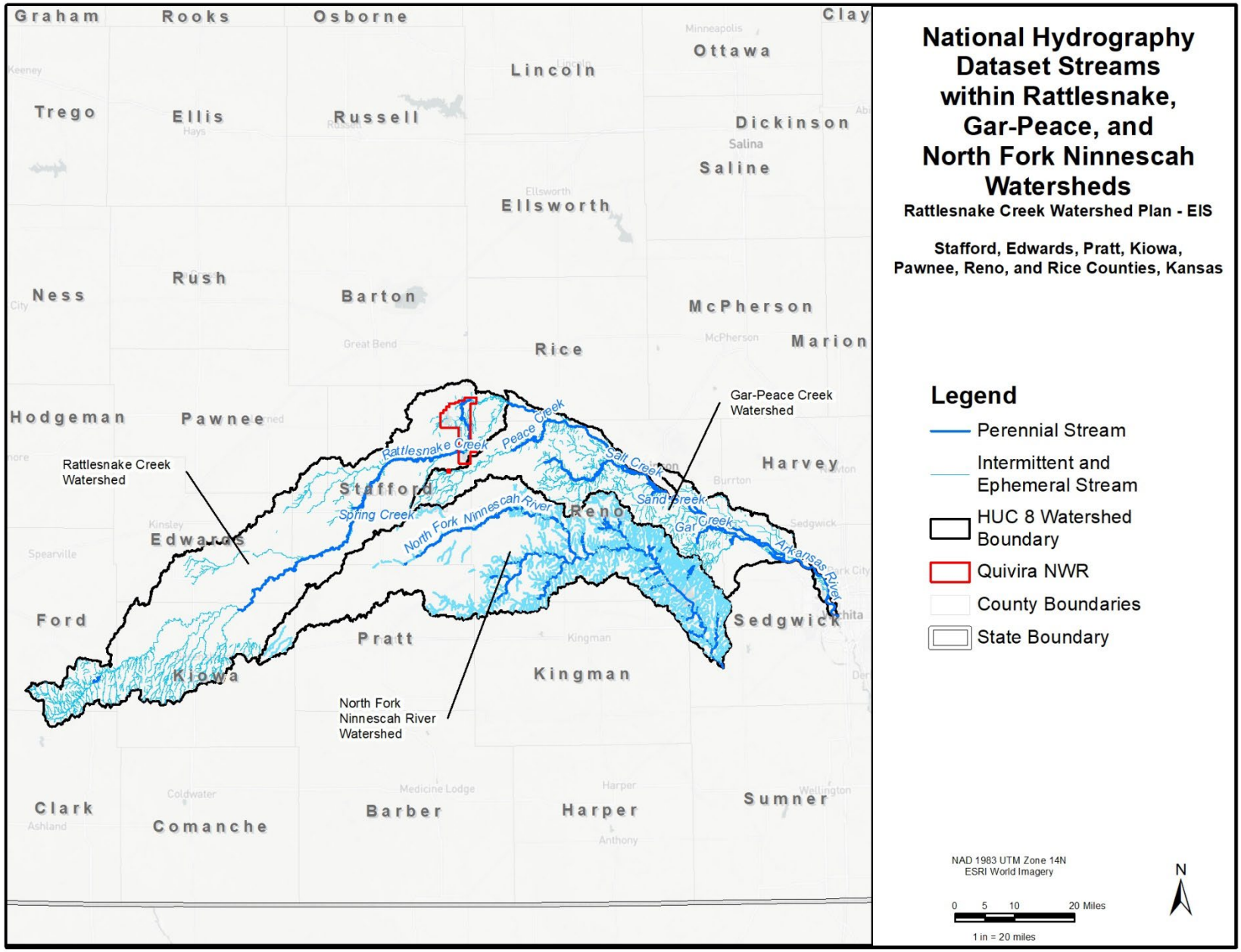

Figure 4.10.3-1. National Hydrography Dataset (NHD) Streams Within Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds (USGS 2019a).

Perennial Stream Trends in Kansas

Perennial streams in Kansas have shown a decrease in total length since the 1960s, particularly in western Kansas. Figure 4.10.3-2 below shows perennial stream loss in Kansas from 1961 to 2009. The upper reach of Rattlesnake Creek has changed from perennial to intermittent, and while Peace Creek remained perennial between 1961 and 2009 (KDA-DWR 2010), it has since become intermittent in the upper reaches (modeled baseflows only occur about 25-30 percent of the time [Balleau 2023a]). The North Fork Ninnescah River remained perennial between 1961 and 2009 (KDA-DWR 2010).

Perennial and intermittent streams are defined in the Federal Register Volume 76, Number 32, Wednesday, February 16, 2011:

> *"Perennial stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for streamflow. Runoff from rainfall is a supplemental source of water for streamflow.*
>
> *Intermittent stream: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for streamflow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for streamflow."*

The loss of perennial streams in western Kansas, including sections of Rattlesnake Creek, is driven by declining water tables that fail to supply groundwater to streams. Groundwater level declines in western Kansas are the result of water loss from aquifer storage (Perkin et al. 2017) partly as a result of historic groundwater withdrawals for irrigation (Angelo 1994; Juracek and Eng 2017). Areas of perennial stream loss shown in Figure 4.10.3-2 generally correspond to areas affected by groundwater declines since the 1950s (Juracek and Eng 2017). Rattlesnake Creek streamflow is projected to continue to decline until 2040 and will stabilize around an annual average of 13 cfs of streamflow (KDA-DWR 2019b).

Wetlands

Wetlands contribute an important role in the ecology of a watershed and are important regulating and supporting ecosystem services. Shallow water, high levels of nutrients, and primary productivity create an ideal environment for organisms at the lowest levels of the food web and provide food and shelter for many species of fish, amphibians, shellfish, reptiles, mammals, birds, and insects. More than one-third of the threatened and endangered species in the U.S. live only in wetlands, and wetlands also provide critical resources for migrating and breeding birds. (EPA 2022b). In addition to their importance to threatened and endangered species, additional ecosystem services provided by wetlands include flood mitigation, climate regulation, water quality protection, nutrient transfer, and numerous human and cultural services (Mitsch and Gosselink 2015).

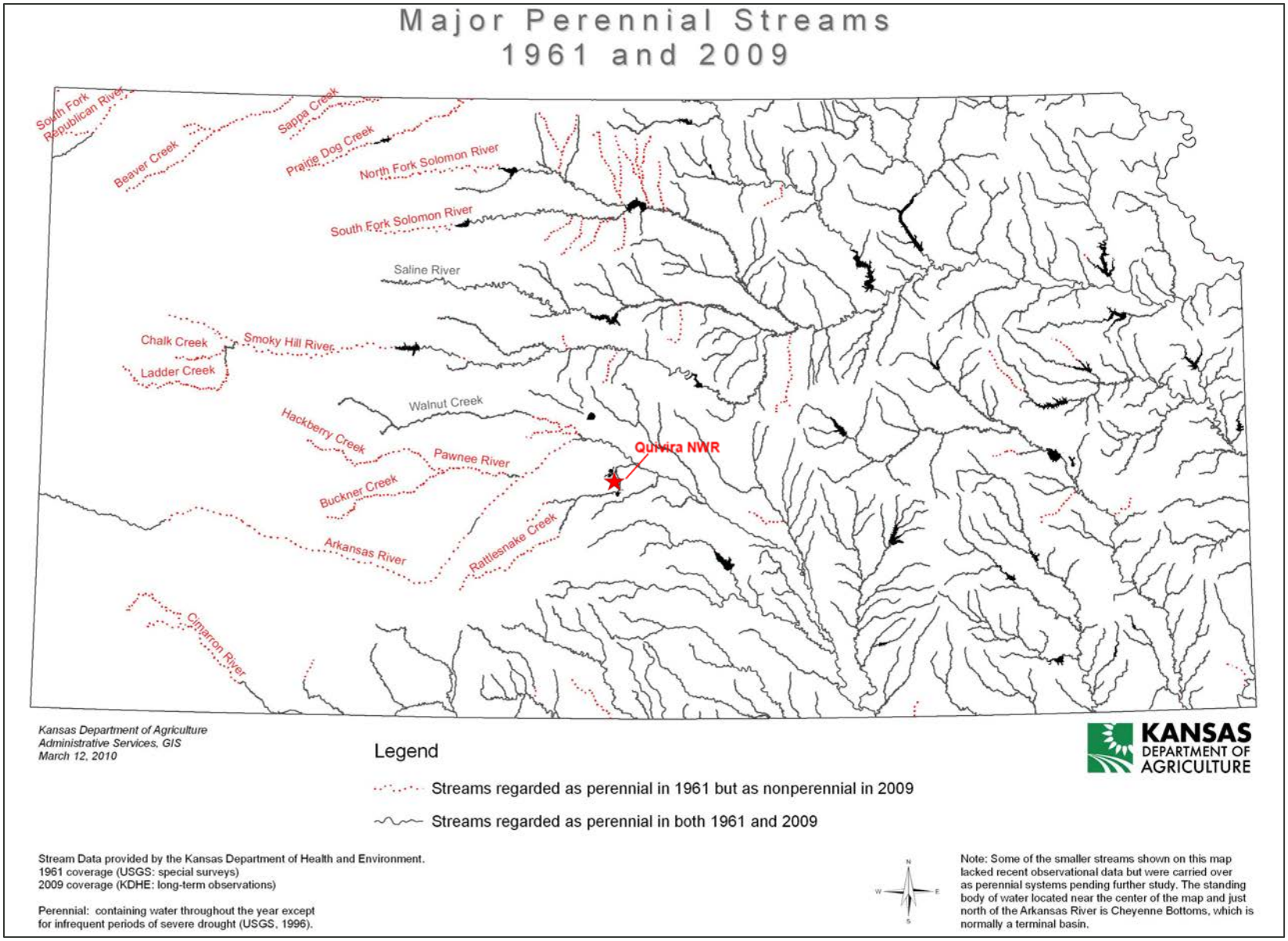

Figure 4.10.3-2. Perennial Stream Loss 1961 to 2009 (KDA-DWR 2010).

Hydrology is an important driver of wetland structure and function and affects both biotic and abiotic factors of wetlands (Mitsch and Gosselink 2015). Water availability and distribution facilitates the development of hydric soils and ultimately supports and sustains wetland vegetation. Wetland hydrology is provided by a balance of inflows and outflows over time. Inflows are provided by surface water, net precipitation, and groundwater recharge, while outflows occur through evapotranspiration, surface water loss, and groundwater discharge (Cherry 2011).

The USFWS National Wetland Inventory (NWI) maps approximately 53,425 acres of wetlands within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds (Figure 4.10.3-3). Freshwater emergent wetlands are the most dominant wetland type across all three watersheds. Approximately 20 percent of all the wetlands mapped within the three watersheds are located within Quivira NWR. Remaining wetlands mapped by the NWI are dispersed relatively equally throughout the three watersheds. In general, locations of forested/shrub wetlands are closely related to perennial streams mapped by the NHD within riparian areas, and emergent wetlands, lakes, and ponds correspond to predominately agricultural areas (USGS 2019a). Table 4.10.3-2 details the types and amounts of wetlands within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds.

Table 4.10.3-2. National Wetlands Inventory Wetlands Within Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds.

Wetland Type	Acres of Wetland within Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds*
Freshwater Emergent Wetland	34,801
Freshwater Forested/Shrub Wetland	3,274
Freshwater Pond	3,557
Lake	11,793

* Rounded to the nearest whole number.

Wetland Trends in Kansas

In Kansas, by 1980, wetlands decreased from an estimated 841,000 acres to 435,400 acres, which represents a 48 percent loss in total wetland acres (Dahl 1990). The primary cause of wetland losses in Kansas is conversion of wetlands to agricultural production. Irrigation withdrawals causing a depletion in groundwater have also caused wetland losses. In western Kansas, surface water is scarce, and wetlands depend on water from precipitation, streamflow, or shallow groundwater. Wetlands are generally directly associated with a stream (riparian wetland) or may exist as sinks or shallow basins. Some wetlands exist in locations with consistent groundwater discharge (Yuhas 1996).

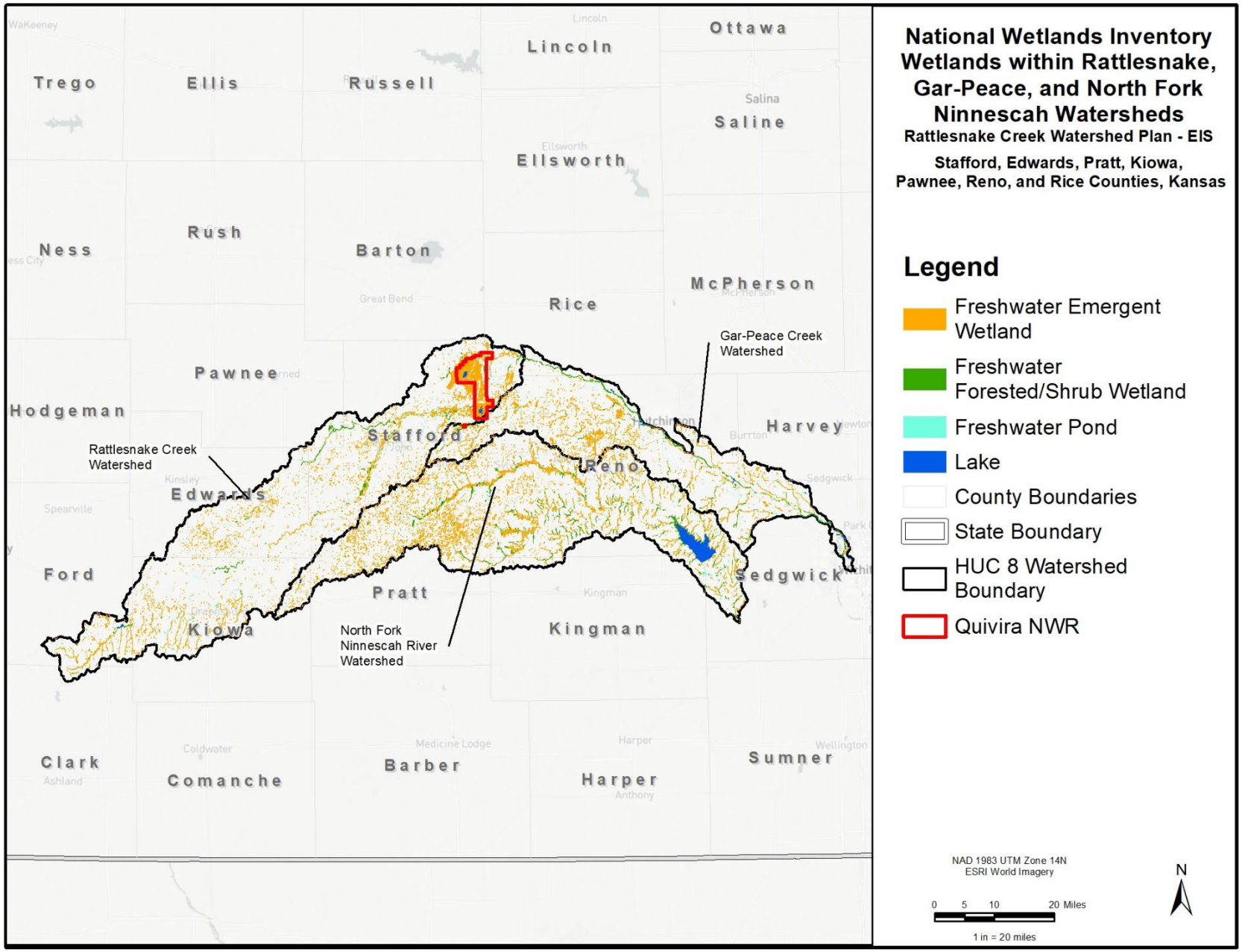

Figure 4.10.3-3. National Wetlands Inventory Wetlands Within Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds.

4.10.4 GMD #5 Water Rights

GMD #5 encompasses approximately 2.5 million acres, including 569,725 authorized irrigated acres, and manages 4,523 water rights with 5,459 points of diversion. The total authorized quantity that these water rights can produce is 768,784 acre-feet of water annually.

The USFWS holds Water Right File Number 7,571 for the management of Quivira NWR. This water right, which is senior in priority to approximately 95 percent of all other water rights in the Rattlesnake Creek Watershed, authorizes the Quivira NWR to divert up to 14,632 AFY of surface water from Rattlesnake Creek. The junior and senior water rights for Rattlesnake Creek are shown in Figure 1.3, Section 1.3.

Table 4.10.4 provides water rights data by response zones described above in Section 1.4 and shown in Figure 1.4-3. Note that response zones to Rattlesnake Creek extend beyond the Rattlesnake Creek Watershed boundary because groundwater does not strictly follow watershed boundaries. The water right holders in Zone A (1,487 water rights), which also includes zones B, C, and D, on average used 73 percent of their water rights between 2012 and 2021. This figure represented 178,949 acre-feet of water used versus their authorized use of 244,541 acre-feet as determined by their water rights. This resulted in 65,592 acre-feet of water rights authorized for use that were not used (KDA-DWR 2022a).

Table 4.10.4. Water Rights Data by Response Zone (KDA-DWR 2022a).

Response Zone	Water Rights (Number)	Water Rights Authorized Use (Acre-feet)	2012-2021 Water Rights Average Use (Acre-feet)	Percent[1] of Water Rights Used	Water Rights Authorized Acres	Average Reported Acres
A	1,487	244,541	178,949	73	221,067	159,132
B	876	138,272	101,657	74	134,410	90,212
C	491	75,796	54,810	72	81,940	49,207
D	275	40,422	28,211	70	48,046	25,876

[1] Average water right use from 2012-2021 divided by the water rights authorized use (acre-feet).

4.10.5 Quivira National Wildlife Refuge Water Management

The landscape and native ecological community conservation goals of Quivira NWR are to (1) actively protect, preserve, manage, and restore the functionality of the diverse ecosystems of the Rattlesnake Creek watershed, and (2) actively conserve and improve environmental conditions within refuge boundaries to promote sustainable ecological communities and support species of concern associated with this region of the Great Plains. Therefore, refuge management considers ecological cycles and species life requirements (USFWS 2013a). Flows within Rattlesnake Creek provide the primary source of water used by Quivira NWR for habitat management. On entry into Quivira NWR near Little Salt Marsh, streamflow from Rattlesnake Creek is diverted through a series of water control structures and distributed to the different wetland units throughout Quivira NWR to meet habitat requirements of target species (USFWS

2013a; USFWS 2017b). Using water control structures, Quivira NWR manages wetland units by controlling the depth and timing of flooding and drawdown (USFWS 2017b), with limitations during periods of extreme high and low flows. Among many factors considered in decision-making are requirements of wildlife food and cover resources (e.g., seed germination, subsequent plant growth), when these need to be available to wildlife (timing of migrations), and various wildlife adaptations and strategies (e.g., foraging water depths, vegetation density). Water control structures employed by Quivira NWR include impoundments, dikes, and canals. Water control structures and wetland units within Quivira NWR are shown in Figure 4.10.5.

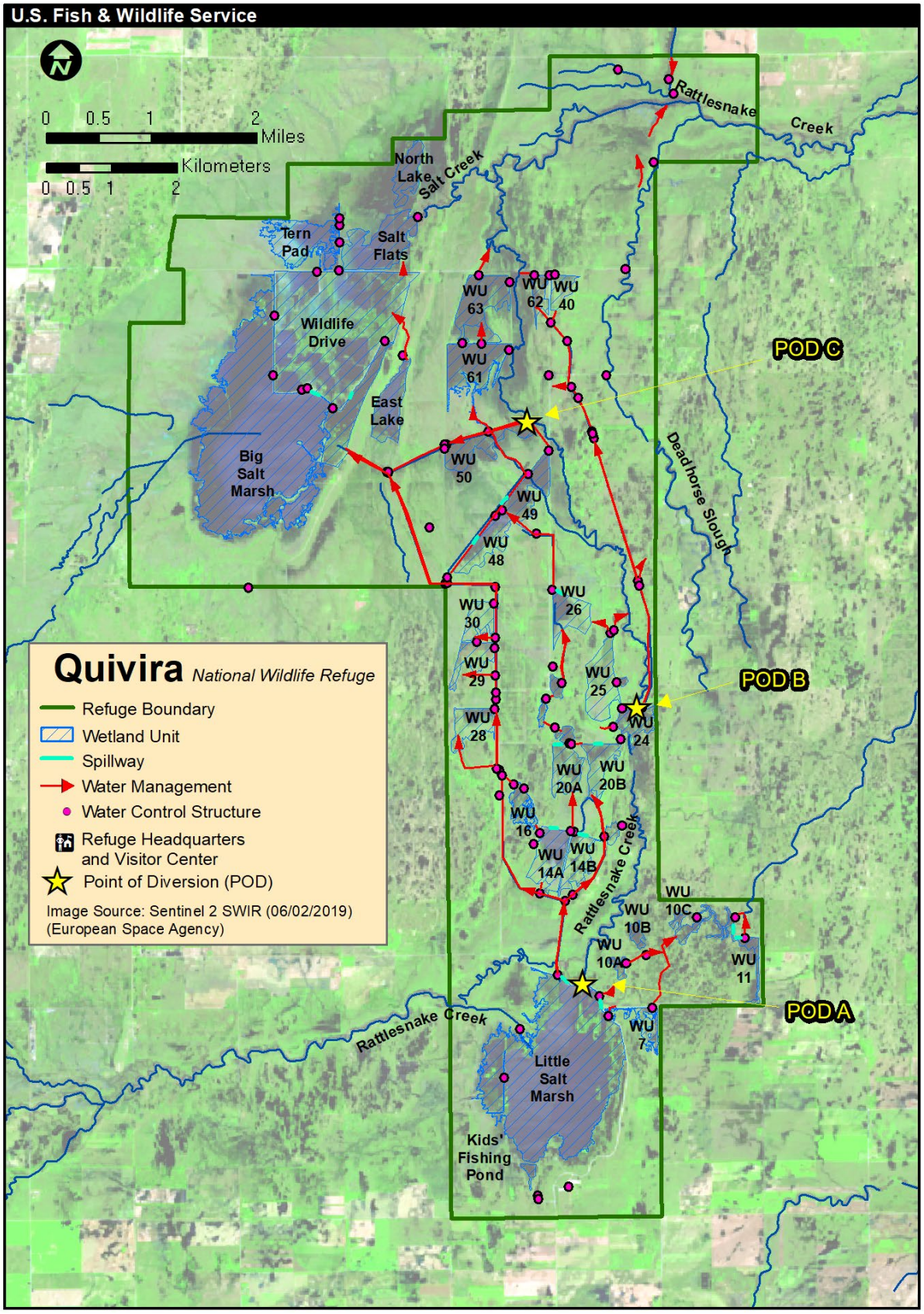

Figure 4.10.5. Quivira National Wildlife Refuge Water Control Structures (USFWS 2013a).

4.11 Regional Water Resource Plans

Kansas Water Authority and the Great Bend Prairie Regional Planning Area

The Kansas Water Authority (KWA) is an advisory board established in 1981 (K.S.A. 74-2622) and is part of the Kansas Water Office. The KWA is comprised of 23 members, including 13 voting members appointed by the governor and legislature. The primary purpose of the KWA is to advise and provide recommendations to the Kansas legislature, governor, and director of the Kansas Water Office on water policy, planning, and expenditures (Kansas Water Office 2022). In 2014, the KWA established 14 Regional Planning Areas (RPAs) and associated Regional Advisor Committees (RACs). RACs within each region are responsible for identifying and prioritizing goals to address water needs and for developing regional action plans to meet these goals (Kansas Water Office 2015).

One of the 14 RPAs established by the KWA is the Great Bend Prairie Planning Region. This RPA encompasses 6,769 square miles and includes the entirety of GMD #5 and a portion of the Arkansas River drainage area. The main priority within the Great Bend Prairie Region is to achieve a long-term, sustainable water supply with the understanding that groundwater supplies 97 percent of water use in the region (Kansas Water Office 2018). As of 2018, regional goals and themes include the following:

- Regional Theme No.1: Water Use Sustainability
  Goal: Achieve water use sustainability (no new net depletions) within the Great Bend Prairie Regional Planning Area that includes a reasonable raising or lowering of the water table based on average weather conditions.
- Regional Theme No. 2: Public Water Supply Training and Technology
  Goal: Maintain annual training funds of 15 percent from the Clean Water Drinking Fee and increase technical training support to public water supply (PWS) systems to enhance new technology and increase water efficiently and effectively, thus reducing water loss. Use available municipal/residential/ commercial irrigation training programs provided by the Irrigation Association.
- Regional Theme No. 3: Monitoring of Industrial Saltwater and Protection of Fresh Waters
  Goal: Enhance the monitoring of poor-quality water to stop and minimize further contamination of fresh water sources. Areas of concern include regions that have saltwater disposal lines, disposal wells, high nitrate levels, and areas with high salt sources.
- Regional Theme No. 4: Research and Development: Alternative Crops and Feed
  Goal: Initiate research and development of alternative feed sources and less water-intensive crops. Technology transfer from this research would have benefits in areas of Kansas where water is not available for production. Multiple research programs such as plant breeding and livestock feeding should be pursued.

- Regional Theme No. 5: Watershed Sustainability

  Goal: Work toward sustainability of watersheds so that flood control capacity is maintained while maintaining streamflow to meet downstream water needs. Progress toward sustainability would be to have 50 percent of the drainage area within watershed districts controlled by watershed structures by 2065. Best available information/data will be evaluated every 10 years to track progress toward meeting this goal.

Kansas Groundwater Management Districts

The Kansas Groundwater Management District Act (KGMDA) recognized the need for and established groundwater management districts (K.S.A. 82a-1020). The management district purposes are as follows:

- Conserve groundwater resources.
- Prevent economic deterioration.
- Achieve associated endeavors within the state of Kansas through the stabilization of agriculture.
- Secure for Kansas the benefit of its fertile soils and favorable location with respect to national and world markets.
- Preserve basic water use doctrine.
- Establish the right of local water users to determine their destiny.

There are five groundwater management districts in Kansas. The GMD #5 district management program was established in 1976 and revised in 1979, 1988, and 2018 (GMD #5 2018). In 1976, the GMD #5 board of directors “recognized the unique nature of the local area and implemented guidelines to protect and conserve the Great Bend Prairie Aquifer.” The 1976 management program called for strict monitoring of water use with flow meters, well spacing requirements, discouragement of water waste, and encouragement of reusing water sources.

In the 1979 management program, a safe yield policy and maximum reasonable quantity for irrigation was implemented to limit groundwater use. Safe yield assures aquifer use does not exceed recharge or replenishment of the aquifer. In 1984, GMD #5 revised the K.A.R. 5-25-4, and the safe yield policy was limited to 3,000 acre-feet in a 2-mile radius. On December 17, 1998, GMD #5 was formally closed to new appropriations or new water rights through another revision to K.A.R. 5-25-4 (GMD #5 2022b).

The 2018 revised management program describes fluctuating water levels and water quality as management issues for GMD #5. Water quality concerns included the following (GMD #5 2018):

- Natural mineral intrusion
- Pollution from oil and gas production
- Pollution from industrial wastes
- Agrichemical pollution

- Unplugged and improperly constructed water wells
- Municipal waste lagoons, animal feedlots, and landfills

To address these concerns the following district programs were identified:

- Conservation and efficient application of water use
- Public education
- Accurate database/geographic information systems (GIS) data management
- Continued research
- Water quality
- Flow meter program
- Water rights administration

Local Enhanced Management Area

To aid in water conservation, a LEMA allows groundwater management districts to set groundwater management districtwide goals and control measures that water right holders within their districts are required to follow. Groundwater management districts were granted authority to create a LEMA by state law in 2012; however, the LEMA must be approved by the KDA-DWR Chief Engineer (KDA-DWR 2018b). A LEMA is required to do the following (KDA-DWR 2018b):

- Propose clear geographic boundaries
- Pertain to an area wholly within the groundwater management district
- Propose goals and corrective control provisions adequate to meet the stated goals
- Give due consideration to water users who already have implemented reductions in water use resulting in voluntary conservation measures
- Include a compliance monitoring and enforcement element
- Remain consistent with state law

The groundwater management district develops the LEMA and submits it to the Chief Engineer for approval. If the Chief Engineer determines that it is acceptable for consideration, then an initial hearing will be held, and ultimately, the Chief Engineer will issue a decision and order (KDA-DWR 2018b).

Intensive Groundwater Use Control Area

The KGMDA included provisions allowing the KDA-DWR Chief Engineer to initiate proceedings for and designate IGUCA. An IGUCA allows the Chief Engineer to implement corrective control provisions in areas where the following occurs (KDA-DWR 2022b):

- Groundwater levels are declining excessively.
- The rate of groundwater withdrawal exceeds the rate of groundwater recharge.
- Unreasonable deterioration of groundwater quality has occurred or may occur.
- Or other conditions exist warranting additional regulation to protect public interest.

An IGUCA is initiated by the KDA-DWR Chief Engineer, and public hearings are completed to determine whether the IGUCA meets the circumstances of Kansas law and whether one or more corrective control provisions should be adopted (KDA-DWR 2009). Based on information presented and evaluated at the public hearings, the IGUCA boundaries and goals are set, and corrective control provisions are determined. The state of Kansas has the burden of proving the need for an IGUCA (KDA-DWR 2009). Additional information on the IGUCA process can be found on the KDA-DWR website, “Summary of Laws and Responsibilities.”

The KDA-DWR Stafford field office covers a region that includes GMD #5 and monitors and regulates the use of water within its boundary (KDA-DWR 2017a). Figure 4.11 shows the closed and restricted areas for groundwater use that are covered by the KDA-DWR Stafford field office. GMD #5 is entirely covered within this boundary. The Equus Beds GMD #2 and Southwest Kansas GMD #3 are located adjacent to GMD #5. There are two existing IGUCAs within the GMD #5 boundary (Pawnee River and Walnut Creek) and one Special Water Quality Use Area (SWQUA; Lyons SWQUA in Rice County). There are three adjacent IGUCA (Arkansas River, Burrton, and McPherson) and one additional nearby SWQUA (Equus Beds; KDA-DWR 2017a).

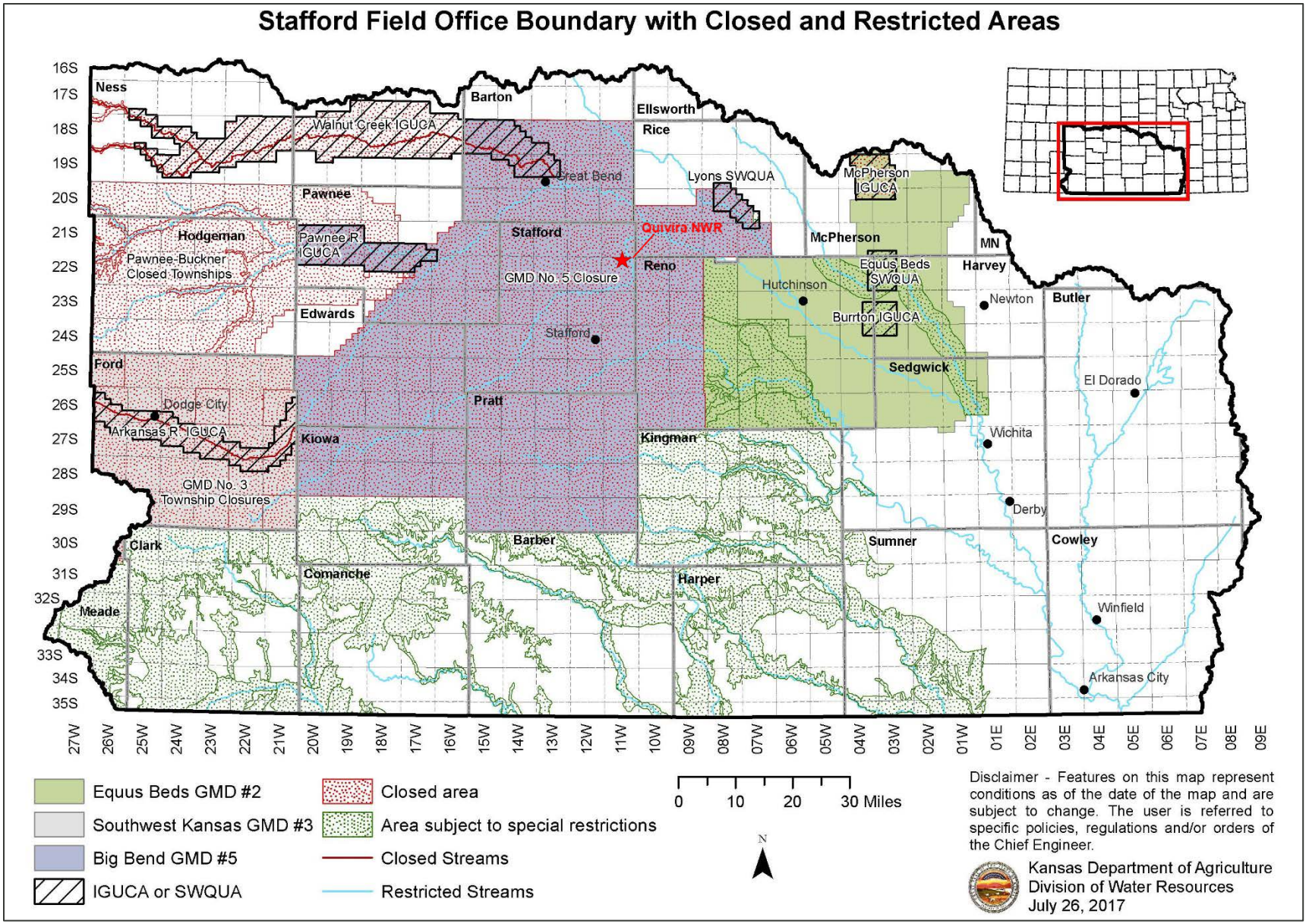

Figure 4.11. Stafford Field Office Boundary with Closed and Restricted Areas (KDA-DWR 2017a).

4.12 Riparian Areas

Riparian areas are defined by the NRCS as transitional zones surrounding water features such as streams, floodplains, and lakeshores (NRCS 2007; NRCS 2012b). Riparian vegetation, including species richness and plant cover, is highly correlated with water table depth (Dwire et al. 2006). Though most commonly associated with aquatic features, riparian areas may be found in any land use area (NRCS 2012b). Their unique vegetation and soil characteristics, which occur as a result of abundant water in the soil, differentiate riparian areas from the surrounding landscape and provide essential ecosystem functions within watersheds and contribute to important regulating ecosystem services (NRCS 2012b; Graziano et al. 2022).

Ecological benefits provided by riparian areas include streambank erosion protection, water quality protection, flood reduction, promotion of biodiversity, and increased nutrient cycling (NRCS 2003a; NRCS 2007). In agricultural areas, such as those typical of southwestern Kansas, the vegetation in riparian areas frequently serves as a filter and buffer by intercepting nutrients and chemical runoff from agricultural fields before it reaches adjacent water resources (Kansas SCC 2000). Though vitally important to these areas, forested riparian buffers have been rapidly declining over the past 150 years because of agricultural development and urbanization (Jones et al. 1999).

In Kansas, there are four different classifications of native riparian areas: riparian meadows, riparian shrublands, riparian woodlands, and riparian forests (Kansas SCC 2000). Riparian meadows are dominated by water-tolerant grasses and forbs including prairie cord grass (*Spartina pectinata*), switchgrass (*Panicum virgatum*), and a variety of sedges, smartweeds, and rushes. Riparian shrublands are typically associated with intermittent streams and are dominated by willows (*Salix* sp.), rough-leafed dogwood (*Cornus drummondii*), and buttonbush (*Cephalanthus occidentalis*). Riparian woodlands occur along perennial streams dominated by trees with understories of grasses and forbs. Trees commonly associated with riparian woodlands include eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*), elms (*Ulmus* sp.), and maples (*Acer* sp.). Riparian forests contain more mature trees than riparian woodlands, with understories of smaller trees, shrubs, and vines. Trees commonly associated with riparian forests include silver maple (*Acer saccharinum*), eastern cottonwood, black walnut (*Juglans nigra*), green ash (*Fraxinus pennsylvanica*), elms, and American sycamores (*Platanus occidentalis*).

Native riparian vegetation within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds has been largely displaced by invasive species including salt cedar, Russian olive, and phragmites (*Phragmites australis*; USFWS 2013a). Additional information on invasive species can be found in Section 4.14.

The geographic scope of analysis for riparian areas includes the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds. The riparian zone was classified as land

within a 100-foot buffer on each side of NHD-mapped streams. Forested riparian areas included the deciduous forest, woody wetlands, and scrub/shrub NLCD land cover classifications, totaling 6,445 acres within the geographic scope. All other land cover classifications within the riparian zone were designated as nonforested riparian areas, totaling 72,401 acres within the geographic scope. Riparian areas are primarily associated with Rattlesnake Creek, Peace Creek, North Fork Ninnescah River, and their respective tributaries and headwaters.

4.13 Fish and Wildlife Resources

The Fish and Wildlife Coordination Act (FWCA) assures that the conservation of fish and wildlife species within the U.S. and its territories is taken into consideration during the planning, development, and maintenance of any water resource development project (16 USC 661-667e, Ch. 55 as amended). PL 83-566 projects are local projects installed with federal assistance and are exempt from the provisions of the FWCA; however, PL 85-624, which contained the 1958 amendments to the FWCA, added Section 12 to PL 83-566. Section 12 (16 USC Section 1008) applies the principles of the FWCA to the PL 83-566 program. A Section 12 consultation letter was sent to USFWS on October 9, 2024. A response was received on October 31, 2024. The letters are included in Appendix A.

The geographic scope of analysis for fish and wildlife resources includes the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds. These areas are located in the Central Great Plains ecoregion (EPA 2013) and include multiple habitat types that support a diverse array of fish and wildlife species that contribute to supporting ecosystem services. Though the Central Great Plains ecoregion was historically dominated by native grasslands with scattered trees and shrubs, much of the ecoregion has been converted to cropland (EPA 2001).

4.13.1 Existing Plant and Animal Communities of the Central Great Plains

Existing plant and animal communities within the Central Great Plains ecoregion have been significantly altered by agricultural practices (EPA 2001). Historically, the sand and mixed-grass prairies of the Central Great Plains were widespread and dominated by native perennial grasses including big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), switchgrass, and Indian grass (*Sorhgastrum nutans*). A large variety of forbs is also a significant component of sand and mixed-grass communities; examples of common sand or mixed-grass prairie forbs include asters (*Symphyotrichum* spp.), sunflowers (*Helianthus* spp.), and coneflowers (*Echinacea* spp.; World Rangeland Learning Experience 2022). More locally, species including sand bluestem (*Andropogon hallii*), sand dropseed (*Sporobolus cryptandrus*), and sand lovegrass (*Eragrostis trichodes*) were historically common in south-central Kansas (KDWP 2015b).

Both saltwater and freshwater wetlands are present within the Central Great Plains ecoregion. In freshwater marshes, vegetation is typically tall and dense and is dominated by prairie cordgrass, sedges, and cattails (*Typha spp.*). In salt marshes, vegetation is dominated by inland

salt grass and seepweed (*Suaeda depressa*), but other grasses, forbs, sedges, and spikerush (*Eleocharis* spp.) are present. Salt marsh vegetation is usually of low to medium height (KDWP 2015b). Wetland and upland plant communities are directly influenced by groundwater availability and interactions. Natural seeps and springs are present in this area of Kansas; the most common type is called a contact spring. In a contact spring, the groundwater moves down the slope through permeable rock until it reaches a location where the rock has been exposed to the atmosphere by erosion. Artesian springs, where water is forced to the surface by pressure, as opposed to gravity, were more common in the state before heavy pumping lowered the water table, which lessened the pressure (KDWP 2015b).

Animal communities within the Central Great Plains are dominated by a variety of large herbivores, small mammals, birds, and insects. Though a variety of large herbivores, including the American bison (*Bison bison*), were once common throughout much of the Central Great Plains, most native grazers have been extirpated (World Rangeland Learning Experience 2022). Today, dominant herbivores and grazers within south-central Kansas are domestic livestock and white-tailed deer (*Odocoileus virginianus*). Other common mammal species present today include various species of fox (*Vulpes vulpes*), coyotes (*Canis latrans*), raccoons (*Procyon lotor*), skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), and mice (*Peromyscus* spp.; Gress 2017).

Amphibians and reptiles in the Central Great Plains are generally adapted to sandy soils and many have some association with surface water habitats (e.g., egg-laying; food resources). Examples of common species include the yellow mud turtle (*Kinosternon flavescens)*, plains spadefoot (*Spea bombifrons)*, common lesser earless lizard (*Holbrookia maculata)*, boreal chorus frog (*Pseudacris maculata)*, great plains toad (*Anaxyrus cognatus),* and plains garter snake (*Thamnophis radix*; FHSU 2022).

Areas within the Central Great Plains (specifically the Quivira NWR) are major migratory bird rests and resource areas for waterfowl, shorebirds, and blackbirds. Interior least terns (*Sterna antillarum athalassos*) are known to successfully nest at Quivira NWR, and numerous other species of state and federal importance occur within this area, which also includes federally designated critical habitat for the whooping crane (KDWP 2015b). Additional information about bird species is available in section 4.16.

4.13.2 Quivira National Wildlife Refuge

Quivira NWR is the largest and most significant wildlife resource within the project area (Figure 3.0). Quivira NWR is a nationally and internationally recognized conservation area and is designated as a Ramsar Wetland of International Importance, a Western Hemisphere Shorebird Reserve Network site, and a Globally Important Bird Area (USFWS 2013a). Quivira NWR was also selected as one of the Eight Wonders of Kansas by the Kansas Sampler Foundation (USFWS 2013a).

Two of the main public attractions at Quivira NWR are spring and fall bird migrations. During migration events, more than 100 species of waterbirds (and hundreds of thousands of individual birds), including several federally listed threatened and endangered species and other rare birds, use Quivira NWR for migration habitat (USFWS 2013a). Though most well-known for its diversity of birds, Quivira NWR also provides habitat for a variety of mammals, reptiles and amphibians, fish, and other wildlife including crayfish and pollinators. Species inventory lists for Quivira NWR indicate occurrences of more than 300 birds, more than 200 moths, more than 60 butterflies, 27 dragonflies, 26 mammals, 32 reptiles and amphibians, 20 fishes, and at least six mollusks as of 2022 (USFWS personal communication 2022).

In addition to wildlife habitat, Quivira NWR also includes hundreds of different plant species across various vegetation habitat types. Herbaceous emergent wetlands dominate much (approximately 49 percent) of the landscape at Quivira NWR (USFWS 2013a). Within herbaceous wetland complexes, dominant species include inland saltgrass, prairie cordgrass, prairie bulrush (*Bolboschoenus maritimus*), spikerush, cattails, three-square bulrush (*Schoenoplectus pungens*), barnyard grass (*Echinochloa crus-galli*), smartweeds (*Polygonum sp.)*, sago pondweed (*Stuckenia pectinata*), and stoneworts (*Chara sp*.). Approximately 22 percent of Quivira NWR is classified as grassland, where dominant warm-season grasses include big bluestem, sand bluestem, little bluestem, switchgrass, and Indian grass. Shrublands and woodland areas, combined, comprise approximately 11 percent of Quivira NWR. Management supports native communities, such as plum (*Prunus* spp.) and cottonwood-willow (*Populus-Salix*) complexes, and continues to reduce cover of invasive species, such as salt cedar, locust (*Robinia* spp.), and Russian olive (USFWS 2013a).

4.14 Invasive Species

Invasive species are defined in Executive Order 13112 (February 3, 1999), as an alien species including species that are not native to a particular continent as well as not native to a particular ecosystem. They are frequently found in areas that have recently been disturbed by human development. The Midwest Invasive Species Information Network (MISIN) tracks the number of invasive species found throughout the Midwest, including Kansas (MISIN 2020).

The geographic scope of analysis for invasive species includes the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds. According to the MISIN (2020) and Kansas Department of Wildlife and Parks (KDWP; 2022a), central Kansas contains numerous invasive plants, fishes, and invertebrates. Of particular concern, particularly within Quivira NWR and the Rattlesnake Creek Watershed, are invasive tree species including salt cedar, Russian olive, and eastern red cedar (*Juniperus virginiana*; USFWS 2013a) and the invasive plant species phragmites (KDWP 2022c). Once established, salt cedar and Russian olive are difficult to remove and readily regrow following cutting and/or burning. Eastern red cedar, native to Kansas, has become a nuisance species because of the lack of prescribed burning that would

have historically occurred in the prairie ecosystem. In the absence of regular burning, eastern red cedar dominates the landscape and quickly displaces native prairie vegetation and wildlife (Rice 2016). Phragmites is a tall, perennial, invasive grass that can reach more than 15 feet in height. It is a fast-growing plant that consumes available growing space by forming dense stands that prevent native plants from growing. This is an issue for wetlands because of the dense growth that can reduce available habitat and foraging areas for birds and fish (KDWP 2022c).

4.15 Threatened and Endangered Species

Federally listed threatened and endangered species are protected under the Endangered Species Act (ESA) of 1973, as amended (16 USC 1531 et seq.). Any adverse effects on federally listed species and/or their habitat requires consultation with the USFWS under Section 7 of the ESA. Section 7 requires federal agencies to make sure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of proposed, endangered, or threatened species or result in the destruction or adverse modification of their critical habitat (USFWS 1973). Threatened and endangered species represent supporting ecosystem services through their ability to support biodiversity resilience. Listed species in Kansas are protected under the Kansas Nongame and Endangered Species Conservation Act of 1975. This act empowers KDWP, through statutes and regulations, to identify and carry out appropriate conservation measures for listed species. KDWP is required to issue special action permits, following environmental review, for activities that may affect state threatened or endangered species. Action permits include special conditions to offset negative impacts on listed species and/or critical habitats (KDWP 2022b).

The geographic scope of the analysis for federally listed species includes the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds. An official USFWS species list was first requested on December 28, 2022, and received via email on January 10, 2023. The list contained 14 ESA-listed species. Because of changes associated with the Project, a second official USFWS species list was requested on April 3, 2023, and received via email on April 11, 2023. This updated species list contained 16 ESA-listed species. An additional request for an updated species list was sent to USFWS on April 3, 2024, and a response was received on April 25, 2024. The updated species list had two changes (one species was removed and one was added) and remained at 16 ESA-listed species. A final species list was received from USFWS via email on August 29, 2025, during coordination for the BA. This list contained 19 species. On August 12, 2025, the U.S. District Court for the Western District of Texas vacated and remanded the USFWS 2022 rule listing the lesser prairie-chicken (*Tympanuchus pallidicinctus*) under the ESA (U.S. District Court for the Western District of Texas 2025), therefore, this species is not included in the EIS. Email communication from USFWS is provided in Appendix A. The KDWP lists state threatened and endangered species for Stafford, Edwards, Pratt, Kiowa, Pawnee, Reno, and Rice counties (KDWP 2022b). Both

agencies were contacted to assess potentially threatened and endangered species in the watersheds. Table 4.15-1 identifies state and federally listed threatened and endangered species that may occur within the geographic scope of analysis. Table 4.15-2 lists state threatened or endangered species that could occur within Stafford, Edwards, Pratt, Kiowa, Pawnee, Reno, and/or Rice counties.

Table 4.15-1. Federally and State-listed Species in the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds.

Common Name	Scientific Name	Status	Habitat
Little Brown Bat	*Myotis lucifugus*	FC	Hibernates in caves and mines over winter and roosts in trees, human-made structures, under rocks, and in piles of wood in summer. Forages over streams and bodies of water and in woodlands near water.
Northern Long-eared Bat	*Myotis septentrionalis*	FE	Migrates from winter caves and mines to summer roost trees. Roosts in live or dead trees with diameters at breast height greater than 3 inches. Prefers mature upland forests near stream corridors for foraging, but the species also uses open spaces such as small forest clearings, water, and along roads.
Tricolored Bat	*Perimyotis subflavus*	FPE	Roosts among live and dead leaf clusters in live or recently dead deciduous trees during nonhibernating seasons. Has been observed summer roosting among pine needles, in eastern red cedar, and a variety of artificial roosts. Forages at treetop level or above. Hibernates in caves and mines, but may also use culverts, tree cavities, and abandoned wells where caves are sparse.
Hoary Bat	*Lasiurus cinereus*	Discretionary Review	Hoary bats are solitary and typically prefer trees in a variety of settings such as heavy forests, open wooded glades, edges of clearings, and shade trees along urban streets and/or parks. They prefer dense leaf coverage and an open area below and have been known to occupy other species' nests. Hoary bats forage along streams, lake shores, treetops and in urban areas, sometimes associating with other bat species.
Cave Myotis	*Myotis velifer*	Discretionary Review	Cave myotis primarily roost in caves, mines, and similar underground structures and forage at night over nearby rivers, wetlands, grasslands, and agricultural areas.
Eastern Black Rail	*Laterallus jamaicensis ssp. jamaicensis*	FT	Inhabits salt, brackish, or freshwater marshes and wetlands with dense vegetative cover.
Eskimo Curlew	*Numenius borealis*	FE	Nests in tundra areas in Alaska and northwestern Canada and winters in South American grasslands. Spring migration through the central U.S. Considered extirpated in Kansas.

Common Name	Scientific Name	Status	Habitat
Piping Plover	*Charadrius melodus*	FT, ST	Require sparsely vegetated, shallow wetlands and open beaches and sandbars adjacent to or within streams and impoundments.
Red Knot	*Calidris canutus rufa*	FT	Uses marine and estuarine coastal habitats for wintering and migration, including tidal flats with exposed sediments in sheltered bays and lagoons. May use inland saline lakes as migration stopover habitat. Nests in dry, upland tundra areas near freshwater wetlands.
Whooping Crane	*Grus americana*	FE, SE	Uses wetlands, coastal marshes, estuaries, inland marshes, lakes, ponds, wet meadows, rivers, and agricultural fields for breeding, foraging, and wintering. Migrates in the spring and fall between central Canada and the Texas coast. Prefers shallow, seasonally inundated wetlands for foraging and roosting. U.S. Fish and Wildlife Service (USFWS) and Kansas Department of Wildlife and Parks (KDWP) designated Quivira National Wildlife Refuge (NWR) as critical habitat for this species.
Peppered Chub	*Macrhybopsis tetranema*	FE, SE	Lives in permanent, fast-flowing rivers and streams with bottoms of fine sand.
Arkansas River Shiner	*Notropis girardi*	FT, SE	Occupies main channels of wide, shallow rivers and larger streams within the Arkansas River Basin. Avoids calm waters and silted stream bottoms, preferring bottoms of clean, fine sand.
Iowa Skipper	*Atrytone arogos iowa*	FC	Primary habitat includes undisturbed mixed-grass and tallgrass native prairie. Iowa skipper is considered a biological indicator of high-quality prairie habitat. Adults rely on big and little bluestem as host plants for reproduction.
Monarch Butterfly	*Danaus plexippus*	FPT	Lives mainly in prairie, meadow, and grassland habitat and roadside areas across North America. Adults feed on the nectar of a variety of flowers but are reliant on milkweed as a host plant for reproduction.
Western Regal Fritillary	*Argynnis idalia occidentalis*	FPT	Occurs in tallgrass and mixed-grass prairies in the Great Plains and meadows and wetlands east to the Atlantic coast.
American Bumble Bee	*Bombus pensylvanicus*	FC	Prefers to inhabit areas of farmland and open fields. Nesting takes place underground or below grasses.
Southern Plains Bumble Bee	*Bombus fraternus*	FC	Typically associated with remnant prairie habitats and urban gardens.

Common Name	Scientific Name	Status	Habitat
Variable Cuckoo Bumble Bee	*Bombus variabilis*	FC	The variable cuckoo bumble bee occurs in native and semi-natural grasslands and prairie landscapes where its host (American bumble bee) is present. This species relies on intact flowering habitats for foraging while parasitizing host nests for reproduction.

FE = Federally Endangered; FT = Federally Threatened; FPE = Federally Proposed Endangered; FPT = Federally Proposed Threatened; FC = Federal Candidate; SE = State Endangered; ST = State Threatened

Table 4.15-2. State-listed Only Species in Stafford, Edwards, Pratt, Kiowa, Pawnee, Reno, and Rice Counties.

Common Name	Scientific Name	Status	Habitat
Least Tern	*Sternula antillarum*	SE	Inhabits barren areas near water, such as salt flats, riverine sand bars, and impoundment shorelines.
Snowy Plover	*Charadrius alexandrines*	ST	Found in central and southwestern Kansas in open areas near water. Favors wetlands, salt flats, river beaches, and sand bars for nesting and foraging. Kansas Department of Wildlife and Parks-designated critical habitat for the species includes all wetlands within Quivira National Wildlife Refuge.
Plains Minnow	*Hybognathus placitus*	ST	Can be found in rivers and streams with variable flow rates and sandy bottoms.
New Mexico Threadsnake	*Rena dissecta*	ST (Kiowa)	Inhabits ant burrows and moist areas of loose soil or sand with rocks to provide cover. Restricted to the southernmost Kansas counties along the Oklahoma border.
Strecker's Chorus Frog	*Pseudacris streckeri*	ST (Pratt)	Inhabits shallow pools filled with wetland vegetation. Prefers habitat where fish are not present and water quality is high. The northern edge of this species' range is located in southern Kansas.

SE = State Endangered; ST = State Threatened

Little Brown Bat

The little brown bat (*Myotis lucifugus*) is currently under review as a candidate for listing under the ESA. It ranges across much of the U.S., except for some central and extreme southern areas (USFWS 2022c). Historically it was known to occur in the eastern two-thirds of Kansas but was likely never abundant because of the lack of suitable hibernacula. Most records in Kansas were associated with a single hibernaculum in Marshall County. There have been few, if any, documented records in the state since the 1960s (Schmidt et al. 2021). The little brown bat uses caves and mines for hibernation and trees, human-made structures, bat houses, rocks, and wood piles during nonhibernating periods. Maternity roosts are commonly in warm locations in human-made structures and less commonly, hollow trees. Foraging habitat consists of

streams and bodies of water and associated nearby woodlands. This once-abundant species has experienced a severe population decline because of white-nose syndrome and is also threatened by mortality associated with wind energy projects (USFWS 2022c).

Northern Long-eared Bat

The northern long-eared bat (*Myotis septentrionalis*) was listed as an endangered species under the ESA in a final rule published on November 29, 2022 (87 FR 73488), which became effective on March 31, 2023. It has a range spanning much of the central and eastern U.S. (USFWS 2022d). In Kansas, it has historically been found in the north-central and northeastern regions of the state near the Saline and Blue rivers but has the potential to occupy most of Kansas (Schmidt et al. 2021). The northern long-eared bat relies on caves and mines for hibernation during the winter. The loose bark of large trees, snags, and cavities or crevices in trees serve as summer roosting habitat for this species. Foraging takes place in the understory of upland forest tracts for both flying insects and motionless insects on vegetation and water surfaces. Threats to this species include disease (white-nose syndrome) and habitat loss (USFWS 2022d).

Tricolored Bat

The tricolored bat (*Perimyotis subflavus*) was proposed for listing as an endangered species under the ESA on September 14, 2022 (87 FR 56381). Its known range includes 39 states in the eastern and central U.S. (USFWS 2022e). In Kansas, it has been documented primarily in the eastern two-thirds of the state, but a specimen has been obtained in far-western Kansas along the Colorado state line (Schmidt et al. 2021). The tricolored bat typically roosts in clusters of live or dead leaves on live or recently dead deciduous hardwood trees. It has also been observed roosting in pine trees or eastern red cedars and on a wide variety of human-made structures (barns, porch roofs, bridges, etc.). Females have shown high fidelity to summer roosting locations from year to year. Foraging typically takes place at treetop level or above. During hibernation, caves and mines are typically used, but in areas where caves are sparse the tricolored bat may hibernate in culverts or occasionally tree cavities or abandoned wells. High site fidelity for hibernacula has also been observed. The primary threat to this species is range-wide population decline because of white-nose syndrome (USFWS 2022e).

Hoary Bat

The hoary bat (*Lasiurus cinereus)* is not currently protected under the ESA. The species will undergo a discretionary status review that is tentatively planned for 2027. A discretionary status review is conducted to make sure that the species has the appropriate level of protection under the ESA and to determine whether the species should be classified differently (USFWS 2019a). Threats to the hoary bat include mortalities related to wind-energy facilities and habitat loss (Bat Conservation International 2021; Anderson 2002). It is considered to be one of the most widespread species of bats in the Americas. The known range of the hoary bat includes all 48 states in the contiguous United States. As a migratory bat, hoary bats range from the tree limit in Canada all the way to Guatemala in Central America. They are rare in most of the eastern

United States and northern Rockies and common in the Pacific Northwest and prairie states. During breeding and migration in the spring and fall seasons, hoary bats can be seen flying in large groups (Anderson 2002). Hoary bats are considered common across North America, but large numbers of fatalities at wind farms have raised concern about the species (Bat Conservation International 2021).

Cave Myotis

The cave myotis (*Myotis velifer*) is under discretionary review for being a listed species. This species ranges from Honduras north to the California-Nevada border and east to Kansas (FHSU 2018). In Kansas, this species was historically restricted to the south-central Red Hills region roosting caves, but human settlement introduced warmer roost sites in old buildings, especially barns, which support faster development of young and have facilitated northward expansion (FHSU 2018). Cave myotis are aerial insectivores that consume a diverse range of insects, including moths, weevils, antlions, small beetles, and flying ants. Their tendency to form large colonies makes them highly vulnerable to disturbance by humans (Bat Conservation International 2025). Kansas populations are non-migratory and forage primarily over water with two activity peaks, early evening and just before dawn. Copulation occurs in October, fertilization peaks in April, and females produce a single young in late June or early July; young are volant at three weeks and weaned by six weeks (FHSU 2018).

Eastern Black Rail

The eastern black rail (*Laterallus jamaicensis jamaicensis*) was listed as a threatened species under the ESA in a final rule published on October 8, 2020. The listing included a final 4(d) rule and determined that the designation of critical habitat was not prudent for this species (85 FR 63764; 50 CFR 17.41[f]). Throughout its range, the species is found in marshes and wetland areas that range in salinity from salt to brackish to fresh. Inhabited marshes are densely vegetated, with room to allow movement beneath the canopy (USFWS 2022f). In Kansas, the species can occur statewide in wet meadows or meadows associated with marshes, particularly at the Cheyenne Bottoms Wildlife Area and Quivira NWR (KDWP 2022b). Primary threats to this species include habitat loss and changes in hydrology (USFWS 2022f).

Eskimo Curlew

The Eskimo curlew (*Numenius borealis*) was listed as an endangered species under the ESA in a final rule published on March 11, 1967 (32 FR 4001). The species nested in tundra habitat in arctic areas of Alaska and northwestern Canada and wintered in grasslands in South America. Spring migrations passed through the central U.S. to return to nesting grounds in the Arctic. According to the Alaska Department of Fish and Game (ADFG), the current population is estimated to be less than 50 individuals, and it is likely that the species is extinct. The last confirmed sighting in the Great Plains was in Nebraska in 1987 (NGP 2023). In Kansas, the historical migration occurred over the eastern two-thirds of the state; the last verified

observation of the bird within the state was in 1902 (KDWP 2022b). The main threat to this species is habitat loss (ADFG 2022).

Least Tern

The least tern (*Sternula antillarum*) was listed as a Kansas state endangered species in 1987. The species inhabits barren areas near water, such as salt flats, riverine sand bars, and impoundment shorelines (KDWP 2023a). This species is a Kansas summer resident and has been recorded nesting in central and western portions of the state, Jeffrey Energy Center (northeast Kansas), and along the Kansas River (KDWP 2023a). Main threats to this species throughout the state include habitat loss (KDWP 2023a). Kansas has designated all lands and waters within Quivira NWR as critical habitat (KDWP 2023a). USFWS removed the inland population of this species from the ESA on February 12, 2021, because of successful increases in the species range and abundance over the past 30 years (USFWS 2023a).

Piping Plover

The piping plover (*Charadrius melodus*) was federally listed under the ESA in a final rule published on December 11, 1985. Under this rule, the Atlantic Coast and Northern Great Plains populations were listed as threatened and the Great Lakes Watershed population was listed as endangered (50 FR 50726). Inland populations of piping plovers nest on river sandbars or unvegetated shorelines of reservoirs and alkaline lakes. Foraging takes place on sandy mud flats or in ephemeral pools with abundant invertebrates (USFWS 2022g). In Kansas, piping plovers can occur statewide as rare migrants. Nesting has been observed on sandbars along the Kansas River, and KDWP has designated all waters along the mainstem of the Kansas River from Geary County to Wyandotte County as state critical habitat. USFWS has not designated critical habitat for piping plovers in Kansas (KDWP 2022b). The main threats to this species include habitat loss, modification of rivers, and agricultural development (USFWS 2022g).

Red Knot

The red knot (*Calidris canutus rufa*) was listed as a threatened species under the ESA in a final rule published on December 11, 2014 (79 FR 73705). The species is a long-distance migrant that breeds in dry, sparsely vegetated areas of the Canadian Arctic and uses migration and wintering areas along the coasts of the Atlantic Ocean and the Gulf of Mexico. Preferred habitat in these areas includes coastal areas along oceans or bays and tidal flats with exposed sediment in sheltered bays and lagoons. Saline aquatic habitat in the central U.S. and Great Plains is known to be used as stopover habitat during migration. In Kansas, the species has been documented in Barton, Rice, Reno, and Stafford counties, but these areas were not included in the critical habitat proposed on July 15, 2021 (USFWS 2022h; 86 FR 37410). Habitat loss is the main threat to this species (USFWS 2022h).

Snowy Plover

The snowy plover (*Charadrisu alexandrinus*) was listed as a Kansas state threatened species in 1987. The species inhabits open salt flats, river beaches, sand bars, and wetlands. It is a regular but uncommon migrant and summer resident in Kansas, nesting in scattered locations in the central and southwestern parts of the state where suitable habitat occurs. All wetlands within the Quivira NWR in Reno, Rice, and Stafford counties are designated as critical habitat (KDWP 2022b). The main threat to this species includes habitat loss (KDWP 2022b).

Whooping Crane

The whooping crane was listed as an endangered species under the ESA on March 11, 1967 (32 FR 4001). Results of a survey conducted over winter 2017-2018 provided an estimate of 505 individuals in the Aransas-Wood Buffalo population, the self-sustaining wild population that migrates between Texas and Canada (Butler and Harrell 2018). During winter months, whooping cranes reside near the Texas coast in salt flats and marshes, feeding on crayfish, macroinvertebrates, and clams (TPWD 2022). The species spends the summer months in marshes, wetlands, and salt flats in central Canada, feeding on large insects, amphibians, minnows, and berries. Whooping cranes migrate biannually, north in March-April and south in October-November (KDWP 2022b). Their migration crosses six states in the Great Plains, including Kansas (Niemuth et al. 2018; Figure 4.15). Stopovers during the journey at wetlands, ponds, and flooded agricultural fields are necessary to feed and rest (Pearse et al. 2020). Quivira NWR, which is within the project area, is located in the central zone of the whooping crane migration corridor (Figure 4.15). The refuge was designated as protected Critical Habitat for the whooping crane on May 15, 1978 (50 CFR 17.95[b]). The refuge provides a unique combination of rare habitats, inland salt marsh, and sand prairie; this combination makes Quivira NWR a vital stopover location for whooping cranes during migration (USFWS 2022a). Present-day threats to this species include habitat loss, agricultural development, river flow reductions, and climate change (USFWS 2023c).

Arkansas River Shiner

The Arkansas River shiner (*Notropis girardi*) was federally listed as threatened under the ESA 1998 (63 FR 64772), the Arkansas river shiner is also classified as endangered by the State of Kansas. The species is known to occupy the main channels of rivers and larger streams that are wide and shallow with sandy bottoms. Calm waters with silted bottoms are avoided (USFWS 2022i). In Kansas, the Arkansas River shiner historically occurred throughout the mainstem of the Arkansas River and the basins of its tributaries. Currently, it is only thought to occur in limited reaches of the Lower Arkansas, Salt Fork Arkansas, and Cimarron river basins. This range restriction has been caused by a decline in streamflow (KDWP 2022b). USFWS has designated much of the mainstem of the Arkansas River, from its confluence with the Pawnee River near Larned, Kansas, to the Kansas/Oklahoma state line in Cowley County, as critical habitat. This includes areas of Barton, Cowley, Pawnee, Reno, Rice, Sedgwick, and Sumner

counties that are crossed by the Arkansas River (70 FR 59808). Main threats to this species include habitat degradation, channelization, and groundwater pumping (USFWS 2022i).

Peppered Chub

The peppered chub (*Machrybopsis tetranema*) was listed as a Kansas state endangered species in 1987 as the speckled chub, prior to a taxonomic name change in 1999 to the current species name. Effective March 30, 2022, the peppered chub was listed as an endangered species under the ESA (87 FR 11188). The species prefers shallow channels of permanent streams with flowing current over a substrate of clean, fine sand. Areas of calm water and silted bottoms are avoided. Critical habitat has been designated by KDWP in several rivers in the Lower Arkansas River basin in south-central Kansas, including the mainstems of the Arkansas and Ninnescah rivers in Rice, Reno, and Pratt counties (KDWP 2022b). Federal critical habitat, designated on February 28, 2022, included approximately 872 river miles in New Mexico, Oklahoma, and Texas. Approximately 197 river miles of critical habitat in Kansas in the Cimarron and Arkansas/Ninnescah rivers was included in the proposed rule but was excluded from the final rule based on the existence of private or nonfederal conservation plans. In 2021, the secretary of KDWP signed a programmatic Safe Harbor Agreement and Candidate Conservation Agreement with Assurances with USFWS, which covered 14 aquatic species including the peppered chub (87 FR 11188; 50 CFR 17.95[e]). Primary threats to this species include river fragmentation and water quality degradation (USFWS 2023d).

Plains Minnow

The plains minnow (*Hybognathus placitus*), listed as a Kansas state threatened species in 2003, was once a predominant fish species in several Kansas rivers. In recent years, it has become relatively scarce among the fish assemblages in the Republican, Smoky Hill, and Arkansas rivers. Variable water flow rates are an essential part of the plains minnow's life cycle, with spawning triggered by high summer flows. The species prefers sandy substrates and is partly herbivorous. Critical habitat has been designated in rivers across Kansas, including the South Fork Ninnescah River in Pratt County (KDWP 2022b). Main threats to this species include alteration of streamflow because of groundwater mining and surface water diversions (KDWP 2022b).

American Bumble Bee

The American bumble bee (*Bombus pensylvanicus*) is currently a candidate for federal listing under the ESA following a 90-day finding published on September 29, 2021 (86 FR 53937). The American bumble bee was once the most abundant and widespread bumble bee species in North America until impacts from pesticides, habitat loss, climate change, and disease resulted in the reduction of the population by 89 percent (USFWS 2023e). This species inhabits areas of farmland and open fields and nests underground or in dense clumps of grass on the ground surface (USFWS 2023e). The northern range of this species has drastically been reduced, but sightings are still common in southern portions of the U.S. (Florida, west to Colorado, Texas,

and New Mexico; USFWS 2023e). This species occurs throughout the state of Kansas, including Quivira NWR; however, sightings are more common in the eastern half of the state (Bumble Bee Atlas 2023).

Iowa Skipper

The Iowa skipper (*Atrytone arogos iowa*) is currently a candidate for federal listing under the ESA following a 90-day finding published on October 8, 2024 . The Iowa skipper is a western subspecies of the arogos skipper (*Atrytone arogos*) and is a mixed-grass and tallgrass prairie specialist and a biological indicator of high-quality prairie habitat (CFFS 2023). In Kansas, this species is listed as a Species of Greatest Conservation Need (SGCN) and is primarily concentrated in large tracts of prairie habitat within the Flint Hills region; however, it can also be occasionally found in smaller prairie patches across the state (KDWP 2015b; CFFS 2023). Recent records (from the past 20 years) of Iowa skippers have been documented in Anderson, Chase, Douglas, and Sedgwick counties. Primary threats to this species include habitat loss and degradation (KDWP 2015b; CFFS 2023).

Monarch Butterfly

The monarch butterfly (*Danaus plexippus*) was proposed for listing as a threatened species with protective regulations (4[d] rule) under the ESA on December 12, 2024 (89 FR 100662). The species occurs across the U.S. and completes yearly migrations to overwinter habitat in central Mexico and coastal California. Monarchs are found in a wide variety of habitats where they feed on the nectar of a range of flowering plants but are dependent on milkweed (*Asclepias spp.)* as a host plant for their eggs (USFWS 2022j). The main threats to this species include habitat loss, degradation, and agricultural development (USFWS 2022j).

Western Regal Fritillary

The western regal fritillary (*Argynnis idalia occidentalis*) was proposed for listing as a threatened species under the ESA on August 6, 2024 (89 FR 63888). Historically, the species occupied tallgrass and mixed-grass prairies in the northern and central Great Plains and eastward to the Atlantic Coast in meadows and wetlands. In recent decades, the eastern subspecies of the regal fritillary has almost entirely disappeared from the eastern half of its range because of habitat loss and the western subspecies is currently restricted to native prairie remnants in the Great Plains. In Kansas, the western regal fritillary is considered locally common in undisturbed or lightly grazed tallgrass prairie remnants in the eastern third of the state (Powell et al. 2007).

Southern Plains Bumble Bee

The southern plains bumble bee (*Bombus fraternus*) is currently a candidate for federal listing under the ESA following a 90-day finding published on January 25, 2024. The southern plains bumble bee is a generalist pollinator of the Great Plains, midwestern, and southeastern U.S. and has experienced a 42 percent decline in modeled occupancy across its range because of threats such as habitat loss/degradation and disease (CFBD 2022). This species inhabits urban and rural prairie fragments, meadows, and grasslands and nests underground or in dense

clumps of grass on the ground surface (GBP 2023). The species has likely been extirpated from six states along its northern range (Indiana, Maryland, Michigan, New Jersey, North Dakota, and Ohio; CFBD 2022). In Kansas, this species occurs throughout the state, including in Quivira NWR; however, sightings are more common in the eastern half of the state (Bumble Bee Atlas 2023).

Variable Cuckoo Bumble Bee

The variable cuckoo bumble bee (*Bombus variablilis*) is listed as a candidate species. This species is a parasitic species that has lost the ability to collect pollen or rear its own young, instead invading nests of its host species, the American bumble bee, and forcing them to raise its offspring (USFWS 2025). This species is one of the rarest bumble bees in North America and its status is closely tied to its host, which has experienced significant population declines (USFWS 2025). Historically, the variable cuckoo bumble bee occurred in the eastern temperate forest and Great Plains regions, but confirmed sightings have been extremely rare in recent decades (USFWS 2025). It relies on floral groups such as Aster, Bidens, and Echinacea for food and faces threats including pesticides, habitat loss, climate change, and diseases introduced by non-native bees (USFWS 2025). Conservation of this species depends on protecting its host species and improving pollinator habitat.

New Mexico Threadsnake

The New Mexico threadsnake (*Rena dissecta*) was listed as a Kansas state threatened species in 1987. It is a nocturnal, enigmatic species that inhabits ant burrows and moist areas with loose soil or sand, using rocks for cover. This species occurs in the southernmost counties of central and western Kansas, along the border with Oklahoma. Designated critical habitat exists in most of these counties, including Kiowa County, which falls within the project area (KDWP 2022b). Threats to blind snakes, in general, are related to habitat loss and degradation because of pesticide use and ground disturbances (e.g., mining, plowing, etc.; KHA 2023).

Strecker's Chorus Frog

Strecker's chorus frog (*Pseudacris streckeri*) is a Kansas state threatened species, listed in 1978. Known habitat occurs in shallow, runoff pools of unpolluted water where there is wetland vegetation available and a lack of predatory fish species. This species was previously known in only Barber and Harper counties, but in 2004, a disjunct population was recorded that extends into Pratt and Kingman counties. Because of its intermittent use of breeding pools, specific locations have not been designated as critical habitat. Instead, all suitable habitats in Barber, Harper, Kingman, and Pratt counties are considered critical habitat (KDWP 2022b). In Kansas, the main threats to this species are the low densities of individuals occurring in the state and the habitat loss and degradation of breeding pool habitat (Gray and Stegall 1986).

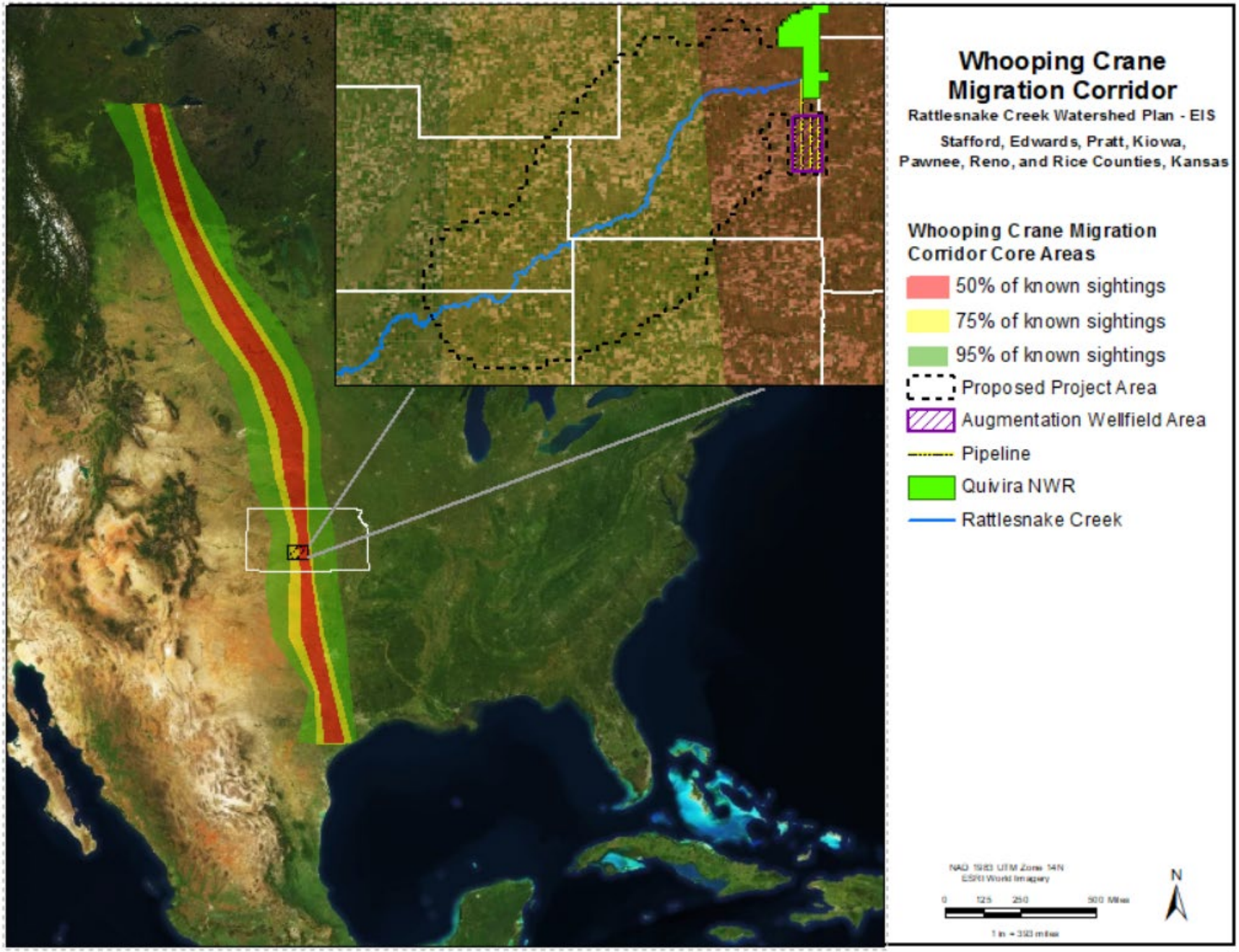

Figure 4.15. Whooping Crane Migration Corridor.

4.16 Migratory Birds, Bald Eagles, and Golden Eagles

Some terrestrial wildlife species are protected under the Migratory Bird Treaty Act (MBTA; 16 USC 703-712, Ch. 128 as amended) and the Bald and Golden Eagle Protection Act (BGEPA; 16 USC 668-668c), which are administered by the USFWS. Migratory birds represent supporting ecosystem services through their ability to support biodiversity resilience.

Construction activities in open grassland, in woodland habitats, and near other structures that could potentially provide nesting habitat that would result in the taking of migratory birds, eggs, young, and/or active nests should be avoided (USFWS 2017b). Although MBTA regulations are applicable year-round, most migratory bird nesting activity in Kansas occurs between April 1 and July 15. However, some migratory birds are known to nest outside the primary nesting season.

Protections under BGEPA prohibit "take" of bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*). "Take" is defined as "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (USFWS 2022k). Bald eagles use tall trees for roosting or nesting and nearby open water for foraging (USFWS 2021). Golden eagles use shortgrass and mixed-grass prairies in open terrain for foraging and rock cliffs and tall trees for nesting (USFWS 2011).

The FWCA requires the USFWS to identify nongame migratory birds that without additional conservation measures are likely to become threatened and endangered species listing candidates. Table 4.16 lists the Birds of Conservation Concern identified that use the project area at some point during their life cycle.

Table 4.16. Birds of Conservation Concern (Cornell Lab of Ornithology 2022, USFWS 2022b).

Common Name	Scientific Name	Breeding Season	Habitat
American Golden-plover	*Pluvialis dominica*	Breeds elsewhere	During migration it can be found foraging within prairies, plowed agricultural fields, pastures, and mudflats; nests in the arctic and subarctic tundra.
Bald Eagle	*Haliaeetus leucocephalus*	October 15 to July 31	Lives and breeds within 2 miles of large open bodies of water or rivers where fish are easily accessible; nests in large, mature trees that are located near bodies of water.
Black Tern	*Chlidonias niger*	May 15 to August 20	Nests within marshes found on the edges of large freshwater wetlands; these marshes are normally 50 acres or larger. Migrants use many different wetland habitats that include sewage lagoons, river edges, lakes, marshes, and beaches.
Bobolink	*Dolichonyx oryzivorus*	May 20 to July 31	Breeds in open areas that include a mixture of grasses and broad-leafed plants (e.g., tallgrass and mixed-grass prairie); during the nonbreeding season it can be found foraging in freshwater marshes and coastal areas.

Common Name	Scientific Name	Breeding Season	Habitat
Chestnut-collared Longspur	*Calcarius ornatus*	Breeds elsewhere	Breeds within the shortgrass prairies of the northern Great Plains; migrates through shortgrass prairie, black-tailed prairie dog towns, fallow fields, and crop fields. It typically overwinters in black-tailed prairie dog colonies, cultivated fields, and isolated water sources.
Golden Eagle	*Aquila chrysaetos*	January 1 to August 31	Builds nests on cliffs or in large trees with unobstructed views of the surrounding habitat. Avoids nesting near urban areas or in densely forested habitat.
Hudsonian Godwit	*Limosa haemastica*	Breeds elsewhere	Breeds within the transitional zone of marshes and drier hummocks (called “muskeg”) within the arctic; plants within these areas typically include black spruce, sweet gale, arctic birch, and larch. During migration, it uses open wetlands such as lakes, large rainwater pools, flooded agricultural areas, sewage ponds, freshwater impoundments, wet pastures, salt marshes, brackish swamps, estuaries, and lagoons. Roost habitat includes areas adjacent to beaches and shell-laden areas.
King Rail	*Rallus elegans*	May 1 to September 5	Breeds in both freshwater marshes and brackish marshes (prefers marshes with very low salinity) and are most numerous in shallow marshes that contain patches of deeper, open water. It can be found in areas with tall vegetation located near pools and shallow water edges for foraging; it avoids areas with woody vegetation.
Lark Bunting	*Calamospiza melanocorys*	May 10 to August 15	Endemic to grasslands and shrub steppe of North America; breeds in large areas of native grassland vegetation (e.g., blue gramma grass, big sagebrush). Avoids bare ground when nesting; migrates through open habitats including dry lake beds, cattle feedlots, and roadside edges.
Lesser Yellowlegs	*Tringa flavipes*	Breeds elsewhere	Uses fresh and brackish wetlands like mudflats, marshes, lake and pond areas, and wet meadows during migration; breeds within open or semiopen woodlands/wet meadows that are interspersed with marshes, bogs, and ponds.
Mountain Plover	*Charadrius montanus*	Breeds elsewhere	Nests in shortgrass prairie, fallow/recently plowed fields, and overgrazed landscapes. Wintering birds use tilled/burned agricultural fields, alkaline flats, and coastal prairies.
Red-headed Woodpecker	*Melanerpes erythrocephalus*	May 10 to September 10	Breeds in deciduous woodlands with oak and beech, dead or dying trees, river bottoms, burned areas, farmland edges, forest edges, and roadsides; dead or partially dead trees that can be used for nest cavities are crucial for breeding habitat.

Common Name	Scientific Name	Breeding Season	Habitat
Sprague's Pipit	*Anthus spragueii*	May 10 to September 10	Breeds in mixed-grass prairie, avoiding overgrazed areas. Does not nest in cropland and is uncommon in nonnative grassland.
Willet	*Tringa semipalmata*	April 20 to August 5	Nests near marshes and other wetlands, prairie pothole ponds, and wet fields within native grassland habitat; migrates through areas with mudflats, tidal estuaries, and sandy beaches.

4.17 Significant Scientific Features

Significant scientific features are locations that contain characteristics that are unique, unusual, or valuable. These areas may provide specific habitat requirements or present an uncommon type of habitat or rare confluence of naturally occurring features. Significant scientific features represent supporting (biodiversity resilience) and cultural (recreation and aesthetic) ecosystem services.

Quivira National Wildlife Refuge

Quivira NWR was established in 1955 by the Migratory Bird Conservation Commission, and it encompasses approximately 22,135 acres of diverse habitat. The refuge is located within GMD #5 and within the Rattlesnake Creek HUC 10 Watershed. Quivira NWR contains two unique, historic salt marsh and salt flat areas and presents a rare, diverse, and high-quality habitat for hundreds of species, including migrating wildlife species and species of concern. The refuge holds several national and international recognitions for its conservation value, listed below:

- Ramsar Wetland of International Importance
- Western Hemisphere Shorebird Reserve Network Site
- Globally Important Bird Area
- One of the Eight Wonders of Kansas
- Audubon Important Bird Area

The salt marshes in the refuge form a wetland complex that is hydrologically connected to area groundwater, Rattlesnake Creek, and Peace Creek (USFWS 2013a). The refuge supports a rare abundance of salt-tolerant vegetation because of brackish salinity levels. Salt predominantly stems from Permian bedrock located below Quivira NWR, and freshwater sources (such as Rattlesnake Creek) are critical for maintaining habitable salinity levels for the resources supported by Quivira NWR.

Quivira NWR's resources include sand prairies, sand dunes, salt flats, and salt and freshwater wetland types managed to "provide migration, nesting, resting, and feeding habitat for migratory birds and to develop, advance, manage, conserve, and protect fish and wildlife resources" (USFWS 2013a). Hundreds of thousands of migratory birds and more than 30 species of

shorebirds visit the refuge each year. Wetland habitat supports more than a hundred wetland-associated species and provides benefits to upland wildlife in the area (USFWS 2013a). Quivira NWR also supports a unique assemblage of at least 118 taxa of diatoms (Harris 1999; Harris and Eberle 2001). Diatoms (single-celled algae) may be associated with and influenced by surface water and groundwater interactions (Banks et al. 2023).

Water is critical to maintaining this diverse complex of salt marsh and native sand prairie communities. These productive habitats can only thrive when the appropriate quantity of water is available to the refuge to support these delicately balanced ecosystems. The midcontinent location of Quivira NWR provides a critical steppingstone for migrating birds (such as the whooping crane) where they can replenish nutrients and find protection (USFWS 2013a).

Quivira NWR receives an estimated five to 10 requests each year to conduct scientific research or monitoring programs. Quivira NWR gives priority to studies that "contribute to the enhancement, protection, preservation, and management of the refuge's native plant, fish, and wildlife populations and their habitats" (USFWS 2013a). Quivira NWR represents an important cultural ecosystem service that provides outstanding value and continuous opportunities for growth of scientific knowledge within this diverse and unique habitat.

5. ALTERNATIVES

The following alternatives are proposed to address the purpose and need (Section 2) of this Plan – EIS. The project purpose is to provide long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin of GMD #5, including project components to meaningfully address the impairment at Quivira NWR.

For the purposes of the Plan – EIS, "long-term" is defined as a period of 50 years and "sustainable" is defined as surface and groundwater use that can be maintained consistent with water rights and the economic viability of the region. The project need was determined by the importance of both Quivira NWR's impaired senior water rights and the local agriculture.

All reasonable alternatives were considered as part of the Plan – EIS and were developed through public and agency scoping meetings and directly through cooperating agency meetings (Council of Environmental Quality [CEQ] Section 40 CFR § 1508.1[z]). The following screening criteria were developed to determine whether a reasonable alternative could meet the project purpose and need:

Screening Criteria A – Quivira NWR Water Supply

> Supplies water to Quivira NWR to meaningfully address its water supply needs required in fulfilling its management goals and objectives as defined in its CCP (USFWS 2013a).

Screening Criteria B – Long-term Agricultural Water Management

Provides long-term agricultural water management that addresses the project purpose and need for a period of at least 50 years.

Screening Criteria C – Sustainable Water Use and Water Sources

Allows for surface and groundwater use that is consistent with Kansas water rights and maintains the economic viability of the affected region. The level of significance is to be evaluated based on the regional economic impacts and sustainability of water sources.

Alternatives that did not meet one or more screening criteria do not meet the project's purpose and need.

5.1 Alternatives Considered but Eliminated from Detailed Study

5.1.1 Capture and Recirculation of Water Leaving the Quivira NWR

Based on a public comment received during the scoping process, an alternative was evaluated that considered capture and recirculation of water leaving the Quivira NWR. Rattlesnake Creek flows through Quivira NWR and water is diverted to supply water to wetlands throughout the refuge. Any water not diverted to the wetlands exits Quivira NWR via Rattlesnake Creek. See Section 4.10.5 for information on water diversion at Quivira NWR.

Rattlesnake Creek has shown regular periods of low flow or no flow and during these periods cannot supply adequate water to Quivira NWR to meet its management goals and objectives through capture and recirculation. These periods provide insufficient water to the wetland complex during critical periods (i.e., spring and fall migration; KDA-DWR 2016).

Additionally, the water quality at the Quivira NWR is the result of a unique mixture of freshwater from Rattlesnake Creek and saltwater from the underlying aquifer. The aquifer in the area has contact with the Lower Permian bed that is high in salt content (sections 4.2 and 4.3). The mixing that occurs creates high salt content in the soils and water (USFWS 2013a). The water quality leaving Quivira NWR would be substantially different from the water quality entering Quivira NWR and this difference in water quality would have an impact on the Quivira NWR management goals. Figure 4.3-4 in Section 4.3 shows the change in salt content from the Edwards-Pratt county line to the Arkansas River. The water quality changes substantially within the mineral intrusion area.

Capture and recirculation of water leaving the Quivira NWR does not meet screening criteria A, B, or C. This alternative was eliminated from detailed study because it would not meet the purpose and need.

5.1.2 Conservation of Water at Quivira NWR

Based on public comments received during the scoping process, an alternative was evaluated that considered water conservation measures at Quivira NWR. Conservation measures would include making use of the existing water resources to reduce the need for additional water from Rattlesnake Creek. Conservation measures could include increasing water storage when water is available and diverting less water when water is scarce.

Quivira NWR holds Water Right File Number 7,571 for 14,632 acre-feet of water and requires water from Rattlesnake Creek to meet its management goals and objectives. Management goals and objectives include providing water for migratory birds during seasonal periods. Quivira filed an impairment claim in 2013 and KDA-DWR issued a final report in 2016 confirming the impairment.

A 1998 USFWS-funded water resource study evaluated and identified the structural and nonstructural options for implementing the most efficient and effective use of the available water resources (Burns & McDonnell 1998). The study evaluated 31 alternatives that ranged from new reservoir storage to improvements on Quivira NWR that would improve water conservation. The water conservation components included raising levees, building a cross dike, filling a borrow area, removing sediment, and installing a bypass canal (Burns & McDonnell 1998). These alternatives were evaluated but were not the selected alternative based on screening criteria. Quivira NWR has implemented conservation practices that include tree removal, ditch clearing, and water structure rehabilitation to allow for more efficient management of available water (Rattlesnake Creek Partnership 2012). Conservation of water at Quivira NWR does not meet screening criteria A, B, or C. This alternative was eliminated from detailed study because it would not meet the Purpose and Need.

5.2 No Action Alternative

The No Action Alternative describes a scenario of the default effects of not implementing a federal alternative. This provides a baseline for evaluating the other alternatives and illustrates the repercussions of no federal action.

CEQ 1986 guidance states, “Where a choice of [no action] by the agency would result in predictable actions by others, this consequence of the [no action] alternative should be included in the analysis.” The NRCS *Watershed Program Management Manual* states, “The effects of other programs and compliance with existing laws will be considered in projecting FWOP [future without project] conditions.” Therefore, the No Action Alternative assumes USFWS, as the senior water right holder, will take the predictable action of filing a request to secure water with KDA-DWR. The No Action Alternative, then, evaluates the likely scenario that KDA-DWR will administer water rights consistent with its statutory authority under Kansas law to address USFWS’s request to secure water.

As stated in the Purpose and Need section, KDA-DWR issued a final report of its impairment investigation on July 16, 2016, finding that Quivira NWR water supply “has been regularly and substantially impacted by junior [water right holders] groundwater pumping.” Therefore, the USFWS can file a request to secure water because of the impairment finding. USFWS filing a request to secure water is the predictable action that would occur in the absence of a federally funded PL 83-566 authorized project. KDA-DWR would then administer the water right consistent with K.S.A. 82a-706b.

As part of the impairment investigation, KDA-DWR evaluated numerous alternatives that it might implement to address the impairment. The specific regulatory mechanism, quantity, timing, and degree to which pumping might be restricted following a request to secure water is currently unknown. If no action were taken under this Plan – EIS, the range of impacts could include a variety of water right enforcement activities, development of a mutually acceptable water use arrangement between parties (such as rotating water use), or other acceptable measures.

Developing a plan for water rights administration is a dynamic and constantly evolving process. Following the 2022 project scoping meeting, KDA-DWR provided comments on the No Action Alternative and a likely scenario should USFWS file a request to secure water. These comments can be found in Appendix A. The Plan – EIS No Action Alternative was developed based on KDA-DWR’s assessment of its likely administration in the event USFWS files a request to secure water. KDA-DWR’s definitive administration procedures would be established at the time any administration is employed. In January 2024, KDA-DWR notified water right holders via mail of a proposed plan to administer water rights beginning January 1, 2025, pursuant to K.S.A. 82a-706b. This mailing was informational in nature, nondeterminative, and is not an official order. Prior to implementation, any plan may be further modified based on new information, public input, or legal challenge. All information pertaining to agency comments, mailing information, and the perspective plan for administration is included in Appendix A.

Because the January 25, 2024, KDA-DWR Plan for Administration is not final and is a continued evolution of the plan for administration, the No Action Alternative was not adjusted from the 2022 KDA-DWR Response to the No Action Alternative described below. The No Action Alternative described within this Plan – EIS is based on the best available information at the time of writing. The January 25, 2024, KDA-DWR proposed for administration would include similar baseline conditions as the current No Action Alternative. A key difference between the two scenarios would be potentially reduced economic impacts that may occur by spreading the water rights administration over a larger group of water right holders and allocating water rights over a longer duration compared to the current No Action Alternative. These differences were considered in selection of the preferred alternative. Under the Plan – EIS No Action Alternative, junior water rights curtailment within Zone B (areas with a 20 percent or greater streamflow impact) would be completed initially and then KDA-DWR would annually evaluate the effectiveness in securing Quivira NWR’s water right. The junior water rights curtailment would

result in all water rights within Zone B that are junior to Water Right File Number 7,571 to cease groundwater pumping (which consists of 810 water rights, equivalent to 109,000 authorized irrigated acres). Adjustments in the level of regulation would occur based on the annual evaluation. An analysis conducted by Balleau indicates that restricting all pumping throughout Zone B would increase baseflow by approximately 10 cfs (7,200 AFY) within two years (Balleau 2022). After the first few years, baseflow would continue to improve relative to estimated baseflow without curtailment. At the end of the 53-year simulation period, baseflow in Rattlesnake Creek is projected to increase by an average of 23,400 AFY. However, considering the natural variability of water supplies and the intra-annual water needs at the refuge, it is unclear whether or when certain, less-junior water rights holders might be allowed to resume using water in the future.

5.3 Augmentation Wellfield and Groundwater Use Reduction Alternative

Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, a groundwater augmentation project would be constructed; targeted water right retirements would be implemented in Zone D; and an adaptive management approach would be developed that allows for adjustments based on results over time. Each of these components is further discussed below.

Augmentation Wellfield

Under this alternative, a groundwater wellfield with associated collection and delivery pipelines would be constructed south of Quivira NWR (within the Gar-Peace Creek and North Fork Ninnescah watersheds; Figure 5.3-1).

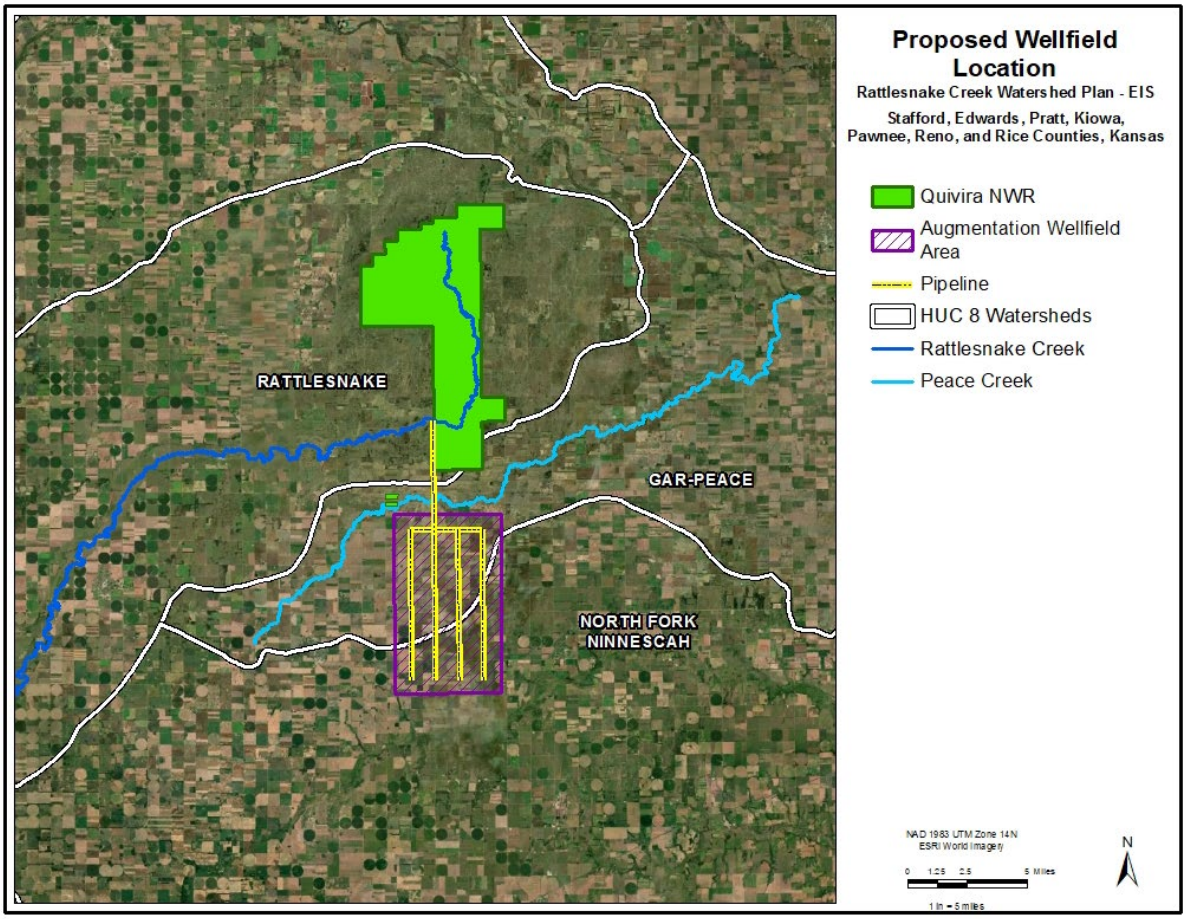

Figure 5.3-1. Location of the Proposed Wellfield.

Up to 18 cfs of groundwater from the wellfield would be transported via pipeline to a discharge point in Rattlesnake Creek downstream of the Zenith gage (northeast near 110th Avenue) and upstream of Quivira NWR. Land for the wells and pipeline would be acquired by a permanent easement or purchase from the current landowner by GMD #5. It is assumed that a temporary easement of 0.5 acre around each well site and within a 40-foot buffer of pipelines would be required for construction activities. Disturbed ground would be reseeded, stabilized, and generally restored to its preconstruction condition within one to three years. To allow for operation and maintenance activities, a permanent easement of 0.1 acre around each well site and within a 10-foot buffer of pipelines would be required.

Operation of the augmentation wellfield would increase surface flows within Rattlesnake Creek at the point of delivery and downstream within Quivira NWR. Water storage in Little Salt Marsh could help retime the augmentation and streamflow and allow for extended use. Little Salt Marsh is under USFWS management and storage considerations would be made on completion of the Plan – EIS, at the discretion of the USFWS, and would be consistent with the USFWS CCP.

Augmentation Wellfield Technical Assessment

During the latter half of 2022, a series of data collection efforts were completed to provide a better understanding of the groundwater resources in the general vicinity of the proposed wellfield. Specifically, a better understanding of drawdown when pumping, the lithology, and resistivity of aquifer materials was sought to evaluate the feasibility of an augmentation wellfield. Initially, three locations were identified (Figure 5.3-2), and once access rights were obtained, a series of well drilling and testing was completed at each site. The drilling and testing included the following:

1. Installation of and data collection from a deep monitoring well drilled to bedrock (sites 1, 2, 3, 4, and 5)
2. Installation of and data collection from a shallow and intermediate monitoring well (sites 1, 2, and 3)
3. Installation of a pumping well for use in a subsequent 24-hour pumping test (sites 1, 2, and 3)
4. Collection of surficial electrical geophysical data (sites 1, 2, 3, 4, 5, 6, and Q)

After this work, additional deep well drilling was conducted at two additional sites and additional geophysical data collection was completed at three additional sites. Figure 5.3-2 shows the location of all the field activities relative to the general location of the proposed wellfield. Resistivity data was also collected at the boundary of Quivira NWR (Site Q) for comparative purposes. The complete report provides a full description of all data collected (Olsson 2023a).

The data collected during the initial assessment (Olsson 2023a) indicated that there is a quantity of groundwater of sufficient quality for use (KDHE 2018) in augmentation found in the intermediate and upper portion of the sand and gravel materials encountered; these materials were generally encountered at relatively shallow depths of 12 to 25 feet, varying slightly by location. When the pumping wells were pumped at a high rate (500 gallons per minute [gpm]) for a 24-hour period the reduction in water levels a few hundred feet from the pumping wells was small relative to the saturated thickness of the aquifer (i.e., 0.1–1.4 feet). Moreover, good aquifer quantity and quality (meaning water of suitable quality for streamflow augmentation in this area) was encountered within the proposed wellfield area (sites 2, 3, and 6), and aquifer conditions and suitability for use were reduced about 1 mile north of the northern boundary of the proposed wellfield (sites 1 and 5). The aquifer pumping conducted at sites 2 and 3 had a moderate impact on the shallower wells but essentially no impact on the deep wells, indicating a relative lack of connection between the shallow, fresher water and the deeper, more saline water. The deeper bedrock is known to produce more saline water, so the lack of connection is significant from a water quality perspective. Overall, the existing data indicates that some substantial level of augmentation could be developed and maintained over time at the proposed augmentation wellfield site (this understanding would be refined in the design phase when additional field work would be completed).

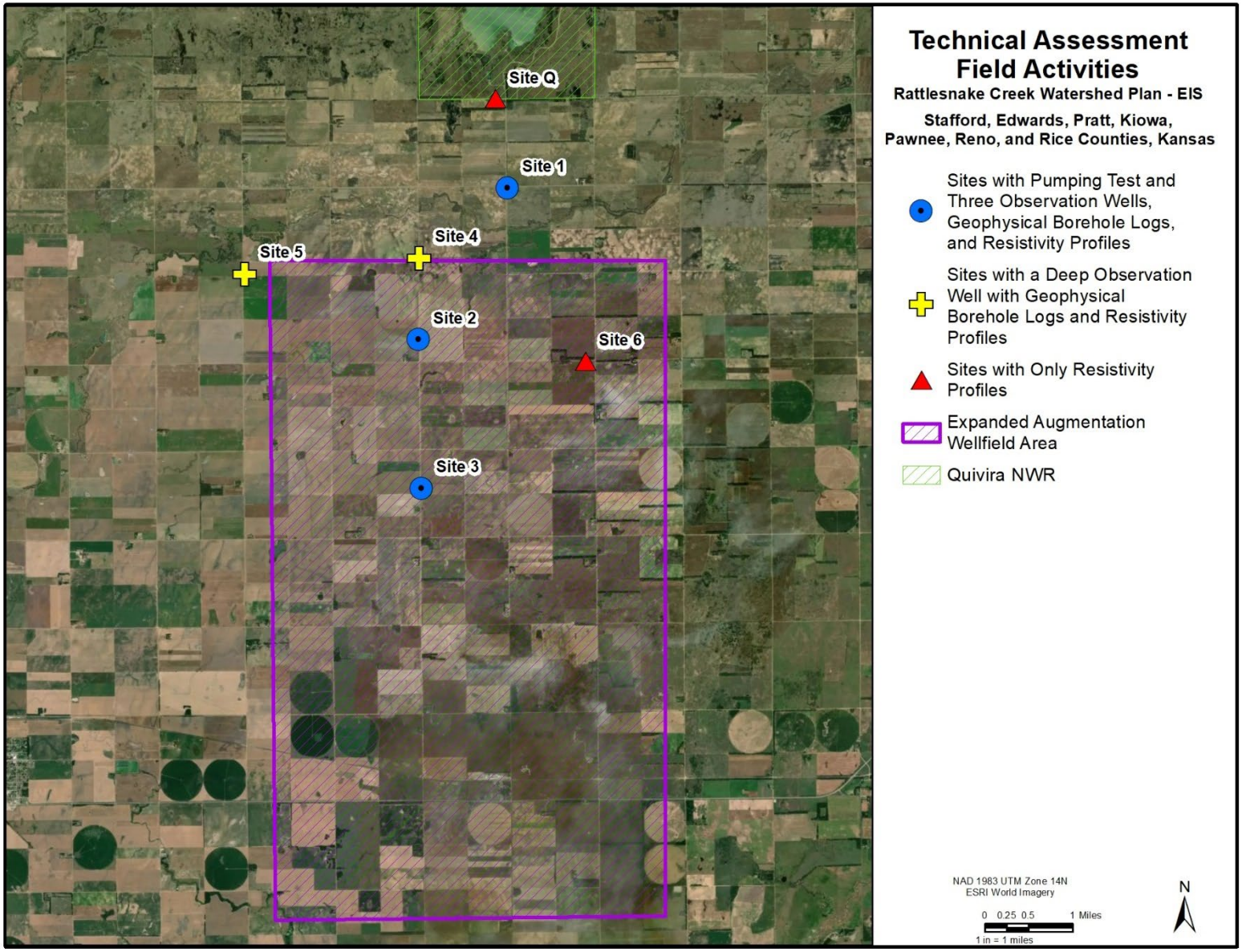

Figure 5.3-2. Technical Assessment Field Activities.

Augmentation Wellfield Modeling

Effects of the potential augmentation wellfield were estimated using the Balleau groundwater model (Balleau 2010). Two hypothetical scenarios were modeled to develop the limits of potential impacts that may occur. By conducting the two scenarios, a range of potential impacts could be estimated as presented in Chapter 6. Additional modeling using the updated 2023 Balleau groundwater model will be conducted in the design phase of the proposed project.

Augmentation Wellfield Siting and Design

Based on the technical assessment (Olsson 2023a) conducted for the proposed project, two siting configurations are under consideration. During the engineering design phase, to be completed following authorization of the Plan – EIS, the wellfield configuration and exact well locations would be determined. The options described below are examined to determine the effects of possible configurations and the geographic extent of the wellfield area. The configuration and exact locations may be as described in the options below or may be a combination of the options. Though the layouts are different, the quantity of water produced would be the same between both options. The wellfield configurations were determined based on testing various layouts with a range of potential impacts to the three watersheds.

Option 1: Compact Configuration

Option 1 includes up to 28 well sites; each site contains a battery of two wells for a total of 56 wells (two shallow wells per site will have less localized impact than one well pumping at the combined rate of two wells). Wells would be approximately 100 feet deep and spaced approximately 0.25 mile apart in four north-south oriented rows. The four rows would be approximately 1 mile apart and would contain 14 wells each. The total area of disturbance, including the wellfield and pipelines, is approximately 122 acres. The maximum yield is approximately 150 gpm per well. The wellfield would be located approximately 2.5 miles south of Quivira NWR and about 1 mile south of Peace Creek. The wellfield straddles the Gar-Peace Creek and North Fork Ninnescah River watersheds with 52 of the 56 wells located in the Gar-Peace Creek Watershed. The compact configuration is shown on Figure 5.3-3.

Option 2: Expanded Configuration

Option 2 includes up to 28 well sites; each site contains a battery of two wells for a total of 56 wells. Wells would be approximately 100 feet deep and spaced approximately 0.5 mile apart in four north-south oriented rows. The four rows would be approximately 1 mile apart and would contain 14 wells. The total area of disturbance, including the wellfield and pipelines, is approximately 179 acres. The maximum yield is approximately 150 gpm per well. The wellfield would be located south of Quivira NWR. The wellfield straddles the Gar-Peace Creek and North Fork Ninnescah River watersheds with 32 of the 56 wells located in the Gar-Peace Creek Watershed. The expanded wellfield doubles the well spacing in the southern direction and shifts the pumping stress south. The expanded configuration is shown on Figure 5.3-4.

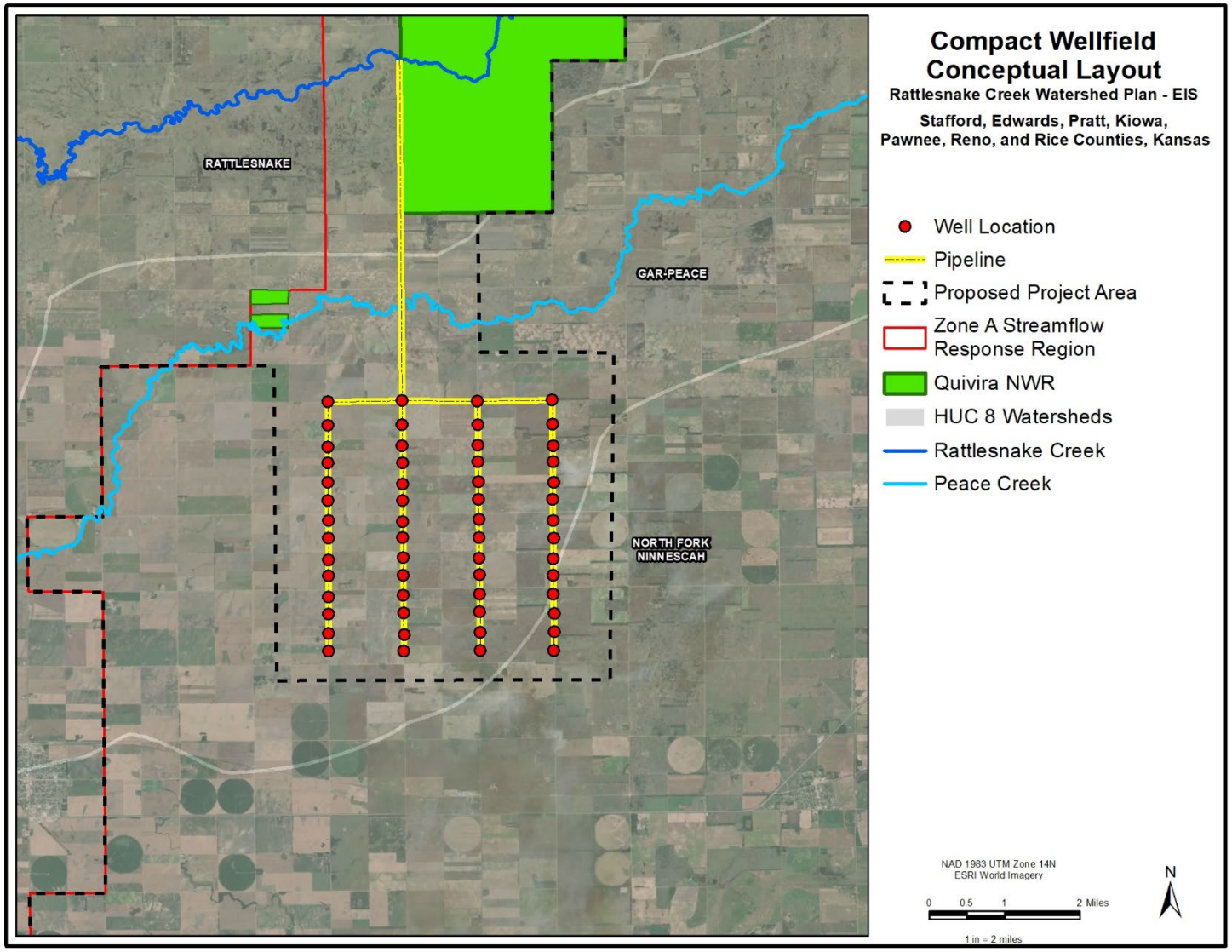

Figure 5.3-3. Compact Wellfield Conceptual Layout.

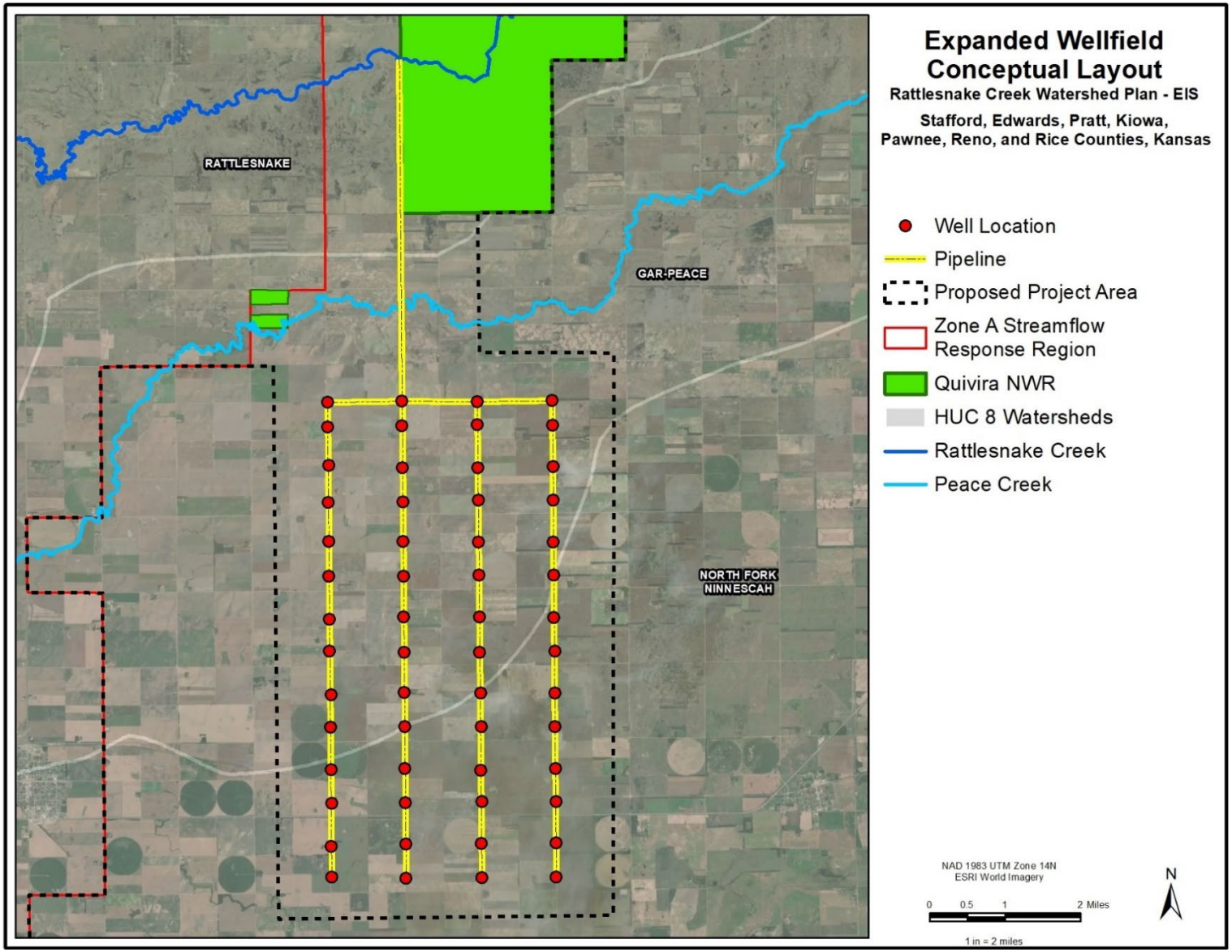

Figure 5.3-4. Expanded Wellfield Conceptual Layout.

Augmentation Wellfield Operation

The augmentation wellfield would provide up to 18 cfs of groundwater via pipeline to Rattlesnake Creek. It is anticipated that the wells would provide up to 15 cfs throughout any year, and an additional 3 cfs during critical time periods (i.e., droughts). Operational limitations on pumping from the wellfield will assure it can provide a long-term (minimum of 50 years) water source with both the quality and quantity needed. These limitations may occur when Quivira NWR does not need additional water or by focusing pumping increases to occur during critical periods. The Quivira NWR seasonal water right use estimates, largely based on species-habitat requirements, were described in a 2015 response to KDA-DWR by USFWS and are shown in Table 5.3 (USFWS 2015). The 18 cfs figure is anticipated to help meet the increased seasonal water use needs of Quivira NWR from July through November.

Table 5.3. Quivira National Wildlife Refuge Seasonal Water Use Estimate (USFWS 2015).

Quantity	January – February	March – April	May – June	July – September	October – November	December	Total
Seasonal Water Use (Acre-feet)	1,500	3,500	2,000	3,500	3,632	500	14,632

The augmented water available from the wellfield is determined by groundwater quantities (short-term and long-term) and salinity. The aquifer in the vicinity of the wellfield will be monitored to evaluate the pumping impact to existing users in the area, which are primarily domestic. This effort will entail shallow and deep monitoring wells that will be monitored for water levels and water quality over time. Furthermore, the quality of water delivered to Rattlesnake Creek will have a chloride concentration limitation that considers the mixing that will occur between the groundwater pumped from the augmentation wellfield and streamflow in Rattlesnake Creek at the point of delivery. Thus, the water quality in the Rattlesnake Creek flows and the augmentation wellfield will need to be monitored to meet the appropriate salinity. Within the wellfield, each well will be equipped with a water level and water quality monitoring device. As demands for augmentation water change, and as discharge water quality fluctuates, the exact number of wells pumping and their flow rate will be adjusted to optimize the benefits from the wellfield and minimize impacts to the aquifer. Additionally, the low-turbidity water delivered to Rattlesnake Creek from augmentation pumping may lead to bed and bank erosion within the creek; the design of the augmentation pumping regime may attempt to minimize this through energy dissipation, but the channel would also need to be routinely examined for any necessary stabilization work over the life of the project. This ongoing monitoring and adjustments made over the lifetime of the project are part of the Operations and Maintenance (O&M) Plan to be finalized during the design process in conjunction with the Adaptive Management Plan (AMP), which is described below. An O&M Memo (Olsson 2023c) containing additional details is included in Appendix D.

Based on communication with KDHE, the chloride concentration of the augmentation water will need to be less than 1,660 mg/L, depending on the streamflow in Rattlesnake Creek at the Zenith gage and the amount of augmentation water being provided (KDHE 2018). The threshold for inflows into Quivira NWR is chloride concentration at or below 1,400 mg/L. The salinity in Rattlesnake Creek tends to be greater when streamflow is lower, which will require the augmentation water to have a lower chloride concentration to stay within that threshold.

As discussed above, the augmentation wellfield assessment supports the assumption that a substantial quantity of sufficient quality groundwater exists in the proposed augmentation area, which may meet the augmentation wellfield's long-term demand (this assumption needs to be further examined with additional data collected in a future design phase). Because climatic conditions and actual streamflow in the future are unknown, this alternative will use adaptive management, as described below, to make sure the purpose and need of this Plan – EIS is met over the long term. More specifically, the adaptive management committee will develop an ongoing monitoring plan to assess the effectiveness of the augmentation wellfield and make adjustments as necessary.

Targeted Water Right Retirements and Transfers

Targeted water right retirements and transfers are defined as methods of reducing the number of water rights and amount of groundwater use associated with the water rights within the high-impact area (Zone D).

Under this alternative, GMD #5 will retire or reduce 2,500 acre-feet of authorized water use within the high-impact zone (Zone D). The high-impact area was determined by using the GMD #5 groundwater model (Balleau 2010) to test the potential impact of wells across the Rattlesnake Creek subbasin. The high-impact area, Zone D, is defined as the area where pumping depletes streamflow by 40 percent of the volume pumped, and it is the area where wells have the greatest impact on Rattlesnake Creek flows based on the Balleau model. Reduction in groundwater use associated with the water rights in the high-impact area will increase Rattlesnake Creek streamflow over time (Balleau 2010). The 2,500 AF of water right retirements was determined to be the amount that would likely meet the residual unmet demand present after augmentation deliveries (Balleau 2023c; Appendix D).

GMD #5 will purchase, lease-to-purchase, or transfer 2,500 acre-feet of authorized water use within Zone D as soon as possible from willing sellers pursuant to its statutory authority under the KGMDA. On purchase, such water rights will be permanently retired or transferred from the subbasin. To date, GMD #5 has completed two water right retirements totaling 258.5 acre-feet within the high-impact zone. GMD #5 has also completed two additional water right retirements (in Zone C) just outside the high-impact zone that total 390 acre-feet. These retirements will be included in the 2,500 acre-feet retirement goal by discounting the total acre-feet retired to reflect the lesser benefit they provide because they are not fully within the high-impact zone. Discounting means that a water right purchased outside of Zone D will not receive full credit

toward the 2,500 acre-feet goal. For example, a water right for 100 acre-feet on the edge of Zone B or Zone C would deplete streamflow at a rate of 30 percent on average. This does not meet the minimum 40 percent requirement (30 percent is only three quarters of 40 percent) and would therefore need to be discounted by 25 percent and would only provide 75 acre-feet toward the 2,500 acre-feet goal. GMD #5 will be responsible for identifying the additional water right retirements within the high-impact area and securing funding sources and agreements for the water right retirements. GMD #5 will seek additional funding as needed to meet the 2,500 acre-feet of groundwater use reduction. Additional funding sources may include but are not limited to the PL 83-566 program. GMD #5 is aware of additional water rights that may be purchased for this alternative and will pursue such additional purchases as soon as the Record of Decision (ROD) is final.

In a comparable manner, GMD #5 and private landowners in the region have transferred water rights from within Zone D to areas outside of Zone D through the implementation of existing regulations promulgated by GMD #5. To date, GMD #5 has facilitated eight water right transfers out of Zone D totaling 1,131.85 acre-feet. GMD #5 has also enabled two additional water right transfers out of Zone C, one transfer out of Zone B, and one transfer out of Zone A totaling 390 acre-feet, 170 acre-feet, and 187 acre-feet, respectively. The water right transfers from outside Zone D will be included in the 2,500 acre-feet goal by discounting the total acre-feet transferred to reflect the lesser benefit provided to streamflow.

Temporary Water Leases Until Water Rights are Purchased and Retired

Until GMD #5 purchases and retires 2,500 acre-feet of authorized water use within Zone D for retirement, GMD #5 will reduce water use in sensitive areas of Rattlesnake Creek by participating in temporary water right lease programs. The Central Kansas Water Bank Association runs several programs, including a deposit/lease program, which allows water users to deposit their historical use from one location for use at another location (Central Kansas Water Bank Association 2022). Similarly, GMD #5 will approach water right holders located in and around sensitive areas of Rattlesnake Creek to temporarily lease water rights until the 2,500 acre-feet of authorized water use is purchased and retired. Such leasing programs will facilitate the movement of water use away from the sensitive areas of Rattlesnake Creek. GMD #5 will continue to maintain support of water right leasing efforts within the district.

Working Through the Chief Engineer to Reduce Groundwater Use

If 2,500 acre-feet of water rights are not purchased and retired from willing sellers, transferred, or leased and taken out of use in a timely manner, GMD #5 will work with the Chief Engineer as necessary to establish a plan to administer water in the Rattlesnake Creek subbasin. K.S.A. 82a-1028(u) allows GMD #5 to recommend that the Chief Engineer initiate proceedings to create an IGUCA. Once created, the Chief Engineer can restrict groundwater use to permissible levels, total withdrawal amounts, or as otherwise necessary to protect the public interest under K.S.A. 82a-1038. Alternatively, GMD #5 may recommend that the Chief Engineer approve a

LEMA under K.S.A. 82a-1041. Like an IGUCA, the district would submit a LEMA plan to the Chief Engineer proposing voluntary methods and corrective controls to reduce groundwater withdrawals.

Additional Authority to Reduce Groundwater Use

As necessary, GMD #5 will facilitate the completion of the 2,500 acre-feet of targeted water right retirements by exercising the following authority:

- GMD #5 will stop the preventable waste of water within the district's boundaries as authorized under K.S.A. 82a-1028(o)-(q). This section authorizes GMD #5 to propose rules to the Chief Engineer, KDHE, State Conservation Commission, or other appropriate agency relating to conservation and groundwater management within the district. Such rules may involve limiting water use within the district. The district is already closed to new surface water and groundwater appropriations as of December 17, 1997. Once adopted, GMD #5 can enforce such rules under K.S.A. 82a-1028(q).
    - Per K.A.R. 5-25-8, the Chief Engineer has already adopted rules authorizing GMD #5 to restrict water use in certain conditions. This regulation provides that no one in the district may commit or allow a "waste of water," which Kansas law defines, among other things, as (1) the diversion or withdrawal of water from a source of supply that is not used or reapplied to a beneficial use or in connection with the place of use authorized by a vested right, an appropriation right, or an approval of application for a permit to appropriate water for beneficial use; (2) the escaping and draining of water intended for irrigation use from the authorized place of use; and (3) the application of water to an authorized beneficial use in excess of the needs for this use.
    - Per K.A.R. 5-25-9. If the "waste of water" occurs, this regulation authorizes GMD #5's board of directors or manager to file a complaint alleging waste and gives the district 30 days to investigate any reported waste. The district can thereafter direct the wasteful user to take corrective action and seek an injunction against the water use if the affected user fails to comply with the district's directive.
- GMD #5 will exercise its authority to acquire water rights under K.S.A. 82a-1028(f). The KGMDA authorizes GMD #5 to use eminent domain to acquire "land and interests in land," which under Kansas law includes a user's water right. Any water rights acquired through eminent domain would be retired to achieve reduction goals under this objective.

Any additional water right retirements needed to meet the purpose and need of this project will be evaluated by the adaptive management committee in subsequent review years.

Adaptive Management

Adaptive management is a structured, data-driven approach that will provide a basis for making project adjustments that minimize environmental and social impacts while assuring accountability and meeting the purpose and need. The project's purpose and need involves providing long-term, sustainable water management within the Rattlesnake Creek subbasin of GMD #5, including project components to meaningfully address the impairment at Quivira NWR.

An adaptive management approach that increases scientific knowledge through continued monitoring and analysis with a commitment to engage in future actions, where needed, is proposed for achieving the purpose and need through this alternative. The long-term success of this project will depend on future climatic conditions, which are inherently unknown and may not be consistent with historical averages. Adaptive management is necessary so that adjustments can be made in the face of these uncertainties as the effectiveness of management decisions and other events are observed in practice.

The Augmentation Wellfield and Groundwater Use Reduction Alternative will incorporate an Adaptive Management Plan (AMP), which is a multiagency decision-making approach based on analysis of monitored conditions to inform management effectiveness. The AMP will be evaluated on an annual basis and adjustments will be made, as necessary, based on identified performance metrics. Meeting the purpose and need of the project will be heavily influenced by weather conditions, groundwater levels, water quality, streamflow conditions (i.e., continued depletion), and under this alternative, wellfield operation effectiveness. Prolonged periods of drought or above-average precipitation may provide an incorrect assessment of project success or failure. Implementing adaptive management will increase long-term project success while also meeting the purpose and need.

An adaptive management approach that includes a combination of changes in the amount of augmentation water and increases in targeted water right retirements will be used to meet the project purpose and need. Such adjustments will be based on meeting the metrics. Feasibility testing and analysis of the aquifer in the vicinity of the proposed wellfield indicates that adequate water may, within the chloride concentration requirements, be available for augmentation use.

Adaptive management decisions will be made pursuant to a structured agreement between participating agencies that will comprise the Adaptive Management Committee (AMC). The terms of this agreement will be developed following the finalization of the ROD. However, initial agency meetings have occurred to outline the structure of the AMP and a current draft of the AMP is located in Appendix D. Additional state and federal resource agencies would be asked to participate in the adaptive management process as appropriate. Driving factors in the adaptive management discussions will be Quivira NWR's water right impairment and agricultural economic impacts. USFWS maintains its water right and may submit a request to secure water

in the future. KDA-DWR would ultimately be charged with determining whether impairment still exists and to what extent in accordance with Kansas water law.

Because of the gradual nature by which results of any adjustments may be observed and monitored, and the ongoing influences of climatic factors, adjustments in pumping or increases in targeted water retirements will be implemented at intervals based on review of annual data and modeling analysis by the AMC.

Performance Metrics

The success of this alternative (i.e., augmentation wellfield and water right retirements, leases, and transfers) will be measured by performance metrics. These metrics will be based on the finalization of the Operations Manual and AMP during the design phase of the project. Performance metrics and targets are focused on water quality, water quantity, and agricultural water management. These metrics could include elements related to the following items or as determined by the AMC, and are subject to modification and change as needed throughout the life of the project:

- Impacts to sustainable agricultural yields
- Impacts to agricultural economy
- Maintaining water delivery rates and quantity to meaningfully address water demand at Quivira NWR
- Increasing Rattlesnake Creek water flows
- Supporting fish and wildlife habitat downstream of the delivery point
- Maintaining water quality standards
- Downstream impacts to Peace Creek
- Impacts to surrounding water users
- Other metrics as may be identified by the adaptive management committee

The economic impacts considered within the adaptive management approach may be determined by future economic studies or estimated by reductions in water rights. Through the adaptive management approach, adjustments to the augmentation wellfield, water right retirements, water leases, and water transfers may be made. These adjustments would consider many factors including climatic conditions, farming practices, or other unforeseen changes in the region.

Communication, Consultation, and Monitoring Process

The AMC will undergo a thorough communication and consultation process in implementing this alternative. The AMC will memorialize a formal decision-making process and stakeholder engagement milestones to assure decisions are based on the best available information regarding subbasin conditions and potential effects on the NWR. The AMP will specify the monitoring structure and frequency for assessing the performance metrics and the responsible

monitoring agency. Finally, the AMP will specifically establish the decision-making model to identify and implement adjustments as recommended by AMC.

Prior to implementing any such adjustments, the AMC will hold annual meetings for interested stakeholders, where it will present the best available scientific information and data obtained from ongoing monitoring. The AMC will describe any adjustments being considered for the upcoming year and will consider input from stakeholders before such adjustments are made. These meetings are intended to provide an opportunity for participants to share and obtain the most up-to-date information on the project and the status of resources. The AMC will strive to reach consensus recommendations based on monitoring for the purpose of maintaining sustainable agriculture in the subbasin and to meaningfully address the impairment at Quivira NWR.

5.4 Groundwater Use Reduction Alternative

The Groundwater Use Reduction Alternative would rely solely on reductions in groundwater use to reverse current streamflow depletion trends and stabilize streamflow in Rattlesnake Creek. In Kansas, in lieu of direct water right curtailment by KDA-DWR as outlined in the No Action Alternative, reductions in the amount of allowable use by each water user can be accomplished through the development of a LEMA (KDA-DWR 2022c) or an IGUCA (KDA-DWR 2009). Though there are some procedural differences in the way that a LEMA is enacted versus an IGUCA, ultimately, they are both enforceable groundwater use restrictions that are enforced by KDA-DWR.

Local Enhanced Management Area

To aid in water conservation, a LEMA allows groundwater management districts to set groundwater management goals and control measures that water right holders within their districts are required to follow. Groundwater management districts were granted authority to create a LEMA by state law in 2012; however, the LEMA must be approved by KDA-DWR's Chief Engineer (KDA-DWR 2018b).

The groundwater management district develops the LEMA management program and submits it to the Chief Engineer for approval. If the Chief Engineer determines that it is acceptable for consideration, then an initial hearing will be held, and ultimately, the Chief Engineer will issue a decision and order (KDA-DWR 2018b).

Intensive Groundwater Use Control Area

An IGUCA is initiated by the KDA-DWR Chief Engineer, and public hearings are completed to determine whether the IGUCA meets the circumstances of Kansas law and whether one or more corrective control provisions should be adopted (KDA-DWR 2009). Based on information presented and evaluated at the public hearings, the IGUCA boundaries and goals are set, and corrective control provisions are determined.

Quantity of Groundwater Use Reductions

The previously described No Action Alternative includes restricting all water use from water rights junior to Quivira NWR in Zone B. Under the Groundwater Use Reduction Alternative, a larger area is used (Zone A) to reduce water use from a larger number of junior water rights. This approach will avoid complete curtailment from any one water right holder by spreading reductions in water use over a larger area. However, because the Rattlesnake Creek response from Zone A is 10 percent versus 20 percent in Zone B, an increased reduction in water use is required.

KDA-DWR previously determined that a LEMA, which included an augmentation wellfield, would need water use reductions between 15 and 30 percent in Zone A (KDA-DWR 2017c; Appendix A). However, this level of reduction simply served to stabilize streamflow at its current level and would not recover streamflow. In a 2019 response to GMD #5 on its proposed LEMA (KDA-DWR 2019c), KDA-DWR stated that if augmentation did not come online by January 1, 2023, water use in Zone A would be decreased to 150,000 AFY (39 percent reduction in authorized water rights, and a 16 percent reduction from average historic use during 2012-2021). The 39 percent reduction was also meant to stabilize streamflow and an IGUCA request from GMD #5 would be needed to further address water use reductions (KDA-DWR 2019c). This LEMA was not executed, and reductions were not taken.

Further coordination was completed with KDA-DWR in 2022 to determine the quantity of groundwater use reduction required in Zone A for the purposes of this alternative. KDA-DWR identified the quantity of groundwater use reduction at a 60 percent reduction in water use relative to historical use (described below) to recover streamflow to a level that would likely address the impairment of the USFWS water right (KDA-DWR 2022d). KDA-DWR noted that when the stream's baseflow had recovered, additional pumping may be allowed. However, this scenario has not been modeled and would be influenced by climatic factors.

Historical use is the actual amount of water used under the water right and may be less than the actual water right authorization. The historical use was measured as the average water use by water right holders from 2012 to 2021 (KDA-DWR 2022a). The reduction in water use measured by the historical use from the actual water right is the decision of the water right holder. Table 5.4 lists authorized use, the average historical use, and the percent of authorized use for each response zone.

Table 5.4. Water Rights Data (Irrigation Users) Junior to Quivira National Wildlife Refuge by Response Zone (KDA-DWR 2022a).

Response Zone	Water Rights (number)	Water Rights Authorized Use (acre-feet)	2012-2021 Water Rights Average Use (acre-feet)	Percent[1] of Water Right Used	Water Rights Authorized Acres	Average Reported Acres
A	1,487	244,541	178,949	73	221,067	159,132

Response Zone	Water Rights (number)	Water Rights Authorized Use (acre-feet)	2012-2021 Water Rights Average Use (acre-feet)	Percent[1] of Water Right Used	Water Rights Authorized Acres	Average Reported Acres
B	876	138,272	101,657	74	134,410	90,212
C	491	75,796	54,810	72	81,940	49,207
D	275	40,422	28,211	70	48,046	25,876

[1] Percent of water rights authorized use (acre-feet) from 2012-2021 average use.

Because historical use has generally been less than allowable use under existing water rights, the 60 percent reduction in historical use will translate to an approximately 71 percent reduction in authorized quantity of the existing water rights. Under this alternative, average annual groundwater use would be limited to approximately 71,580 acre-feet instead of the 244,541 acre-feet authorized by water rights across Zone A. The allocation could be set under either a LEMA or an IGUCA, and the allocation would be administered by KDA-DWR. The LEMA or IGUCA may include a multiyear allocation allowing each water right holder to choose the appropriate year to use the allocated water.

Additional flexibility could also be possible through the use of the Central Kansas Water Bank Association or through the establishment of a Water Conservation Area (WCA). The general concept of a WCA is to pool water rights so a water right holder can use the total pool of water as desired across all the parcels in a specific pool.

6. ENVIRONMENTAL CONSEQUENCES AND CUMULATIVE IMPACTS

This section describes the impacts that each alternative would have on the human, physical, and biological environment. National Environmental Policy Act (NEPA) requires consideration of the direct, indirect, and cumulative impacts of a proposed action and its alternatives on the environment.

- **Direct effects** are those that are caused by the action and occur at the same time and place.
- **Indirect effects** are those that are caused by the action and occur later or farther away (off-site) but are still reasonably foreseeable.
- **Cumulative impacts** are defined as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such actions.

Each section in this chapter includes discussion of the direct, indirect, and cumulative impacts for resources potentially affected by the project. To effectively evaluate the significance of impacts, it is important to establish a baseline against which to compare the impacts of the action alternatives. The No Action Alternative represents the likely scenario if one of the action alternatives is not selected (FWOP) and will be used as the baseline to compare the action alternatives. The No Action Alternative is a future condition that has not yet occurred; therefore, to provide additional context for potential impacts, the action alternatives are compared against the No Action Alternative and against existing conditions. The No Action Alternative is singularly compared against existing conditions.

To aid in measuring the degree of impact on a resource the following definitions were used:

- **No Effect**: There would be no measurable or perceptible impact.
- **Negligible Effect**: The impact would be inconsequential and barely perceptible.
- **Minor Effect (short-term)**: The impact would be measurable or perceptible but would be slight and would only affect a limited area of a resource or group of resources over a limited period of time.
- **Minor Effect (long-term)**: The impact would be measurable or perceptible, but would be slight and would only affect a limited area of a resource or group of resources over an extended period of time.
- **Moderate Effect**: The impact would be measurable and perceptible.
- **Major Effect**: The impact would be substantial, noticeable, and permanent.

In addition, a qualifier was assigned to illustrate whether the degree of impact is positive or negative.

- **Beneficial**: The impact would be positive and improve the quality of the resource.
- **Negative**: The impact would adverse and detrimental to the quality of the resource.

The Comparison of Environmental Consequences table below (Table 6.0) provides a side-by-side summary comparison of the environmental effects and degree of impact determination for the No Action Alternative, Augmentation Wellfield and Groundwater Use Reduction Alternative, and the Groundwater Use Reduction Alternative. Impacts to identified resources are further explained in the following sections.

Table 6.0. Comparison of Environmental Consequences.

Affected Environment Category	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Geology and Soils	No ground disturbance will occur.	Ground disturbance activities for construction of the augmentation wellfield will result in soil disturbance and potential soil loss. This will be mitigated with the use of erosion control devices and disturbances should generally occur in previously disturbed areas.	No ground disturbance will occur.
Determination Compared to No Action Alternative	*N/A*	*Negative Minor Effect (short-term)*	*No Effect*
Determination Compared to Existing Conditions	*No Effect*	*Negative Minor Effect (short-term)*	*No Effect*
Aquifers and Sole Source Aquifers	The decrease in groundwater withdrawals would have a beneficial impact (32,400 AFY) to the Great Bend Prairie Aquifer.	The predicted reduction in aquifer storage resulting from augmentation pumping is 950-980 acre-feet per year (AFY), depending on wellfield configuration. The impact of this reduction in aquifer storage on water levels in the aquifer increased over time and depended on augmentation demands. Long-term changes in water levels caused by operation of the wellfield are anticipated to be a decline of approximately 5-10 feet over the projected 50-year project life in the vicinity of the wellfield. This includes the USFWS owned Hornbaker Tract which is expected to be within the 0.5-2 foot drawdown (depending on wellfield configuration and quantity of pumping).	The decrease in groundwater withdrawals would have a beneficial impact (46,400 AFY) to the Great Bend Prairie Aquifer.
Determination Compared to No Action Alternative	*N/A*	*Negative Minor Effect (long-term)*	*Beneficial Minor Effect (long-term)*
Determination Compared to Existing Conditions	*Beneficial Minor Effect (long-term)*	*Negative Minor Effect (long-term)*	*Negligible Effect*
Climate	Water right retirements (101,657 acre-feet) would reduce carbon dioxide emissions by 58,418 metric tons (MT) per year.	Net energy usage from the augmentation wellfield (with an electrical power source) and the targeted retirements would reduce carbon dioxide emissions by 1,436 MT per year.	Water right retirements (107,369 acre-feet) would reduce carbon dioxide emissions by 61,700 MT per year.

Affected Environment Category	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Determination Compared to No Action Alternative	*N/A*	*Negative Minor Effect (long-term)*	*Negligible Effect*
Determination Compared to Existing Conditions	*Beneficial Minor Effect (long-term)*	*Beneficial Minor Effect (long-term)*	*Beneficial Minor Effect (long-term)*
Historic Properties	No ground disturbance will occur.	Although ground disturbance will occur, no historic properties will be impacted. If archaeological resources are discovered during construction, proper mitigation and notification procedures will be followed and resources will be avoided.	No ground disturbance will occur.
Determination Compared to No Action Alternative	N/A	No effect	No effect
Determination Compared to Existing Conditions	No effect	No effect	No effect
Socioeconomics	The curtailment of junior water rights within Zone B has the potential to affect 90,212 acres of currently reporting irrigated croplands. Net farm income would decrease on average by $5 million annually. Total jobs lost is estimated at 154.	Net farm income under the Augmentation Wellfield and Groundwater Use Reduction Alternative would increase on average by $4.9 million annually, relative to the No Action Alternative. This alternative is expected to maintain 107 jobs that would be lost under the No Action Alternative.	Net farm income would decrease on average by $1.4 million annually, relative to the No Action Alternative. Employment is expected to decrease by two jobs annually relative to the No Action Alternative.
Determination Compared to No Action Alternative	*N/A*	*Beneficial Major Effect*	*Negative Minor Effect (long-term)*
Determination Compared to Existing Conditions	*Negative Major Effect*	*Negative Minor Effect (long-term)*	*Negative Major Effect*
Parklands and Natural Areas	Increased supply of water to Quivira National Wildlife Refuge (NWR) will support the recreational opportunities available there.	Increased supply of water to Quivira NWR will support the recreational opportunities available there.	Increased supply of water to Quivira NWR will support the recreational opportunities available there.
Determination Compared to No Action Alternative	*N/A*	*Negligible Effect*	*Negligible Effect*

Affected Environment Category	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Determination Compared to Existing Conditions	*Beneficial Major Effect*	*Beneficial Major Effect*	*Beneficial Major Effect*
Land Cover and Land Use	Although no ground disturbance will occur, the 90,212 acres of currently reporting irrigated croplands will need to be converted to a nonirrigated land use (i.e., dryland cultivated cropland, pasture/hay) following the water right curtailment. Distribution of and total acres of land cover classifications should not be significantly affected.	Land cover and land use changes will be highly localized and limited to 5.6 acres within easements surrounding well sites and 2,300 acres will be converted to a nonirrigated land use (i.e., dryland cultivated cropland, pasture/hay) following the water right retirements. Distribution of and total acres of land cover classifications should remain unchanged.	No ground disturbance will occur, and because farmers in Zone A would be allowed to maintain some level of groundwater pumping, any transition from agricultural land use would not be expected. A mixture of irrigation and dryland farming practices would be supported by reduced groundwater pumping.
Determination Compared to No Action Alternative	*N/A*	*Negligible Effect*	*Negligible Effect*
Determination Compared to Existing Conditions	*Negligible Effect*	*Negligible Effect*	*Negligible Effect*
Prime Farmland	Curtailment of junior water rights within Zone B would lead to changes in farming practices to less water-intensive forms of agriculture. However, the use of this land for agriculture is expected to be maintained; permanent conversion of prime farmland from agricultural to nonagricultural land use is possible but not expected.	Conversion of prime or unique farmland will be highly localized and limited to the 5.6 acres within easements surrounding well sites. Drawdown from the augmentation wellfield has the potential to cause a slight decrease in crop productivity near the well sites; however, prime farmland status should be maintained.	No ground disturbance will occur, and because farmers in Zone A would be allowed to maintain some level of groundwater pumping, permanent conversion of prime farmland from agricultural to nonagricultural land use is not expected.
Determination Compared to No Action Alternative	*N/A*	*Negative Minor Effect (long-term)*	*No Effect*
Determination Compared to Existing Conditions	*No Effect*	*Negative Minor Effect (long-term)*	*No Effect*

Affected Environment Category	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Surface Water Resources and Water Quality	Curtailment of the 810 junior water rights (90,212 acres) within Zone B would result in an average increase in baseflow of 23,400 AFY in Rattlesnake Creek over the 53-year simulation period. Quality of habitat for streams and wetlands would be improved.	Net increase (augmentation deliveries plus increases from water right retirements) to downstream Rattlesnake Creek would be approximately 6,500 AFY. Wetland habitat downstream of the augmentation deliveries would be improved. The total reduction in streamflow to all streams would range between 1,560 AFY to 2,060 AFY. Wetlands in the vicinity of the augmentation wellfield could have decreased surface hydrology within the cone of depression but are anticipated to retain their wetland status. Changes in water quality may occur.	A 60 percent reduction in pumping by all groundwater users in Zone A would result in an average increase in baseflow of 18,800 AFY over the 53-year simulation period. Quality of habitat for streams and wetlands would be improved. Water quality could be improved by decreasing surface runoff.
Determination Compared to No Action Alternative	*N/A*	*Upstream Rattlesnake Creek: Negative Moderate Effect (due to continued pumping in Zone B); Downstream Rattlesnake Creek: Negligible Effect (benefits to surface water resources would be similar but not as beneficial as the No Action Alternative)* *Negative Minor Effect (long-term from reductions in streamflow and changes to water quality).*	*Negligible Effect (benefits to surface water resources would be similar to the No Action Alternative)*
Determination Compared to Existing Conditions	*Beneficial Major Effect*	*Beneficial Moderate Effect (from baseflow increases), Negative Minor Effect (long-term from reductions in streamflow and changes to water quality).*	*Beneficial Major Effect*
Regional Water Resource Plans	No impacts or changes to existing regional water resource plans would occur.	No impacts or changes to existing regional water resource plans would occur.	Would affect existing regional water resource plans through the establishment of a new Local Enhanced Management Area (LEMA) or Intensive Groundwater Use Control Area (IGUCA). This would be supported by the existing framework Regional Water Resource Plans.
Determination Compared to No Action Alternative	*N/A*	*No Effect*	*Negligible Effect*

Affected Environment Category	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Determination Compared to Existing Conditions	*No Effect*	*No Effect*	*Negligible Effect*
Riparian Areas	No ground disturbance will occur. Reductions in groundwater pumping will lead to increased stream levels, which would benefit the existing 5,516 acres of riparian areas in Zone B.	Water right retirements will lead to increased stream levels that will have varying benefits (depending on proximity) to the 3,340 acres of riparian areas in Zone D. Positive impacts to riparian areas will occur downstream of the delivery point in Rattlesnake Creek. Pipeline construction will have direct impacts to 2.9 acres of riparian areas. Drawdown from the augmentation wellfield will result in indirect impacts to riparian areas. Potential changes in vegetation may cause a shift in species composition.	No ground disturbance will occur. Reductions in groundwater pumping will lead to increased stream levels, which would benefit the existing 9,556 acres of riparian areas in Zone A.
Determination Compared to No Action Alternative	*N/A*	*Negligible Effect (benefits to riparian areas would be similar to the No Action Alternative)* *Negative Minor Effect (short-term from construction and long-term from augmentation wellfield drawdown)*	*Negligible Effect (benefits to riparian areas would be similar to the No Action Alternative)*
Determination Compared to Existing Conditions	*Beneficial Minor Effect (long-term)*	*Negative Minor Effect (short-term from construction and long-term from augmentation wellfield drawdown)* *Beneficial Minor Effect (long-term) to Rattlesnake Creek (increased stream levels from augmentation and water right retirements).*	*Beneficial Minor Effect (long-term)*
Fish and Wildlife Resources	Cessation of pumping in Zone B will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability would increase habitat availability for multiple aquatic, avian, and terrestrial species.	Downstream Rattlesnake Creek wetland habitat would be enhanced by increased surface waters from water right retirements and augmentation deliveries. Temporary impacts to wildlife habitat will occur as a result of construction; however, no permanent impacts to wildlife are expected. Water provided by the augmentation wellfield would be different from natural water delivered by Rattlesnake Creek, which may affect species composition for fish and wildlife species.	Reduction of pumping in Zone A will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability would increase habitat availability for multiple aquatic, avian, and terrestrial species.

Affected Environment Category	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Determination Compared to No Action Alternative	*N/A*	*Negligible Effect (benefits to fish and wildlife resources would be similar to the No Action Alternative)* *Negative Minor Effect (short-term from construction and long-term from differences between surface water and groundwater)*	*Negligible Effect (benefits to fish and wildlife resources would be similar to the No Action Alternative)*
Determination Compared to Existing Conditions	*Beneficial Moderate Effect*	*Negative Minor Effect (short-term from construction and long-term from differences between surface water and groundwater)* *Beneficial Moderate Effect to downstream Rattlesnake Creek (as a result of increased stream levels from augmentation deliveries and water right retirements).*	*Beneficial Moderate Effect*
Invasive Species	No ground disturbance will occur. The No Action Alternative would not contribute to the introduction, spread, or persistence of invasive species.	Construction of the augmentation wellfield and associated pipeline system would involve a maximum of 179 acres of ground disturbance. Construction and land disturbance activities may inadvertently serve as transportation or introduction vectors for invasive plant species. Implementation of construction best management practices (BMPs) would minimize the risk of the spread or introduction of invasive plant species.	No ground disturbance will occur. The Groundwater Use Reduction Alternative would not contribute to the introduction, spread, or persistence of invasive species.
Determination Compared to No Action Alternative	*N/A*	*Negligible Effect*	*No Effect*
Determination Compared to Existing Conditions	*No Effect*	*Negligible Effect*	*No Effect*

Affected Environment Category	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Threatened and Endangered Species	Cessation of pumping in Zone B will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability could increase habitat availability for threatened and endangered species.	Downstream Rattlesnake Creek wetland habitat would be enhanced by increased surface waters from water right retirements and augmentation deliveries.. Temporary impacts will occur as a result of construction; however, no permanent impacts to threatened and endangered species are expected as a result of construction and operation of the augmentation wellfield. The change of water supply from surface water to pumped groundwater may cause habitat changes downstream of the delivery point that could potentially result in impacts to threatened and endangered species and their habitat.	Reduction of pumping in Zone A will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability could increase habitat availability for threatened and endangered species.
Determination Compared to No Action Alternative	*N/A*	*Negligible Effect (benefits to threatened and endangered species habitat would be similar to the No Action Alternative)* *Negative Minor Effect (short-term from construction and long-term from differences between surface water and groundwater)*	*Negligible Effect (benefits to threatened and endangered species habitat would be similar to the No Action Alternative)*
Determination Compared to Existing Conditions	*Beneficial Minor Effect (long-term)*	*Negative Minor Effect (short-term from construction and long-term from differences between surface water and groundwater)* *Beneficial Minor Effect (long-term as a result of increased stream levels from augmentation deliveries and water right retirements).*	*Beneficial Minor Effect (long-term)*
Migratory Birds, Bald Eagles, and Golden Eagles	Cessation of pumping in Zone B will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability would increase habitat availability for migratory bird and eagle habitat.	Ground disturbance and construction activities could result in temporary impacts. Protective measures will be put in place and no permanent impacts are anticipated as a result of construction. Increased water availability to downstream Rattlesnake Creek and Quivira NWR would support nesting, feeding, and resting habitat for migratory birds and eagles.	Reduction of pumping in Zone A will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability would increase habitat availability for migratory bird and eagle habitat.

Affected Environment Category	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Determination Compared to No Action Alternative	*N/A*	*Negligible Effect (benefits to migratory bird and eagle habitat would be similar to the No Action Alternative)* *Negative Minor Effect (short-term from construction)*	*Negligible Effect (benefits to migratory bird and eagle habitat would be similar to the No Action Alternative)*
Determination Compared to Existing Conditions	*Beneficial Minor Effect (long-term)*	*Negative Minor Effect (short-term from construction)* *Beneficial Minor Effect (long-term as a result of increased stream levels from augmentation deliveries and water right retirements).*	*Beneficial Minor Effect (long-term)*
Significant Scientific Features	No ground disturbance would occur. Implementation of the No Action Alternative would benefit the refuge by contributing to the stabilization of streamflow in Rattlesnake Creek. By curtailing groundwater pumping in Zone B, baseflow in Rattlesnake Creek would increase over time and result in additional water availability within Quivira NWR, resulting in improved water supply to support the refuge's unique wetland habitat.	Ground disturbance activities would occur outside of the boundaries of Quivira NWR and would have no impacts to significant scientific features. Changes in discharge to Rattlesnake Creek along the entire reach versus pumped to a single location may cause differences in minerals, nutrients, pollutants, and biotic components. These differences in water composition should be minimized as water flows into Rattlesnake Creek and is mixed in Little Salt Marsh. Deliveries from the augmentation wellfield will increase baseflow and result in additional water availability within Quivira NWR, resulting in improved water supply to support the refuge's unique wetland habitat.	No ground disturbance would occur. Implementation of the Groundwater Use Reduction Alternative would benefit the refuge by contributing to the stabilization of streamflow in Rattlesnake Creek. By reducing groundwater pumping in Zone A, baseflow in Rattlesnake Creek would increase over time and result in additional water availability within Quivira NWR, resulting in improved water supply to support the refuge's unique wetland habitat.
Determination Compared to No Action Alternative	*N/A*	*Negligible Effect (benefits to significant scientific features would be similar to the No Action Alternative)* *Negative Minor Effect (long-term from differences between surface water and groundwater)*	*Negligible Effect (benefits to significant scientific features would be similar to the No Action Alternative)*
Determination Compared to Existing Conditions	*Beneficial Major Effect*	*Negative Minor Effect (long-term from differences between surface water and groundwater)* *Beneficial Major Effect (as a result of increased water availability within Quivira NWR).*	*Beneficial Major Effect*

Cumulative Effects Analysis

Cumulative effects consider past, present, and reasonably foreseeable future effects. Impacts associated with agricultural practices and the regional economy, and those resulting in long-term declines in the levels and quality of groundwater and aquifer storage as a result of irrigation pumping, are cumulatively considerable when added to other past, present, and reasonably foreseeable future actions. The sections below detail the past, present, and reasonably foreseeable future effects within the project area and were also included in the resource sections where they would contribute to a cumulative effect.

Past/Present

Farming and Economy

Farming in Kansas dates back to the 19th century and agriculture has historically been a significant driver of the Kansas economy. In the 1850s, settlers from the eastern United States and Europe brought seeds of crops and farming traditions to Kansas. Wheat was established as an extensively successful crop to grow in Kansas, and the state became known as the “Wheat State,” Advances in farming techniques and technology allowed farmers to expand their farm size and crop margins, which have progressed over time as Kansas has become an agricultural powerhouse (KHS 2016). Today, Kansas is a leading state in crop and livestock production; the most profitable products consist of winter wheat, grain sorghum, and beef cattle (KDA 2024). Farms in Kansas are primarily family-owned, with 93 percent of farms falling under a family ownership structure in 2022. According to the 2022 USDA Census of Agriculture, Kansas farms encompass more than 85 percent of the land area in Kansas, with 55,734 farms that generated approximately $24 billion in market value of agricultural products sold in 2022 (USDA 2024). Irrigated farmland has a substantial impact on the economy in GMD #5. Irrigation increases crop production, which has a direct economic benefit to the producer and has an indirect benefit to livestock production and agribusinesses (Hendricks et al. 2018).

Population

The population of rural Kansas peaked approximately 50 years ago, and regions such as the Rattlesnake Creek Watershed continue to see a decline in population. The small levels of population growth in Kansas are concentrated in the eastern half of the state in and near larger urban areas (Brown 2023). According to the USCB, all seven counties that fall within the Project area recorded population decreases between 2010 and 2020 (USCB 2023).

Water Resources (disappearing perennial stream reach)

Perennial streams in Kansas have shown a decrease in total length since the 1960s, particularly in western Kansas. The upper reaches of many perennial streams (including Rattlesnake Creek and Peace Creek) have become intermittent. This loss is driven by declining water tables that fail to supply groundwater to streams. This water loss from aquifer storage is partially because of historical groundwater withdrawals for irrigation (Angelo 1994; Juracek and Eng 2017).

Section 4.10 in Affected Environment provides additional detail about perennial stream trends in Kansas.

Water Right Restrictions/Moratorium on Water Rights in GMD #5

Water right development began in the GMD #5 region during the 1940s and significantly expanded between 1970 and 1980 with the adoption of the center pivot irrigation system. GMD #5 was formed in March 1976 under the authority of K.S.A. 82a-1020 et seq. After the 1980s, water right development slowed considerably until GMD #5 formally closed to new appropriations in 1993 (K.A.R. 5-25-4). Additional information about the history of GMD #5 can be found in Section 1.2.

Rattlesnake Creek Declines and Quivira NWR

The Rattlesnake Creek subbasin, which includes Quivira NWR, is approximately 800,000 acres in size. The landscape is primarily dominated by agriculture, where on average 160,000 acres are irrigated per year (KDA-DWR 2016). Agricultural groundwater irrigation makes up approximately 89 percent of total active groundwater rights in the subbasin. The USFWS holds Water Right File Number 7,571, which was filed on August 15, 1957, and approved in 1963, for the management of Quivira NWR. This water right, which is senior in priority to approximately 95 percent of all other water rights in the Rattlesnake Creek subbasin, entitles Quivira NWR to divert up to 14,632 AFY of surface water from Rattlesnake Creek. USFWS has filed requests to secure water in 2018, 2019, and 2023.

Based on the Balleau model, annual flow in Rattlesnake Creek was generally between 30 and 60 cfs in the 1940s and 1950s, prior to the increase in active water rights in GMD #5 that occurred in the 1970s and 1980s. By 2020, the modeled baseflow was significantly reduced and by 2075, the modeled baseflow (portion of streamflow from groundwater) would be reduced to near zero cfs (KDA-DWR 2019a). This reduction in flow in Rattlesnake Creek has contributed to shortages of water available to Quivira NWR during certain years and periods of those years, making it more difficult for the refuge to fulfill its purpose and management objectives (USFWS 2013a).

Reasonably Foreseeable Future Actions

KDA-DWR Administration

KDA-DWR issued a final report of its impairment investigation on July 16, 2016, finding that Quivira NWR water supply “has been regularly and substantially impacted by junior [water right holders] groundwater pumping” (KDA-DWR 2016). Therefore, the USFWS can file a request to secure water because of the impairment finding. USFWS has filed requests to secure water in 2018, 2019, and 2023. The most likely foreseeable future action in the absence of a PL 83-566 project is that KDA-DWR would then administer the water right consistent with K.S.A. 82a-706b.

Regional Economic Decline

As discussed above, in the absence of a PL 83-566 project, USFWS will file a request to secure water and KDA-DWR will administer the water right. Although the exact method of administration is not determined at the time of this writing, the administration enforced by KDA-DWR will entail a cessation of pumping by junior water right users. This action would require all water rights junior to the USFWS senior water right to cease groundwater pumping. Curtailing junior water rights will reduce crop productivity, leading to reductions in net farm income. Because the agricultural industry is a primary driver for economic activity in this region, the economic impact of a reduction in net farm incomes would result in notable impacts to the larger regional economy.

Climate

Climate projections indicate that summer temperatures across the Great Plains region will increase over the next century. The southern Great Plains region is expected to experience fewer severe increases in temperatures compared to northern states but experience a significantly drier climate (NOAA 2022). Specifically in southwestern and south-central Kansas, in the vicinity of the Rattlesnake Creek Watershed, summer temperatures are expected to increase, and spring precipitation amounts are expected to decrease. By midcentury, temperature levels are projected to exceed historical record levels regardless of emission pathways (NOAA 2022). These expected changes, and their impacts on Kansas' agricultural community, are complex and often interrelated. Irrigation, water conservation, and impacts to streamflow are affected by droughts, which means longer and/or more intense droughts may further the need for water conservation measures in the future.

Streamflow Decreases in Rattlesnake Creek

Under the baseline future condition presented in the Balleau analysis (Balleau 2010), annual streamflow (baseflow plus runoff) at the Zenith gage would fall below 14,632 AFY approximately 67 percent of the time. This is an annual volume that doesn't consider the intra-annual timing of when water is desired under the USFWS's management plans, so there would likely be additional years where these intra-annual targets are not met. Streamflow in Rattlesnake Creek is projected to continue to decline until 2040 and will stabilize at around 13 cfs of streamflow (streamflow is anticipated to come from runoff only at this time and baseflow contributions from groundwater will be zero [KDA-DWR 2019b]).

6.1 Geology and Soils

Information on aquifers and sole source aquifers is found in Section 6.2.

6.1.1 No Action Alternative

The No Action Alternative would not require ground disturbance or construction that would affect geology or soils. The curtailment of junior water rights in Zone B would lead to changes in farming practices that include conversion of irrigated crops to less water-intensive forms of agriculture, including dryland farming, pasture, or grazing systems (See Section 6.8 Prime Farmland). Conversion to pasture or cattle grazing systems would result in increases in soil stability and reduced soil loss through the establishment of permanent vegetation. Minor impacts such as changes to overall trends in soil moisture conditions may occur. However, dryland farming is common in the region and would likely support profitable yields and continue to persist. Dryland farming is more susceptible to wind erosion; however, with proper management, soil erosion potential can be decreased.

Increases in groundwater levels associated with reductions in Zone B pumping would increase groundwater to soil interactions. This is dependent on current groundwater depth and the increases to groundwater depth associated with reductions in pumping.

Indirect and Direct Effects Determination

No ground disturbance would occur; therefore, the No Action Alternative would have no effect on geology or soils compared to existing conditions.

6.1.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

The augmentation wellfield and associated pipeline installations would require ground disturbance and construction activities. The wellfield installation would require drilling into the existing geology and maintaining a permanent conduit to groundwater. Groundwater supplied to Rattlesnake Creek would be low in suspended sediment. Because of the lack of sediment, augmented flows could increase streambank erosion near the point of delivery as a result of sediment-starved (hungry) water. The well depth is anticipated to be up to 100 feet. Installation activities would occur within a half-acre area of a well and within a 40-foot buffer of a pipeline. The total maximum disturbed area would be approximately 179 acres (maximum under the expanded wellfield option). Construction impacts would exceed 1 acre and would require a stormwater pollution prevention plan (SWPPP) permit issued by KDHE. The SWPPP permit would require that preventive measures are installed that would reduce soil loss. Following installation, the disturbed ground would be reseeded, stabilized, and generally restored to preconstruction condition within one to three years except for the immediate vicinity of the well and any access roads. Impacts to soils would result in soil loss where soil disturbance occurs; however, losses would generally be minimal compared to cultivation activities. Cultivation activities exist within the proposed wellfield area and depending on the site selection, disturbances may occur where cultivation activities are ongoing.

The augmentation wellfield cone of depression would cause a reduction to groundwater levels of up to 5-10 feet in the immediate vicinity of the augmentation wellfield. Depending on total aquifer depth, groundwater interactions with soil layers could be reduced. In contrast, under the No Action Alternative, reductions in pumping would increase aquifer depth in Zone B and increase groundwater interactions with soil layers.

Water Right Retirements

The 2,500 AFY of water right retirements will result in a similar scenario as the No Action Alternative. The water right retirements could lead to changes in farming practices that include conversion of irrigated crops to less water-intensive forms of agriculture, including dryland farming and pasture or cattle grazing systems.

Indirect and Direct Effects Determination

Ground disturbance activities for construction of the augmentation wellfield will result in soil disturbance and potential soil loss. These impacts are direct effects related to construction activities and would cease following wellfield and pipeline construction. This will be mitigated with the use of erosion control devices and disturbances should generally occur in previously disturbed areas. Therefore, the Augmentation Wellfield and Groundwater Use Reduction Alternative would have a minor effect (short-term) on geology and soils compared to the No Action Alternative or compared to existing conditions.

6.1.3 Groundwater Use Reduction Alternative

Similar to the No Action Alternative, the Groundwater Use Reduction Alternative would not result in any ground disturbance or construction activities that would affect geology or soils. The Groundwater Use Reduction Alternative would result in reductions in water rights over a larger area than the No Action Alternative, but the reductions would be less severe and farther from the high-impact zone next to Rattlesnake Creek. Depending on how the LEMA or IGUCA is established, water right holders in Zone A would have reductions in their water rights but would maintain some level of irrigation. Because some level of pumping would still be allowed, farmland conversion to pasture or cattle grazing systems would be unlikely. The farming practices would be a mixture of irrigation and dryland systems instead of a straight irrigation system. Soil disturbances would not increase or decrease under the Groundwater Use Reduction Alternative and there would be minimal changes in soil loss.

Increases in groundwater levels associated with reductions in Zone A pumping are anticipated to increase groundwater to soil interactions. This is dependent on current groundwater depth and increases to groundwater depth associated with reductions in pumping.

Indirect and Direct Effects Determination

No ground disturbance would occur; therefore, the Groundwater Use Reduction Alternative would have no effect on geology or soils compared to the No Action Alternative or compared to existing conditions.

6.1.4 Cumulative Impacts

Within the geographic scope of analysis, activities that cumulatively affect geology and soils are related to agricultural activities, which include farming and cattle grazing. Based on NLCD data, 92 percent of the land cover within the project area is either cultivated crops (farming) or herbaceous (cattle grazing). Farming practices result in annual soil loss from crop fields. Land use conversion from farming to other land uses would result in a reduction in soil loss if the new land use had less soil loss than the existing land use. For example, conversion from farming to haying or grazing operations would result in less soil loss. Conversion from irrigated to nonirrigated would result in minimal changes in soil loss. Minor impacts such as changes to overall trends in soil moisture conditions may occur as a result of decreased water withdrawals associated with farming but are not anticipated to have a substantial impact on soil health.

Changes in groundwater levels from either a reduction in pumping or increase in pumping may impact soil to groundwater interactions. Prolonged groundwater saturation can promote hydric conditions and facilitate wetland formation.

Cumulative Effects Determination

The alternatives considered are not anticipated to significantly contribute to cumulative geology and soil impacts because there would be no significant soil loss as a result of implementation of any of the alternatives. The minor (short-term) effects as a result of construction of the augmentation wellfield would not contribute to cumulative impacts to soils from farming practices.

6.2 Aquifers and Sole Source Aquifers

Aquifers and sole source aquifers are discussed below. Refer to Section 6.9 for surface water resources, water quality descriptions, streams, and wetlands.

6.2.1 No Action Alternative

Under the No Action Alternative, all water rights junior to Water Right File Number 7,571 within Zone B (which includes zones C and D) would be required to cease groundwater pumping. Of the 876 total water rights within Zone B, 810 water rights, totaling 109,000 irrigated acres, are junior to Water Right File Number 7,571. A shutdown of the 810 junior water rights or 92 percent of the water rights in Zone B would increase the water level in the Great Bend Prairie Aquifer. According to analysis conducted by Balleau, the No Action Alternative would result in an average increase in aquifer storage of 32,400 AFY over the 53-year simulation period (Balleau 2022). This result equates to approximately 41 percent of the net reduction in groundwater

pumping in Zone B, which averaged 79,900 AFY. The term “net reduction in groundwater pumping” refers to the total groundwater pumped minus the portion that returns to the aquifer as recharge.

The increase in groundwater or aquifer levels would vary based on proximity to Rattlesnake Creek and the relative level of historical pumping at any location within Zone B. Groundwater level increases would be relatively small in proximity to Rattlesnake Creek because groundwater pumping depletes baseflow at a higher proportion than aquifer storage in proximity to streams. Therefore, any reduction in groundwater pumping close to Rattlesnake Creek will not result in as large of an increase in groundwater levels as pumping reductions farther from the stream. This concept is explained in Section 1.2. However, based on the total area of Zone B (408,300 acres), and the fact that most of the increase in aquifer storage would occur in Zone B (because it is located farther from Rattlesnake Creek), and assuming a porosity of 20 percent, the simulated increase in aquifer storage would equate to an average water level increase of approximately 5 inches per year across Zone B (32,400 acre-feet/408,300 acres x 12 inches per foot /0.2 [porosity]= 4.75 inches), though water level increases would be more rapid in the short term and taper off over the long term. Conversions from irrigated to nonirrigated agriculture would result in reductions in fertilizer and pesticide application. These reductions would result in fewer chemicals and nutrients available to enter the aquifer and lead to improvements in aquifer water quality over time.

Indirect and Direct Effects Determination

The decrease in groundwater withdrawals would have a beneficial impact to the Great Bend Prairie Aquifer; therefore, the No Action Alternative would have a beneficial minor effect (long-term) on the Great Bend Prairie Aquifer compared to existing conditions.

6.2.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, an augmentation wellfield consisting of up to 56 wells would provide up to 15 cfs throughout any year, as needed, and an additional 3 cfs during critical time periods, as needed. The potential wellfield configurations are described in Section 5. Note that augmentation well sites (battery of two wells per site) are expected to be spaced approximately one-quarter to one-half mile apart and pump at a combined rate of 290 gpm.

As a result of the augmentation pumping, aquifer storage in the vicinity of the wellfield would be affected. For example, aquifer testing completed as part of this Plan – EIS produced a drawdown of the water table of approximately 1 foot in an observation well located 300 feet from the pumping well. The 1-foot drawdown was caused by pumping at a rate of 500 gpm for 24 hours. Water levels recovered rapidly (within 24 hours) following the cessation of pumping

during the aquifer tests. Further information on the aquifer testing conducted as part of this Plan – EIS can be found in the complete technical report (Olsson 2023a).

Because augmentation pumping is only expected to occur on an as-needed basis, water levels in the aquifer in the vicinity of the augmentation wellfield should be expected to fluctuate over time based on the extent (or lack) of recent augmentation pumping amounts. Impacts to water levels in the immediate vicinity of the pumping wells will decrease in magnitude with distance from the wells.

Balleau conducted an analysis of the potential impact in the future of a hypothetical schedule of augmentation pumping based on a future modeled baseline condition, an augmentation capacity of 18 cfs, and the seasonal water demands at Quivira NWR (Balleau 2023a). Based on these factors, the average annual augmentation pumping was estimated to be 5,580 AFY. The predicted reduction in aquifer storage resulting from the augmentation pumping ranged from 950 to 980 AFY, depending on wellfield configuration. The impact of this reduction in aquifer storage on water levels in the aquifer increased over time and depended on augmentation demands at any time. Several snapshots of aquifer drawdowns occurring approximately 50 years into the future indicate a maximum drawdown level of 5 feet in the vicinity of the wellfield during a relatively low pumping period and a maximum drawdown level of 10 feet in the vicinity of the wellfield during a relatively heavy drawdown period (Balleau 2023a). The area of maximum drawdown is generally smaller in the expanded wellfield configuration because the wells are more spread out, thus resulting in less overlap of their respective cones of depression. Maximum drawdowns are confined to the footprint of the wellfield and drawdowns are less with distance from the wellfield. The cone of depression in the water table is generally elongated in the east-west direction; it is constrained by the location of Peace Creek to the north and the North Fork Ninnescah River to the south. In general, drawdown values of 2 feet or greater over a 50-year period are constrained to an area of approximately 80 square miles under the compact configuration or 90 square miles under the expanded configuration (Balleau 2023a).

The augmentation wellfield configurations place the location of the wells within the Gar-Peace Creek and North Fork Ninnescah River watersheds, which are outside the areas affected in the Rattlesnake Creek Watershed by the No Action and Groundwater Use Reduction alternatives. Although the wellfield configurations lie in different watersheds, watershed boundaries have little to do with aquifer extents. Streams within both the Gar-Peace Creek and Rattlesnake Creek watersheds are hydrologically connected to the Great Bend Prairie Aquifer and impacts to aquifer storage because of augmentation pumping will not be limited to the watershed where the pumping occurs. However, proximity of the augmentation wellfield to streams will influence the relative impact of pumping on water levels in Gar-Peace Creek and the North Fork Ninnescah River versus Rattlesnake Creek. As described in Section 6.2.1, the No Action Alternative provides increased aquifer levels as a result of the cessation of pumping associated with the

810 junior water rights in Zone B. These increased aquifer levels would not be realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

In addition to impacts on aquifer storage and baseflow, impacts to neighboring wells from the augmentation wellfield were considered. According to the Water Well Completion database (KGS 2022), there are 57 oil field water supply wells, 30 domestic wells, 13 livestock wells, seven irrigation wells, two industrial wells, one lawn and garden well, and one recreation well in the augmentation wellfield area. Table 6.2.2 includes information on all the wells within the conceptual augmentation wellfield area. The screen interval is the section of the well that interacts with the aquifer and allows water to enter the well column. Static water level is the level of water in the well under nonpumping (static) conditions. The domestic wells range from 50 to 95 feet deep, with the screen intervals typically extending over the bottom 10 to 20 feet of the well. Considering static water levels in the wells and the drawdown results from the aquifer testing completed for this Plan – EIS (1 foot of drawdown in an observation well 300 feet away from a well pumping 500 gpm), wellfield layout could be designed in a way that the distance to any preexisting wells is prioritized to limit potential impacts. Long-term changes in water levels caused by operation of the wellfield are anticipated to be approximately 5-10 feet over the projected 50-year project life in the vicinity of the wellfield. Considering the screen interval data and long-term drawdown estimates caused by operation of the augmentation wellfield, it is not anticipated that any existing wells in the area will suffer detrimental consequences (defined as significantly limiting or eliminating the ability to pump those wells).

Table 6.2.2. Information on Existing Wells Within the Conceptual Augmentation Wellfield Area (KGS 2022).

KGS ID Number	Well Use	Screen Interval (ft bgs[1])	Total Depth (ft bgs)	Static Water Level[2] (ft bgs)	Wellfield Configuration
53585	Domestic	53-73	73	35	Expanded
53587	Oil Field Well	55-75	75	15	Expanded
54305	Oil Field Well	75-95	95	26	Compact/Expanded
54307	Oil Field Well	80-100	100	38	Compact/Expanded
54308	Domestic	66-76	76	24	Compact/Expanded
54343	Oil Field Well	60-120	120	48	Expanded
54346	Domestic	41-51	51	31	Expanded
54347	Oil Field Well	70-80	80	26	Expanded
54348	Oil Field Well	86-96	96	22	Expanded
83532	Domestic	47-57	57	15	Compact/Expanded
83533	Irrigation	68-98	98	21	Compact/Expanded

KGS ID Number	Well Use	Screen Interval (ft bgs[1])	Total Depth (ft bgs)	Static Water Level[2] (ft bgs)	Wellfield Configuration
83534	Domestic	50-60	60	28	Compact/Expanded
83535	Oil Field Well	60-80	80	18	Compact/Expanded
83536	Oil Field Well	40-60	60	10	Compact/Expanded
83544	Domestic	50-60	60	21	Compact/Expanded
83545	Irrigation	39-78	78	19	Compact/Expanded
83546	Domestic	30-50	50	24	Compact/Expanded
83547	Oil Field Well	60-80	80	27	Compact/Expanded
84010	Oil Field Well	70-90	90	N/A[3]	Compact/Expanded
84011	Oil Field Well	160-180	180	50	Compact/Expanded
84013	Oil Field Well	95-115	115	20	Compact/Expanded
84014	Oil Field Well	60-80	80	25	Compact/Expanded
84025	Oil Field Well	55-75	75	30	Expanded
84026	Oil Field Well	45-65	65	17	Expanded
84028	Oil Field Well	70-90	90	N/A	Expanded
84029	Oil Field Well	80-100	100	14	Compact/Expanded
84031	Oil Field Well	60-80	80	22	Expanded
84032	Oil Field Well	62-82	82	19	Expanded
84033	Oil Field Well	60-80	80	N/A	Expanded
84034	Oil Field Well	86-105	105	32	Expanded
84036	Oil Field Well	60-80	80	30	Expanded
84037	Oil Field Well	85-105	105	30	Expanded
84038	Oil Field Well	90-110	110	44	Expanded
84039	Oil Field Well	85-105	105	30	Expanded
84040	Oil Field Well	120-140	140	52	Expanded
84041	Oil Field Well	65-75	75	17	Expanded
84042	Domestic	66-76	76	24	Expanded
84043	Oil Field Well	100-120	120	N/A	Expanded
84044	Oil Field Well	85-105	105	30	Expanded
84046	Domestic	35-55	55	25	Expanded
84047	Oil Field Well	90-110	110	30	Expanded

KGS ID Number	Well Use	Screen Interval (ft bgs[1])	Total Depth (ft bgs)	Static Water Level[2] (ft bgs)	Wellfield Configuration
84048	Irrigation	40-84	84	21	Expanded
84049	Domestic	43-63	63	21	Expanded
84050	Oil Field Well	50-70	70	22	Expanded
84057	Oil Field Well	60-80	80	33	Expanded
84058	Oil Field Well	55-75	75	28	Expanded
84061	Oil Field Well	90-110	110	60	Expanded
84062	Oil Field Well	73-83	83	21	Expanded
84063	Oil Field Well	85-105	105	44	Expanded
84064	Oil Field Well	70-90	90	40	Expanded
84065	Oil Field Well	85-105	105	32	Expanded
84066	Oil Field Well	85-105	105	35	Expanded
84067	Oil Field Well	90-110	110	30	Expanded
84068	Oil Field Well	89-109	109	73	Expanded
84070	Oil Field Well	90-110	110	40	Expanded
84071	Oil Field Well	75-95	95	45	Expanded
84072	Oil Field Well	52-72	72	26	Expanded
84073	Oil Field Well	72-82	82	34	Expanded
84074	Oil Field Well	70-80	80	33	Expanded
84076	Domestic	46-66	66	20	Expanded
84077	Oil Field Well	65-85	85	36	Expanded
84078	Oil Field Well	70-80	90	50	Expanded
84079	Domestic	51-61	61	36	Expanded
84080	Oil Field Well	73-83	73	35	Expanded
84081	Oil Field Well	71-81	81	32	Expanded
84082	Domestic	75-85	85	37	Expanded
84083	Oil Field Well	77-87	87	36	Expanded
116639	Oil Field Well	136-156	156	33	Compact/Expanded
305295	Irrigation	N/A	99	41	Expanded
305296	Irrigation	N/A	87	39	Expanded

KGS ID Number	Well Use	Screen Interval (ft bgs[1])	Total Depth (ft bgs)	Static Water Level[2] (ft bgs)	Wellfield Configuration
305652	Feedlot/Livestock/ Windmill	N/A	76	22	Expanded
308141	Irrigation	N/A	79	15	Expanded
308590	Oil Field Well	N/A	106	45	Expanded
312044	Domestic, Livestock	N/A	92	72	Compact/Expanded
316157	Pond/Swimming Pool/Recreation	N/A	42	8	Compact/Expanded
333407	Domestic	N/A	75	25	Compact/Expanded
339085	Domestic	N/A	62	14	Compact/Expanded
339086	Domestic, Livestock	N/A	64	25	Expanded
349507	Irrigation	N/A	71	20	Expanded
385837	Domestic, Livestock	N/A	64	34	Expanded
391427	Domestic	N/A	65	25	Expanded
464957	Domestic, Livestock	N/A	80	19	Expanded
467421	Domestic	N/A	70	45	Expanded
479166	Oil Field Well	N/A	104	55	Expanded
488819	Oil Field Well	N/A	85	22	Expanded
488859	Oil Field Well	N/A	110	40	Expanded
489844	Domestic, Livestock	50-60	60	13	Compact/Expanded
491191	Industrial	N/A	94	40	Expanded
493328	Domestic, Livestock	N/A	80	21	Expanded
496082	Industrial	N/A	80	43	Expanded
508906	Oil Field Well	N/A	77	17	Compact/Expanded
517290	Domestic, Livestock	N/A	80	41	Expanded
530317	Domestic, Livestock	N/A	62	15	Compact/Expanded
537563	Domestic, Livestock	N/A	76	34	Expanded

KGS ID Number	Well Use	Screen Interval (ft bgs[1])	Total Depth (ft bgs)	Static Water Level[2] (ft bgs)	Wellfield Configuration
538642	Domestic, Livestock	N/A	95	36	Compact/Expanded
543369	Domestic, Lawn and Garden	50-60	60	12	Expanded
543908	Domestic, Livestock	60-80	80	17	Compact/Expanded
552352	Domestic, Livestock	60-80	80	15	Expanded

[1]ft bgs: feet below ground surface [2]Static water level information collected on well completion. N/A: Not Available; KGS: Kansas Geological Survey

Water Right Retirements

This alternative would also involve the retirement of 2,500 acre-feet of irrigation water use within Zone D, where groundwater pumping has at least a 40 percent or greater impact on streamflow. Though the specific water rights (and their locations) have not been determined, any reductions in water use for irrigation will have a positive impact on the Great Bend Prairie Aquifer. This positive impact will be minimal based on the scale of the aquifer.

Indirect and Direct Effects Determination

The reduction in aquifer storage resulting from augmentation withdrawals (950-980 AFY) would have a negative impact to the Great Bend Prairie Aquifer. In comparison to the No Action Alternative, the aquifer benefits described in Section 6.2.1 from reducing the pumping associated with 810 junior water rights in Zone B would not be realized within the Great Bend Prairie Aquifer.

Therefore, the Augmentation Wellfield and Groundwater Use Reduction Alternative would have a negative minor effect (long-term) on the Great Bend Prairie Aquifer compared to the No Action Alternative or compared to existing conditions.

6.2.3 Groundwater Use Reduction Alternative

Under the Groundwater Use Reduction Alternative, all wells located within Zone A with water rights junior to Quivira NWR will be required to reduce their water use by 60 percent. There are 1,487 water rights in Zone A, totaling approximately 221,000 irrigated acres. According to analysis conducted by Balleau, the Groundwater Use Reduction Alternative would result in an average increase in aquifer storage of 46,400 AFY over the 53-year simulation period (Balleau 2022). According to analysis conducted by Balleau, the Groundwater Use Reduction Alternative would result in an increase in aquifer storage over the 53-year simulation period that equates to approximately 49 percent of the net reduction in net groundwater pumping.

The increase in groundwater levels would vary based on proximity to Rattlesnake Creek and the relative level of historical pumping at any location within Zone A. Groundwater level increases

would be relatively small in proximity to Rattlesnake Creek because groundwater pumping depletes baseflow at a higher proportion than aquifer storage. Therefore, any reduction in groundwater pumping close to Rattlesnake Creek will not result in as large of an increase in water levels as pumping reductions farther from the stream. This concept is explained in Section 1.2. However, based on the total area of Zone A (665,600 acres), the fact that most of the increase in aquifer storage would occur in Zone A, and assuming a porosity of 20 percent, the simulated increase in aquifer storage would equate to an average water level increase of about 4 inches per year across Zone A. Water level increases would be greater in areas with a higher density of wells and/or farther from a stream and they will be lower in areas with a low density of wells and/or closer to a stream.

Conversions from irrigated to nonirrigated agriculture would result in reductions in fertilizer and pesticide application. These reductions would result in fewer chemicals and nutrients available to enter the aquifer and lead to improvements in aquifer water quality over time.

Indirect and Direct Effects Determination

The decrease in groundwater withdrawals would have a beneficial impact to the Great Bend Prairie Aquifer; therefore, the Groundwater Use Reduction Alternative would have a beneficial minor effect (long-term) on the Great Bend Prairie Aquifer compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits to the aquifer would be similar but not identical.

6.2.4 Cumulative Impacts

Groundwater levels in the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds have been relatively stable over time (McGuire 2017). Though some modest declines have occurred in the western portions of GMD #5, they are small in comparison to the declines that have occurred in southwestern Kansas, west of GMD #5. Currently, the entirety of GMD #5 is closed to new surface water and groundwater appropriations (K.A.R. 5-25-4); however, K.A.R. 5-25-4 contains an exception [part 10] for augmentation wells. The augmentation wellfield would contribute to cumulative declines in groundwater levels. The ongoing aquifer impacts are based on current levels of agricultural irrigation. Within GMD #5 there are 569,725 authorized irrigated acres and 4,523 water rights with 5,459 points of diversion. The total authorized quantity that these water rights can produce is 768,784 acre-feet of water annually (GMD #5 2022a).

The No Action and Groundwater Use Reduction alternatives are anticipated to result in a reduction in total aquifer pumping and a positive impact to the Great Bend Prairie Aquifer. However, as mentioned above, the groundwater levels have been relatively stable over time and aquifer declines have not occurred to the level or significance as aquifers in western Kansas. Streamflow declines observed in Rattlesnake Creek indicate groundwater declines

have occurred, and these declines would be improved with both the No Action and Groundwater Use Reduction alternatives.

The augmentation wellfield is expected to add about 5,580 acre-feet of pumping on average, and the target water right retirements will total 2,500 acre-feet, for a net increase in aquifer pumping of 3,080 AFY on average. This additional pumping will cause a reduction in aquifer levels that are cumulative to any current aquifer declines.

Cumulative Effects Determination

The No Action and Groundwater Use Reduction Alternatives are anticipated to positively contribute to cumulative aquifer impacts because of the decrease in groundwater withdrawals. The Augmentation Wellfield and Groundwater Use Reduction Alternative would contribute a negative minor cumulative impact to the Great Bend Prairie Aquifer, somewhat offset by the water right retirements. The negative minor impacts would be cumulative to irrigation agriculture in the region.

6.3 Climate

6.3.1 No Action Alternative

The No Action Alternative does not include construction activities that would result in the release of GHG emissions that could contribute to climate change.

Under the No Action Alternative, all water rights junior to Water Right File Number 7,571 within Zone B would be required to cease groundwater pumping. Groundwater pumping results in GHG emissions related to operation and maintenance of wells. The cessation of pumping in Zone B would result in a decrease in GHG emissions.

Though climate science has established a clear relationship between GHG emissions and climate change at a continental to global scale, the Greenhouse Gas Reporting Program (GHGRP) does not estimate contributions to GHG emissions from agriculture (EPA 2023b). The reduction in junior water right pumping and associated reduction in GHG emissions would in a minor way contribute to reductions in climate change on a global scale. Table 6.3.1 illustrates the energy savings that would result from the junior water rights curtailment in Zone B (approximately 101,657 acre-feet based on the average historical use for 2012-2021). In the event that water right users were allowed to resume pumping after streamflow was restored, these values would decrease.

Table 6.3.1. Total Energy Usage Split by Power Source for 101,657 Acre-feet of Groundwater Retirements.

Category	Diesel	Electricity	Natural Gas
Consumed Quantity	768,571 gallons/year	12,825,351 kilowatt-hours/year	833,187 thousand cubic feet/year
Average Unit Energy Content (British thermal unit [BTU])	138,690	3,412	1,020,000
Total Energy Usage (BTU per year)	106,593,089,220	43,760,098,116	849,850,758,162
Carbon Dioxide Emissions (metric tons [MT] per year)	7,903	5,548	44,967
Equivalent Carbon Dioxide Emissions[1]	1,759 gasoline-powered passenger vehicles driven for one year	1,235 gasoline-powered passenger vehicles driven for one year	10,007 gasoline-powered passenger vehicles driven for one year

[1] EPA 2024b

Overall, 101,657 acre-feet of water right retirements would reduce carbon dioxide emissions by 58,418 metric tons (MT) per year (EPA 2024b). Applying the social cost of carbon to this reduction results in an annual benefit of $11.2 million (Abt 2024). Implementation of the No Action Alternative would benefit Quivira NWR by contributing to the stabilization of streamflow in Rattlesnake Creek and restoring hydrologic processes associated with and required by the different communities in the refuge. By restoring hydrological processes and natural water flow patterns in Rattlesnake Creek, and ultimately Quivira NWR, the No Action Alternative would support climate change resiliency in Rattlesnake Creek, in the vicinity of Zone B, and within the refuge.

Indirect and Direct Effects Determination

Water right retirements (101,657 acre-feet) would reduce carbon dioxide emissions by 58,418 MT per year; therefore, the No Action Alternative would have a beneficial minor effect (long-term) on climate compared to existing conditions.

6.3.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

The Augmentation Wellfield and Groundwater Use Reduction Alternative includes construction of an augmentation wellfield to provide groundwater via pipeline to Rattlesnake Creek upstream of Quivira NWR. Construction activities would result in short-term increases in GHG emissions and generate intermittent, short-term carbon dioxide emissions associated with the combustion of gasoline and diesel fuel resulting from the transport of construction materials to the site and operation of construction equipment on-site. To reduce impacts associated with construction,

the contractor will be required to implement standard best management practices (BMP) measures to reduce emissions associated with the transport of materials and use of construction equipment (refer to Section 8.3).

Operation and maintenance of the wellfield over an anticipated 50-year period would result in long-term GHG emissions associated with operation of each well and additional vehicular trips to the wellfield to conduct periodic maintenance.

Energy consumption of the wellfield can be estimated based on typical irrigation well data. The preliminary wellfield design consists of 56 augmentation wells pumping up to 150 gpm. Field work in the area suggests that an assumed total depth of 100 feet per well is appropriate (Olsson 2023a). The wellfield is expected to pump on average 5,580 AFY (Balleau 2023a). Preliminary wellfield design includes modification and construction of an electrical system to supply power to the wells. With this design, the wellfield would use approximately, 3.35 million kilowatt-hours per year pumping 60 percent of the time, or 5.63 million kilowatt-hours per year pumping 100 percent of the time (Martin et al. 2011). Energy sources are converted to British thermal units (BTU) and carbon dioxide emissions (MT); the emission equivalents are provided for the purposes of comparison in Table 6.3.2-1. Energy usage by the augmentation wellfield would be offset by a decrease in groundwater pumping resulting from the targeted water right retirements within Zone D, discussed below.

Table 6.3.2-1. Total Electricity Energy Usage for the Augmentation Wellfield.

Category	Year-round Scenario (pumping 100 percent of the time)	Median Scenario (pumping 60 percent of the time)
Consumed Quantity	5,633,218 kilowatt-hours/year	3,350,307 kilowatt-hours/year
Average Unit Energy Content (British thermal unit [BTU])	3,412	3,412
Total Energy Usage (BTU per year)	19,220,539,816	11,431,247,484
Carbon Dioxide Emissions (metric tons [MT] per year)	2437	1449
Equivalent Carbon Dioxide Emissions[1]	542 gasoline-powered passenger vehicles driven for one year	323 gasoline-powered passenger vehicles driven for one year

[1] EPA 2024b

The augmentation wells are expected to deliver 15-18 cfs of water via pipeline, which discharges into Rattlesnake Creek just upstream of Quivira NWR. This additional water will assure that Quivira NWR has an adequate supply of surface flows to divert throughout wetland complexes within the refuge, even during dry periods when flows have been historically insufficient. By restoring flow patterns in Rattlesnake Creek, and ultimately Quivira NWR, operation of the wellfield would support climate change resiliency in the refuge.

Compared to the No Action Alternative, the reduced GHG emissions resulting from pumping reductions of the 810 junior water rights in Zone B (Table 6.3.1) would not occur under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

Water Right Retirements

Targeted water right retirements within Zone D would not require ground disturbance or construction activities that would result in the release of GHG emissions. Targeted retirements of 2,500 AFY equates to about 2,480 acres, assuming corn production and an average irrigation application depth of 12.11 inches per acre in GMD #5 (KDA-DWR 2017b). The average application depth was calculated by the KDA based on data from 2013-2017, which includes abnormally dry and wet years. Assuming a 70 percent pump efficiency and information on energy requirements to pump 1 acre-inch of irrigation water, the retired irrigation wells use about 57,000 gallons of diesel per year, 806,000 kilowatt-hours per year, or 12,000 cubic feet of natural gas per year (Martin et al. 2011). Total energy usage of the retired wells is converted to BTU and MTs of carbon dioxide emissions, and the emissions equivalents are provided for the purpose of comparison in Table 6.3.2-2.

Table 6.3.2-2. Total Energy Usage Split by Power Source for 2,500 Acre-feet of Targeted Groundwater Retirements.

Category	Diesel	Electricity	Natural Gas
Consumed Quantity	18,901 gallons/year	315,407 kilowatt-hours/year	20,490 thousand cubic feet/year
Average Unit Energy Content (British thermal unit [BTU])	138,690	3,412	1,020,000
Total Energy Usage (BTU per year)	2,621,390,785	1,076,170,311	20,899,956,672
Carbon Dioxide Emissions (metric tons [MT] per year)	194	136	1,106
Equivalent Carbon Dioxide Emissions[1]	43 gasoline-powered passenger vehicles driven for one year	30 gasoline-powered passenger vehicles driven for one year	246 gasoline-powered passenger vehicles driven for one year

[1] EPA 2024b

In Kansas, nearly half of irrigation wells are powered by natural gas. Natural gas powers about 49 percent of all Kansas irrigation wells, electricity powers 39 percent, and diesel powers 11 percent (McCarthy et al. 2020). Net energy usage of the Augmentation Wellfield and Groundwater Use Reduction Alternative (with an electrical power source) and the targeted retirements is approximately -1.6 billion BTU per year (net decrease in energy usage; Abt 2024). This is equivalent to a decrease in carbon dioxide emissions of 1,436 MT per year and an annual benefit of $275,000 (Abt 2024).

Indirect and Direct Effects Determination

Net energy usage from the augmentation wellfield (with an electrical power source) and the targeted retirements would reduce carbon dioxide emissions by 1,436 MT per year (Abt 2024). This is a negative minor effect (long-term) compared to the No Action Alternative because there will be a smaller reduction in carbon dioxide emissions. Compared to existing conditions, the Augmentation Wellfield and Groundwater Use Reduction Alternative would have a beneficial minor effect (long-term) as a result of the reduction in carbon dioxide emissions.

6.3.3 Groundwater Use Reduction Alternative

Similar to the No Action Alternative, the Groundwater Use Reduction Alternative does not include ground disturbance or construction activities that would result in the release of GHG emissions.

The Groundwater Use Reduction Alternative requires reductions in groundwater use among water right holders in Zone A. This approach avoids complete curtailment from any one water right holder by spreading reductions in water use over a larger area, as compared to the No Action Alternative. By restricting groundwater pumping, baseflow in Rattlesnake Creek would increase over time and result in increased water availability within the creek and the refuge. This approach will aid in restoring hydrological processes and natural water flow patterns and support climate change resiliency in the refuge.

Similar to the No Action Alternative, there would be reduced groundwater pumping under this alternative and a corresponding reduction in GHG emissions. The reduction in junior water right pumping and associated reduction in GHG emissions would, in a minor way, contribute to reductions in climate change on a global scale.

Table 6.3.3 illustrates the energy savings that would result from the 60 percent reduction in groundwater pumping in Zone A (approximately 107,369 acre-feet based on the average historic use for 2012 to 2021). In the event that water right users were allowed to resume pumping after streamflow was restored, these values would decrease.

Table 6.3.3. Total Energy Usage Split by Power Source for 107,369 Acre-feet of Groundwater Retirements.

Category	Diesel	Electricity	Natural Gas
Consumed Quantity	811,756 gallons/year	13,545,994 kilowatt-hours/year	880,003 thousand cubic feet/year
Average Unit Energy Content (British thermal unit [BTU])	138,690	3,412	1,020,000
Total Energy Usage (BTU per year)	112,582,442,886	46,218,932,042	897,602,979,166

Category	Diesel	Electricity	Natural Gas
Carbon Dioxide Emissions (metric tons [MT] per year)	8,347	5,860	47,494
Equivalent Carbon Dioxide Emissions[1]	1,857 gasoline-powered passenger vehicles driven for one year	1,304 gasoline-powered passenger vehicles driven for one year	10,569 gasoline-powered passenger vehicles driven for one year

[1] EPA 2024b

Overall, 107,369 acre-feet of water right retirements would reduce carbon dioxide emissions by 61,700 MT per year. Applying the social cost of carbon to this reduction results in an annual benefit of $11.8 million (Abt 2024). Implementation of the Groundwater Use Retirement Alternative would benefit Quivira NWR by contributing to the stabilization of streamflow in Rattlesnake Creek and restoring hydrologic processes associated with and required by the different communities in the refuge.

Indirect and Direct Effects Determination

Water right retirements (107,369 acre-feet) would reduce carbon dioxide emissions by 61,700 MT per year (Abt 2024); therefore, the Groundwater Use Reduction Alternative would have a beneficial minor effect (long-term) on climate compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the reductions in carbon dioxide emissions would be similar but not identical.

6.3.4 CUMULATIVE IMPACTS

Climate projections indicate that summer temperatures across the Great Plains region will increase over the next century, and precipitation amounts will vary by location; wet areas will become wetter and dry areas will become drier (USGCRP 2023). Specifically in southwestern and south-central Kansas, in the vicinity of the Rattlesnake Creek Watershed, summer temperatures will increase, and spring precipitation amounts will decrease. By the end of the 21st century, summer temperatures in southwestern and south-central Kansas are projected to increase between 6- and 10-degrees Fahrenheit, depending on different emission scenarios. As a result of warming temperatures, soils have become drier and the demand for water has increased (EPA 2016). Projections for increasing temperatures, faster evaporation rates, and more sustained droughts brought on by climate change will only add more stress to overtaxed water sources.

A warmer climate would lead to less snow and earlier snowmelt, resulting in higher streamflow in winter and spring. In the summer, without large increases in precipitation, higher temperatures and increased evaporation could lower streamflow. Groundwater levels also could be reduced by lower spring and summer recharge. Streamflow already suffers because of the increased irrigation demands. “Studies suggest that the impact of climate change on recharge in the High Plains Aquifer will vary spatially, with moderate increases in recharge in the north,

shifting to moderate decreases in the south. This change would exacerbate existing water shortages in the south and increase recharge in the northern portions of the aquifer" (Meixner et al. 2016). It is projected that water shortages in the southern portion of the High Plains Aquifer will only increase because of climate change.

Climate change resilience is the ability to anticipate, prepare for, and respond to hazardous events, trends, or disturbances related to climate. Improving climate change resilience involves assessing how climate change will create new or alter current climate-related risks and taking steps to better cope with these risks.

The alternatives presented are not expected to measurably contribute to the cumulative effects of climate change; however, by restoring hydrological processes and water flow patterns in Rattlesnake Creek, and ultimately Quivira NWR, the alternatives improve climate change resilience within Quivira NWR. Additionally, the No Action and Groundwater Use Reduction alternatives improve climate resilience in the region by improving aquifer levels, streamflows, wetland hydrology, riparian areas, and wildlife habitat through reductions in groundwater pumping.

Cumulative Effects Determination

Cumulative impacts from all alternatives have a beneficial effect on climate. Although the level of benefit varies by alternative, all alternatives would result in a reduction to carbon dioxide emissions. Cumulative effects would see benefits to climate resilience with the restoration of hydrological processes.

6.4 Cultural Resources and Historic Properties

6.4.1 No Action Alternative

The No Action Alternative does not include ground disturbance or construction activities. Therefore, it does not have the potential to affect cultural resources or historic properties.

Indirect and Direct Effects Determination

No ground disturbance would occur; therefore, the No Action Alternative would have no effect on cultural resources or historic properties compared to existing conditions.

6.4.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

Ground disturbance and construction activities would be associated with installation of the augmentation wellfield and associated pipeline. The project's depth of disturbance caused by well boring has the potential to affect cultural resources, including archaeological sites, within the construction site. At this time, the well sites and pipeline alignment have not been determined. Additionally, the property where the wells and pipeline will be located has not been

purchased, nor has an easement been acquired. Because of the unknown location of the final well sites and pipeline alignment, a cultural resources survey has not yet been completed.

The NRCS is the lead federal agency responsible for completion of the NRHP Section 106 process. On October 3, 2022, NRCS sent written correspondence to the Kansas State Historic Preservation Office (SHPO) to request consultation on the Rattlesnake Creek Watershed Plan -- EIS. The SHPO replied on October 26, 2022, that “the project area is not proximal to any recorded archaeological sites” (KHS 2022). However, the project will take place adjacent to Peace Creek, and the SHPO identified this area as having moderate archeological potential and that this area of Stafford County is severely underrepresented in the archeological survey record (KHS 2022). Because the area has not been surveyed; is in proximity to Peace Creek, which has a moderate archaeological potential; and the depth of disturbance has the potential to affect buried archaeological deposits; SHPO requested that a professional archaeologist survey the area prior to beginning construction.

Because the location of the well sites and pipeline alignment are unknown, cultural surveys have not yet been completed. In consultation with SHPO and NRCS, a cultural resources survey plan was prepared that details the methodology and approach to a future cultural resources survey. Section 106 compliance will be completed through the PA and cultural resources survey (Buried Past 2023; Appendix A). It is anticipated that the cultural resources survey will be completed during the engineering design phase of the project, after the Plan – EIS is completed and authorized. Impacts of the Augmentation Wellfield and Groundwater Use Reduction Alternative will be assessed following completion of the survey. Results of the survey will be provided to SHPO and will help inform any necessary mitigation to protect cultural resources during ground-disturbing activities. In consultation with SHPO and the tribes, NRCS developed a PA to defer identification and evaluation of cultural resources and historic properties in accordance with 36 CFR 800.4(b)(2). Any required mitigation will be addressed through the PA. The PA was signed by the Kansas State Conservationist on July 29, 2025, and transmitted to ACHP in accordance with 36 CFR 800.6(a)(1)(i)(C). The ACHP accepted the PA by letter on August 27, 2025. The PA, cultural resources study plan, and acceptance letter from ACHP are included in Appendix A.

The project APE includes all measures where ground disturbance may affect cultural resources or historic properties. The APE will be refined during the design process prior to the commencement of archaeological surveys. These areas will be subject to a cultural resources survey to identify and evaluate properties for historic significance using NRHP criteria of eligibility. Any cultural resources or historic properties identified through tribal consultation, archaeological survey, or background research will be avoided or minimized through project design modifications and in consultation. The PA includes appendices on treatment and mitigation plans and an inadvertent discovery plan.

NRCS sent letters notifying the Osage Nation of Oklahoma and the Wichita and Affiliated Tribes of the NEPA scoping process with a request for comments as well as an initiation of consultation under NHPA Section 106 on January 6, 2022; a follow-up letter was sent to both tribes on September 29, 2022. In mid-2023, the Kiowa Indian Nation of Oklahoma notified NRCS of its consultation interest in projects throughout Kansas. Subsequently, NRCS sent a letter notifying the Kiowa Indian Tribe of Oklahoma of the NEPA scoping process with a request for comments and an initiation of consultation under NHPA Section 106 on May 6, 2024. In June 2024, NRCS learned of Prairie Band Potawatomi Nation's consultation interest in projects throughout Kansas and initiated consultation. NRCS transmitted the draft PA to the SHPO and 5 tribes (Osage Nation of Oklahoma, Wichita and Affiliated Tribes, Kiowa Tribe of Oklahoma, Prairie Band Potawatomi Nation, and Cheyenne and Arapaho Tribes of Oklahoma) from August 21, 2024 and September 3, 2024, and transmitted follow-up emails 4 times from October 2024 to December 2024. All consultation documents are included in Appendix A.

Water Right Retirements

Targeted water right retirements within Zone D do not require ground disturbance or construction activities. Therefore, they do not have the potential to affect cultural resources or historic properties.

Indirect and Direct Effects Determination

Although ground disturbance will occur with the Augmentation Wellfield and Groundwater Use Reduction Alternative, no known historic properties will be impacted. If cultural resources or historic properties are discovered during cultural resource surveys or during construction, proper mitigation and notification procedures will be followed and no direct, indirect, or cumulative effects are anticipated. Therefore, the Augmentation Wellfield and Groundwater Use Reduction Alternative is anticipated to have no effect on cultural resources or historic properties compared to the No Action Alternative or compared to existing conditions.

6.4.3 Groundwater Use Reduction Alternative

Groundwater use reductions within Zone A do not require ground disturbance or construction activities. Therefore, they do not have the potential to affect cultural resources or historic properties.

Indirect and Direct Effects Determination

No ground disturbance would occur; therefore, the Groundwater Use Reduction Alternative would have no effect on cultural resources or historic properties compared to the No Action Alternative or compared to existing conditions.

6.4.4 Cumulative Impacts

Construction of the project and installation of the wellfield and associated pipelines has the potential to contribute to cumulative impacts to cultural resources and historic properties; however, no impacts are anticipated based on currently available information. A cultural

resources survey report will be completed for the APE that will include a summary of past, present, and reasonably foreseeable future impacts to cultural resources and historic properties in addition to the proposed project-related impacts.

Cumulative Effects Determination

Based on current information, no substantial project-related impacts are anticipated. Pending results of cultural resources surveys, cumulative impacts from all alternatives are not anticipated to have a cumulative effect on cultural resources or historic properties.

6.5 Socioeconomics

Evaluation of the socioeconomic impacts of each of the alternatives started with an assessment of changes in net farm income with proposed restrictions in access to groundwater for irrigation purposes. Under each of the alternatives, the analysis considered the response region that would experience restrictions in access to water for irrigation, the typical crops grown in the area, and changes in yields expected with irrigated and dryland farming techniques. Changes in yields were applied to normalized prices and costs to estimate changes in net farm income under each of the alternatives. Because of the uncertainty associated with how individual farms would react to changes in access to water for irrigation, four cropping scenarios were developed. The four scenarios are designed to simulate a range of possible cropping patterns and production technique changes that would impact changes in farm income. The impact analysis is reported as an average of impacts generated from these different scenarios (Abt 2024). A full description of the economic analysis is provided in Appendix D.

6.5.1 No Action Alternative

Under the No Action Alternative, it is assumed that USFWS, as a senior water right holder, will file a request to secure water with the KDA-DWR. Under this scenario, KDA-DWR in its capacity to administer water rights in the state would require the curtailment of junior water rights within response Zone B. This action would require all water rights junior to the USFWS senior water right to cease groundwater pumping. It was estimated that the curtailment of junior water rights within Zone B has the potential to affect 90,212 acres of currently reporting irrigated croplands (Abt 2024; Appendix D). Curtailing junior water rights has the potential to reduce crop productivity, leading to reductions in net farm income. An analysis was conducted to evaluate various scenarios on how irrigators may react to a curtailment in junior water rights. These scenarios include relying on dryland farming practices to switch to less water-intensive crops. Current predicted actions under the No Action Alternative could lead to reductions in net farm income. It was estimated that the losses could average $5.0 million, annually, as compared to existing conditions (Abt 2024; Appendix D). This represents a decrease of 22 percent of total net cash farm income for the five counties within the study area (see Table 4.6-4).

For rural areas such as the study area for the project, the agricultural industry is a primary driver for other economic activity. Thus, the economic impact of a reduction in net farm incomes under

the No Action Alternative has notable implications to the larger regional economy. Without this primary economic engine of agriculture, the regional economy will experience declines in other support industries such as retail and wholesale trade, services, and transportation. According to the impact analysis for planning (IMPLAN), restrictions on access to irrigation under the No Action Alternative are estimated to reduce grain sales by $41.2 million annually. The reduction in grain sales under the No Action Alternative represents approximately a 10 percent reduction compared to sales under existing conditions. The decrease in grain production leads to a reduction in farm employment of 75 jobs. As the decreased income ripples through the economy, the total job loss would be 154 jobs. The value added (profits) shows an $8 million loss to farm income, and with the multiplier effect in the local economy, this figure increases to a $14.5 million loss in total value added (profits). In addition, the initial $41 million decreased output (sales) of grain sales increases to a $57 million loss in sales throughout the region with the multiplier effect (IMPLAN 2024). These expected losses of jobs and income in the agricultural sector and other downstream industries can further result in population decreases as individuals leave the area for better economic opportunities.

The direct impacts described above are likely to occur in Pratt, Stafford, Kiowa, and Edwards counties where Zone B is located. However, the indirect economic impacts are likely to occur in a larger regional area, considering the importance of agriculture to the economy. The loss in net farm income is likely to result in declines in employment and income to other industries that support the agricultural sector (e.g., co-ops, grain elevators, fuel, etc.). There is also potential for impacts to occur under the No Action Alternative because community workers may rely on the agricultural industry for jobs and income throughout the region.

Indirect and Direct Effects Determination

The curtailment of junior water rights within Zone B has the potential to affect 90,212 acres of currently reporting irrigated croplands. Net farm income would decrease on average by $5 million annually and the total loss of employment is estimated at 154 jobs. The No Action Alternative will have an indirect major effect to the local economy. Estimated loss to net farm income would be significant and consequential for the agricultural producers in the Rattlesnake Creek Watershed. The No Action Alternative will have a negative major effect on the local economy compared to existing conditions. The No Action Alternative may also have a negative impact on local government tax base and revenues. While the analysis did not assume a change in land use or values, that result could occur under the No Action Alternative if farms reduce their crop acreages. Lower land and asset values can result in lower tax revenues for local government entities impacting the level and quality of services provided in the study area.

6.5.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

Under this alternative, a groundwater wellfield with associated collection and delivery pipelines would be constructed south of Quivira NWR. The development of the augmentation wellfield reduces the likelihood that KDA-DWR would need to curtail junior water rights as described under the No Action Alternative. Without a curtailment in junior water rights, the majority of irrigators will maintain their access to water for irrigation under this alternative. The existing socioeconomic conditions would be maintained except for associated impacts with 2,500 acre-feet of water right retirements in Zone D as well as project implementation and on-going operation of the augmentation wellfield.

Crop productivity will remain at current levels and net farm incomes will generally not decline except for farms impacted by water right retirements. Compared to existing conditions, this alternative would result in an average reduction in net farm income of $160,000 (0.7 percent decrease), as a result of water right retirements in Zone D. Grain sales are expected to decrease by $12.6 million under the Augmentation Wellfield and Groundwater Use Reduction Alternative with fewer acres of irrigated crops (anticipated to convert to dryland crops).

The $27 million in construction expenses for the Augmentation Wellfield and Groundwater Use Reduction Alternative (for the compact wellfield) are also expected to have a one-time positive regional economic impact. This one-time expenditure is expected to generate 12 total jobs and $0.5 million in labor income in the regional economy. In addition, the Augmentation Wellfield and Groundwater Use Reduction Alternative will require operations, maintenance, and replacement expenditures of roughly $900,000 per year. These expenditures also have a small regional economic effect, estimated using IMPLAN, of six total jobs and $289,000 in labor income per year (IMPLAN 2024).

In comparison to the No Action Alternative, the economic analysis showed net farm income under the Augmentation Wellfield and Groundwater Use Reduction Alternative would increase on average by $4.9 million (36 percent increase) and grain sales would increase $28.6 million. Farm employment is expected to avoid the loss of 107 jobs expected to occur under the No Action Alternative. Because of the avoidance of job losses, total labor income under this alternative will increase by $7.9 million annually relative to the No Action Alternative. Without the significant declines in net farm income, indirect impacts to the regional economy are also not expected to occur under this alternative compared to the No Action Alternative.

This alternative is not expected to have net negative impacts to the local population. Because net farm income is expected to increase under this alternative relative to the No Action Alternative, and direct and indirect industries will not be negatively affected, local populations that rely on the agricultural industry for employment are also not expected to be negatively affected by this alternative. In addition, the construction and operation of the wellfield are not

expected to affect the local population because of the rural nature of the area where the wellfield will be constructed and the negligible impacts to populations that live near the proposed wellfield location.

Water Right Retirements

Under this alternative, GMD #5 would also retire 2,500 acre-feet of authorized water used within the high-impact area (Zone D). Under this alternative, water right holders would be compensated for the retirement of their water rights. Using estimates of average water use from Zone D, retiring the 2,500 acre-feet results in a conversion of approximately 2,300 acres of irrigated crops. Though the reduction in crop productivity on 2,300 acres would result in a slight reduction in net farm income and other impacts throughout the economy, these impacts are minimized under this alternative because water right holders would be compensated for the retirements. Therefore, retirement of water rights under this alternative is not expected to negatively affect net farm incomes or lead to further economic impacts to direct and indirect industries.

Indirect and Direct Effects Determination

Compared to existing conditions, net farm income under the Augmentation Wellfield and Groundwater Use Reduction Alternative would be reduced by an average of $160,000 (0.7 percent decrease), as a result of water right retirements in Zone D. Grain sales are expected to decrease by $12.6 million under the Augmentation Wellfield and Groundwater Use Reduction Alternative with fewer acres of irrigated crops (anticipated to convert to dryland crops).

In comparison to the No Action Alternative, the loss in net farm income and job losses described in Section 6.5.1 would not occur under the Augmentation Wellfield and Groundwater Use Reduction Alternative. This is a beneficial major effect, because the regional economy will not see the losses anticipated under the No Action Alternative. Compared to existing conditions, the Augmentation Wellfield and Groundwater Use Reduction Alternative will have a negative minor effect (long-term) because of minor decreases to net farm income (annual average of $160,000 or a 0.7 percent decrease) as a result of water right retirements in Zone D. Impacts to the local tax base (land values) are expected to be minor under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

6.5.3 Groundwater Use Reduction Alternative

The Groundwater Use Reduction Alternative would rely solely on reductions in groundwater use without development of an augmentation wellfield to reverse current streamflow depletion trends and stabilize streamflow in Rattlesnake Creek. Under the Groundwater Use Reduction Alternative, a larger area (Zone A) is used to reduce water from a larger number of water rights. This alternative assumes that water use would be curtailed on 60 percent of the junior water right holders in Zone A, leading to less irrigated acreage and reductions in crop productivity. The economic analysis (Abt 2024; Appendix D) showed that implementation of this alternative could

lead to a reduction in net farm income on average $1.4 million (9 percent reduction) annually relative to the No Action Alternative. Compared to existing conditions, this alternative would result in a reduction in net farm income between $1.0 million and $9.3 million. Decreases in net farm income associated with this alternative are expected to result in additional indirect impacts across the regional economy because of the importance of the agricultural industry. Grain sales under the Groundwater Use Reduction Alternative are expected to decline by $40.6 million relative to existing conditions. Because this is similar to losses expected under the No Action Alternative, decreases in employment and income are also expected to be similar. Under this alternative, total employment is expected to decrease by 152 jobs and labor income will be reduced by $11.2 million annually relative to existing conditions (IMPLAN 2024). Job losses are expected to directly affect farm workers and affect other industries that support the agricultural sector. This alternative has the potential to also have adverse impacts on the local population that relies on the agricultural industry for jobs and income.

Indirect and Direct Effects Determination

Relative to the No Action Alternative, net farm income would decrease on average by $1.4 million, annually, and employment is expected to decrease by two jobs. Compared to existing conditions, this alternative would result in an annual reduction in net farm income on average of $6.4 million. The Groundwater Use Reduction Alternative will have an indirect major effect on socioeconomics. Estimated loss to net farm income would be significant and consequential for the agricultural producers in the Rattlesnake Creek Watershed. The No Action Alternative will have a negative major effect on socioeconomics compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative will have a negative minor effect (long-term) because the regional economy would incur an additional decrease to net farm income. The Groundwater Use Reduction Alternative may also have a negative major impact on local government tax base and revenues. If this alternative results in farms reducing their crop acreages, lower land and asset values are expected. This can result in lower tax revenues for local government entities, which impacts the level and quality of services provided in the region.

6.5.4 Cumulative Impacts

The area surrounding Rattlesnake Creek is similar to other parts of rural Kansas and continues to see declines in its population. For much of rural Kansas, the population peaked nearly 50 years ago. The small levels of population growth are concentrated in urban areas in the eastern half of the state near larger urban areas (Brown 2018). The exception is southwestern Kansas, where communities with slaughterhouses and feedlots have seen their population grow with an influx of immigrant workers to work in these facilities. The regional economy of the project area remains highly dependent on the agricultural industry for jobs and income. Therefore, impacts to the agricultural industry can further exacerbate downward trends in employment opportunities in the region, resulting in further declines in population.

In western and south-central Kansas, groundwater has historically been the most reliable source of large volumes of water for municipal, industrial, and irrigation use. Quantities of available groundwater are declining in many areas, often because of overdevelopment. Average groundwater levels across western and south-central Kansas fell by nearly 2 feet in 2022, according to preliminary data compiled by the Kansas Geological Survey (KGS).

Reduced groundwater availability results in long-term uncertainty of water supplies for irrigation. The state of Kansas and USDA are supporting land and water conservation efforts through CREP enrollments in the region. These enrollments offer federal or state assistance to retire eligible water rights in portions of the region. These impacts can help farmers as they transition away from agricultural production or to other conservation practices. Reductions in agriculture in the region can place pressure on remaining agriculture for maintaining economic stability for farming families. Impacts caused by any of the alternatives may be intensified when combined with broader pressures to retire farmlands and conserve water in farming practices.

The agricultural industry is subject to global markets and thus can be affected by things such as supply shocks, rising input prices, transportation issues, global pandemics, etc. In addition, changes in weather patterns and long-term climate conditions can affect the profitability of farms throughout the region. Impacts caused by any of the alternatives may be exacerbated when combined with market and environmental factors facing farmers in the region.

Cumulative Effects Determination

The No Action and Groundwater Use Reduction alternatives are anticipated to contribute to negative cumulative socioeconomic impacts because there would be decreases to net farm income as a result of implementation. Decreases in net farm income can result in impacts to the regional economy as indirect impacts. The regional economic impacts are in addition to the economic and farming trends described above. The Augmentation Wellfield and Groundwater Use Reduction Alternative will have a positive cumulative impact to the net-farm income compared to the No Action Alternative and a negative minor (long-term) cumulative impact relative to existing conditions.

6.6 Parklands and Natural Areas

6.6.1 No Action Alternative

The No Action Alternative does not include ground disturbance, construction activities, or acquisition of public land that would adversely affect existing parklands and natural areas within the project area.

Of the five recreational resources located within the project area, Quivira NWR is the only one that would be affected by implementation of the No Action Alternative. Quivira NWR offers the public many recreational activities including hunting, fishing, hiking, birdwatching, and photography (USFWS 2022a). Quivira NWR would benefit from the No Action Alternative

because it would contribute to the stabilization of streamflow in Rattlesnake Creek. Curtailing groundwater pumping in Zone B would increase the baseflow in Rattlesnake Creek over time and result in additional water availability within Quivira NWR. The additional water benefits the refuge and supports the recreational opportunities available there. See Section 6.16 for additional information.

Indirect and Direct Effects Determination

The increased supply of water to Quivira NWR will support the recreational opportunities available at the refuge. The decrease in groundwater withdrawals would have a beneficial impact to parklands and natural areas; therefore, the No Action Alternative would have a beneficial major effect on parklands and natural areas compared to existing conditions.

6.6.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

Construction of the augmentation wellfield and pipeline would take place outside the boundaries of all parklands and natural areas within the project area, including Quivira NWR. Further, no acquisition of public land would be required for construction.

Operation of the augmentation wellfield would contribute to the reliability of streamflow in Rattlesnake Creek, resulting in additional water availability within Quivira NWR. The additional water benefits the refuge and supports the recreational opportunities available there. Water pumped from the augmentation wellfield to Quivira NWR would consist of groundwater directly pumped and piped from the wellfield. Water naturally occurring in Rattlesnake Creek and flowing to Quivira NWR would still be from a groundwater source; however, changes in discharge to Rattlesnake Creek along the entire reach versus pumping the discharge to a single location may cause differences in minerals, nutrients, pollutants, and biotic components. These differences in water composition may be minimized as water flows in Rattlesnake Creek and is held in Little Salt Marsh. However, the difference may also cause changes in the ecological communities at the Quivira NWR.

The augmentation wellfield would allow the ability to pump water during drought conditions and may make water available to Quivira NWR when previously unavailable. Management at Quivira NWR would have the discretion to use the previously unavailable water to benefit aquatic habitat and vegetation communities that support threatened and endangered species and various fish and wildlife species.

Compared to the No Action Alternative, similar recreational opportunities and benefits are anticipated. Additional water during peak migration may provide improved recreational opportunities to the public under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

Water Right Retirements

Targeted water right retirements within Zone D do not require ground disturbance, construction activities, or acquisition of public lands that would adversely affect existing parklands and natural areas within the project area. However, Quivira NWR would benefit from targeted water right retirements. Reduction in groundwater use in Zone D would increase Rattlesnake Creek streamflow over time and result in increased water availability within Quivira NWR, supporting the recreational activities available there.

Indirect and Direct Effects Determination

The increased supply of water to Quivira NWR will support the recreational opportunities available at the refuge. Augmentation deliveries and decreases to groundwater withdrawals would have a beneficial impact to parklands and natural areas; therefore, the Augmentation Wellfield and Groundwater Use Reduction Alternative would have a beneficial major effect to parklands and natural areas compared to existing conditions. Compared to the No Action Alternative, the Augmentation Wellfield and Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits would be similar but not identical.

6.6.3 Groundwater Use Reduction Alternative

Groundwater use reductions within Zone A do not include ground disturbance, construction activities, or acquisition of public land that would adversely affect existing parklands and natural areas within the project area. However, Quivira NWR would benefit from groundwater use reductions. Curtailing groundwater pumping in Zone A allows the baseflow in Rattlesnake Creek to increase over time and result in additional water availability within Quivira NWR. Additional water availability would benefit the refuge and support the recreational activities Quivira NWR has to offer.

Indirect and Direct Effects Determination

The increased supply of water to Quivira NWR will support the recreational opportunities available at the refuge. The decrease in groundwater withdrawals would have a beneficial impact to parklands and natural areas; therefore, the Groundwater Use Reduction Alternative would have a beneficial major effect to parklands and natural areas compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits would be similar but not identical.

6.6.4 Cumulative Impacts

Historical and ongoing agricultural irrigation through groundwater pumping has reduced flows in Rattlesnake Creek and reduced the available water to Quivira NWR. KDA-DWR determined that existing groundwater use is impairing the water right for Quivira NWR. The water in Rattlesnake Creek is used to support the recreational opportunities at Quivira NWR. Reductions in water availability reduce the aquatic habitat and vegetation communities that support threatened and endangered species and various fish and wildlife species. Agricultural activities have also

increased chemical and nutrient levels in Rattlesnake Creek, which drains to Quivira NWR. Activities that affect water availability and water quality would have cumulative effects to Quivira NWR.

The alternatives considered are anticipated to have a positive cumulative impact to Quivira NWR because there would be an increase in water supplied to Quivira NWR. The No Action Alternative and Water Use Reduction Alternative would have increased benefits because of the natural process by which water would be restored. The Augmentation Wellfield and Groundwater Use Reduction Alternative would provide Quivira NWR benefits compared to current conditions but the difference in water composition would not provide the same benefit as the No Action Alternative. The ability to pump water during drought conditions or consistent with management decisions (i.e. migration) may make water available to Quivira NWR when previously unavailable. Management at Quivira NWR would have the discretion to use the previously unavailable water to benefit aquatic habitat and vegetation communities that support threatened and endangered species and various fish and wildlife species. Increased recreational opportunities (which support cultural ecosystem services in the region) may exist based on management decisions.

Cumulative Effects Determination

The cumulative impacts from all alternatives have a beneficial effect to parklands and natural areas. The increased supply of water to Quivira NWR will support the recreational opportunities available at the refuge.

6.7 Land Cover and Land Use

6.7.1 No Action Alternative

The No Action Alternative would not require ground disturbance or construction and would not result in direct changes to land use or land cover. The distribution of and total acres of land cover classifications detailed in Section 4.8 would not be significantly affected.

According to the NLCD, land cover in Zone B is approximately 61 percent (248,938 acres) cultivated crops. An additional 32 percent of Zone B is comprised of other land cover classifications associated with agricultural land uses, including herbaceous, hay, and pasture. The 876 water rights in this zone irrigate, on average, 90,212 acres of farmland. The curtailment of junior water rights in Zone B would lead to changes in farming practices that include conversion of irrigated crops to less water-intensive forms of agricultural land use including dryland farming, pasture, or grazing systems. According to the 2022 Census of Agriculture, the average of irrigated acres within farmland in Stafford, Edwards, Pratt, Kiowa, and Pawnee counties (which contain Zone B) is approximately 13.6 percent (USDA 2024). This suggests that dryland farming in the region is common, and impacts associated with the conversion of land currently used for cultivated crops to herbaceous, hay, or pastureland cover would be minimal. Land conversion from agricultural to nonagricultural land use is possible but not expected.

Increased streamflow resulting from decreased groundwater pumping may have impacts to land cover in areas adjacent to streams. See Section 6.9 (Surface Water Resources and Water Quality) and Section 6.11 (Riparian Areas) for additional information on anticipated impacts from reductions in groundwater pumping.

Indirect and Direct Effects Determination

Although no ground disturbance will occur, the 90,212 acres of currently reporting irrigated croplands will need to be converted to a nonirrigated land use (e.g., dryland cultivated cropland, pasture/hay) following the water right curtailment. Distribution of and total acres of land cover classifications should not be significantly affected. The No Action Alternative will have a negligible effect on land cover and land use compared to existing conditions.

6.7.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

The augmentation wellfield and associated pipeline installation would require ground disturbance and construction activities. Approximately 94 percent (20,245 acres) of the proposed wellfield area is comprised of agricultural land uses, including cultivated crops, herbaceous ground cover, or hay/pasture. Installation activities would temporarily affect the 0.5-acre area surrounding individual wells and a 40-foot buffer surrounding pipelines. Following installation, the disturbed ground would be reseeded, stabilized, and generally restored to its preconstruction condition within one to three years.

To allow for operation and maintenance activities, a permanent easement of 0.1 acre around each well site and within a 10-foot buffer of pipelines would be required. Land within the permanent pipeline easement could still be farmed; however, land within the permanent well site easement would be excluded from future farming (5.6 acres).

Land cover and land use changes will be highly localized and limited to the 5.6 acres within easements surrounding well sites, which is a relatively minor amount of the nearly 663,000 combined acres of cultivated crops, herbaceous, hay, and pastureland cover types within the project area. Any additional changes in land cover associated with the No Action Alternative, would not occur under the Augmentation Wellfield and Groundwater Use Reduction Alternative. This would include conversion from irrigated agriculture to dry land farming or pasture-based systems in Zone B.

Water Right Retirements

The 2,500 AFY of water right retirements in Zone D would not require ground disturbance or construction activities. Zone D is approximately 59 percent cultivated crops and more than 32 percent herbaceous, hay, and pasture. On average, 25,876 acres within this zone are irrigated and could be affected by water right retirements. Approximately 2,300 acres of irrigated acres would need to be converted to a nonirrigated agricultural or other land use to fulfill the 2,500

AFY of water right retirements. Because these areas will likely still be used for agriculture, land use changes are not anticipated. Similar to the No Action Alternative, changes in farming practices related to the water right retirements would not be expected to cause significant land cover and land use changes.

Within the currently irrigated acres where the water right retirements would occur, the primary land use conversion would be from irrigated farmland to dryland farming, pasture, or grazing systems. According to the 2022 Census of Agriculture, the average of irrigated acres within farmland in Stafford and Pratt counties (which contain Zone D) is approximately 16 percent (USDA 2024). This suggests that dryland farming in the region is common, and impacts associated with the conversion to pasture or grazing systems would be minimal. Land conversion from agricultural to nonagricultural land use is possible but not expected. As with the No Action Alternative, increased streamflow associated with water right retirements may have impacts to land cover types adjacent to streams.

Indirect and Direct Effects Determination

Land cover and land use changes will be highly localized and limited to 5.6 acres within easements surrounding the well sites and 2,300 acres will be converted to a nonirrigated land use (e.g., dryland cultivated cropland, pasture/hay) following the water right retirements. Distribution of, and the total acres of land cover classifications, should remain unchanged. The Augmentation Wellfield and Groundwater Use Reduction Alternative will have a negligible effect on land cover and land use compared to the No Action Alternative or compared to existing conditions.

6.7.3 Groundwater Use Reduction Alternative

As with the No Action Alternative, the Groundwater Use Reduction Alternative would include no ground disturbance or construction and would not directly result in any changes to land cover or land use.

Zone A is approximately 665,607 acres, of which almost 65 percent is cultivated crops, and an additional 29 percent is herbaceous, hay, or pasture. The 1,487 water rights in this zone irrigate, on average, 159,132 acres of farmland. Therefore, the reductions in water rights and thus irrigated farmland acres would take place over a larger area than the No Action Alternative, but reductions would be less severe. Because farmers in Zone A would be allowed to maintain some level of groundwater pumping, any transition from agricultural land use would not be expected. A mixture of irrigation and dryland farming practices would be supported by reduced groundwater pumping. Dryland farming in the region is common, and impacts associated with the conversion to pasture or grazing systems would be minimal. As with the No Action Alternative, increased streamflow resulting from decreased groundwater pumping may have impacts to land cover types adjacent to streams. The Groundwater Use Reduction Alternative is

not anticipated to have significant adverse impacts on land cover and land use within the project area.

Indirect and Direct Effects Determination

No ground disturbance will occur, and because farmers in Zone A would be allowed to maintain some level of groundwater pumping, any transition from agricultural land use would not be expected. A mixture of irrigation and dryland farming practices would be supported by reduced groundwater pumping. The Groundwater Use Reduction Alternative will have a negligible effect to land cover and land use compared to the No Action Alternative or compared to existing conditions.

6.7.4 Cumulative Impacts

The project area is dominated by cultivated crops and other land cover types available for agricultural use. Impacts to these land use and land cover types are primarily caused by conversion to nonagricultural use through urban or industrial development. As is typical in much of western Kansas, the population of the project area is in decline. According to the USCB, all seven counties that fall within the project area recorded population decreases between 2010 and 2020 (USCB 2023). Coupled with the fact that there are no larger cities or population centers within the project area, the primary drivers of land use change (i.e., urban and industrial development) are largely absent from the region.

Stafford County provides the most comprehensive information on planning and zoning of the counties within the project area. The goals of the alternatives presented in this document are consistent with the goals approved by the Stafford County Planning Board in 1997, which focus on balancing the costs associated with land use planning on the environment and economy considering a declining population and the presence of significant natural resources. The board's goals include special attention to the effects of land use on groundwater quality and availability, agricultural productivity, Quivira NWR, and Rattlesnake Creek (Stafford County 2021).

This data supports the conclusion that there is no significant existing or projected trend in land use and land cover changes in the south-central region of Kansas or the project area. Only the Augmentation Wellfield and Groundwater Use Reduction Alternative would result in any direct conversion of 5.6 acres of agricultural land. The alternatives considered are not anticipated to contribute to cumulative land use and land cover impacts because there would be no significant changes to land use as a result of implementation of any of the alternatives.

Cumulative Effects Determination

The cumulative impacts from all alternatives are anticipated to have a negligible effect to land cover and land use. Currently reporting irrigated croplands will need to be converted to a nonirrigated land use (which will likely still be agricultural in nature) following water right

retirements, reductions, or curtailments. Distribution of and the total acres of land cover classifications should remain unchanged.

6.8 Prime Farmland

6.8.1 No Action Alternative

The No Action Alternative would not require ground disturbance or construction and would not result in the irreversible or unnecessary conversion of prime or unique farmland to nonagricultural uses. The distribution of and total acres of farmland resources shown in Figure 4.9 would not be affected, including the total acres of prime farmland.

Zone B contains nearly 360,000 combined acres of prime farmland and farmland of statewide importance. The 876 water rights in this zone irrigate, on average, 90,212 acres of farmland. As discussed in Section 6.7, the curtailment of junior water rights within Zone B would lead to changes in farming practices to less water-intensive forms of agriculture. However, the use of this land for agriculture is expected to be maintained; permanent conversion of prime farmland from agricultural to nonagricultural land use is possible but not expected. In the event that Zone B junior water right holders are ordered to cease or reduce pumping, this land has the potential for loss of productivity and profitability, reduction in property value, and could be subject to potential loss of prime farmland status.

Indirect and Direct Effects Determination

Curtailment of junior water rights within Zone B would lead to changes in farming practices to less water-intensive forms of agriculture. However, the use of this land for agriculture is expected to be maintained; permanent conversion of prime farmland from agricultural to nonagricultural land use is possible but not expected. The No Action Alternative will have no effect on prime farmland compared to existing conditions.

6.8.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

The augmentation wellfield and associated pipeline installation would require ground disturbance and construction activities. Most of the proposed wellfield area is comprised of prime farmland or farmland of statewide importance. Land for the wells and pipeline would be acquired by a permanent easement or purchased from the current landowner by GMD #5. It is assumed that a temporary easement of 0.5 acre around each well site and within a 40-foot buffer of pipelines would be required for construction activities. Disturbed ground would be reseeded, stabilized, and generally restored to its preconstruction condition within one to three years.

To allow for operation and maintenance activities, a permanent easement of 0.1 acre around each well site and within a 10-foot buffer of pipelines would be required. Land within the

permanent pipeline easement could still be farmed; however, land within the permanent well site easement would be excluded from future farming (5.6 acres).

Reduced groundwater levels from the drawdown localized around the augmentation wellfield may lead to decreases in crop productivity in the project area. Drawdown levels are highest in proximity to the wellfield and decrease rapidly as distance from the wellfield increases, and they are also based on pumping demand of the augmentation wellfield. This decrease is not expected to result in the conversion of prime or unique farmland to nonagricultural use.

The NRCS Farmland Conversion Impact Rating (AD-1006) Form will be used to assess the impacts of the proposed wellfield design on prime or unique farmland and consider alternative sites or designs as required.

Conversion of prime or unique farmland will be highly localized and limited to the 5.6 acres within easements surrounding well sites, a relatively minor amount of the more than 630,000 acres of prime farmland and farmland of statewide importance within the total project area.

Compared to the No Action Alternative, continued irrigation of the 810 junior water rights in Zone B would result in maintaining productivity, profitability, property value, and would not be subject to potential loss of prime farmland status that could occur under the No Action Alternative.

Water Right Retirements

The 2,500 AFY of water right retirements in Zone D would not require ground disturbance or construction activities. On average, 25,876 acres within this zone are irrigated and could be affected by water right retirements. Approximately 2,300 irrigated acres would need to be converted to a nonirrigated agricultural or other land use to fulfill the 2,500 AFY of water right retirements. Because these areas will likely still be used for agriculture, conversion of prime farmland is not anticipated. Similar to the No Action Alternative, changes in farming practices to less water-intensive forms of agriculture would not result in the conversion of prime or unique farmland to a nonagricultural use.

Indirect and Direct Effects Determination

Conversion of prime or unique farmland will be highly localized and limited to the 5.6 acres within easements surrounding well sites. Drawdown from the augmentation wellfield has the potential to cause a slight decrease in crop productivity near the well sites; however, prime farmland status should be maintained. The Augmentation Wellfield and Groundwater Use Reduction Alternative will have a negative minor effect (long-term) to prime farmland compared to the No Action Alternative or compared to existing conditions.

6.8.3 Groundwater Use Reduction Alternative

As with the No Action Alternative, the Groundwater Use Reduction Alternative would include no ground disturbance or construction and would not result in conversion of prime or unique farmland to nonagricultural use.

Zone A is approximately 665,607 acres, including almost 595,000 combined acres of prime farmland and farmland of statewide importance. The 1,487 water rights in this zone irrigate, on average, 159,132 acres of farmland. Therefore, the reductions in water rights and thus irrigated farmland acres would take place over a larger area than the No Action Alternative, but reductions would be less severe. Because farmers in Zone A would be allowed to maintain some level of groundwater pumping, any transition from agriculture would not be expected. A mixture of irrigation and dryland farming practices would be supported by reduced groundwater pumping, and there would be no anticipated conversion of prime or unique farmland to nonagricultural use. Existing prime farmland has the potential for loss of productivity and profitability, reduction in property value, and it could be subject to potential loss of prime farmland status because of the Groundwater Use Reduction Alternative.

Indirect and Direct Effects Determination

No ground disturbance will occur, and because farmers in Zone A would be allowed to maintain some level of groundwater pumping, permanent conversion of prime farmland from agricultural to nonagricultural land use is not expected. The Groundwater Use Reduction Alternative will have no effect on prime farmland compared to the No Action Alternative or compared to existing conditions.

6.8.4 Cumulative Impacts

Conversion of prime and unique farmland is closely related to land use changes and development on rural land. These factors are discussed in more detail in Section 6.7. Statewide estimates show a slight declining trend in nonfederal rural land classified as prime farmland since 1982. In the 35 years between 1982 and 2017, this decline was approximately 160,000 acres, or 0.7 percent (USDA 2017b).

The available data supports the conclusion that there is no significant existing or projected trend in farmland conversion in the south-central region of Kansas or the project area that poses a threat to prime or unique farmland. Only The Augmentation Wellfield and Groundwater Use Reduction Alternative would result in any direct conversion of up to 5.6 acres of prime or unique farmland for the augmentation wellfield. This minor amount of conversion is not anticipated to significantly contribute to cumulative impacts related to prime farmland conversion.

Cumulative Effects Determination

The No Action and Groundwater Use Reduction alternatives considered are not anticipated to contribute to cumulative prime farmland impacts because conversion of prime farmland to other land uses as a result of implementation is not anticipated. The conversion of 5.6 acres of prime

farmland under the Augmentation Wellfield and Groundwater Use Reduction Alternative would add a minor contribution to prime farmland cumulative impacts.

6.9 Surface Water Resources and Water Quality

Surface water resources and water quality including wetlands and streams are described below. Aquifers and sole source aquifers are described in Section 6.2 above.

6.9.1 No Action Alternative

Under the No Action Alternative, all water rights junior to Water Right File Number 7,571 within Zone B would be required to cease groundwater pumping. Of the 876 total water rights within Zone B, 810 water rights, totaling 109,000 irrigated acres, are junior to Water Right File Number 7,571. According to analysis conducted by Balleau, the No Action Alternative would result in an average increase in baseflow of 23,400 AFY over the 53-year simulation period (Balleau 2022). This equates to approximately 29 percent of the net reduction in groundwater pumping, which averaged 79,900 AFY. Though the average increase of 23,400 AFY is significantly more than the amount granted under Water Right File Number 7,571 (14,632 AFY), this does not represent the initial increase in baseflow, which would be much lower during the first few years. Over time, baseflow levels could recover to a point where a portion of the junior water right holders could resume some level of groundwater pumping, but that is highly dependent on multiple variables regarding timing and amount of groundwater pumping.

Streams

Under the baseline future condition presented in the Balleau analysis (Balleau 2010), annual streamflow (baseflow plus runoff) at the Zenith gage would fall below 14,632 AFY approximately 67 percent of the time. This is an annual volume that doesn't consider the intra-annual timing of water that is desired under the USFWS's management plans, so there would likely be additional years where these intra-annual targets are not met. Under the No Action Alternative, the percentage of years that flows would fall below 14,632 AFY would be reduced to approximately 4 percent, occurring only in the first two years of the simulation (which happen to be very dry years within the simulation). However, flows barely exceed 14,632 AFY in one year (year 37) of the simulation, indicating that some of the intra-annual targets were likely not met. Though the Balleau baseline and change simulations use a reasonable variation in climatic conditions based on historically observed climate variability, future climate patterns are impossible to predict and could be somewhat similar to the baseline conditions, very different from those conditions, or anywhere in between.

Curtailment of the 810 junior water rights within Zone B would increase the amount of available surface water for Quivira NWR to meet its management needs and fulfill its senior water right requirement. As junior water rights in Zone B cease groundwater pumping, these wells would no longer intercept water that discharged to Rattlesnake Creek prior to well development in the watershed. An increase in the available Rattlesnake Creek surface flows under the No Action

Alternative would aid Quivira NWR in meeting its management needs by eventually providing sufficient flows to satisfy its water right throughout the year. However, the specific length of time that would be needed to restore streamflow so that sufficient water was available at the necessary times of year is likely to be several years at a minimum, unless the timing of the initiation of this alternative happened to coincide with very wet climatic conditions.

The streamflow benefits from reduced pumping would not be limited to Quivira NWR but would also extend upstream of the Rattlesnake Creek Zenith gage. Figure 4.10.3-2 shows the loss of perennial stream lengths in Rattlesnake Creek and KDA-DWR (2019b) indicates additional loss in streamflow until stabilization occurs in 2040. Under the No Action Alternative, streamflow would be increased to potentially restore past perennial streamflow losses and avoid future perennial streamflow losses.

The No Action Alternative increases river flow by 23,400 AFY (53-year average). However, the impairment analysis shows that only 5,580 AFY is needed. Accordingly, an average of 17,820 AFY (23,400 AFY minus 5,580 AFY) exceeds the objective; it then flows out of the basin (and it cannot provide a specific quantity of water during drought periods). The administrative process of curtailing groundwater pumping is a broad-brush approach that will result in increased surface flow that is dependent on precipitation and climactic variables.

Consistent and increased hydrology in Rattlesnake Creek would provide better quality habitat for aquatic species and increase riparian health for the entirety of the Rattlesnake Creek Watershed within Zone B. This would extend to ephemeral and intermittent streams in addition to perennial stream lengths.

Wetlands

Existing wetlands within Quivira NWR and within Zone B would benefit from implementation of the No Action Alternative. Because the No Action Alternative would result in Quivira NWR eventually receiving its full water right, Quivira NWR would have sufficient surface flows in Rattlesnake Creek to divert to its wetland complexes consistent with management goals and seasonal water needs identified by USFWS. The wetland complexes rely on water from Rattlesnake Creek to maintain hydrology and perform the required wetland functions. Past limitations on hydrology and future reductions in water availability would not occur except during severe drought conditions. Modeling projects future water needs to be available for management consideration except during drought conditions under the No Action Alternative.

Beyond Quivira NWR, wetland features within Zone B that derive hydrology from adjacent streams or from groundwater may benefit from the No Action Alternative based on the increased streamflow in Rattlesnake Creek and its tributaries and the increased availability of groundwater. Increases to groundwater storage averages 32,400 AFY within Zone B. The associated increases in groundwater levels would vary based on proximity to Rattlesnake Creek and the relative level of historical pumping at any location within Zone B. However, based on the

total area of Zone B (408,300 acres), the fact that most of the increase in aquifer storage would occur in Zone B (because of its location farther from Rattlesnake Creek), and assuming a porosity of 20 percent, the simulated increase in aquifer storage would equate to an average water level increase of approximately 5 inches per year across Zone B (32,400 acre-feet/408,300 acre x 12 inches per foot/ 0.2 [porosity] = 4.75 inches). There are currently 4,083 acres of wetlands in Zone B. The increased availability of groundwater and streamflow within Zone B may result in an increase in total wetlands, an increase in wetland acres, and/or an increase in wetland hydrology (increased time and extent of saturated soils) during dry periods.

Surface Water Quality

The No Action Alternative would improve water quality within Rattlesnake Creek, flows in Zone B, and Quivira NWR by restricting groundwater pumping by junior water right holders. Low streamflow resulting from groundwater pumping corresponds to increases in the portion of surface water derived from groundwater, which is naturally high in sodium, chloride, and sulfate within the project area because of underlying geology. A reduction in 810 junior water rights would increase surface flows and dilute base flows, resulting in improved water quality for these major ions within Rattlesnake Creek. Streamflow improvements would primarily be in Zone B. Similarly, increased surface flows within Rattlesnake Creek resulting from the No Action Alternative would also have a dilution effect on nitrogen and phosphorous, whose primary inputs are derived from agricultural runoff rather than underlying geology.

Indirect and Direct Effects Determination

Curtailment of the 810 junior water rights (90,212 acres) within Zone B would result in an average increase in baseflow of 23,400 AFY in Rattlesnake Creek over the 53-year simulation period. Quality of habitat for streams and wetlands would be improved. The increased supply of water to Quivira NWR will support the surface water resources at the refuge. The No Action Alternative would have a beneficial major effect on surface water resources and water quality compared to existing conditions.

6.9.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Streams

Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, an augmentation wellfield would provide up to 18 cfs of water to Rattlesnake Creek via pipeline to a delivery point just west of Quivira NWR's boundary. Design and construction of the augmentation wellfield is anticipated to take several years. Once the augmentation wellfield construction has been completed, surface water flows would experience an immediate increase downstream of the delivery point as a result of augmentation deliveries during periods when sufficient flows are not available. Water provided by the Augmentation Wellfield and Groundwater Use Reduction Alternative could be available during strategic periods (i.e. migration) based on management decisions. Increasing flows to Rattlesnake Creek is not an

option under existing conditions or the No Action Alternative because flows are based on precipitation events.

Based on a future scenario developed by Balleau (2023a), average annual augmentation pumping would be 5,580 AFY. The total impact to all streams in the groundwater model would range between 1,560 AFY to 2,060 AFY, on average, for the compact and expanded wellfield, respectively. Compared to the 23,400 AFY of water provided under the No Action Alternative, the Augmentation Wellfield and Groundwater Use Reduction Alternative results in less water upstream (2,500 AF of water right retirements) and downstream (augmentation wellfield deliveries) of Zenith gage. The increased quantity of water provided by the No Action Alternative is an additional benefit to Rattlesnake Creek that is not realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

The reductions in streamflow caused by the augmentation pumping would occur within three separate watersheds: Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River. A breakdown of the average annual flow reductions for the streams found in these watersheds (Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah) under the compact and expanded wellfield options are presented in Table 6.9.2-1 and Table 6.9.2-2.

Table 6.9.2-1. Reduction in Streamflow Under the Two Wellfield Scenarios (acre-feet per year).

Wellfield Scenario	Rattlesnake Creek above Zenith gage	Rattlesnake Creek below Zenith gage	Peace Creek	North Fork Ninnescah River
Compact	90	80	450	940
Expanded	80	50	360	1,570

Table 6.9.2-2. Reduction in Streamflow Under the Two Wellfield Scenarios (cubic feet per second).

Wellfield Scenario	Rattlesnake Creek above Zenith gage	Rattlesnake Creek below Zenith gage	Peace Creek	North Fork Ninnescah River
Compact	0.1	0.1	0.6	1.3
Expanded	0.1	0.1	0.5	2.2

Surface flows in Rattlesnake Creek upstream and downstream of the delivery point (i.e., Zenith gage) would be minimally affected by the drawdown caused by augmentation pumping and fully offset by the water right retirements. Because the proposed augmentation wellfield is located within the Gar-Peace Creek and North Fork Ninnescah River watersheds, augmentation pumping has a somewhat larger effect in these watersheds. Because of the temporal lag associated with groundwater pumping, decreases in streamflow would generally be smaller in the earlier years of the scenario and larger during the later years of the scenario, though the

rate of growth by the end of the scenario is likely very small. Compared to the No Action Alternative, the Augmentation Wellfield and Groundwater Use Reduction Alternative does not increase streamflow in the Gar-Peace and North Fork Ninnescah River watersheds from pumping reductions in Zone B as in the No Action Alternative.

Quivira NWR has two land parcels called the Hornbaker Tracts that are not contiguous with the main system. These land parcels are located adjacent to Peace Creek and are not within the 5 to 10 feet of aquifer drawdown zone. Thus, impacts are anticipated to be minor in these areas.

Quivira NWR Main System and the Quivira NWR Hornbaker Tracts are within the following aquifer drawdown zones for the augmentation wellfield:

- High Pumping Response-Expanded Wellfield
    - Hornbaker Tract - 0.5 – 1 foot, 50-year drawdown
    - Quivira NWR Main System – On the 0.5 foot line
- High Pumping Response – Compact Wellfield
    - Hornbaker - 1 – 2 foot, 50-year drawdown
    - Quivira NWR Main System– 0 – 1 foot, 50-year drawdown
- Low Pumping Response – Expanded Wellfield
    - Hornbaker – None – 0.5 foot, 50-year drawdown
    - Quivira NWR Main System – 0.0 feet
- Low Pumping Response – Compact Wellfield
    - Hornbaker – 0.5 – 1 foot, 50-year drawdown
    - Quivira NWR Main System– 0.0 feet

To put these values into the proper context, Balleau (2023a) presents a series of hydrographs/flow duration curves for a series of locations on these three streams (Balleau 2023a). In some cases, these represent modeled flow only because they represent a location that does not have a stream gage. These plots present the streamflow without the impact of augmentation pumping and with the impact of augmentation pumping. In most cases, the differences are as small as 1 cfs or less. The main exception to this is the streamflow in Peace Creek immediately below the location of the wellfield. However, it should be noted that Peace Creek is an intermittent stream in that portion of the watershed (modeled baseflows only occur about 25-30 percent of the time), so the impacts occur during relatively wet periods when there is flow in the stream. Wellfield operation during dry periods would have no impact to flow in Peace Creek because the stream is intermittent, and no flow would typically be in Peace Creek during dry periods. Wellfield operation during wet periods would have a reduction in baseflow that would reduce volume of flow and may reduce periods of time when baseflow occurs. However, under the baseline and the augmentation pumping simulations, Peace Creek discharges some amount of water to the Arkansas River during the entire simulation. The

reduction in hydrology could prolong the length of dry periods and has the potential to cause reduction in flow during wet periods.

MDS requirements are part of the Kansas Water Appropriation Act; the general purpose is to make sure base flows in certain streams are sufficient to protect existing water rights and meet instream uses related to water quality, fish and wildlife, and recreation. All applications to appropriate water for beneficial use filed on or after April 12, 1984, are subject to any MDS requirements identified and established pursuant to statute K.S.A. 82a-703a, b, and c. Depletions to the North Fork Ninnescah River have some potential to impact the MDS. According to the USGS stream gage records (average daily flow in cfs; gaging station ID 07144780) for October 1990 (beginning of record) through December 2023, the North Fork Ninnescah River has not met its MDS approximately 5.1 percent of the time.

Balleau's modeling (Balleau 2023a) indicates that the expanded augmentation wellfield configuration average depletion was 2.2 cfs to the North Fork Ninnescah River over 54 years, and the maximum depletion was approximately 7-8 cfs. Comparison of the average modeled scenario (actual recorded flow minus modeled average of 2.2 cfs depletion) to the MDS concluded that MDS would not be met 6.8 percent of the time, which is less than a 2 percent increase to the historical shortage of 5.1 percent. Comparison of the maximum modeled scenario (actual recorded flow minus modeled maximum depletion of 8 cfs) to the MDS concluded that MDS would not be met 13.1 percent of the time. However, it is important to note that the maximum modeled scenario would only happen during certain high pumping times toward the end of the simulation (after 50 years). Under the compact augmentation wellfield configuration, these impacts would be decreased. For appropriation of water to the augmentation wellfield, GMD #5 will need KDA-DWR Water Appropriation Permits and could attempt to purchase or otherwise retire water rights from senior water right holders near the North Fork Ninnescah River. The water right retirements could offset the anticipated minor depletions and thus reduce the need to cease operation of the augmentation wellfield to meet the MDS of the North Fork Ninnescah River should depletions to the river occur as a result of augmentation pumping that then forces flows below the MDS.

A review of WIMAS (KGS 2023) indicates there are several water rights along these streams that appear to have direct stream diversion points. These water rights would potentially have less access to water at certain times as a result of these impacts. Most significantly, Cheney Reservoir is located downstream on the North Fork Ninnescah River. The city of Wichita receives about 40 percent of its water supply from the Cheney Reservoir. As shown on Figure 6.9.2, since 1980, the City of Wichita's demand on Cheney Reservoir has never come close to the reservoir's end-of-September content (i.e., near the end of irrigation season, which corresponds to the time of year that inflows to the reservoir can be expected to be lowest). Flood control release amounts (to maintain flood control/conservation pool levels) from Cheney Reservoir have exceeded municipal withdrawals most of the time. This indicates that the

amount of water available in Cheney Reservoir has consistently been more than enough to satisfy public water supply needs for the City of Wichita. Operation of the augmentation wellfield is, at maximum, modeled to deplete flows on the North Fork Ninnescah River by 2.2 to 8 cfs, amounting to approximately 1,600 to 5,800 AFY. Conversely, under the No Action Alternative, additional flows may be available in the North Fork Ninnescah River by ceasing pumping in Zone B.

The City of Wichita's population, assuming a growth rate consistent with projections for Sedgwick County, could be expected to grow to 499,772 by 2073, the end of the project life (Wichita State University 2023). As domestic, public-supplied water use per capita per day is declining for Sedgwick County (down to 56 gallons/person/day in 2015, the most recent year for which data is available [USGS 2018]), it is reasonable to assume that population growth at the end of the project life would represent a maximum of an additional 2,600 AFY withdrawn from Cheney Reservoir to supply the City of Wichita's water system. As Figure 6.9.2 demonstrates, this additional withdrawal from Cheney Reservoir would not be impacted by augmentation pumping.

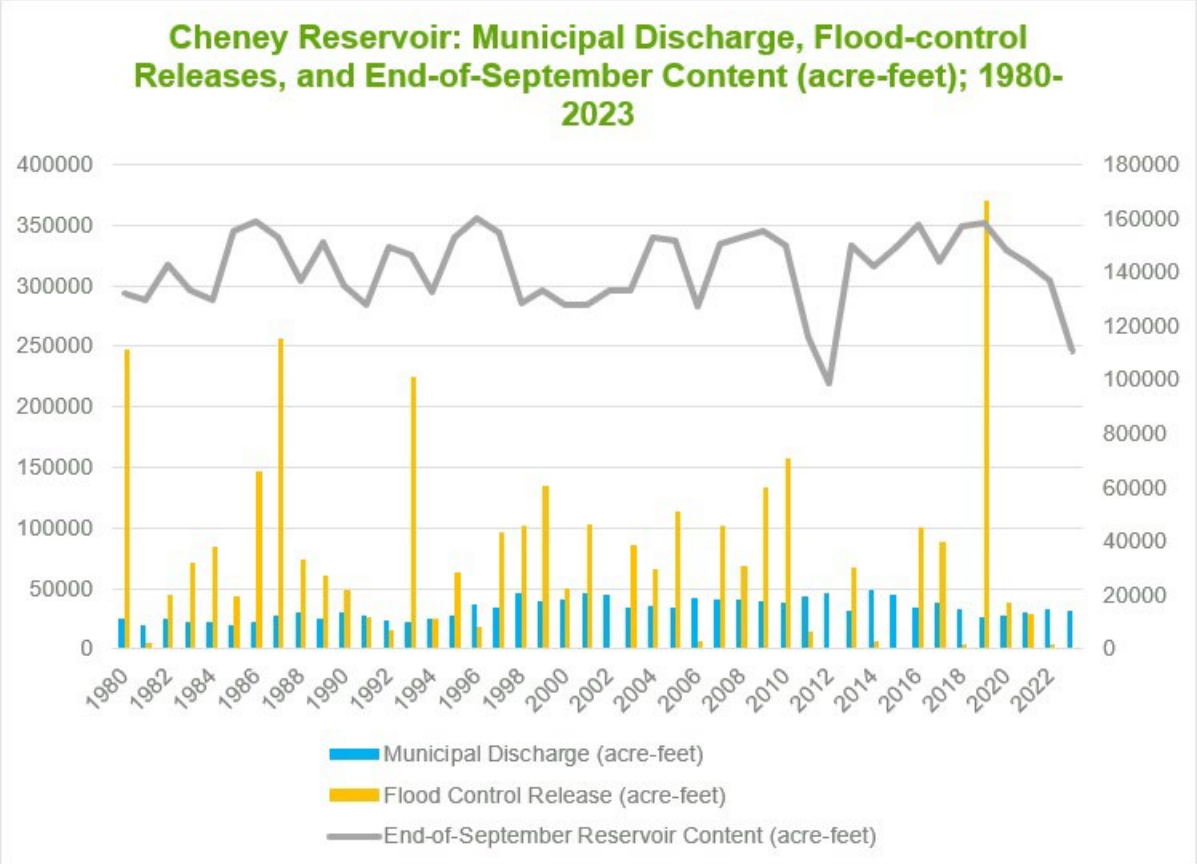

Figure 6.9.2. Cheney Reservoir: Municipal Discharge, Flood-control Releases, and End-of-September Content (acre-feet); 1980 to 2023

Within the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds there are 558 miles of perennial stream and 2,647 miles of ephemeral or intermittent streams. Current agricultural irrigation and groundwater pumping exists in the three watersheds. As described previously, the groundwater levels in the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds have been relatively stable over time (McGuire 2017). However, Figure 4.10.3-2 shows the loss of perennial stream reaches. Tables 6.9.2-1 and 6.9.2-2 show the reductions in streamflows to Rattlesnake Creek, Peace Creek, and the North Fork Ninnescah River. Ephemeral streams, by definition, flow in response to rainfall events and typically have limited groundwater interaction. However, intermittent streams receive a portion of their hydrology from groundwater. Similar to the perennial streams in the three watersheds, the intermittent streams would be expected to have a reduction in hydrology. This reduction may cause prolonged dry periods and a reduction to total streamflow. However, the impacts are anticipated to be greatest within the direct vicinity of the augmentation wellfield. Peace Creek is the primary intermittent stream in this area and is described above.

Under the No Action Alternative, streamflows would increase in these watersheds as a result of reductions in pumping in Zone B. Flows in Rattlesnake Creek upstream of Zenith gage that would benefit (increased flows) under the No Action Alternative would continue to decline under the Augmentation Wellfield and Groundwater Use Reduction Alternative. While the augmentation wellfield would not be responsible for that continued decline, the increased benefits of the No Action Alternative would not be realized (i.e. cessation of pumping in Zone B). Thus, perennial stream loss would continue under the Augmentation Wellfield and Groundwater Use Reduction Alternative, while being reversed under the No Action Alternative (dependent on climatic factors).

In comparison to the No Action Alternative, Peace Creek and the North Fork Ninnescah River are not located within Zone B where the 810 junior water rights would cease pumping under the No Action Alternative. However, indirect increases in stream flow may occur under the No Action Alternative that would not be realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative. Any increases in stream flow would be an additional benefit under the No Action Alternative as opposed to impacts to streamflow described in the Augmentation Wellfield and Groundwater Use Reduction Alternative.

As part of the Augmentation Wellfield and Groundwater Use Reduction Alternative, GMD #5 would retire 2,500 acre-feet of authorized water use within Zone D by developing a water rights retirement program. Though the specific baseflow impacts to streams in Zone D is currently unknown, by definition, as long as they are located in Zone D, their baseflow impact will be at least 40 percent of the historical pumping. Therefore, retirement of 2,500 acre-feet of water rights within Zone D would increase baseflows in Rattlesnake Creek by at least 1,000 AFY over the 50-year evaluation period (Balleau 2023c; Appendix D). Peace Creek would also see an increase in baseflows with retirements in Zone D, although to a lesser degree than in

Rattlesnake Creek. The magnitude of baseflow increases in Peace Creek would depend on retirement proximity to Peace Creek. The 2,500 acre-feet of water right retirements would fully offset flow reductions in Rattlesnake Creek caused by the augmentation wellfield.

The Balleau analysis (Balleau 2010) shows that 5,580 AFY is needed to support the unmet monthly demand (53-year average) for Quivira NWR. The augmentation wellfield would only be operational when this demand is not met and during drought periods. The Augmentation Wellfield and Groundwater Use Reduction Alternative has total management control by turning on the wellfield when water is needed and off when water is not needed. The Augmentation Wellfield and Groundwater Use Reduction Alternative shows parallel support for agricultural production while simultaneously meeting the unmet demand for Quivira NWR. The targeted water right retirements associated with the Augmentation Wellfield and Groundwater Use Reduction Alternative would result in groundwater use reduction of approximately 1,000 AFY in Zone D, which represents a portion of the average quantity needed for supporting the unmet demand (5,580 AFY). The Adaptive Management program will be available to evaluate observed conditions and adjust as needed. In this manner, the agricultural producers can make the maximum use of available water in Rattlesnake Creek while Quivira NWR also meets its water right demand.

Wetlands

Wetlands within Quivira NWR would benefit directly from the Augmentation Wellfield and Groundwater Use Reduction Alternative. Once construction of the augmentation wellfield and pipeline is completed, augmentation deliveries of 15-18 cfs would provide surface flows in Rattlesnake Creek that flow to Quivira NWR consistent with Water Right File Number 7,571 and seasonal water needs throughout the year. Quivira NWR will have an adequate supply of surface flows to divert throughout wetland complexes within the refuge, even during dry periods when flows have been historically insufficient. Augmentation deliveries of 15-18 cfs would allow Quivira NWR to meet its management goals and objectives. Water provided by the Augmentation Wellfield and Groundwater Use Reduction Alternative could be available during strategic periods (i.e. migration) based on management decisions.

Under this alternative, the Quivira NWR would benefit from a large net increase in the water supply available for refuge management. As discussed above, the average level of augmentation pumping (and delivery) would be 5,580 AFY, while the rate of depletion to streamflow on Rattlesnake Creek (above and within Quivira NWR) would range from 130 to 170 AFY depending on the wellfield configuration. Therefore, the net benefit to Quivira NWR would be an average annual increase in streamflow for use in creating and sustaining wetland habitat that would range from 5,410 to 5,450 AFY. Moreover, because the augmentation capacity would be approximately 11,000 AFY, the Augmentation Wellfield and Groundwater Use Reduction Alternative would provide greater benefits in the driest years when additional streamflow is needed the most. In comparison to the No Action Alternative, additional water provided through

the No Action Alternative (23,400 AFY) may provide additional benefits to wetland hydrology if the additional water can be captured and stored in the wetlands or if the water is allowed to flow through the Quivira NWR wetland complex. However, only a percentage of large rainfall events can be captured for wetland hydrology.

The water source under the No Action Alternative would be groundwater intercepted by Rattlesnake Creek along its entire reach. In contrast, the water source under the Augmentation Wellfield and Groundwater Use Reduction Alternative would be groundwater directly pumped into Rattlesnake Creek west of Quivira NWR. Inherent differences in chemistry and biologic components of the water would exist.

Augmentation pumping of 15-18 cfs would indirectly affect existing wetlands in the Gar-Peace Creek Watershed by reducing the groundwater available for evapotranspiration, which occurs primarily in areas with a shallow water table such as wetland areas. Aquifer and stream pumping in the area are two of the three sources of water for the augmentation wellfield; the evapotranspiration portion of the water budget is the third source (i.e., augmentation pumping can also reduce evapotranspiration). Just as groundwater pumping intercepts water that would otherwise end up as stream baseflow, it would also intercept some water that would otherwise leave the system through the process of evapotranspiration. The range in impact to streamflow for the two wellfield scenarios discussed above is almost accounted for by a similar range in the evapotranspiration impacts. The reduction in evapotranspiration varies between 2,530 and 3,040 AFY for the compact and expanded wellfields, respectively.

Though these values might seem like large amounts of water, it should be noted that these impacts are spread out over a large area (though not evenly, because evapotranspiration occurs along stream corridors and at wetlands) within all three watersheds. Moreover, the reductions in water available for evapotranspiration are small when compared to the baseline level of evapotranspiration that occurs in these watersheds. In Peace Creek, the baseline evapotranspiration is 17,400 acre-feet and this would be reduced by 2,230 AFY, a reduction of approximately 13 percent, with the compact wellfield configuration. This impact is reduced to approximately 10 percent with the expanded wellfield. In the North Fork Ninnescah River, the baseline evapotranspiration is 20,700 AFY, and this would be reduced by 440 AFY, a reduction of approximately 2 percent, under the expanded wellfield. The effects are even less with the compact wellfield. Though these percentages are relatively small, this could still translate into some reduction of vegetation/habitat to wetlands within the Gar-Peace Creek and North Fork Ninnescah River watersheds.

The implementation of the augmentation wellfield will cause a drawdown that will impact wetlands in the Gar-Peace Creek and North Fork Ninnescah River watersheds (and potentially Rattlesnake Creek Watershed near the augmentation wellfield). Aquifer drawdowns over a 50-year period into the future indicate a maximum drawdown level of 5 feet in the vicinity of the wellfield during a relatively low pumping period and a maximum drawdown level of 10 feet in the

vicinity of the wellfield during a relatively heavy drawdown period (Balleau 2023a). The acres of wetlands located within the drawdown cone of depression for both the compact and expanded wellfield configurations are shown in Table 6.9.2-3 below. Areas outside the immediate vicinity of the wellfield will have drawdowns of 0.5 to 1.0 foot over a 50-year period.

Table 6.9.2-3. Wetlands Within the Augmentation Wellfield Cone of Depression.

Aquifer Drawdown (feet)	Acres of Wetlands (Compact Wellfield Configuration)*	Acres of Wetlands (Expanded Wellfield Configuration)*
10	83	39
5	181	277
2	247	246
1	324	254
0.5	319	388
Total Wetland Acres	**1,153**	**1,204**

* High Pumping Response model results from the Balleau Groundwater Inc. Technical Assessment (Balleau 2023a)

The magnitude of wetland impacts will vary based on each individual wetland's hydrology. Wetlands that receive hydrology primarily from surface precipitation, runoff, or ephemeral streams would be impacted the least. Wetlands that receive hydrology from groundwater discharge will be impacted the most in areas with 5 to 10 feet of drawdown and may see minor impacts in areas with 0.5 to 2.0 feet of drawdown. Wetlands that receive hydrology from adjacent streams would be impacted the most in the vicinity of Peace Creek and may receive minor impacts near other intermittent or perennial streams (i.e., Rattlesnake Creek and North Fork Ninnescah River).

A complete loss in hydrology and subsequent wetland losses are not anticipated. Wetlands receiving hydrology from adjacent streams would incur the greatest hydrologic impacts if they are located along Peace Creek. However, even along Peace Creek, flows are anticipated to be maintained and not incur a loss. Thus, wetlands receiving hydrology from Peace Creek are anticipated to have changes in species composition but no loss of hydrology. These changes in hydrology could result in prolonged dry periods and a reduction in total water available. There are 316 acres of wetlands identified by NWI within these areas. Impacts are anticipated to be prolonged dry periods and a reduction in total water available on an annual basis for wetlands that rely on groundwater discharge, which will be most noticeable in wetlands receiving hydrology from groundwater discharge in the 5- to 10-foot aquifer drawdown area. Quivira NWR has two land parcels called the Hornbaker Tracts that are not continuous with the main system. These land parcels are located adjacent to Peace Creek and are not within the 5 to 10 feet of aquifer drawdown zone. Thus, impacts are anticipated to be minor in these areas (less than 2 feet). Under the No Action Alternative, aquifer increases could be anticipated as a result of the cessation of pumping from the 810 junior water rights in Zone B. Wetlands with hydrologic

connections to groundwater would see increased hydrology. Any increase in wetland hydrology under the No Action Alternative would not be realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative because of the continued pumping in Zone B.

Additionally, the No Action Alternative would not have a cone of depression from pumping or any wetland impacts. Conversely, the wells associated with the 810 water rights would have their own cone of depression similar to the augmentation wellfield. Because these wells have been pumping for many years, the cone of depression is currently in place and part of existing conditions. Wetlands have been impacted over the past few decades since the wells were installed. Wetlands that historically had hydrological connections to groundwater may have been reduced and thus these wetlands have reduced hydrology. The No Action Alternative and the cessation of pumping associated with 810 junior water rights would reverse the cone of depression and reconnect groundwater hydrology. This would benefit wetlands with a hydrologic connection in Zone B and within the historic cone of depression. These wetland hydrology benefits would not be realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

Targeted water right retirements would benefit wetlands upstream of the augmentation delivery point as a result of increased streamflow of approximately 1-2 cfs within Rattlesnake Creek. These measures would benefit flows within Rattlesnake Creek and provide hydrology to adjacent wetlands dependent on streamflow and groundwater interactions. Depending on locations of the retirements, Peace Creek baseflows and adjacent wetlands could also receive some benefit. Benefits to wetlands resulting from water right retirements would occur over a 50-year period.

Surface Water Quality

Under this alternative, augmentation water, combined with the natural flows of Rattlesnake Creek, would be required to maintain chloride concentrations of water flowing into Quivira NWR of less than 1,400 mg/L (KDHE 2018). At natural flows of equal to or less than 16 cfs, when augmentation deliveries are mostly going to occur, the chloride concentration in Rattlesnake Creek tends to exceed 1,400 mg/L. Therefore, the augmentation water delivered to Rattlesnake Creek will generally need to have chloride concentrations of less than 1,400 mg/L. Samples of shallow groundwater collected from the pumping wells installed as part of the development of this Plan – EIS were found to have chloride contents ranging from approximately 90 to 280 mg/L. Note that these are the chloride concentrations found before and after test pumping at Site 1. Site 1 is located outside of the area currently being considered for augmentation because of the higher chloride levels found at depth there (Olsson 2023a). So, after augmentation water is mixed with the natural flows in the stream, water quality should be maintained at or below 1,400 mg/L chloride content. Additional streamflow resulting from the water right retirements associated with this alternative would also have a dilution effect (relative

to without the water right retirements) on nitrogen and phosphorous, whose primary inputs are derived from agricultural runoff rather than underlying geology.

Water pumped from the augmentation wellfield to Quivira NWR would consist of groundwater directly pumped and piped from the wellfield. Water naturally occurring in Rattlesnake Creek and flowing to Quivira NWR would still be from a groundwater source; however, changes in discharge to Rattlesnake Creek along the entire reach versus pumped to a single location may cause differences in minerals, nutrients, pollutants, and biotic components. These differences in water composition may be minimized as current management includes water flows from Rattlesnake Creek being held in Little Salt Marsh. However, these differences in water quality may affect aquatic and terrestrial species that use water from Rattlesnake Creek.

Indirect and Direct Effects Determination

Net increase (augmentation deliveries plus increases from water right retirements) to downstream Rattlesnake Creek would be approximately 6,500 AFY. Quality of habitat for streams and wetlands downstream of the augmentation deliveries would be improved. The increased supply of water to Quivira NWR will support the surface water resources at the refuge. This increase would contribute a beneficial moderate effect compared to existing conditions and could contribute a negligible effect compared to the No Action Alternative because the benefits would be similar but not as beneficial.

The total reduction in streamflow to all streams would range between 1,560 AFY to 2,060 AFY as a result of drawdown from the augmentation wellfield. Wetlands in the vicinity of the augmentation wellfield could have decreased surface hydrology within the cone of depression but are anticipated to retain their wetland status. Changes in water quality may occur. This reduction would contribute a negative minor effect (long-term) on surface water resources and water quality compared to existing conditions or compared to the No Action Alternative.

6.9.3 Groundwater Use Reduction Alternative

Streams

Under the Groundwater Use Reduction Alternative, all groundwater users within Zone A would be required to reduce groundwater pumping by 60 percent. According to analysis conducted by Balleau, the Groundwater Use Reduction Alternative would result in an average increase in baseflow of 18,800 AFY over the 53-year simulation period (Balleau 2022). This reduction equates to approximately 20 percent of the net reduction in groundwater pumping, which averaged 94,600 AFY. Though the average increase of 18,800 AFY is significantly more than the amount granted under Water Right File Number 7,571 (14,632 AFY), this value is heavily skewed by the late time data toward the middle and end of the 53-year simulation.

Under the baseline future condition presented in the Balleau analysis, annual streamflow (baseflow plus runoff) at the Zenith gage would fall below 14,632 AFY approximately 67 percent of the time. This is an annual volume that doesn't consider the intra-annual timing of water that

is desired under the USFWS's management plans, so there would likely be additional years where these intra-annual targets are not met. Under the Groundwater Use Reduction Alternative, the percentage of years that flows would fall below 14,632 AFY would be reduced to approximately 10 percent; however, flows barely exceed 14,632 AFY during six additional years of the simulation, indicating that some of the intra-annual targets were very likely not met. These 11 years when the flows are below or barely above 14,632 AFY are scattered through the first approximately 40 years of the simulation, indicating that the 60 percent reduction in groundwater pumping would likely need to be maintained for at least several decades.

The streamflow benefits from reduced pumping would not be limited to Quivira NWR but would also extend upstream of Rattlesnake Creek Zenith gage. Figure 4.10.3-2 shows the loss of perennial stream lengths in Rattlesnake Creek and KDA-DWR (2019b) indicates additional loss in streamflow until stabilization occurs in 2040. Under the Groundwater Use Reduction Alternative, streamflow would be increased to potentially restore past perennial streamflow losses and avoid future perennial streamflow losses.

The Groundwater Use Reduction Alternative increases river flow by 18,800 AFY (53-year average). However, the impairment analysis shows that only 5,580 AFY is needed. Accordingly, an average of 13,220 AFY (18,800 AFY minus 5,580 AFY) exceeds the objective; it then flows out of the basin (and it cannot provide a specific quantity of water during drought periods). The administrative process of curtailing groundwater pumping is a broad-brush approach that will result in increased surface flow that is dependent on precipitation and climactic variables.

Increased and more consistent hydrology in Rattlesnake Creek would provide better quality habitat for aquatic species and increase riparian health for the entirety of the Rattlesnake Creek Watershed within Zone A. These benefits would extend to ephemeral and intermittent streams in addition to perennial stream lengths.

Wetlands

Existing wetlands within Quivira NWR and Zone A would benefit from implementation of the Groundwater Use Reduction Alternative. Because this alternative would result in Quivira NWR receiving its full water right most of the time, Quivira NWR would have sufficient surface flows to maintain its wetland complexes consistent with management goals and seasonal water needs identified by USFWS. Beyond Quivira NWR, wetland features within Zone A that derive hydrology from adjacent streams or from groundwater features will benefit from the Groundwater Use Reduction Alternative based on the increased streamflow in Rattlesnake Creek and its tributaries and the increased availability of groundwater. Remaining wetland features within the project area and wetland features within Zone A that do not rely on streamflow or groundwater for hydrology will not be affected by the Groundwater Use Reduction Alternative.

Surface Water Quality

The Groundwater Use Reduction Alternative would improve water quality within Rattlesnake Creek flows in Zone A and Quivira NWR by reducing groundwater pumping in Zone A. Low streamflow resulting from groundwater pumping corresponds to increases in the portion of surface water derived from groundwater, which is naturally high in sodium, chloride, and sulfate within the project area because of underlying geology. A reduction in groundwater pumping by 60 percent would increase surface flows and dilute base flows, resulting in improved water quality for these major ions within Rattlesnake Creek. Similarly, increased surface flows within Rattlesnake Creek resulting from the Groundwater Use Reduction Alternative would also have a dilution effect on nitrogen and phosphorous, whose primary inputs are derived from agricultural runoff rather than underlying geology.

Indirect and Direct Effects Determination

A 60 percent reduction in pumping by all groundwater users in Zone A would result in an average increase in baseflow of 18,800 AFY over the 53-year simulation period. Quality of habitat for streams and wetlands would be improved. Water quality could be improved by decreasing surface runoff. The Groundwater Use Reduction Alternative would have a beneficial major effect on surface water resources and water quality compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits would be similar but not identical.

6.9.4 CUMULATIVE IMPACTS

Streams

Perennial streams in Kansas have shown a decrease in total length since the 1960s, particularly in western Kansas. The primary cause of the decline in streamflow (because of lower groundwater tables) is from the extraction of water for irrigated agriculture. High rates of agricultural pumping will continue to cause decreases in perennial stream reach throughout the state of Kansas. Figure 4.10.3-2 shows the loss of perennial stream in Rattlesnake Creek and KDA-DWR (2019b) indicates additional stream declines until stabilization occurs in 2040 under existing conditions. In 2009, perennial stream reach extended approximately 24.5 miles upstream from Quivira NWR. Balleau calculated potential perennial stream reach after 50 years of groundwater pumping for three climate states (dry, median, and wet) under a continuation of existing conditions. In a dry climate state (10th percentile groundwater flow gain) there is approximately 16 miles of perennial stream reach upstream of Rattlesnake Creek. Median (50th percentile) perennial stream reach is approximately 21.7 miles and wet (90th percentile) climate state is approximately 36 miles (Balleau 2023b; Appendix D).

In the condition of drier than average conditions (10th percentile groundwater flow gain), there are approximately 16 miles of active flow on Rattlesnake Creek above Quivira NWR under the continuation of existing conditions. In the median (50th percentile) and wetter than average (90th

percentile) conditions, the active flow reach increases to approximately 21.7 miles and 36 miles above Quivira NWR, respectively.

Under the No Action and Groundwater Use Reduction alternatives, curtailment of junior water rights within Zone A or Zone B would result in improved streamflow to Rattlesnake Creek and within proximity of water use reduction areas (Zone A or Zone B). Increases in streamflow could restore hydrology in reaches of perennial streams that have become intermittent as a result of agricultural groundwater use.

The Augmentation Wellfield and Groundwater Use Reduction Alternative would result in negative impacts to streamflow in the Gar-Peace Creek and North Fork Ninnescah River watersheds because of withdrawals for augmentation pumping. No loss of perennial stream reach is anticipated because the upper reach of Peace Creek is intermittent, and North Fork Ninnescah River impacts are minor. Water right retirements would result in a positive increase in streamflow to upstream Rattlesnake Creek (1-2 cfs) because of the decrease in pumping.

This increase in streamflow would partially offset the stream flow reductions from the augmentation wellfield. However, ongoing irrigation is projected to reduce perennial stream reaches in Rattlesnake Creek under existing conditions. The Augmentation Wellfield and Groundwater Use Reduction Alternative does not address the perennial stream reach loss, while the No Action Alternative addresses this loss and results in increases to stream flow.

Wetlands

The primary cause of wetland losses in Kansas is conversion of wetlands to agricultural production. Irrigation withdrawals causing a depletion in groundwater have also resulted in decreases to and loss of wetlands. Kansas has lost about one-half its wetlands during the past 200 years because of this conversion to cropland and depletion of surface and ground water as a result of irrigation withdrawals (USGS 1997). Agricultural pumping has resulted in less surface water being conveyed along Rattlesnake Creek to Quivira NWR, which results in less wetland hydrology at Quivira NWR. Twenty percent of the wetlands mapped within the three watersheds are within Quivira NWR.

Under the No Action and Groundwater Use Reduction alternatives, curtailment of junior water rights within Zone A and Zone B would result in improved surface flows in the Rattlesnake Creek Watershed, increased aquifer levels, and increased hydrology for wetlands within Quivira NWR and within proximity to water use reduction areas (Zone A or Zone B). The increased wetland hydrology would result in increased wet periods and increased water quantities on an annual basis.

The Augmentation Wellfield and Groundwater Use Reduction Alternative would result in negative impacts to wetlands in the Gar-Peace Creek Watershed and within the 5-10 feet aquifer reduction areas. Negative impacts are anticipated to be a result of reduced hydrology and would include prolonged dry periods and reduced water quantity on an annual basis. The

wetlands in Quivira NWR will receive positive impacts from augmentation deliveries and increased water from Rattlesnake Creek. Wetlands in the Rattlesnake Creek Watershed will see positive impacts resulting from the decreased water withdrawals associated with the water right retirements.

The No Action and Groundwater Use Reduction alternatives would have increased benefits because of the natural process through which water would be restored. The Augmentation Wellfield and Groundwater Use Reduction Alternative would provide wetlands at Quivira NWR benefits compared to current conditions, but the difference in water composition would not provide the same benefit as the No Action Alternative. The ability to pump water during drought conditions may make water available to Quivira NWR when previously unavailable. Management at Quivira NWR would have the discretion to use the previously unavailable water to benefit wetlands.

Surface Water Quality

Agricultural practices including irrigation, fertilizer application, and pesticide application have impacted water quality over the past 50 years and have ongoing impacts. Baseflows in Rattlesnake Creek have declined over time because of the development of groundwater pumping for agricultural use in the watershed. The naturally occurring phenomenon of mineral intrusion caused by salt upwelling from the Permian bedrock and increasing chloride levels in groundwater and surface water has been intensified by groundwater use. Reductions in baseflows reduce freshwater mixing and increase salt concentrations. Fertilizer and pesticide application has led to increased levels of nitrogen, phosphorus, and other chemicals from agricultural runoff.

The No Action and Groundwater Use Reduction alternatives will reduce fertilizer and pesticide applications as a result of reduced irrigated farmland acres (conversion to dryland farming) and subsequent reduction in fertilizer and pesticide needs. Increased baseflows resulting from these alternatives will increase freshwater dilution and improve water quality.

The Augmentation Wellfield and Groundwater Use Reduction Alternative will include increases in overall pumping by approximately 3,000 AFY and may contribute to minor declines in baseflows. Water quality from the augmentation wellfield will be monitored and maintained with the KDHE threshold to avoid increases in chloride levels. Fertilizer and pesticide application would be reduced slightly by reducing 2,500 AFY of groundwater use, but these effects would be minor in comparison to the No Action Alternative.

Cumulative Effects Determination

The cumulative impacts from all alternatives have a beneficial effect to surface water resources compared to existing conditions. The No Action and Groundwater Use Reduction alternatives would have increased benefits because of the natural process through which water would be restored. The Augmentation Wellfield and Groundwater Use Reduction Alternative would

provide benefits to surface water resources compared to current conditions, but the difference in water composition would not provide the same benefit as the No Action and Groundwater Use Reduction alternatives. Reductions in streamflow caused by operation of the augmentation wellfield would result in negative minor cumulative impacts to wetlands within the cone of depression and water quality downstream of the delivery point as a result of physical and chemical differences between surface water and groundwater.

6.10 Regional Water Resource Plans

6.10.1 No Action Alternative

Implementation of the No Action Alternative would not result in any changes to existing regional water resource plans, organizations, or groundwater management districts. Curtailment of groundwater pumping within Zone B occurring under the No Action Alternative would be administered by KDA-DWR and would not require administrative or statutory action on the part of existing groundwater management districts or implementation of a LEMA or IGUCA. Kansas groundwater management districts, including GMD #5, would continue to exist under the No Action Alternative and would continue to be responsible for monitoring groundwater use and assuring that a safe yield policy and maximum reasonable quantity for irrigation are maintained.

The No Action Alternative would not result in any impacts or changes to existing regional water resource plans.

Indirect and Direct Effects Determination

No impacts or changes to existing regional water resource plans would occur; therefore, the No Action Alternative would have no effect on existing regional water resource plans compared to existing conditions.

6.10.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

Construction and operation of the augmentation wellfield would not result in any impacts to existing regional water resource plans, organizations, or groundwater management districts. GMD #5 would be responsible for operating and maintaining the augmentation wellfield and assuring the safe yield policy outlined in K.A.R. 5-25-4 is followed.

Water Right Retirements

Purchase and retirement of water rights within Zone D would not result in any impacts to existing regional water resource plans, organizations, or groundwater management districts. Retirement of water rights by GMD #5 for the purposes of groundwater conservation is consistent with purposes and goals of the KGMDA and GMD #5 district management program.

Indirect and Direct Effects Determination

No impacts or changes to existing regional water resource plans would occur; therefore, the Augmentation Wellfield and Groundwater Use Reduction Alternative would have no effect on existing regional water resource plans compared to the No Action Alternative or compared to existing conditions.

6.10.3 Groundwater Use Reduction Alternative

Under the Groundwater Use Reduction Alternative, enforceable groundwater use reductions would affect existing regional groundwater resource plans through development of a new LEMA or new IGUCA. Development of a LEMA under this alternative would rely on statutory authority granted to GMD #5 by K.S.A. 82a-1041 to develop a LEMA plan for review and approval by KDA-DWR. Development and enforcement of an IGUCA under this alternative would rely on statutory authority possessed by KDA-DWR by the KGMDA to initiate and implement targeted pumping reductions.

The Groundwater Use Reduction Alternative would affect existing regional groundwater resource plans through the establishment of a new LEMA or a new IGUCA, both of which are supported by and consistent with statutory authorities and frameworks of existing regional groundwater resource plans and regulations.

Indirect and Direct Effects Determination

The Groundwater Use Reduction Alternative would affect existing regional water resource plans through the establishment of a new LEMA or IGUCA. This effort would be supported by the existing framework of the Regional Water Resource Plans; therefore, the Groundwater Use Reduction Alternative would have a negligible effect on existing regional water resource plans compared to the No Action Alternative or compared to existing conditions.

6.10.4 Cumulative Impacts

Past and present actions affecting regional water resource plans include existing LEMAs and IGUCAs in Kansas. In Kansas, two LEMAs have been approved in GMD #4, one LEMA has been approved in GMD #1, and one LEMA is currently under development in GMD #1. In total, seven IGUCA orders have been approved in Kansas, and one IGUCA order (Walnut Creek) is currently under review. Past and present LEMAs and IGUCAs have been triggered by unsustainable groundwater irrigation rates, which may become complicated by climate change in the future. In the context of future climate change and the potential impacts on existing groundwater resources, use of LEMAs and IGUCAs could become more frequent and widespread.

The alternatives considered are not anticipated to contribute to cumulative regional water resource plans because there would be no significant changes to any existing plans as a result of implementation of any of the alternatives.

Cumulative Effects Determination

The alternatives considered are not anticipated to significantly contribute to cumulative impacts to existing regional water resource plans. There would be no changes to existing plans as a result of implementation of the No Action or Augmentation Wellfield and Groundwater Use Reduction alternatives. Any changes needed because of the establishment of a LEMA or IGUCA for the Groundwater Use Reduction Alternative would be supported by the existing plans and would not constitute a cumulative impact.

6.11 Riparian Areas

6.11.1 No Action Alternative

Riparian areas, both forested and nonforested, total approximately 1.6 percent (11,633 acres) of the total land area within the project area. The No Action Alternative would not include any ground disturbance or construction activities and therefore would not negatively affect the existing forested and nonforested riparian areas within the project area.

Riparian areas are fundamentally dependent on the interaction between groundwater levels and streamflow (Rohde et al. 2021), and implementation of the No Action Alternative could result in benefits to these areas by increasing groundwater levels through reductions in groundwater pumping in Zone B. Increased groundwater levels would lead to increased streamflow, which would benefit the existing 5,516 acres of riparian areas in Zone B by providing the soil moisture and seasonal flooding needed to sustain riparian vegetation. As groundwater availability and streamflow increase as a result of pumping curtailment, nonforested riparian areas could transition to forested riparian communities as water becomes more accessible (Ahring and Steward 2012).

Indirect and Direct Effects Determination

No ground disturbance will occur. Reductions in groundwater pumping will lead to increased stream levels, which would benefit the existing 5,516 acres of riparian areas present in Zone B. Quality of habitat for riparian areas would be improved. The No Action Alternative would have a beneficial minor effect (long-term) on riparian areas compared to existing conditions.

6.11.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

Construction of the augmentation wellfield and pipeline would involve ground disturbance activities including well placement, drilling, and placement of pipeline. Individual wells could be sited to avoid impacts to riparian areas. However, construction of the pipeline system, including excavation, grading, and clearing that are necessary to lay the pipe, would result in permanent and direct impacts to the 2.9 acres of riparian areas within the disturbance footprint of proposed pipelines and associated easement areas. Riparian vegetation within the footprint of pipelines and easement areas would be removed during construction but would be restored and

reseeded following construction in compliance with a SWPPP for the project. Negative direct impacts to riparian areas resulting from construction of the pipeline would likely be offset by beneficial impacts resulting from water right retirements.

Groundwater pumping from the augmentation wellfield would result in indirect negative impacts to riparian areas in the Gar-Peace Creek and North Fork Ninnescah River watersheds. Impacts would be greatest within the augmentation wellfield and substantially less outside the augmentation wellfield area. Augmentation pumping is anticipated to occur at a rate of 15-18 cfs, which would result in lowering groundwater levels in the vicinity of the wellfield between 5 feet and 10 feet over a period of 40-50 years. Impacts to groundwater levels resulting from augmentation pumping are detailed in Section 6.2.2, above. Impacts to streams from augmentation pumping is detailed in Section 6.9.2. Lowering groundwater levels, particularly as the result of pumping, has been shown to alter the vegetation communities of established riparian areas. As depth to groundwater level increases, tree species decrease (Ahring and Steward 2012); therefore, riparian areas within the Peace Creek and North Fork Ninnescah River may shift from forested to herbaceous communities over time as a result of augmentation pumping. Additionally, augmentation pumping would further affect riparian areas by decreasing the amount of available soil moisture, decreasing streamflow, and affecting normal hydrologic processes, such as periodic flooding. Vegetation communities may shift to species that can tolerate prolonged dry periods or drier overall conditions.

In comparison, the No Action Alternative would provide increased hydrology to riparian areas along intermittent and perennial streams in Zone B and any associated cone of depression. Existing conditions include historic reductions in hydrology to Peace Creek and Rattlesnake Creek from pumping associated with agricultural producers. While riparian areas still exist along Peace Creek and Rattlesnake Creek, vegetation shifts may have occurred and conversion of stream reaches to intermittent or ephemeral may have reduced the total riparian corridor width and resulted in a loss of riparian habitat. Historic land use changes would also have an impact on the riparian corridor width. The No Action Alternative would result in an improvement to existing conditions and reversing hydrology loss back towards pre-development levels. Increases to hydrology in the riparian corridor under the No Action Alternative would not be realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

Riparian areas in the Rattlesnake Creek Watershed downstream of the augmentation delivery point would benefit from augmentation pumping. Augmentation pumping would result in increased streamflow in Rattlesnake Creek. Increased streamflow, and associated flow variability, are important contributors to the development of riparian areas (Auble et al. 2005). By restoring normal hydrology, increasing surface flows, and allowing natural hydrologic disturbance, riparian areas downstream of the proposed delivery point would benefit from stream augmentation.

Water deliveries to Rattlesnake Creek from the augmentation wellfield will differ from existing flows in Rattlesnake Creek, because augmentation flows at the point of delivery will have lower temperatures, lower turbidity, and higher flow rates. However, as water is mixed with natural flows in Rattlesnake Creek, these differences will be negligible and are not anticipated to substantially alter the existing riparian vegetation composition of riparian areas. No negative effects to riparian communities within the Rattlesnake Creek Watershed are anticipated to occur as a result of this alternative.

Water Right Retirements

Retirement of 2,500 acre-feet of water rights in Zone D would not involve construction or ground disturbance activities and would not result in a direct impact to riparian areas.

The resulting reduction in irrigation and changes in crop selection that could occur as a result of water right retirements would result in increased groundwater availability and increased streamflow (1-2 cfs in Rattlesnake Creek), both of which contribute to development and function of riparian areas (NRCS 2012b). There are 3,340 acres of existing riparian areas within Zone D that would receive varying levels of indirect benefits as a result of water right retirements. Riparian areas closest to the reduction in groundwater use may see the most immediate benefits, while long-term benefits may be more widespread. Water right retirement benefits as a result of 2,500 AFY of retirements are anticipated to be similar to the No Action Alternative but at a lower magnitude because of the decreased total volume. However, the proximity to Rattlesnake Creek will have a more direct influence on hydrology in Rattlesnake Creek and subsequently, riparian areas along Rattlesnake Creek.

Indirect and Direct Effects Determination

Water right retirements will lead to increased stream levels, which will have varying benefits (depending on proximity) to the 3,340 acres of riparian areas in Zone D. Positive impacts to riparian areas will occur downstream of the delivery point in Rattlesnake Creek. Quality of habitat for riparian areas downstream of the augmentation deliveries would be improved. This would contribute a beneficial minor effect (long-term) compared to existing conditions and could contribute a negligible effect compared to the No Action Alternative because the benefits would be similar but not identical.

Pipeline construction for the augmentation wellfield will have direct impacts to 2.9 acres of riparian areas. Drawdown from the augmentation wellfield will result in indirect impacts to riparian areas and potential changes in vegetation may cause a shift in riparian species composition. This would contribute a negative minor effect (short-term from construction and long-term from augmentation wellfield drawdown) on riparian areas compared to existing conditions or compared to the No Action Alternative.

6.11.3 Groundwater Use Reduction Alternative

Similar to the No Action Alternative, the Groundwater Use Reduction Alternative would not involve any ground disturbance or construction activities and would have no direct impact to riparian areas.

The Groundwater Use Reduction Alternative would result in an average increase in aquifer storage of 46,400 AFY, which would equate to an average water level increase of approximately 5 inches across Zone A (see 6.2.3 for additional detail). Implementation of the Groundwater Use Reduction Alternative would result in indirect beneficial impacts to the 9,566 acres of existing riparian areas in Zone A because soil moisture, groundwater levels, and streamflow increase as a result of decreased groundwater pumping. Beneficial impacts to riparian areas associated with this alternative would be similar to those described previously in the No Action Alternative; however, beneficial impacts to riparian areas would be spread across a larger area than the No Action Alternative, because reductions associated with the Groundwater Use Reduction Alternative would occur throughout Zone A, as opposed to Zone B, in the No Action Alternative.

Indirect and Direct Effects Determination

No ground disturbance will occur. Reductions in groundwater pumping will lead to increased stream levels, which would benefit the existing 9,556 acres of riparian areas present in Zone A. Quality of habitat for riparian areas would be improved. The Groundwater Use Reduction Alternative would have a beneficial minor effect (long-term) on riparian areas compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits would be similar but not identical.

6.11.4 Cumulative Impacts

Past, present, and reasonably foreseeable future actions affecting riparian areas in the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds are related to agriculture, including irrigation, crop production, pasture, and grazing. Primary drivers of riparian area decline in Kansas include urbanization and conversion of riparian areas to cropland (Kansas Forest Service 2010). Groundwater pumping reduces groundwater flow, which in turn impacts perennial stream reach and riparian vegetation. Specific to the project area, riparian areas have been impacted by declines in Rattlesnake Creek that have caused conversion from perennial to intermittent status (see Section 6.9.2). Ongoing pumping is continuing to cause streamflow reductions that would impact riparian areas.

Implementation of the No Action or Groundwater Use Reduction alternatives would increase streamflow, soil moisture, and groundwater levels and thus improve riparian areas. These benefits would be anticipated in the areas with water use reductions (Zone A or Zone B) and would be specific to Quivira NWR. Streams and streamflow benefits are described in Section 4.9.3 and Section 6.9.1. Additional streamflow in Rattlesnake Creek and potential conversion

from intermittent to perennial status may benefit riparian areas. Peace Creek would also see increased streamflow and have riparian benefits.

The Augmentation Wellfield and Groundwater Use Reduction Alternative will negatively contribute to cumulative impacts of riparian areas in the Gar-Peace Creek and North Fork Ninnescah River watersheds. The greatest riparian stream impacts would occur along Peace Creek where prolonged dry periods and reductions in overall hydrology would occur. Implementation of the augmentation wellfield may affect riparian areas by decreasing the amount of available soil moisture and decreasing streamflow, which may cause forested riparian areas to become more herbaceous over time. As species composition changes, native riparian trees and shrubs including willows, elms, maples, and others could be displaced by native herbaceous grasses such as prairie chord grass, switchgrass, sedges, and rushes. In some instances, native riparian vegetation could be displaced by salt-tolerant invasive species including phragmites or salt cedar. Riparian areas downstream of the delivery point in the Rattlesnake Creek Watershed may see a positive cumulative impact because of increases to soil moisture, groundwater levels, and streamflow as a result of water right retirements. Riparian areas upstream of Zenith gage would continue to see stream flow declines under the Augmentation Wellfield and Groundwater Use Reduction Alternative and would not result in beneficial stream flow increases that would be realized as part of the No Action Alternative.

As discussed previously, water provided by the augmentation wellfield will be different from natural water delivered by Rattlesnake Creek. This may affect species composition within riparian areas.

Cumulative Effects Determination

The cumulative impacts from all alternatives have a beneficial effect to riparian areas compared to existing conditions. Although the level and location of benefit varies by alternative, all alternatives would result in increased stream levels that would benefit riparian areas. The Augmentation Wellfield and Groundwater Use Reduction Alternative would also negatively contribute to cumulative impacts to riparian areas within the cone of depression for the augmentation wellfield as decreases to streamflow and available soil moisture may cause changes in riparian species composition.

6.12 Fish and Wildlife Resources

6.12.1 No Action Alternative

Under the No Action Alternative, all water rights junior to Water Right File Number 7,571 within Zone B would be required to cease groundwater pumping. Over time, groundwater levels would increase in the underlying aquifer resulting in increased streamflow in Rattlesnake Creek and water delivery to Quivira NWR.

Increased streamflows could also be anticipated in the Gar-Peace Creek and North Fork Ninnescah watersheds. Wetlands, streams, and riparian areas provide habitat for many fish and wildlife species. The environmental consequences are described for wetlands and streams (Section 6.9.1) and riparian areas (Section 6.11.1). Under the No Action Alternative, the increases in hydrology and the benefits to streams, wetlands, and riparian areas will provide additional and higher quality habitat for fish and wildlife resources.

Quivira NWR

The No Action Alternative does not include ground disturbance or construction in Quivira NWR and would not result in degradation or reduction of wildlife habitat within the refuge. The reduction in pumping would allow Rattlesnake Creek to intercept groundwater along its reach and increase streamflow. This increased streamflow would improve surface water delivery to Quivira NWR and allow managers to fluctuate wetland water levels year-round, therefore providing foraging and nesting habitat to a variety of wildlife (e.g., bats, waterbirds, amphibians, etc.). Additional streamflow not captured by the refuge would flow downstream and provide beneficial uses to downstream fish and wildlife resources. See Section 6.16.1 for additional information on Quivira NWR.

Wildlife Resources

Outside of Quivira NWR, the project area is dominated by cropland and nonnative grasslands that are used by a variety of wildlife. The relatively few intact fragments of natural habitat (woodlands, prairie, wetlands, etc.) on the margins of these disturbed areas are highly significant for wildlife (e.g., shelter, food, migration corridors, etc.) but are constantly threatened by the encroachment of agriculture (Lark et al. 2020).

Under the No Action Alternative, curtailment of groundwater pumping in Zone B would lead to changes in farming practices that include conversion of irrigated crops to less water-intensive forms of agriculture including dryland farming and grazing or pasture-based systems.

These less water-intensive forms of agriculture may provide additional habitat for wildlife species that use agricultural areas. Conversion of irrigated corn to dryland corn may have minimal habitat differences and may leave less grain for deer, migratory and upland birds, and small mammals. Conversion of irrigated corn to pasture or alfalfa may provide additional habitat benefits but fewer food resources.

The cone of depression resulting from historic pumping in Zone B would decrease over time. As a result of increases in stream flows, riparian habitat and wetland hydrology would provide additional habitat for wildlife species. Amphibians, waterfowl, and shorebirds which rely on riparian areas and wetlands would see the greatest benefits and likely increase in abundance and diversity. Changes in land use over the past 50 years would limit habitat benefits to areas generally outside of intensive agricultural production. However, riparian areas associated with pastures, fenced off from use or outside of agricultural production could see increased

hydrologic benefits. Wetlands hydrologically connected to groundwater would see benefits through increased hydrology throughout the year. This increased hydrology would support vegetation production and potentially increases in species richness. Groundwater levels in the Great Bend Prairie Aquifer have been relatively stable in recent decades (McGuire 2017). Thus, benefits from groundwater connections would be limited to impacts that have been realized under existing conditions.

The No Action Alternative would have a minimal effect on upland areas and the associated wildlife resources. The cessation of pumping may allow additional groundwater availability that otherwise would have been intercepted by the agricultural wells in Zone B. Perennial upland vegetation may be able to reach groundwater at a shallower depth depending on the historic extent of the existing cone of depression from agricultural pumping. An increased groundwater connection could support perennial vegetation and increased density that may provide better habitat for upland species. Current land use, including grazing systems, would also influence habitat quality.

Aquatic Resources

The No Action Alternative will help restore and increase the reliability of surface water in Rattlesnake Creek and associated tributaries by increasing the underlying water table (approximately 32,400 AFY over a 53-year period; see Section 6.2.1). Elevated surface waters will increase the water column height and restore longitudinal connectivity of upper reaches in the watershed, thus improving the availability, diversity, and quality of stream habitat for fishes and aquatic macroinvertebrates within Rattlesnake Creek. Historic loss of perennial stream reaches in Rattlesnake Creek could be restored. Fish populations that rely on perennial stream reaches could recolonize these areas and increase the species viability. See Section 6.9 for additional information on surface water resources.

Aquatic resources including fish populations, amphibians, and invertebrates rely on steady flows to support habitat. Changes in stream type such as perennial to intermittent affect fish assemblages and diversity of species that can use the stream reaches. Positive changes in species richness and diversity can be expected with increased hydrology. Specific to Rattlesnake Creek, increases in surface flow can also lower salt content which affects fish and aquatic resources present.

The effects of reduced pumping are anticipated to be localized. Peace Creek and the North Fork Ninnescah River are outside of Zone B and should see minimal fluctuations in water level associated with the curtailment. Any changes in water level are anticipated to be beneficial to water levels in streamflow in Peace Creek and the North Fork Ninnescah River; however, effects are anticipated to be minimal based on their location in relation to the pumping reductions.

Indirect and Direct Effects Determination

Cessation of pumping in Zone B will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability would increase habitat availability for multiple aquatic, avian, and terrestrial species. The No Action Alternative would have a beneficial moderate effect on fish and wildlife resources compared to existing conditions.

6.12.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, the augmentation wellfield would provide supplemental surface flow to areas downstream of the augmentation pipeline delivery point for Rattlesnake Creek and Quivira NWR. The 2,500 AF of water right retirements would provide supplemental surface flow along reaches of Rattlesnake Creek associated with the reductions in pumping. The augmentation wellfield would create a cone of depression that would impact groundwater levels and stream flows near the augmentation wellfield area. Changes in hydrology and impacts to wetlands, streams, and riparian areas may affect fish and wildlife resources. The environmental consequences are described for wetlands and streams (Section 6.9.2) and riparian areas (Section 6.11.2).

Quivira NWR

As with the No Action Alternative, the Augmentation Wellfield and Groundwater Use Reduction Alternative would not include ground disturbance or construction within Quivira NWR and is not likely to result in degradation or loss of wildlife habitat because of construction. Wetland habitat would be enhanced by increased surface waters from Rattlesnake Creek and augmentation deliveries.

As described in Section 5.3, the augmentation wellfield would provide water to Quivira NWR and could be managed to deliver water during critical periods (i.e. migration). Augmentation water could be diverted to provide wetland habitat consistent with the Quivira NWR management goals. Additional wetland hydrology creates habitat and food sources for shorebirds, waterfowl, and other fish and wildlife resources that use the refuge. In comparison, the No Action Alternative provides additional water in Rattlesnake Creek that would provide increased fish and wildlife benefits to Quivira NWR as well as upstream and downstream Rattlesnake Creek.

As discussed in Section 6.9.2, water provided by the augmentation wellfield will be groundwater delivered to a single location along Rattlesnake Creek. Under the No Action Alternative, groundwater is intercepted by Rattlesnake Creek and naturally flows to Quivira NWR. Differences in water composition may affect macroinvertebrates, plant species composition, and aquatic flora and fauna, which in turn may affect species composition of fish and wildlife species at Quivira NWR. See Section 6.16.2 for additional information on Quivira NWR.

Wildlife Resources

The wellfield will be constructed in an area dominated by cropland, while the pipeline will run along roadways between the wellfield and Rattlesnake Creek delivery point. Both areas of construction would result in a total estimated 179 acres of ground disturbance (maximum under the expanded wellfield option; see Section 6.1.2). Many species, such as plains spotted skunk (*Spilogale interrupta*), New Mexico threadsnake, and ring-necked pheasant (*Phasianus cochicus*) will use tall ground cover along roadside ditches and fencerows throughout much of the year (Anderson 1996; KDWP 2022b; NMHS 2023). Additionally, amphibians in the area, such as the Strecker's chorus frog, have been documented using flooded cropland and roadside ditches for breeding purposes (ODWC 2023).

The Augmentation Wellfield and Groundwater Use Reduction Alternative will likely have a temporary negative effect on wildlife inhabiting areas of construction because of habitat loss as a result of construction of access roads, the augmentation wellfield, and pipeline corridor and degradation (fragmentation, disturbance, etc.). Disturbed areas will be reseeded, stabilized, and generally restored to preconstruction condition within one to three years. Though the augmentation wellfield would become a permanent figure on the landscape, the wellfield would be sited in previously disturbed agricultural areas that possess low-quality habitat for wildlife. Based on the previously disturbed nature of agricultural areas and small footprint of wells in comparison to the existing landscape, no permanent impacts to wildlife are anticipated to occur as a result of the construction and operation of the augmentation wellfield.

Positive permanent impacts to wildlife habitat associated with this alternative would be caused by increased streamflows to downstream Rattlesnake Creek from augmentation deliveries and water right retirements. Increases in Rattlesnake Creek streamflow as a result of the water right retirements (1-2 cfs in Rattlesnake Creek) and augmentation deliveries (15-18 cfs) may improve riparian and wetland habitat along Rattlesnake Creek and improve wetland and prairie habitat in Quivira NWR, which would positively impact wildlife species occupying these habitats. Compared to the No Action Alternative, less water is provided to Rattlesnake Creek and significant increased hydrology is not provided upstream of Zenith gage. The No Action Alternative has wildlife benefits upstream of Zenith gage and downstream of Quivira NWR that are not realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative. Additionally, as discussed in Section 6.9.2, groundwater water provided by the augmentation wellfield will be different from surface flow delivered by Rattlesnake Creek. Thus, a reduced benefit to wildlife resources is anticipated because of the physical, chemical, and biotic differences in water sources. Streamflow reductions because of groundwater pumping are expected within Gar-Peace Creek and the North Fork Ninnescah River watersheds, which may result in a decrease in riparian and wetland habitat along these stream corridors. Potential impacts could result from prolonged dry periods or overall reduction in water availability in streams and wetlands that could alter species composition over time. Species composition may

change in response to altered water temperature, salinity, availability, or riparian vegetation type depending on each species' individual habitat preferences. However, impacts to wildlife as a result of groundwater level alterations associated with Augmentation Wellfield and Groundwater Use Reduction Alternative are generally expected to be negligible and minor because of the limited amount of drawdown anticipated during augmentation pumping (maximum modeled drawdown of 5-10 feet). In comparison, the No Action Alternative may have ancillary benefits in the Gar-Peace Creek and North Fork Ninnescah River watersheds that would support wildlife habitat.

Aquatic Resources

As with the No Action Alternative, the Augmentation Wellfield and Groundwater Use Reduction Alternative will help restore water levels downstream of the delivery pipeline in Rattlesnake Creek, therefore improving the availability and diversity of habitat for fishes and invertebrates in the stream and riparian and wetland habitats along the stream corridor and in Quivira NWR. As discussed previously, water provided by the augmentation wellfield will be different from natural water currently delivered by Rattlesnake Creek and under the No Action Alternative. Additionally, Rattlesnake Creek upstream of Zenith gage will continue to see flow declines affecting fish and wildlife resources. Under the No Action Alternative, these stream reaches will see increases in flow and benefits to fish and wildlife resources.

Pumping 15-18 cfs of groundwater from the Gar-Peace Creek and North Fork Ninnescah River watersheds will negatively affect groundwater levels in the Great Bend Prairie Aquifer (see Section 6.2). Peace Creek is an intermittent stream, and the wellfield may cause prolonged dry periods and reduced water availability. Flow impacts will be greatest in proximity to the wellfield and will be minimal as flow reaches the Arkansas River. The North Fork Ninnescah River will have a reduction in streamflow of 940 to 1,570 AFY depending on the wellfield configuration. This level of impact equates to 1.3 to 2.2 cfs or 1 to 2 percent of the average flow (113 cfs) in the North Fork Ninnescah River from 2000 to 2022 (USGS 2023). The reduction in surface waters in Peace Creek and the North Fork Ninnescah River may reduce the aquatic species habitat along these stream corridors. Aquatic habitat impacts will be greatest in areas of Peace Creek that are closest to the wellfield. In comparison, the No Action Alternative could increase flows in Peace Creek and the North Fork Ninnescah River.

Construction of the delivery pipeline would affect riparian habitat along Rattlesnake Creek that is temporarily disturbed and could result in streambank erosion and soil deposition downstream of the delivery point prior to restoration.

Indirect and Direct Effects Determination

Wetland habitat would be enhanced by increased surface waters from Rattlesnake Creek and augmentation deliveries. Increased water availability would increase habitat availability for multiple aquatic, avian, and terrestrial species. This increase would contribute a beneficial

moderate effect compared to existing conditions and could contribute a negligible effect compared to the No Action Alternative because the benefits would be similar but not identical.

Temporary impacts to wildlife habitat will occur as a result of construction; however, no permanent impacts to wildlife are expected. Water provided by the augmentation wellfield would be different from natural water delivered by Rattlesnake Creek that may affect species composition for fish and wildlife species. This water would contribute a negative minor effect (short-term from construction and long-term from differences between surface water and groundwater) on fish and wildlife resources compared to existing conditions or compared to the No Action Alternative.

6.12.3 Groundwater Use Reduction Alternative

Under the Groundwater Use Reduction Alternative, all wells located within Zone A with water rights junior to Quivira NWR will be required to reduce their water use by 60 percent to restore and stabilize streamflow in Rattlesnake Creek, thus providing more surface water delivery to Quivira NWR.

Quivira NWR

As with the No Action Alternative, the Groundwater Use Reduction Alternative would include no ground disturbance or construction in Quivira NWR and would result in no degradation or loss of wildlife habitat within the refuge. Elevated streamflow in Rattlesnake Creek would increase surface water delivered to Quivira NWR and allow managers at Quivira NWR to effectively manage wetland water levels throughout the year, therefore improving foraging and nesting habitat for a variety of wildlife (e.g., bats, waterbirds, amphibians, etc.).

Wildlife Resources

Similar to the No Action Alternative, the Groundwater Use Reduction Alternative could potentially lead to changes in farming practices within Zone A that include conversion of irrigated crops to less water-intensive forms of agriculture that could impact wildlife inhabiting Zone A. Increases in Rattlesnake Creek streamflow as a result of groundwater pumping reductions will improve riparian and wetland habitat along Rattlesnake Creek and within Quivira NWR.

Aquatic Resources

As with the No Action Alternative, the Groundwater Use Reduction Alternative will help restore surface water in Rattlesnake Creek by increasing the underlying water table (approximately 46,400 AFY over a 53-year period; see Section 6.2.3). Elevated surface waters will increase the water column height and restore longitudinal connectivity of upper reaches in the watershed, thus improving the availability, diversity, and quality of stream habitat for fishes and aquatic macroinvertebrates within Rattlesnake Creek.

The effects of reduced pumping are anticipated to be localized. Peace Creek and the North Fork Ninnescah River are outside of Zone A and should see minimal fluctuations in water level

associated with the groundwater use reduction. Any changes in water level are anticipated to be beneficial to water levels in streamflow in Peace Creek and the North Fork Ninnescah River; however, effects are anticipated to be minimal based on their location in relation to the pumping reductions.

Indirect and Direct Effects Determination

Reduction of pumping in Zone A will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability would increase and improve habitat for multiple aquatic, avian, and terrestrial species. The Groundwater Use Reduction Alternative would have a beneficial moderate effect on riparian areas compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits would be similar but not identical.

6.12.4 Cumulative Impacts

Kansas has designated ecological focus areas (EFAs) throughout the state. The Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds are located within the Lower Arkansas aquatic EFA and the Rattlesnake Creek and Gar-Peace Creek watersheds are located within the Quivira terrestrial EFA (Rohweder 2022). Conservation issues within these EFAs primarily focus on impacts to wildlife from agriculture (wetland/stream degradation, removal of riparian buffers, groundwater depletion, and pollution), urbanization, and invasive species.

Groundwater levels in the Great Bend Prairie Aquifer have been relatively stable in recent decades (McGuire 2017); however, ongoing groundwater pumping for agricultural use has led to declines in surface waters within the larger High Plains Aquifer in western Kansas, and the decline is anticipated to continue into the future. Surface water declines resulting from groundwater pumping can lead to habitat loss and degradation (e.g., reduction in stream headwaters, loss of wetlands, and riparian degradation) for a wide variety of fish and wildlife. State and local water management plans have long-term goals of reducing or stopping aquifer depletions, which will require changes to current agricultural practices and irrigation methods. Stream impacts have been observed in Rattlesnake Creek that have caused sections to convert from perennial to intermittent.

Under the No Action and the Groundwater Use Reduction alternatives, groundwater storage in the Great Bend Prairie Aquifer is expected to increase by approximately 32,400 AFY and 46,400 AFY (over 53-year period), respectively, thus benefiting fish and wildlife habitat. Rattlesnake Creek will have increased streamflow and natural water will be available to Quivira NWR. These benefits are anticipated to help reduce or eliminate the ongoing impacts related to agricultural groundwater pumping.

The Augmentation Wellfield and Groundwater Use Reduction Alternative is expected to reduce the groundwater level by approximately 5 to 10 feet (over a 50-year period) within the immediate

footprint of the wellfield. The groundwater level reduction would result in changes and potential loss of fish and wildlife habitat. The greatest impacts are anticipated along Peace Creek and within the immediate footprint of the wellfield. Groundwater and corresponding fish and wildlife habitat impacts would decrease in magnitude with distance from the wells. Changes in riparian areas, wetlands, and streams that were described previously may result in loss or changed habitat for fish and wildlife species.

Water pumped from the augmentation wellfield to Quivira NWR would consist of groundwater directly pumped and piped from the wellfield. Water naturally occurring in Rattlesnake Creek and flowing to Quivira NWR would still be from a groundwater source; however, changes in discharge to Rattlesnake Creek along the entire reach versus pumped to a single location may cause differences in minerals, nutrients, pollutants, and biotic components. These differences in water composition may be minimized as water flows in Rattlesnake Creek and is held in Little Salt Marsh. Increases to Rattlesnake Creek streamflow downstream of the delivery point because of augmentation deliveries will improve riparian habitat along Rattlesnake Creek and wetland and prairie habitat in Quivira NWR.

Cumulative Effects Determination

The cumulative impacts from all alternatives have a beneficial effect to fish and wildlife resources compared to existing conditions. Although the level and location of benefit varies by alternative, all alternatives would result in increased stream levels that would benefit fish and wildlife resources. The Augmentation Wellfield and Groundwater Use Reduction Alternative could negatively contribute to cumulative impacts to fish and wildlife resources because of minor (long-term) impacts to aquatic habitat as a result of differences between groundwater and surface water.

6.13 Invasive Species

6.13.1 No Action Alternative

Under the No Action Alternative, there would be no construction or ground disturbance activities that increase the probability of the spread or introduction of invasive plant species (Mayfield et al. 2021). Implementation of the No Action Alternative would not significantly contribute to the introduction, spread, or persistence of invasive species.

Indirect and Direct Effects Determination

No ground disturbance will occur. The No Action Alternative would not contribute to the introduction, spread, or persistence of invasive species. The No Action Alternative will have no effect on invasive species compared to existing conditions.

6.13.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

Construction of the augmentation wellfield and associated pipeline system would involve a maximum of 179 acres of ground disturbance activities using heavy equipment and construction vehicles. Construction and land disturbance activities may inadvertently serve as transportation or introduction vectors for invasive plant species common in the area including phragmites, cheatgrass (*Bromus tectorum*), salt cedar, or Russian olive. Disturbance in areas of low species diversity, such as the cultivated crop lands where the augmentation wellfield and pipeline system are likely to be constructed, is correlated with invasive plant introduction and spread (Meyer et al. 2021). Invasive plant species are well adapted to colonizing disturbed areas including construction sites. Construction and operation of this alternative will likely have a negligible impact on the transport, introduction, or spread of invasive fishes or invertebrates.

Implementation of construction BMPs would minimize the risk of the spread or introduction of invasive plant species. Construction BMPs would be implemented consistent with the SWPPP and land disturbance permit for the project.

Water Right Retirements

Water right retirements in Zone D would not result in construction or ground disturbance activities that have the potential to result in the introduction or spread of invasive plant species.

Indirect and Direct Effects Determination

Construction of the augmentation wellfield and associated pipeline system would involve a maximum of 179 acres of ground disturbance. Construction and land disturbance activities may inadvertently serve as transportation or introduction vectors for invasive plant species. Implementation of construction BMPs would minimize the risk of the spread or introduction of invasive plant species. The Augmentation Wellfield and Groundwater Use Reduction Alternative will have a negligible effect on invasive species compared to the No Action Alternative or compared to existing conditions.

6.13.3 Groundwater Use Reduction Alternative

Under the Groundwater Use Reduction Alternative, there would be no construction or ground disturbance activities that have the potential to result in the introduction or spread of invasive plant species.

Indirect and Direct Effects Determination

No ground disturbance will occur. The Groundwater Use Reduction Alternative would not contribute to the introduction, spread, or persistence of invasive species. The Groundwater Use Reduction Alternative will have no effect on invasive species compared to the No Action Alternative or compared to existing conditions.

6.13.4 Cumulative Impacts

Past, present, and reasonably foreseeable future actions contributing to the introduction and spread of invasive species in the Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River watersheds include crop production, livestock grazing, and development of private and public infrastructure. These activities are anticipated to continue in the future, which will continue to facilitate the introduction and spread of invasive species. Future climate change represents a significant unknown relative to invasive species but will likely result in changes to invasive species distribution, spread, and impact (Hellmann et al. 2008; Gritti et al. 2006).

Management activities limiting the spread of invasive species include localized removal of salt cedar and Russian olive along Rattlesnake Creek and within Quivira NWR. Since 2018, the Kansas Forestry Service and The Nature Conservancy have implemented an ongoing removal program with the cooperation of private landowners to facilitate removing salt cedar and Russian olive by means of tree removal, prescribed burns, and herbicide application. To date, more than 6,700 acres of salt cedar and Russian olive have been removed along 30 miles of Rattlesnake Creek, upstream of Quivira NWR (Ducks Unlimited 2023). Continuation of the removal program is dependent on grant funding. Within Quivira NWR, staff routinely use a variety of mechanical methods (including tree cutting) to manage woody vegetation coverage and spread within the refuge (USFWS 2013a).

Implementation of the No Action Alternative or Groundwater Use Reduction Alternative would not result in the introduction or spread of invasive species.

Impacts to invasive species resulting from the Augmentation Wellfield and Groundwater Use Reduction Alternative would be short term and limited to the duration of construction activities. With implementation of appropriate construction BMPs and conditions outlined in applicable permits (e.g., land disturbance permit, SWPPP), the proposed project is not expected to contribute to the cumulative introduction, spread, or persistence of invasive species in the Rattlesnake Creek, Gar-Peace Creek, or North Fork Ninnescah River watersheds.

Cumulative Effects Determination

The cumulative impacts from the No Action and the Groundwater Use Reduction Alternatives will have no effect to invasive species because no ground disturbance will occur. The cumulative impacts from the Augmentation Wellfield and Groundwater Use Reduction Alternative could have a negligible effect to invasive species as a result of the potential for construction activities to inadvertently serve as transportation or introduction vectors for invasive plant species; however, implementation of construction BMPs will minimize this potential and cumulative impacts to invasive species are not anticipated.

6.14 Threatened and Endangered Species

6.14.1 No Action Alternative

Under the No Action Alternative, all water rights junior to Water Right File Number 7,571 within Zone B would be required to cease groundwater pumping. Over time, the level of the underlying aquifer would increase, thus raising the water table and improving surface flow in perennial and intermittent reaches of Rattlesnake Creek and other streams in Zone B. In addition, the elevated baseflow of Rattlesnake Creek would increase the amount of surface water available for Quivira NWR to divert into its wetlands, thus meeting its management needs and senior water right, especially during dry periods of the year when water demand is high.

Mammals: Bats

Streams and wetlands provide important foraging habitat for insectivorous bat species because of the high abundance of insects that concentrate in aquatic and riparian habitats (Ancillotto et al. 2019). Tricolored bat, little brown bat, and northern long-eared bat will frequently forage along or near aquatic corridors (USFWS 2022c-e), feeding on emerging aquatic insects (e.g., caddisflies [*Trichoptera*], mayflies [*Ephemeroptera*], blackflies [*Simuliidae*], stoneflies [*Plecoptera*], etc.) and terrestrial insects inhabiting the riparian zone. Natural flow regimes are important for stream insect biodiversity; however, consistent decreases in flow can have negative impacts on aquatic insects causing downstream drift to more favorable water conditions and decreases in abundance of emerging insects in the affected area (Minshall and Winger 1968). The No Action Alternative will help improve perennial portions of Rattlesnake Creek and other streams in Zone B and prevent future losses by providing additional baseflows and a higher water table, therefore providing improved conditions for aquatic insect development and increased foraging opportunities for bat species along stream corridors.

Standing surface waters, such as wetlands, are also an important resource to insectivorous bat species (Korine et al. 2015). Bats use standing water for drinking while in flight, and the flat surface improves the effectiveness of echolocation, thus improving foraging efficiency (Korine et al. 2015). The No Action Alternative will assure that Rattlesnake Creek and Quivira NWR will have increased surface water that will provide improved habitat for foraging and drinking purposes.

The No Action Alternative will result in no disturbance to caves/mines; therefore, it will have no impact on winter hibernacula for bat species.

Birds: Waterbirds

The loss and degradation of natural wetlands worldwide has negatively affected waterbirds in all stages of life and made natural and artificial wetland management a necessary and critical component in waterbird conservation (Zhijun et al. 2010). Fluctuating water levels in wetlands create optimal foraging and nesting habitat for waterbirds as long as the water resource is readily available during periods when water input is needed (Zhijun et al. 2010). Quivira NWR

has been listed as a wetland of global importance because of its optimal location within the Central Flyway and diverse habitats (salt marsh and sand prairie; USFWS 2022a). Quivira NWR is home to more than 35 waterbirds including the whooping crane, eastern black rail, piping plover, snowy plover, red knot, and least tern (USFWS 2022a; Avibase 2023). The No Action Alternative will help assure that Quivira NWR has sufficient surface water to divert from Rattlesnake Creek into its wetlands for management purposes, therefore providing foraging and nesting habitat for waterbirds year-round.

Fish

The streams in the project area have been affected by groundwater pumping as evidenced by reduced flow in Rattlesnake Creek. Excessive groundwater pumping can lead to the reduction in stream length and homogenization of fish communities to smaller, more tolerant fishes (Perkin et al. 2017). Additionally, the reduction in streamflow caused by the depletion of surface waters can provide undesirable habitat for species such as Arkansas river shiner and peppered chub, who prefer faster-flowing waters (USFWS 2022i; KDWP 2023b). Rattlesnake Creek is a shallow (less than 3 feet) and narrow (9-15 feet) stream dominated by fine substrates (sand/silt), run and pool habitat, and low gradients (approximately 2.5 feet; Eberle et al. 1996). As the stream passes Quivira NWR, it accumulates high concentrations of chlorides from the underlying Permian geologic formation resulting in low-saline conditions upstream and high-saline conditions downstream of Quivira NWR. Fish community surveys have shown higher proportions of low-saline tolerant species (red shiner [*Cyprinella lutrensis*] and common carp [*Cyprinus carpio*]) in upper portions of Rattlesnake Creek and high-saline tolerant species (plains killifish [*Fundulus zebrinus*]) in lower portions of Rattlesnake Creek (Eberle et al. 1996).

The No Action Alternative will help restore and stabilize flows in Rattlesnake Creek by increasing the underlying water table. Elevated surface waters will increase the water column height and restore longitudinal connectivity of upper reaches in the watershed, thus improving the availability and diversity of habitat for stream fishes such as the plains minnow, if present. Since the Arkansas river shiner and peppered chub are not known to be present in the Project area, there will be no impacts to those species (beneficial or adverse).

Insects/Pollinators

Many pollinators, such as the monarch butterfly, western regal fritillary, Iowa skipper, southern plains bumble bee, and variable cuckoo bumble bee require relatively intact prairie habitat for foraging and reproduction needs (USFWS 2023g). Quivira NWR, although surrounded completely by agriculture, provides an essential prairie habitat for pollinators. In addition, some pollinators, such as the American bumble bee, can thrive in open field and farmland habitat (USFWS 2023e). The No Action Alternative would include no ground disturbance or construction in Quivira NWR or surrounding farmlands and would result in no degradation or reduction of existing habitat for threatened and endangered pollinators. Increased surface water in Rattlesnake Creek and Quivira NWR will benefit important pollinator plants (e.g., milkweeds,

little bluestem, big bluestem) along the Rattlesnake Creek corridor and within Quivira NWR; therefore, improving pollinator habitat.

Amphibians and Reptiles

The New Mexico threadsnake spends most of its time foraging in underground burrows and will occasionally come to the surface during rain events (KDWP 2022b; NMHS 2023). In Kansas, the species is located in the far southern counties along the Oklahoma state line and southern extent of the project area (KDWP 2022b). The No Action Alternative would include no ground disturbance or construction and would have no impact on New Mexico threadsnake habitat.

The Strecker's chorus frog inhabits woodlands, prairies, and cultivated fields and breeds in shallow, runoff pools of unpolluted water where there is wetland vegetation available and a lack of predatory fish species (KDWP 2022b; ODWC 2023). In Kansas, the species is known to occur in Pratt, Kingman, Barber, and Harper counties in the south-central part of the state, just south of the project area. The No Action Alternative would help make sure that Quivira NWR has sufficient surface water to divert from Rattlesnake Creek into its wetlands for management purposes, therefore providing potential breeding habitat for Strecker's chorus frog just outside of the northern range of the species.

Indirect and Direct Effects Determination

Cessation of pumping in Zone B will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability would improve and increase habitat for threatened and endangered species. The No Action Alternative would have a beneficial minor effect (long-term) to threatened and endangered species habitat compared to existing conditions.

6.14.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, an augmentation wellfield would pump 15-18 cfs of Great Bend Prairie Aquifer groundwater from the Gar-Peace Creek and North Fork Ninnescah River watersheds to Rattlesnake Creek, via pipeline, just upstream of Quivira NWR. In addition, targeted water right retirements in Zone D (2,500 acre-feet) and an adaptive management approach would be implemented.

In compliance with Section 7 of the ESA, a Biological Assessment (BA) has been completed for the Augmentation Wellfield and Groundwater Use Reduction Alternative. Concurrence was received from USFWS on December 17, 2025, and is included in Appendix A.

Mammals: Bats

The Augmentation Wellfield and Groundwater Use Reduction Alternative will supply water to downstream portions of Rattlesnake Creek and Quivira NWR's wetlands, therefore providing improved conditions for insect diversity/abundance and bat foraging opportunities. Pumping 15-18 cfs of groundwater from the Gar-Peace Creek and North Fork Ninnescah River watersheds will ultimately lower surface waters or reduce hydrology in wetlands in Peace Creek and the

North Fork Ninnescah River These reductions in hydrology could have negative impacts on bat foraging opportunities by creating undesirable conditions for aquatic and terrestrial insects along these stream corridors and in wetlands.

Under the No Action Alternative, there would be beneficial hydrologic impacts from the reduction in pumping in Zone B. These would not be realized in the Augmentation Wellfield and Groundwater Use Reduction Alternative. Thus, the reductions in hydrology from the augmentation wellfield and benefits not realized through pumping reductions in Zone B would result in less surface area for wetlands and reduced flows in Peace Creek as a result of the Augmentation Wellfield and Groundwater Use Reduction Alternative. The reduced wetland and stream hydrology would impact terrestrial and aquatic insect populations that are foraged by bats.

Tricolored bat, little brown bat, and northern long-eared bat will roost in caves/mines in the winter and in trees for the remainder of the year (USFWS 2022c-e). The wellfield will be constructed just south of Peace Creek in an area dominated by agriculture, while the pipeline will run along roadways between the wellfield and the Rattlesnake Creek delivery point near Quivira NWR. Both areas of construction lack a high abundance of mature trees; therefore, potential impacts to nonwinter bat roosting habitat would be minimal in the construction sites. The Augmentation Wellfield and Groundwater Use Reduction Alternative will result in no disturbance to caves/mines; therefore, it will have no impact on winter hibernacula for bat species.

Birds: Waterbirds

The Augmentation Wellfield and Groundwater Use Reduction Alternative will help supply water to downstream portions of Rattlesnake Creek and Quivira NWR. The reliable source of water will allow Quivira NWR managers to fluctuate wetland water levels year-round, therefore providing improved foraging and nesting habitat to waterbirds, such as the eastern black rail, piping plover, snowy plover, red knot, least tern, and whooping crane. Since the Eskimo curlew is not known to be present in the Project area, therefore, no impacts (beneficial or adverse) are anticipated. The pumping of 15-18 cfs of groundwater from the Gar-Peace Creek and North Fork Ninnescah River watersheds will ultimately lower surface waters in Peace Creek and the North Fork Ninnescah River and could have negative impacts on foraging and nesting habitat for waterbirds that occasionally use stream or wetland habitats such as the piping plover, snowy plover, least tern, and whooping crane (KDWP 2022b; USFWS 2022g; KDWP 2023a; USFWS 2023h). The Eskimo curlew is assumed not to be present within the Project area. The change of water supply from groundwater intercepted by Rattlesnake Creek to pumped groundwater delivered to a single location, may cause habitat changes downstream of the delivery point that could result in changes in vegetation, micro- and macroinvertebrate communities and aquatic population health, diversity, and abundance over the 50-year life of the project. Construction of the delivery pipeline would affect riparian habitat along Rattlesnake Creek that is temporarily

disturbed and could result in streambank erosion and soil deposition downstream of the delivery point prior to restoration. Construction of the wellfield and delivery pipeline will take place outside of Quivira NWR, in areas primarily dominated by agriculture, and would result in minimal impact to waterbird habitat.

Compared to the No Action Alternative, the quantity of water provided to Quivira would be less, but the timing of when the water could be provided would be improved. The No Action Alternative provides more water to Rattlesnake Creek throughout a normal year than the Augmentation Wellfield and Groundwater Use Reduction Alternative. Additional benefits would be provided downstream of Rattlesnake Creek, but Quivira NWR's water usage would be limited by their wetland storage volume and climactic variability. The augmentation wellfield would be used to provide water that best suits Quivira NWR management goals and could include timing augmentation deliveries to encourage vegetation growth and wetland hydrology prior to and during shorebird migration.

The differences in water sources may impact vegetation and macroinvertebrate composition which are used by shorebirds for habitat and food sources. Maintaining the KDHE 1,400 mg/l chloride threshold will minimize these impacts. Additionally, since groundwater is a natural water source for wetlands, the impacts are anticipated to be minimal.

Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, Rattlesnake Creek upstream of Zenith gage will not see an increase in flow as expected under the No Action Alternative. Decreases to streamflow from the augmentation wellfield are anticipated to be fully offset by the 2,500 AFY of water right retirements. However, the benefits from increases in streamflow as a result of reduced pumping from the 810 junior water rights in Zone B under the No Action Alternative would not be realized.

Fish

The Augmentation Wellfield and Groundwater Use Reduction Alternative will provide reliable flows in the downstream segment of Rattlesnake Creek, thereby improving the availability and diversity of habitat for threatened and endangered stream fishes in the watershed. Rattlesnake Creek upstream of Zenith gage would continue to see declines in flow as described in Section 6.9.2. These continued declines could result in changes to the fish assemblage and the ability of these reaches to provide habitat for threatened or endangered fish species, if present. In comparison, the No Action Alternative would result in increased perennial and intermittent flow along upstream reaches and benefits to habitat that would not be realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

The change of water supply from surface water to pumped groundwater may cause habitat changes downstream of the delivery point that could result in changes in vegetation, micro- and macroinvertebrate communities and aquatic population health, diversity, and abundance, which could contribute to long-term impacts to fishes of conservation concern.

Pumping 15-18 cfs of groundwater from the Gar-Peace Creek and North Fork Ninnescah River watersheds will negatively affect groundwater levels in the Great Bend Prairie Aquifer (see Section 6.2). Peace Creek is an intermittent stream, and the wellfield may cause an increase in this intermittent nature. Flow impacts will be greatest in proximity to the wellfield and will be minimal as flow reaches the Arkansas River. The North Fork Ninnescah River will have a reduction from 940 to 1,570 AFY, depending on the wellfield configuration. This level of impact equates to 1.3 to 2.2 cfs or 1 to 2 percent of the average flow (113 cfs) that occurred in the North Fork Ninnescah River from 2000 to 2022 (USGS 2023). The reduction in surface waters in Peace Creek and the North Fork Ninnescah River may reduce fish habitat along these stream corridors. Fish habitat impacts will be greatest in areas of Peace Creek that are closest to the wellfield. As described previously, beneficial effects from the No Action Alternative and any increases in hydrology to Peace Creek and the North Fork Ninnescah River would not be realized.

Construction of the delivery pipeline would affect riparian habitat along Rattlesnake Creek that is temporarily disturbed and could result in streambank erosion and soil deposition downstream of the delivery point prior to restoration. Stream deposition can have negative impacts on fish by degrading water quality and reducing prey habitat along stream substrate (e.g., macroinvertebrates, benthic fishes). In addition, fish that are sensitive to environmental disturbance may be affected by fluctuating chloride levels from the mixing of augmentation wellfield water and surface waters in Rattlesnake Creek, however, since salinity levels will be monitored at the delivery point, this is anticipated to be minor. Since the Arkansas river shiner and peppered chub are not known to be present in the Project area, no impacts to those species (beneficial or adverse) are anticipated.

Insects/Pollinators

The Augmentation Wellfield and Groundwater Use Reduction Alternative would include no ground disturbance or construction in Quivira NWR; therefore, in this context it would have no impact on the large tracts of pollinator habitat inside the refuge. Outside of Quivira NWR, an estimated 179 acres of ground disturbance (maximum under the expanded wellfield option) will take place to allow for construction of the wellfield and delivery pipeline (see Section 6.1.2). Pollinators that use open fields and farmlands, such as the American bumble bee (USFWS 2023e), could be affected during the development and post-development phase of the construction until restoration efforts have been finished.

Amphibians and Reptiles

Construction of the augmentation wellfield and delivery pipeline would take place in Stafford County, which is just outside of known populations of New Mexico threadsnake and Strecker’s chorus frog. Wellfield augmentation will reduce groundwater levels within the North Fork Ninnescah River and the Gar-Peace Creek watersheds, which are currently inhabited by known populations of Strecker’s chorus frog. Strecker’s chorus frog needs temporary pools that lack

predatory fish species for reproduction purposes. This species has been documented using flooded agricultural fields and roadside ditches for breeding habitat within areas of regular ground disturbance (ODWC 2023). Water levels of riparian and wetland areas within the North Fork Ninnescah River and the Gar-Peace Creek watersheds may see a decrease because of augmentation pumping. It is possible there will be a decrease of available habitat for amphibians and reptiles resulting from implementation of the augmentation wellfield. The change of water supply from surface water to pumped groundwater may cause habitat changes downstream of the delivery point that could result in changes in vegetation, micro- and macroinvertebrate communities and aquatic population health, diversity, and abundance over the 50-year life of the project. Construction of the delivery pipeline would affect riparian habitat along Rattlesnake Creek that is temporarily disturbed and could result in streambank erosion and soil deposition downstream of the delivery point prior to restoration.

Targeted water right retirements within Zone D of the Rattlesnake Creek Watershed may slightly increase the availability of flooded agricultural fields for breeding purposes within current ranges in northeast Pratt County (see Figure 1.4-3).

Compared to the No Action Alternative, increases in surface hydrology to upstream Rattlesnake Creek including wetlands and streams as a result of the cessation of pumping associated with the 810 junior water rights would not be realized under the Augmentation Wellfield and Groundwater Use Reduction Alternative. These increases in hydrology would provide additional habitat for amphibians and reptiles. Under all alternatives, increases in streamflow to downstream Rattlesnake Creek and Quivira NWR will improve wetland and stream hydrology, which will support habitat for amphibians and reptiles.

Indirect and Direct Effects Determination

Wetland habitat would be enhanced by increased surface waters from Rattlesnake Creek and augmentation deliveries. Increased water availability would improve and increase habitat for threatened and endangered species. This increase would contribute a beneficial minor effect (long-term) compared to existing conditions and could contribute a negligible effect compared to the No Action Alternative because the benefits would be similar but not identical.

Temporary impacts to potential habitat may occur as a result of construction; however, no permanent impacts to threatened and endangered species are expected as a result of construction and operation of the augmentation wellfield. The change of water supply from surface water to pumped groundwater may cause habitat changes downstream of the delivery point that could potentially result in impacts to threatened and endangered species and their habitat. This change would contribute a negative minor effect (short-term from construction and long-term from differences between surface water and groundwater) on threatened and endangered species compared to existing conditions or compared to the No Action Alternative.

6.14.3 GROUNDWATER USE REDUCTION ALTERNATIVE

Under the Groundwater Use Reduction Alternative, all wells located within Zone A with water rights junior to Quivira NWR will be required to reduce their water use by 60 percent to restore streamflow in Rattlesnake Creek.

Mammals: Bats

The Groundwater Use Reduction Alternative would help restore water quantity and quality in both Rattlesnake Creek and Quivira NWR's wetlands, therefore providing improved conditions for insect diversity and abundance and bat foraging opportunities. Furthermore, the Groundwater Use Reduction Alternative will result in no disturbance to caves/mines; therefore, it will have no impact on winter hibernacula for bat species.

Birds: Waterbirds

As with the No Action Alternative, the Groundwater Use Reduction Alternative would help assure that Quivira NWR has sufficient surface water to divert from Rattlesnake Creek into its wetlands for management purposes, therefore providing optimal foraging and nesting habitat for waterbirds year-round.

Fish

As with the No Action Alternative, the Groundwater Use Reduction Alternative will help restore and stabilize water levels in Rattlesnake Creek, therefore improving the availability and diversity of habitat for stream fishes. Since the Arkansas river shiner and peppered chub are not known to be present in the Project area, no impacts to those species (beneficial or adverse) are anticipated.

Insects/Pollinators

As with the No Action Alternative, the Groundwater Use Reduction Alternative would include no ground disturbance or construction that would result in degradation or reduction of pollinator habitat. Further, this alternative would improve riparian and wetland habitat used by pollinators of conservation concern.

Amphibians and Reptiles

The Groundwater Use Reduction Alternative would include no ground disturbance or construction and would have no impact on New Mexico threadsnake habitat. Though the project area is just outside the northern range of Strecker's chorus frog, the increased streamflow from Rattlesnake Creek into Quivira NWR, under this alternative, would increase the amount of potential breeding habitat for this species.

Indirect and Direct Effects Determination

Reduction of pumping in Zone A will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability could improve and increase habitat for threatened and endangered species. The Groundwater Use Reduction Alternative would have a beneficial minor effect (long-term) compared to existing conditions. Compared to the No

Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits would be similar but not identical.

6.14.4 Cumulative Impacts

White-nose Syndrome

White-nose syndrome is the main threat for many bat species including the northern long-eared bat, tricolored bat, and little brown bat (USFWS 2022c-e). This fungal disease affects hibernating bats and is considered one of the worst wildlife diseases in modern times; it has killed millions of bats across North America (WNSRT 2023). The construction and/or implementation of any of the proposed alternatives is not likely to result in a cumulative impact to preexisting declines in bat populations because of white-nose syndrome, because none of the alternatives affect winter hibernacula.

Habitat Loss: Terrestrial

Habitat loss and fragmentation is one of the main threats to threatened and endangered species (NGS 2023). In Kansas, agriculture and urbanization are the driving forces in the loss of grassland and prairie habitats, which are required by many terrestrial species (Shepherd 2022). The implementation of either the No Action or Groundwater Use Reduction alternatives will result in no physical alterations to the terrestrial landscape and therefore will have no cumulative impact to preexisting declines in grassland and/or prairie habitats. The Augmentation Wellfield and Groundwater Use Reduction Alternative may result in cumulative impacts to ongoing declines in grassland and/or prairie habitats because of the construction of the augmentation wellfield and delivery pipeline; however, the construction will be taking place within existing agricultural fields and not grassland/prairie habitats. Furthermore, any ground disturbance would be reseeded, stabilized, and generally restored to its preconstruction condition within one to three years, making any impact to terrestrial habitat temporary.

Habitat Loss: Aquatic

In western and central Kansas, water depletion from agricultural irrigation has resulted in major declines in aquatic habitats. Large wetlands, once prominent in the state, are now restricted to Quivira NWR and Cheyenne Bottoms (Rohweder 2022). Conversion of grassland to cropland has led to the loss and degradation of wetlands in Kansas. The No Action and Groundwater Use Reduction alternatives will ultimately improve groundwater levels and surface streamflow and benefit wetlands in the project area; therefore, it will have a positive cumulative impact on past and ongoing declines of aquatic habitats in the Rattlesnake Creek Watershed. The implementation of the Augmentation Wellfield and Groundwater Use Reduction Alternative, however, will contribute to ongoing declines of aquatic habitats in the Gar-Peace Creek and North Fork Ninnescah River watersheds. Rattlesnake Creek upstream of the delivery point will see increased streamflow because of water right retirements; however, those retirements will not offset the continued decline of the stream, and the continued decline of habitat may still

occur. Aquatic habitat within Quivira NWR will see a positive cumulative impact as a result of augmentation deliveries, which will increase water availability to the wetland complex.

Cumulative Effects Determination

The cumulative impacts from all alternatives have a beneficial effect to threatened and endangered species and their habitat compared to existing conditions. Although the level and location of benefit varies by alternative, all alternatives would result in increased stream levels that would benefit threatened and endangered species habitat. The Augmentation Wellfield and Groundwater Use Reduction Alternative could negatively contribute to cumulative impacts to threatened and endangered species habitat because of minor (long-term) impacts to aquatic habitat used by threatened and endangered species as a result of differences between groundwater and surface water.

6.15 Migratory Birds, Bald Eagles, and Golden Eagles

6.15.1 No Action Alternative

The No Action Alternative does not include ground disturbance or construction activities that could affect migratory birds, bald eagles, or golden eagles.

Under the No Action Alternative, it is assumed that KDA-DWR's administration of water rights would result in a scenario where all water rights junior to Water Right File Number 7,571 within Zone B would be required to cease groundwater pumping. By restricting groundwater pumping, baseflow in Rattlesnake Creek would increase over time. This increase in streamflow could beneficially affect habitat adjacent to Rattlesnake Creek and result in increased water availability within Quivira NWR that would support nesting, feeding, and resting habitat for migratory birds and bald and golden eagles. See Section 6.9 (Surface Water Resources and Water Quality) and Section 6.11 (Riparian Areas) for additional information on anticipated impacts.

Indirect and Direct Effects Determination

Cessation of pumping in Zone B will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability would improve and increase habitat for migratory birds and eagles. The No Action Alternative would have a beneficial minor effect (long-term) to migratory bird and eagle habitat compared to existing conditions.

6.15.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

The augmentation wellfield and associated pipelines installation would require ground disturbance and construction activities that could result in temporary impacts to nesting migratory birds and raptors. If project-related activities, including vegetation and tree removal, are scheduled between April 1 and July 15 (typical nesting season), protective measures will be

put in place to protect nesting migratory birds and raptors (refer to Section 8.3). Deliveries of water via the augmentation wellfield to Quivira NWR will bolster available habitat for migratory birds and eagles in the area.

The Augmentation Wellfield and Groundwater Use Reduction Alternative would result in less hydrology in Peace Creek (due to the cone of depression) and upstream of Zenith gage (due to continued agricultural pumping in Zone B). The reduction in stream hydrology could impact large trees and hydrology that support nesting, feeding, and resting habitat for migratory birds, bald eagles, and golden eagles. In contrast, the No Action Alternative would increase hydrology and may support tree growth and hydrology along Rattlesnake Creek upstream and downstream of Zenith gage.

Water Right Retirements

Targeted water right retirements within Zone D would not require ground disturbance or construction activities. Reduction in groundwater use in Zone D would increase Rattlesnake Creek streamflow over time and result in increased water availability within the creek and the refuge, which would support nesting, feeding, and resting habitat for migratory birds, bald eagles, and golden eagles. Additional water could also support development of riparian corridors, which would provide new nesting habitat for birds that was not previously available.

Indirect and Direct Effects Determination

Wetland habitat would be enhanced by increased surface waters from Rattlesnake Creek and augmentation deliveries. Increased water availability would improve and increase habitat for migratory birds and eagles. This increase would contribute a beneficial minor effect (long-term) compared to existing conditions and could contribute a negligible effect compared to the No Action Alternative because the benefits would be similar but not identical.

Temporary impacts to potential habitat may occur as a result of construction; however, no permanent impacts to migratory bird and eagle habitat are expected as a result of construction and operation of the augmentation wellfield. This would contribute a negative minor effect (short-term) to migratory birds and eagles (if present) compared to existing conditions or compared to the No Action Alternative.

6.15.3 Groundwater Use Reduction Alternative

Similar to the No Action Alternative, the Groundwater Use Reduction Alternative would not result in any ground disturbance or construction activities that could affect migratory birds, bald eagles, or golden eagles.

The Groundwater Use Reduction Alternative would require reductions in groundwater use among water right holders in Zone A. This approach avoids complete curtailment from any one water right holder by spreading reductions in water use over a larger area, as compared to the No Action Alternative. By restricting groundwater pumping, baseflow in Rattlesnake Creek

would increase over time and result in increased water availability within the creek and the refuge, which would support nesting, feeding, and resting habitat for migratory birds and bald and golden eagles.

Indirect and Direct Effects Determination

Reduction of pumping in Zone A will result in increased streamflow to Rattlesnake Creek and water delivery to Quivira NWR. Increased water availability could improve and increase habitat for migratory birds and eagles. The Groundwater Use Reduction Alternative would have a beneficial minor effect (long-term) compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits would be similar but not identical.

6.15.4 Cumulative Impacts

Over the past 50 years, the total population of North American birds has declined by an estimated 3 billion birds (Rosenberg et al. 2019). Many of the 1,093 species of birds protected under the MBTA (50 CFR 10.13) are experiencing population declines as a result of both natural and human-caused sources of bird mortality. These mortality impacts are exacerbated by lost or degraded habitat, ecological alterations resulting from changing climate, and natural causes of mortality (USFWS 2023i). The golden eagle population has remained stable since 2014, while the bald eagle population has quadrupled since 2009 (USFWS 2023b).

Cumulative impacts to migratory birds and eagles are primarily caused by destruction of habitat. Construction activities in open grassland, in woodland habitats, and near other structures that could potentially provide nesting habitat that would result in the taking of migratory birds, eggs, young, and/or active nests have caused declines in these species. Birds of Conservation Concern can be affected by vegetation alteration, vegetation removal, ground disturbance, structures, noise, light, chemicals, and human presence (USFWS 2023i). Reductions in streamflow and wetland habitat loss because of pumping for agricultural irrigation have reduced available foraging and nesting habitat for birds protected under the MBTA.

The No Action and Groundwater Use Reduction alternatives are not likely to result in cumulative impacts and are expected to support nesting, feeding, and resting habitat for migratory birds, bald eagles, and golden eagles.

The Augmentation Wellfield and Groundwater Use Reduction Alternative would impact streamflow in Peace Creek and the North Fork Ninnescah River (Section 6.9) and associated riparian habitat (Section 6.11). Loss of streamflow and riparian habitat may reduce habitat for migratory birds and bald eagles and result in cumulative impacts. Additionally, wetland impacts (Section 6.9.2) may also reduce habitat for migratory birds and bald eagles.

All alternatives considered will benefit the refuge by contributing to the reliability of streamflow in Rattlesnake Creek. An elevated baseflow in Rattlesnake Creek would increase the amount of available surface water flowing into Quivira NWR. A consistent and reliable source of surface

water allows Quivira NWR managers to fluctuate wetland water levels year-round, which will benefit the wetlands and provide secure roosting and foraging opportunities for migratory birds, bald eagles, and golden eagles that rely on the refuge.

Cumulative Effects Determination

The cumulative impacts from all alternatives have a beneficial effect to migratory birds, eagles, and their habitat compared to existing conditions. Although the level and location of benefit varies by alternative, all alternatives would result in increased stream levels, which would benefit the habitat for migratory birds and eagles, if present. Temporary impacts as a result of construction of the Augmentation Wellfield and Groundwater Use Reduction Alternative would not contribute to cumulative impacts to migratory birds and eagles or their habitat.

6.16 Significant Scientific Features

6.16.1 No Action Alternative

Quivira NWR contains two unique, historic salt marsh and salt flat areas and presents a rare, diverse, and high-quality habitat for hundreds of species, including migrating wildlife species and species of concern. Quivira NWR relies on streamflow from Rattlesnake Creek to maintain the refuge, wetlands, and salt marshes.

The No Action Alternative does not include ground disturbance or construction activities that would affect the significant scientific features of Quivira NWR. Implementation of the No Action Alternative would not adversely affect the significant scientific features of Quivira NWR, but rather benefit the refuge by contributing to the stabilization of streamflow in Rattlesnake Creek. By curtailing groundwater pumping in Zone B, baseflow in Rattlesnake Creek would increase over time and result in additional water availability within Quivira NWR, which is critical for maintaining its diverse complex of salt marsh and native sand prairie communities and the species that use them.

Indirect and Direct Effects Determination

No ground disturbance would occur. Implementation of the No Action Alternative would benefit Quivira NWR by contributing to the stabilization of streamflow in Rattlesnake Creek. By curtailing groundwater pumping in Zone B, baseflow in Rattlesnake Creek would increase over time and result in additional water availability within Quivira NWR, resulting in improved water supply to support the refuge's unique wetland habitat. The No Action Alternative would have a beneficial moderate effect to significant scientific features compared to existing conditions.

6.16.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

Augmentation Wellfield

Ground disturbance activities associated with installation of the augmentation wellfield and associated pipelines would occur outside of the boundaries of Quivira NWR. Therefore,

construction activities would have no impact on the significant scientific features of Quivira NWR.

Water pumped from the augmentation wellfield to Quivira NWR would consist of groundwater directly pumped and piped from the wellfield. Water naturally occurring in Rattlesnake Creek and flowing to Quivira NWR would still be from a groundwater source; however, changes in discharge to Rattlesnake Creek along the entire reach versus pumped to a single location may cause differences in minerals, nutrients, pollutants, and biotic components. Piped augmentation water, when combined with the natural flows of Rattlesnake Creek, would be required by KDHE to maintain chloride concentrations of water flowing into Quivira NWR of less than 1,400 mg/L to assure water quality parameters are being met. These differences in water composition should be minimized as water flows in Rattlesnake Creek and is held in Little Salt Marsh.

With protective measures in place to monitor water quality (refer to Section 8.3), implementation of the Augmentation Wellfield and Groundwater Use Reduction Alternative would result in a net benefit to the significant scientific features of Quivira NWR. Implementation of this alternative would result in more water being available for the refuge compared to existing conditions, allowing management flexibility and support for the wetland habitats and fish and wildlife species that depend on the refuge.

Compared to the No Action Alternative, less water would be supplied to Quivira NWR and allowed to flow through the refuge for downstream use. Total wetland storage at Quivira NWR would limit the capture of water flowing through Rattlesnake Creek. Additionally, the timing of water supply would be based on precipitation events and climatic factors under the No Action Alternative, but timing of augmentation deliveries could be used as a management tool with the augmentation wellfield. Differences in water sources described above could result in habitat changes and affect management decisions.

Water Right Retirements

Targeted water right retirements within Zone D would not require ground disturbance or construction activities. Reduction in groundwater use in Zone D would increase Rattlesnake Creek streamflow over time and result in increased water availability within Quivira NWR, supporting the wetland habitats and fish and wildlife species that depend on the rare, diverse, and high-quality habitat present within the refuge.

Indirect and Direct Effects Determination

Ground disturbance activities would occur outside of the boundaries of Quivira NWR and would have no impacts to significant scientific features. Deliveries from the augmentation wellfield will increase baseflow and result in additional water availability within Quivira NWR, resulting in improved water supply to support the refuge's unique wetland habitat. This would contribute a beneficial moderate effect compared to existing conditions and could contribute a negligible

effect compared to the No Action Alternative because the benefits would be similar but not identical.

Changes in discharge to Rattlesnake Creek along the entire reach versus pumped to a single location may cause differences in minerals, nutrients, pollutants, and biotic components. These differences in water composition should be minimized as water flows in Rattlesnake Creek and is held in Little Salt Marsh. This could contribute a negative minor effect (long-term) on significant scientific features compared to existing conditions or compared to the No Action Alternative.

6.16.3 Groundwater Use Reduction Alternative

The Groundwater Use Reduction Alternative does not include ground disturbance or construction activities that would affect the significant scientific features of Quivira NWR. Implementation of the Groundwater Use Reduction Alternative would not adversely affect the significant scientific features of Quivira NWR, but would benefit the refuge by contributing to the stabilization of streamflow in Rattlesnake Creek. By curtailing groundwater pumping in Zone A, baseflow in Rattlesnake Creek would increase over time and result in additional water availability within Quivira NWR that is critical for maintaining its diverse complex of salt marsh and native sand prairie communities and the species that use them.

Indirect and Direct Effects Determination

No ground disturbance would occur. Implementation of the Groundwater Use Reduction Alternative would benefit the refuge by contributing to the stabilization of streamflow in Rattlesnake Creek. By reducing groundwater pumping in Zone A, baseflow in Rattlesnake Creek would increase over time and result in additional water availability within Quivira NWR, resulting in improved water supply to support the refuge's unique wetland habitat. The Groundwater Use Reduction Alternative would have a beneficial moderate effect to significant scientific features compared to existing conditions. Compared to the No Action Alternative, the Groundwater Use Reduction Alternative could contribute a negligible effect because the benefits would be similar but not identical.

6.16.4 Cumulative Impacts

Quivira NWR's resources include sand prairies, sand dunes, salt flats, and salt and freshwater wetland types managed to "provide migration, nesting, resting, and feeding habitat for migratory birds and to develop, advance, manage, conserve, and protect fish and wildlife resources" (USFWS 2013a). The refuge supports more than 100 wetland-associated species. More than 30 species of shorebirds use the refuge, and many have populations that have declined over time (USFWS 2013a; Smith et al. 2020). The unique habitat of the refuge attracts hundreds of thousands of migratory birds each year, including federally protected species such as the whooping crane. Wetland habitat also provides benefits to many upland-associated wildlife (e.g., shelter, food resources).

More than 30 years ago, flows in Rattlesnake Creek began to diminish as other water users (primarily agricultural irrigation) within the subbasin began diverting more water (KDA-DWR 2016). This reduction in flow in Rattlesnake Creek has contributed to shortages of water available to Quivira NWR during certain years and periods of those years, impairing Quivira NWR's water right and making it more difficult for the refuge to fulfill its purpose and management objectives (USFWS 2013a).

Construction and/or implementation of any of the alternatives is not likely to result in cumulative impacts to the significant scientific features of Quivira NWR, including sand prairies; sand dunes; salt flats; and salt and freshwater wetland types that provide migration, nesting, resting, and foraging habitat for migratory birds and support other fish and wildlife resources. All the alternatives considered are anticipated to have a positive cumulative impact to Quivira NWR because there would be an increase in water supplied to Quivira NWR. A consistent and reliable source of surface water allows Quivira NWR managers to fluctuate wetland water levels year-round, which will benefit the wetlands and provide secure roosting and foraging opportunities for migratory birds and support other fish and wildlife species that rely on the refuge.

The No Action and Groundwater Use Reduction alternatives will result in an elevated baseflow in Rattlesnake Creek, which would naturally increase the amount of available surface water flowing into Quivira NWR. The No Action Alternative and Water Use Reduction Alternative would have increased benefits because of the natural process by which water would be restored.

The Augmentation Wellfield and Groundwater Use Reduction Alternative would provide Quivira NWR benefits compared to current conditions, but the difference in water composition would not provide the same benefit as the No Action Alternative. Water provided by the augmentation wellfield would still be from a groundwater source; however, changes in discharge to Rattlesnake Creek at a single location rather than along the entire reach may cause differences in minerals, nutrients, pollutants, and biotic components. These differences in water composition may be minimized as water flows in Rattlesnake Creek and is held in Little Salt Marsh. However, the difference may also cause changes in the ecological communities at the Quivira NWR.

The ability to pump water during drought conditions may make water available to Quivira NWR when previously unavailable. Management at Quivira NWR would have the discretion to use the previously unavailable water to benefit aquatic habitat and vegetation communities that support threatened and endangered species and various fish and wildlife species.

Cumulative Effects Determination

The cumulative impacts from all alternatives would have a beneficial effect to significant scientific features. All alternatives would result in increased water availability to Quivira NWR that would benefit the refuge's unique wetland habitat. The Augmentation Wellfield and

Groundwater Use Reduction Alternative could potentially result in cumulative minor (long-term) impacts to aquatic habitat because of differences between groundwater and surface water.

6.17 Risk and Uncertainty

6.17.1 Impacts to Quivira NWR

Water pumped from the augmentation wellfield to Quivira NWR would consist of groundwater directly pumped and piped from the wellfield. The water from the augmentation wellfield would be inherently different from water currently flowing in Rattlesnake Creek.

Water naturally occurring in Rattlesnake Creek and flowing to Quivira NWR is from a groundwater source; however, groundwater discharges to Rattlesnake Creek occur along the entire reach. Water pumped from a single location may cause differences in minerals, nutrients, pollutants, and biotic components. Minimization of augmentation water differences from natural flows include maintaining chloride concentrations of water flowing into Quivira NWR of less than 1,400 mg/L to assure water quality parameters established by KDHE are being met. As the pumped water is assimilated through Rattlesnake Creek and Little Salt Marsh, any differences will be further minimized.

The potential impacts of changing the physical and biotic water composition include changes in species composition of plant and animals in the Quivira NWR wetlands and riparian areas. The wetlands and riparian areas provide habitat for threatened and endangered species and provide habitat for multiple species of birds, which has established Quivira NWR as a nationally recognized birding area.

The minimization measures are anticipated to reduce potential effects of water quality changes; however, based on the best available information, the extent of species composition changes cannot be definitively known.

6.17.2 Aquifer Impacts on Natural Resources

The augmentation wellfield will cause a local drawdown effect on aquifer levels. This drawdown was modeled as a 5- to10-foot drop near the augmentation wellfield and a 0.5- to 2-foot drop within a larger geographic area. This is described in detail in Section 6.9.2. The impacts are characterized as minimal for the following reasons:

- Pumping is a common practice in the region (predominantly from agricultural sources) and the level of pumping proposed is minor compared to overall pumping quantities.
- The level of aquifer level reduction may not cause a disconnect of surface water features from the aquifer, or the surface water features may already be disconnected.
- Reductions in surface hydrology will occur but are not likely to eliminate natural resource features.

The resulting natural resource impacts of the aquifer drawdown on wetlands, streams, riparian areas, land cover, and other natural resources within the drawdown area of effect is a risk that is not fully known based on best available information.

6.17.3 Augmentation Wellfield Operation

The augmentation wellfield will provide 15-18 cfs of water that meets the water quality requirements for Rattlesnake Creek. A technical field study was completed in 2022 that collected data that supports the augmentation wellfield in being able to provide the quantity and quality of water needed to meet the modeled requirements of the USFWS water right.

The water needs from the augmentation wellfield would occur over a 50-year period and assume the quantity and quality of water will be available. Though the field data and modeling suggest that the wellfield will be able to meet the water quality and quantity requirements, information is not available to fully confirm these assumptions. The complete results from the field study are available in the technical report (Olsson 2023a).

6.17.4 Climate Change

Climate change is well documented to cause more dramatic weather events (see Section 4.4). As severe weather conditions continue that include prolonged and more severe droughts, this may cause modeling projections to be inaccurate. Modeling projections were relied on to estimate the fulfillment of Quivira NWR's water needs from the alternatives, including water right retirements and augmentation water supplementation. The potential exists that additional water may be needed by USFWS to meet its water right based on prolonged, more severe drought conditions or an overall reduction in precipitation amounts in the region.

Adaptive management has been proposed as a method to meet future water needs and requires cooperation between GMD #5 and USFWS. Should climate change cause more severe weather events and if adaptive management is not successful, there are inherent risks in the success of the proposed project.

6.17.5 Wellfield impacts to North Fork Ninnescah River

The wellfield is modeled to impact the North Fork Ninnescah River. The North Fork Ninnescah River provides water to Cheney Reservoir and the City of Wichita and has a required MDS (ranging from 5 cfs to 50 cfs depending on the month). For augmentation wellfield operation, GMD #5 will need a KDA-DWR permit and could attempt to purchase or otherwise retire water rights from senior water right holders near the North Fork Ninnescah River. The water right retirements could reduce the need to cease operation of the augmentation wellfield to meet required minimum streamflow of the North Fork Ninnescah River, should augmentation pumping produce this effect. According to observed data and with the assumption that in the future, flow behavior of the North Fork Ninnescah River will remain consistent with historical flows since October 1990, the average depletion from the augmentation wellfield poses minimal risk to MDS requirements, only increasing the likelihood that the MDS will not be met by less than 2 percent. Further, we can note that MDS requirements in the North Fork Ninnescah River have historically

not been met 5.1 percent of the time and augmentation pumping will not pose significant additional threat to flows on this stream not meeting the MDS.

6.17.6 Project Implementation

The proposed project requires engineering design of the augmentation wellfield, land purchase or easement, permits from KDA-DWR and other agencies, water right retirements or transfers from local water right holders, and additional field studies to determine potential impacts from construction activities to WOTUS and historic properties.

Engineering design will determine where the wells, pipelines, and access roads are located. Land will then need to be purchased or easements obtained for construction. Landowner cooperation is an inherent risk and GMD #5 will avoid to the extent possible the need to exercise eminent domain.

Permits will be required prior to construction that allow operation of the augmentation wellfield and land disturbance to occur during construction activities. The KDA-DWR permit would allow for the operation of new wells within GMD #5 that may affect the North Fork Ninnescah River. This process includes a public involvement component. Implementation of the augmentation wellfield requires successful issuance of the KDA-DWR permit.

Water right retirements or transfers away from Rattlesnake Creek require participation from local water right holders. GMD #5 is required to attain water right retirements or transfers equivalent to 2,500 acre-feet and if this does not occur, the proposed alternative would not be successful in meeting the purpose and need of the project.

Because engineering design has not been completed, the location of ground disturbance is not known. Archaeological surveys and wetland delineations cannot be completed until the ground disturbance area is known. Flexibility in engineering design is anticipated to avoid impacting any historic properties or WOTUS located during additional necessary field surveys. Because the field surveys have not been completed, there is risk in not knowing whether these resources are present or where they are located, which may cause changes to the project to avoid and minimize any potential impacts.

6.17.7 Data Limitations of the Economic Analysis

Though estimates are based on the best available data, this data used may not accurately estimate future crop yields, prices, and production costs. Additionally, yield and production cost data are not available for irrigated wheat and sorghum in the south-central Kansas region. Estimates assume that dryland and irrigated land share the same production costs and yields for wheat and sorghum. To the extent that dryland yields are lower than irrigated crop yields under the alternative scenarios, losses in net farm income may be greater than estimated. However, higher irrigation costs may partially or wholly offset losses because of lower yields.

The simplifying assumptions used in this analysis produce estimates that may represent a “worst-case” scenario for farm income. For example, estimates assume that shifts from irrigated

to dryland production will reduce crop yields by 54.2 percent for corn and 58.7 percent for soybeans. However, dryland yields may be higher than estimated for several reasons. Changes in farming practices or differences in the allocation of crops other than those assumed here may generate higher yields than estimated. For example, farmers may shift production of corn and soybeans to less water-dependent crops, such as milo. Other factors, including the amount of precipitation in the region and changes to more efficient irrigation techniques could result in higher than estimated yields and higher net farm income under the alternative scenarios.

6.18 Ecosystems Services Trade-off Analysis

6.18.1 Provisioning Services

Provisioning services are tangible goods provided for direct human use and consumption. Within the watershed, this includes crop production, which is affected by land use, prime and unique farmland, groundwater use, water quality, and soil resources. Currently in south-central Kansas, both corn and soybeans are farmed using irrigated and dryland production methods. The yield per acre for corn is estimated at 116 bushels per acre (bu/ac) for dryland production and 192 bu/ac. This brings a net return per acre of $19.80 for dryland production and $96.72 for irrigated production. The yield per acre for soybeans is estimated at 41.83 bu/ac for dryland production and 59.91 bu/ac for irrigated production. Net return for soybeans is $64.91 for dryland production and $132.65 for irrigated production (Abt 2024). Although the type and quantity of impacted crops have yet to be determined, this information shows the decrease to crop yields and resulting net farm income as a result of implementation of the alternatives.

No Action Alternative

The No Action Alternative would cause long-term impacts to provisioning services. The conversion of irrigated farmland acres to nonirrigated farmland acres in Zone B would result in a reduction in water application and lower crop yields per acre. The crops may be used for direct or indirect human use and consumption. Crops in this region are used for cattle feed in addition to other uses like soybean oil. The No Action Alternative would decrease groundwater use and fertilizer application, which would benefit water quality along Rattlesnake Creek.

Augmentation Wellfield and Groundwater Use Reduction Alternative

The Augmentation Wellfield and Groundwater Use Reduction Alternative would cause beneficial, long-term impacts to provisioning services compared to the No Action Alternative. The 2,500 acre-feet of water right retirements would result in the conversion of irrigated farmland acres to nonirrigated farmland acres. Similar to the No Action Alternative, cropland conversion would result in a reduction in water application and a minor reduction in crop yields. However, the augmentation wellfield would allow agricultural irrigation to continue on most of the irrigated acres in Zone B. The Augmentation Wellfield and Groundwater Use Reduction Alternative supports provisioning services by implementing the lowest amount of groundwater restrictions practicable and allowing the

maximum number of agricultural producers to continue irrigated farming production practices, which supports higher crop yields and profit margins.

Groundwater Use Reduction Alternative

The Groundwater Use Reduction Alternative would cause long-term impacts to provisioning services. The conversion of irrigation farmland acres to nonirrigated farmland acres in Zone A would result in a reduction in water application and lower crop yields per acre. Similar to the No Action Alternative, cropland conversion would result in a reduction in water application and lower crop yields on an increased number of acres. The Groundwater Use Reduction Alternative would decrease groundwater use and fertilizer application, which would benefit water quality along Rattlesnake Creek.

6.18.2 Regulating Services

Regulating services maintain a world where it is possible for people to live by providing critical benefits that buffer against environmental catastrophe. Within the watershed, water regulation from the aquifer and wetlands, climate regulation including GHG emissions, and ecosystem effects including vegetation, soils, and riparian buffers are the regulating services.

No Action Alternative

The No Action Alternative would provide beneficial, long-term impacts to regulating services. This alternative would result in an average increase in aquifer storage of 32,400 AFY over the 53-year simulation period (Balleau 2022), and improved wetland hydrology would increase resilience to drought conditions. Changes in farming practices will result in decreases to erosion and runoff and improved water quality from decreased application of fertilizers. For the No Action Alternative, GHG emissions would be reduced by approximately 58,500 MT of carbon dioxide per year, and benefits are predicted for the ecosystem through improved water availability and water cycling.

Augmentation Wellfield and Groundwater Use Reduction Alternative

The Augmentation Wellfield and Groundwater Use Reduction Alternative would have a slight, negative long-term impact on regulating services. The augmentation wellfield would reduce aquifer levels 950-980 AFY (depending on wellfield configuration) over the 50-year lifespan of the project and impact wetlands, streams, and riparian areas. GHG emissions that occur from the wellfield will be fully offset by the 2,500 acre-feet of water right retirements with an overall reduction in carbon dioxide emissions of approximately 1,500 MT of carbon dioxide per year.

Groundwater Use Reduction Alternative

Similar to the No Action Alternative, the Groundwater Use Reduction Alternative would provide beneficial, long-term impacts to regulating services. This alternative would result in an average increase in aquifer storage of 46,400 AFY over the 53-year simulation period (Balleau 2022), and improved wetland hydrology would increase resilience to drought conditions. GHG

emissions would be reduced by approximately 61,700 MT of carbon dioxide per year, and benefits are predicted for the ecosystem through improved water availability and water cycling.

6.18.3 Cultural Services

Cultural services make the world a place where people want to live and include recreational use, spiritual resources, aesthetic viewsheds, or tribal values. Within the watershed, archaeological and architectural resources, tribal resources, Rattlesnake Creek, and Quivira NWR provide cultural services.

No Action Alternative

The No Action Alternative provides beneficial, long-term impacts to cultural services. There are no ground disturbances that may impact sensitive cultural sites or tribal resources. The increased water provided in Rattlesnake Creek and to Quivira NWR provides benefits to recreational areas and increases the aesthetic value of the region.

Augmentation Wellfield and Groundwater Use Reduction Alternative

The Augmentation Wellfield and Groundwater Use Reduction Alternative provides beneficial, long-term impacts to cultural services. The ground disturbance for installation of the augmentation wellfield is anticipated to avoid sensitive cultural or tribal resources. Field studies are planned to identify any historic properties, and flexibility in design is intended to avoid these resources to the greatest extent practicable. The PA addresses the plan for treatment/mitigation and inadvertent discovery that will direct avoidance as a preferred outcome and strategies to otherwise minimize impacts if avoidance is not possible. Similar to the No Action Alternative, water will be provided to Quivira NWR to provide recreational benefits and increased aesthetic value in the region. Changes in water properties from the augmentation wellfield may reduce the benefits as compared to the No Action Alternative.

Groundwater Use Reduction Alternative

The Groundwater Use Reduction Alternative provides beneficial, long-term impacts to cultural services. Similar to the No Action Alternative, the Groundwater Use Reduction Alternative does not include ground disturbance activities and has similar benefits such as providing hydrology to Rattlesnake Creek and Quivira NWR.

6.18.4 Supporting Services

Supporting services are the underlying processes maintaining conditions for life on Earth, including nutrient cycling, soil formation and retention, primary production, water cycling, production of atmospheric oxygen, and provision of habitat.

No Action Alternative

The No Action Alternative would provide beneficial, long-term impacts to supporting services. This alternative would cause increased aquifer levels and improved water cycling resulting in

benefits to vegetation and habitat, which in turn support the biodiversity resilience within the riparian, stream, and wetland habitat.

Augmentation Wellfield and Groundwater Use Reduction Alternative

The Augmentation Wellfield and Groundwater Use Reduction Alternative would have a slight, negative long-term impact on supporting services. The augmentation wellfield would reduce aquifer levels over the 50-year lifespan and impact wetlands, streams, and riparian areas, resulting in reductions in potential habitat; however, these impacts would be offset by the improved water cycling and benefits to vegetation and habitat downstream of the augmentation wellfield delivery point (including Quivira NWR).

Groundwater Use Reduction Alternative

Similar to the No Action Alternative, the Groundwater Use Reduction Alternative would provide beneficial, long-term impacts to supporting services. This alternative would cause increased aquifer levels and improved water cycling, resulting in benefits to vegetation and habitat, which in turn support the biodiversity resilience within the riparian, stream, and wetland habitat.

6.18.5 Regional Economic Impacts

A regional economic assessment was conducted using the IMPLAN model of the Rattlesnake Creek Watershed Plan – EIS Alternatives. The analysis evaluated changes in employment and income throughout the five-county study area.

No Action Alternative

The primary driver of economic impacts from the No Action Alternative is expected to occur with a decline in grain sales relative to existing conditions. The No Action Alternative shows a reduction in grain sales of $41.2 million annually from reduced access to irrigation. The reduction in grain sales under the No Action Alternative represents approximately a 10 percent reduction compared to sales under existing conditions. The decrease in grain production leads to a reduction in farm employment of 75 jobs. As the decreased income ripples through the economy, the total job loss would be 153 jobs. Direct labor income is estimated to decline by $7.4 million per year and total income by $11.4 million.

Augmentation Wellfield and Groundwater Use Reduction Alternative

Relative to existing conditions, grain sales are expected to decrease by $12.6 million per year, with fewer acres of irrigated crops converting to dryland crops under the Augmentation Wellfield and Groundwater Use Reduction Alternative. Thus, the negative regional economic effects are less under this alternative. The decrease in grain production leads to a reduction in total employment of 47 jobs relative to existing conditions but an increase of 106 jobs relative to the No Action Alternative. Total labor income would decline by $3.5 million relative to existing conditions but increase by $7.9 million relative to the No Action Alternative.

Groundwater Use Reduction Alternative

Relative to existing conditions, grain sales are expected to decrease by similar levels under the Groundwater Use Reduction Alternative ($40.6 million) as under the No Action Alternative. Thus, the negative regional economic effects will be similar, with a decline of total annual employment of 152 jobs relative to existing conditions compared to 154 jobs under the No Action Alternative. Total labor income would decline by $11.2 million relative to existing conditions but increase $0.2 million relative to the No Action Alternative.

Table 6.18 (NRCS Table 501-D5) illustrates a summary and comparison of alternatives for the Ecosystems Services Tradeoff Analysis. Additional cost details are provided in Chapter 8.

Table 6.18 (Natural Resources Conservation Service [NRCS] Table 501-D5) Summary and Comparison of Alternatives – Ecosystem Services Trade-off Analysis

Guiding Principles, Ecosystem Services Benefits, and Economic Analysis	Alternatives		
	No Action	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Locally Preferred		X	
Non-structural	X		X
Environmentally Preferred	X		
Maximum Net Monetized Benefits Plan		X	
Socially Preferred		X	
Preferred Alternative		X	
Guiding Principles			
Healthy and Resilient Ecosystems	X		X
Sustainable Economic Development		X	
Floodplains	n/a	n/a	n/a
Public Safety	n/a	n/a	n/a
Watershed Approach		X	
Ecosystem Services Benefits			
	No Action	**Augmentation Wellfield and Groundwater Use Reduction Alternative**	**Groundwater Use Reduction Alternative**
Provisioning Services			
Crop Production (monetized)		X	
Prime and Unique Farmland	X		X
Groundwater Use	X		X
Water Quality	X		X
Regulating Services			
Water Regulation	X		X
Climate Regulation	X		X
Ecosystem Effects	X		X
Cultural Services			
Quivira NWR	X	X	X
Rattlesnake Creek	X		X
Archaeological/Architectural	n/a	n/a	n/a
Supporting Services			
Water Cycling	X		X
Habitat	X		X
Economic Analysis			
	No Action	**Augmentation Wellfield and Groundwater Use Reduction Alternative**	**Groundwater Use Reduction Alternative**
Monetized Costs			
Project Investment – present value[1]	$0	$2,341,791	$0
Annual O&M Costs[1]	$0	$900,000	$0
Monetized Benefits for Ecosystem Services			
Provisioning[1]	--	$2,835,063	--
Regulating[2]	$11,179,482	$274,808	$11,807,560

Economic Analysis			
	No Action	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Monetized Benefits for Ecosystem Services			
Cultural	--	--	--
Supporting	--	--	--
Total Annual Monetized Benefits[1]		$4,499,273	
Total Annual Monetized Costs[1]		$2,341,791	
Cost-Benefit Ratio[1]		1.92 Benefit Cost Ratio	
Annual Monetized Net Benefit[1]		$2,157,482	
Regional Economic Development/Economic Impact Assessment			
Regional Employment[2]	(154)	(41)	(152)
Regional Income[2]	($14,539,365)	($4,459,423)	($14,323,880)
Regional Impacts Construction, one-time employment[2]	0	49	0
Regional Impacts Construction, one-time income[2]		$3,177,822	

[1] Evaluated relative to No Action Alternative.
[2] Evaluated relative to Existing Conditions.

7. CONSULTATION, COORDINATION, AND PUBLIC PARTICIPATION

7.1 Background

NRCS began development of the Watershed Plan and environmental document contemplating that an environmental assessment (EA) would be the appropriate document for compliance with NEPA. Since 2021, NRCS worked diligently to prepare a Watershed Plan – EA (Plan – EA) and implement the appropriate consultation, coordination, and public participation. As the work progressed, it became apparent that an environmental impact statement (EIS) would be the more appropriate document for the following reasons:

- Based on current estimates, the project implementation cost may exceed $25 million. The 2018 Agriculture Appropriations Act amended the Watershed Protection and Flood Prevention Act to require Congressional funding authorization for watershed projects that exceed a $25 million threshold for implementation. The NRCS National Watershed Program Manual (Section 501.22B) requires that a Plan – EIS be prepared for watershed projects that require Congressional action.
- The alternatives proposed in the draft Rattlesnake Creek Plan and environmental document have the potential to significantly affect the human environment. The NRCS National Watershed Program Manual (Section 501.22B) requires that a Plan – EIS be

prepared for federal actions that significantly affect the human environment (defined as the natural and physical environment and the relationship of people with that environment).

- NRCS recognizes that this project has a decades-long history of contention among the stakeholders. The NRCS National Environmental Compliance Manual (Section 610.45D[4]) indicates that an EIS is the appropriate environmental document when actions, even those resulting in significant positive impacts, are associated with controversy regarding the effects.

Therefore, in April 2023, NRCS began transitioning the document from an EA to an EIS. This section includes discussion of the original Plan – EA consultation, coordination, and public participation process (prior to April 2023) and for the EIS (post-April 2023).

7.2 Consultation

7.2.1 USFWS Consultation

The NRCS is the lead federal agency responsible for completion of the ESA Section 7 consultation process. Through an initial project-level review, threatened and endangered species were determined to have the potential to occur within the project area. Informal consultation was initiated with USFWS to receive technical assistance on species that may be affected by the proposed project and coordinate a BA to document effects that the proposed project may have on the listed species.

A virtual meeting was held among USFWS, NRCS, Olsson, and GMD #5 on November 16, 2022. Discussions included species reviewed in the draft Plan – EA and additional species that may need to be reviewed. BA options discussed included completion within the draft Plan – EA or as a separate document. An official species list was requested by email on December 28, 2022, and received by email on January 10, 2023. An updated species list was received on April 11, 2023; an additional update was requested on April 3, 2024; and a response was received on April 25, 2024. The updated species list had two changes (one species was removed and one was added) and remained at 16 ESA-listed species. A final species list was received from USFWS via email on August 29, 2025, during coordination for the BA. This list contained 19 species. Email communication from USFWS is provided in Appendix A. The BA has been completed by NRCS and submitted to USFWS. Concurrence from USFWS was received on December 17, 2025 (Appendix A).

7.2.2 Kansas State Historic Preservation Office Consultation

The NRCS is the lead federal agency responsible for completion of the NRHP Section 106 process. On October 3, 2022, NRCS sent written correspondence to the Kansas SHPO to request consultation on the Rattlesnake Creek Watershed Plan - EIS. The SHPO replied on October 26, 2022, that “the project area is not proximal to any recorded archaeological sites” (KHS 2022). However, the project will take place adjacent to Peace Creek, and the SHPO

identified this area as having moderate archeological potential and that this area of Stafford County is severely underrepresented in the archeological survey record (KHS 2022). Because the area has not been surveyed before, is in proximity to Peace Creek (which has a moderate archaeological potential), and the depth of disturbance may affect buried cultural deposits, SHPO requested that a professional archaeologist survey the area prior to beginning construction. This consultation is included in Appendix A.

In consultation with SHPO and the tribes, NRCS has developed a PA to defer identification and evaluation of cultural resources and historic properties in accordance with 36 CFR 800.4(b)(2). Any required mitigation will be addressed through the PA. The PA was signed by the Kansas State Conservationist on July 29, 2025, and transmitted to ACHP in accordance with 36 CFR 800.6(a)(1)(i)(C). The ACHP accepted the PA by letter on August 27, 2025. The acceptance letter is in Appendix A.

7.2.3 Tribal Consultation

NRCS sent letters notifying the Osage Nation of Oklahoma and the Wichita and Affiliated Tribes of the NEPA scoping process with a request for comments and an initiation of consultation under NHPA Section 106 on January 6, 2022; a follow up letter was sent to both tribes on September 29, 2022. In mid-2023, the Kiowa Indian Nation of Oklahoma notified NRCS of its consultation interest in projects throughout Kansas. Subsequently, NRCS sent a letter notifying the Kiowa Indian Tribe of Oklahoma of the NEPA scoping process with a request for comments and an initiation of consultation under NHPA Section 106 on May 6, 2024. In June 2024, NRCS learned of Prairie Band Potawatomi Nation's consultation interest in projects throughout Kansas and initiated consultation. NRCS transmitted the draft PA to the SHPO and five tribes (Osage Nation of Oklahoma, Wichita and Affiliated Tribes, Kiowa Tribe of Oklahoma, Prairie Band Potawatomi Nation, and Cheyenne and Arapaho Tribes of Oklahoma) from August 21, 2024, and September 3, 2024, and transmitted follow-up emails four times from October 2024 to December 2024. All consultation documents are included in Appendix A.

7.3 Other Agency Coordination

Formal requests to become cooperating agencies were sent to agencies with an interest in the Plan – EA process by NRCS and were accepted by five agencies: USACE, USFWS, EPA, KDHE, and KDA. These agencies have been kept informed of the Plan – EA/ EIS process through virtual progress update meetings. In USACE's acceptance to become a cooperating agency, it was noted that a Section 404 permit will not need to be obtained from USACE if proposed improvements do not require the discharge of dredge or fill materials into WOTUS. Early coordination indicated that a Section 404 permit is unlikely to be needed based on the scope of proposed improvements, but WOTUS impacts and associated Section 404 permitting needs will not be fully known until the project proceeds to design. Because of GMD #5's involvement with KDA and USFWS through the water right impairment, additional coordination

has occurred with these agencies. This additional coordination has been accomplished through technical committee meetings and additional meetings to discuss the Plan – EA/EIS.

Technical committee meetings were intended to discuss the test well drilling efforts and associated data collected and to discuss the modeling of the augmentation wellfield impacts. The technical committee was tasked with evaluating the test well drilling ability to support the quantity and quality of water from the augmentation wellfield. Meetings were held as needed and occurred prior to and after the test well drilling efforts. Following completion of the test well drilling and after discussions had occurred on the final data, the technical committee met to discuss the modeling effort. The technical committee generally included USFWS, Olsson, GMD #5, KDA, and Balleau. KGS was also included in some technical committee meetings.

Coordination with USFWS has occurred throughout the Plan – EA/EIS process. Big Bend GMD #5 staff, legal counsel, and consultants met with USFWS every two weeks (more frequently if appropriate) via conference calls to maintain an active dialogue regarding a potential resolution of KDA-DWR's impairment finding at Quivira NWR. Coordination with USFWS and KDA occurred as part of the cooperative agreement on the Plan – EA/EIS to provide comments and edits. Specific Plan – EA/EIS reviews are documented below:

- November 23, 2021, Plan – EA purpose and need section review
- May 10, 2022, Plan – EA No Action Alternative section review
- July 14, 2022, Plan – EA Chapters 1–5 partial document review
- September 29, 2022, Plan – EA purpose and need section review
- November 30, 2022, Plan – EA Chapter 5 alternatives section review
- February 7, 2023, Plan – EA Chapter 5 alternatives section review
- August 8, 2023, provided a draft EIS for agency review
- September 11, 2023, agency comments were received
- February 2, 2024, draft EIS with comment responses submitted to USFWS
- April 18, 2025, draft EIS posted to the Federal Register for public/agency review
- September 19, 2025, cooperating agency meeting

7.4 Public Participation

7.4.1 Scoping Public Meeting

An open house public meeting was held January 13, 2022, from 4:00-6:00 p.m. in the Community Room at the Stafford County Annex in St. John, Kansas. The purpose of the meeting was to share information about the Plan – EA process and to gather feedback from the public on how to improve agricultural water supply and fish and wildlife habitat within the Rattlesnake Creek Watershed in Stafford County. Approximately 31 people signed into the meeting. Public notices advertising the meeting were published in the *Great Bend Tribune, Hutchinson News, Stafford Courier, Pratt Tribune,* and *Saint John News* newspapers. Postcard

invitations were sent to approximately 775 citizens and other interested parties near the proposed project area. A meeting notice was also published on the Big Bend GMD #5's website.

Information shared at the meeting included the project background and location, project purpose and need, description of the purpose of and process for developing a Plan – EA, environmental considerations within the project area, organizational information about the NRCS and Big Bend GMD #5, and methods for providing public input. Draft scoping information and an executive summary were also provided at the meeting. The project team received 11 comments during the specified 30-day comment period (December 29, 2021-January 31, 2022). Comments received are included in Appendix A.

7.4.2 Notice of Intent

On December 28, 2023, a Notice of Intent (NOI) was published in the Federal Register announcing the NRCS' intent to prepare a watershed plan and EIS for the Rattlesnake Creek Watershed Plan, in Stafford County, KS.

7.4.3 Notice of Availability

On April 18, 2025, a Notice of Availability (NOA) was published in the FR announcing a request for public comment on the Rattlesnake Creek Draft EIS (FRL OP-OFA-174). The NOA established a 45-day public review and comment period and provided details on how to contact NRCS to submit comments. The NRCS communicated directly with agencies, organizations and Tribal Nations via email regarding the availability of the Draft EIS on the NRCS project website (NRCS 2025) and provided instructions and timeline for submitting comments.

The project team received 117 comments during the 45-day comment period. A summary report including comments, responses to comments, and a description of any resulting changes made to the Draft EIS is included in Appendix A.

7.4.4 Draft Environmental Impact Statement Public Meeting

The NRCS held an in-person public meeting on May 08, 2025, at the Stafford County Annex in St. John, Kansas. The meeting was an open house format without a formal presentation. The purpose of this meeting was to share information about the Watershed Plan-EIS process and to gather feedback from the public. The meeting included the display of presentation materials on the Draft EIS, how to provide comments via email, telephone, or scanning a QR code, and next steps in the NEPA process. The NRCS, NEPA preparers, and project sponsor attended the meeting and were available to take questions from attendees. Formal comments were not submitted at the public meeting. The presentation materials were made available online on the GMD #5 website (GMD #5 2025).

8. THE PROPOSED ACTION ALTERNATIVE

8.1 Rationale for Alternative Preference

The Proposed Action Alternative was selected from the reasonable range of alternatives described in Section 5 that met the purpose and need of the proposed project. These alternatives include the following:

- No Action Alternative
- Augmentation Wellfield and Groundwater Use Reduction Alternative
- Groundwater Use Reduction Alternative

These alternatives were developed following a public and agency scoping meeting and after receiving written and verbal comments on the alternatives from cooperating and supporting agencies. Refer to Section 5 for detailed descriptions of each alternative and Section 6 for discussion of environmental consequences and cumulative impacts. As part of the selection process, the alternatives were evaluated to determine the Proposed Action Alternative, National Economic Development (NED) alternative, and the environmentally preferable alternative. After detailed consideration of economic, environmental, and social factors, the Proposed Action Alternative was subsequently selected. Definitions of each of these alternatives is provided in the bulleted list below.

- **NED Alternative**: The NED alternative represents the alternative that reasonably maximizes net economic benefits consistent with protecting the nation's environment (NRCS 2015).
- **Environmentally Preferable Alternative**: The environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101 (CEQ 1986).
- **Proposed Action Alternative**: The Proposed Action Alternative must be the alternative that meets the purpose and need for the project in an environmentally acceptable manner while maximizing public benefits and all nonmonetary and unquantifiable ecosystem services (NRCS 2024).

For comparative purposes, Table 8.1 summarizes the actions to be implemented under each alternative and the resulting effects to resource areas most acutely affected by implementation of the proposed action, including surface water resources, water quality, groundwater levels, aquifer storage, riparian areas, and economics.

Table 8.1. Alternative Actions and Resulting Effects.

Actions and Effects	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Actions ***Reference: Section 5.0 Alternatives***	Curtailment of junior water rights within Zone B (areas with a 20 percent or greater streamflow impact). Annual evaluation to determine effectiveness and make adjustments.	Augmentation wellfield that provides 15-18 cubic feet per second (cfs) to Rattlesnake Creek. Retirement of 2,500 acre-feet per year (AFY) of authorized water use. Adaptive management program to evaluate success of alternative.	Reduce groundwater use 60 percent from historical pumping in Zone A (Local Enhanced Management Area [LEMA]/ Intensive Groundwater Use Control Area [IGUCA]).
Rattlesnake Creek Stream Depletion ***Reference: Section 6.9 Surface Water Resources and Water Quality***	Reverses depletion trends.	Continued depletion upstream of Zenith Gage; average rate of depletion downstream (not including augmentation inputs) is 130-170 AFY depending on wellfield configuration.	Reverses depletion trends.
Rattlesnake Creek Streamflow Increases (cfs) ***Reference: Section 6.9 Surface Water Resources and Water Quality***	Increase in baseflow by approximately 10 cfs within two years; average of 32.3 cfs over 53-year simulation period.	Downstream only, 15-18 cfs added to streamflow because of augmentation groundwater pumping. The 2,500 AFY of water right retirements are anticipated to stop or slow continued depletions.	Increase in baseflow similar to the No Action Alternative, except the increases will be over a longer time period.
Rattlesnake Creek Streamflow Increases (AFY) ***Reference: Section 6.9 Surface Water Resources and Water Quality***	Within approximately two years, 7,200 AFY; average increase in baseflow by 23,400 AFY over 53-year simulation period.	Downstream only, augmentation groundwater pumping expected to supply 5,580 AFY.	Average increase in baseflow of 18,800 AFY over the 53-year simulation period.

Actions and Effects	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Water Quality ***Reference: Section 6.9 Surface Water Resources and Water Quality***	Improved because of decline in irrigated farming, less groundwater pumping, and less fertilizer and chemical usage.	Improvements resulting from the No Action Alternative would not be realized. Water provided to Rattlesnake Creek and Quivira NWR would be different than current water quality. Salt content would be maintained as a result of mixing of natural flows with augmentation water and consistent with Kansas Department of Health and Environment (KDHE) guidance.	Improved because of decline in irrigated farming, less groundwater pumping, and less fertilizer and chemical usage.
Groundwater Levels ***Reference: Section 6.2 Aquifers and Sole Source Aquifer***	Varies depending on proximity to stream and past pumping. Average increase of approximately 1 inch per year across Zone B.	Lowering of groundwater levels in the vicinity of the wellfield between 5 and 10 feet over the 50-year project life. Other areas in the watershed would see 0.5- to 2-foot declines over 50 years.	Varies depending on proximity to stream and past pumping. Average increase of approximately 1 inch per year across Zone A.
Aquifer Storage (AFY) ***Reference: Section 6.2 Aquifers and Sole Source Aquifer***	Average increase in aquifer storage of 32,400 AFY over the 53-year simulation period.	Predicted reduction in aquifer storage ranges from 950-980 AFY, depending on the wellfield configuration.	Average increase in aquifer storage of 46,400 AFY over the 53-year simulation period.
Riparian Areas ***Reference: Section 6.11 Riparian Areas***	No direct construction impacts. Benefit to existing approximately 5,500 acres of riparian areas in Zone B because of increase in groundwater levels.	Direct construction impacts (2.9 acres). Impact to riparian areas by decreasing groundwater levels in the vicinity of the wellfield. Benefit to riparian areas downstream of the augmentation delivery point although to a lesser extent than the No Action Alternative. Indirect negative impacts to riparian areas upstream of the Rattlesnake Creek delivery point and in the Gar-Peace Creek and North Fork Ninnescah River watersheds.	No direct construction impacts. Benefit to existing approximately 9,500 acres of riparian areas in Zone A because of increase in groundwater levels.

Actions and Effects	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Economics ***Reference: Section 6.5 Socioeconomics***	Net farm income under the No Action Alternative could decrease on average $5.0 million, annually, as compared to existing conditions.	Net farm income under the Augmentation Wellfield and Groundwater Use Reduction Alternative would increase on average by $4.9 million, annually, relative to the No Action Alternative.	Net farm income would decrease on average $1.4 million, annually, relative to the No Action Alternative.

8.1.1 NED ALTERNATIVE

Economic impacts of each alternative were determined through a NED analysis. The NED analysis considered regional economic impacts to net farm income, grain sales, employment, and labor income that may occur under each alternative. Based on the results of the NED analysis, the **Augmentation Wellfield and Groundwater Use Reduction Alternative** was determined to be the NED alternative. Appendix D includes an economic assessment of the alternatives and their impact to the regional economy (Abt 2024). In summary, the analysis showed the following for each alternative based on four different crop scenarios (described in detail in Appendix D). Note that the lower end of the range for each alternative represents irrigated soybeans and corn crops moving to dryland sorghum production (Scenario D). The higher end of the range represents irrigated soybean production converting to dryland wheat production and irrigated corn converting to dryland corn production (Scenario C; Abt 2024). Table 8.1-.1 summarizes the regional economic impacts under each alternative.

Table 8.1.1. Summary of Regional Economic Impacts.

Economic Resource	No Action Alternative	Augmentation Wellfield and Groundwater Use Reduction Alternative	Groundwater Use Reduction Alternative
Net Farm Income	Net farm income would decrease on average by $5.0 million, annually, compared to existing conditions.	Net farm income would increase on average by $5 million, annually, relative to the No Action Alternative.	Net farm income would decrease on average by $1.4 million, annually, relative to the No Action Alternative.
Grain Sales	Grain sales are expected to be reduced by $41.2 million annually, compared to existing conditions.	Grain sales will increase by $28.6 million relative to the No Action Alternative.	Grain sales are expected to increase slightly by approximately $610,000 relative to the No Action Alternative.
Employment	Total job loss is estimated at 154 jobs relative to existing conditions.	Employment is expected to maintain 107 jobs that would be lost under the No Action Alternative (47 jobs would be lost).	Total employment is expected to maintain 2 jobs that would be lost under the No Action Alternative (152 jobs would be lost).
Labor Income	Total labor income under this alternative will decrease by $11.4 million annually relative to existing conditions.	Total labor income under this alternative will increase by $7.9 million annually relative to the No Action Alternative.	Total labor income under this alternative will increase slightly by approximately $168,000 relative to the No Action Alternative.

Source: Abt 2024, IMPLAN 2024

Implementation of the Augmentation Wellfield and Groundwater Use Reduction Alternative would result in a positive impact on the regional economy (socioeconomics) and the population that lives and works in the area compared to the No Action Alternative. Under the No Action and Groundwater Use Reduction alternatives, the reduction in irrigation pumping comes at a major

and significant cost to the regional economy and local population. Under the No Action and Groundwater Use Reduction alternatives, net farm income would be reduced depending on crop scenario (on average $5 million annually compared to existing conditions for the No Action Alternative and on average an additional decrease of $1.4 million annually for the Groundwater Use Reduction Alternative). Net farm income under the Augmentation Wellfield and Groundwater Use Reduction Alternative would also decrease relative to existing conditions, but to a far less degree than the No Action or Groundwater Use Reduction alternatives (up to $2 million annually depending on crop scenario). Relative to the No Action Alternative, net farm income would increase up to $7 million annually under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

Grain sales would be reduced under the No Action Alternative ($41.2 million annually) and the Groundwater Reduction Alternative ($40.6 million annually). Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, grain sales would increase $26.8 million relative to the No Action Alternative and decrease $12.6 million relative to existing conditions (IMPLAN 2024). Decreases in grain production would result in reductions in farm employment. Under the No Action Alternative and Groundwater Use Reduction Alternative, total job loss would be 154 jobs and 152 jobs, respectively, compared to existing conditions. Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, 107 jobs would be maintained that would be lost under the No Action Alternative. These decreases in jobs would, in turn, reduce labor income in the regional economy by approximately $11 million under the No Action and Groundwater Use Reduction Alternatives. Labor income would increase by approximately $2 million under the Augmentation Wellfield and Groundwater Use Reduction Alternative (IMPLAN 2024).

The Augmentation Wellfield and Groundwater Use Reduction Alternative achieves the primary objective of maximizing net economic benefits while minimizing environmental impacts. Benefits to the public under the NED alternative include monetized net economic benefits and benefits to provisioning ecosystem services.

8.1.2 Environmentally Preferable Alternative

The environmentally preferable alternative represents the alternative that causes the least damage to the biological and physical environment; it also represents the alternative that best protects, preserves, and enhances historic, cultural, and natural resources. The environmentally preferable alternative is the **No Action Alternative**. Table 6.0 in Chapter 6 provides a detailed, side-by-side comparison of the environmental effects and degree of impact determination for the No Action Alternative, Augmentation Wellfield and Groundwater Use Reduction Alternative, and Groundwater Use Reduction Alternative. The action alternatives were compared against the No Action Alternative and against existing conditions to provide additional context. A representative summary of the environmental effects determinations is presented in Table 8.1.2 below.

Table 8.1.2. Summary of Environmental Consequences.

Affected Environment Category	No Action Alternative: *Compared to Existing Conditions*	Augmentation Wellfield and Groundwater Use Reduction Alternative: *Compared to No Action Alternative*	Augmentation Wellfield and Groundwater Use Reduction Alternative: *Compared to Existing Conditions*	Groundwater Use Reduction Alternative: *Compared to No Action Alternative*	Groundwater Use Reduction Alternative: *Compared to Existing Conditions*
Geology and Soils	No Effect	Negative Minor Effect (short-term)	Negative Minor Effect (short-term)	No Effect	No Effect
Aquifers and Sole Source Aquifers	Beneficial Minor Effect (long-term)	Negative Minor Effect (long-term)	Negative Minor Effect (long-term)	Negligible Effect	Beneficial Minor Effect (long-term)
Climate	Beneficial Minor Effect (long-term)	Negative Minor Effect (long-term)	Beneficial Minor Effect (long-term)	Negligible Effect	Beneficial Minor Effect (long-term)
Historic Properties	No Effect	To be determined pending execution of Programmatic Agreement and cultural resource surveys	To be determined pending execution of Programmatic Agreement and cultural resource surveys	No Effect	No Effect
Socioeconomics	Negative Major Effect	Beneficial Major Effect	Negative Minor Effect (long-term)	Negative Minor Effect (long-term)	Negative Major Effect
Parklands and Natural Areas	Beneficial Major Effect	Negligible Effect	Beneficial Major Effect	Negligible Effect	Beneficial Major Effect
Land Cover and Land Use	Negligible Effect	Negligible Effect	Negligible Effect	Negligible Effect	Negligible Effect
Prime Farmland	No Effect	Negative Minor Effect (long-term)	Negative Minor Effect (long-term)	No Effect	No Effect
Surface Water Resources and Water Quality	Beneficial Major Effect	Negligible Effect, Negative Minor Effect (long-term)	Beneficial Minor Effect (long-term), Negative Minor Effect (long-term), Negative Moderate Effect	Negligible Effect	Beneficial Major Effect
Regional Water Resource Plans	No Effect	No Effect	No Effect	Negligible Effect	Negligible Effect

Affected Environment Category	No Action Alternative: *Compared to Existing Conditions*	Augmentation Wellfield and Groundwater Use Reduction Alternative: *Compared to No Action Alternative*	Augmentation Wellfield and Groundwater Use Reduction Alternative: *Compared to Existing Conditions*	Groundwater Use Reduction Alternative: *Compared to No Action Alternative*	Groundwater Use Reduction Alternative: *Compared to Existing Conditions*
Riparian Areas	Beneficial Minor Effect (long-term)	Negligible Effect, Negative Minor Effect (short- and long-term)	Negative Minor Effect (short- and long-term), Beneficial Minor Effect (long-term)	Negligible Effect	Beneficial Minor Effect (long-term)
Fish and Wildlife Resources	Beneficial Moderate Effect	Negligible Effect, Negative Minor Effect (short- and long-term)	Negative Minor Effect (short- and long-term), Beneficial Moderate Effect	Negligible Effect	Beneficial Moderate Effect
Invasive Species	No Effect	Negligible Effect	Negligible Effect	No Effect	No Effect
Threatened and Endangered Species	Beneficial Minor Effect (long-term)	Negligible Effect, Negative Minor Effect (short- and long-term)	Negative Minor Effect (short- and long-term), Beneficial Minor Effect (long-term)	Negligible Effect	Beneficial Minor Effect (long-term)
Migratory Birds, Bald Eagles, and Golden Eagles	Beneficial Minor Effect (long-term)	Negligible Effect, Negative Minor Effect (short-term)	Negative Minor Effect (short-term), Beneficial Minor Effect (long-term)	Negligible Effect	Beneficial Minor Effect (long-term)
Significant Scientific Features	Beneficial Major Effect	Negligible Effect, Negative Minor Effect (long-term)	Beneficial Major Effect (long-term), Negative Minor Effect (long-term)	Negligible Effect	Beneficial Major Effect

The No Action and Groundwater Use Reduction alternatives would both result in a reduction in irrigation pumping that would provide beneficial impacts to, and beyond, Rattlesnake Creek and Quivira NWR, including benefits to the local aquifer depths, surface water resources, and riparian areas. These effects would benefit fish and wildlife resources, wildlife habitat, and potentially threatened and endangered species both inside and outside of Quivira NWR. Supporting ecosystem services would be majorly improved under these two alternatives, because surface and groundwater resources would be more available, which could facilitate greater nutrient recycling and biodiversity resilience.

Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, hydrology and aquifer changes are anticipated to cause reductions in streamflow (Peace Creek, Rattlesnake Creek, and North Fork Ninnescah River), loss of riparian habitat, and hydrologic changes to groundwater-fed wetlands. Impacts to streamflow in Rattlesnake Creek, Peace Creek, and the North Fork Ninnescah River are anticipated to be long-term and minor. Positive or negative impacts to streamflow, riparian areas, and wetlands would have an associated impact on fish and wildlife; threatened and endangered species; and migratory birds, bald eagles, and golden eagles that use those specific areas. Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, habitat along Rattlesnake Creek, Peace Creek, and the North Fork Ninnescah River could have long-term minor to negligible impacts and associated fish and wildlife, threatened and endangered species, and migratory birds, bald eagles, and golden eagles using this habitat could also experience long-term minor to negligible impacts.

Under all alternatives, parklands and natural areas, including Quivira NWR and its associated significant scientific features, would have beneficial impacts because of increases in streamflow to downstream Rattlesnake Creek. These alternatives would benefit the refuge by contributing to the stabilization of streamflow in Rattlesnake Creek, which would result in additional water availability within Quivira NWR and improvements to wetlands, habitat, and cultural ecosystem services.

After weighing all environmental benefits and potential consequences, the environmentally preferable alternative was determined to be the No Action Alternative. Although the Groundwater Use Reduction Alternative has similar environmental benefits and consequences, the No Action Alternative best protects, preserves, and enhances historic, cultural, and natural resources.

8.1.3 Proposed Action Alternative (Agency/Sponsor Preferred Alternative)

The Proposed Action Alternative was selected after consideration of the NED alternative and the environmentally preferable alternative. In addition to meeting the purpose and need, the Proposed Action Alternative must maximize net public benefits in an environmentally acceptable manner (NRCS 2024). After consideration, the **Augmentation Wellfield and Groundwater Use Reduction Alternative** was selected as the Proposed Action Alternative for the project based on its ability to meet the purpose and need (Chapter 2), the economic and environmental

benefits it provides (Chapter 6), and its ability to meet the goals and objectives for agricultural water management (NRCS 2015).

The Balleau analysis (Balleau 2010) shows that 5,580 AFY is needed to support the unmet monthly demand (53-year average) for Quivira NWR. The Augmentation Wellfield and Groundwater Use Reduction Alternative precisely meets that objective, whereas the No Action and Groundwater Use Reduction alternatives significantly overshoot Quivira NWR's unmet need. The augmentation wellfield would only be operational when the demand is not met and during periods of drought. Therefore, the alternative has total management control by turning on the wellfield when water is needed and off when water is not needed. The Augmentation Wellfield and Groundwater Use Reduction Alternative shows parallel support for agricultural production while simultaneously meeting the unmet demand for Quivira NWR. In addition to the augmentation deliveries, targeted water right retirements associated with the Augmentation Wellfield and Groundwater Use Reduction Alternative would result in groundwater use reduction of 2,500 AFY in Zone D, which represents nearly half of the average quantity needed for augmentation (5,580 AFY). The Adaptive Management Plan will evaluate observed conditions and adjust as needed. In this manner, the agricultural producers can make the maximum use of available water in Rattlesnake Creek, while Quivira NWR also meets its water right demand.

The No Action Alternative increases flow in Rattlesnake Creek by 23,400 AFY and the Groundwater Use Reduction Alternative increases streamflow in Rattlesnake Creek by 18,800 AFY (53-year average). However, the impairment analysis shows that an average of 5,580 AFY is needed (Balleau 2010). Accordingly, these alternatives then exceed the objective by an average of 17,820 AFY (No Action Alternative) or 13,220 AFY (Groundwater Use Reduction Alternative) that then flows out of the basin. This approach also cannot provide a specific quantity of water during drought periods. The administrative process of curtailing groundwater pumping is a broad brush approach that will result in increased surface flow that is dependent on precipitation and climactic variables. The most advantageous solution is to provide the unmet demand with the most accurate method (augmentation and water right retirements) to deliver the precise quantity of water needed.

Though the environmental benefits of the No Action Alternative are significant, these benefits are considered within the context of the economic impact to the regional agricultural producers. The regional economic impact is the primary driver behind the selection of the Augmentation Wellfield and Groundwater Use Reduction Alternative as the Preferred Action Alternative. Irrigated agricultural production is a cornerstone of the region, and specifically in GMD #5, where communities depend on economic and employment opportunities provided by irrigated farming. Crop productivity will remain near current levels and net farm incomes will not decline under the Augmentation Wellfield and Groundwater Use Reduction Alternative as expected under the No Action Alternative. As discussed above, the Augmentation Wellfield and Groundwater Use Reduction Alternative was determined to be the NED alternative, which

reasonably maximizes net economic benefits consistent with protecting the nation's environment. Although the Proposed Action Alternative is not the environmentally preferable alternative, the tradeoffs are environmentally acceptable with respect to the economic benefit to the regional economy as opposed to the FWOFI (future without federal investment; i.e. the No Action Alternative).

The significant reduction in economic cost over time compared to the FWOFI clearly demonstrates that the Augmentation Wellfield and Groundwater Use Reduction Alternative achieves the approved project purpose of Agricultural Water Management. This authorized project purpose is applicable because once Quivira NWR files a request to secure water, KDA-DWR will be required to enforce restrictions on junior water right users, and these irrigators will have a water deficit. Even though the water deficit (damage) is not presently happening, it is projected to occur in the FWOFI. Implementation of the Augmentation Wellfield and Groundwater Use Reduction Alternative will prevent severe economic impacts to the agricultural producers in the Rattlesnake Creek Watershed. Through efficient and effective Agricultural Water Management, junior agricultural producers will have access to irrigation water from Rattlesnake Creek (compared to the FWOFI), while at the same time, Quivira NWR receives the benefit of additional water that will satisfy its impaired senior water right. Waiting until the events predicted to occur in the FWOFI transpire (USFWS files a request to secure its water, KDA-DWR exercises enforcement on junior users), would allow the economic damage (water deficit) to occur to the agricultural producers.

After consideration of project impacts and benefits, the NRCS determined that the **Augmentation Wellfield and Groundwater Use Reduction Alternative** represents the best overall balance between environmental, economic, and social factors while still meeting the purpose and need of the project by providing a predictable and consistent source of water to support the local agricultural economy while meaningfully addressing the impairment of the senior water right at Quivira NWR.

8.1.4 Ecosystem Services Benefits

The Proposed Action Alternative would enhance provisioning ecosystem services (compared to the No Action Alternative) by continuing to allow agricultural producers to use irrigation methods as their primary agricultural farming practice. Implementation of this alternative maintains productive cropland, supports biodiversity resilience, and enhances wetland habitat at Quivira NWR, which provides regulating, supporting, and cultural ecosystem services. Regulating services will receive benefits because GHG emissions that occur from the wellfield will be fully offset by the 2,500 acre-feet of water right retirements, with an overall reduction in carbon dioxide emissions of approximately 1,500 MT of carbon dioxide per year.

8.2 Measures to be Installed

Measures to be installed include an augmentation wellfield and associated water collection and delivery pipelines. The augmentation wellfield would be installed south of Quivira NWR. The wellfield includes up to 28 well sites; each site contains a battery of two wells for a total of 56 wells. It is anticipated that each well would be approximately 100 feet deep and produce a maximum yield of 150 gpm.

Collection and delivery pipelines would transport up to 18 cfs of groundwater from the wellfield to a discharge point in Rattlesnake Creek upstream of Quivira NWR. It is anticipated that the wells would provide up to 15 cfs throughout any year and an additional 3 cfs during critical time periods.

During the engineering design phase, which will include additional field data collection and analysis and be completed following authorization of the Plan – EIS, the wellfield configuration and exact well locations would be determined. Land for the wells and pipeline would be acquired by a permanent easement or purchase from the current landowner by GMD #5. It is assumed that a temporary easement of 0.5 acre around each well site and within a 40-foot buffer of pipelines would be required for construction activities. Disturbed ground would be reseeded, stabilized, and generally restored to its preconstruction condition within one to three years. To allow for operation and maintenance activities, a permanent easement of 0.1 acre around each well site and within a 10-foot buffer of pipelines would be required. Refer to Section 5.3 for additional information.

The Proposed Action Alternative also includes retirement of 2,500 acre-feet of authorized water use within Zone D (high-impact area). Details related to implementation of these two components of the Proposed Action Alternative will be documented in a future program that will be developed by GMD #5.

8.3 Mitigation

8.3.1 Erosion

Erosion may occur on disturbed and cleared areas within the project boundary during precipitation events. Proper BMPs would be installed during and after construction to prevent and control soil erosion. Areas disturbed during construction activities would be restored and stabilized through the establishment of ground cover.

8.3.2 Surface Water Quality

Construction activities may temporarily affect surface water quality, but project design elements, including BMPs, would be implemented to reduce the quantity of sediment (1) entering drainages, and (2) flowing downstream and violating any federal or state water quality rules and regulations. Construction BMPs would include, but are not limited to, the following:

- An SWPPP would be required and implemented that contains erosion and sediment control and pollution prevention BMPs, such as, but not limited to, silt fences, fiber wattles, and/or earth berms.
- Construction and staging areas would be assessed for the feasibility of such measures as straw bales, silt fences, and other appropriate sediment control BMPs, which would be implemented to prevent the entry of sediment and other contaminants into downstream drainages.
- To make sure that accidental spills do not enter waters, the storage of petroleum-based fuels and other hazardous materials and the refueling of construction machinery would not occur outside of approved designated staging areas. Furthermore, the project would comply with federal and state water quality standards and toxic effluent standards to minimize any potential adverse impacts from discharges to WOTUS or wetlands.

In addition to construction BMPs, augmentation water, combined with the natural flows of Rattlesnake Creek, would be required to maintain chloride concentrations of water flowing into Quivira NWR of less than 1,400 mg/L (KDHE 2018).

8.3.3 Air Quality

Construction activities would temporarily emit air pollutants. Fugitive dust, mobile source air toxics (MSAT), and GHG emission increases associated with construction would be minimized through implementation of the following applicable BMPs:

- Spraying the soil on-site with water or other similar approved dust suppressant/soil binder.
- Wetting materials hauled in trucks, providing adequate freeboard (space from the top of the material to the top of the truck), or covering loads to reduce emissions during material transportation/handling.
- Providing a stabilized construction entrance (track-out pad), wheel washers, and/or other similar BMPs at construction site access points to reduce track-out of site materials onto the adjacent roadway network.
- Removing tracked-out materials deposited onto adjacent roadways.
- Wetting material stockpiles to prevent wind-blown emissions.
- Establishing vegetative cover on bare ground as soon as possible after grading to reduce windblown dust.
- Requiring appropriate emission-control devices on all construction equipment.
- Requiring the use of cleaner-burning fuels.
- Using only properly operating, well-maintained construction equipment.

8.3.4 Noxious Weeds and Invasive Plants

Construction activities could result in the introduction and/or spread of invasive plants. To reduce this risk, the following measures will be implemented during construction:

- Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of invasive weeds.
- Minimize surface disturbance to the greatest extent feasible to complete the work.
- Use certified, weed-free, imported erosion-control materials (or rice straw in upland areas).
- Use locally grown native plant stock and native or naturalized (noninvasive) grass seed during revegetation.
- Prior to arrival at the project site and prior to leaving the project site, the construction contractor must clean all construction equipment that may contain invasive plants and/or seeds to reduce the spreading of noxious weeds.

8.3.5 Migratory Birds/Bald Eagles

Construction activities could result in temporary impacts to nesting migratory birds and raptors. To reduce impacts, the following measures will be implemented:

- Construction activities would be limited to the smallest extent practicable within the project area.
- Disturbed areas would be restored following construction.
- Vegetation clearing activities will be conducted between July 16 and March 31 to avoid migratory bird breeding/nesting periods.
- If construction activities occur during migratory bird breeding/nesting periods (April 1 to July 15), the project area (and surrounding habitats) would be surveyed by a qualified biologist for active nests no more than five days prior to the commencement of work. If active nests are found during surveys, spatial buffers would be established around them in coordination with USFWS and NRCS. Construction activities within the buffer areas would be prohibited until a qualified biologist confirmed that all nests are no longer active.

8.3.6 Hazardous Materials

The contractor must comply with all federal, state, and local laws and regulations pertaining to pollution and contamination of the environment to prevent pollution of surface water, groundwater, soil, and air with any hazardous materials.

8.3.7 Visual Resources

Areas disturbed during construction activities would be restored following construction by grading to match natural contours and stabilizing through establishment of ground cover. These areas would be reestablished by seeding with an herbaceous plant seed mixture and revegetation with NRCS-approved plant species to match the surrounding plant community.

8.3.8 Cultural Resources and Historic Properties

A Cultural Resources Survey Plan (Buried Past 2023; Appendix A) will be implemented. Based on results of the cultural resources survey and consultation with SHPO, any recommended measures will be applied during project implementation. In consultation with SHPO and the

tribes, a PA was developed by NRCS to defer identification and evaluation of cultural resources and historic properties in accordance with 36 CFR 800.4(b)(2). Any required mitigation will be addressed through the PA with avoidance considered the preferred alternative and minimization of impacts in cases where avoidance is not possible. A treatment/mitigation plan and an inadvertent discovery plan will be appended to the PA to direct actions in these scenarios. The PA was signed by the Kansas State Conservationist on July 29, 2025, and transmitted to ACHP in accordance with 36 CFR 800.6(a)(1)(i)(C). The ACHP accepted the PA by letter on August 27, 2025. The PA and acceptance letter is included in Appendix A.

8.4 Permits and Compliance

The Proposed Action Alternative involves work to be performed within areas that are regulated by several federal, state, and local agencies. Potentially applicable environmental permits, approvals, and consultations for measures to be installed include the following:

- **Clean Water Act Section 404.** A Clean Water Act Section 404 permit must be obtained from the USACE to account for fills within jurisdictional WOTUS. If needed, GMD #5 will obtain a Clean Water Act Section 404 permit prior to construction.
- **Endangered Species Act Section 7.** GMD #5 has developed a BA to support ESA Section 7 consultation with the USFWS. Based on this consultation, the USFWS has concurred with the effects determination in the BA. Concurrence from USFWS was received on December 17, 2025 and is included in Appendix A.
- **National Historic Preservation Act Section 106**. A Cultural Resources Inventory Report will be prepared and submitted to the Kansas SHPO for concurrence. Based on results in the report and the Kansas SHPO recommendations, NRCS will determine whether the project may affect historic properties that are either listed or eligible for listing on the NRHP. In consultation with SHPO and the tribes, NRCS has developed a PA to defer identification and evaluation of cultural resources and historic properties in accordance with 36 CFR 800.4(b)(2). Any required mitigation will be addressed through the PA. The PA was signed by the Kansas State Conservationist on July 29, 2025, and transmitted to ACHP in accordance with 36 CFR 800.6(a)(1)(i)(C). The ACHP accepted the PA by letter on August 27, 2025. The PA and acceptance letter is in Appendix A.
- **State Sensitive Species.** GMD #5 will consult with the KDWP for activities that may affect state threatened or endangered species. If needed, the KDWP is required to issue special action permits for activities that may affect these species or state-designated critical habitat.
- **National Pollutant Discharge Elimination System / Stormwater Pollution Prevention Plan.** A construction site discharge permit (NPDES) is required by the KDHE on behalf of the EPA if a construction site footprint is greater than 1 acre. Construction of the Proposed Action Alternative would involve more than 1 acre of disturbance; therefore, an SWPPP will be developed to minimize pollution from soil erosion and other sources during construction.

- **Kansas Department of Transportation (KDOT).** Multiple permits from KDOT will potentially be needed for project construction including but not limited to: Right-of-way (ROW) Permit, Highway Permit, and Oversize Permit.
- **KDA-DWR**. The KDA-DWR Water Appropriation program administers the Kansas Water Appropriation Act pertaining to the management of water resources. This program issues permits to appropriate water, regulates water use, and maintains records of all water rights in the state. A water appropriation permit is required for the construction of a water well or withdrawal of surface or groundwater in accordance with the Kansas Water Appropriation Act (K.S.A. 82a-701 through 82a-722, 82a-724 through 82a-734a, 82a-736, 82a-737, 82a-741 through 82a-745). Multiple permits will potentially be needed based on wellfield configuration and location of water withdrawals.
- **Local Construction Permits:** Any construction permits required from Stafford County will be obtained prior to construction.

8.5 Costs and Cost Sharing

Costs for the construction of the project will be shared between the NRCS and GMD #5. According to the Title 390 – National Watershed Program Manual, Part 500, Subpart E, 500.42, financial assistance for agricultural water management projects will not exceed the rate of assistance for measures installed for similar purposes through other available federal programs; where rates are identified for similar purposes under other available programs, Watershed Program funds may provide up to a maximum of 75 percent of installation costs and up to 100 percent of engineering or technical assistance costs. No cost sharing is available for real property rights for this purpose. Wells, water treatment facilities, pipelines, and similar practices, listed in Title 450, National Handbook of Conservation Practices (NHCP), are eligible for Watershed Program assistance.

The following sections describe the major components of installation costs and specific costs and the percentage of cost share of each component. See tables 8.8-1 through 8.8-5 for a summary of costs and Appendix D for detailed cost information (Olsson 2023b). Measures and resulting costs/benefits will be jointly considered by project partners as part of the adaptive management plan. These costs will be the responsibility of GMD #5.

8.5.1 Engineering

Major components of engineering costs consist of design, surveys, and a geotechnical investigation. It is assumed that Watershed Program funds would cover 100 percent of engineering costs. For the augmentation wellfield – compact configuration, the estimated federal engineering cost is $1,936,000. For the augmentation wellfield – expanded configuration, the estimated federal engineering cost is $2,958,000.

8.5.2 Construction

Construction costs include all costs to build the proposed project. Major components consist of mobilization, earthwork, well drilling, pipeline installation, electrical system for wells, well

discharge structure, seeding, mitigation, construction observation, monitoring equipment, and demobilization. It is assumed that Watershed Program funds would cover 75 percent, and the remaining 25 percent would be the responsibility of GMD #5. For the augmentation wellfield – compact configuration, the estimated federal construction cost is $20,335,000 and estimated GMD #5 cost is $6,778,000. For the augmentation wellfield – expanded configuration, the estimated federal construction cost is $31,285,000 and the estimated GMD #5 cost is $10,428,000.

8.5.3 Real Property Acquisition and Easement

GMD #5 is responsible for 100 percent of real property acquisition and easements costs. For the augmentation wellfield – compact configuration, the estimated GMD #5 real property acquisition and easement cost is $558,000. For the augmentation wellfield – expanded configuration, the estimated GMD #5 real property acquisition and easement cost is $614,000.

8.5.4 Water Right Retirements

Water right retirement costs are estimated to be $11,253,000. For both configurations, the estimated federal water right retirement cost is $8,440,000 and estimated GMD #5 cost is $2,813,000. Wells would likely be transitioned to a domestic or livestock well and not decommissioned.

8.5.5 Project Administration

Project administration costs include contract administration, maintenance of records, and other overhead costs of installing structural measures. Project administration costs are not shared. Each participating agency bears its own administration costs, which are estimated to be 2 percent of total cost.

8.6 Installation and Financing

8.6.1 Framework for Carrying out the Plan

Final design for the augmentation wellfield would occur in the first two years following plan authorization. GMD #5 would secure all needed permits, easements, and rights for installation, operation, and maintenance. Once the final design is completed, permits obtained, and all easement agreements are in place, construction is anticipated to last one to two years. NRCS would provide technical assistance, engineering services, consultation for special environmental concerns, and project administration.

8.6.2 Planned Sequence of Installation

Major construction elements for the augmentation wellfield and pipeline installation would be sequenced as summarized in Table 8.6.

Table 8.6. Summary of Planned Sequence of Installation.

Activity	Responsibility	Time Frame
Easement / Land Acquisition	GMD #5	Year 1
Engineering and Design	NRCS / GMD #5	Year 1-2
Permitting	GMD #5	Year 1
Construction	NRCS / GMD #5	Year 3-4
Post-construction Monitoring	GMD #5	Year 5

8.6.3 Responsibilities

GMD #5 would obtain permits and follow the compliance actions as identified in Section 8.4. In addition, GMD #5 is responsible for obtaining land rights and construction easements required for the project. GMD #5 has analyzed its financial needs and is able to make funds available when needed.

Federal funds are to be provided by NRCS for technical assistance, engineering services, water right retirements, construction, and project administration. The availability of federal funds is contingent on appropriations available for this purpose. Prior to entering into agreements that obligate funds of NRCS, GMD #5 would have a financial management system for control, accountability, and disclosure of PL 83-566 funds received and for control and accountability for property and other assets purchased with PL 83-566 funds.

8.6.4 Contracting

The project will be installed by means of a GMD #5-led construction contract, with reimbursements through a cooperative agreement with NRCS. Contracting arrangements will be agreed to between NRCS and GMD #5 before either party commences work activities. A project or other implementation agreement between NRCS and GMD #5 will detail the work activities and financial responsibilities for both parties.

8.6.5 Real Property and Relocations

Property within the project area is on private lands. Easements for proposed improvements (including egress/ingress), easements for future O&M activities, or property acquisition, would need to be obtained by GMD #5. No relocations are anticipated.

8.6.6 Financing

The NRCS will use funds appropriated annually under PL 83-566, the Watershed Protection and Flood Prevention Act, as the source of the federal share of the installation cost. GMD #5 will bear the remaining costs using cash reserves, loans, bonds, and/or annual tax revenues appropriated to it by the state.

GMD #5 will be responsible for identifying the additional water right retirements within the high-impact area and identifying funding sources and agreements for the water right retirements. GMD #5 has committed to and will implement a water right retirements program and will seek additional funding, as needed, to meet the 2,500 acre-feet requirement.

8.6.7 Conditions for Providing Assistance

The estimated cost of installing the augmentation wellfield is $44,465,000 for the compact configuration and $61,658,000 for the expanded configuration. The NRCS, under authority of the Watershed Protection and Flood Prevention Act, PL 83-566, as amended, will provide $33,324,000 (compact configuration) or $46,467,000 (expanded configuration). GMD #5, using other authorities and private funds, will provide $11,141,000 (compact configuration) or $15,191,000 (expanded configuration). Federal financial assistance for construction is contingent on appropriations for this purpose.

8.7 Operation, Maintenance, and Replacement

Operation of facilities includes the administration, management, and performance of non-maintenance activities necessary to keep the facilities safe and functioning as designed. Details on the anticipated operation of the augmentation wellfield is provided in Appendix D. Maintenance includes recurring activities necessary to retain or restore the facilities in a safe and functioning condition, including the management of vegetation, the repair or replacement of failed components, the prevention or treatment of deterioration, and the repair of damages caused by flooding or vandalism. Maintenance includes both routine and as-needed measures. GMD #5 would be responsible for the operation, maintenance, and future modifications to facilities, and the estimated annual O&M cost for the project ranges from $600,000 to $900,000. A specific O&M Plan would be prepared by NRCS and GMD #5 in accordance with the NRCS National Operation and Maintenance Manual (NRCS 2003b). This plan and agreement would be entered into prior to the start of construction activities and would be in place for the extended life of the project as well as utilized as part of the AMP. The agreement would provide for inspections, reports, and procedures for performing the maintenance items. The agreement would include specific provisions for retention, use, and property improved with PL 83-566 (as amended by PL 106-472) assistance.

8.8 Economic and Structural Tables

The tables provided in this subsection are described in the National Watershed Program Manual (Part 506, Subpart B, sections 506.10 to 506.21). Only those tables applicable to this plan are included. The installation cost estimate for the Proposed Action Alternative ranges from $44,465,000 to $61,658,000, depending on the configuration implemented, as identified in Table 8.8-1. Economic tables have been included to present information relevant to the costs and benefits of the Proposed Action Alternative. Structural tables have been included to present the relevant structural information pertinent to the design of the Proposed Action Alternative. The

costs for the Proposed Action Alternative are conceptual-level cost estimates only, with an estimated range of accuracy at plus-or-minus 30 percent. Detailed structural designs and construction cost estimates would be prepared for the project during the final design phase and prior to the start of the competitive bidding process. The final cost of the project would be the price received from the winning construction bid plus-or-minus the amount of contract modifications.

Table 8.8-1 includes estimated installation costs divided between federal and nonfederal funding sources. Only nonfederal land is involved with this project. Costs for the compact and expanded augmentation wellfield configurations are included for comparison and to provide an expected range of costs.

Table 8.8-1. Economic Table 1: Estimated Installation Cost; Rattlesnake Creek Watershed, Kansas (dollars[1]).

Works of Improvement	PL 83-566 Funds[2]	Other Funds[2]	Total
Augmentation Wellfield (compact configuration)	$33,324,000	$11,141,000	$44,465,000
Augmentation Wellfield (expanded configuration)	$46,467,000	$15,191,000	$61,658,000

[1] Price base: 2023
[2] Only nonfederal land is involved in this project.

The estimated cost distribution in Table 8.8-2 shows the estimated installation costs for works of improvement between PL 83-566 funds and the costs borne by GMD #5. The project has the purpose of agricultural water management and meaningfully addressing the impairment at Quivira NWR.

Table 8.8-2. Economic Table 2: Estimated Cost Distribution – Water Resource Project Measures; Rattlesnake Creek Watershed, Kansas (dollars[1]).

Funding Source	Cost Component	Works of Improvement	
		Augmentation Wellfield (compact configuration)	Augmentation Wellfield (expanded configuration)
Installation Costs PL 83-566	Engineering[2]	$1,936,000	$2,958,000
	Construction[3]	$20,335,000	$31,285,000
	Real Property Rights	$0	$0
	Water Right Retirements	$8,440,000	$8,440,000
	Project Administration	$645,000	$893,000
	Interest for Water Right Retirements	$232,000	$232,000
	Interest for Engineering, Construction and Project Administration Costs	$1,736,000	$2,659,000
	Total PL 83-566[4]	**$33,324,000**	**$46,467,000**
Installation Costs Other Funds	Engineering[2]	$0	$0
	Construction	$6,778,000	$10,428,000
	Real Property Rights	$558,000	$614,000
	Water Right Retirements	$2,813,000	$2,813,000
	Project Administration	$212,000	$289,000
	Permits	$150,000	$150,000
	Interest for Water Right Retirements	$77,000	$77,000
	Interest for Engineering, Construction and Project Administration Costs	$553,000	$820,000
	Total Other Funds[4]	$11,141,000	$15,191,000
	Total	**$44,465,000**	**$61,658,000**

[1] Price base: 2023

[2] Includes design, surveys, and geotechnical investigations.

[3] Includes construction, construction observation, mitigation, and monitoring equipment.

[4] Costs associated with post-construction monitoring requirements are unknown at this time and are therefore not included. These costs will be the responsibility of GMD #5.

Table 8.8-3 provides information on the estimated average annual NED costs. Estimated average annual costs were amortized for 50 years at a discount rate of 2.75 percent. Average

annual NED costs for the compact and expanded configurations are $2,342,000 and $2,885,000, respectively.

Table 8.8-3. Economic Table 4: Estimated Average Annual National Economic Development Costs; Rattlesnake Creek Watershed, Kansas (dollars[1]).

Works of Improvement	Amortization of Installation Cost	Operation, Maintenance, and Replacement Cost[2]	Total
Compact Configuration			
Wellfield Augmentation	$1,025,000	$900,000	$1,925,000
Groundwater Retirements	$417,000	$0	$417,000
Total	**$1,442,000**	**$900,000**	**$2,342,000**
Expanded Configuration			
Wellfield Augmentation	$1,568,000	$900,000	$2,468,000
Groundwater Retirements	$417,000	$0	$417,000
Total	**$1,985,000**	**$900,000**	**$2,885,000**

[1] Price base: 2023, amortized over 50 years at a discount rate of 2.75 percent.
[2]Includes $900,000 annually for operation, maintenance, and replacement (high end of range).

Table 8.8-4 provides the estimated average annual damage reduction benefits. Total estimated annual average damage reduction benefit is $4,499,000.

Table 8.8-4. Economic Table 5a: Estimated Average Annual Damage Reduction Benefits; Rattlesnake Creek Watershed, Kansas (dollars[1]).

Item	Damage Reduction Benefit, Average Annual
On-site	
Maintaining Productivity	$4,499,000
Groundwater Retirements[2]	$0
Subtotal	$4,499,000
Off-site/Public	$0
Total	$4,499,000

[1] Price Base: 2023
[2] Benefits of groundwater retirements are included with maintaining productivity.

Table 8.8-5 provides a comparison of on-site and off-site NED benefits and costs. The number of direct beneficiaries is 876 water right holders. Other beneficial effects in physical terms include the beneficial effects to Quivira NWR as described in Section 2. Other beneficial effects are described in Section 6. The benefit-to-cost ratio for the compact and expanded wellfield are 1.92 and 1.56, respectively.

Table 8.8-5. Economic Table 6: Comparison of National Economic Development (NED) Benefits and Costs; Rattlesnake Creek Watershed, Kansas (dollars[1]).

Works of Improvement	Agricultural-Related	Average Annual Benefits	Average Annual Costs	Benefit-cost Ratio
Compact Configuration	Maintain Productivity	$4,499,000	$2,342,000	1.92
Expanded Configuration	Maintain Productivity	$4,499,000	$2,885,000	1.56

[1] Price Base: 2023

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11. DISTRIBUTION LIST

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Table 11.0. Distribution List.

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Appendix A

Public Participation

Agency Coordination

Public Participation

PUBLIC MEETING NO. 1 - PUBLIC SCOPING MEETING

SUMMARY

In accordance with the Public Participation Plan, an open house public meeting was held January 13, 2022, from 4:00-6:00 pm in at the Community Room at the Stafford County Annex in St. John, KS. The purpose of this meeting was to share information about the Watershed Plan-EA process and to gather feedback from the public on how to improve agricultural water supply and fish and wildlife habitat within the Rattlesnake Creek Watershed in Stafford County. Approximately 31 people signed into the meeting. Public notices advertising the meeting were published in the *Great Bend Tribune, Hutchinson News, Stafford Courier, Pratt Tribune* and *Saint John News* newspapers. Postcard invitations were sent to approximately 775 citizens and other interested parties near the proposed project area. A meeting notice was also published on the Big Bend Groundwater Management District (GMD) #5's website.

Information shared at the meeting included the project background and location, project purpose and need, description of the purpose of and process for developing a watershed plan-EA, environmental considerations within the project area, organizational information about the Natural Resources Conservation Service (NRCS) and Big Bend GMD #5, and methods for providing public input. Draft scoping information and executive summary were also provided at the meeting.

The project team received 11 comments during the specified 30-day comment period (December 29, 2021-January 31, 2022). Comments received are included in this Appendix.

BIG BEND GROUNDWATER MANAGEMENT DISTRICT #5 DRAFT WATERSHED PLAN – ENVIRONMENTAL ASSESSMENT

SCOPING INFORMATION

Natural Resources Conservation Service
Salina, Kansas

January 2022
Olsson Project No. 021-00451

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ACRONYMS AND ABBREVIATIONS

Aquifer ..... Great Bend Prairie Aquifer
cfs ..... cubic feet per second
EA ..... Environmental Assessment
GMD #5 ..... Big Bend Groundwater Management District Number 5
HUC ..... Hydrologic Unit Code
KDA-DWR ..... Kansas Department of Agriculture-Division of Water Resources
LEMA ..... Local Enhanced Management Area
mg/l ..... milligrams per liter
MOA ..... Memorandum of Agreement
NWR ..... National Wildlife Refuge
NRCS ..... Natural Resources Conservation Service
Plan-EA ..... Watershed Plan Environmental Assessment
SLO ..... Sponsoring Local Organization
TDS ..... Total Dissolved Solids
USFWS ..... U.S. Fish and Wildlife Service

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EXECUTIVE SUMMARY

Quivira National Wildlife Refuge (NWR), located in central Kansas, encompasses approximately 22,135 acres of diverse habitat and is recognized nationally and internationally for its wildlife value. The major source of water for Quivira NWR is streamflow within the Rattlesnake Creek watershed. In Kansas, water users with older (or senior) water rights are given priority access to water relative to newer (or junior) water right holders in times of water shortages. The United States Fish and Wildlife Service (USFWS) holds Water Right File No. 7,571 for the operation and objectives of Quivira NWR, which is senior in priority to approximately 95 percent of all other water rights in the Rattlesnake Creek watershed. The Big Bend Groundwater Management District #5 (GMD #5) was formed in 1976 for the conservation of groundwater within multiple hydrologic units, including Rattlesnake Creek subbasin. Beginning over 30 years ago, flows in Rattlesnake Creek began to diminish, due in large part to newer water users within the subbasin who began diverting water for other purposes, primarily agricultural irrigation. Irrigated agriculture provides a substantial boost to the local economy within the Rattlesnake Creek subbasin.

Past attempts by multiple groups to address water shortages within the Rattlesnake Creek subbasin have failed to meet objectives. In 2021, funding though the Watershed Protection and Flood Prevention Act, Public Law (PL) 566, was obtained by GMD #5 to develop a watershed plan environmental assessment (Plan-EA) for Rattlesnake Creek. As part of that Plan-EA, a feasibility study of groundwater pumping will also be completed. The need for developing a Plan-EA is twofold. a) the sustainability of Quivira NWR relies primarily on surface water diversions that have been impaired because of agricultural groundwater use, and b) a predictable and consistent source of water is required to maintain the existing agricultural economy.

Initial assessments have identified preliminary alternatives to addressing the water use conflicts within Rattlesnake Creek subbasin. The “no action” alternative entails possible actions to reduce the use of groundwater by junior water right holders, increasing available streamflow for Quivira NWR, however the timeframe for any such reduction is not known. An alternative that includes reductions in groundwater use and Rattlesnake Creek flow augmentation may also be considered. The flow augmentation would be completed through construction of a wellfield and associated pipelines that would pump groundwater to Rattlesnake Creek at a location just upstream of Quivira NWR. An alternative that includes a reduction in groundwater use without an augmentation wellfield is also being considered.

Public and agency comments are requested related to the range of actions, alternatives, and impacts to be considered in the Plan-EA. Additionally, based on the preliminary alternatives, impacts associated with direct and indirect effects, as well as connected and cumulative actions, are requested. Public and agency comments are solicited to determine the issues and concerns related to the purpose and need and to determine reasonable alternatives that may be considered.

1. SCOPE OF THE WATERSHED PLAN ENVIRONMENTAL ASSESSMENT

Big Bend Groundwater Management District #5 (GMD #5) has been awarded federal funding from the Natural Resources Conservation Service (NRCS) through the Watershed Protection and Flood Prevention Act, Public Law (PL) 566. Through PL-566, the NRCS offers assistance (either technical or financial) to local government sponsors that are planning and implementing watershed projects. Projects can include flood prevention (including structural and land treatment measures), the conservation, development, utilization, and disposal of water, or the conservation and proper utilization of land. Funding received by GMD #5 from NRCS through the PL-566 program will be used to develop a watershed plan environmental assessment (Plan-EA) for the draft project area shown in Figure 1.

NRCS requires that the scope of the Plan-EA be completed in accordance with the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and 40 CFR Section 1501.7 (NRCS 2015). Public and agency comments are requested related to the range of actions, alternatives, and impacts to be considered in the Plan-EA. Additionally, based on the preliminary alternatives, impacts associated with direct and indirect effects and connected and cumulative actions are requested. Public and agency comments are solicited to determine the issues and concerns related to the proposed action and to determine potential reasonable alternatives to be evaluated in the Plan-EA.

The NRCS National Watershed Program Manual (NRCS 2015) requires that the following (Table 1) concerns be addressed in the scoping process. Public and agency comments on the following categories are requested.

Table 1. Laws, Regulations, and Guidance.

Categories	Laws, Regulations, and Guidance
(1) National Economic Development (NED) Principles and Guidelines	Title 390, National Watershed Program Handbook and Title 180, National Planning Procedures Handbook, Part 600
(2) Air quality	The Clean Air Act (42 U.S.C. Sections 7401 to 7671q)
(3) Cultural resources	Public Law 89-665, the National Historic Preservation Act of 1966, as amended, 36 CFR Part 800, Public Law 96-95, the Archaeological Resources Protection Act of 1979, and Public Law 101-601, the Native American Graves Protection and Repatriation Act
(4) Ecologically critical areas	Ecosystem Services | US EPA (EPA 2021)
(5) Endangered and threatened species	Public Law 93-205, the Endangered Species Act of 1973

(6) Environmental justice and civil rights	Executive Order 12898 and Public Law 91-646, the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. Section 4601 et seq.)
(7) Essential fish habitat	Public Law 90-542, the Wild and Scenic Rivers Act of 1968
(8) Fish and wildlife (including coordination requirements)	Public Law 93-205, the Endangered Species Act of 1973, The Protection of Bald and Golden Eagles Act of 1990 (16 U.S.C. Sections 668a to d, 54 Stat. Section 250), and Executive Order 12962
(9) Floodplain management	Executive Order 11988
(10) Forest resources	National Forest Management Act of 1976
(11) Invasive species	Executive Order 13112
(12) Land use	Public Law 91-646, the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. Section 4601 et seq.)
(13) Migratory birds	The Migratory Bird Treaty Act of 1918 (16 U.S.C. Sections 703 to 712, 40 Stat. Section 755)
(14) Natural areas	Wilderness Act of 1964
(15) Prime and unique farmland and farmland of statewide significance	Public Law 97-98, the Farmland Protection Policy Act of 1981, as Amended (7 U.S.C. Section 4201 et seq.) and Public Law 104-127, the Federal Agriculture Improvement and Reform Act of 1996
(16) Public health and safety	Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks and Public Law 99-198, the Food Security Act of 1985
(17) Regional water resource plans (including coastal zone plans)	7 CFR Part 622, Executive Order 10584,
(18) Riparian areas	NRCS Riparian Areas Reservoirs of Diversity. (NRCS 1996)
(19) Scenic beauty	Public Law 90-542, the Wild and Scenic Rivers Act of 1968
(20) Scientific resources	NRCS Technical Resources (NRCS 2021)
(21) Sole source aquifers	Section 1424(e) of the Safe Drinking Water Act of 1974 (42 U.S.C. 201, 300 et. Seq., and 21 U.S.C. 349)
(22) Social issues	Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
(23) Soil resources	Public Law 95-192, the Soil and Water Resources Conservation Act of 1977
(24) Water quality	Public Law 92-500, the Clean Water Act, as amended
(25) Water resources	Executive Order 12322 and Public Law 92-500, the Clean Water Act, as amended
(26) Waters of the U.S., including special aquatic sites	Section 404 of the Clean Water Act
(27) Wetlands	Public Law 92-500, the Clean Water Act, as amended and Executive Order 11990

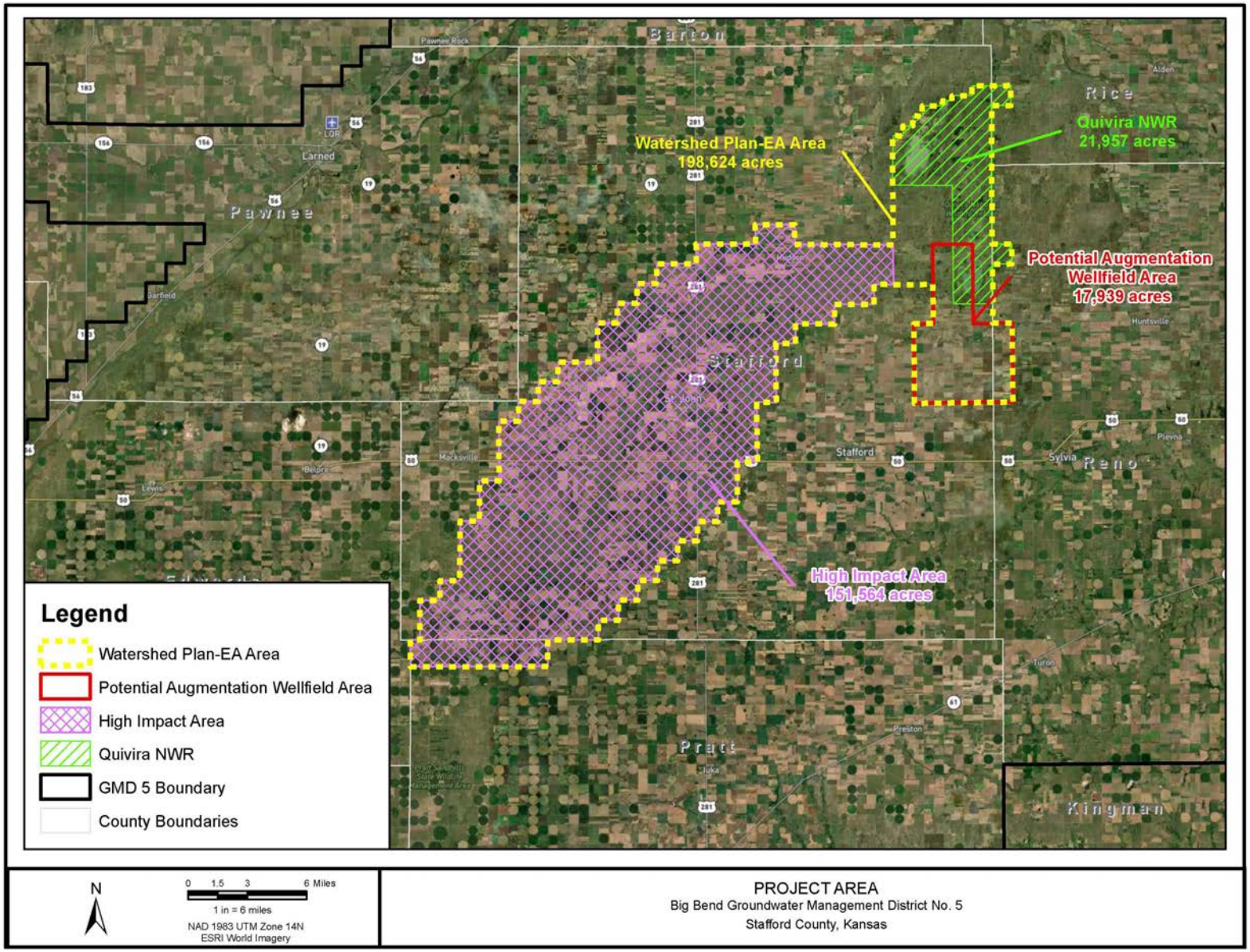

Figure 1. Watershed Plan Environmental Assessment (Plan-EA) Project Area.

2. INTRODUCTION AND BACKGROUND

Surface water and groundwater are essential resources to the central Kansas economy and environment. Management of the Rattlesnake Creek subbasin and its interrelated water resources has been difficult and complex, with multiple users competing for the limited resource (Figure 2). This resource is relied upon principally for wildlife habitat (through diversions of surface water at the Quivira National Wildlife Refuge (NWR)) and for irrigated agriculture (through groundwater pumping). To regulate water use, the state of Kansas uses a system of water rights, which dictates when and how much water may be accessed by users. GMD #5 can assist the state of Kansas with the management of groundwater through various statutory and incentive-based options. Quivira NWR and GMD #5 have been working on a solution to these complex water issues for many years. Historically, surface water flows have been insufficient to support management practices at Quivira NWR during certain years and periods within those years because of the reductions in streamflow due to groundwater use. Finding an agreeable solution that balances the needs of the Quivira NWR while limiting impacts to agriculture has been challenging. Table 2 shows a timeline of significant events that have occurred in the buildup to the Plan-EA.

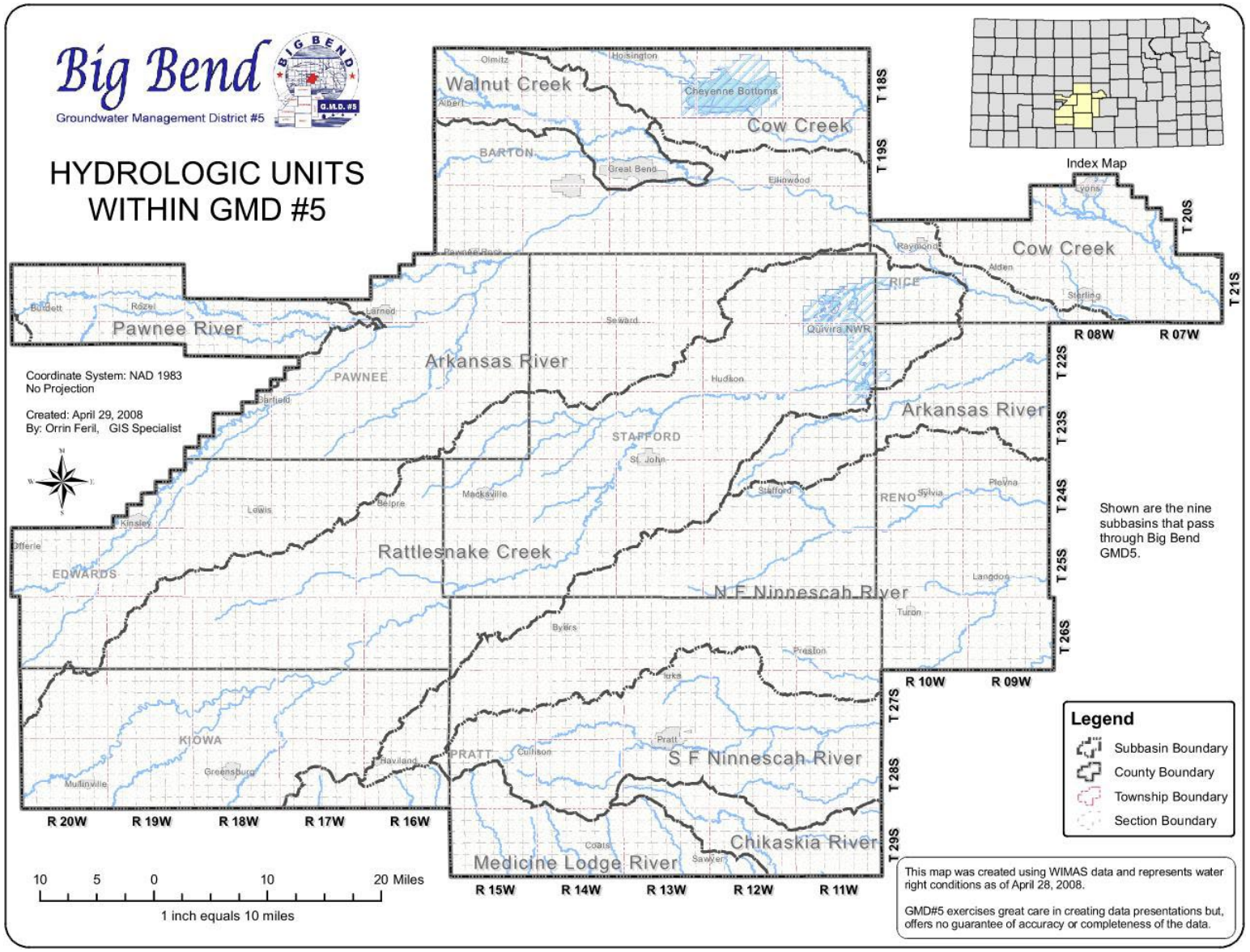

Figure 2. Groundwater Management District #5 Boundary Map (Big Bend GMD #5 2022a).

Table 2. Timeline of Significant Events in Rattlesnake Creek.

Date	Significant Event
1955	Quivira National Wildlife Refuge (NWR) is established
1957	Quivira NWR filed for a water right
1976	Groundwater Management District #5 (GMD #5) is established
1993	Rattlesnake Creek/Quivira Partnership is formed
1996	Kansas Department Agriculture-Division of Water Resources (KDA-DWR) certified the Quivira NWR water right for diversion of 14,632 acre-feet of water per year from Rattlesnake Creek
2000	Rattlesnake Creek Management Program Proposed by Rattlesnake Creek/Quivira Partnership
2010	Balleau Groundwater Inc. produces Hydrologic Model of GMD #5 Report
2013	U.S. Fish and Wildlife Service (USFWS) files Impairment Claim on water right 7,571
2016	KDA-DWR chief engineer submits the final report on the USFWS Impairment Claim
2018	Memorandum of Understanding signed between GMD #5 and KDA-DWR
2018	GMD #5 submits Rattlesnake Creek/Quivira NWR Local Enhanced Management Area (LEMA) plan
2019	KDA-DWR rejects LEMA plan proposed by GMD #5
2020	Memorandum of Agreement signed between USFWS and GMD #5
2021	GMD #5 produces the Rattlesnake Creek Streamflow Augmentation Proposal

Extensive background information including emails, reports, studies and analyses, and engineering and regulatory documents related to the Plan EA are publicly available at the following websites:

- GMD #5 Website – Quivira NWR Resolution
  - https://gmd5.org/quivira-nwr
- Quivira NWR – Comprehensive Conservation Plan
  - https://www.fws.gov/mountain-prairie/refuges/ks_qvr.php
- Kansas Department Agriculture-Division of Water Resources (KDA-DWR) Website – GMD #5 Rattlesnake/Quivira Local Enhanced Management Area (LEMA)
  - https://agriculture.ks.gov/divisions-programs/dwr/managing-kansas-water-resources/local-enhanced-management-areas/gmd5-rattlesnake-quivira-lema
- KDA-DWR Website – Quivira NWR Impairment Complaint
  - https://agriculture.ks.gov/divisions-programs/dwr/water-appropriation/impairment-complaints/quivira-national-wildlife-refuge

2.1 Quivira National Wildlife Refuge

Quivira NWR, located in south-central Kansas, encompasses approximately 22,135 acres of diverse habitat. The refuge was established by the U.S. Fish and Wildlife Service (USFWS) in 1955 and supports over 300 species of birds including more than 30 species of shorebirds (USFWS 2013). The refuge is recognized nationally and internationally for its wildlife value and is a Ramsar Wetland of International Importance, a Western Hemisphere Shorebird Reserve Network site, and a Globally Important Bird Area (USFWS 2013).

Quivira NWR's landscape includes sand prairies, sand dunes, salt flats, and salt and freshwater marshes (USFWS 2013). The refuge's rare landscape features exist partially because of the presence of large salt deposits near the surface of the soil and the associated groundwater interaction. Salinity levels throughout most of the refuge remain high enough to support a rare abundance of salt-tolerant vegetation such as alkali sacaton (*Sporobolus airoides*) and inland salt grass (*Distichlis spicata*). The refuge's salt marshes form a wetland complex that is hydrologically connected to area groundwater and Rattlesnake Creek (USFWS 2013). The unique habitat of the refuge attracts thousands of migratory birds each year, including federally protected species such as the whooping crane (*Grus americana*).

Quivira NWR's purpose is to "provide migration, nesting, resting, and feeding habitat for migratory birds and to develop, advance, manage, conserve, and protect fish and wildlife resources" (USFWS 2013). To meet these objectives, land throughout the refuge must be managed to maintain habitat integrity for the species the habitat supports. Over 100 water control structures, including dikes and canals, are present in the refuge, allowing the manipulation of water levels to support the wetland complex (USFWS 2013). The use of water control structures allows for seasonal fluctuation of water levels throughout the wetland complex to provide habitat (food, cover, and water) for a diversity of waterbirds that occur throughout the year (USFWS 2013).

To facilitate the refuge's purpose and management objectives, Quivira NWR draws water from Rattlesnake Creek and diverts the water through the water control structures and wetland complex. The diverted water supplements groundwater inflows to the wetland complex. Over 30 years ago, flows in Rattlesnake Creek began to diminish as other water users within the subbasin began diverting more water for purposes such as agricultural irrigation (KDA-DWR 2016). This reduction in flow in Rattlesnake Creek has contributed to shortages of water available to Quivira NWR during certain years and periods of those years, making it more difficult for the refuge to fulfill its purpose and management objectives (USFWS 2013).

2.2 Big Bend Groundwater Management District #5

GMD #5 was formed in March of 1976 under the authority of Kansas Statutes Annotated 82a-1020 et seq. GMD #5 was formed for the conservation of GMD #5's groundwater and established the following purposes for the district (Big Bend GMD #5 2022a):

- Establish a data-gathering bank including the measurement of water withdrawal, measurement of aquifer recharge, and other pertinent information.
- Establish a water quality monitoring program.
- Discourage waste of water.
- Develop an educational program on optimum water use.
- Develop well spacing criteria.
- Encourage accurate production measurements.
- Promote tail-water pits.
- Exert action to prevent water pollution.
- Review replacement wells.
- Review and authorize annual appropriation of water usage.
- Investigate alternate points of diversion.
- Explore and develop artificial recharge.
- Provide advice and assistance in the management of drainage problems and surface water.

GMD #5 encompasses approximately 2.5 million acres, including 569,725 authorized irrigated acres, and manages 4,523 water rights with 5,459 points of diversion. The total authorized quantity that these water rights can produce is 768,784 acre-feet of water. Within GMD #5's boundary, there are also two notable wetland complexes: Cheyenne Bottoms Wildlife Refuge (state) and Quivira NWR (federal); and there are nine hydrologic units including the following (Big Bend GMD #5 2022a):

1. Walnut Creek subbasin
2. Pawnee River subbasin
3. Cow Creek subbasin
4. Arkansas River subbasin
5. Rattlesnake Creek subbasin
6. North Fork of the Ninnescah River subbasin
7. South Fork of the Ninnescah River subbasin
8. Medicine Lodge River subbasin
9. Chikaskia River subbasin

Rattlesnake Creek subbasin, which includes Quivira NWR, is 842,880 acres in size and located in the Arkansas River lowlands and High Plains regions. Both regions are generally flat to rolling

with gentle slopes and sand dunes present periodically. The landscape is primarily dominated by agriculture, where on average 160,000 acres are irrigated per year (KDA-DWR 2016). Agricultural groundwater irrigation makes up about 89% of total active groundwater rights in the subbasin (see Figure 3). Municipal, industrial, and recreational uses also occur, but on a relatively smaller scale.

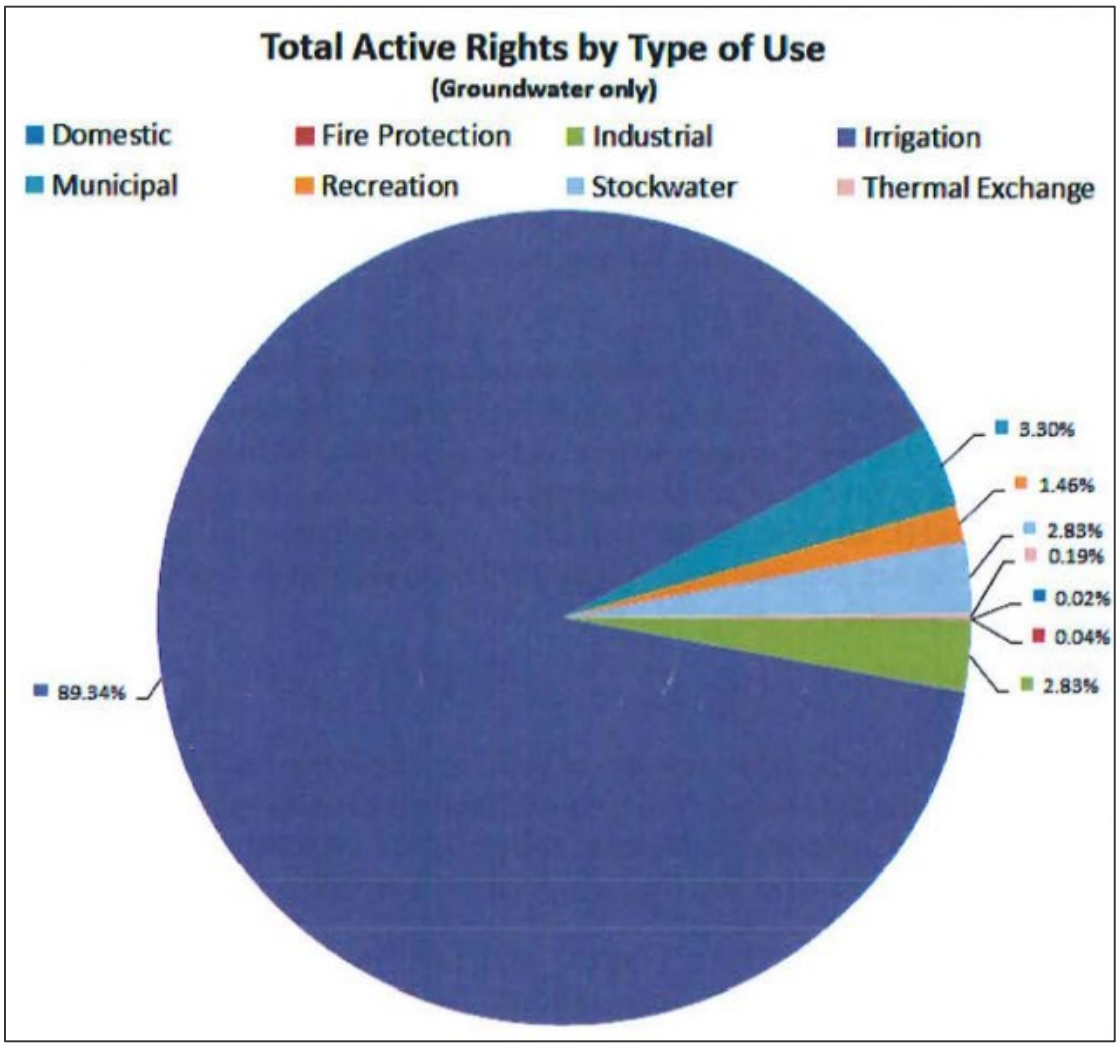

Figure 3 Active groundwater rights in GMD #5 by type of use (GMD #5 2018).

Most irrigation wells are installed into the Great Bend Prairie Aquifer, which consists of Quaternary aged sediments. Irrigation development began in the GMD #5 region during the 1940's, and significantly expanded between 1970 to 1980 with the advent of the center pivot irrigation system (see Figure 4).

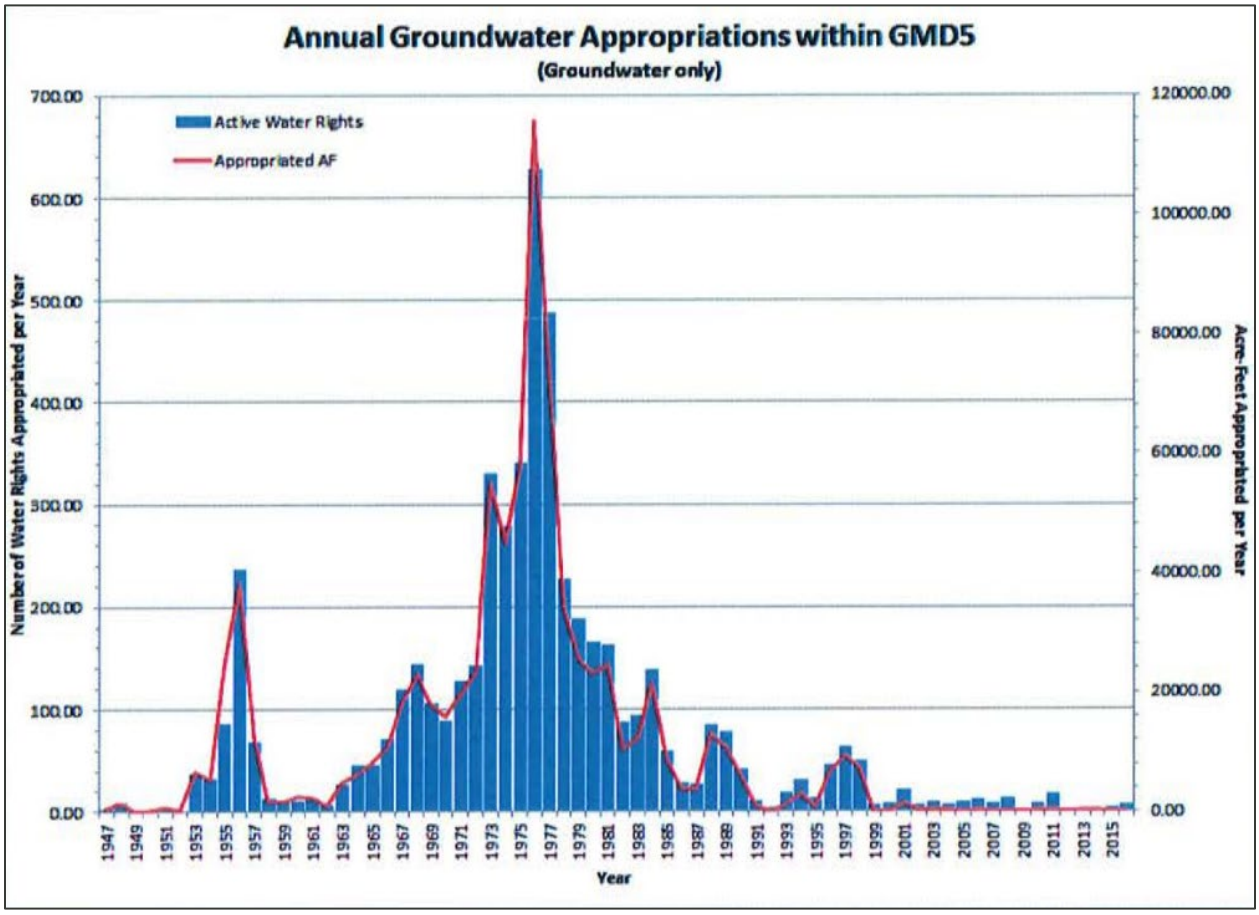

Figure 4. Groundwater rights issued in the GMD #5 from 1947 to 2015 (GMD #5 2018).

After the 1980's, irrigation development slowed considerably. The KDA-DWR maintains a record of all non-domestic water use information in their online database called the Water Information Management Analysis System (WIMAS). According to WIMAS, the number of groundwater rights in the subbasin totals 1,680 with about 1,370 of those rights reporting use since 2003 (KDA-DWR 2016).

In a hydrologically connected surface and groundwater system like the Rattlesnake Creek subbasin, depletions to streamflow due to groundwater pumping can occur in two ways: (1) by wells that intercept water that would have discharged to the stream under natural conditions, or (2) under increased pumping, water from the stream can flow directly to the well (Figure 5). To quantify and predict streamflow depletions, groundwater models must be used. Depletions are calculated by determining the difference between streamflow that would have occurred if the well was not pumped and the streamflow that occurs when a well is pumped.

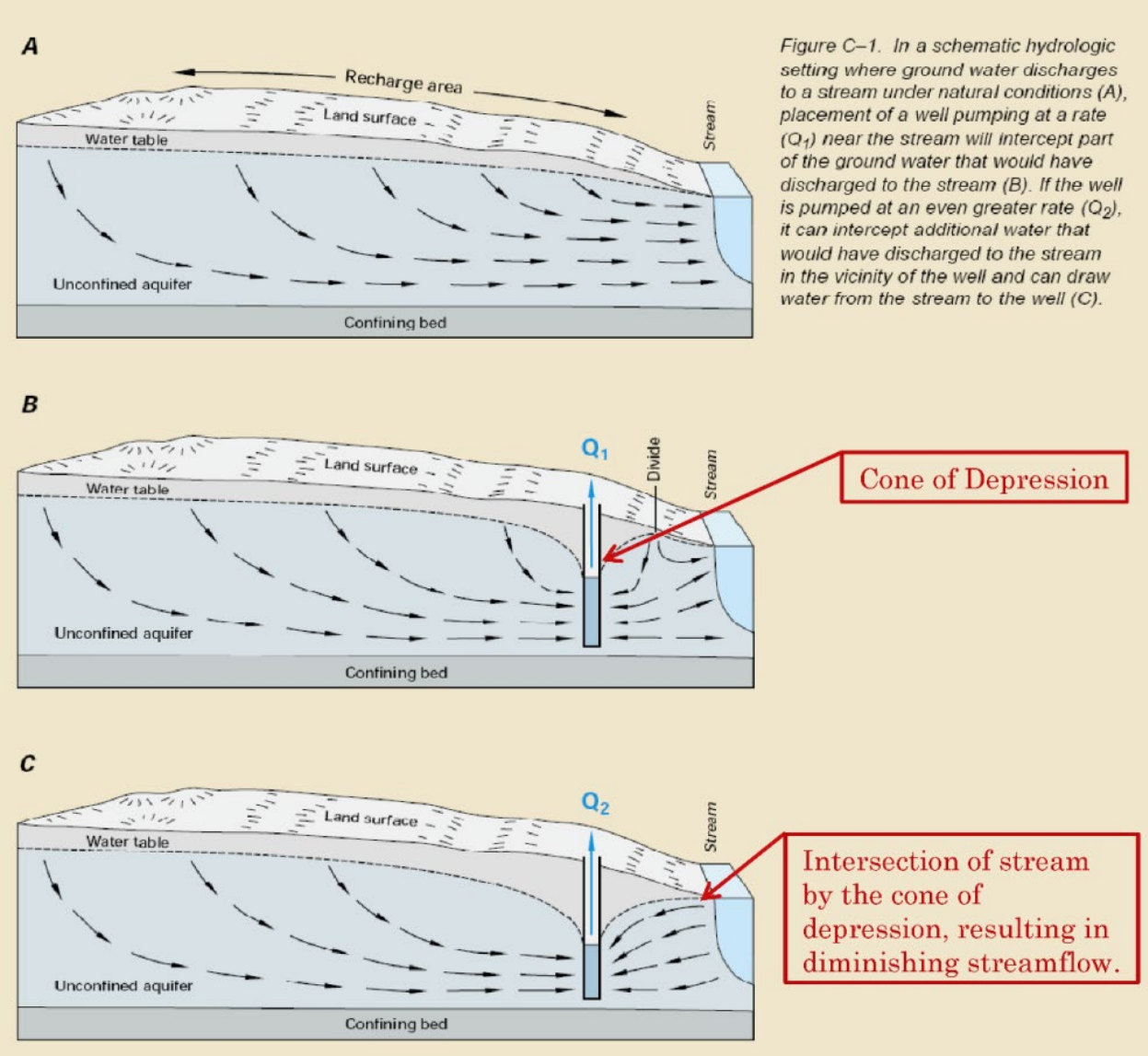

Figure 5 Schematic showing the hydrologic connection between a well, the aquifer, and the stream under three different conditions (KDA-DWR 2016).

Irrigated farmland has a substantial impact on the economy in GMD #5 (Table 3). Irrigation increases crop production, which has a direct economic benefit to the producer and has an indirect benefit to livestock production and agribusinesses (Hendricks et. al. 2018). Based on the 2012 Census of Agriculture (Hendricks et. al. 2018), agriculture in the GMD #5 boundary provides the following economic value:

Table 3. Groundwater Management District #5 (GMD #5) 2012 Census of Agriculture Values (Hendricks et. al. 2018).

Livestock and Agribusiness	Value in millions
Sales from Animals	$817.2
Hogs Sold	$96.2
Milk Sales	$2.4
Fertilizer Expenditures	$112.9
Chemical Expenditures	$70.5
Farm Operating Expenditures	$1,286.2
TOTAL	$2,385.4

Economic impacts are increasingly more important within GMD #5 boundaries because of a higher percentage of people in poverty and a lower median household income than the state and national average. Table 4 provides information from the U.S. Census Bureau (USCB) 2019 census (USCB 2019).

Table 4. Kansas 2019 Census Income and Poverty (USCB 2019).

	Persons in Poverty (percent)	Median Household Income	Per Capita Income in the Past 12 Months
Groundwater Management District #5 (GMD #5) Average	12.6	$51,059	$26,961
State of Kansas Average	11.4	$59,597	$31,814
National Average	10.5	$69,560	$42,065

2.3 Kansas Water Rights

In Kansas, the use of water is monitored and regulated by KDA-DWR. Anyone intending to use Kansas waters for any purpose other than domestic use is required to obtain a permit, or "water right." Water right holders may include municipalities, farmers, commercial businesses, or even national wildlife refuges. Kansas regulates water use under the prior appropriation doctrine, which means those with older (or senior) water rights have priority access to water relative to newer (or junior) water right holders in times of water shortages (KDA 2021).

The USFWS holds Water Right File No. 7,571 for the management of Quivira NWR. This water right, which is senior in priority to approximately 95 percent of all other water rights in the Rattlesnake Creek subbasin, entitles the Quivira NWR to divert up to 14,632 acre-feet per year of surface water from Rattlesnake Creek. However, KDA–DWR has found that this water right has been impaired, at times, by junior water right holders in the watershed who divert the water for agricultural use (KDA-DWR 2016). Figure 6, below, illustrates points of diversion within the Rattlesnake Creek subbasin and indicates the status of water rights (junior or senior) as compared to the Quivira NWR water right (KDA-DWR 2016).

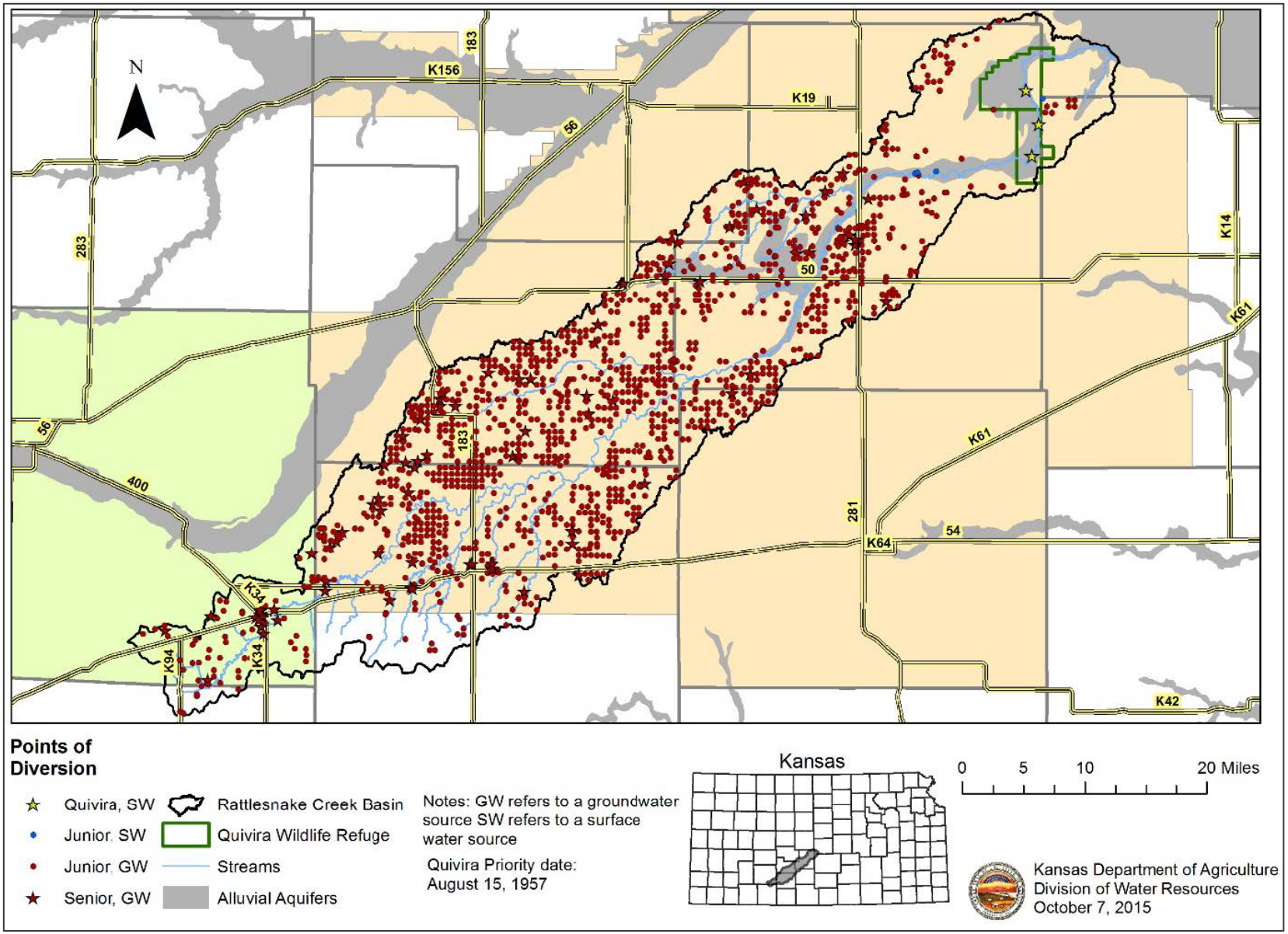

Figure 6. Points of Diversion within the Rattlesnake Creek Subbasin (KDA-DWR 2016).

2.4 Current and Past Solutions

In 2000, the Rattlesnake Creek/Quivira Partnership comprised of the Water Protection Association of Central Kansas, GMD #5, USFWS, Quivira NWR, and KDA-DWR produced the Rattlesnake Creek Management Program Proposal in an attempt to address water shortages in Rattlesnake Creek. The goal of this program was to reduce water use by junior water right holders through incentive-based programs and community outreach. Local farmers were given the opportunity to enroll in programs such as the Water Transition Assistance Program where cash incentives were offered to irrigators for permanent retirement of their water rights. Voluntary removal of irrigator end guns was also incentivized; participants who removed their end guns would receive credit toward any reduction required by alternative management actions. After 12 years of implementation, it was determined that the Rattlesnake Creek Management Program was unsuccessful at significantly lowering water use rates by junior water right holders because of low community participation (Rattlesnake Creek/Quivira Partnership 2000).

In 2013, the USFWS and Quivira NWR filed a water impairment claim that asserted agricultural irrigation infringed on their senior water right (KDA-DWR 2016). KDA-DWR reviewed the claim and issued a final report of the chief engineer regarding the water right impairment claim. The final report determined that the USFWS's, Quivira NWR claim number 7,571 had been impaired by junior water rights (KDA-DWR 2016).

Following the chief engineers' decision, continuing efforts to address the impairment claim resulted in a July 25, 2020, memorandum of agreement (MOA) between the USFWS and GMD #5. The 2020 MOA stated that the Quivira NWR would not submit a request to secure water to address its impairment claim in 2020 and 2021 while the two sides work on short-term and long-term projects, water storage measures, and monitoring. The MOA short-term project includes construction of an augmentation wellfield near Rattlesnake Creek to provide 15 cubic feet per second (cfs) during normal conditions and an additional 3 cfs during other critical, agreed-upon times of year (MOA 2020). The MOA long-term projects included the following (MOA 2020):

- Retire 2,500 acre-feet of water rights from areas close to the stream
- Use the Central Kansas Water Bank Association to move some water uses from sensitive areas (areas of higher impact to Rattlesnake Creek) to less-sensitive areas in the district (areas with a lower impact to Rattlesnake Creek)
- If the water rights purchase program is unable to retire 2,500 acre-feet of water close to Rattlesnake Creek, then GMD #5 will incentivize end gun removal

The MOA states that when the augmentation wellfield is operational, USFWS would store 383 acre-feet of water in Little Salt Marsh to provide wetland habitat to other wetland complexes within the refuge (MOA 2020).

A resolution from the MOA was that the GMD #5 would apply for funding through the Watershed Protection and Flood Prevention Act, PL 566, to develop a Watershed Plan for Rattlesnake Creek to evaluate an augmentation wellfield that could enhance streamflows into Quivira NWR. The NRCS offers aid, either technical or financial, to local governments in the development of watershed projects that will improve the watershed in some way via PL-566. The PL-566 funding includes development of a Plan-EA. As part of the watershed plan, a feasibility study of the augmentation wellfield will also be completed.

3. PURPOSE AND NEED FOR ACTION

In determining the project purpose, PL-83-566 statute was considered to establish eligible project purposes. PL-83-566 projects must meet one of three general purposes or as characterized in the statute “works of improvements” (Watershed Protection and Flood Prevention Act 1954):

1. flood prevention (including structural and land treatment measures),
2. the conservation, development, utilization, and disposal of water, or
3. the conservation and proper utilization of land.

Additionally, the statute states that “Each project must contain benefits directly related to agriculture, including rural communities, that account for at least 20 percent of the total benefits of the project” (Watershed Protection and Flood Prevention Act 1954).

Once the above requirements on works of improvements and agricultural benefits have been met, Sections 3 and 4 of PL-83-566 specifically authorizes the following project components (Watershed Protection and Flood Prevention Act 1954):

1. Flood prevention (flood damage reduction)
2. Watershed protection
3. Public recreation
4. Public fish and wildlife
5. Agricultural water management
6. Municipal and industrial water supply
7. Water quality management
8. Watershed Structure Rehabilitation

Within the PL-83-566 authorization, the purpose of the Big Bend GMD #5 Plan-EA is to provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin of GMD #5. For the purposes of this Plan-EA, “long-term” is defined as a period of 50 years, recognizing that changes in water use may take years to affect Rattlesnake Creek and the Great Bend Prairie aquifer. A 50-year period allows for a sufficient simulation time to model

the impacts from implementation options, evaluation of the long-term sustainability of water management, and adaptive management where needed. For the purposes of the Plan-EA, “sustainable agricultural water management” is defined as surface and groundwater use that can be maintained consistent with water rights, the economic viability of the region’s agriculture.

The need for developing the GMD #5 Plan-EA is twofold: Quivira NWR water supply needs and the importance of groundwater to the agricultural economy. The sustainability of Quivira NWR relies primarily on surface water diversions that have been impaired because of agricultural groundwater use. However, a predictable and consistent source of water is required to support the agricultural economy. Providing long-term agricultural water management for the region would help provide water resources for both the agricultural economy and Quivira NWR. A project will be developed under this Plan-EA that could assure a water supply for Quivira NWR while considering and minimizing economic impacts to the surrounding agricultural economy. Details regarding these two needs within the region are outlined herein.

Quivira NWR is located within GMD #5 and within the Rattlesnake Creek hydrologic unit code (HUC) 10 watershed. Quivira NWR totals 22,135 acres and provides a wetland complex for migratory birds that includes federally threatened and endangered species. Surface and groundwater resources provide the water supply for the wetland complex that include Big Salt Marsh and Little Salt Marsh. The importance of natural resources with Quivira NWR range from local to global, as recognized with multiple conservation designations (e.g. one of the eight wonders of Kansas, Ramsar wetland, Audubon Important Bird Area, and Western Hemisphere Shorebird Reserve Network site). USFWS owns water right file number 7,571, which allows for up to 14,632 acre-feet per year of water diversion at a maximum rate of 300 cfs (USFWS 2013). This water right permit has a priority date of August 15, 1957, which is senior in priority to most agricultural uses of water in the region. From 2000 to 2012, Quivira NWR and GMD #5 formally worked on voluntary solutions to reduce groundwater use in the subbasin. On April 8, 2013, Quivira NWR filed a water impairment claim with the KDA-DWR. KDA-DWR completed the final report of the chief engineer in 2016 that concluded “upstream, junior groundwater pumping regularly and significantly impairs the Service’s ability to use its Water Right File No. 7,571” (KDA-DWR 2016).

Irrigated agriculture is an essential economic driver for the region and for agricultural producers in the GMD #5 watershed. The region’s 4,587 farms produce an estimated $1.89 billion in crop and livestock sales, annually (Hendricks et al. 2018). Approximately 12.6 percent of the residents in the region are below the poverty line (USCB 2019), and agriculture represents the primary economic and employment engine in the region, so the establishment of a long-term sustainable agricultural water supply is critical to the economic health of the region.

4. ALTERNATIVES

The following alternatives are proposed to address the purpose and need of the GMD #5 Plan-EA. All reasonable alternatives will be considered as part of the GMD #5 Plan-EA and are therefore requested for consideration.

4.1 No Action Alternative

As previously stated, the KDA-DWR issued a final report of its impairment investigation on July 16, 2016, finding that Quivira NWR's water supply "has been regularly and substantially impacted by junior [water right holders] groundwater pumping." Therefore, the USFWS can file a request to secure water due to the impairment finding. As part of the impairment investigation, the KDA-DWR evaluated numerous alternatives that it might implement to address impairment. The specific regulatory mechanism, quantity, timing, and degree to which pumping might be restricted following a request to secure water is currently unknown. If no action were taken under this Plan-EA (or any other program), the range of impacts could include a variety of water right enforcement activities, development of a mutually acceptable water use arrangements between parties (such as rotating water use), or other acceptable measures. The method and timing of enforcement or implementation is currently unknown.

4.2 Augmentation Wellfield and Groundwater Use Reduction Alternative

The Augmentation Wellfield and Groundwater Use Reduction Alternative (Wellfield and Use Reduction Alternative) includes an augmentation wellfield and reductions in agricultural groundwater use. The augmentation wellfield and associated pipelines would pump groundwater from an area south of Quivira NWR and deliver that water to Rattlesnake Creek at a location just upstream of Quivira NWR (Figure 7). The groundwater pumping amount and timing would be partially determined by the augmentation wellfield feasibility study and agency and public input received in the Plan-EA process. The agricultural groundwater use reductions must include accountable and enforceable measures and may include the following: retirement of water rights close to Rattlesnake Creek, moving some water use further away from Rattlesnake Creek, and/or incentivization of end-gun removal.

FEASIBILITY STUDY

The proposed augmentation wellfield would pump groundwater from an area south of Quivira NWR to augment streamflows in Rattlesnake Creek that would be available for diversion by Quivira NWR. The primary question surrounding the technical feasibility of the augmentation wellfield is the extent to which there is a sufficient quantity of water of sufficient quality to provide a sustainable source of water supply for streamflow augmentation without significantly affecting existing water users in the area. The aquifer in this area is known as the Great Bend

Prairie Aquifer (Aquifer). Though it is generally known that there is good quality groundwater in the upper portion of the Aquifer, it is also well established that underlying bedrock contains water that is high in total dissolved solids (TDS) (Buddemeier et. al. 1992). The threshold for maximum TDS of discharge water to Rattlesnake Creek is considerably higher than the drinking water standard (1400 milligrams per liter [mg/l] versus 250 mg/l, respectively). However, it is possible that the proposed augmentation wellfield may not be able to sustainably provide water at that quality while also ensuring that other water users in the area, principally domestic in nature, are not negatively affected.

GMD #5 has invested in the development of a regional groundwater flow model of the area encompassing GMD #5 and other areas to the west of GMD #5. That model has been employed to estimate the impacts of augmentation pumping on the Aquifer in the area of the wellfield (Balleau Groundwater 2010). However, because of a lack of hydrogeologic site-specific information in the GMD #5 model, additional data collection and potential additional model refinement will occur as part of the feasibility study, which is a component of the Plan-EA. Currently, three sites within the proposed wellfield area have been selected for intensive investigation of aquifer materials, water quality, and aquifer response to pumping at a relatively high rate. Based on the results of those evaluations, additional test drilling and/or other investigations may occur as part of this Plan-EA.

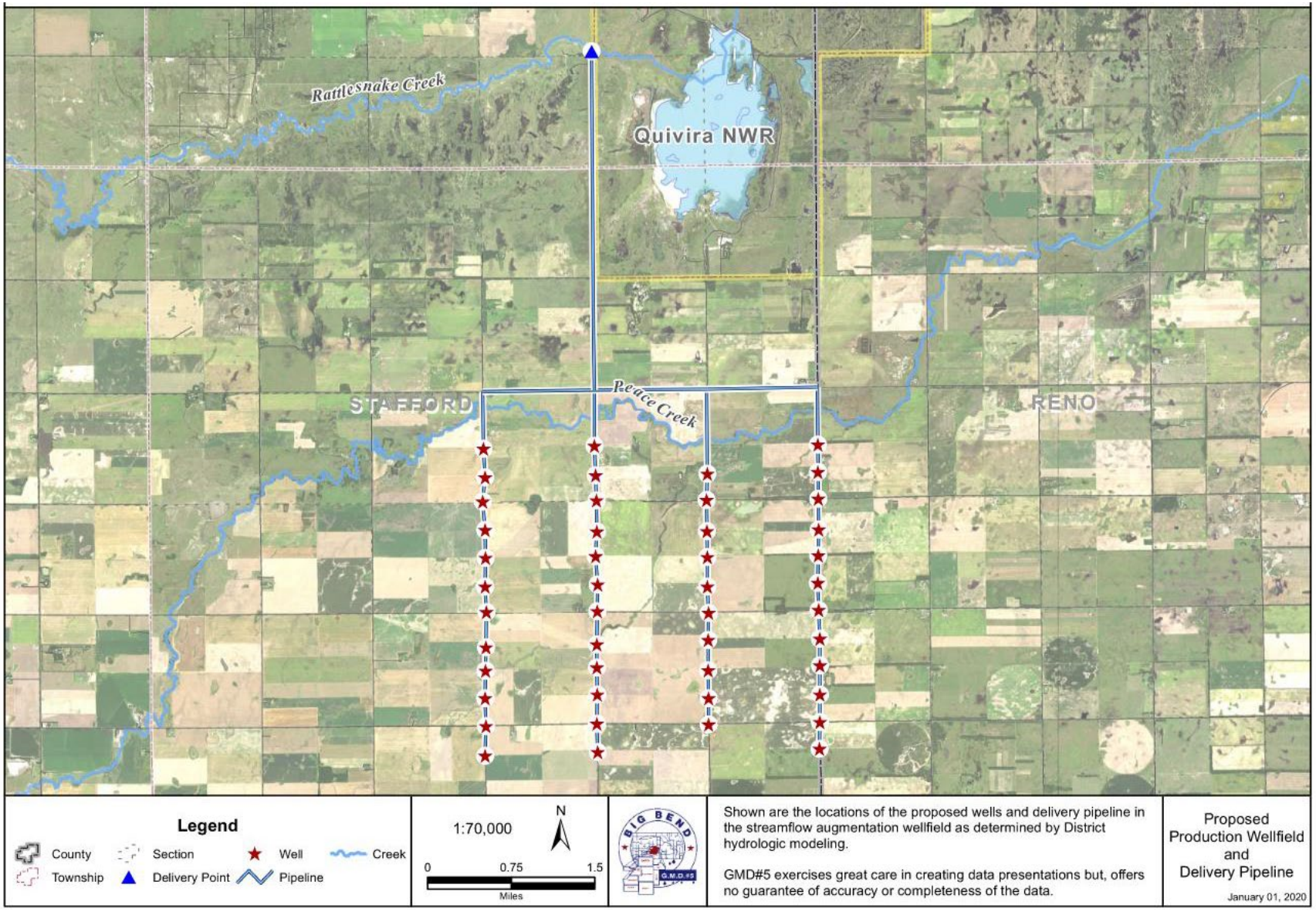

Figure 7. Conceptual Layout of Augmentation Wellfield and Delivery Pipeline (Big Bend GMD #5 2022b).

4.3 Groundwater Use Reduction Alternative

The Groundwater Use Reduction Alternative includes reductions in groundwater pumping similar to the Wellfield and Use Reduction Alternative; however, an augmentation wellfield is not included. The agricultural groundwater use reductions must include accountable and enforceable measures and may include the following: retirement of water rights close to Rattlesnake Creek, moving some water use further away from Rattlesnake Creek, and/or incentivization of end-gun removal. Without an augmentation wellfield a larger amount of groundwater use reductions are anticipated. However, the initial and long-term augmentation wellfield costs of construction and operation would not be required.

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BIG BEND GROUNDWATER MANAGEMENT DISTRICT #5

DRAFT WATERSHED PLAN – ENVIRONMENTAL ASSESSMENT SCOPING DOCUMENT

January 2022

Olsson Project Number 021-00451

Rattlesnake Creek
22-01-13 Public Meeting Comment Matrix

Name	Comment
William Chapman 115th W 4th Street Carned KS 67550	In reviewing draft RA & presentation material I have more questions of the proposed treatment that were not part of treatment alternatives or described well enough to assist with providing a conclusive treatment. But based on the material provided the augmentation treatment is not my preferred alternative.
Jackie Augustine Audubon of Kansas PO Box 1106 Manhattan, KS 66505 785-537-4385 jackie@andubouofkansas.org	Concerns 1) Augmentation will shift the problem to an adjacent watershed 2) Wellfield is relatively undisturbed & I have seen Whooping Cranes (endangered species) use the area. How will disturbance from well drilling and lower water table in the area disrupt the habitat? 3) Without augmentation, irrigators will need to reduce water use. This should not be voluntary well upgrades and capped wells will need to be mandatory. Voluntary measures have not worked. 4) Concerns about water quality – want to ensure that water chemistry pumped in does not affect water quality at Quivira.
Kyle Kaiser 1149 NW 10th Ave St. John, KS 67576 620-549-3241 kyle@goldenbeltfeeders.com	Golden Belt Feeders employs over 30 Stafford County residents with families, children, and dependents in this area. We work hard to use our allocated water efficiently and effectively. A solution to this issue that does not hinder our ability to pump our allocated ground water was well as the water rights of our neighbors who provide us valuable commodities is vital to the continued support of this county by our business. We believe that augmenting the streamflow into Quivira is an important step to solve this issue. We look forward to seeing the progress of this project. An important consideration is the water that flows through the refuge. We request the refuge work hard to conserve water in the same manner that area agricultural producers do. We also believe that daming portions of the refuge so that excess water that accumulates during periods of heavy precipitation would dramatically help the refuge realize adequate water levels at all times of the year. Retention ponds at the east end of Rattlesnake Creek is another option to help properly manage all of the water at the refuge's disposal. Put simply Golden Belt Feeders believes that efficiently managing, retaining, and storing every drop of water that flows to the refuge is vital to creating and maintaining a solution to this issue. We look forward to being productive partners in the resolution of this issue in a manner that is positively impacts the people, animals and land in this area.
Roger Stotts 22259 HWY 185 Greenby KS 67654 620-546-3467 roger@morningstarfarms.net	Very impressive project, the displays today helped me to more fully understand the various aspects. The augmenting part of the projects looks to be great protective benefits to the Quivira wildlife area for decades to come. All aspects of wildlife will benefit & prosper. Thanks to the many efforts put in at all levels private sector, public sector, Fish & Game etc., Parks for new advice and dollars from the NRCS. I am glad to see ongoing mitigation of trees & shrubs in the basin. Conservation have greatly diminished the runoff basins that has reduced the quality of water runoff flowing into the refuge. Very neat to see a work together for the common good. Thanks for the positive efforts.
Justin Williams, Ducks Unlimited Inc. juwilliams@ducks.org	Ducks Unlimited (DU) has reviewed the online presentation slides for The Watershed Plan- EA public meeting held on January 13, 2022. Thank you for the opportunity to provide comments. DU is a non-profit conservation organization. DU's mission is …"to conserve, restore, and manage wetlands and associated habitats for North America's waterfowl. These habitats also benefit other wildlife and people." DU has designated Landscape Conservation Priority (LCP) areas that guide our conservation work throughout North America, prioritizing specific geographies to protect and improve important wildlife habitats. The Central Kansas Marshes LCP area includes Quivira NWR, Cheyenne Bottoms, and certain surrounding areas such as the Rattlesnake Creek watershed. DU supports various conservation strategies in the area, including KDA's proposal to expand the CREP area to include portions of Rattlesnake Creek watershed. DU has completed numerous conservations projects in the area, working together with various stakeholders. We are very much interested in helping with any collaborative conservation approaches going forward. The Central Kansas Marshes LCP area also includes the area indicated as potential augmentation wellfield. The proposed wellfield area appears to be concentrated within the Peace Creek Watershed, a tributary to the Arkansas River. The Peace Creek watershed contains numerous riverine and depressional wetlands (for example, see the general area approximately 2 miles south of Little Salt Marsh). It is unclear the effect of pumping and transferring large volumes of water out of the Peace Creek watershed would have on wetlands and other aquatic resources. We ask that consideration of these aquatic resources be evaluated as part of the

Name	Comment
(Cont.)	Watershed Plan-EA. It should be noted that the National Wetlands Inventory data layer often underestimates the presence and/or size of wetlands. A more accurate estimate could be achieved by analyzing a series of aerial images (there are several standardized procedures and guidance documents available for using aerial imagery to assess wetland hydrology).
Ed Fox 12540 Smokey Ridge Guthrie, OK 73044 620-770-2266	The public open house meeting on Jan. 13 was informative. My question is how this project will be funded. This is a concern for tax paying landowners who have been taxed to the limit. What is the plan? Is there government grant money to cover the cost? These are valid questions that deserve an answer.
Stan Kaiser Golden Belt Feeders 1149 NW 10th Ave. St. John, KS 67576 kaiser@goldenbeltfeeders.com	Hello, We operate Golden Belt Feeders/Grimes Family Farms/KBJ Cattle Company/Golden Gelt Beef from our location at 1149 NW 10th Avenue, St. John, KS. 67576. We're a 3rd generation company that was started in 1968. Merlin & Nelva Grimes decided on this location after performing numerous water tests that showed a productive aquafer branch at this location. They started out small but knew they wanted to grow and expand the operation over time. Our normal cattle capacity is 22,500 head in the facility and we graze approximately 4,000- 8,000 head depending on rainfall and other factors. We currently employ 36 fulltime and 3 part time colleagues so we're one of the largest employers located in Stafford County. Our history shows we've been excellent stewards of the farm ground and cattle facility. We're required to maintain consistent records of water usage, fuel/fertilizer/herbicide usage, and manure taken out of our facility and spread across our acres and our neighbor's acres. Our #1 goal has always been to take great care of the cattle every day of the year. In order to do this we need an ample water supply. And we certainly do our part to conserve water on a daily basis. In fact, throughout our facility you'll see signs posted about conserving water and keeping dust levels to a minimum. And if a water lead occurs in one of our 250+ holding pens we'll immediately repair it so water is not wasted. We're not alone as Stafford county is filled with folks that do the right thing and take excellent care of their farms. The mindset is to conserve and make the ground better for future generations. We'll do our part to conserve and help reduce water usage, but in turn Quivira has to do their part to maximize water usage. It can't be "let's just get the farmers to reduce their water by a certain %". This is our livelihood and our way of life. How is Quivira going to conserve and what are they going to do from an innovation standpoint to fix the issue? How can they move their own water around to make it more efficient? Understand that any water reduction from our place will in turn reduce our cattle #'s, reduce acres planted, and that means a reduced workforce and lost jobs. And then the county sees folks move out and none of us want to see that. We're already dealing with a limited workforce to pull from. Lastly, I don't believe mankind can control the climate. Mother Nature decides weather patterns, rainfall amounts and locations, and droughts. And history shows it's cyclical. Rivers, creeks, marsh land, ponds all fill back up over time. No need to panic or make unnecessary longterm changes that negatively affect current and future landowners. Wildlife can adaps and have shown they do adapt to their current surroundings. Nature finds a way.

Rattlesnake Creek
22-01-13 Public Meeting Comment Matrix

Name	Comment
MICAH SCHWALB, ESQ. ROENBAUGH SCHWALB micah.schwalb@roenbaughschwalb.com 720-773-0970 (o) 303-887-3407 (m) ACRES Initiative Inc Josh Roe jroe@ksgrains.com Kansas Livestock Association Aaron Popelka aaron@kla.org Kansas Corn Growers Association Greg Krissek Water Protection Association of Central Kansas Kent Moore kentmoore11@gmail.com TNC heidi.mehl@tnc.org Ducks Unlimited juwilliams@ducks.org CKWBA oferil@gmd5.org	January 31, 2022 Olsson 601 P Street, Suite 200 Lincoln, NE 68508 Attn: Stacey Roach Re: Big Bend Groundwater Management District No. 5 (GMD5) Draft Watershed Plan - Environmental Assessment Scoping Information Document dated January 2022 (Plan-EA) Ladies & Gentlemen: Thank you for providing us with an opportunity to comment on the draft Plan-EA. The organizations signing this letter offer the following thoughts for your consideration: 1. The No Action Alternative described as Alternative 4.1 is not realistic and should not be adopted. If watershed-related efforts yield nothing, including measures considered in the 2020 Memorandum of Agreement between GMD5 and the U.S. Fish and Wildlife Service, the area faces a heightened likelihood of economic devastation.1 2. The Plan-EA should address all relevant requirements of Part 501 of the National Watershed Program Manual and Part 601 of the National Watershed Program Handbook, each as amended to date. 3. In conjunction with the augmentation approach outlined in Plan-EA Alternative 4.2, as well as the approach outlined in Plan-EA Alternative 4.3, please consider whether it would be appropriate to include voluntary demand management tools like those described in the following materials: a. The Water Bank Work Group, Upper Basin Demand Management Economic Study in Western Colorado, Sept. 8, 2020, available at https://swwcd.org/wp-content/uploads/2020/09/upper- basin-demand-management-economic-study-in-western- colorado.pdf b. Colorado Water Conservation Board, Demand Management Feasibility, https://cwcb.colorado.gov/focus-areas/supply/demand-management (last visited January 30, 2022) c. Ted Kowalski, Guest Commentary: A Wet Year Has Filled Our Reservoirs but We Must Prepare for The Drought to Come, DENVER POST, Aug. 14, 2019, https://www.denverpost.com/2019/08/14/guest-commentary-a-wet-year-has-filled-our- reservoirs-but-we-must-prepare-for-the-drought-to-come/ We remain committed to partnering with GMD5 and others as the Plan-EA evolves. There are many pieces to this complex puzzle, but it remains imperative that we work in concert with all stakeholders to complete 1 See, e.g., Jerd Smith, Farmers Sweat Lack of Water, ROCKY MTN. N., May 10, 2006, available at https://www.ksre.k- state.edu/irrigate/oow/p09/Graves09.pdf; Nathan P. Hendricks, et. al., The Value of Water in GMD5, Dec. 20, 2018,
(Cont.)	1 See, e.g., Jerd Smith, Farmers Sweat Lack of Water, ROCKY MTN. N., May 10, 2006, available at https://www.ksre.k- state.edu/irrigate/oow/p09/Graves09.pdf; Nathan P. Hendricks, et. al., The Value of Water in GMD5, Dec. 20, 2018,http://archive.gmd5.org/Misc/2018-12-23_WaterPACK_EconStudy.pdf; N-CORPE, Fact Sheet https://www.ncorpe.org/sites/default/files/NCORPEFactSheetFinalpdf.pdf. the work required. It remains our wish that a cooperative, collaborative path can be identified and followed. Yours truly: ACRES Initiative Inc. Josh Roe Secretary Kansas Livestock Association Aaron Popelka VP of Legal and Government Affairs Kansas Corn Growers Association Greg Krissek CEOWater Protection Association of Central Kansas Kent Moore President Copy: CKWBA Ducks Unlimited TNC

United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Lakewood, Colorado 80228

In Reply Refer to:
FWS/IR05/IR07

Aaron Ball
Vice President, Olsson
7301 W. 133rd Street, Suite 200
Overland Park, KS 66213

February 1, 2022
Sent via email: aball@olsson.com

Dear Mr. Ball,

I appreciate your cooperation in fostering the environmental analysis process and feasibility study for an augmentation well field for the Rattlesnake Creek Watershed. The U.S. Fish and Wildlife Service (FWS) was invited to participate in a cooperating agency scoping meeting and public meeting on January 13, 2022, for the Natural Resources Conservation Service and Groundwater Management District #5 Watershed Plan Environmental Analysis (EA). At that meeting, conducted by Olsson Inc., the FWS was encouraged to submit comments regarding the scoping document and other items related to the EA. The FWS provides the following attached comments for consideration.

We realize that many of the items raised in the comments attached may be addressed at a later stage within the EA process, but encourage discussion around these items soon. We appreciate the opportunity to provide comments and look forward to continued collaboration on this process as a cooperating agency.

Sincerely,

Stacy Armitage
Assistant Regional Director
National Wildlife Refuge System
DOI Regions 5 and 7

cc: (*via email*)
Mr. Orrin Feril (*oferil@gmd5.org*)
Mr. Jim Schneider (*jschneider@olsson.com*)

Attachments:
1) USFWS Comments for the Scoping Document and the Cooperating Agency Meeting
2) USFWS Suggested Edits for the Scoping Document

USFWS Comments for the Scoping Document and the Cooperating Agency Meeting for the GMD 5 Watershed Plan EA
January 28, 2022

Inclusion of KDA-DWR in Future Meetings
The FWS would like for the Kansas Division of Water Resources-Division of Water Resources (KDA-DWR) to have increased participation in technical meetings and generally be more involved in the Environmental Assessment (EA) process. The KDA-DWR has been involved in efforts to manage groundwater within the Rattlesnake Creek Basin for decades and has staff that are experts in permitting, groundwater modeling, and Kansas statutes and procedures. Their early inclusion within the process can help ensure that future challenges are avoided.

Additionally, because aspects of the feasibility study and EA include gathering field data and performing updates and additional model simulations using the Groundwater Management District 5 (GMD 5) MODFLOW groundwater model, KDA-DWR presence is needed. The KDA-DWR has used the GMD 5 groundwater model as the key component of the impairment investigation and the drafting of potential administrative orders to remedy impairment. As expressed at the cooperating agency meeting, any modification of the model should be done in consultation with KDA-DWR to ensure concurrence with the analysis. We request that NRCS invite KDA-DWR to further meetings.

Condemnation and the Use of Eminent Domain
An augmentation well field has been considered for several decades as a potential method to increase streamflow in Rattlesnake Creek. As part of the Local Enhanced Management Area (LEMA) discussions with KDA-DWR in 2018, GMD 5 identified the proposed augmentation well field site and provided assurances that an augmentation well field will at least partially resolve impairment. Though GMD 5 has been proposing and promoting the current proposed well field as an impairment remedy for several years, it does not appear to have the support of many local landowners or have secured easements and other access to the proposed site. The FWS is concerned that condemnation through eminent domain may have to be used for the placement of wells and infrastructure associated with the augmentation well field. Though the FWS understands that under K.S.A. 82a-1028, GMD 5 has the power to condemn land, the FWS does not support the use of eminent domain for securing water supplies for the Refuge. We believe that the FWS will ultimately be viewed as the responsible party for this action and viewed in a highly negative way. We ask that the methods by which easements and potential infrastructure are acquired is evaluated as part of the feasibility study and EA.

Edits to the Scoping Document Text
Please see the attached pdf with recommended minor edits/comments for improved content and accuracy regarding descriptions of the Refuge.

Reference to the July 25, 2020, Memorandum of Agreement (MOA).
On page 14 of the Scoping Document, it references the July 25, 2020, MOA between the FWS and GMD 5. The Scoping document indicates "that when the augmentation wellfield is operational, USFWS *would store 383 acre-feet of water in Little Salt Marsh..."* The phrasing within the Scoping document suggests this is a definitive action that will occur, while the MOA recognizes that no management decisions will be made until NEPA is completed. We believe that a NEPA process will help inform the appropriate course of action.

Sustainable Agricultural Water Management

As mentioned in other comments previously submitted to Olsson/GMD 5, the FWS believes that the definition of "sustainable agricultural water management" should include sustainability in regard to maintaining or enhancing the ecosystem health of Rattlesnake Creek and Peace Creek. Consideration of the environmental effects of agricultural water management should be an integral component of the NEPA analysis and we are concerned that by using a definition of sustainability that does not consider the stream ecosystem tries to remove that consideration from the NEPA analysis. Further, functional stream systems are indicators of a healthy watershed and may be viewed as benefiting the long-term sustainability of agricultural water management.

Groundwater Use Reductions Mentioned in Alternative 4.2 and 4.3

The Scoping Document suggests that the methods of groundwater use reduction considered under alternatives 4.2 and 4.3 would include: *"retirement of water rights close to Rattlesnake Creek, moving some water use further away from Rattlesnake Creek, and/or incentivization of end-gun removal."* The FWS believes that there are other options available that should be considered and evaluated as part of this alternative. Primarily those being the creation of a Local Enhanced Management Area (LEMA) or an Intensive Groundwater Use Control Area (IGUCA) that requests a percentage reduction in the authorized pumping associated with water rights that impact the surface water flows in Rattlesnake Creek. Additionally, individual components of a LEMA or IGUCA, or other measures such as switching to less water-intensive crops, should also be evaluated.

The state of Kansas has a unique set of tools available for the management and sustainability of groundwater and watershed resources. There are currently eight IGUCAs enacted in the state and three LEMAs enacted. These existing LEMAs and IGUCAs have been in place in some cases for decades and can be used to gauge the effectiveness and economic impacts of pumping reductions. Additionally, GMD 5 has previously requested the creation of an IGUCA for resolution of the water rights impairment of Cheyenne Bottoms State Wildlife Area in the Walnut Creek watershed. The Walnut Creek IGUCA has been in place since 1992 and is actively undergoing review and groundwater modeling updates. It seems possible that NRCS funds could be utilized to support actions taken under an IGUCA or LEMA based on the discussions at the Cooperating Agency meeting. The FWS requests that the groundwater use reductions listed in alternatives 4.2 and 4.3 broaden in scope to consider the formation of an IGUCA or LEMA for watershed management.

End-Gun Removal

The current information available from KDA-DWR indicates that the retirement of end-guns did not provide measurable water savings in previous field tests (see January 4, 2019, memo titled, "Evaluation of the impact of end gun removal on water use within GMD 5 under its 2010 AWEP"). The removal of an end-gun itself does not provide water-use savings unless it is combined with a modification of a water right permit to reduce the annual authorized quantity. Unless end-gun removal is combined with water permit modifications, the FWS does not view end-gun removal as a valid way to reduce groundwater use and suggests removing it from consideration.

Alternative Assessment

The scoping document provides general descriptions of the proposed alternatives but does not provide details about how or where the potential impacts of the alternatives will be analyzed. We suggest including a discussion on how potential economic and environmental impacts will be evaluated, and how those results will be used to make decisions on alternatives and what threshold is present to consider impacts "significant." In addition, there were assurances given in the scoping meeting about consideration of impacts beyond the proposed project boundaries indicated on the map. The FWS

anticipates future review of the details of the assessment, but we believe an evaluation of alternative impacts must include all affected streams, not just segments within the project area, and includes environmental resources influenced by activities regardless of the location within or outside of the proposed project boundaries.

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Mike Beam, Secretary

Laura Kelly, Governor

March 3, 2022

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STACEY ROACH
601 P STREET; SUITE 200
LINCOLN, NE 68508

Dear Ms. Roach:

The Kansas Department of Agriculture Division of Water Resources is committed to actively engaging in the Watershed Plan-Environmental Assessment for Big Bend Groundwater Management District #5. We received and responded to your December 23, 2021 invitation to participate as a Cooperating Agency. We attended and participated in the agency and public scoping meetings on January 13, 2022 in St. John. In addition to those we offered at the January 13 agency meeting, we provide the following comments on your document, "Big Bend Groundwater Management District #5 Draft Watershed Plan-Environmental Assessment Scoping Information" dated January 2022 ("Draft Plan EA").

Purpose and Need

In section 3. of the Draft Plan EA, you state that the Purpose of a project is "to provide for long-term sustainable agricultural water management within the Rattlesnake Creek subbasin of GMD #5." You go on to helpfully define sustainable agricultural water management as, in part, "surface and groundwater use that can be maintained consistent with water rights, the economic viability of the region's agriculture". The second phrase appears to be incomplete. We agree that water use must be consistent with water rights and agree that finding a solution that protects regional agriculture is preferred, but Kansas law is clear that when there is insufficient water to satisfy all needs, first in time is first in right, regardless of the effects, economic or otherwise, on junior water right holders. The Purpose and its qualifier appear to encompass the intent of resolving the impairment without explicitly saying so.

You state that the Need for a project is twofold: "Quivira water supply needs and the importance of groundwater to the agricultural community." We generally agree with these, but it might be clearer to state that Quivira needs the ability to fully exercise its water right to Rattlesnake Creek to fulfill its mission and the agricultural community relies heavily on groundwater, some of which supplies Rattlesnake Creek, for irrigation to sustain the local economy.

The last sentence of p16pp2 highlights one of our major concerns with how this effort is being portrayed to the community and the community's expectations thereof. That sentence does not say that the project will, or even seeks to, resolve the impairment of Quivira NWR. We think it's fair to assume that the public's expectation is that this effort, provided it makes it through the process, will

resolve the impairment. We think it would be helpful to address the expectations regarding impairment explicitly and as unequivocally as possible. Perhaps it would be enough to state that the project intends to resolve the impairment (if indeed it does), or that it may not solve the impairment completely but will be a significant step towards it.

Alternatives

Your description of the "No Action Alternative" correctly includes a range of likely outcomes that includes water rights administration by KDA-DWR and "development of … mutually acceptable water use arrangements…, or other acceptable measures." We generally agree with this broad list of possible actions and would add that, in terms of specific water management tools that are available within Kansas water law, there is the Local Enhanced Management Area ("LEMA"), Intensive Groundwater Use Control Area ("IGUCA"), and the Water Conservation Area ("WCA"), all of which are ultimately enforceable by the chief engineer. What is the functional difference between this alternative and the "Groundwater Use Reduction Alternative" on p20?

We suggest that, to make a distinction between those alternatives, perhaps "No Action" should be limited to a possible/probable reaction from USFWS to request to secure its water right, and then from KDA-DWR to administer water rights accordingly. The "Groundwater Use Reduction Alternative" could then be predicated on USFWS's cooperation in not requesting to secure its water right, but rather allowing and possibly participating in other processes to establish restrictions on water use. Groundwater use reduction could then be accomplished by locally initiated action to implement mandatory water use reductions (e.g., LEMA), state-initiated action (e.g., IGUCA), and any other water-use reducing or water sharing arrangements agreeable to and enforceable by the chief engineer.

The "Augmentation Wellfield and Groundwater Use Reduction Alternative" does not state an intent to resolve the impairment, nor does it tie the amount of groundwater use reduction to the amount of water that may be available for augmentation. This leaves the alternative somewhat ambiguous in its goal. Assuming that some level of augmentation is feasible, it might be helpful to parse this alternative into two sub-scenarios based on the same two conditions described above; if voluntary reductions are insufficient, either USFWS requests to secure its water right or it cooperates to allow for voluntary but enforceable actions (e.g., water right retirements, moving away from stream), and if necessary, development and implementation of other enforceable water restrictions (e.g., LEMA, IGUCA).

No Action KDA-DWR Water Rights Administration

At the January 13 agency meeting in St John, it was suggested that it would be helpful to identify a likely plan for how KDA-DWR would administer water rights in the case that USFWS requested that its water right be secured, so that you could evaluate the impacts of the No Action scenario. We presented a plan for administration to the public at an October 21, 2019 meeting in St John. That plan involved phasing in water allocations by response zone (wells that had higher impacts to streamflow being reduced first) over the course of three years and was based on 1) a commitment by GMD #5 to develop an augmentation project with a certain capacity and 2) that voluntary actions (moving water diversions away from the stream, retiring water rights, rotation – water sharing agreements) would provide a certain level of relief to chronic and increasing stream depletions caused by groundwater pumping.

For the No Action scenario, we will assume that, unlike the 2019 plan, no augmentation project or significant voluntary water reductions are imminent. We will further assume that "no federal action" does not apply to the senior Kansas water right holder (USFWS) which happens to be a federal agency but is not NRCS - the agency administering this PL-566 authorized project. In other words, we will assume that USFWS will act like any other reasonable Kansas water right holder who has complained of water right impairment, has received a report from the chief engineer affirming and quantifying the impairment to their water right, and sees no serious effort by the impairing water rights to resolve the impairment.

Modeling work performed during the development of the 2016 Final Impairment Report ("Report") showed that shutting off all pumping within basin that has a 20% or greater impact to streamflow will increase baseflow by roughly 10 cfs within two years. This would restore approximately 7,200 acre-feet of streamflow. Based on the model, the Report concluded that Quivira NWR's water right was regularly impaired by 6,000 or more acre-feet per year when the model period ended in 2007. The model shows that, on average, groundwater pumping continues to reduce streamflow on the order of an additional 400 acre-feet per year. Given these facts, one likely scenario would see USFWS lodging its request to secure water and KDA-DWR subsequently ordering the curtailment of all junior water rights that impact the stream by 20% or more as a first step. This would amount to 810 water rights affecting 109,000 irrigated acres. KDA-DWR would then annually evaluate the effectiveness of its administration and adjust to ensure that the level of regulation is appropriate.

Sincerely,

Earl Lewis, PE
Chief Engineer

C:

Orrin Feril
Manager
Big Bend Groundwater Management District #5
125 S Main St
Stafford, KS 67578

Kevin Gustafson
NRCS
760 S Broadway Blvd
Salina, KS 67401

MEMO

DATE: February 23, 2022
TO: Stacey Roach, Public Engagement - Olsson
FROM: Angela Anderson, Planning & Outreach Lead
RE: Agency Input: Rattlesnake Creek Watershed Plan and EA

900 SW Jackson Street, Suite 404
Topeka, KS 66612
Phone: (785) 296-3185
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The Kansas Water Office (KWO), as the water planning, policy, coordination and marketing agency for the state, appreciates the opportunity to provide agency input in conjunction with the ongoing planning efforts within Big Bend Groundwater Management District #5 on the Rattlesnake Creek Watershed Plan and Environmental Assessment. Below please find information pertaining to the agency input requested during the agency coordination meeting which took place on January 13, 2022:

How do you want to be consulted prior to availability of the Draft Plan-EA?
The Kansas Water Office would appreciate the opportunity to be involved in continued agency coordination efforts associated with the development of a Draft Plan-EA leading up to a formal public comment period on a full draft document. Additional KWO feedback would also be anticipated during a future public comment period.

Are there critical resources or concerns within the watershed that need to be accounted for?
In conjunction with state water planning efforts, the Great Bend Prairie Regional Advisory Committee provides feedback and advice to the Kansas Water Authority (KWA) and KWO regarding local water resource issues within the Great Bend Prairie Regional Planning Area which includes all of the Rattlesnake Creek Watershed. General water resource issues and/or concerns highlighted by the Great Bend Prairie Regional Advisory Committee as reflected within regional goals and associated action plans include the following themes:

- Regional water use sustainability;
- Training and technical assistance for municipalities and rural water districts to reduce water loss;
- Regional water quality with specific attention on salt water and nitrates;
- Research and development of alternative feed sources and less water intensive crops; and
- Watershed district flood control capacity.

The KWO would request that all of these resource concerns be known during the Draft Plan-EA development process, with specific attention provided to the regional water use sustainability and regional water quality-related goals and action plans. Additional information regarding the regional goals and action plans within the Great Bend Prairie Regional Planning Area, which includes all of the Rattlesnake Creek Watershed Plan-EA Area, can be found in the attachment accompanying this memo.

If you have any questions regarding this or any other information, please feel free to contact myself or Amelia Nill by email at (angela.anderson@kwo.ks.gov; amelia.nill@kwo.ks.gov) and/or the contact information listed above.

Great Bend Prairie Draft Revised Action Plan

Final Draft Form

Priority Goal #1: Achieve water use sustainability within the Great Bend Prairie Regional Planning Area that includes a reasonable raising or lowering of the water table based on average weather conditions.

Action Steps

Short-term Actions

I. Identify existing voluntary conservation programs and determine if new incentivized conservation programs are needed to compliment current programs.
II. Work with the appropriate agencies to ensure that cost-shares are current and economically competitive.
III. Hold stakeholder meetings in conjunction with the appropriate agencies to inform the public about the various programs available.

Long-term Actions

I. Utilize the KDAMOD* to determine rate of withdrawal from the aquifer from all uses (irrigation, industrial, evapotranspiration, municipal, etc.) versus the rate of recharge to the aquifer from all sources (precipitation, streambank, infiltration, etc.) for the GBP RAC area.
II. Compile the model data into presentation materials for area stakeholder groups/agencies to identify appropriate management units for further analysis with BBGMDMOD*. This data will analyze the rate of depletion spatially across the area to assist with prioritization of projects and funding.
III. Coordinate with state agencies & GMD#5 to assess and implement appropriate management controls to bring areas of concern into balance. "

* The Big Bend Groundwater Management District high-resolution hydrologic model (BBGMDMOD) was initially created with seven layers, each representing a geologic formation below the ground surface allowing for analysis of water movement between the layers. KDA–DWR unified the seven layers of the BBGMDMOD to create the KDAMOD for quick water quantity assessments for the region. Both variants are based on the same datasets. BBGMDMOD can track water quality between the geologic formations.

Priority Goal #2: Developed for Municipalities and Rural Water Districts.
Maintain annual training funds of 15% from Clean Water Drinking Fee and increase technical training support to Public Water Supply (PWS) systems to enhance new technology and increase water efficiently and effectively, thus reducing water loss. Utilize available municipal/residential/commercial "LAWN" irrigation training programs provided by the Irrigation Association.

Actions Steps

I. Work with state agencies, cities, rural water districts, and public water suppliers to ensure that the Clean Water Drinking Fee is being appropriately carried out.
II. Continue to provide a minimum of 15% and increase more (up to 30%) of Clean Drinking Water Fee for technical assistance by the Kansas Rural Water Association for Public Water Suppliers.
III. Work with Irrigation Associations to develop free training opportunities for LAWN irrigators and landscapers.

Priority Goal #3: Enhance the monitoring of poor quality water to stop and minimize further contamination of fresh water sources. Areas of concern include regions which have salt water disposal lines, disposal wells, high nitrate levels, and areas with high salt sources.

Action Steps

I. Establish a program if a problem is observed to ensure the problem does not get worse.
II. Start using mapping techniques and disposal line maintenance and replacement to ensure this goal is met.
III. Evaluate extent of KDHE surface water monitoring network in petroleum producing areas and areas with high salt sources within Great Bend Prairie Regional Planning Area.
    a. Work with KDHE to modify surface water monitoring network if evaluation finds that necessary.
IV. Develop inventory of current active and legacy salt water disposal lines in Great Bend Prairie Regional Planning Area.
V. Continue programs to evaluate current extent of salt water disposal well inventory.
VI. Evaluate effectiveness of current spill and escape notification requirements.
    a. Work with KCC to modify current spill and escape notification requirements if evaluation finds that necessary.
VII. For all Sensitive Groundwater Areas in the Great Bend Prairie Regional Planning Area:
    a. Check the integrity of active and known legacy disposal systems.
    b. Investigate the integrity of plugged abandoned wells suspected of leaking.
    c. Continued programs to conduct Mechanical Integrity Tests on all injection or disposal wells.
    d. Develop a routine groundwater quality program to help determine extent and sources of contamination.
VIII. Educate public in Great Bend Prairie Regional Planning Area about causes and trends of salinity and nitrate issues.

Priority Goal #4: Initiate research and development of alternative feed sources and less water-intensive crops. Technology transfer from this research would have benefits in areas of Kansas where water is not available for production. Multiple research programs such as plant breeding and livestock feeding should be pursued.

Action Steps

I. Achieve large scale feeding trials by 2025.
II. Coordinate with the Kansas Department of Agriculture (KDA) to improved adoptability of feed wheat, along with other alternative crops, through marketing, commodity segregation, research and education as stated within the Vision for the Future of Water Supply in Kansas.
III. Create a program to be able to roll out small and large scale feeding trials
IV. Find several feedlots to help roll out program
V. Utilize membership of stakeholder groups to solicit interest
VI. Coordinate with KDA to implement demonstration plots for yield evaluation.
VII. Coordinate with KDA to develop markets for feed wheat and other alternative crops for use feed sources.

Priority Goal #5: Work towards sustainability of watersheds so that flood control capacity is maintained while maintaining streamflow to meet downstream water needs. Progress towards sustainability would be to have 50% of the drainage area within watershed districts controlled by watershed structures by 2065. Best available information/data will be evaluated every 10 years to track progress towards meeting this goal.

Action Steps

I. Determine percent controlled by watershed structures within watershed districts in Great Bend Prairie Regional Planning Area.
II. Work with landowners to promote watershed dams and the important role they have in the community and environment.
III. Work with watershed boards and community leaders.
IV. Determine groundwater recharge potential of watershed structures through modeling efforts.
V. Work with watershed districts to determine costs (needs inventory) associated with building additional structures leading up to 50% of drainage area within districts controlled by structures.
VI. Evaluate the potential of a Multipurpose Small Lake through KDA-DOC in the Great Bend Prairie Regional Planning Area.

RATTLESNAKE CREEK DEIS
PUBLIC AND AGENCY COMMENT SUMMARY
Appendix A

1. INTRODUCTION AND BACKGROUND

This report summarizes the review period implemented for the draft Rattlesnake Creek Watershed Plan - Environmental Impact Statement (Plan-EIS), which began on April 18 and closed on June 02, 2025. The U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) prepared the Plan-EIS in compliance with the National Environmental Policy Act (NEPA) under guidance provided by USDA's Environmental Policies and Procedures (7 Code of Federal Regulations [CFR] 1970 et seq.). The purpose of the review period is to ensure that all interested and affected parties are aware of the Rattlesnake Creek Watershed Project and the release of the Draft EIS (DEIS). The U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (USEPA), Kansas Department of Health and Environment (KDHE), and Kansas Department of Agriculture (KDA) are serving as cooperating agencies in the environmental review process. This report summarizes the overall themes represented in the comments received during the review period.

Although this summary is focused on the DEIS review period and comments received, it is important to note that the review period is one part of a broader public participation plan. Additional information regarding how the NRCS engaged the public throughout this process and details about consultation and coordination with agencies and Tribes can be found in Chapter 7 and Appendix A of the Plan-EIS.

This summary document includes an overview of the public review process and timeline information related to the DEIS comment period (Section 1.2) as well as a detailed summary of the comments received, broken down into three categories: public, cooperating agencies, and other agencies and organizations (Section 1.3). As part of the comment response process, revisions to the DEIS resulting from comments made during the review period are identified in Section 1.4 of this summary.

2. SUMMARY OF THE PUBLIC REVIEW PROCESS AND TIMELINE

On April 18, 2025, a Notice of Availability (NOA) was published in the Federal Register (FR) announcing a request for public comment on the Rattlesnake Creek DEIS (FRL OP-OFA-174). The NOA established a 45-day public review and comment period and provided details on how

to contact NRCS to submit comments. The NRCS communicated directly with agencies, organizations and Tribal Nations via email regarding the availability of the DEIS on the NRCS project website (NRCS 2025) and provided instructions and timeline for submitting comments.

The NRCS held an in-person public meeting on May 08, 2025, at the Stafford County Annex in St. John, Kansas. The meeting was an open house format without a formal presentation. The purpose of this meeting was to share information about the Watershed Plan-EIS process and to gather feedback from the public. The meeting included the display of presentation materials on the DEIS, how to provide comments via email, telephone, or scanning a QR code, and next steps in the NEPA process. The NRCS, NEPA document preparers, and project sponsor were in attendance at the meeting and available to take questions from attendees. Formal comments were not submitted at the public meeting. The presentation materials were made available online on the GMD #5 website (GMD #5 2025).

3. SUMMARY OF COMMENTS RECEIVED

NRCS has reviewed all comments received through June 02, 2025. The comments were categorized by commentor type in order to streamline comment reference. The commentor type categories by which comments were organized include; public, cooperating agencies, and other agencies and organizations. The comments are summarized by category below.

3.1 Public

For the purposes of categorization and organization, a comment was considered a “public comment” if submitted by an individual who was not speaking on the behalf of or officially representing an agency or organization.

NRCS received 94 public comments. Overall, 68% of the public comments submitted supported the Augmentation Wellfield and Groundwater Use Reduction Alternative (Proposed Action Alternative). Those that supported the No Action Alternative or the Groundwater Use Reduction Alternative (23%) were most often cited wildlife or other environmental reasons, though there were some comments which questioned the legality of the wellfield and referenced regulations related to junior water right holders. The remaining comments (9%) were of a neutral or suggestive nature.

Support for the Preferred Alternative

A significant number of commenters, including farmers, local business owners, agricultural organizations, and residents, strongly support the augmentation wellfield proposed by #GMD 5. Their comments state it is the only long-term, durable, and economically viable solution to sustain both irrigated agricultural practices and wildlife habitat at Quivira NWR. Supporters emphasize that augmentation allows water delivery when needed, protects the local economy,

and prevents catastrophic impacts such as loss of farms, reduced tax bases, and community decline.

Commenters highlighted several key points in support of the preferred alternative. They emphasized that augmentation helps to maintain consistent seasonal streamflow, which is crucial for supporting wildlife habitat. In addition, the augmentation wellfield is seen as mitigating the financial impact on communities that rely on irrigated agriculture. Commenters also referenced the success of existing pilot augmentation projects, noting that these efforts should be expanded. Furthermore, many expressed concern that large reductions in water allocations for irrigated water users (under the No Action and Groundwater Use Reduction alternatives) would result in significant economic and social harm to the region.

Concerns and Opposition to the Preferred Alternative

Other commenters expressed strong opposition to the preferred alternative, raising several concerns. Some believe that the wellfield is an expensive and potentially ineffective solution that fails to address the root cause of over-pumping. There are also worries that drilling new wells south of Quivira NWR could negatively affect other watersheds, lower groundwater levels, and impact local wells, including the risk of mineral intrusion such as chlorides.

Additional concerns include the possibility that the plan may circumvent Kansas water law, particularly the “first-in-time, first-in-right” principle, by avoiding curtailment of junior water rights holders. Skepticism remains regarding who will own, operate, and fund the wellfield, as well as the environmental impact the wellfield could have.

Some individuals prefer alternatives such as Groundwater Use Reduction and the No Action Alternative, which enforce senior water rights, viewing these as fairer and more environmentally sound options. Furthermore, certain commenters emphasize the importance of conserving water, transitioning to dryland farming, and holding Quivira NWR accountable for water conservation.

Environmental and Ecological Considerations

Several comments highlight the ecological importance of Quivira NWR as a Ramsar Wetland of International Importance and a critical habitat for migratory birds, including the endangered whooping crane. Concerns are raised about maintaining streamflow, preventing habitat degradation, and managing invasive species like salt cedar. Some suggest incorporating climate resilience into the plan to address future hydrological changes.

Socioeconomic and Legal Issues

Some comments address the socioeconomic impacts of water management decisions, including potential devaluation of land, reduced tax revenues affecting schools and public services, and

the broader economic consequences for rural communities. Several comments call for fair compensation for landowners affected by the drawdown from the augmentation wellfield and emphasize the need for cooperation among stakeholders.

3.2 Cooperating Agencies

The Rattlesnake Creek Watershed Plan-EIS has five cooperating agencies split between the state and federal level. Federal agencies include the U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), and the U.S. Environmental Protection Agency (USEPA). State cooperating agencies are comprised of Kansas Department of Health and Environment (KDHE) and Kansas Department of Agriculture – Division of Water Resources (KDA-DWR). Comments from four cooperating agencies are summarized below.

3.2.1 Cooperating Federal Agency Comments

Substantive comments were provided by USFWS, through their role as a cooperating agency, who participated regularly and provided feedback throughout the EIS process. In addition to their previous feedback and input as a cooperating agency, USFWS submitted comments on the DEIS during the review period. Of the other federal cooperating agencies, USEPA submitted a letter stating they did not have any comments on the DEIS, and USACE did not submit a comment.

The USFWS submitted 238 comments related to specific chapters, sections or appendices of the DEIS. The Alternatives (Chapter 5), Environmental Consequences and Cumulative Impacts (Chapter 6), and The Proposed Action Alternative (Chapter 8) chapters received the highest quantity of comments. The comments ranged from clerical to substantive and included requests for clarification in how certain features of an alternative were defined or outcomes and conclusions from analysis were determined. Most comments related to Chapter 5 focused on the Augmentation Wellfield and Groundwater Use Reduction Alternative (Section 5.3) citing concerns regarding how water thresholds are defined in the alternative, adaptive management, and overall implementation of the alternative. Within the comments specific to Chapter 6, the Surface Water Resources and Water Quality Section (6.9) received the most comments, providing feedback on effect determinations, comparison of actions to the No Action Alternative or existing conditions and the use of ground water from pumping in terms of water quality.

In addition to the comments within the document, USFWS submitted an additional attachment condensing their feedback to 13 major themes for the overall EIS. USFWS cited adaptive management, effects on streamflow and riparian habitat, impacts from pumping and use of groundwater. They also provided feedback on the economic, hydrologic analysis, and technical feasibility study that contributed to the EIS. Further detail about the nature of these comments is provided below.

Environmental Impacts Analysis and Discussions

The USFWS highlights that the DEIS frames the “No Action Alternative” as a major action involving the shutdown of 810 irrigation wells in Zone B, reducing pumping by about 105,000 acre-feet (ac-ft) per year. This sets a unique baseline that is significantly different from existing conditions and is essentially reverting to circa 1957 watershed conditions. The Augmentation Wellfield and Groundwater Use Reduction Alternative primarily compares impacts against existing conditions rather than what the baseline would be under the No Action Alternative, which the USFWS argues leads to an incomplete and confusing impact analysis, especially since the Augmentation Wellfield and Groundwater Use Reduction Alternative involves continued pumping from 810 wells in Zone B plus a 15–18 cfs wellfield and retirement of 2,500 ac-ft in water rights. The environmental impacts from the continued pumping of these 810 wells are largely omitted in the DEIS’s narrative, particularly regarding hydrology and streamflow depletion upstream of the augmentation delivery point. The USFWS recommends revisions to impact tables and narrative. The USFWS also notes that the DEIS inadequately addresses water quality impacts from the pumping of the 810 wells, particularly the preferential removal of freshwater baseflow west of Highway 281, which affects water quality and availability for Quivira NWR. They emphasize that augmentation does not compensate for continued impacts upstream of the pipeline delivery point.

Socioeconomic impacts are discussed more thoroughly in relation to the 810 wells, but environmental impacts such as streamflow depletion and greenhouse gas emissions are not fully accounted for in the Augmentation Wellfield and Groundwater Use Reduction Alternative. The USFWS recommends clarifying tables and impact narratives to reflect all components of the alternative, including the increase in pumping from the 810 wells.

Adaptive Management

The DEIS proposes an adaptive management plan involving an Adaptive Management Agreement and Committee to oversee adjustments in augmentation water, water rights retirements, and other factors in response to changing conditions. The USFWS expresses concern that the current plan lacks enforceability and specific performance metrics, relying heavily on future committee decisions that are non-binding and may be overruled by GMD #5. USFWS stresses the importance of including enforceable actions and contingency measures in the EIS to ensure meaningful outcomes.

Economic Analysis

The USFWS comments that the economic analysis in the EIS primarily rates socioeconomic impacts related to water rights reductions as major effects, while other environmental impacts are rated lower. They had previously suggested including sorghum as a dryland crop in the economic model, which was incorporated. However, they raise concerns about changes in

underlying data and methodology that may not reflect the most profitable crop conversion scenarios, potentially overstating net farm income reductions. They provide alternative analyses showing smaller reductions or gains in net farm income with different crop selections and recommend revising the economic analysis accordingly.

Significant Scientific Features Analysis

The USFWS questions whether the Augmentation Wellfield Alternative truly preserves the significant scientific features of the Quivira NWR wetlands. They argue that supplying augmentation water from a different source and location changes the natural hydrology, hydroperiod, water quality, and ecological connectivity of the refuge, which is not adequately captured in the EIS. They emphasize that the Little Salt Marsh is a critical scientific feature, not merely a staging area for water mixing, and that Executive Order 11990 on wetlands protection should be considered.

Alternative Comparison Matrix and Selection

The USFWS finds the alternatives comparison table unclear and inconsistent, particularly in rating the benefits of the No Action and Groundwater Use Reduction Alternatives, which fully resolve impairment to the refuge. They argue that these alternatives should be rated as providing “major” benefits to natural areas, water quality, and significant scientific features, rather than “moderate” benefits. They also note that the No Action Alternative reduces low-flow occurrences significantly, which merits a “major” benefit designation.

Regulatory and Statutory Considerations

The USFWS requests more detailed discussion of Kansas statutes and regulations relevant to water rights permitting, including the feasibility of obtaining water rights permits for the 56 proposed augmentation wells. They inquire about the classification of augmentation water as a “discharge” under KDHE regulations and whether the wellfield’s location outside the Rattlesnake Creek hydrologic unit code (HUC) complies with KSA 82A-706B.

The USFWS also raises concerns about potential depletions to the North Fork of the Ninnescah River, which supplies the Cheney Reservoir and the City of Wichita’s municipal water, especially during drought conditions. They recommend consultation with the City of Wichita due to possible impacts from the wellfield’s pumping.

Habitat and Hydrology Impacts

The USFWS notes the DEIS provides limited quantification of positive habitat impacts from reduced groundwater pumping, such as increased perennial stream length, wetland permanence, and riparian habitat improvements. They recommend including more detailed information on these benefits. Regarding impacts on wetlands and riparian areas, the USFWS

stresses the need for analysis of aquifer drawdown effects on vegetation, especially in Quivira NWR's Hornbaker Tract and areas with two feet or more of water level decline from the augmentation wellfield cone of depression. They highlight potential shifts in vegetation communities due to lowered groundwater and streamflow reductions.

Stream Segmentation and Cumulative Impacts

The USFWS recommends analyzing Rattlesnake Creek as two segments—above and below the augmentation delivery point —due to significant streamflow depletion upstream that is not adequately addressed. They note projections concerning upstream conversion from perennial stream to intermittent stream within Rattlesnake Creek and urge incorporation of this into the cumulative effects analysis in the EIS.

Reasonable Alternatives and Enforceability

The USFWS suggests broadening the range of alternatives, particularly combining enforceable groundwater reductions with augmentation. They emphasize enforceability as a key metric for success and express concern that the Augmentation Wellfield and Groundwater Use Reduction Alternative lacks binding mechanisms, relying on voluntary actions and adaptive management.

The USFWS points out that the current alternative resembles the 2019 Local Enhanced Management Area (LEMA) plan, which was rejected for insufficient reductions. They reference KDA-DWR's recommendation for larger reductions (15% in Zone A plus 4,400 ac-ft retirements in Zone D) and call for alternatives incorporating these solutions.

Water Rights Retirement and Legal Mechanisms

The USFWS expresses concerns that the 2,500 ac-ft retirement goal may underestimate impairment reduction, confusing streamflow depletion with water rights impairment. They estimate a 10:1 ratio between depletion and impairment and suggest a higher retirement goal is needed. They also question the enforceability of retirements and oppose the use of eminent domain.

Naming and Alternative Similarities

The USFWS suggests renaming the Augmentation Wellfield and Groundwater Use Reduction Alternative to reflect that groundwater pumping actually increases under this alternative. They also note the Groundwater Use Reduction Alternative is very similar to the No Action Alternative, limiting the range of distinct options.

Concerns with No Action Alternative Framing

The USFWS believes the No Action Alternative presents a worst-case scenario of complete cessation of 810 water rights, which may not align with likely KDA-DWR administration practices

that would distribute reductions more equitably. They note ongoing progress in the Rattlesnake Creek Working Group towards cooperative solutions.

Characterization of Stream Water

The USFWS requests removal of terminology describing stream water not consumed by agriculture as “unused” or “overshot,” emphasizing the ecological importance of maintaining streamflows per Kansas Minimum Desirable Streamflow (MDS) regulations.

Wellfield Operations and Monitoring

The USFWS critiques the December 18, 2023 memo on wellfield operations for lacking operational details during droughts and contingencies for water quality issues in individual wells. They recommend modeling scenarios for months with highest refuge water demand (March-April and October-November) to assess augmentation capacity.

Technical Groundwater Modeling and Field Work

The USFWS reiterates earlier concerns about the adequacy of the 2010 Balleau Groundwater Model, noting it is not a perfect match with pump test data near the wellfield and does not incorporate recent model updates from 2023. They emphasize that the model may not capture vertical leakage and upwelling of poor-quality water and recommend refining the model with a finer grid and lithologic data. They also highlight the lack of water quality data and limited field testing in the southern wellfield area, where brackish (salty) water is known.

Collaboration and Comment Integration

The USFWS notes that many of their earlier comments remain relevant and that some substantive issues are unresolved. They express willingness to continue collaboration with NRCS and GMD #5.

3.2.2 Cooperating State Agency Comments

From the state cooperating agencies, KDHE - Bureau of Water clarified that augmentation water constitutes a transfer rather than an NPDES discharge while maintaining antidegradation safeguards through cessation triggers when chloride concentrations exceed 1,400 mg/L. KDHE favors the compact wellfield configuration to minimize streamflow depletions, particularly on the North Fork Ninnescah and Cheney Reservoir, and recommended operational monitoring, periodic resting of wells, alternating pumping, leasing opportunities along Rattlesnake Creek, and consideration of rescinding the MDS at Zenith Gage. KDA-DWR acknowledged permitting uncertainties, statutory criteria for non-impairment and reasonable streamflow and water-level outcomes, and the likelihood of substantial public interest and potential litigation, although emphasizing that NRCS acknowledged these risks and referenced Section 8.4 on Water Appropriation permits in the DEIS.

3.3 Other Agencies and Organizations

A comment was considered as “other agency or organization” if submitted by an individual or office officially representing a government office or non-cooperating agency (county, city, state, or federal), a special interest group, business, or another organization with official status.

During the review period NRCS received 19 separate comments from other agencies and organizations. Those other agencies and organizations included state agencies, local organizations representing agricultural or conservation interests, cities, and counties.

Overarching themes reflect regulatory constraints, hydrological and water quality protection requirements, socioeconomic impact disagreements, ongoing debate over the alternatives, and requests for clearer governance structures. Commenters emphasized the need to satisfy state permitting standards, uphold Tier 3 Outstanding National Resource Waters (ONRW) protections at Quivira, and complete ecological reviews for infrastructure. Some organizations expressed understanding regarding the need for action and the difficulty and complexity of the problem. Other agencies and organizations expressed concern regarding tax revenue changes resulting from reduced irrigation in the region, water rights, and impacts to downstream water supply resources. Conservation organizations highlighted the importance of Quivira NWR and its role in supporting migratory birds and other species. Additional details organized by general commenter type are included below.

3.3.1 Other State Agency Comments

The Kansas Department of Wildlife and Parks (KDWP) recommended early coordination and ecological reviews for the augmentation infrastructure. The Kansas Water Office (KWO) raised concerns about statements it viewed as assumptions rather than facts, asked for clearer articulation of the project purpose focused on impairment resolution, and sought fuller accounting of external impacts on the North Fork Ninnescah and Cheney Reservoir, especially under drought conditions. KWO requested inclusion in multiagency processes and posed detailed questions about damage-reduction benefit definitions, the 50-year horizon rationale, sustainability definitions, flood-prevention components, model selection, and adaptive management governance relative to the Chief Engineer’s authority. Overall, neutral or process-focused stances were consistent from both cooperating and other state agencies, emphasizing regulatory reviews, water-quality protection, permitting risks, governance clarity, and external impact accounting.

3.3.2 Local Agency Comments

Local governments and economic development organizations asserted that the DEIS underestimates socio-economic impacts, arguing that the analysis is too narrow and does not fully capture tax base reductions, school enrollment changes, municipal finance pressures, and ripple effects across non-agricultural sectors. Commentors noted that impacts under No Action

or Groundwater Use Reduction alternatives would likely be larger and cited prior estimates of regional losses in the range of $20–$50 million dollars annually. They requested stronger accounting for ongoing local cost burdens, whereas the DEIS assumes continued production under reduced irrigation and that operations would be within #GMD 5's budget. Commenters also challenged the elimination of alternatives considering the internal conservation of water at Quivira NWR from consideration in the DEIS (which states that those measures fall outside the scope of PL-83-566) and questioned if state impairment findings and Kansas water law support the DEIS framing. The City of Wichita commented about several points, including: overestimation of streamflow in the Ninnescah River in the Balleau model (Balleau 2010), limitation of the hydrological simulation to long-term average conditions, streamflow records for the Ninnescah River show long-term declines that are not represented by the Balleau model, and MDS streamflows that would not be supported. Support or conditional support for the Preferred Alternative comes from the Kansas Livestock Association, Kansas Farm Bureau, Stafford County Farm Bureau, Edwards County Economic Development, and the Pratt County Commissioner.

3.3.3 Conservation Organizations

Comments from conservation organizations and individual conservation advocates strongly preferred the No Action Alternative, or accepted the Groundwater Use Reduction Alternative, while opposing augmentation on the grounds of environmental impacts, cost, complexity, and uncertainties with implementation. These commenters emphasized Quivira NWR's ecological significance and migratory bird reliance on the Refuge and questioned the expenditure of public funds on an engineered solution. Opposition to augmentation or preference for the No Action and Groundwater Use Reduction alternatives appears in Audubon of Kansas and allied commenters, who cite environmental risks, fiscal concerns, and legal principles. The Nature Conservancy is supportive of the Augmentation Wellfield and Groundwater Use Reduction Alternative with recommendations to expand the sustainability definition, add voluntary conservation and nature-based solutions through adaptive management, broaden performance metrics beyond Quivira NWR, and consider mitigation strategies for long-term impacts.

3.3.4 Agriculture and Industry Groups

Agriculture and industry groups supported the Augmentation Wellfield and Groundwater Use Reduction Alternative, arguing that augmentation provides timely water when needed, reduces litigation risk, sustains regional economic activity, and better aligns with Quivira's managed water-control operations. Kansas Livestock Association warned that the No Action and Groundwater Use Reduction alternatives could severely impact cattle feeding operations and stockwater rights, while Kansas Farm Bureau endorsed augmentation paired with voluntary retirements and adaptive management, with administrative reductions as a subsequent step if needed.

4. UPDATES TO THE DEIS

After careful review and consideration, the following updates were made to the DEIS because of the comments received during the 45-day comment period.

4.1 Threatened and Endangered Species

During informal consultation with USFWS for the Biological Assessment, an updated species list was received on August 29, 2025. This list contained 19 species. As a result, the following species were added to the FEIS: cave myotis (*Myotis velifer*), variable cuckoo bumble bee (*Bombus variabilis*) and the Arkansas river shiner (*Notropis girardi*) was added to the federal list of species (it had previously been included as a state-listed species only). Information was added to the lesser prairie chicken (*Tympanuchus pallidicinctus*) section describing the August 12, 2025 vacatur of the USFWS 2022 rule listing the species under the ESA. Other updates to existing species (i.e. listing status) were brought up to date concurrent with the list received from USFWS on August 29, 2025. The impact analysis for threatened and endangered species did not change as a result of any of these additions or changes.

4.2 Adaptive Management

As a result of comments received on the DEIS, the NRCS decided to host a meeting with appropriate stakeholders to formulate a draft Adaptive Management Plan (AMP) in support of the Augmentation Wellfield and Groundwater Use Reduction Alternative. The decision to formulate the draft AMP was to provide additional details about the role of adaptive management during implementation and overall life of the project. The draft AMP is included in Appendix D in the Final EIS (FEIS).

4.3 Impact Analysis

The alternatives comparison tables have been revised for clarity and consistency, particularly in rating the benefits of the No Action and Groundwater Use Reduction alternatives in Table 6.0 and Table 8.1.2. The following updates have been made to the DEIS.

- Parklands and Natural Areas resource impacts were changed to “Beneficial Major Effect” for all three alternatives.
- Surface Water Resources and Water Quality had several changes, including: a change from Negative Minor Effect to Negative Moderate Effect for the Augmentation Wellfield and Groundwater Use Reduction Alternative compared to the No Action Alternative; and compared to existing conditions, the No Action and Groundwater Use Reduction alternatives were changed to a Beneficial Major Effect.
- The word “downstream” was added to several resource sections in Table 6 for added clarity.

- Significant Scientific Features was changed to a Beneficial Major Effect for all three alternatives.

Updates to Chapter 5 (Impacts) include acknowledgment of the continued agricultural pumping in Zone B under the Augmentation Wellfield and Groundwater Use Reduction Alternative. An additional subheading was added to each resource to compare to the No Action Alternative. At minimum, this addition acknowledges the positive or negative impacts described in the No Action Alternative will not be realized under the action alternatives. In addition, the economic resource section was restructured for consistency across resource sections.

5. REFERENCES

Balleau (Balleau Groundwater Inc.) 2010. Hydrologic Model of Big Bend Groundwater Management District Number 5. Available at: https://gmd5.org/district-hydrologic-model.

GMD #5. 2025. Watershed Plan. https://gmd5.org/watershed-plan.

NRCS. 2025. Rattlesnake Creek Watershed Draft Plan Environmental Impact Statement. https://www.nrcs.usda.gov/state-offices/kansas/news/rattlesnake-creek-watershed-draft-plan-environmental-impact-statement.

Agency Coordination

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Kansas State Office
760 S. Broadway Blvd.
Salina, Kansas 67401

October 9, 2024

Jason Luginbill
U.S. Fish and Wildlife Service – Ecological Services
2609 Anderson Avenue
Manhattan, KS 66502
jason_luginbill@fws.gov

Subject: Initiation of P.L. 83-566 Section 12 Consultation for Rattlesnake Creek Watershed Project, Stafford County, KS

Jason Luginbill:

In accordance with Section 12 of Public Law 83-566, the Natural Resources Conservation Services (NRCS) is notifying the Department of the Interior that we are investigating a water resource project. The Great Bend Groundwater Management District No. 5 (GMD#5) requested NRCS assistance through the NRCS Watershed and Flood Protection Program (Public Law 83-566). This letter serves as formal notification that the project has been approved for assistance, and NRCS will consult with U.S. Fish and Wildlife Service on recommendations for technically and economically feasible works of improvement for wildlife purposes. Please reply within 30 days of receiving this notice whether your Agency intends to make any additional surveys, investigations, or recommendations concerning the conservation and development of wildlife resources in preparing the plan for works of improvement for this project.

The project sponsors and NRCS have prepared the Environmental Impact State (Plan-EIS) to evaluate alternatives to meet the project's need. NRCS is the lead Agency preparing the Watershed Plan-EIS for the Rattlesnake Creek Watershed Project. The purpose of the Rattlesnake Creek Watershed Plan-EIS and proposed action is to provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin of GMD #5. Surface water and groundwater are essential resources to the central Kansas economy and environment. Management of the Rattlesnake Creek subbasin and its interrelated water resources (such as Quivira National Wildlife Refuge [NWR]) has been difficult and complex because it involves administration of multiple users of a limited resource. This resource is relied on principally for ecosystem sustainability (through management of surface water at the Quivira NWR for irrigated agriculture (through groundwater pumping). The sustainability of the Quivira NWR relies primarily on surface water diversions that have been impaired because of agricultural groundwater use.

(more)

However, a predictable and consistent source of water is required to support the agricultural economy. Providing long-term agricultural water management for the region would help provide water resources for the agricultural economy and help remedy Quivira NWR's impaired senior water right.

The proposed project consists of an augmentation wellfield located in the Gar-Peace Creek and North Fork Ninnescah watersheds, that provide 15-18 cubic feet per second (cfs) of water via pipeline to Rattlesnake Creek upstream of the Quivira NWR in the Rattlesnake Creek Watershed. Quivira NWR is located approximately 1.8 miles north of the proposed augmentation wellfield. Additionally, 2,500 acre-feet of authorized water use would be retired as part of a water right retirement program, and compensated conservation measures would be implemented. The proposed project includes implementation of a multistakeholder adaptive management approach (to be developed following the National Environmental Policy Act (NEPA) process) that would evaluate the success of the wellfield, water right retirements, and compensated conservation measures on an annual basis and decrease pumping or increase groundwater retirements as needed to meet Quivira NWR management goals and objectives.

Thank you for your timely response and cooperation with this project. For any concerns or questions related to this project, contact Larry Schieferecke, Kansas NRCS State Conservation Engineer by email at larry.schieferecke@usda.gov.

Sincerely,

DAVID S. DOCTORIAN
State Conservationist

Enclosures: GMD #5 Boundary Area, Map of Rattlesnake Project Area,

ec:
R. Dean Krehbiel, State Resource Conservationist, NRCS, Salina, Kansas
Larry J. Schieferecke, State Conservation Engineer, NRCS, Salina, Kansas
Kris R. Ethridge, Assistant State Conservationist for Field Operations, NRCS, Hutchinson, Kansas
Andrew G. Burr, State Biologist, NRCS, Salina, Kansas
Joshua Adelhardt, Supervisory District Conservationist, NRCS, Pratt, Kansas
Aaron Ball, Vice President, Olsson, 7301 W. 133rd Street, Suite 200, Overland Park, Kansas 66213
Orrin Feril, Manager, Big Bend Groundwater Management District 5, 125 S Main St, Stafford, Kansas 67578

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
FWS/R6/NWRS

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
1 Denver Federal Center
Building 53, Room FW-192
Denver, Colorado 80225

David S. Doctorian
USDA NRCS State Conservationist
Kansas State Office
760 S. Broadway Blvd.
Salina, Kansas 67401

October 31, 2024
Sent via email: david.doctorian@usda.gov

Subject: RE: Initiation of P.L. 83-566 Section 12 Consultation for Rattlesnake Creek Watershed Project, Stafford County, KS

Dear Mr. Doctorian:

Thank you for your October 9, 2024, letter notifying the U.S. Fish and Wildlife Service (FWS) that the Great Bend Groundwater Management District No. 5's (GMD) request to the Natural Resources Conservation Services (NRCS) for assistance has been approved. In accordance with Section 12 of Public Law 83-566, we confirm that we do intend to provide additional recommendations for technically and economically feasible works of improvement for wildlife purposes.

The FWS has been a cooperating agency to the GMD's Watershed Plan Environmental Impact Statement (EIS) and has worked with the GMD, and their EIS development contractor Olsson, for the past several years providing review and comments. The last Cooperating Agency draft EIS document we reviewed was provided on August 8, 2023. We provided several comments on this draft in a September 11, 2023, letter. We have not had the opportunity to review the latest draft to see if any of our requested edits and/or comments were addressed. We would like to discuss with your office how best to engage under Section 12, given that we have already submitted recommendations on an EIS draft through our role as Cooperating Agency. We request a meeting with your office to further discuss how to best submit recommendations and to ensure we fully understand the process.

We welcome the opportunity to provide further comments and look forward to continued cooperation with NRCS on this important issue.

Sincerely,

Stacy Armitage
Assistant Regional Director
National Wildlife Refuge System
Region 6

cc: Larry Schieferecke, Kansas NRCS State Conservation Engineer (larry.schieferecke@usda.gov)

Jennifer Sinclair

From: Luginbill, Jason S <jason_luginbill@fws.gov>
Sent: Thursday, April 25, 2024 1:13 PM
To: Aaron Ball
Cc: Larson, Paul - NRCS, Salina, KS; Burr, Andy - NRCS, Salina, KS; Orrin Feril; O'Meilia, Chris; Oldham, Mike; Jennifer Sinclair
Subject: RE: [EXTERNAL] RE: Updated Species List

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Hi Aaron,

Plains spotted skunk finding was not warranted, removed. Added Hoary bat, discretionary review tentative for FY27. Update coming on national work plan, any changes to the below and I will reach back out with updates.

Eskimo Curlew - endangered
Northern Long-eared Bat – endangered
Peppered Chub – endangered
Whooping Crane – endangered

Eastern Black Rail - threatened
Lesser Prairie-chicken - threatened
Piping Plover - threatened
Rufa Red Knot - threatened

Little Brown Bat - candidate, under review
Monarch Butterfly - candidate, under review
Regal Fritillary - candidate, under review
Tricolored Bat - candidate, proposed endangered
Southern Plains Bumblebee - candidate, under review
American Bumblebee - candidate, under review
Iowa Skipper – petitioned, 90 day finding still underway
Hoary Bat – discretionary status review FY27

Jason S. Luginbill, Project Leader
U.S. Fish and Wildlife Service
Ecological Services
2609 Anderson Ave.
Manhattan, KS 66502
Cell: 785-313-0772
Fax: 785-539-8567

Please call work cell, thank you

From: Aaron Ball <aball@olsson.com>
Sent: Tuesday, April 16, 2024 7:34 AM
To: Luginbill, Jason S <jason_luginbill@fws.gov>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>; Oldham, Mike <mike_oldham@fws.gov>;

Jennifer Sinclair <jsinclair@olsson.com>
Subject: RE: [EXTERNAL] RE: Updated Species List

Thank you, Jason!

From: Luginbill, Jason S <jason_luginbill@fws.gov>
Sent: Monday, April 15, 2024 3:36 PM
To: Aaron Ball <aball@olsson.com>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>; Oldham, Mike <mike_oldham@fws.gov>; Jennifer Sinclair <jsinclair@olsson.com>
Subject: RE: [EXTERNAL] RE: Updated Species List

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Hi Aaron,
Been busy, will check for any new updates this week and get back to you, thank ya.

Jason S. Luginbill, Project Leader
U.S. Fish and Wildlife Service
Ecological Services
2609 Anderson Ave.
Manhattan, KS 66502
Cell: 785-313-0772
Fax: 785-539-8567

Please call work cell, thank you

From: Aaron Ball <aball@olsson.com>
Sent: Wednesday, April 3, 2024 10:42 AM
To: Luginbill, Jason S <jason_luginbill@fws.gov>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>; Oldham, Mike <mike_oldham@fws.gov>; Jennifer Sinclair <jsinclair@olsson.com>
Subject: RE: [EXTERNAL] RE: Updated Species List

Hi Jason,

We are preparing to submit the draft Rattlesnake Creek Biological Assessment to you soon. We have been updating the BA based on ongoing changes to the EIS, so we are hopeful both documents are consistent. Since it has been a year since we requested the last official species list and I believe there has been an update to the eastern spotted skunk, could I request an official updated species list, please?

Regards,
Aaron

From: Luginbill, Jason S <jason_luginbill@fws.gov>
Sent: Tuesday, April 11, 2023 6:05 PM
To: Aaron Ball <aball@olsson.com>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>; Jeff Williams <jwilliams2@olsson.com>; Oldham, Mike <mike_oldham@fws.gov>
Subject: RE: [EXTERNAL] RE: Updated Species List

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Hi Aaron,
Please see below. Added one aquatic with the expanded footprint, peppered chub. Iowa Skipper added, recently petitioned, under 90 day finding.

Eskimo Curlew - endangered
Northern Long-eared Bat – endangered
Peppered Chub – endangered
Whooping Crane – endangered

Eastern Black Rail - threatened
Lesser Prairie-chicken - threatened
Piping Plover - threatened
Red Knot - threatened

Little Brown Bat - candidate, under review
Monarch Butterfly - candidate, under review
Plains Spotted Skunk - candidate, under review
Regal Fritillary - candidate, under review
Tricolored Bat - candidate, proposed endangered
Southern Plains Bumblebee - candidate, under review
American Bumblebee - candidate, under review
Iowa Skipper – petitioned, 90 day finding underway

Jason S. Luginbill, Project Leader
U.S. Fish and Wildlife Service
Ecological Services
2609 Anderson Ave.
Manhattan, KS 66502
Cell: 785-313-0772
Fax: 785-539-8567

Please call work cell, thank you

From: Aaron Ball <aball@olsson.com>
Sent: Monday, April 3, 2023 4:04 PM
To: Luginbill, Jason S <jason_luginbill@fws.gov>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>; Jeff Williams <jwilliams2@olsson.com>; Oldham, Mike <mike_oldham@fws.gov>
Subject: RE: [EXTERNAL] RE: Updated Species List

Good afternoon, Jason -

I would like to request an updated species list for the Rattlesnake Creek Watershed Plan Environmental Assessment and associated biological assessment. Within the past month, two alternative wellfield configurations have been considered, which would extend further south of the previously provided wellfield configuration and expand over a larger geographic footprint. Additionally, we have received modeling data completed by Balleau Groundwater Inc, that shows impacts from the proposed wellfield and two alternative wellfield configurations extends outside the previously provided Project area and over a larger geographic extent.

The attached map shows an updated Project area and potential impacts area that includes Quivira NWR, the expanded potential wellfield area, Zone A response zone, and the watersheds where the modeling data showed hydrologic impacts may occur. The Zone A response zone is the area where agricultural irrigation pumping may be reduced. Please let me know if you have any questions or would like to discuss.

Regards,
Aaron

From: Aaron Ball <aball@olsson.com>
Sent: Tuesday, January 10, 2023 3:38 PM
To: Luginbill, Jason S <jason_luginbill@fws.gov>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>
Subject: RE: [EXTERNAL] RE: Updated Species List

Thank you, Jason. I appreciate your help on this.

Regards,
Aaron

From: Luginbill, Jason S <jason_luginbill@fws.gov>
Sent: Tuesday, January 10, 2023 2:10 PM
To: Aaron Ball <aball@olsson.com>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>
Subject: RE: [EXTERNAL] RE: Updated Species List

Aaron, this should be more reflective of the footprint. Added two bumblebees that I missed on the previous email, candidates.

Eskimo Curlew - endangered
Northern Long-eared Bat - endangered
Whooping Crane - endangered

Eastern Black Rail - threatened
Lesser Prairie-chicken - threatened
Piping Plover - threatened
Red Knot - threatened

Little Brown Bat - candidate, under review
Monarch Butterfly - candidate, under review
Plains Spotted Skunk - candidate, under review
Regal Fritillary - candidate, under review
Tricolored Bat - candidate, proposed endangered
Southern Plains Bumblebee - candidate, under review
American Bumblebee - candidate, under review

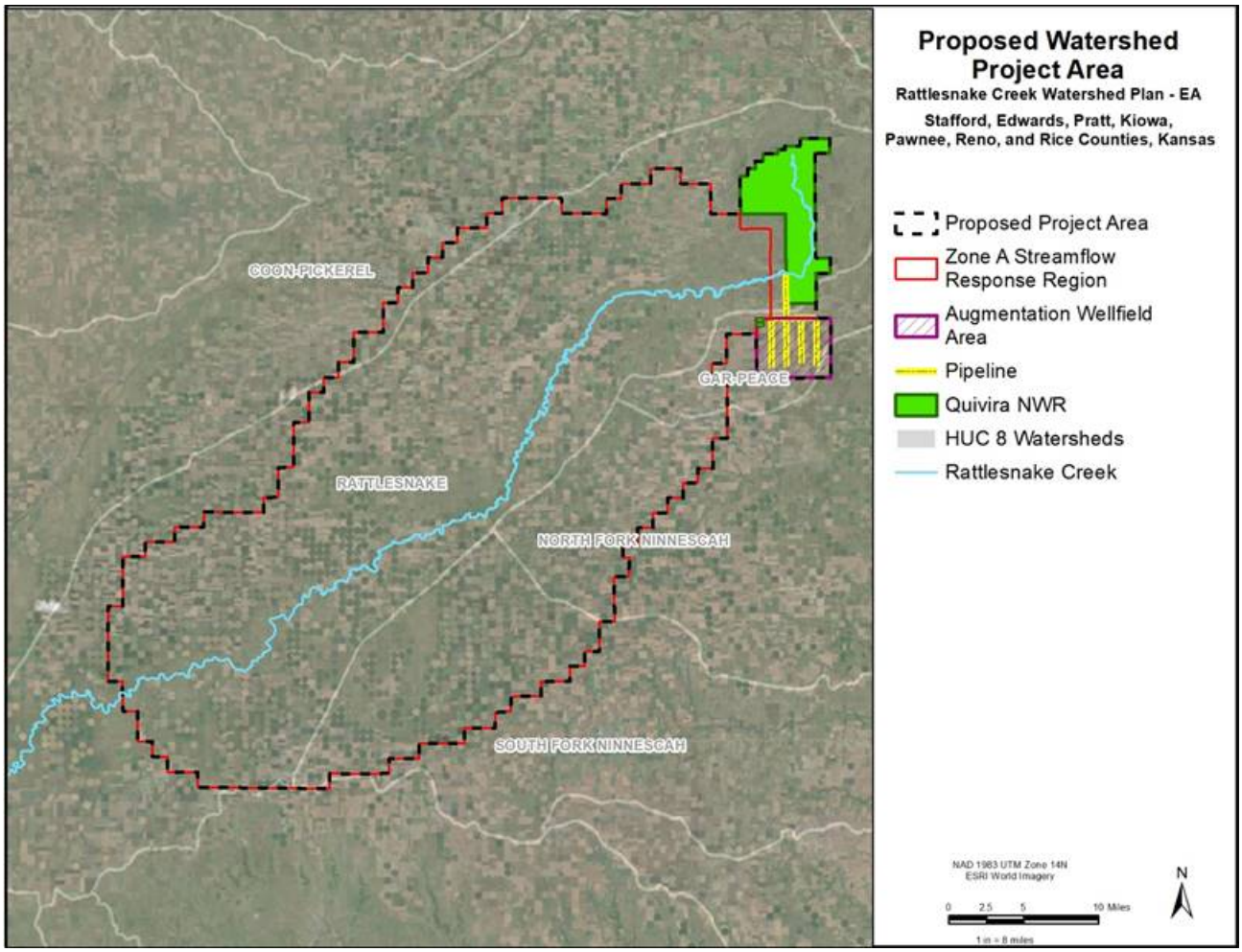
Jason S. Luginbill, Project Leader
U.S. Fish and Wildlife Service
Ecological Services
2609 Anderson Ave.
Manhattan, KS 66502
Work: 785-539-3474 Ext. 105
Cell: 785-313-0772
Fax: 785-539-8567

From: Aaron Ball <aball@olsson.com>
Sent: Friday, January 6, 2023 7:49 AM
To: Luginbill, Jason S <jason_luginbill@fws.gov>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>
Subject: RE: [EXTERNAL] RE: Updated Species List

Hi Jason,

Thank you for the information. Could we get a list that is specific to our watershed project area? I provided a map below and I can provide shapefiles if that is helpful. Since your IPaC system is not updated, could we compare the species geographic ranges with our proposed watershed project area? I would think a few of these species, like the pallid sturgeon, would be easy to cross off the list.

Thanks,
Aaron



From: Luginbill, Jason S <jason_luginbill@fws.gov>
Sent: Thursday, January 5, 2023 6:43 PM
To: Aaron Ball <aball@olsson.com>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>; O'Meilia, Chris <chris_omeilia@fws.gov>
Subject: RE: [EXTERNAL] RE: Updated Species List

Hi Aaron,

Please accept the below list of species as our official species list for Kansas; Endangered, Threatened and Candidate species. We are still trying to get our planning system updated. This is an inclusive list and not specific to project boundaries. Hit us up with any questions.

Black-footed Ferret - endangered
Eskimo Curlew - endangered
Gray Bat - endangered
Neosho Mucket - endangered
Northern Long-eared Bat - endangered
Pallid Sturgeon - endangered
Peppered Chub - endangered
Topeka Shiner - endangered
Whooping Crane - endangered

Alligator Snapping Turtle - threatened
American Burying Beetle - threatened
Arkansas River Shiner - threatened
Eastern Black Rail - threatened
Lesser Prairie-chicken - threatened
Mead's Milkweed - threatened
Neosho Madtom - threatened
Ozark Cavefish - threatened
Piping Plover - threatened
Rabbitsfoot - threatened
Red Knot - threatened
Western Prairie Fringed Orchid - threatened

Little Brown Bat - candidate, under review
Monarch Butterfly - candidate, under review
Plains Spotted Skunk - candidate, under review
Regal Fritillary - candidate, under review
Sicklefin Chub - candidate, under review
Sturgeon Chub - candidate, under review
Tricolored Bat - candidate, proposed endangered

Thank you for your patience. Sincerely,

Jason S. Luginbill, Project Leader
U.S. Fish and Wildlife Service
Ecological Services
2609 Anderson Ave.
Manhattan, KS 66502
Work: 785-539-3474 Ext. 105
Cell: 785-313-0772
Fax: 785-539-8567

From: Aaron Ball <aball@olsson.com>
Sent: Wednesday, December 28, 2022 11:24 AM
To: Luginbill, Jason S <jason_luginbill@fws.gov>
Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>
Subject: [EXTERNAL] RE: Updated Species List

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Hi Jason,

Following up on the email below, could we get an updated species list for the draft Rattlesnake Creek Watershed Plan EA project?

Thanks,
Aaron

From: Aaron Ball <aball@olsson.com>
Sent: Wednesday, November 16, 2022 2:26 PM
To: Luginbill, Jason S <jason_luginbill@fws.gov>

Cc: Larson, Paul - NRCS, Salina, KS <paul.larson@usda.gov>; Burr, Andy - NRCS, Salina, KS <andy.burr@usda.gov>; Orrin Feril <oferil@gmd5.org>
Subject: Updated Species List

Good afternoon, Jason –

As we discussed this morning, here is the latest IPaC that we have generated for the draft Rattlesnake Creek Watershed Plan EA. I would like to request an updated species list. Per our call this morning, we discussed the following threatened and endangered species:

- Eastern black rail
- Red knot
- Eskimo curlew

Additionally, we discuss the following candidate species:

- Tricolored bat
- Regal fritillary
- Plains spotted skunk
- Little brown bat
- Northern long-eared bat

Thank you,
Aaron

Aaron Ball, CPRM
(He, Him, His)
Vice President

C 816.832.1759

7301 W. 133rd Street, Suite 200
Overland Park, KS 66213
O 913.381.1170

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Potentially Occuring Species in RCWP Action Area

KSESFO Update (IPaC and KSESFO compiled)- August 29, 2025

Species	Status
Little Brown Bat	National Listing Workplan (NLWP) Under Review, decision scheduled FY2029
Northern Long-eared Bat	Endangered; Not likely to occur in action area
Tricolored bat	Federally Proposed Endangered
Hoary Bat	Discretionary Review, decision scheduled after FY2029
Eastern Black Rail	Federally Threatened
Eskimo Curlew	Federal Endangered
Lesser Prairie-Chicken	Federally Threatened, but court ordered listing rule vacature on 8/12/2025
Piping Plover	Federally Threatened
Red Knot	Federally Threatened
Whooping Crane	Federally Endangered
Peppered Chub	Federally Endangered; Extirpated in Kansas (but included in IPaC because of future expected releases associated with KS Aquatic SHA)
Iowa Skipper	Positive 90-day finding and status review initiation on 10.08.2024; No NLWP schedule to date
Monarch Butterfly	Federally Proposed Threatened
Western Regal Fritillary	Federally Proposed Threatened
American Bumble Bee	NLWP Under Review, decision scheduled FY2028
Southern Plains Bumble Bee	Positive 90-day finding and status review initiation on 1.25.2024; No NLWP schedule to date
Whooping Crane Designated Critical Habitat	Federal Critical Habitat
Arkansas River Shiner	Federally Threatened; Extirpated in Kansas (but included in IPaC because of future expected releases associated with KS Aquatic SHA)
Cave myotis (Myotis velifer)	Discretionary Review, No NLWP schdule to date
Variable Cuckoo Bumble Bee	Positive 90-day finding and status review initiated on February 8, 2022; NLWP decision schedule FY2027

National Domestic Listing Workplan (NLWP; https://www.fws.gov/project/national-listing-workplan)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kansas Ecological Services Field Office
2609 Anderson Avenue
Manhattan, Kansas 66502

In Reply Refer to:
FWS/R6/2026-0027619

December 17, 2025

Mr. Dean Krehbiel
Assistant State Conservationist
Natural Resources Conservation Service
Kansas State Office
760 South Broadway Blvd.
Salina, Kansas 67401

Mr. Krehbiel,

Thank you for contacting the U.S. Fish and Wildlife Service (Service), Kansas Ecological Services Field Office on December 17, 2025 with your request for our concurrence with the findings of the Biological Assessment (BA) for the Rattlesnake Creek Augmentation Wellfield and Groundwater Use Reduction Project (Project). The Project proponent, Big Bend Groundwater Management District #5 is proposing implementation of voluntary groundwater use reduction, construction of an augmentation wellfield in Gar-Peace Creek and North Fork Ninnescah watersheds that provides water via pipeline to Rattlesnake Creek upstream of Quivira National Wildlife Refuge in the Rattlesnake Creek Watershed, located in portions of Stafford County, Kansas. Service comments are provided in accordance with the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

The Service has completed our review of the proposed Project as described with the information provided in your BA and the draft Environmental Impact Statement. Based on the provided description of the proposed Project, our desktop review of the site, and our experience and expertise with the potentially occurring species, we concur with your Project determinations. Specifically, the No Effect determination for Eskimo curlew, Arkansas River shiner, peppered chub are supported by the lack of the species occurrence in or near the action area and the subsequent lack of the species exposure to effects of the Project. Additionally, the May Affect, Not Likely to Adversely Affect determinations for northern long-eared bat, eastern black rail, piping plover, red knot, and whooping crane, as well as your determination of no destruction or adverse modification of whooping crane designated critical habitat are supported by the consideration of the species life histories, the type and limited extent of effects from the proposed Project, and the incorporation of environmental commitments as recommended by the Service.

With aspects of the Project still to be finalized resulting in potential for changes to portions of the Project, which may or may not occur, beyond the description of the proposed Project provided in the BA, we provide a reminder that the ESA provides for reinitiation of consultation under specific situations. As is acknowledged and committed to in the BA, the lead Federal agency should evaluate the need for reinitiation of consultation for the proposed Project as aspects of the design and permitting are finalized. Specifically, the reinitiation criteria (§ 50 CFR 402.16) germane to this informal consultation, indicate it is required and shall be requested by the Federal agency, where discretionary Federal involvement or control over the action has been retained or is authorized by law, and:

(1) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

(2) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or

(3) If a new species is listed or critical habitat designated that may be affected by the identified action.

We appreciate the opportunity to partner with you in conservation of federally listed species and other important trust resources benefiting the American people. If you have any questions regarding this letter, please contact Chris O'Meilia of this office at chris_omeilia@fws.gov, or (785) 306-4284.

Sincerely,

Michael Disney
Acting Project Leader

January 4, 2022

CERTIFIED–RETURN RECEIPT REQUESTED

Wichita and Affiliated Tribes
ATTN: Tribal Council
P. O. Box 729
Anadarko, Oklahoma 73005

Dear Robin Williams:

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed, a surface water source for Quivira National Wildlife Refuge. GMD-5 has contracted with an Architectural and Engineering (A&E) firm to complete the Work Plan and Environmental Assessment (Plan-EA). The Work Plan is required to address all social, environmental, and economic impacts, as well as the completion according to all requirements of the National Environmental Policy Act (NEPA).

As the lead agency, NRCS policy requires the completion of consultation with Tribes that have ancestral land claims within the watershed. This consultation cannot be completed by the A&E firm. NRCS would like to present an overview of the project to your Tribal leadership as soon as possible. We are seeking assistance and advice from your Tribe during the planning process for this project. Therefore, we ask your Tribe to identify goals and provide ideas, suggestions, and input to maximize the potential benefits from the final planned activities while meeting your objectives.

The expected impact area includes the portion of Rattlesnake Creek in Stafford County, Kansas. The successful completion of this plan will allow the implementation of measures to augment surface flows throughout the watershed. The attached map shows the extent of the Rattlesnake Creek Watershed.

If you have any cultural resource concerns related to this project, please provide it within **30 days** of receipt of this letter. Your response will be addressed by Christopher J. Eck, Jr., Archaeologist and Cultural Resources Specialist. Your response may be sent to the following address:

Christopher J. Eck Jr.
Archaeologist
Natural Resources Conservation Service
760 South Boulevard
Salina, Kansas 67401-4604

(more)

USDA is an equal opportunity provider, employer, and lender.

If you have any additional questions or concerns, please contact Kevin D. Gustafson, State Conservation Engineer, by phone at 785-823-4534 or email kevin.gustafson@usda.gov.

Sincerely,

KAREN A. WOODRICH
State Conservationist

Enclosure:
1. Rattlesnake Watershed Map

ec:
Kevin D. Gustafson, State Conservation Engineer, NRCS, Salina, Kansas
R. Dean Krehbiel, State Resource Conservationist, NRCS, Salina, Kansas
Christopher J. Eck, Jr., Archaeologist, NRCS, Salina, Kansas
Brandy A. Dacus, Archaeologist, NRCS, Salina, Kansas
Jim Schneider, Senior Scientist, Olsson, 601 P Street, Lincoln, Nebraska 68508
Orrin Feril, Manager, Big Bend Groundwater Management District 5, 125 S. Main Street, Stafford, Kansas 67578

January 6, 2022

CERTIFIED–RETURN RECEIPT REQUESTED

Osage Nation of Oklahoma
ATTN: Tribal Historic Preservation Officer
627 Grandview Avenue
Pawhuska, Oklahoma 74056

Dear Dr. Andrea Hunter,

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed, a surface water source for Quivira National Wildlife Refuge. GMD-5 has contracted with an Architectural and Engineering (A&E) firm to complete the Work Plan and Environmental Assessment (Plan-EA). The Work Plan is required to address all social, environmental, and economic impacts, as well as the completion according to all requirements of the National Environmental Policy Act (NEPA).

As the lead agency, NRCS policy requires the completion of consultation with Tribes that have ancestral land claims within the watershed. This consultation cannot be completed by the A&E firm. NRCS would like to present an overview of the project to your Tribal leadership as soon as possible. We are seeking assistance and advice from your Tribe during the planning process for this project. Therefore, we ask your Tribe to identify goals and provide ideas, suggestions, and input to maximize the potential benefits from the final planned activities while meeting your objectives.

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Christopher J. Eck Jr.
Archaeologist
Natural Resources Conservation Service
760 South Boulevard
Salina, Kansas 67401-4604

(more)

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If you have any additional questions or concerns, please contact Kevin D. Gustafson, State Conservation Engineer, by phone at 785-823-4534 or email kevin.gustafson@usda.gov.

Sincerely,

KAREN A. WOODRICH
State Conservationist

Enclosure:
1. Rattlesnake Watershed Map

ec:
Kevin D. Gustafson, State Conservation Engineer, NRCS, Salina, Kansas
R. Dean Krehbiel, State Resource Conservationist, NRCS, Salina, Kansas
Christopher J. Eck, Jr., Archaeologist, NRCS, Salina, Kansas
Brandy A. Dacus, Archaeologist, NRCS, Salina, Kansas
Jim Schneider, Senior Scientist, Olsson, 601 P Street, Lincoln, Nebraska 68508
Orrin Feril, Manager, Big Bend Groundwater Management District 5, 125 S. Main Street, Stafford, Kansas 67578

September 28, 2022

CERTIFIED–RETURN RECEIPT REQUESTED

Osage Nation of Oklahoma
ATTN: Tribal Historic Preservation Officer
627 Grandview Avenue
Pawhuska, Oklahoma 74056

Dear Dr. Andrea Hunter,

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed, a surface water source for Quivira National Wildlife Refuge (QNWR). GMD-5 has contracted with an Architectural and Engineering (A&E) firm to complete the Work Plan and Environmental Assessment (Plan-EA). The Work Plan is required to address all social, environmental, and economic impacts, as well as the completion according to all requirements of the National Environmental Policy Act (NEPA).

NRCS, as the lead Federal Agency, is completing a Plan-EA to develop solutions that will provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin. The solutions currently proposed, which are being evaluated through the National Environmental Policy Act (NEPA) process, include reductions in agricultural irrigation, conservation practices aimed at reducing water needs or consumption, and an augmentation wellfield. The proposed augmentation wellfield would consist of up to 45 wells that pump groundwater to a collection pipeline that discharges to Rattlesnake Creek at the QNWR border.

The location of the augmentation wellfield is shown on the Project Area map (Figure 1). The wellfield area where the proposed ground disturbance could occur is shown in Figure 2.

If you have any cultural resource concerns related to this project, please provide it within 30 days of receipt of this letter. Your response will be addressed by Brandy A. Dacus, Archaeologist and Cultural Resources Specialist, and may be sent to the following address:

Brandy A. Dacus
Cultural Resources Specialist
Natural Resources Conservation Service
760 South Broadway Boulevard
Salina, Kansas 67401-4604
brandy.dacus@usda.gov

(more)

USDA is an equal opportunity provider, employer, and lender.

Sincerely,

JEANNE L. HAMILTON
Acting State Conservationist

Enclosures:

1. Figure 1. Proposed Project Area with Rattlesnake Watershed and Wellfield Augmentation Area locations.
2. Figure 2. Conceptual Layout of Augmentation Wellfield and Delivery Pipeline (GMD #5 2022b). Area of Installation corresponds with Wellfield augmentation area depicted by purple hatched polygon in Figure 1.

ec:
R. Dean Krehbiel, State Resource Conservationist, NRCS, Salina, Kansas
Larry J. Schieferecke, State Conservation Engineer, NRCS, Salina, Kansas
Kris R. Ethridge, Assistant State Conservationist for Field Operations, NRCS, Hutchinson, Kansas
Brandy A. Dacus, Cultural Resources Specialist, NRCS, Salina, Kansas
Joshua Adelhardt, Supervisory District Conservationist, NRCS, Pratt, Kansas
Aaron Ball, Vice President, Olsson, 7301 W. 133rd Street, Suite 200, Overland Park, Kansas 66213
Orrin Feril, Manager, Big Bend Groundwater Management District 5, 125 S. Main Street, Stafford, Kansas 67578

September 29, 2022

Patrick Zollner
State Historical Preservation Officer
Kansas State Historical Society
6425 SW 6th Avenue
Topeka, Kansas 66615

Dear Patrick Zollner:

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed, a surface water source for Quivira National Wildlife Refuge (QNWR). GMD-5 has contracted with an Architectural and Engineering (A&E) firm to complete the Work Plan and Environmental Assessment (Plan-EA). The Work Plan is required to address all social, environmental, and economic impacts, as well as the completion according to all requirements of the National Environmental Policy Act (NEPA).

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The location of the augmentation wellfield is shown on the Project Area map (Figure 1). The wellfield area where the proposed ground disturbance could occur is shown in Figure 2.

If you have any cultural resource concerns related to this project, please provide it within 30 days of receipt of this letter. Your response will be addressed by Brandy A. Dacus, Archaeologist and Cultural Resources Specialist. Your response may be sent to the following address or the KSHS dashboard entry for this project:

Brandy A. Dacus
Cultural Resources Specialist
Natural Resources Conservation Service
760 South Broadway Boulevard
Salina, Kansas 67401-4604
brandy.dacus@usda.gov

(more)

USDA is an equal opportunity provider, employer, and lender.

Sincerely,

JEANNE L. HAMILTON
Acting State Conservationist

Enclosures:

1. Figure 1. Proposed Project Area with Rattlesnake Watershed and Wellfield Augmentation Area locations.
2. Figure 2. Conceptual Layout of Augmentation Wellfield and Delivery Pipeline (GMD #5 2022b). Area of Installation corresponds with Wellfield augmentation area depicted by purple hatched polygon in Figure 1.

ec:
R. Dean Krehbiel, State Resource Conservationist, NRCS, Salina, Kansas
Larry J. Schieferecke, State Conservation Engineer, NRCS, Salina, Kansas
Kris R. Ethridge, Assistant State Conservationist for Field Operations, NRCS, Hutchinson, Kansas
Brandy A. Dacus, Cultural Resources Specialist, NRCS, Salina, Kansas
Joshua Adelhardt, Supervisory District Conservationist, NRCS, Pratt, Kansas
Aaron Ball, Vice President, Olsson, 7301 W. 133rd Street, Suite 200, Overland Park, Kansas 66213
Orrin Feril, Manager, Big Bend Groundwater Management District 5, 125 S Main St, Stafford, Kansas 67578

September 29, 2022

CERTIFIED–RETURN RECEIPT REQUESTED

Wichita and Affiliated Tribes
ATTN: Tribal Council
P. O. Box 729
Anadarko, Oklahoma 73005

Dear Robin Williams:

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed, a surface water source for Quivira National Wildlife Refuge (QNWR). GMD-5 has contracted with an Architectural and Engineering (A&E) firm to complete the Work Plan and Environmental Assessment (Plan-EA). The Work Plan is required to address all social, environmental, and economic impacts, as well as the completion according to all requirements of the National Environmental Policy Act (NEPA).

NRCS, as the lead Federal Agency, is completing a Plan-EA to develop solutions that will provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin. The solutions currently proposed, which are being evaluated through the National Environmental Policy Act (NEPA) process, include reductions in agricultural irrigation, conservation practices aimed at reducing water needs or consumption, and an augmentation wellfield. The proposed augmentation wellfield would consist of up to 45 wells that pump groundwater to a collection pipeline that discharges to Rattlesnake Creek at the QNWR border.

The location of the augmentation wellfield is shown on the Project Area map (Figure 1). The wellfield area where the proposed ground disturbance could occur is shown in Figure 2.

If you have any cultural resource concerns related to this project, please provide it within 30 days of receipt of this letter. Your response will be addressed by Brandy A. Dacus, Archaeologist and Cultural Resources Specialist. Your response may be sent to the following address:

Brandy A. Dacus
Cultural Resources Specialist
Natural Resources Conservation Service
760 South Broadway Boulevard
Salina, Kansas 67401-4604
brandy.dacus@usda.gov

(more)

USDA is an equal opportunity provider, employer, and lender.

Sincerely,

JEANNE L. HAMILTON
Acting State Conservationist

Enclosures:

1. Figure 1. Proposed Project Area with Rattlesnake Watershed and Wellfield Augmentation Area locations.
2. Figure 2. Conceptual Layout of Augmentation Wellfield and Delivery Pipeline (GMD #5 2022b). Area of Installation corresponds with Wellfield augmentation area depicted by purple hatched polygon in Figure 1.

ec:
R. Dean Krehbiel, State Resource Conservationist, NRCS, Salina, Kansas
Larry J. Schieferecke, State Conservation Engineer, NRCS, Salina, Kansas
Kris R. Ethridge, Assistant State Conservationist for Field Operations, NRCS, Hutchinson, Kansas
Brandy A. Dacus, Cultural Resources Specialist, NRCS, Salina, Kansas
Joshua Adelhardt, Supervisory District Conservationist, NRCS, Pratt, Kansas
Aaron Ball, Vice President, Olsson, 7301 W. 133rd Street, Suite 200, Overland Park, Kansas 66213
Orrin Feril, Manager, Big Bend Groundwater Management District 5, 125 S Main St, Stafford, Kansas 67578

Cultural Resources Division
State Historic Preservation Office
6425 SW 6th Avenue
Topeka KS 66615-1099

Kansas Historical Society

785-272-8681
fax 785-272-8682
kshs.shpo@ks.gov
kshs.org

Patrick Zollner, Acting Executive Director

Laura Kelly, Governor

KSR&C # 22-10-002
October 26, 2022

Brandy Dacus
NRCS

Via Email

RE: Rattlesnake Creek Watershed Plan
T23-R11W
Stafford County

The Kansas State Historic Preservation Office has reviewed your message and attached documentation (dated October 3, 2022) regarding the above-referenced project. According to our records, the project area is not proximal to any recorded archeological sites. However, the project will take place adjacent to the intermittent stream Peace Creek, which is a tributary of the perennial Rattlesnake Creek. This area has a moderate archeological potential, and this area of Stafford County is severely underrepresented in the archeological survey record. The project's depth of disturbance due to well-boring presents a significant potential to disturb buried cultural deposits. The project area has not been previously surveyed, and the ground is relatively undisturbed. Therefore, our office therefore requests that a professional archeologist survey the area prior to beginning construction.

Any archeologist meeting the Minimum Professional Qualifications of this office as outlined in *The State Historic Preservation Officer's Guide for Archeological Survey, Assessment, and Reports* (SHPO's Guide), is eligible to perform the requested work. A list of archeological contractors meeting these standards is available from our web site at: http://www.kshs.org/p/archeological-consultants/14593.

This information is provided at your request to assist you in identifying historic properties, as specified in 36 CFR 800 for Section 106 consultation procedures. If you have questions or need additional information regarding these comments, please contact Austin Main at 785-272-8681 (ext. 228) or Lauren Jones at 785-272-8681 (ext. 214).

Sincerely,

Patrick Zollner

Patrick Zollner, Acting Executive Director and
State Historic Preservation Officer

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Kansas State Office
760 S. Broadway Blvd.
Salina, Kansas 67401

May 6, 2024

CERTIFIED – RETURN RECEIPT REQUESTED

Kiowa Indian Tribe of Oklahoma
Attn: Amanda Hill, Tribal Historic Preservation Officer
P.O. Box 369
Carnegie, Oklahoma 73015-0369

Dear Amanda Hill:

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Plan Environmental Impact Statement (Plan-EIS) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed, a surface water source for Quivira National Wildlife Refuge (QNWR). GMD-5 has contracted with an Architectural and Engineering (A&E) firm, Olsson, to complete the Plan-EIS. The Plan-EIS is required to address all social, environmental, and economic impacts, as well as the completion according to all requirements of the National Environmental Policy Act (NEPA).

NRCS, as the lead Federal Agency, is completing a Plan-EIS to develop solutions that will provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin. The solutions currently proposed, which are being evaluated through the process, include reductions in agricultural irrigation, conservation practices aimed at reducing water needs or consumption, and an augmentation wellfield. The proposed augmentation wellfield would consist of up to 45 wells that pump groundwater to a collection pipeline that discharges to Rattlesnake Creek at the QNWR border. A Cultural Resources Phase II survey (as requested by the State Historic Preservation Office (SHPO) will be completed during the design phase, after the Watershed Plan-EIS is complete and authorized.

The location of the augmentation wellfield is shown on the Project Area map Figure 1. The wellfield area where the proposed ground disturbance could occur is shown in Figure 2.

If you have any cultural resource concerns related to this project, please provide it in writing by mail or email within 30 days of receipt of this letter.

(more)

Your response will be addressed by Brandy A. Dacus, Archaeologist and Cultural Resources Specialist. Your response may be sent to the following address:

Brandy A. Dacus
Cultural Resources Specialist
Natural Resources Conservation Service
760 South Broadway Boulevard
Salina, Kansas 67401-4604
brandy.dacus@usda.gov

Sincerely,

DAVID S. DOCTORIAN
State Conservationist

Enclosures:

1. Figure 1. Proposed Project Area with Rattlesnake Watershed and Wellfield Augmentation Area locations.
2. Figure 2. Conceptual Layout of Augmentation Wellfield and Delivery Pipeline (GMD #5 2022b). Area of Installation corresponds with Wellfield augmentation area depicted by purple hatched polygon in Figure 1.

ec:
Andrew G. Burr, Acting State Resource Conservationist, NRCS, Salina, Kansas
Larry J. Schieferecke, State Conservation Engineer, NRCS, Salina, Kansas
Brandy A. Dacus, Cultural Resources Specialist, NRCS, Salina, Kansas
Kris R. Ethridge, Assistant State Conservationist for Field Operations, NRCS, Hutchinson, Kansas
Joshua Adelhardt, Supervisory District Conservationist, NRCS, Pratt, Kansas
Aaron Ball, Vice President, Olsson, 7301 W. 133rd Street, Suite 200, Overland Park, Kansas 66213
Orrin Feril, Manager, Big Bend Groundwater Management District 5, 125 S Main St, Stafford, Kansas 67578

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
760 S Broadway, Salina, Kansas, 67401
P: (785) 823-4534 | c: (785) 515-8122
e: larry.schieferecke@usda.gov | w: www.ks.nrcs.usda.gov
USDA is an equal opportunity provider, employer, and lender.

From: Dacus, Brandy - FPAC-NRCS, KS <brandy.dacus@usda.gov>
Sent: Wednesday, August 21, 2024 9:23 AM
To: Katrina Ringler [KSHS] <Katrina.Ringler@ks.gov>; Beltz, Shelby [KSHS] <Shelby.Beltz@ks.gov>
Cc: Schieferecke, Larry - FPAC-NRCS, KS <larry.schieferecke@usda.gov>; Krehbiel, Dean - FPAC-NRCS, KS <dean.krehbiel@usda.gov>
Subject: 22-10-002 Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO Draft

Dear Ms. Ringler,

The Great Bend Groundwater Management District No.5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed in Stafford County, Kansas. Due to the project's being a voluntary enrollment, the final location of the project components are not known during the planning phase. A draft version of this programmatic agreement for a phased cultural resource survey approach has been drafted by Kansas NRCS with guidance from the National Watershed Management Team.

As your office is a main signatory, we are submitting it informally to your o ice to allow for your team to review and comment in the Phased PA draft. Please send us any comments and/or suggestions you have by September 20, 2024 (30 calendar days). If you would like to discuss this agreement, please let me know at your earliest availability to meet. Once the agreement has been reviewed and if no major edits from your office need to be addressed, the agreement will be submitted for signature formally through your review of compliance

portal. and file the signed document with the ACHP. Once the ACHP is in receipt this agreement, the agreement will be considered executed. Additionally, we are also circulating this for informal comments by our consulting tribal parties that have an interest in Stafford County, Kansas.

Sincerely,

Brandy A Dacus, M.S., RPA
Kansas NRCS State Archeologist

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

760 South Broadway Blvd, Salina, Kansas, 67401
p: 785.823.4522 | c: 785.955-2042
e: brandy.dacus@usda.gov | w: www.nrcs.usda.gov/Kansas

Larson, Paul - FPAC-NRCS, KS

From: Schieferecke, Larry - FPAC-NRCS, KS
Sent: Wednesday, August 21, 2024 9:42 AM
To: Larson, Paul - FPAC-NRCS, KS; Hunninghake, Kimberly - FPAC-NRCS, KS; Reisinger, Megan - FPAC-NRCS, KS; Gray, Laura - FPAC-NRCS, KS
Subject: FW: Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO
Attachments: Draft_Watershed PHASED PA_Rattlesnake Creek 2024-07-29.docx

Tribal consultation…

Larry J. Schieferecke
State Conservation Engineer

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
760 S Broadway, Salina, Kansas, 67401
P: (785) 823-4534 | c: (785) 515-8122
e: larry.schieferecke@usda.gov | w: www.ks.nrcs.usda.gov
USDA is an equal opportunity provider, employer, and lender.

From: Dacus, Brandy - FPAC-NRCS, KS <brandy.dacus@usda.gov>
Sent: Wednesday, August 21, 2024 9:41 AM
To: Prairie Band Potawatomi Nation <raphaelwahwassuck@pbpnation.org>
Cc: Schieferecke, Larry - FPAC-NRCS, KS <larry.schieferecke@usda.gov>; Krehbiel, Dean - FPAC-NRCS, KS <dean.krehbiel@usda.gov>
Subject: Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO

Dear Mr. Wahwassuck,

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed in Stafford County, Kansas. Due to the project's being a voluntary enrollment, the final location of the project components are not known during the planning phase. A draft version of this programmatic agreement for a phased cultural resource survey approach has been drafted by Kansas NRCS with guidance from the National Watershed Management Team. **As your office is a consulting party, we are submitting it informally to your office to allow for review and comments on this Phased PA draft.** Please send us any comments and/or suggestions you have by September 20, 2024 (30 calendar days). If you would like to discuss this agreement, please let me know at your earliest availability to meet. Once the agreement has been commented on, Kansas NRCS and the Kansas SHPO's office will be finalizing this phased approach agreement. The signed phase programmatic agreement draft will be filed with the ACHP. Once the ACHP is in receipt this agreement, the agreement will be considered executed.

Sincerely,

Brandy A Dacus, M.S., RPA
Kansas NRCS State Archeologist

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
760 South Broadway Blvd, Salina, Kansas, 67401
p: 785.823.4522 | c: 785.955-2042
e: brandy.dacus@usda.gov | w: www.nrcs.usda.gov/Kansas

Larson, Paul - FPAC-NRCS, KS

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Sent: Wednesday, August 21, 2024 9:41 AM
To: Larson, Paul - FPAC-NRCS, KS; Hunninghake, Kimberly - FPAC-NRCS, KS; Reisinger, Megan - FPAC-NRCS, KS; Gray, Laura - FPAC-NRCS, KS
Subject: FW: Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO
Attachments: Draft_Watershed PHASED PA_Rattlesnake Creek 2024-07-29.docx

Another THPO consultation…

Larry J. Schieferecke
State Conservation Engineer

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
760 S Broadway, Salina, Kansas, 67401
P: (785) 823-4534 | c: (785) 515-8122
e: larry.schieferecke@usda.gov | w: www.ks.nrcs.usda.gov
USDA is an equal opportunity provider, employer, and lender.

From: Dacus, Brandy - FPAC-NRCS, KS <brandy.dacus@usda.gov>
Sent: Wednesday, August 21, 2024 9:39 AM
To: Amanda Hill (ahill@kiowatribe.org) <ahill@kiowatribe.org>; Kiowa Tribe of Indians in Okalahoma (thpo@kiowatribe.org) <thpo@kiowatribe.org>
Cc: Schieferecke, Larry - FPAC-NRCS, KS <larry.schieferecke@usda.gov>; Krehbiel, Dean - FPAC-NRCS, KS <dean.krehbiel@usda.gov>
Subject: Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO

Dear Ms. Hill,

The Great Bend Groundwater Management District No. 5 (GMD-5) s cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed in Stafford County, Kansas. Due to the project's being a voluntary enrollment, the final location of the project components are not known during the planning phase. A draft version of this programmatic agreement for a phased cultural resource survey approach has been drafted by Kansas NRCS with guidance from the National Watershed Management Team.
As your office is a consulting party, we are submitting it informally to your office to allow for review and comments on this Phased PA draft. Please send us any comments and/or suggestions you have by September 20, 2024 (30 calendar days). If you would like to discuss this agreement, please let me know at your earliest availability to meet. Once the agreement has been commented on, Kansas NRCS and the Kansas SHPO's office will be finalizing this phased approach agreement. The signed phase programmatic agreement draft will be filed with the ACHP. Once the ACHP is in receipt this agreement, the agreement will be considered executed.

Sincerely,

Brandy A Dacus, M.S., RPA
Kansas NRCS State Archeologist

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
760 South Broadway Blvd, Salina, Kansas, 67401
p: 785.823.4522 | c: 785.955-2042
e: brandy.dacus@usda.gov | w: www.nrcs.usda.gov/Kansas

Larson, Paul - FPAC-NRCS, KS

From: Schieferecke, Larry - FPAC-NRCS, KS
Sent: Wednesday, August 21, 2024 9:40 AM
To: Larson, Paul - FPAC-NRCS, KS; Hunninghake, Kimberly - FPAC-NRCS, KS; Reisinger, Megan - FPAC-NRCS, KS; Gray, Laura - FPAC-NRCS, KS
Subject: FW: Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO
Attachments: Draft_Watershed PHASED PA_Rattlesnake Creek 2024-07-29.docx

FYI… More THPO consultations.

Larry J. Schieferecke
State Conservation Engineer

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
760 S Broadway, Salina, Kansas, 67401
P: (785) 823-4534 | c: (785) 515-8122
e: larry.schieferecke@usda.gov | w: www.ks.nrcs.usda.gov
USDA is an equal opportunity provider, employer, and lender.

From: Dacus, Brandy - FPAC-NRCS, KS <brandy.dacus@usda.gov>
Sent: Wednesday, August 21, 2024 9:38 AM
To: Wichita and Affiliated Tribes <robin.williams@wichitatribe.com>
Cc: Schieferecke, Larry - FPAC-NRCS, KS <larry.schieferecke@usda.gov>; Krehbiel, Dean - FPAC-NRCS, KS <dean.krehbiel@usda.gov>
Subject: Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO

Dear Ms. Williams,

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed in Stafford County, Kansas. Due to the project's being a voluntary enrollment, the final location of the project components are not known during the planning phase. A draft version of this programmatic agreement for a phased cultural resource survey approach has been drafted by Kansas NRCS with guidance from the National Watershed Management Team.
As your office is a consulting party, we are submitting it informally to your office to allow for review and comments on this Phased PA draft. Please send us any comments and/or suggestions you have by September 20, 2024 (30 calendar days). If you would like to discuss this agreement, please let me know at your earliest availability to meet. Once the agreement has been commented on, Kansas NRCS and the Kansas SHPO's office will be finalizing this phased approach agreement. The signed phase programmatic agreement draft will be filed with the ACHP. Once the ACHP is in receipt this agreement, the agreement will be considered executed.

Sincerely,

Brandy A Dacus, M.S., RPA
Kansas NRCS State Archeologist

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p: 785.823.4522 | c: 785.955-2042
e: brandy.dacus@usda.gov | w: www.nrcs.usda.gov/Kansas

Larson, Paul - FPAC-NRCS, KS

From: Schieferecke, Larry - FPAC-NRCS, KS
Sent: Wednesday, August 21, 2024 9:39 AM
To: Larson, Paul - FPAC-NRCS, KS; Hunninghake, Kimberly - FPAC-NRCS, KS; Reisinger, Megan - FPAC-NRCS, KS; Gray, Laura - FPAC-NRCS, KS
Subject: FW: Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO
Attachments: Draft_Watershed PHASED PA_Rattlesnake Creek 2024-07-29.docx

FYI…

Larry J. Schieferecke
State Conservation Engineer

USDA Natural Resources Conservation Service
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760 S Broadway, Salina, Kansas, 67401
P: (785) 823-4534 | c: (785) 515-8122
e: larry.schieferecke@usda.gov | w: www.ks.nrcs.usda.gov
USDA is an equal opportunity provider, employer, and lender.

From: Dacus, Brandy - FPAC-NRCS, KS <brandy.dacus@usda.gov>
Sent: Wednesday, August 21, 2024 9:37 AM
To: Edgar Alarcon <edgar.alarcon@osagenation-nsn.gov>; Colleen A. Bell <colleen.bell@osagenation-nsn.gov>
Cc: Schieferecke, Larry - FPAC-NRCS, KS <larry.schieferecke@usda.gov>; Krehbiel, Dean - FPAC-NRCS, KS <dean.krehbiel@usda.gov>
Subject: Rattlesnake Creek Watershed Plan EIS: DRAFT Phased programmatic agreement between NRCS Kansas and Kansas SHPO

Dear Tribal Historic Preservation Officer,

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed in Stafford County, Kansas. Due to the project's being a voluntary enrollment, the final location of the project components are not known during the planning phase. A draft version of this programmatic agreement for a phased cultural resource survey approach has been drafted by Kansas NRCS with guidance from the National Watershed Management Team.

As your office is a consulting party, we are submitting it informally to your office to allow for review and comments on this Phased PA draft. Please send us any comments and/or suggestions you have by September 20, 2024 (30 calendar days). If you would like to discuss this agreement, please let me know at your earliest availability to meet. Once the agreement has been commented on, Kansas NRCS and the Kansas SHPO's office will be finalizing this phased approach agreement. The signed phase programmatic agreement draft will be filed with the ACHP. Once the ACHP is in receipt this agreement, the agreement will be considered executed.

Sincerely,

Brandy A Dacus, M.S., RPA
Kansas NRCS State Archeologist

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE
760 South Broadway Blvd, Salina, Kansas, 67401
p: 785.823.4522 | c: 785.955-2042
e: brandy.dacus@usda.gov | w: www.nrcs.usda.gov/Kansas

Larson, Paul - FPAC-NRCS, KS

From: SM.FPAC.NRCS.KS.CulturalResources
Sent: Tuesday, September 3, 2024 2:02 PM
To: mbear@cheyenneandarapaho-nsn.gov
Cc: Larson, Paul - FPAC-NRCS, KS; Schieferecke, Larry - FPAC-NRCS, KS; White, John - FPAC-NRCS, KS; Hunninghake, Kimberly - FPAC-NRCS, KS
Subject: 22-10-002 Rattlesnake Creek Watershed Plan EIS: Phased programmatic agreement between NRCS Kansas and Kansas SHPO Draft
Attachments: Draft_Watershed PHASED PA_Rattlesnake Creek 2024-08-09.docx

Dear Max Bear,

We recently were made aware that your office is interested in this watershed project in Stafford County, Kansas. At this time, there is a Separate consultation letter being drafted and sent as well inviting you to be a consulting party on this watershed project. This e-mail is being sent to solicit comments for a phased programmatic agreement we have drafted to be signed by the Kansas SHPO, with several tribes being included as interested consulting parties.

The Great Bend Groundwater Management District No. 5 (GMD-5) is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Watershed Work Plan (Work Plan) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed in Stafford County, Kansas. Due to the project's being a voluntary enrollment, the final location of the project components are not known during the planning phase. A draft version of this programmatic agreement for a phased cultural resource survey approach has been drafted by Kansas NRCS with guidance from the National Watershed Management Team.

As your office is a consulting party, we are submitting it informally to your office to allow for review and comments on this Phased PA draft. Please send us any comments and/or suggestions you have by October 3, 2024 (30 calendar days). If you would like to discuss this agreement, please let me know at your earliest availability to meet. Once the agreement has been commented on, Kansas NRCS and the Kansas SHPO's office will be finalizing this phased approach agreement. The signed phase programmatic agreement draft will be filed with the ACHP. Once the ACHP is in receipt this agreement, the agreement will be considered executed.

Sincerely,

Brandy A Dacus, M.S., RPA
Kansas NRCS State Archeologist

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USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Kansas State Office
760 S. Broadway Blvd.
Salina, Kansas 67401

September 6, 2024

CERTIFIED – RETURN RECEIPT REQUESTED

Cheyenne and Arapaho Tribes, Oklahoma
Attn: Max Bear, Tribal Historic Preservation Officer
700 Black Kettle Blvd
Concho, OK – 73022

RE: NHPA Section 106 Consultation for Great Bend Groundwater Management District No. 5 (GMD#5) Rattlesnake Creek Watershed Project, Stafford County, KS

Dear Max Bear:

The GMD#5 is cooperating with Kansas Natural Resources Conservation Service (NRCS) in the development of a Plan Environmental Impact Statement (Plan-EIS) to provide management and timing of surface water flow throughout the Rattlesnake Creek Watershed, a surface water source for Quivira National Wildlife Refuge (QNWR). GMD#5 has contracted with an Architectural and Engineering (A&E) firm, Olsson, to complete the Plan-EIS. The Plan-EIS is required to address all social, environmental, and economic impacts, as well as the completion according to all requirements of the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA).

NRCS, as the lead Federal Agency, is completing a Plan-EIS to develop solutions that will provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin. The solutions currently proposed, which are being evaluated through the process, include reductions in agricultural irrigation, conservation practices aimed at reducing water needs or consumption, and an augmentation wellfield. The proposed augmentation wellfield would consist of up to 56 wells that pump groundwater to a collection pipeline that discharges to Rattlesnake Creek at the QNWR border.

To comply with the NHPA Section 106, NRCS must consult with Federal, State, Certified Local Governments, Tribal Governments, Special Commissions with statutory authority to coordinate resource planning, and other agencies and entities, as applicable and required by laws and policies. A Cultural Resources Phase II survey (as requested by the State Historic Preservation Office (SHPO)) will be completed during the design phase, after the Watershed Plan-EIS is complete and authorized. NRCS, with the concurrence of Kansas

(more)

SHPO, has decided to comply with Section 106 of the NHPA through the execution and implementation of a Programmatic Agreement (PA) for a phased approach because NRCS Kansas cannot fully determine the effects the project will have on Historic Properties [36 C.F.R. § 800.14(b)(1)(ii)], before the project will be approved and funded. The PA will establish the process NRCS Kansas follows for compliance with NHPA regarding the project, taking into consideration the views of the required signatories, invited signatory and concurring parties. Cheyenne and Arapaho Tribes of Oklahoma will be consulted through the PA process as a concurring party.

The proposed location of the augmentation wellfield is shown on the Project Area map in Figure 1. The wellfield area where the proposed ground disturbance could occur is shown in Figure 2. If you have any cultural resource concerns related to this project, please provide it in writing by mail or email within 30 days of receipt of this letter.

Your response will be addressed by Brandy A. Dacus, Archaeologist and Cultural Resources Specialist. Your response may be sent to the following address:

Brandy A. Dacus
Cultural Resources Specialist
Natural Resources Conservation Service
760 South Broadway Boulevard
Salina, Kansas 67401-4604
brandy.dacus@usda.gov

Sincerely,

DAVID S. DOCTORIAN
State Conservationist

Enclosures:

1. Figure 1. Proposed Project Area with Rattlesnake Watershed and Wellfield Augmentation Area locations.
2. Figure 2. Conceptual Layout of Augmentation Wellfield and Delivery Pipeline (GMD#5 2022b). Area of Installation corresponds with Wellfield augmentation area depicted by purple hatched polygon in Figure 1.

ec:
Andrew G. Burr, Acting State Resource Conservationist, NRCS, Salina, Kansas
Larry J. Schieferecke, State Conservation Engineer, NRCS, Salina, Kansas
Brandy A. Dacus, Cultural Resources Specialist, NRCS, Salina, Kansas

Kris R. Ethridge, Assistant State Conservationist for Field Operations, NRCS, Hutchinson, Kansas
Joshua Adelhardt, Supervisory District Conservationist, NRCS, Pratt, Kansas
Aaron Ball, Vice President, Olsson, 7301 W. 133rd Street, Suite 200, Overland Park, Kansas 66213
Orrin Feril, Manager, Big Bend Groundwater Management District 5, 125 S Main St, Stafford, Kansas 67578

August 27, 2025

Brandy Dacus
Cultural Resources Specialist
Natural Resources Conservation Service

Ref: *Programmatic Agreement for Rattlesnake Creek Watershed Improvement Project*
Stafford County, Kansas
ACHP Project Number: 022846

Dear Mr. Dacus:

On August 13, 2025, the Advisory Council on Historic Preservation (ACHP) received a copy of the executed Section 106 agreement document (Agreement) for the referenced undertaking. In accordance with 36 CFR § 800.6(b)(1)(iv), the ACHP acknowledges receipt of the Agreement. The filing of the Agreement and implementation of its terms fulfills the requirements of Section 106 of the National Historic Preservation Act and its implementing regulations, "Protection of Historic Properties" (36 CFR Part 800).

We appreciate receiving a copy of this Agreement for our records. Please ensure that all consulting parties are provided a copy of the executed Agreement in accordance with 36 CFR § 800.6(c)(9). If you have any questions or require additional assistance, please contact Alexis Clark at (202) 517-0208 or by e-mail at aclark@achp.gov and reference the ACHP Project Number above.

Sincerely,

Dana Daniels
Historic Preservation Technician
Office of Federal Agency Programs

PROGRAMMATIC AGREEMENT FOR A PHASED APPROACH AMONG THE US DEPARTMENT OF AGRICULTURE, NATURAL RESOURCES CONSERVATION SERVICE KANSAS, KANSAS STATE HISTORIC PRESERVATION OFFICER, BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5, AND THE OSAGE NATION

REGARDING RATTLESNAKE CREEK WATERSHED PROJECT

WHEREAS, the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) administers numerous voluntary assistance programs, special initiatives, and grant and emergency response programs for soil, water, and related resource conservation activities available to eligible private producers, States, commonwealths, Federally Recognized Tribal governments, other government entities, and other applicants for conservation assistance, pursuant to the Agricultural Act of 2018 (2018 Farm Bill, Public Law 113-79); the Flood Control Act of 1944 (Public Law 78-534, as amended); the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended, 16 U.S.C. 1001-1012); the Flood Control Act of 1936 (Public Law 74-738; and executive and secretarial orders, implementing regulations and related authorities; and

WHEREAS, NRCS Kansas, through the Watershed Protection and Flood Prevention program, as authorized by the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended, 16 U.S.C. 1001-1012), is providing assistance to Big Bend Groundwater Management District No. 5 (GMD#5) to develop a watershed plan - environmental impact statement to identify agricultural water management improvements for the Rattlesnake Creek Watershed (Undertaking); and

WHEREAS, GMD#5 is the non-Federal project sponsor for the Undertaking, and GMD#5 is an Invited Signatory to this Programmatic Agreement (PA); and

WHEREAS, GMD#5 has applied for NRCS financial assistance for the planning of the Project and NRCS has obligated funding, making it an undertaking subject to review under Section 106 of the National Historic Preservation Act (NHPA; 54 USC 306108) and its implementing regulations, Protection of Historic Properties (36 CFR Part 800); and

WHEREAS, NRCS Kansas has coordinated public participation for this PA through the process set forth in the National Environmental Policy Act (NEPA); and

WHEREAS, NRCS is phasing identification and evaluation of historic properties and application of the criteria of adverse effects in accordance with 36 CFR Part 800.4(b)(2) and 36 CFR Part 800.5(a)(3), respectively, because the Project consists of an extensive water well field and pipeline system, and the precise location of these components will not be determined until the Design phase. The Area of Potential Effect (APE) will be defined in the Design phase for Section 106 identification and evaluation of historical properties; and

WHEREAS, NRCS Kansas, with the concurrence of Kansas State Historic Preservation Officer (SHPO), has decided to comply with Section 106 of the NHPA for the undertaking through the execution and implementation of this PA because NRCS Kansas cannot fully determine the effects of the Undertaking on Historic Properties [36 C.F.R. § 800.14(b)(1)(ii)], before the project will be approved and funded; and

WHEREAS, this PA shall establish the process NRCS Kansas shall follow for compliance with NHPA regarding the Undertaking, taking into consideration the views of the Required Signatories, Invited Signatories, and Concurring Parties; and

WHEREAS, in accordance with 36 C.F.R. §§ 800.2(c)(2)(ii)(A), 800.3(f)(2), and 800.14(b)(2)(i), NRCS Kansas has contacted Wichita and Affiliated Tribes, The Osage Nation, Kiowa Tribe of Oklahoma, Prairie Band Potawatomi Nation, and Cheyenne and Arapaho Tribes of Oklahoma to invite them to consult on this Undertaking and to participate as Invited Signatories or Concurring Parties to this PA; and

WHEREAS, The Osage Nation accepted to participate as an Invited Signatory to this PA; and

WHEREAS, the Wichita and Affiliated Tribes, Kiowa Tribe of Oklahoma, Prairie Band Potawatomi Nation, and Cheyenne and Arapaho Tribes of Oklahoma have not responded, and NRCS Kansas will continue to consult with them throughout the development and implementation of this PA; and

WHEREAS, in accordance with 36 C.F.R. § 800.14(b)(3), NRCS Kansas notified and invited the Advisory Council on Historic Preservation (ACHP) per 36 C.F.R. § 800.6(a)(1)(C) to participate in consultation to develop this PA, and the ACHP declined to participate in a letter dated 05/2/2025; and

WHEREAS, GMD#5 is responsible for the design, engineering, and construction of the Undertaking and will coordinate with NRCS to facilitate and fund the completion of any needed historic property inventory survey. GMD#5 will also coordinate with NRCS to facilitate and fund any measures required for mitigation of adverse effects to historic properties as determined by NRCS; and

NOW, THEREFORE, the NRCS Kansas, Big Bend Groundwater Management District No. 5, the Kansas SHPO, and The Osage Nation (Consulting Parties) agree that this

Undertaking in Kansas shall be implemented in accordance with the following stipulations to consider the effect of the undertaking on historic properties.

STIPULATIONS

NRCS shall ensure that the following stipulations are met and carried out:

I. Conditions

a. The definitions set forth in 36 CFR 800.16 are incorporated herein by reference and apply throughout this Agreement.

b. NRCS Kansas shall administer this PA consistent with the requirements of 36 CFR 800.2(a).

c. Unless otherwise noted, all timelines are in calendar days.

d. NRCS Kansas will submit determinations, findings, draft and final reports, treatment plans, and site forms to the Consulting Parties for their review and comment.

e. Concurrence: When NRCS Kansas provides determinations, findings, draft and final reports, treatment plans, and site forms to consulting parties for a thirty (30) day review period, on day twenty-five (25), NRCS Kansas shall contact The Osage Nation to determine their intent to response. No response by the other consulting parties within thirty (30) days shall be understood to indicate concurrence with (no objection to) the materials provided.

f. NRCS will ensure that GMD#5 fulfills its responsibilities under this PA and Section 106 concludes prior to any ground disturbance and construction.

g. GMD#5 shall:

   i. Notify NRCS Kansas of all proposed activities related to this Project and changes of contractors within fourteen (14) days.

   ii. Prior to the start of the Project, submit to NRCS Kansas, in writing, that they are aware that NRCS Kansas reserves the right, based on NRCS Policy in 420 GM 401.23, to withdraw all funds if project work commences prior to the completion of Section 106.

   iii. Ensure contractors will not begin work prior to the NRCS Kansas State Conservationist having issued a Notice to Proceed for each portion of the Project after completion of the Section 106 process.

   iv. Ensure contractors follow the standards for survey and reporting set forth in *the Kansas SHPO's Guide to Archeological Survey, Assessment, and Reports* (2004, Updated 2023)

   v. Submit, or have their contractor submit, shapefiles of 60 percent design drawings of the Project to the NRCS Kansas Cultural Resource Specialist/Archeologist to aid in

the development of the APE.

vi. Include a stop work order clause in all construction contracts that includes the provisions of Appendix B per Stipulation X (Inadvertent Construction Discovery Plan) of this PA.

NRCS will provide notification of completion of the Section 106 process to GMD#5.

II. Professional Qualification Standards

a. All technical work required for historic preservation activities implemented pursuant to this PA shall be carried out by or under the direct in-field supervision of, at a minimum, a Cultural Resource specialist that meets the *Secretary of the Interior's Professional Qualifications Standards* for archeology or history, as appropriate (48 CFR 44739). "Technical work" is defined as all efforts to inventory, evaluate, and perform subsequent treatment such as data recovery excavation or recordation of potential Historic Properties that is required under this PA. This stipulation shall not be construed to limit peer review, guidance, or editing of documents by Consulting Parties.

b. In consultation with the Consulting Parties, and any Indian tribe that attaches religious and cultural significance to identified properties and guided by the Secretary's standards and guidelines for evaluation, the agency official shall apply the National Register criteria (36 CFR part 63) to properties identified within the area of potential effects that have not been previously evaluated for National Register eligibility. The passage of time, changing perceptions of significance, or incomplete prior evaluations may require the agency official to reevaluate properties previously determined eligible or ineligible. The agency official shall acknowledge that Indian tribes possess special expertise in assessing the eligibility of historic properties that may possess religious and cultural significance to them (36 CFR 800.4.c.(1)).

c. GMD#5 will comply with federal, state, and local permit requirements.

III. Defining the Area of Potential Effects (APE)

a. The Project Area, as established (Appendix A: Figures 3 and 4), encompasses the entirety of the Undertaking. The APE is defined as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may vary for different kinds of effects caused by the undertaking [36 CFR 800.16(d)]. As the locations of the components for the Undertaking are identified and finalized, NRCS Kansas will define the APE for the Undertaking.

b. Once established, NRCS Kansas will submit the APE to all parties to the PA for review and comment prior to commencing cultural resources inventories. Upon receipt, all parties will have thirty (30) days to review and provide comments to NRCS Kansas on the

proposed revised APE. NRCS Kansas will consider any comments received to finalize the APE. Failure of any party to comment within thirty (30) days shall not preclude NRCS Kansas from finalizing the revised APE. After the comment period, NRCS Kansas is responsible for distributing the final APE to all parties to the PA. NRCS Kansas will follow the Dispute Resolution process outlined in Stipulation XI. of this PA for disputes regarding delineation of the APE that cannot be resolved during the thirty (30) day review and comment period as set forth above.

c. The APE will include all areas that may be affected by all ground disturbance and construction of the undertaking including all staging areas, access roads, borrow areas, utility lines, and other related transmission infrastructure for this Undertaking. NRCS Kansas may modify the APE in consultation and concurrence with the Consulting Parties.

d. As the Undertaking progresses, design changes may be necessary. If any such changes would necessitate modification of an APE that has already been agreed to, NRCS Kansas will submit a modified APE to all parties to this PA for review and comment as outlined above. The APE may be changed as described herein without requiring amendment to this PA proper.

IV. Inventory and Evaluation of Historic Properties

a. NRCS Kansas is responsible for identifying historic properties present within the APE prior to any activity that has the potential to cause effects to historic properties.

b. In accordance with 36 CFR Part 800.4(a) and (b), NRCS Kansas, in consultation and concurrence with the Consulting Parties, will identify the appropriate scope and level of effort needed to identify historic properties, including those to which Indian tribes attach traditional religious and cultural significance. The scope and level of effort for the identification effort shall meet the reasonable and good faith regulatory standard (36 CFR Part 800.4(b)(1)).

c. Identification of Historic Properties: After NRCS Kansas finalizes the APE, an archeological field investigation will be conducted utilizing the guidelines set forth in the *Kansas SHPO's Guide to Archeological Survey, Assessment, and Reports* as well as *The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation* (48 FR 44716-42).

d. A viewshed analysis will be performed once the APE is defined to assess the potential effects to the Built Environment. A Geographic Information System viewshed analysis will be used to evaluate the visual effects of this Undertaking on historic properties within a 200-meter radius of large, permanent above-ground structures. If any historic properties are located within that radius, NRCS Kansas will consult with the Consulting Parties regarding landscaping, color, or architectural design of permanent above-ground structures to minimize adverse visual effects to nearby historic

properties. Constructed structures, facilities, and features would be designed to blend with the architectural characteristics of surrounding structures.

V. Historic Property Identification during Construction

This phase will include archeological and architectural surveys as needed, of any modifications and/or additions to the Project that are outside the currently defined APE (including changes in construction rights of-way, access roads, borrow pits, staging areas, and ancillary areas). Where NRCS Kansas, in consultation and concurrence with the Consulting Parties, determines that additional inventory is needed, no ground disturbance will be authorized in the newly defined APE until the inventory, the effects determinations, and any required on-site mitigation measures are completed, and a Notice to Proceed is issued. NRCS Kansas will determine where construction may continue while the additional work is being completed.

VI. Reports and Technical Review

a. All archeological and architectural resources identified during surface and/or subsurface surveys will be recorded on the appropriate Kansas Historic Resources Inventory (KHRI) and Kansas Archeological Survey (KSHS) site forms. The results of such field investigations shall be documented in stand-alone reports or in combined archeological, architectural, and/or ethnographic technical reports that meet the standards set forth in the Kansas *SHPO's Guide to Archeological Survey, Assessment, and Reports* (2004, Updated 2023) per Stipulation I.g.iv. All archeological technical reports shall include a Shovel Test Log and Shovel Test map that clearly depicts each labeled Shovel Test location, which shall be appended to the document. As archeological and architectural survey efforts may be non-concurrent, based on project phase, access to land, and availability of funding, multiple technical archeological and architectural survey reports may be produced. If cultural resources can be evaluated for National Register eligibility based on survey-level identification efforts alone, the resulting archeological and architectural survey report(s) may also include the National Register evaluation(s) of those resources as required in 36 CFR 800.11.

   NRCS Kansas will provide completed technical reports to consultation parties for review. The review period shall be thirty (30) days from the date of receipt by the consulting party. On day twenty-five (25), NRCS Kansas shall contact The Osage Nation to determine their intent to response. If no objections or requests for review extension are received by the thirty-first (31st) day, NRCS Kansas will move to the next step in the process.

b. Data, technical reports, and other information will be treated by NRCS Kansas and all Consulting Parties in accordance with the confidentiality requirements in Stipulation X.

c. If more than 10 technical reports are completed throughout the project, a single, final report summarizing work, recommendations, and findings—incorporating any comments obtained during each document's review period—will be generated and distributed to all consulting parties.

d. NRCS Kansas (or a party contracted by either NRCS or GMD#5) shall prepare a technical report(s) upon completion of field investigations. The technical report(s) shall include summary background information, environment, methodology, and analysis, results, recommendations for further study, maps, photos, relative scale drawings, references, and graphics as appropriate to meet the Kansas SHPO requirements. NRCS Kansas will review the report(s) for technical compliance and will provide the report(s) to all Consulting Parties. Consulting Parties will evaluate the completed technical report(s). The review period shall end thirty (30) days from the date of delivery to the Consulting Parties. On day twenty-five (25), NRCS Kansas shall contact The Osage Nation to determine their intent to response. If NRCS receives no objections by the thirty-first (31st) day, NRCS will move to the next step in the process.

e. The report(s) shall include a recommendation of eligibility and finding of effect for the Undertaking.

VII. Assessment of Effects

a. In accordance with 36 CFR 800.5, when historic properties are identified within the APE and being affected by the Undertaking, the NRCS Kansas will apply the criteria of adverse effects within the area of potential effects in consultation and concurrence with the Consulting Parties. NRCS Kansas remains responsible for all determinations of effects.

b. When historic properties will be adversely affected, mitigation shall occur in accordance with the Treatment Plan, which shall be developed in consultation and concurrence with the Consulting Parties.

VIII. Treatment Plan

a. Before construction begins, NRCS Kansas, in consultation and concurrence with the Consulting Parties and any Tribe(s) that attaches religious and cultural significance to identified historic properties, will prepare a Treatment Plan designed to resolve adverse effects on eligible Historic Properties within the APE. NRCS Kansas will consider any views concerning such effects which have been provided by the Consulting Parties and the public.

b. The Treatment Plan will be appended to this PA and will list all historic properties located within the APE that have been identified and are subject to adverse effects. The Treatment Plan will address all characteristics contributing to the Properties' eligibility to the NRHP and will identify the specific mitigation strategies proposed to address the direct, indirect, and cumulative effects of the Undertaking. The Treatment Plan will be consistent with *The Secretary of the Interior's Standards for the Treatment of Historic Properties* (36 CFR 68) and *The Secretary of the*

Interior's Standards and Guidelines for Archeology and Historic Preservation (48 FR 44716-42).

IX. Inadvertent / Construction Discovery Plan (IDP/CDP)

a. An IDP/CDP (see Appendix B) was developed as a component of this PA.

b. The IDP/CDP provides a logical process applicable to post-review discoveries of cultural resources or historic properties. The IDP/CDP includes notification of law enforcement in the event human remains are encountered.

X. Confidentiality

a. All Consulting Parties will ensure that shared data, including data concerning the precise location and nature of archeological historic properties and properties of religious and cultural significance, are protected from public disclosure to the greatest extent permitted by law, including conformance to Section 304 of the NHPA, as amended (54 U.S.C. § 307103) and implementing regulations under 36 CFR § 800.6(a)(5) and 36 CFR § 800.11(c); FOIA; E.O. 13007, and FR 61-104, dated May 24, 1996.

b. NRCS Kansas shall ensure that GMD#5 understands the requirements of the federal laws applicable to confidentiality and historic properties.

XI. Duration

a. This PA will be null and void if its terms are not carried out within ten (10) years from the date of its execution.

b. Prior to such time, NRCS Kansas may consult with the Consulting Parties to reconsider the terms of the PA and amend in accordance with Stipulation XIV below.

XII. Dispute Resolution

a. Should any party to this PA object at any time to any actions proposed or the manner in which the terms of this PA are implemented, NRCS Kansas shall consult with the objecting party (or parties) to resolve the objection. If NRCS Kansas determines, within thirty (30) days, that such objection(s) cannot be resolved, NRCS Kansas will forward all documentation relevant to the dispute to the Advisory Council on Historic Preservation (ACHP) in accordance with 36 CFR 800.2(b)(2). Upon receipt of adequate documentation, the ACHP shall review and advise NRCS Kansas on the resolution of the objection within thirty (30) days. Any comment provided by the ACHP, and all comments from the parties to the PA, will be considered by NRCS Kansas in reaching a final decision regarding the dispute.

b. If the ACHP does not provide comments regarding the dispute within thirty (30) days after receipt of adequate documentation, NRCS Kansas may

render a decision regarding the dispute. In reaching its decision, NRCS Kansas will consider all comments regarding the dispute from the Consulting Parties to the PA.

c. NRCS Kansas remains responsible to carry out all other actions subject to the terms of this PA that are not the subject of the dispute. NRCS Kansas will notify all Consulting Parties of its decision in writing before implementing that portion of the Undertaking subject to dispute under this stipulation. The NRCS Kansas decision will be final.

XIII. Amendments

a. Any Consulting Party to this PA may request, in writing, to the other Consulting Parties that it be amended, whereupon the Consulting Parties will consult for a period of no more than thirty (30) business days to consider such amendment. If any Consulting Party to this PA determines that its terms will not or cannot be carried out or that an amendment to its terms must be made, that party shall immediately consult with the other Consulting Parties to develop an amendment to this PA pursuant to 36 CFR 800.6(c)(7) and 800.6(c)(8).

b. The amendment will be effective on the date a copy signed by all the Consulting Parties is filed with the ACHP. If the Consulting Parties cannot agree to appropriate terms to amend the PA, any Consulting Party may terminate the PA in accordance with Stipulation XIII below.

XIV. Termination

a. If any Signatory or Invited Signatory to this PA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other Consulting Parties to attempt to develop an amendment per Stipulation XII, above. If within thirty (30) days (or another time period agreed to by all Consulting Parties) an amendment cannot be reached, any Signatory or Invited Signatory may terminate the PA upon written notification to the other Consulting Parties. Once the PA is terminated, and prior to work continuing on the Undertaking, NRCS Kansas must either (a) execute a PA pursuant to 36 CFR § 800.6 or (b) request, consider, and respond to the comments of the ACHP under 36 CFR § 800.7. NRCS Kansas shall notify the Consulting Parties of the course of action it will pursue.

b. If the PA is not amended following the consultation set out in Stipulation XII, it may be terminated by any Signatory or Invited Signatory. Within thirty (30) days following termination, NRCS Kansas shall notify the Consulting Parties if it will initiate consultation to execute a new PA with the Consulting Parties under 36 CFR 800.6(c)(l) or request the comments of the ACHP under 36 CFR 800.7(a) and proceed accordingly.

XV. Appendices

The following appendices are provided for reference after the signature pages.

a. Appendix A – Maps
b. Appendix B – Inadvertent / Construction Discovery Plan (IDP/CDP)

EXECUTION

Execution of this PA by the Consulting Parties, its submission to the ACHP, and subsequent implementation of its terms, is evidence that NRCS Kansas has afforded the ACHP an opportunity to comment on the Undertaking and its effects on historic properties; that NRCS Kansas has considered the effects of the Undertaking on historic properties; and that NRCS Kansas has satisfied its responsibilities under Section 106 and applicable implementing regulations for all aspects of the Undertaking.

PROGRAMMATIC AGREEMENT FOR A PHASED APPROACH

AMONG THE

US DEPARTMENT OF AGRICULTURE,

NATURAL RESOURCES CONSERVATION SERVICE KANSAS,

KANSAS STATE HISTORIC PRESERVATION OFFICER,

BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5,

AND

THE OSAGE NATION

REGARDING RATTLESNAKE CREEK WATERSHED PROJECT

Signatory

US DEPARTMENT OF AGRICULTURE - NATURAL RESOURCES CONSERVATION SERVICE - KANSAS

By: DAVID DOCTORIAN Digitally signed by DAVID DOCTORIAN Date: 2025.07.29 11:52:32 -05'00'

Name and Title: David S. Doctorian State Conservationist

Date: 7/29/25

PROGRAMMATIC AGREEMENT FOR A PHASED APPROACH

AMONG THE

US DEPARTMENT OF AGRICULTURE,

NATURAL RESOURCES CONSERVATION SERVICE KANSAS,

KANSAS STATE HISTORIC PRESERVATION OFFICER,

BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5,

AND

THE OSAGE NATION

REGARDING RATTLESNAKE CREEK WATERSHED PROJECT

Signatory

KANSAS STATE HISTORIC PRESERVATION OFFICER

By: Patrick Zollner

Name and Title: Patrick Zollner SHPO

Date: 6-10-25

PROGRAMMATIC AGREEMENT FOR A PHASED APPROACH

AMONG THE

US DEPARTMENT OF AGRICULTURE,

NATURAL RESOURCES CONSERVATION SERVICE KANSAS,

KANSAS STATE HISTORIC PRESERVATION OFFICER,

BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5,

AND

THE OSAGE NATION

REGARDING RATTLESNAKE CREEK WATERSHED PROJECT

Invited Signatory

BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5

By: _____

Name and Title: ORRIN FERIL MANAGER

Date: 7/18/2025

PROGRAMMATIC AGREEMENT FOR A PHASED APPROACH

AMONG THE

US DEPARTMENT OF AGRICULTURE,

NATURAL RESOURCES CONSERVATION SERVICE KANSAS,

KANSAS STATE HISTORIC PRESERVATION OFFICER,

BIG BEND GROUNDWATER MANAGEMENT DISTRICT NO. 5,

AND

THE OSAGE NATION

REGARDING RATTLESNAKE CREEK WATERSHED PROJECT

Invited Signatory

THE OSAGE NATION

By:

Geoffrey M. Standing Bear, Principal Chief

Date: 6/27/25

Appendix A - Maps

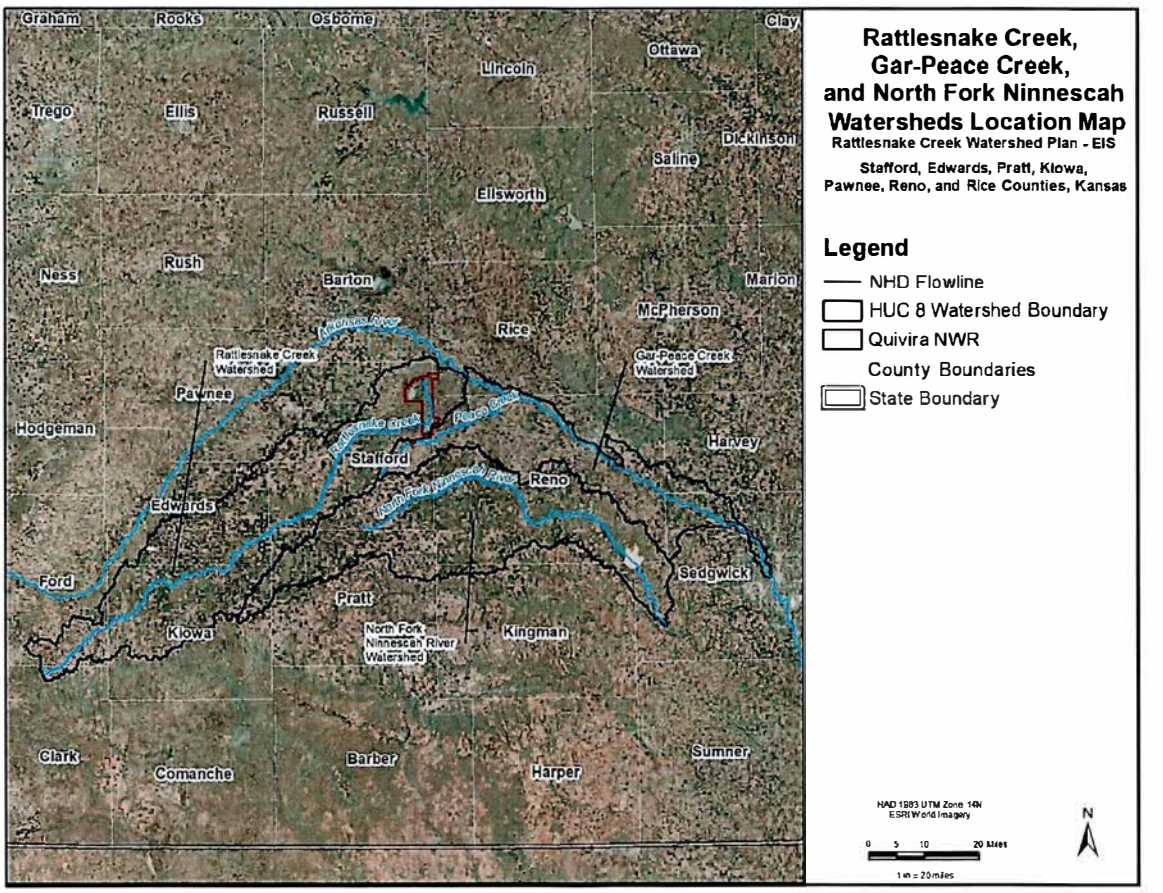


Figure 1. Rattlesnake Creek, Gar-Peace Creek, and North Fork Ninnescah River Watersheds Location Map.

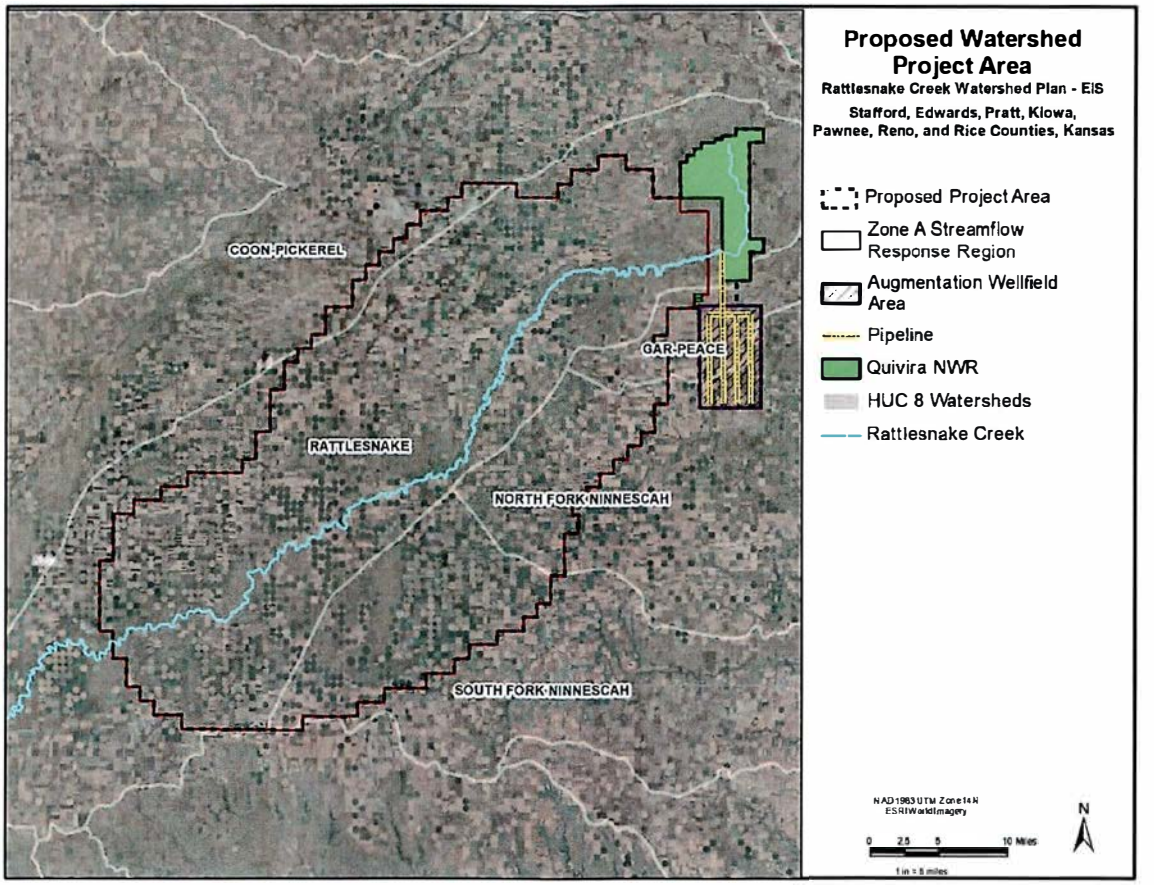


Figure 2. Watershed Plan Environmental Impact Statement (Plan-EIS) Project Area

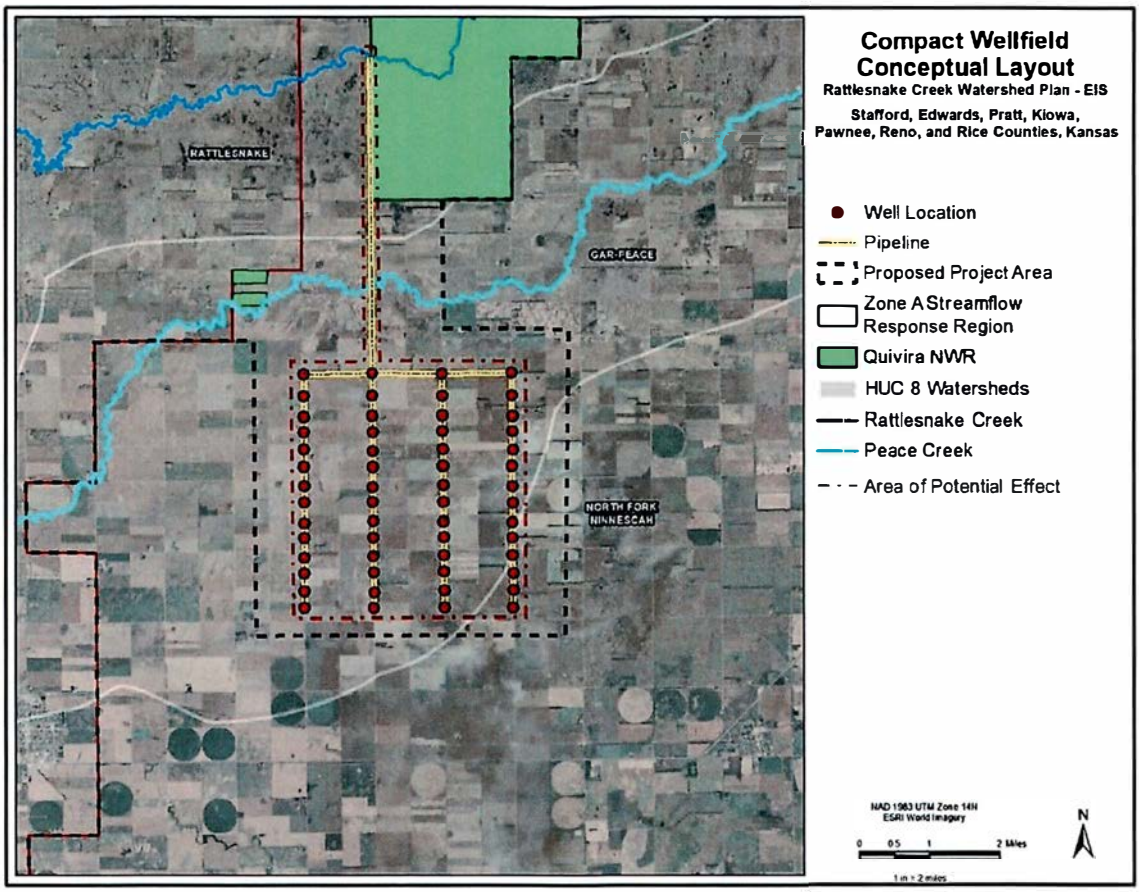


Figure 3. Project area: Compact Wellfield Conceptual Layout with a potential APE depicted with red hatched polygon.

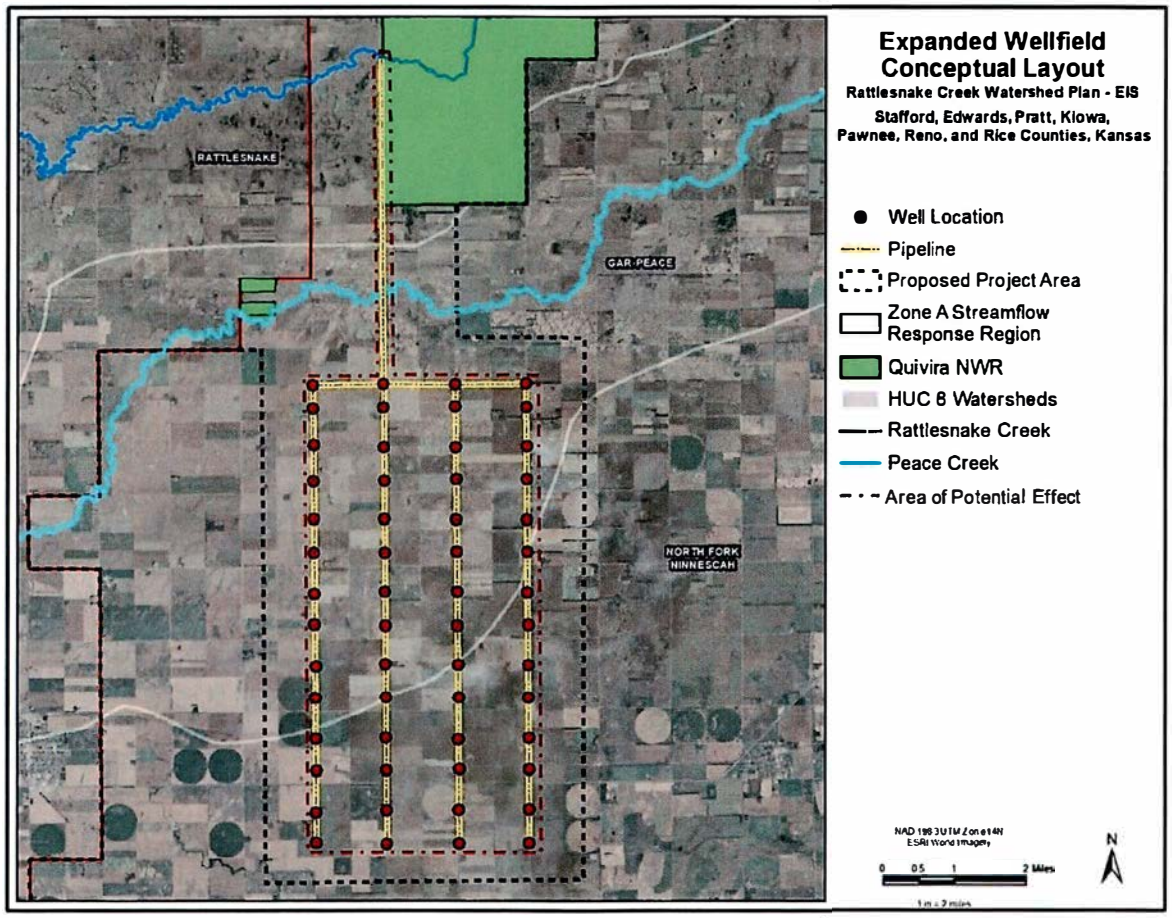


Figure 4. Project Area: Expanded Wellfield Conceptual Layout with a potential APE depicted with red hatched polygon.

Appendix B – Inadvertent Construction Discovery Plan (IDP/CDP)

This plan applies to post-review discoveries of cultural resources or historic properties and unanticipated effects to cultural resources or historic properties.

a. Where construction has not yet begun and a cultural resource is discovered after Section 106 review is complete, the NRCS shall consult to seek avoidance or minimization strategies in consultation and concurrence with the SHPO and Consulting Tribes, and/or to resolve adverse effects in accordance with 36 CFR Part 800.6.

b. The NRCS shall ensure that every contract during project implementation includes provisions for immediately halting construction in the area when potential historic properties are discovered or unanticipated effects to historic properties are found. When such a discovery occurs, GMD#5 or their contractor shall immediately notify the NRCS State Conservationist's Office, NRCS Cultural Resources Specialist (CRS), and supervisory NRCS personnel for the area. The NRCS CRS shall immediately notify the SHPO (SHPO contact info is included in Appendix [XX], KS State Archaeologist (contact info is included in Appendix [XX]) and Consulting Tribes. (Consulting Tribes includes Tribes listed in Appendix [XXX]).

    1. NRCS CRS shall inspect the discovery by the end of the next business day, if weather permits. In consultation with the local NRCS Supervisory District Conservationist, the NRCS State Conservation Engineer, Consulting Tribes, the SHPO, and GMD#5, the CRS shall establish a protective buffer zone surrounding the discovery. This action may require inspection by tribal or other cultural resources experts.

    2. NRCS Kansas employees, contractors, and applicants or their agents, representatives, and employees shall not contact or interact with members of the print, broadcast, digital, or other media or post, upload, or otherwise communicate via digital or social media matters or details concerning post-review discoveries absent prior consultation and concurrence with the affiliated Tribe/s with the historic property and SHPO. Access to these areas by unapproved visitors and media will not be permitted.

    3. Security shall be established to protect the resources/historic properties, workers, and private property. Local law enforcement authorities will be notified in accordance with applicable State law and NRCS policy to protect the resources. Construction work may resume outside the buffer only when the

State Conservationist determines it is appropriate and safe for the resources and workers.

4. NRCS CRS shall notify the SHPO, Consulting Tribes, and the ACHP no later than 2 business days after the discovery and describe the NRCS assessment of the National Register eligibility of the property and the proposed actions to resolve any adverse effects to historic properties. The eligibility determination may require the assessment and advice of Consulting Tribes, the SHPO, and technical experts (such as historic landscape architects) not employed by NRCS.
5. The SHPO, Consulting Tribes, and the ACHP shall respond within 48 hours from receipt of the notification with any comments on the discovery and proposed actions.
6. NRCS shall consider all responses and carry out appropriate actions to resolve any adverse effects.
7. NRCS shall provide a report to the SHPO, Consulting Tribes, and the ACHP of the actions when they are completed.

c. When human remains are discovered, the NRCS shall follow all applicable federal, tribal, and state burial laws and ordinances, including the Native American Graves Protection and Repatriation Act and its implementing regulations (NAGPRA) when on tribal or federal lands, the Kansas Unmarked Burial Site Preservation Act (KS.A. 75-2741 to 75- 2754, and K.A.R. 126-1-1 to 126-1-2) when on state or private lands, and related human rights and health statutes, where appropriate. NRCS shall also refer to the ACHP's Policy Statement regarding Treatment of Burial Sites, Human Remains and Funerary Objects and the ACHP's Section 106 Archeology Guidance. NRCS shall also follow USDA and NRCS policy on treatment of human remains and consultation. NRCS shall provide a post discovery letter to GMD#5 outlining the steps for inadvertent discoveries.

i. Post-Discovery Policy Timeline

The following steps shall be taken if an inadvertent discovery of human remains occurs during the implementation of the watershed plan:

1. All construction work will stop immediately within 100 meters of the discovery and the remains shall be protected *in situ* from any potential disturbance (including vandalism or theft). The remains will be covered with canvas and not exposed to public view.
2. The local Sheriff must be notified in the event human remains are encountered and are of forensic interest. The Sheriff will contact the State Archeologist and/or the District Coroner to assess if the remains are archeological or forensic in nature. If the remains are determined to

be recent human remains and/or associated with a crime through consultation with the district coroner or deputy district coroner, law enforcement will assume complete control of the effort. Upon notification the remains are not of criminal interest, the Kansas State Historical Society (KSHS) shall assume jurisdiction over the human skeletal remains, and any goods interred with such remains (Kansas Unmarked Burial Sites Statute and Regulations **75-2749.b.)**.

3. No Photographs will be taken of human remains. If necessary, only hand-drawn illustrations or plan notes may be used in documentation and other communication. Should unforeseen, unusual circumstances arise, law enforcement may request that photographs be taken in the case of a crime scene. These photographs will, however, be taken only after consultation with NRCS Kansas and the Consulting Tribes. After conclusion of the criminal case, all photographs of human remains will be turned over to the affiliated Tribe for destruction.
4. GMD#5 will notify, via telephone, the NRCS point of contact and the Consulting Tribes within twenty-four (24) hours of discovery. This telephone notification will be followed by written notification that contains all information regarding the status of the discovery within forty-eight (48) hours after initial notification.
5. Consulting Tribes will be provided the opportunity to visit the location and be provided an on-site orientation of the location where the human remains were discovered prior to any further disturbance or excavation in the location. NRCS Kansas will arrange and facilitate the visit with the Consulting Tribes to the location. NRCS Kansas staff will be present on the site for safety and access but provide respectful distance to the Consulting Tribes during the visit.
6. Wherever possible, burials are left in place and any further project activities avoid the burial with an appropriate buffer area, to be determined by consulting THPOs and KSHS on a case-by-case basis.
7. NRCS Kansas, the Consulting Tribes, and KSHS will consult to develop a Plan of Action should excavation be deemed necessary by both parties.
8. At minimum, this Plan of Action will address the requirements of 43 CFR 10.4(b), the federal Inadvertent Discovery standards of NAGPRA.
9. Neither NRCS Kansas, the GMD#5 staff, KSHS staff, nor any of its contracted employees will conduct excavation, handling, or removal of any human remains without consent.

10. The GMD#5 and/or the construction contractor may resume construction activities in the discovery area upon receipt of written authorization from the Unmarked Burial Sites Preservation Board and a Notice to Proceed from the State Conservationist.

PROPOSED
SCOPE OF WORK

for Cultural Resources Survey
of an Augmentation Wellfield,
Groundwater Management District No. 5
Stafford County, Kansas

Buried Past Consulting, LLC
Oskaloosa, Kansas

2023

Groundwater Management District No. 5 is proposing to install an augmentation wellfield potentially spanning the Rattlesnake, Gar-Peace, and North Fork Ninnescah watersheds. To analyze potential impacts to cultural resources associated with installation of the wellfield, a Cultural Resources Survey Plan was developed. Once final design has been determined and the Area of Potential Effects (APE) delineated, the study plan described below would be implemented.

This document outlines the expectations for an intensive investigation that would meet Kansas SHPO standards as outlined in the SHPO's *Guide for Archeological Survey, Assessment, and Reports*. All work will be conducted to professional standards and guidelines in accordance with the *Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation*, (48 FR 44716-44742) and in accordance with the *Secretary's Standard for Identification* (48 FR 44720-44723).

In consideration of this, an intensive cultural resources survey is proposed to consist of the following relying on Kansas SHPO standards for cultural resource survey and reporting:

- Prior to beginning fieldwork, comprehensive background research will be carried out to determine the locations of previously recorded archaeological sites and the past cultural resource surveys carried out within a minimum of one mile of the project APE. If any sites are in or immediately adjacent to the Project Area, survey will attempt to relocate and confirm any site boundaries that happen to fall within the project APE.

  Archival research shall also attempt to identify the locations of contact and settlement period habitations and travel corridors that may coincide with the project APE. Reliance on historic maps, plats, and atlases identified during archival research will assist in this assessment.

- Fieldwork may incorporate two aspects of identification: 1) visual inspection/walkover and 2) subsurface excavation/shovel testing.

  - Pedestrian visual inspection survey of planned areas of ground disturbance. Intensive survey will focus on the locations of the paired well locations within the wellfield as well as linear corridors for proposed of connecting water line easements and possible access roads and other infrastructure as identified as part of final/preferred alternative design. Survey will seek to visually identify the presence of any archaeological sites or other features of cultural significance in or immediately adjacent to the planned areas of disturbance where surface visibility exceeds 40%.

  - Walkover survey will be accompanied by systematic shovel testing as an additional test for the presence of cultural material in the APE in areas of moderate to high potential for cultural resources where ground surface visibility is limited (less than 40%).

    - Subsurface excavations should be on intervals not exceeding 15 meters (50 feet) when conditions require employment of shovel testing. Relying on field observation, areas of mechanical exposure, erosion, concentrations of

animal burrows, and other occasions of localized ground surface exposure in the project APE may mediate the necessity of systematic subsurface testing.

- All excavated soil will be screened through 1/4" mesh to improve recovery. Excavations will be immediately backfilled upon completion and every effort taken to minimize the disturbance or appearance of disturbance of the excavated area. Shovel tests will be a minimum of 30 centimeters (12 inches) in diameter and excavated in 10-centimeter (4 inch) levels, or in stratigraphic/natural soil levels into sterile subsoil with no potential for buried cultural deposits.

- Where an increased potential for more deeply buried cultural materials is judged to be present by the principal investigator, deeper excavations may be carried out by shovel and/or hand auger to depths not exceeding the anticipated depth of APE disturbances.

- For any archaeological site that is discovered, additional shovel tests may be excavated within the APE to provide details of the associated soils and as a further attempt to recover cultural material and assist in delineation of site boundaries within the APE. Identification of site boundaries via shovel testing will be conducted on intervals of 5 meters within the project APE and will not extend beyond the project corridor. Site recording will include attempts to determine the potential significance of the cultural materials encountered and the necessity of any further investigations or alternate project planning.

- Photographs will consistently be taken within the project APE to document the ongoing survey effort, any noticeable areas of past disturbance, any observed cultural resources, and to document the project locale in general. Select images will be utilized in the survey report to depict the survey effort and results.

- A report of the results of the investigation including a historical/cultural context for the current work, summary of any previous investigations and previously recorded cultural resources around the project APE and recommendations concerning cultural resources that could be directly affected by the project APE will be submitted for review. If cultural resources are encountered, a formal site form will be completed and filed with the Kansas Historical Society in addition to preliminary consideration of the significance of the find and potential need for alternate project planning as needed.

Appendix B

Project Map

The project map is contained within the main document.

Appendix C

Support Maps

The support maps are contained within the main document.

Appendix D

Investigations and Analyses

APPENDIX D – INVESTIGATIONS AND ANALYSIS REPORT

This appendix provides supporting information for the formulation, evaluation, and conclusions presented in the Rattlesnake Creek Watershed Plan Environmental Impact Statement (Plan-EIS). Full reports are referenced and/or attached to this Appendix as indicated within this report.

Project Formulation

The purpose of the project is to a provide long-term, sustainable agricultural water management within Rattlesnake Creek subbasin of Big Bend Groundwater Management District (GMD #5) and to meaningfully address the impairment at Quivira National Wildlife Refuge (NWR). To meet the project purpose, a reasonable range of alternatives were developed and presented to the public and agencies for comment. Alternatives were formulated based on various technical studies completed for the project, including:

Summary of Field Work Completed for the Rattlesnake Creek Watershed Plan-EA (Olsson 2023a) documents the field work performed, including information about test site locations, well specifications, geophysical logs, borehole data, water quality, aquifer testing, and resistivity profiles to measure conductivity. This summary of field work contains supporting information for the augmentation alternative discussed in detail within the Plan-EIS. Decisions and conclusions regarding the feasibility of the augmentation alternative are not documented in this summary. Geophysical logs, resistivity profiles, and water quality samples indicate that salinity increases with depth and with proximity towards Quivira NWR.

The data collected during the initial field work assessment indicated that at shallow depths of 12 to 25 feet, there is sufficient quantity and quality of groundwater for use in augmentation. The materials encountered in the upper portion of the aquifer consists of predominantly sand and gravel, which is then restricted from the lower aquifer by a thick clay layer. This indicates a relative lack of connection between the shallow, fresher water and the deeper, more saline water known to be located in the bedrock of the lower aquifer. This restricting clay layer becomes thinner with proximity to Quivira NWR (as salinity increases). The lack of connection between the upper and lower aquifer is significant from a water quality perspective. Data was collected from deep and shallow monitoring wells during the testing. When the wells were pumped at a high rate (500 gallons per minute [gpm]) for a 24-hour period, results indicated that the upper aquifer is productive, because the reduction in water levels from the pumping wells was small relative to the saturated thickness of the aquifer.

In summary, the aquifer is split into an upper and lower aquifer by a thick clay layer that becomes thinner as it approaches Quivira NWR. The upper aquifer is generally of good quality and is productive, as the three test sites with pumping wells were able to sustain 24-hours of pumping at a constant rate of 500 gpm with less than 18 feet of drawdown. Existing data indicates that the shallow water table and sufficient permeability present in the area allows for rapid recharge. Overall, this would support a substantial level of augmentation that could be developed and maintained over time at the proposed augmentation wellfield site (this understanding would be refined in the design phase when additional field work would be completed). The complete report is available on the GMD #5 website at: https://archive.gmd5.org/Watershed_Plan/Appendices/D1_Olsson_Field_Data_Report_Mar_2023.pdf

Assessment of Hydrologic Effects from Potential Augmentation Project (Balleau 2023a) documents an analysis of a potential augmentation project as an alternative to supplement water downstream of Quivira NWR. The hydrologic effects of the wellfield were analyzed utilizing the GMD5 Model (Balleau 2010), which was found to reasonably characterize the hydraulic response observed during the aquifer testing conducted by Olsson (Olsson 2023a). The analysis of potential augmentation pumping was based on two GMD #5 model runs: one with and one without augmentation pumping. The change to the hydrologic system induced by pumping was isolated in order to quantify the change induced by the wellfield pumping over a 54-year projection. After the hydrologic effect from the augmentation pumping is quantified, the GMD #5 model provides a breakdown of how potential augmentation pumping affects four hydrologic components: regional and sub-regional hydrologic flow budgets, aquifer water levels, downstream river flow, and source water that supplies pumping. The complete report is available on the GMD #5 website at: https://archive.gmd5.org/Watershed_Plan/Appendices/D2_Balleau_HydroAssessment_Jul_2023.pdf

Assessment of Rattlesnake Creek Active Flow Length and Project Groundwater Pumping in Groundwater Management District 5 (Balleau 2023b) documents how the active flow length of Rattlesnake Creek will change into the future with continued groundwater pumping in GMD #5 projected for approximately 50 years. This technical memorandum is attached to this Appendix.

Assessment of Surface-Water Supply and Quivira National Wildlife Refuge Water Demand (Balleau 2023c) which provides details on the proposed reduction of 2,500 acre-feet per year (AFY) of irrigation pumping in Zone D and the hydrologic factors that were considered, one of which is the basis for the 2,500 AFY. This technical memorandum is attached to this Appendix.

Cost Allocation

Costs for the construction of the project will be shared between the NRCS and GMD #5. According to the Title 390 – National Watershed Program Manual, Part 500, Subpart E, 500.42, financial assistance for agricultural water management projects will not exceed the rate of assistance for measures installed for similar purposes through other available federal programs; where rates are identified for similar purposes under other available programs, Watershed Program funds may provide up to a maximum of 75 percent of installation costs and up to 100 percent of engineering or technical assistance costs. No cost sharing is available for real property rights for this purpose. Wells, water treatment facilities, pipelines, and similar practices listed in Title 450, National Handbook of Conservation Practices (NHCP), are eligible for Watershed Program assistance.

The Plan-EIS provides a description of costs based on two memos prepared by GMD #5 – (1) a cost estimate memo that describes the assumptions made in formulating the costs associated with construction of the preferred alternative (Olsson 2023b); and (2) a memo that details operation and monitoring activities and equipment, including the cost of monitoring equipment, that would be used for the project (Olsson 2023c). Both documents are attached to this Appendix.

Engineering

Engineering will be completed following completion of the NEPA review process. A conceptual wellfield and pipeline layout was generated for the area based on technical studies. This

conceptual layout will be modified based on preliminary and final design to optimize the well locations. While the main subject of the cost estimate (Olsson 2023b) as described above is the cost estimate for the Augmentation Wellfield and Groundwater Use Reduction Alternative, the cost estimate also includes a description of assumptions made for how the augmentation wellfield would be engineered.

Adaptive Management

Adaptive Management will be an integral part of the Augmentation Wellfield and Groundwater Use Reduction Alternative. An Adaptive Management Plan (AMP) was drafted to provide additional details on how adaptive management will play a role in project execution and long term management of wellfield operations. The draft AMP is included as an attachment to this Appendix.

Cultural Resources

NRCS has executed a *Programmatic Agreement (PA)* that outlines the procedures for phased identification of historic properties in accordance with 36 CFR 800.14(b). The approach to field surveys and analysis of potential impacts to cultural resources associated with implementation of the Augmentation Wellfield and Groundwater Use Reduction Alternative is described in the *Proposed Scope of Work for Cultural Resources Survey of an Augmentation Wellfield, Groundwater Management District No. 5, Stafford County, Kansas* (Buried Past 2023). Section 106 compliance will be completed through the PA and cultural resources survey. Both documents are included in Appendix A.

Hydrology and Geology

Information contained in *Summary of Field Work Completed for the Rattlesnake Creek Watershed Plan-EA* (Olsson 2023a), *Assessment of Hydrologic Effects from Potential Augmentation Project* (Balleau 2023a), *Assessment of Rattlesnake Creek Active Flow Length and Project Groundwater Pumping in Groundwater Management District 5* (Balleau 2023b), and *Assessment of Surface-Water Supply and Quivira National Wildlife Refuge Water Demand* (Balleau 2023c) were used to support evaluation and conclusions included in the Plan-EIS for hydrology and geology resources within the Rattlesnake Creek Watershed.

Water Quality

Information in *Summary of Field Work Completed for the Rattlesnake Creek Watershed Plan-EA* (Olsson 2023a), outlines the results of water quality testing from the wellfield pump tests conducted during field work in the project area and was used to support evaluation and conclusions in the Plan-EIS related to water quality.

Economics

An analysis of impacts to net farm incomes in the project area, under various scenarios within each element of the alternatives, is provided in the *Economic Assessment of Rattlesnake Creek Watershed Plan Alternative* (Abt 2024). The assessment is attached to this Appendix.

Real Property Rights to Support Policy

Construction of the Augmentation Wellfield and Groundwater Use Reduction Alternative would require acquisition of private property. GMD #5 is responsible for 100 percent of real property acquisition and easement costs. Assumptions related to real property and easements are included in the cost estimate (Olsson 2023b).

TECHNICAL NOTE

December 19, 2023

From: Dave M. Romero and Steven E. Silver

Assessment of Rattlesnake Creek Active Flow Length with Projected Groundwater Pumping in Groundwater Management District 5

Background

1. Olsson developed an NRCS PL 83-566 Watershed Plan DRAFT Environmental Impact Statement (DEIS) for Rattlesnake Creek (RSC) watershed improvement. Comments on the DEIS from the U.S. Fish and Wildlife (Cooperating Agency), and associated technical discussions, have raised a question regarding how the flow length of RSC will change into the future with continued groundwater pumping in Groundwater Management District 5 (GMD5). This Technical Note provides an assessment of the active flow length of RSC with GMD5 groundwater pumping projected for approximately 50 years.

Technical Assessment

2. At the time that Balleau Groundwater, Inc. (BGW) developed the GMD5 Model (BGW, 2010), we inspected the flow condition of RSC. Of particular interest was the observation that the active flow length on RSC has reduced historically. This reduction is summarized on Figure 1, which is adapted from a Kansas Department of Agriculture (KDA) state-wide study of perennial[1] stream flow (KDA, 2010). The KDA study reports approximately 24.4 miles of perennial flow on RSC above Quivira National Wildlife Refuge (NWR) in 2009.
3. Figure 1 also shows the locations of the Macksville and Zenith gages on RSC. Considering the historically observed reduction in active flow length, a key element of calibrating the GMD5 Model was to simulate the reduction in flow historically observed at the Macksville and Zenith gages with particular interest in the transition from perennial to nonperennial conditions at Macksville. The model exhibits a good calibration of the historical flow condition at these gages (see Attachment).

[1] The KDA study describes perennial as "containing water throughout the year except for infrequent periods of severe drought."

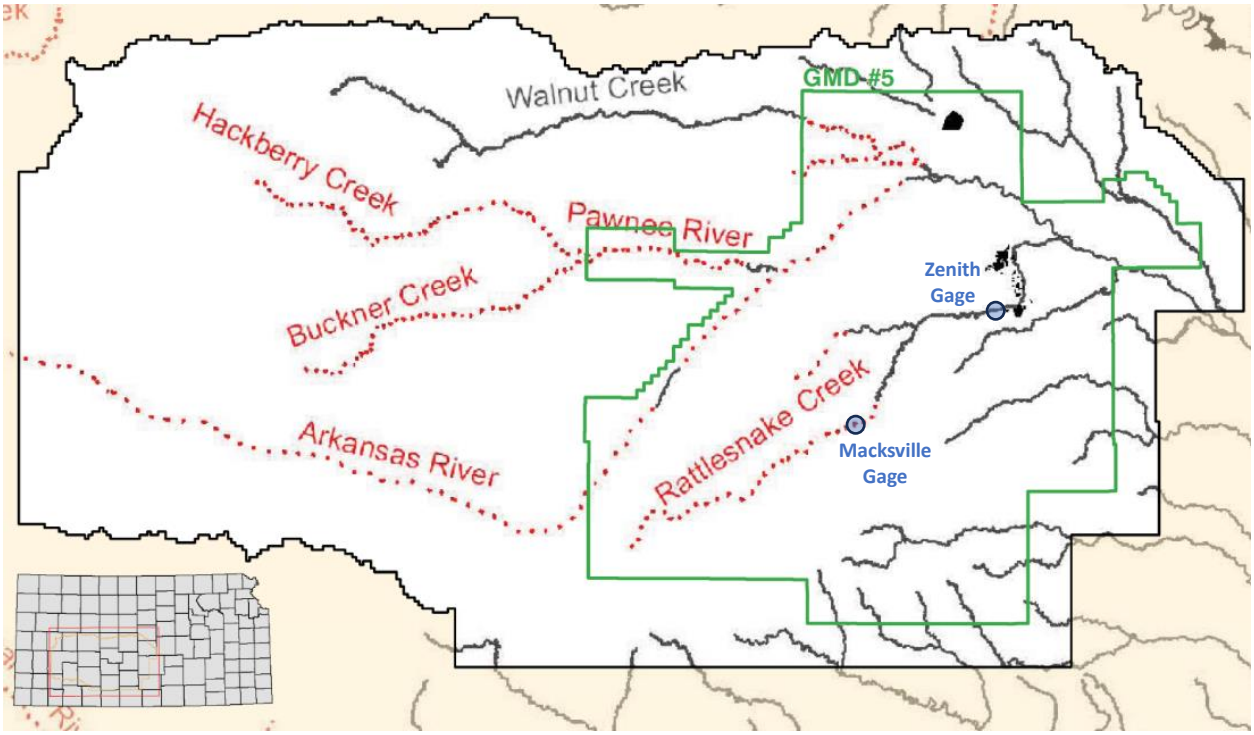


Figure 1. Historical change of perennial stream flow. Red dots indicate streams regarded as perennial in 1961 but as nonperennial in 2009. Grey lines indicate streams regarded as perennial in 1961 and 2009 (KDA, 2010).

4. An assessment of the RSC active flow length with projected GMD5 groundwater pumping requires a baseline projection. The baseline projection, used in the DEIS, can be used for this type of assessment, recognizing that it assumes a single sequence of climate conditions that is not a certain prediction of the future (a repeat of the 68-year historical climate from 1940 through 2007).[2] However, there is utility in examining the single-case sequence of projected conditions while evaluating some degree of variability in the long-term projected active river condition depending on whether the climate is in a state of median, wet or dry conditions. The simplified approach implemented herein is described below.

    a. The baseline period runs from 2008 through 2075 with irrigation pumping in GMD5. In that baseline, the period from 2022 through 2075 represents a

[2] A more comprehensive approach would require multiple baseline simulations within a probabilistic framework intended to characterize a degree of uncertainty in the projected condition. The example analysis herein is not as analytically rigorous because it assumes a single case that is a repeat of the climate sequence that occurred from 1940 through 2007 (i.e. although the variability of climate is reasonably represented, the sequence in which it occurs is uncertain).

projected 54-year period. The GMD5 Model derives the active flow condition of RSC in that setting.

b. We inspected the RSC flow condition in the last 10 years of the baseline (2066 through 2075) and sorted the modeled flow of discharge from groundwater to RSC (baseflow gain) for the purpose of examining active flow in terms of percentiles.[3] We then ranked baseflow gain into the median (50th), wetter than average (90th) and drier than average (10th) percentiles to examine the length of active RSC flow with a degree of climatic variability. The results are mapped in Figure 2 (in a form similar to the KDA (2010) map on Figure 1).

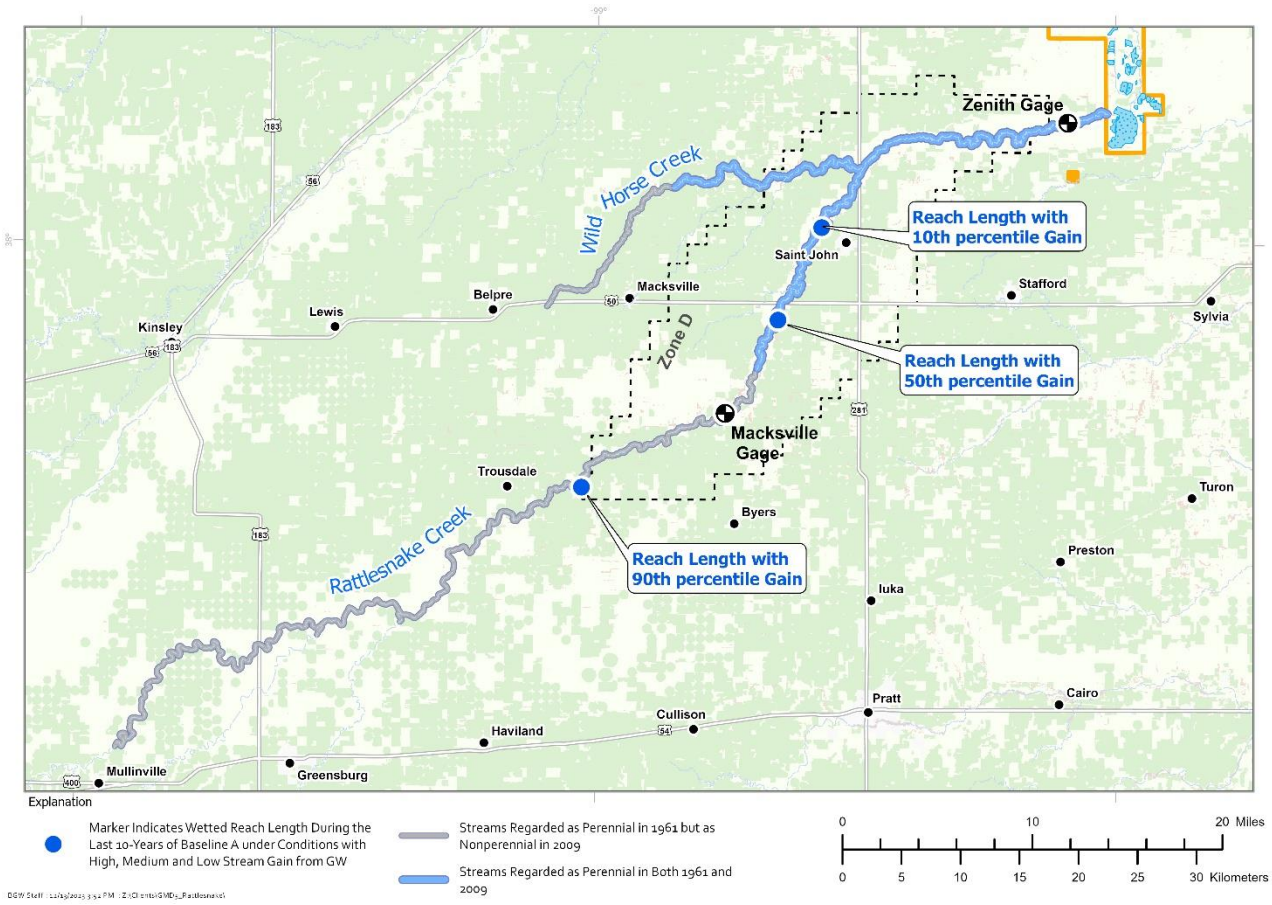


Figure 2. Variability of active reach on Rattlesnake Creek projected with GMD5 groundwater pumping projected for approximately 50 years.

[3] The purpose of developing a rank based on flow gain from groundwater is to assess the model-derived active length with existence of flow contributions from baseflow (rather than a runoff-dominated regime), since river baseflow tends to be more consistent than runoff. However, we note that in wet periods groundwater pumping for irrigation is reduced, which has a lagged effect of increased baseflow response in RSC (i.e. the interaction between the river and the aquifer is dynamic.)

Finding

5. The observation in this assessment is that with approximately 50 years of projected GMD5 groundwater pumping, RSC maintains active flow reaches with a length that varies depending on whether the climate is in a state of dry, median, or wet conditions. In the condition of drier than average conditions (10th percentile groundwater flow gain), there is approximately 16 miles of active flow on RSC above Quivira NWR. In the median (50th percentile) and wetter than average (90th percentile) conditions, the active flow reach increases to approximately 21.7 miles and 36 miles above Quivira NWR, respectively. The assessment herein is conservative in that it does not include the 2,500 acre-feet per year (AFY) pumping reduction in Zone D of GMD5 as described in the DEIS. However, a GMD5 Model response analysis[4] indicates that reducing 2,500 AFY of water use in Zone D would produce 1.2 to 2.4 cubic feet per second of additional flow in Zone D, which would increase downstream water supply. The intent of this Technical Note is to project the active reach condition of RSC to examine its length above Quivira NWR. It implements a simplified baseline approach to generally assess whether the RSC reach remains active or not. A separate BGW Technical Note Assessment of Surface-Water Supply and Quivira National Wildlife Refuge Water Demand, BGW (2023) describes a detailed projection of water supply and Quivira NWR demand with augmentation pumping and a reduction of 2,500 AFY within Zone D as described in the DEIS.

Attachment: GMD5 Modeled flow comparison at Macksville and Zenith Flow Gages

[4] BGW used the KDA-DWR administrative tool (KDA-DWR, 2018) to analyze the response from a reduction of 2,500 AFY of irrigation use in Zone D. The tool is derived from the GMD5 Model developed by BGW. The analysis indicates that 2,500 AFY of reduced use in Zone D increases RSC flow by 900 AFY (1.2 cfs) if the reduction is from wells farthest from RSC; if the reduction in use is from wells closest to RSC, the increase to RSC flow is 1,800 AFY (2.4 cfs).

References

[BGW] Balleau Groundwater, Inc., 2010, Hydrologic Model of Big Bend Groundwater Management District No. 5: Report prepared for Big Bend GMD No. 5., report dated June 23, 2010.

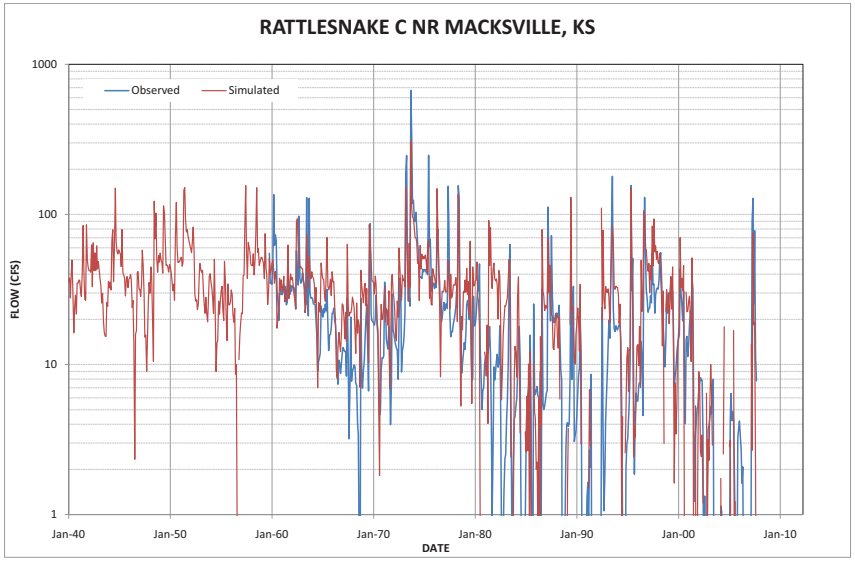
[BGW] Balleau Groundwater, Inc. 2023, Assessment of Surface-Water Supply and Quivira National Wildlife Refuge Water Demand: Technical Note, dated December 19, 2023

[KDA] Kansas Department of Agriculture, 2010, Major Perennial Streams 1961 and 2009: stream data provided by the Kansas Department of Health and Environment, 1961 coverage (USGS: special surveys), 2009 coverage (KDHE: long-term observations), Kansas Department of Agriculture Administrative Services, GIS, map dated March 12, 2010.

[KDA] Kansas Department of Agriculture, 2018, Administrative Response Tool for calculation of groundwater pumping effects on Rattlesnake Creek: spreadsheet (rsc_lema_allocation_v5.xlsm).

GMD #5

MODEL



nTCStrmLake.xlsb
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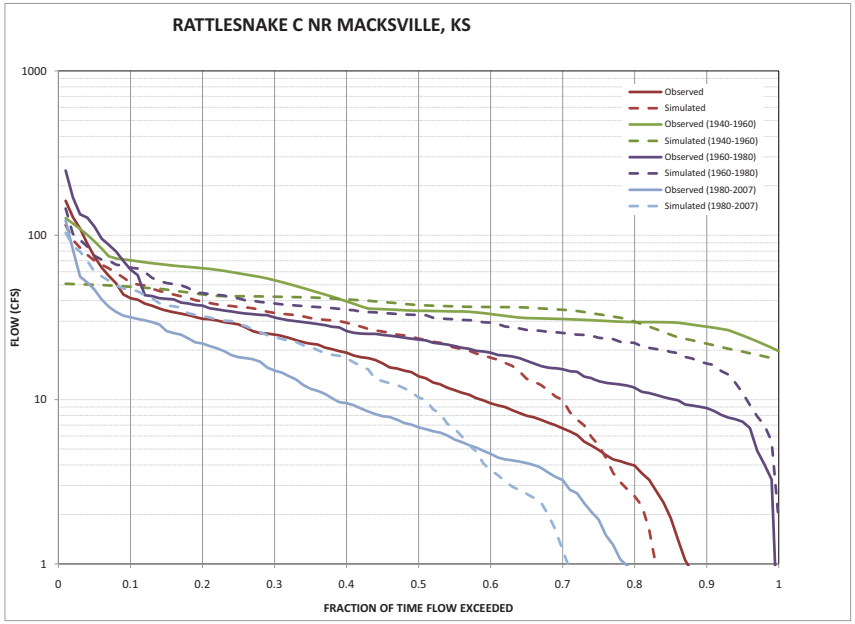
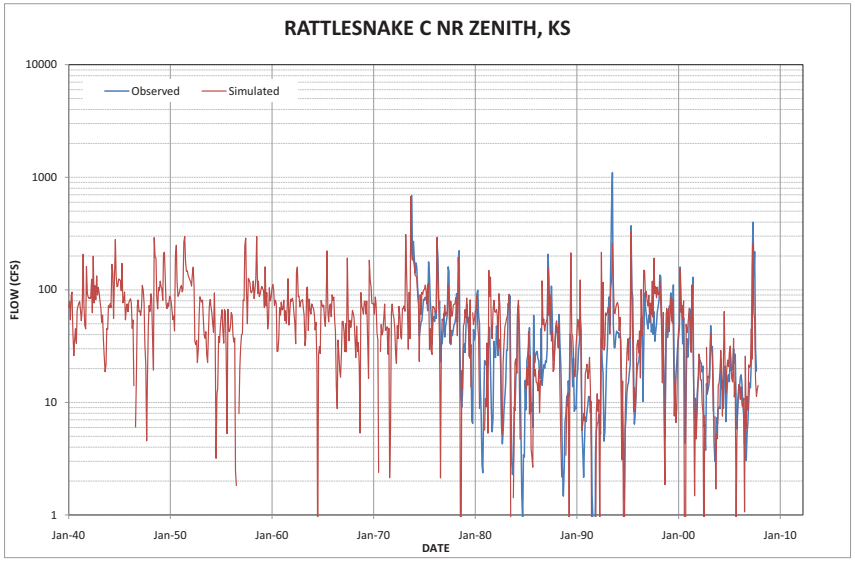
6/18/2010

BALLEAU GROUNDWATER, INC.



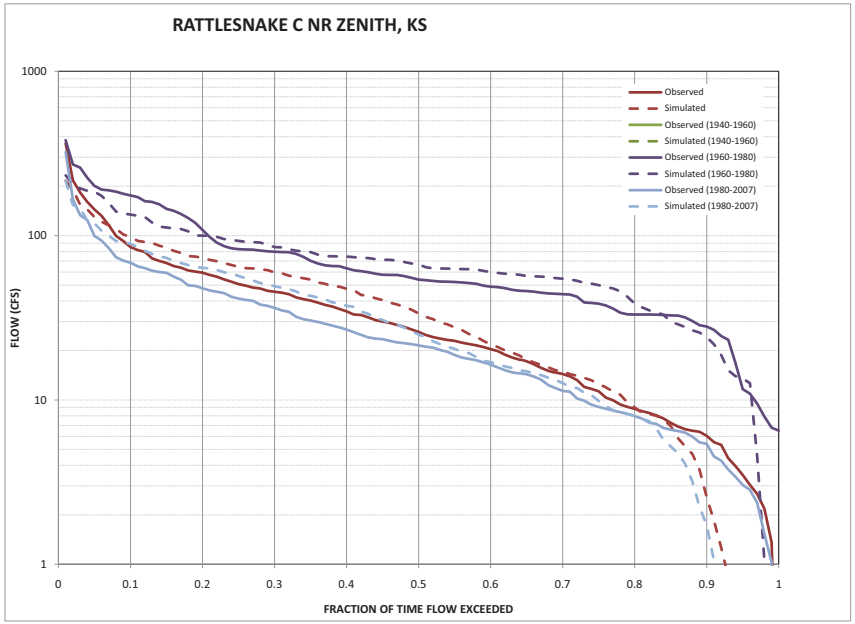
GMD #5

MODEL



nTCStrmLake.xlsb
SES
6/18/2010

BALLEAU GROUNDWATER, INC.



TECHNICAL NOTE

December 19, 2023

From: Dave M. Romero and Steven E. Silver

Assessment of Surface-Water Supply
and Quivira National Wildlife Refuge Water Demand

Background

1. Olsson developed an NRCS PL 83-566 Watershed Plan DRAFT Environmental Impact Statement (DEIS) for Rattlesnake Creek (RSC) watershed improvement. Comments on the DEIS from the U.S. Fish and Wildlife (Cooperating Agency), and associated technical discussions, have raised a question about the proposed reduction of 2,500 acre-feet per year (AFY) of reduced irrigation pumping in Zone D. That reduction, and other factors, came into play following an analysis (in the spring of 2020) of surface-water supply in RSC as it relates to Quivira National Wildlife Refuge (NWR) demand. The analysis involved a collaborative effort between Groundwater Management District 5 (GMD5) and the U.S. Fish and Wildlife Service (USFWS). This Technical Note provides additional detail on how that analysis was developed and describes the hydrologic factors that were considered, one of which is the basis for the 2,500 AFY.

Technical Assessment

2. Section 1.4 of the DEIS provides a summary of current and past solutions to address water shortages in Rattlesnake Creek. To clarify, the technical assessment described herein is a culmination of technical analyses developed from 2016 to the spring of 2020 with intent to understand the RSC water supply as it relates to Quivira NWR water demand. The approach involved supplementing RSC flow with an augmentation wellfield with a capacity of 15 cubic feet per second (cfs). Prior to 2020, Balleau Groundwater, Inc. (BGW) developed a spreadsheet tool that was linked to the GMD5 Modeled (BGW, 2010) surface water supply of RSC (hereafter "Spreadsheet Tool"). Within the Spreadsheet Tool, monthly comparisons of projected flow at Zenith gage could be compared to the Quivira NWR schedule of demand (Table 1).

Table 1. Seasonal Rattlesnake Creek surface water need estimates for Quivira NWR (USFWS, 2015a).

Seasonal Water Use (Acre-Feet)						
Jan-Feb	Mar-Apr	May-Jun	Jul-Sep	Oct-Nov	Dec	Total
1,500	3,500	2,000	3,500	3,632	500	14,632

3. By early 2020, the Spreadsheet Tool was developed into a form capable of providing a concise summary of water supply and Quivira NWR demand on a monthly basis. At that time, BGW and the USFWS began technical discussions geared toward the type of analysis that the Spreadsheet Tool was developed for. Initial discussions involved describing the GMD5 Model and the Spreadsheet Tool to the USFWS. The Spreadsheet Tool had an account of Rattlesnake Creek flow (including drought conditions) and up to 15 cfs of augmentation pumping; it did not have an account of water storage in Little Salt Marsh (LSM). At the time, the USFWS had developed updated area-capacity information for LSM (USFWS, 2020a). The next logical technical step was to develop LSM storage information into the Spreadsheet Tool. The USFWS did so and prepared a summary report (USFWS, 2020b). We adapted a figure from that report and present it below (Figure 1) as a concise comparison of water supply with Quivira NWR demand. A key aspect of the chart is it presents the amount of Quivira NWR demand not met. When the analysis results are presented this way, it is straightforward to quantify how much additional water would be needed to meet demand.

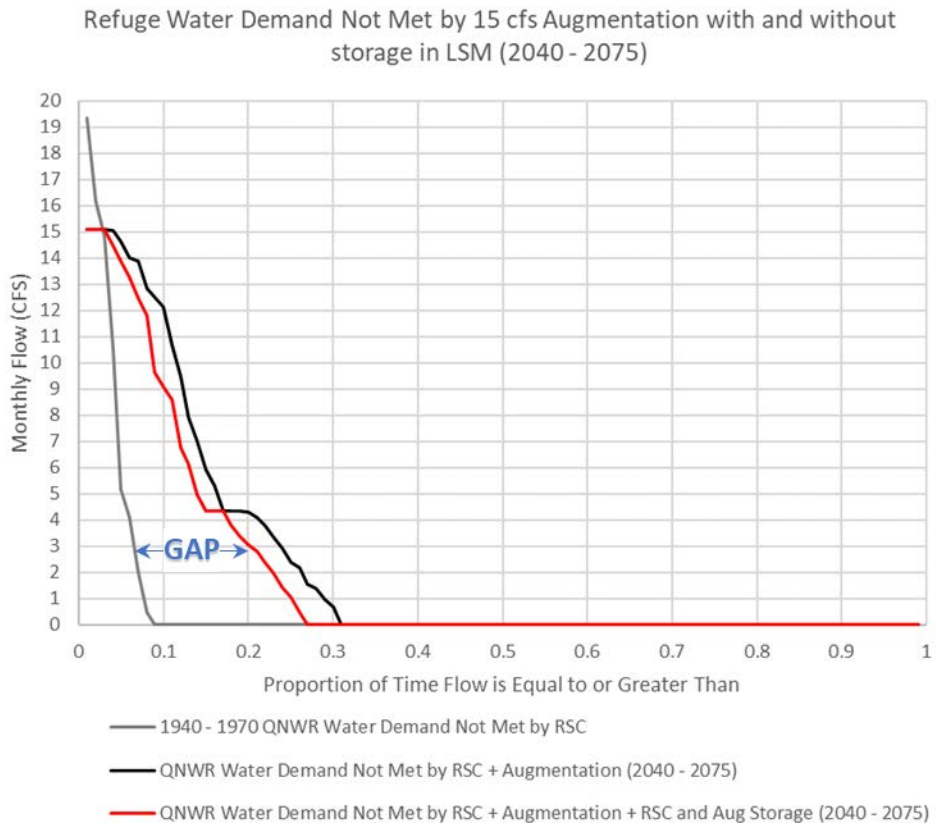


Figure 1. Comparison of water supplied and Quivira NWR water demand. The GAP represents demand not met.

4. Figure 1 illustrates a "GAP" representing the portion of Quivira NWR demand that is not met. The hydrologic components in Figure 1 are described below.
    a. *1940 -1970 QNWR Water Demand Not Met by RSC* - This component (grey line) is intended to represent drought conditions (when RSC would not provide a full supply because of drought). We used this modeled condition because it represents a period without substantial groundwater development and in the GMD5 Model it is a period prior to adjustment of precipitation/runoff/recharge curves to account for regional land development changes (BGW, 2010). In a long-term analysis of surface-water supply and demand, it is appropriate to account for drought because there will be periods where the supply is short owing to drought.
    b. *QNWR Water Demand Not Met by RSC + Augmentation* - Where the black line rises above the horizontal axis, it indicates the region where Quivira NWR demand is not met (without an account of LSM storage).
    c. *QNWR Water Demand Not Met by RSC + Augmentation + RSC and Aug Storage* - Where the red line rises above the horizontal axis, it indicates the region where Quivira NWR demand is not met (with an account of LSM storage). We note that the USFWS has indicated minimum and maximum desired levels of storage in LSM to provide acceptable habitat conditions (USFWS, 2020b, Fig 2). To the extent that LSM storage is used, it contributes to making the GAP smaller. Figure 1 illustrates one example of that case.

Observation

5. Upon examining the GAP (unmet demand) in Figure 1, we find that it is 1,078 acre-feet. In the DEIS, GMD5 provides an additional 3 cfs of augmentation pumping capacity (in addition to the 15 cfs analyzed on Figure 1) for up to two months per year, which would result in an additional 362 acre-feet reducing the GAP to 716 acre-feet. The DEIS also describes reducing water use in Zone D in the amount of 2,500 AFY. We used the KDA Administrative tool (2018) to analyze the response in RSC from a reduction of 2,500 AFY of irrigation use in Zone D (the tool is derived from the GMD5 Model). The analysis indicates that 2,500 AFY of reduced use in Zone D increases RSC flow by 900 AFY if the reduction is from wells farthest from RSC; if the reduction in use is from wells closest to RSC, the increase to RSC flow is 1,800 AFY. In either case, analysis of the 2,500 AFY reduction in use provides a volume of water intended to address the remaining GAP to meet Quivira FWS water demand.

References

[BGW] Balleau Groundwater, Inc., 2010, Hydrologic Model of Big Bend Groundwater Management District No. 5: Report prepared for Groundwater Management District 5, dated June 23, 2010.

[USFWS] U.S. Fish and Wildlife Service, 2015, Seasonal Rattlesnake Creek Water Needs Estimate for Quivira National Wildlife Refuge, Prepared May 2015.

[USFWS] U.S. Fish and Wildlife Service, 2020a, Action Item Follow Up Quivira NWR Water Right Impairment Meeting, April 9 2020 - USFWS DOI Regions 5 & 7, Water Resources Division, document dated April 15, 2020.

[USFWS] U.S. Fish and Wildlife Service, 2020b, Quivira National Wildlife Refuge Water Rights Impairment Summary of FWS Storage Modeling, document dated April 28, 2020.

[KDA] Kansas Department of Agriculture, 2010, Major Perennial Streams 1961 and 2009: stream data provided by the Kansas Department of Health and Environment, 1961 coverage (USGS: special surveys), 2009 coverage (KDHE: long-term observations), Kansas Department of Agriculture Administrative Services, GIS, map dated March 12, 2010.

[KDA] Kansas Department of Agriculture, 2018, Administrative Response Tool for calculation of groundwater pumping effects on Rattlesnake Creek: spreadsheet (rsc_lema_allocation_v5.xlsm).

MEMO

☐ Overnight
☐ Regular Mail
☐ Hand Delivery
☒ Other: Email

To:	Orrin Feril, GMD #5
From:	Mallory Morton, PE
RE:	Wellfield/Groundwater Reduction Alternative Cost Estimates Rattlesnake Creek Watershed Plan-EIS
Date:	July 28, 2023
Project #:	021-00451
Phase:	500
Task:	50001

The purpose of this memo is to describe the assumptions made in formulating the cost estimates for the augmentation wellfield alternative and groundwater use reduction alternative for the Rattlesnake Creek Watershed Plan-EIS. A team of electrical engineers, water resources engineers, wastewater engineers, and real estate professionals at Olsson collaborated to provide the information below. The cost estimate is broken down into several parts (property acquisition, wellfield infrastructure, electrical infrastructure), and then totaled to provide anticipated construction costs for two potential wellfield configurations. An estimate of groundwater retirement costs are presented separately.

Property Acquisition

Property acquisition anticipated for the construction of an augmentation wellfield includes permanent easements for the wellheads and transmission main pipeline. The level of effort required for property acquisition depends on landowner cooperation. Costs provided are based on past experience in negotiating easements for the wells drilled as part of the field work study appended to the Watershed Plan-EIS. Property acquisition costs for the compact and expanded configurations of the augmentation wellfield are included in Tables 1 and 2, respectively.

Assumptions include:

- Landowner coordination is limited to two certified letters, up to three phone calls, and one in-person meeting
- Estimate does not include any crossing permits, driveway permits or similar permits.
- All easements are acquired voluntarily, and condemnation is not exercised.
- No temporary constructions easements are needed as all construction activities will take place inside the permanent easement area.
- Cost of any appraisals are not included.
- Easement width of approximately 10 feet for underground transmission main to be laid on private property
- Wellhead easement area is 0.1 acres each
- Sales comparisons of land values in Stafford County show a range of values between $2,100-$5,300 per acre for tillable ground. Estimate uses $3,500 as the average per acre market value. Well sites are valued at full market value, while the easement area of the pipeline would allow for continued farming and is valued at 50% of market value.
- A 20% contingency is included for administrative/legal fees, and market volatility.

Table 1. Property acquisition costs for the augmentation wellfield (compact configuration).

Item	Quantity	Unit	Cost/Unit	Extension
Pipeline Easement	41	Acres	$2,625	$61,467
Well Site Easement	6	Acres	$5,250	$29,400
Negotiator Fee	56	Per Parcel	$3,500	$196,000
Title Reports	56	Per Parcel	$500	$28,000
Survey (Metes/Bounds Description)	56	LS	-	$150,000
Subtotal	**-**	**-**	-	$464,867
Contingency (20%)	**-**	**-**	-	$92,973
Total	**-**	**-**	-	$557,840

Table 2. Property acquisition costs for the augmentation wellfield (expanded configuration).

Item	Quantity	Unit	Cost/Unit	Extension
Pipeline Easement	23	Acres	$2,625	$108,471
Well Site Easement	6	Acres	$5,250	$29,400
Negotiator Fee	56	Per Parcel	$3,500	$196,000
Title Reports	56	Per Parcel	$500	$28,000
Survey (Metes/Bounds Description)	56	LS	-	$150,000
Subtotal	**-**	**-**	-	$511,871
Contingency (20%)	**-**	**-**	-	$102,374
Total	**-**	**-**	-	$614,245

Wellfield Infrastructure

The construction cost estimate for the augmentation wellfield infrastructure includes drilling and installing 56 wells, production pumps and motors, valve vault manholes with internal equipment, and transmission mains to convey water to Rattlesnake Creek. Test well information from the field work study appended to the Watershed Plan-EIS was used to determine preliminary pump sizing. The pump size was determined for the farthest well from the delivery point and used for cost estimation. Pump sizing calculations are provided in Table 3. Transmission mains are sized based upon a flow velocity of approximately 5 feet per second, based on the anticipated pumping capacity of 150 gallons per minute from each well site. The construction cost estimate for the compact and expanded wellfield configurations are included in Tables 4 and 5, respectively.

Table 3. Pump sizing calculations.

Item	Total
Approximate Ground Elevation	1810.00
Static Water Level (ft)	17.5
Static Water Elevation (ft)	1792.50
Pumping Water Level (ft)	27.00
Pumping Water Elevation (ft)	**1783.00**
High Point of Transmission Main (ft)	1820.00
Head Boost to achieve 20 psi (ft)	46
Upper Elevation (ft)	**1866.00**
Elevation Head (ft)	83.00
4" Main Friction Head Loss (ft)	25
6" Main Friction Head Loss (ft)	7
8" Main Friction Head Loss (ft)	2
10" Main Friction Head Loss (ft)	0.8
12" Main Friction Head Loss (ft)	0.6
24" Main Friction Head Loss (ft)	0.05
Total Friction Head Loss (ft)	35.5
Total Dynamic Head (ft)	118.5

Assumptions include:

- Pump head calculations assume that a minimum of 20 pounds per square inch is maintained at all locations along the transmission main.
- Calculations consider a single pump running from a single well. Design/construction of the project would require more complex analysis considering multiple pumps running simultaneously and the head loss associated with these varying conditions.
- Transmission mains are constructed using a cost per inch/linear foot value of $15.15/in-ft. This cost accounts for installation, fittings, valves, testing, bedding/backfill, seeding, and other miscellaneous items of construction.
- Wells in the project area are submersible without a wellhouse. All control valves are to be installed within an adjacent valve vault, with controls and variable frequency drive installed above ground.
- Pump sizing, gravel, screen and casing selection would be finalized upon completion of a test hole and test well at each site prior to design.
- Cost estimate considers 8" diameter wells drilled to a depth of approximately 100 feet.
- A 20% contingency for well construction is included for administrative/engineering fees, and market volatility.

Table 4. Construction costs for the augmentation wellfield infrastructure (compact configuration).

Item	Quantity	Unit	Cost/Unit	Extension
4-inch Transmission Main	5,500	LF	$61	$333,300
6-inch Transmission Main	11,000	LF	$91	$999,900
8-inch Transmission Main	11,000	LF	$121	$1,333,200
10-inch Transmission Main	16,000	LF	$152	$2,424,000
12-inch Transmission Main	26,500	LF	$182	$4,817,700
16-inch Transmission Main	8,000	LF	$242	$1,939,200
24-inch Transmission Main	24,000	LF	$364	$8,726,400
Subtotal				$20,573,700
Drill and install well casings/screen	56	EA	$15,000	$840,000
Production Pump and Motor	56	EA	$25,000	$1,400,000
Valve Vault Manhole and internal equipment	56	EA	$5,000	$280,000
Subtotal	**-**	**-**	-	$2,520,000
Contingency (20%)	**-**	**-**	-	$504,000
Total	**-**	**-**	-	$23,597,700

Table 5. Construction costs for the augmentation wellfield infrastructure (expanded configuration).

Item	Quantity	Unit	Cost/Unit	Extension
4-inch Transmission Main	11,000	LF	$61	$666,600
6-inch Transmission Main	22,000	LF	$91	$1,999,800
8-inch Transmission Main	22,000	LF	$121	$2,666,400
10-inch Transmission Main	32,000	LF	$152	$4,848,000
12-inch Transmission Main	53,000	LF	$182	$9,635,400
16-inch Transmission Main	16,000	LF	$242	$3,878,400
24-inch Transmission Main	24,000	LF	$364	$8,726,400
Subtotal				$32,421,000
Drill and install well casings/screen	56	EA	$15,000	$840,000
Production Pump and Motor	56	EA	$25,000	$1,400,000
Valve Vault Manhole and internal equipment	56	EA	$5,000	$280,000
Subtotal	**-**	**-**	-	$2,520,000
Contingency (20%)	**-**	**-**	-	$504,000
Total	**-**	**-**	-	$35,445,000

Electrical System Infrastructure

The electrical system construction cost estimate considers using existing medium voltage distribution lines where possible and adding 73,000 feet of new distribution line consisting of 3 phase 336.4 ACSR overhead conductors and an estimated 384 distribution wood poles. Each well tap would consist of a pole mounted 15kVA, 12470-480V three phase transformer. The transformer high side would be protected by fused cutout and the low side would be connected to a pole mounted meter cabinet and adjustable speed drive (ASD) mounted in a NEMA 3R cabinet. The pump would be connected to the starter via #8 cable running through a pole riser and 2-inch schedule 80 PVC conduit. Construction costs for the electrical system infrastructure of the compact and expanded wellfield configurations are included in Tables 6 and 7, respectively.

Assumptions include:

- Medium voltage distribution lines are 12.47 kV
- Use of a 15 hp 460V 3 phase motor at each well location
- Control is limited to local control only. Any remote system integration has not been included.
- Distribution pole span is 250 feet
- Does not include any cost share from the local utility
- A 20% contingency for electrical infrastructure construction is included for administrative/engineering fees, and market volatility.

Table 6. Construction costs for the electrical system infrastructure (compact configuration).

Item	Quantity	Unit	Cost/Unit	Extension
Pole mount 3PH, 15kVA, 12.47kV transformer	56	EA	$900	$50,400
Adjustable Speed Drive, 15 HP, 460V 24A, NEMA 3R	56	EA	$2,300	$128,800
336.4 ACSR OH new distribution conductor 3Ø	36,500	FT	$47	$1,715,500
Wood distribution pole	192	EA	$1,475	$283,200
3Ø fused cable riser	56	EA	$871	$48,776
Primary metering cabinet	56	EA	$5,360	$300,160
15Kv Fuse	138	EA	$150	$20,700
3*C*/#8 Cable	3,500	EA	$10	$35,000
2" PVC conduit	3,500	FT	$16	$56,000
Pole Grounding	192	EA	$600	$115,200
LV Cable Termination	736	EA	$15	$11,040
Trenching	1,500	FT	$18	$27,000
Boring	1,000	FT	$30	$30,000
Easement & ROW	1	LS	-	$88,000
Mobilization	1	LS	-	$20,000
Subtotal	**-**	**-**	-	$2,929,776
Contingency (20%)	**-**	**-**	-	$585,955
Total	**-**	**-**	-	$3,515,731

Table 7. Construction costs for the electrical system infrastructure (expanded configuration).

Item	Quantity	Unit	Cost/Unit	Extension
Pole mount 3PH, 15kVA, 12.47kV transformer	56	EA	$900	$50,400
Adjustable Speed Drive, 15 HP, 460V 24A, NEMA 3R	56	EA	$2,300	$128,800
336.4 ACSR OH new distribution conductor 3Ø	36,500	FT	$47	$3,431,000
Wood distribution pole	192	EA	$1,475	$566,400
3Ø fused cable riser	56	EA	$871	$48,776
Primary metering cabinet	56	EA	$5,360	$300,160
15Kv Fuse	138	EA	$150	$41,400
3*Cl*#8 Cable	3,500	EA	$10	$70,000
2" PVC conduit	3,500	FT	$16	$112,000
Pole Grounding*	192	EA	$600	$230,400
LV Cable Termination	736	EA	$15	$22,080
Trenching	1,500	FT	$18	$54,000
Boring	1,000	FT	$30	$60,000
Easement & ROW	1	LS	-	$88,000
Mobilization	1	LS	-	$20,000
Subtotal	**-**	**-**	-	$5,223,416
Contingency (20%)	**-**	**-**	-	$1,044,683
Total	**-**	**-**	-	$6,268,099

Total Construction Costs

Total construction costs for the compact and expanded configurations of the augmentation wellfield are presented in Tables 8 and 9, respectively.

Table 8. Total construction costs for the augmentation wellfield (compact configuration).

Item	Quantity
Property Acquisition	$557,840
Wellfield Infrastructure	$23,597,700
Electrical Infrastructure	$3,515,731
Total	$27,671,271

Table 9. Total construction costs for the augmentation wellfield (expanded configuration).

Item	Quantity
Property Acquisition	$614,245
Wellfield Infrastructure	$35,445,000
Electrical Infrastructure	$6,268,099
Total	$42,327,344

Groundwater Retirement Costs

Groundwater Management District #5 (GMD5) has made several water rights purchases from willing sellers since 2006. Cost estimates for water rights retirements are based upon these purchases and information provided by GMD5. Costs for six water rights purchases GMD5 has made since 2006 total $2,828,050. Area and water rights retired totals approximately 1,289 acres and 754 acre-feet. Therefore,

cost per acre is about $2,194 and cost per acre-foot is about $3,751. Costs of the groundwater use reduction alternative are presented in Table 10. A 20% contingency is included to address market volatility.

Table 10. Costs associated with the groundwater use reduction alternative.

Item	Quantity	Unit	Cost/Unit	Extension
Groundwater Retirements	2,500	AF	$3,751	$9,377,500
Contingency (20%)	**-**	**-**	-	$1,875,500
Total	**-**	**-**	-	$11,253,000

MEMO

☐ Overnight
☐ Regular Mail
☐ Hand Delivery
☒ Other: Email

To:	Groundwater Management District #5 Attn: Mr. Orrin Feril 125 S Main St Stafford, KS 67578
From:	Mallory Morton, PE & Carrie Wiese
RE:	Operation & Monitoring Details Augmentation Wellfield Alternative
Date:	December 18, 2023
Project #:	021-00451
Phase:	500
Task:	500003

The purpose of this memo is to provide details on the anticipated operation of the augmentation wellfield alternative considered as part of the Rattlesnake Creek Plan-EIS. Information on anticipated monitoring needs is also included. The compact and expanded configurations of the wellfield are not evaluated separately in this memo because the operation and monitoring procedures are not expected to differ.

Anticipated Augmentation Wellfield Operation

Augmentation wellfield operation will be controlled by Groundwater Management District #5 (GMD #5) staff through a Supervisory Control and Data Acquisition (SCADA) system. This system will allow staff to remotely turn wells on or off and monitor water levels, flow rates, and chloride concentration of the augmentation water. As explained in Chapter 5 of the EIS, the wellfield is assumed to operate according to the seasonal water use estimates at Quivira National Wildlife Refuge (NWR) provided by the United States Fish & Wildlife Service (USFWS) in 2015 (see Table 1). Actual conditions of streamflow in Rattlesnake Creek at the Zenith Gage will need to be closely monitored to determine whether augmentation is needed. In the case where streamflow is not enough to satisfy USFWS' water right, augmentation water will be added. It is anticipated that the 56 wells would provide up to 15 cubic feet per second (cfs) throughout any particular year, and an additional 3 cfs during critical time periods (i.e., droughts).

Table 1. Quivira NWR Seasonal Water Use Estimate (USFWS 2015).

	January – February	March – April	May – June	July – September	October – November	December	Total
Seasonal Water Use (Acre-feet)	1,500	3,500	2,000	3,500	3,632	500	14,632

Wellfield operation during times of shortage could be addressed in multiple ways. The following example scenarios describe operation schedules that could be enacted. All examples use the July through September timeframe and associated seasonal water use estimate of 3,500 acre-feet. These scenarios can be applied to any of the seasonal timeframes provided in Table 1.

- Example Scenario 1: The augmentation wellfield provides constant flow to Rattlesnake Creek from July 1 to September 30 or until demand is met. Under this scenario, the wells would supply approximately 30 acre-feet of water per day (15 cfs) every day for a total augmentation volume of 2,730 acre-feet. The remaining 770 acre-feet is assumed to come from natural streamflow. If natural streamflow has not been enough to fulfill USFWS' water right, additional augmentation pumping is provided in December or at the beginning of the following year.

- Example Scenario 2: From July 1 to July 31, conditions in Rattlesnake Creek are monitored closely. Any shortage remaining after what has already been provided through natural streamflow over the first month in the time period is addressed through augmentation. The augmentation wellfield provides constant flow from August 1 to September 30 or until demand is met. Rate of flow (15 cfs or 18 cfs) is determined by the magnitude of remaining shortage.

- Example Scenario 3: From July 1 to September 30, streamflow in Rattlesnake Creek is monitored on a daily basis. Determination of augmentation pumping will consider weather forecasts and watershed circumstances. Wells will be powered on or off depending on changing conditions. Any shortages remaining at the end of the year will be provided through additional augmentation pumping in December or at the beginning of the following year.

A combination of the elements provided in these example scenarios could also be considered. Determination of the necessary actions will be accomplished through coordination between GMD #5, USFWS, the Kansas Department of Agriculture – Division of Water Resources (KDA-DWR), and the Kansas Department of Health and Environment (KDHE).

Augmentation Wellfield Monitoring

It is anticipated that significant investment in monitoring equipment must be made. Any references to specific equipment manufacturers made in this memo are for cost estimating purposes only and will not dictate actual equipment purchased. All 56 augmentation wells will be equipped with a calibrated flow meter to measure volume pumped at each well. Additionally, a multi-parameter pressure transducer to monitor water levels, conductivity, and temperature will be installed in each well. The wellfield outlet to Rattlesnake Creek will be equipped with a sensor to track flow and chloride concentration of the augmentation water. The pressure transducers and outlet sensor will include telemetry so that water quantity and quality conditions can be monitored remotely at a daily or hourly timescale. Selection of equipment models will be determined by GMD #5 and according to industry standards.

Monitoring wells will be drilled and completed around the perimeter of the augmentation wellfield area. The number, locations, and specifications of the monitoring wells will be determined during the design phase of the project and based on the best available information. Furthermore, installation of monitoring wells will be dictated by K.A.R. §5-25-10. Monitoring wells will be instrumented with multi-parameter pressure transducers to monitor water levels and conductivity. Periodic water samples will be taken at a frequency to be determined jointly by GMD #5 and KDA-DWR. For the purposes of cost estimation, it is assumed that five dedicated monitoring wells will be drilled and instrumented.

Costs for purchasing monitoring equipment are included in Table 2.

Table 2. Anticipated monitoring equipment costs for the augmentation wellfield alternative.

Item	Quantity	Unit	Cost/Unit	Extension	Assumptions/Description
Pressure Transducer (Aqua Troll 200, 30 psig)	61	EA	$2,000.00	$122,000.00	Includes 56 augmentation wells and five monitoring wells.
Telemetry/SCADA Equipment	62	EA	$2,000.00	$124,000.00	Includes 56 augmentation wells, five monitoring wells, and outlet to Rattlesnake Creek.
Pressure Transducer Cable (Vented)	61	EA	$525.00	$32,025.00	Includes 56 augmentation wells and five monitoring wells
Remote Monitoring Software & Programming	1	LS	$30,000.00	$30,000.00	One year of data access.
Flow Meter (McCrometer 8" Propeller)	56	EA	$3,700.00	$207,200.00	Installed on 56 augmentation wells.
Outlet Multiparameter Sonde (Aqua Troll 500)	1	EA	$3,850.00	$3,850.00	Monitors chloride at outlet.
Ultrasonic Area/Velocity Sensor	1	EA	$4,000.00	$4,000.00	Monitors flow through outlet pipe.
Monitoring Wells	5	EA	$5,200.00	$26,000.00	Based on well drilling costs during feasibility field work plus 20%. Wells assumed to be 2" diameter PVC, 50' deep, with 10' screen length.
TOTAL				**$549,075.00**	

References

Kansas Administrative Regulations (K.A.R.). 2023. §5-25-10. Accessible online at: https://casetext.com/regulation/kansas-administrative-code/agency-5-department-of-agriculture-division-of-water-resources/article-25-big-bend-groundwater-management-district-no-5/section-5-25-10-test-holes-and-water-quality-analyses

USFWS. 2015. Preliminary Rattlesnake Creek Water Use Estimates for Quivira National Wildlife Refuge, March 2015. Email from Mike Oldham (USFWS) to Chris Beightel (KDA-DWR).

RATTLESNAKE CREEK WATERSHED

DRAFT
ADAPTIVE MANAGEMENT PLAN

Prepared for:

NRCS, GMD #5

Stafford County, Kansas

December 2025

Olsson Project No. 021-00451

This Adaptive Management Plan is a draft document which is built on decisions to be made during the design phase and should be treated as preliminary and subject to modification and change as needed throughout the life of the project.

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ACRONYMS AND ABBREVIATIONS

AM.....Adpative Management
AMC ..... Adaptive Management Committee
AMC Chair……..Adaptive Management Committee Chairperson
AMP .....Adaptive Management Plan
EIS .....Environmental Impact Statement
GMD #5..... Groundwater Management District #5
KDA-DWR.....Kansas Department of Agriculture – Division of Water Resources
KDHE ..... Kansas Department of Health and Environment
KGMDA.....Kansas Groundwater Management District Act
KWO .....Kansas Water Office
NEPA .....National Environmental Policy Act
NRCS.....Natural Resource Conservation Service
NWR ..... National Wildlife Refuge
Plan-EIS……..Rattlesnake Creek Watershed Plan - Environmental Impact Statement
USFWS ..... U.S. Fish and Wildlife Service

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1. INTRODUCTION

This Adaptive Management Plan (AMP) details how new information collected over time may result in necessary evolving changes to facilitate agricultural water management in the Rattlesnake Creek Watershed, including meaningfully addressing the senior water right impairment at Quivira NWR. Within the framework of this AMP, changes in agricultural water management will continue to meet the purpose and need of the project as described in the Rattlesnake Creek Watershed Plan - Environmental Impact Statement (Plan-EIS). This framework will be applied to the Augmentation Wellfield and Groundwater Use Reduction Alternative, the preferred alternative identified in the Plan-EIS. Details about the components of the preferred alternative are located in Section 5.3 of the Plan-EIS.

The long-term adaptive management (AM) framework described herein will provide a structured process to systematically evaluate the effectiveness of the alternative components (augmentation wellfield and groundwater use reduction) to improve agriculture water management over time. The new information collected over time provides stakeholders the ability to consider changes in their planning and allows for the latitude to modify actions to progress towards desired outcomes and to maintain required thresholds.

The primary scope of the AMP covers meeting the purpose and need of the Plan-EIS through implementation of the Preferred Alternative.

2. ADAPTIVE MANAGEMENT AND DECISION MAKING

Adaptive management is a structured, data-driven approach that will provide a basis for making progress while assuring accountability and meeting the purpose and need (see Plan-EIS). An AM approach that increases scientific knowledge through continued monitoring and analysis with a commitment to engage in future actions, where needed, is key to achieving the purpose and need through this alternative. The long-term success of this project will depend on future climatic conditions, which are inherently unknown and may not be consistent with historical averages. AM is necessary so that adjustments can be made in the face of these uncertainties as the effectiveness of management decisions and other events are observed in practice.

The Augmentation Wellfield and Groundwater Use Reduction Alternative will use a multiagency decision-making approach, based on analysis of monitored conditions to inform management effectiveness. The AMP will be evaluated on an annual basis and adjustments will be made, as necessary, to meet the purpose and need based on identified performance metrics. Meeting the project purpose and need will be heavily influenced by weather conditions, groundwater levels, water quality, streamflow conditions, and wellfield operation effectiveness. Prolonged periods of drought or above-average precipitation may provide an incorrect assessment of project success or failure. Implementing AM will increase long-term project success while also meeting the purpose and need.

AM decisions will be made pursuant to a structured agreement between stakeholders as identified in Section 3.2. AM can be described as a process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. More simply, acting, monitoring performance, adjusting (AM actions), evaluating. Careful monitoring and evaluation of these outcomes' advance understanding and help adjust operations as part of an iterative learning process.

The AM process begins once the Plan-EIS action(s) is complete, signaling the transition into a dynamic, iterative framework aimed at achieving long-term management goals. The process begins with a structured monitoring phase where performance metrics serve as indicators of whether current actions are effective or if adjustments are needed (Figure 1). If the data suggests that AM is necessary, the committee moves to a plan decision point, where it determines whether to implement an AM action or continue monitoring. When an AM action is deemed necessary, it is implemented and followed by an evaluation phase to assess its effectiveness. If the evaluation shows that targets are not being met, the process loops back to another plan decision, potentially triggering further adjustments. Conversely, if targets are met, the process will return to monitoring.

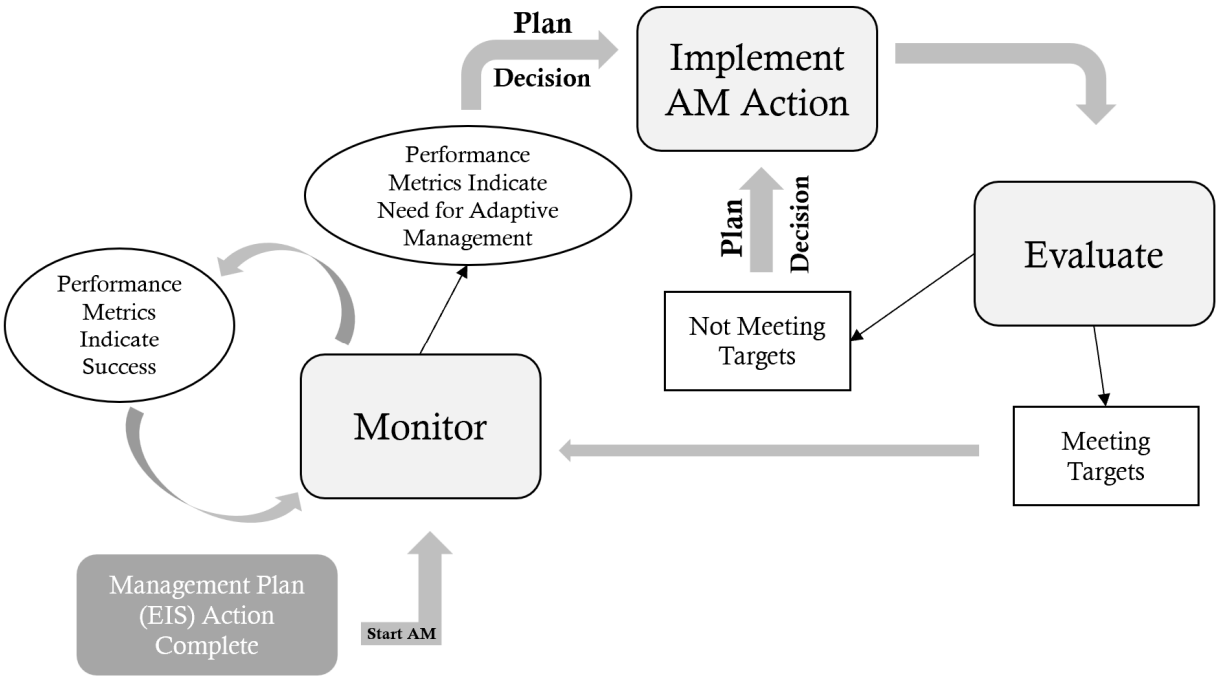

Figure 1: *Adaptive Management process flow: iterative cycle of monitoring, decision-making, implementation, and evaluation to achieve performance targets within the EIS framework.*

2.1 Adaptive Management Scope of Actions

The AMP was developed in association with the Plan-EIS and PL-83-566 funding through NRCS. Additional funding through PL 83-566 requires consistency with the Plan-EIS. Any major deviations from the Plan-EIS that request PL 83-566 funding would require a supplemental EIS.

Scope of actions outside the Plan-EIS may be considered, provided that they meet the goals and objectives of the AMP and are agreed upon by the governance structure defined in Section 3. The scope of AM actions is defined by the approved Plan-EIS. As illustrated in Figure 2 below, routine actions as depicted in the innermost circle are standard operational procedures outlined in the Operations Manual. These actions are not considered part of the AM process, as they are implemented under normal conditions and do not require evaluation or adaptive management. The next tier, Management Actions – Preferred Alternative, includes all AM actions authorized under the current Plan-EIS. These actions fall within the formal scope of the AM framework and can be implemented without additional regulatory review. The outermost circle represents Management Actions not within the purpose and need of the Plan-EIS or the Operations Manual, which would be outside the scope of the existing Plan-EIS. If the AM Committee determines such actions are necessary to meet performance metric thresholds, a supplemental NEPA document would need to be prepared and approved prior to implementation.

Figure 2: *Scope of Management Actions as a part of this adaptive management process.*
*The Operations Manual will be finalized during the design phase and is subject to change at the discretion of GMD #5.

3. ADAPTIVE MANAGEMENT GOVERNANCE

Governance is the organizational structure and decision processes that defines, directs, and guides the AM process and includes a description of what decisions need to be made, who would be involved in the decision-making process, how decisions would be made, and when they would be required. Effective systems of governance contribute to trust-building, knowledge generation, collaborative learning, understanding of preferences, and conflict resolution.

3.1 AMC and Key Stakeholders

Adaptive management decisions will be made by the Adaptive Management Committee (AMC) through a structured decision-making process. The AMC is comprised of 1). Active Committee Members and 2). Advisory Committee Members based on their level of responsibility and required participation in the decision-making process. A separate Science AM Subcommittee will be formed to regularly review and engage with monitoring data to track trends and make science-based recommendations to the AMC. The AMC is represented on the Science AM

Subcommittee. In addition to the AMC and the Science AM Subcommittee, a group of key stakeholders (or others identified at a later date) comprised of interested individuals and organizations, will be included by means of information sharing at the discretion of the AMC.

3.1.1 AMC Members, Roles and Responsibilities

The AMC operates under a structured decision-making process that ensures both scientific rigor and organizational consensus. Active Committee Members, defined as organizations or individuals representing organizations with active decision-making responsibilities, are required to participate in all official votes. For any action to be implemented, the vote must be a super majority among these Active Committee Members. Advisory Committee Members, while not part of the formal voting process, play a critical role by providing expertise, guidance, and recommendations to inform decisions. The Science AM Subcommittee, composed of at least one representative individual from all Active and Advisory Member organizations, is tasked with tracking, collating, and evaluating monitoring data. This subcommittee formulates science-based recommendations regarding the necessity and type of AM actions needed to meet established targets. Monitoring data captured as defined in the Operations Manual will be shared regularly with the Science AM Subcommittee members. The Science AM Subcommittee will analyze and formulate conclusions using appropriate tools and protocols as necessary to develop recommendations and findings related to monitoring and target trends to inform the AM process. These recommendations will be presented to the full committee, where they are discussed and, if agreed upon by a super majority of Active Committee Members, formally adopted and implemented.

Table 1. AMC Members*

Active Committee Members	**Advisory Committee Members**	**Science AM Subcommittee Members**
Active Committee 1	Advisory Committee 1	Science AM Subcommittee 1
Active Committee 2	Advisory Committee 2	Science AM Subcommittee 2
Active Committee 3	Advisory Committee 3	Science AM Subcommittee 3
Active Committee 4	Advisory Committee 4	Science AM Subcommittee 4
Active Committee 5	Advisory Committee 5	Science AM Subcommittee 5

* This table is representative of placeholders. The number of committee members is subject to change and discretion of GMD #5 and upon the agreement of each agency/stakeholder for level of participation.

The role of AMC Chairperson (AMC Chair) will be filled by a representative from GMD #5. The AMC Chair is responsible for the overall management of the AM process and for ensuring participation and compliance with the AMP. Key responsibilities include planning and facilitating the annual AMC meeting, coordinating committee activities throughout the year, and maintaining consistent communication among Active Committee Members and Advisory Committee Members. The AMC Chair also oversees the documentation of decisions, ensuring that meeting minutes, voting outcomes, and implementation actions are accurately recorded and distributed to all members. This documentation serves as the official record of committee proceedings and supports transparency and accountability in the AM process.

3.1.2 Key Stakeholders and Public Engagement

Public involvement will be supported through transparent communication and periodic updates. While formal decision-making will remain within the AMC, GMD #5 will provide public updates during annual meetings and through newsletters or other media to share project progress, successes, and revisions. Key stakeholder organizations will be able to participate and stay apprised of the project's current status upon invitation from GMD #5 or AMC. These groups serve a dual role as stakeholders and conduits for broader public engagement, helping to ensure that diverse perspectives are considered and that the public remains informed and connected to the AM process.

3.2 Adaptive Management Decision Process

Decisions as part of the AM process are defined and limited by the governance structure and occur at specific agreed upon points under specific and defined criteria. Furthermore, decisions can only be made collectively within the terms agreed upon by the AMC.

The AMC is responsible for deciding if an AM action is necessary by evaluating monitoring data and determining if performance metrics are being met or not being met. If it is determined performance metrics are not being met, the AMC will decide on an appropriate AM action to implement.

3.2.1 Adaptive Management Engagement Cycle (AM Engagement Cycle)

The AM Engagement Cycle is structured to promote communication and coordination for the evaluation of monitoring data and informed decision-making around AM actions. The Science AM Subcommittee will meet virtually on a quarterly basis to review and assess monitoring data, track performance metrics progress, and identify potential needs for AM actions. These meetings are intended to maintain continuity in data analysis and provide early insights into emerging trends or concerns or review any new and significant information.

The full AMC, including all Active Committee Members and Advisory Committee Members, shall meet annually in person or virtually, as determined by the AMC Chair. The annual meeting serves as the primary forum for reviewing compiled monitoring data, discussing recommendations from the Science AM Subcommittee, and making formal decisions regarding AM actions. If, during monitoring or evaluation, the Science AM Subcommittee determines that information or data suggests an urgent issue or trend that needs to be addressed sooner than the scheduled annual AMC meeting, the AMC Chair will convene the AMC as needed.

3.2.2 Protocols and Process Procedures

The AMC will follow a structured protocol to ensure that decisions are grounded in scientific evidence and reflect consensus among Active Committee Members. Prior to the annual meeting, the Science AM Subcommittee is responsible for preparing and disseminating a comprehensive summary of monitoring data, including trends, and recommendations for potential AM actions. This information will be shared with all Active Committee Members and

Advisory Committee Members in advance of the meeting to support an informed discussion and decision-making process.

During the annual meeting, the Science AM Subcommittee will present its findings and recommendations. The full committee will hear these presentations and engage in open discussion, with input encouraged from both Active Committee Members and Advisory Committee Members. While Advisory Committee Members do not vote, their expertise and input will be considered and integrated into the decision-making process.

Before any AM action can be taken, the proposed action must be formally discussed by the full committee. Following discussion, a vote will be held among Active Committee Members. A super majority vote is required for any action to be approved and implemented.

3.2.2.1 Dispute resolution

In the event the Active Committee Members are unable to reach super majority agreement on a proposed action, the AMC shall initiate a structured dispute resolution process to facilitate consensus and maintain progress toward AM goals. The AMC Chair will serve as the designated facilitator through a selected mediator, to lead this process by first documenting the nature of the disagreement and identifying the specific concerns raised by Active Committee Members. The AMC Chair will then convene a focused discussion session, which may include input from Advisory Committee Members and the Science AM Subcommittee to provide additional context, technical clarification, or alternative recommendations.

If consensus remains unresolved following initial discussion, the AMC Chair may propose the formation of a temporary working group composed of representatives from both Active Committee and Advisory Committee Members. This group will be tasked with developing a revised proposed action or compromise solution that addresses the concerns raised. The revised proposed action will be presented at a scheduled subsequent AMC meeting for reconsideration and vote.

Throughout the dispute resolution process, a neutral party or mediator (agreed upon by the voting committee) will be responsible to facilitate the process to ensure that all parties are heard, discussions remain constructive, and the process adheres to the principles outlined in the AM Plan. All dispute-related discussions and outcomes will be documented and shared with the full committee. The goal of this process is to foster collaboration, uphold transparency, and ensure that decisions reflect the collective commitment of all AMC members. AMC members must make a good faith effort to meet and confer as often as necessary in attempt to come to a resolution. If AMC members fail to reach an agreement, then the Active Committee can choose to continue the dispute resolution process or end without resolution. If dispute process ends without a resolution other avenues would be explored for solutions to the problem.

3.2.2.2 Introduction of new and significant information

If new scientific information that could help improve decisions or the AM process such as data about species, habitats, economics, or other environmental changes becomes available it will first be vetted by the Science AM Subcommittee. This group then reviews the information for relevancy to the goals and objectives of AMP. If it is determined the information is relevant, important, and significant, the Science AM Subcommittee will engage in analysis and review of the information to understand its implications. Based on their findings, the subcommittee will make science-based recommendations to the full committee. The Active Committee Members then decide whether to take action, study the issue further, or note it without changes. Advisors help guide the process but will not vote on final decisions. If there's disagreement or uncertainty among the Active Committee Members (i.e. voting members), the AMC will engage in the dispute resolution process outlined in Section 3.2.2.1.

3.2.2.3 Initiating and making changes to the AM Plan

Any Active Committee Member or the AMC Chair can propose changes to the AM Plan through a formal written proposal. The proposal is submitted to the AMC Chair who will then review the proposal for completeness and distribute it to all AMC members. The proposal must thoroughly describe the reason for the proposed change, identify the specific section(s) to be modified, and include any relevant supporting data or documentation. If the proposed change involves scientific elements such as monitoring protocols or performance metric thresholds, the Science AM Subcommittee will evaluate its technical merit and provide recommendations. The proposal will then be placed on the agenda for the next annual AMC meeting, where it will be discussed with input from Advisory Committee Members. Following discussion, the AMC Chair will lead the formal voting process. A super majority vote by the Active Committee Members is required for the change to be adopted. If approved, the AMC Chair will oversee documentation of the decision, update the AM Plan accordingly, and distribute the revised version to all members. A summary of the change will also be shared with stakeholders to maintain transparency and accountability.

4. ADAPTIVE MANAGEMENT FOR WATERSHED MANAGEMENT

4.1 Adaptive Management Goals, Objectives, and Scope

The goals of the AMP are to ensure effective implementation of the Watershed Plan-EIS Preferred Alternative by reducing uncertainty and improving decision making. Ultimately, the AMP will help sustain optimal agricultural water management by meeting the performance metrics or targets defined in the AMP through monitoring each state of project implementation. Through strong stakeholder collaboration, this plan will promote long term resilience and sustainability of the Rattlesnake Creek Watershed-Plan.

4.2 AM Performance Metrics or Targets

Performance metrics and targets are thresholds, values, and quantities as defined in the AMP and in the Operations Manual to measure on going trends as part of monitoring or progress after implementation of an AM action. Performance metrics and targets are focused on water

quality, water quantity, and agricultural water management. *Placeholder for specific performance metrics and targets as defined in Operations Manual.*

4.3 AM Framework and Development

The framework for AM is grouped into four phases. Baseline, monitoring, action implementation, and action evaluation. AM relies on comparing new monitoring data to these baseline conditions. Deviations inform whether management actions are working, need adjustment, or if new indicators have emerged that need to be monitored.

4.3.1 Baseline (Desired) Conditions and Assessment

Baseline conditions are the foundation of AM. They provide the starting point for reference in which all AM effects are measured. This is important because it provides a benchmark in order to evaluate the effectiveness of management actions. Baseline conditions are comprised of the physical, chemical, biological, and socioeconomic characteristics of the Rattlesnake Creek Watershed present at the implementation of the preferred alternative.

Existing Data and Data Needs

Establishing baseline conditions involves a combination of actions. The Plan-EIS thoroughly addresses existing conditions within the Rattlesnake Creek watershed in the Affected Environment Chapter (Chapter 4). Additional data will be collected during the design phase of the project which can contribute to baseline information.

Water Quality

- Placeholder: Insert baseline water quality data

Water Quantity

- Placeholder: Insert baseline water quantity (surface and groundwater) data

Agricultural Water Management

- Placeholder: Insert baseline parameters for meeting agricultural purpose and need

4.3.2 Monitoring

Monitoring is the process of measuring to confirm that an action was implemented as planned and defined performance metrics as described above in Section 4.2, are being met. Monitoring data will be collected at regular intervals as appropriate per resource and as defined in the Operations Manual. Data and trends will be discussed and reviewed by the Science AM Subcommittee at least quarterly.

The success of the Augmentation Wellfield and Groundwater Use Reduction Alternative will be judged against the following performance metrics:

Water Quality

- Placeholder: Insert water quality monitoring metrics and thresholds

Water Quantity

- Placeholder: Insert water quantity (surface and ground) metrics and thresholds

Agricultural Water Management

- Placeholder: Insert metrics and thresholds for meeting agricultural purpose and need

4.3.3 AM Action Implementation

AM actions are implemented when the performance of a particular management action is not as anticipated and requires correction. Results of future monitoring may influence future changes in management. As the Quivira NWR and the Rattlesnake Creek Watershed respond to water rights retirements and augmentation pumping, the AM Committee may find it advisable or necessary to adjust management for optimal success. In addition, the AMC may find it advisable or necessary to move the location where augmentation pumping is provided. These potential decisions will be made based on the monitoring data and the progress of meeting the specific AM decision-making triggers outlined above, which will be refined with stakeholder input.

4.3.4 AM Action Evaluation

Evaluation is the process of conducting analyses to compare measured results with anticipated outcomes (targets) related to decision criteria for specific AM actions to determine whether the implementation should be continued, adjusted, or completed.

Water Quality

- Placeholder: Insert water quality evaluation criteria specific to implementation actions or thresholds for success when evaluating post action implementation data and data trends

Water Quantity

- Placeholder: Insert water quantity evaluation criteria specific to implementation actions or thresholds for success when evaluating post action implementation data and data trends

Agricultural Water Management

- Placeholder: Insert agricultural water supply evaluation criteria specific to implementation actions or thresholds for success when evaluating post action implementation data and data trends

Economic Assessment of Rattlesnake Creek Watershed Plan Alternatives

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November 19, 2024

Executive Summary

Abt Global conducted an economic analysis of the alternatives developed for the Rattlesnake Creek Watershed Plan. The analysis considered regional economic impacts to net farm income, grain sales, employment, and labor income that may occur under each alternative. Based on the results of the economic analysis, the Augmentation Wellfield and Groundwater Use Reduction Alternative was determined to be the NED alternative. This appendix describes the approach used to complete the economic assessment of the alternatives and their impact to the regional economy. Table 1 summarizes the regional economic impacts under each alternative.

Table 1. Summary of Regional Economic Impacts.

Economic Resource	No Action Alternative (Compared to Existing Conditions)	Augmentation Wellfield and Groundwater Use Reduction Alternative (Compared to No Action Alternative)	Groundwater Use Reduction Alternative (Compared to No Action Alternative)
Net Farm Income	Net farm income would decrease on average by $5.0 million annually.	Net farm income would increase on average by $4.9 million annually.	Net farm income would decrease on average by $1.4 million annually.
Grain Sales	Grain sales are expected to be reduced by $41.2 million annually.	Grain sales will increase by $28.6 million annually.	Grain sales are expected to increase slightly by $610,000 annually.
Employment	Total job loss is estimated at 154 jobs.	Alternative is expected to maintain 107 jobs that would be lost under the No Action Alternative.	Total employment is expected to maintain 2 jobs that would be lost under the No Action Alternative.
Labor Income	Total labor income under this alternative will decrease by $11.4 million annually.	Total labor income under this alternative will increase by $7.9 million annually.	Total labor income under this alternative will increase slightly $168,600 annually.

Source: ABT 2024

Implementation of the Augmentation Wellfield and Groundwater Use Reduction Alternative would result in a positive impact on the regional economy (socioeconomics) and low-income populations that live and work in the area (environmental justice) compared to the No Action Alternative. Under the No Action and Groundwater Use Reduction alternatives, the reduction in irrigation pumping comes at a major and significant cost to the regional economy and low-income populations. Under the No Action Alternative, net farm income would decline on average by $5 million annually. The Groundwater Use Reduction Alternative is expected to further decrease net farm income relative to the No Action Alternative by $1.4 million on average per year. Net farm income under the Augmentation Wellfield and Groundwater Use Reduction Alternative would also decrease relative to existing conditions, but to a far lesser degree than the No Action or Groundwater Use Reduction alternatives. Relative to the No Action Alternative, net farm income would increase on average by $4.9 million annually under the Augmentation Wellfield and Groundwater Use Reduction Alternative.

Grain sales would be reduced under the No Action Alternative ($41.2 million annually) and the Groundwater Reduction Alternative (an additional $610,700 annually). Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, grain sales would increase $28.6 million relative to the No Action Alternative and decrease $12.6 million relative to existing conditions. In addition, decreases in grain production would result in reductions in farm employment. Under the No Action Alternative total job loss would be 153 compared to existing conditions. The Augmentation Wellfield and Groundwater Use Reduction Alternative is expected to avoid the loss of 107 jobs expected to occur under the No Action Alternative. Employment under the Groundwater Use Reduction Alternative is expected to avoid the loss of 2 jobs relative to the No Action Alternative. These decreases in jobs would, in turn, reduce labor income in the regional economy by approximately $11 million under the No Action and Groundwater Use Reduction Alternatives compared to existing conditions. Labor income would increase by approximately $7.9 million under the Augmentation Wellfield and Groundwater Use Reduction Alternative relative to the No Action Alternative.

The Augmentation Wellfield and Groundwater Use Reduction Alternative achieves the primary objective of maximizing net economic benefits while minimizing environmental impacts. Benefits to the public under the NED alternative include monetized net economic benefits as well as benefits to provisioning ecosystem services.

Introduction

Surface water and groundwater are essential resources to the central Kansas economy and environment. Management of the Rattlesnake Creek subbasin and its interrelated water resources has been difficult and complex, because multiple users are competing for the limited resource. This resource is relied upon principally for wildlife habitat (through diversions of surface water at the Quivira National Wildlife Refuge [NWR]) and for irrigated agriculture (through groundwater pumping). To regulate water use, the state of Kansas uses a system of water rights, which dictates when and how much water may be diverted by users. The Big Bend Groundwater Management District #5 (GMD #5) was formed in 1976 for the conservation of groundwater within multiple hydrologic units, including the Rattlesnake Creek subbasin.

Within the PL-83-566 authorization, the purpose of the GMD #5 Plan-EIS is to provide for long-term, sustainable agricultural water management within the Rattlesnake Creek subbasin of GMD #5. For the purposes of this Plan-EIS, “long-term” is defined as a period of 50 years, recognizing that changes in water use may take years to affect Rattlesnake Creek and the Great Bend Prairie aquifer. A 50-year period allows for sufficient simulation time to model the impacts from implementation options, evaluation of the long-term sustainability of water management, and adaptive management where needed. For the purposes of the Plan-EIS, “sustainable agricultural water management” is defined as surface and groundwater use that can be maintained consistent with water rights and the economic viability of the region’s agriculture.

The No Action Alternative describes a scenario of the default effects of not implementing a federal alternative. This provides a baseline for evaluating the other alternatives and illustrates the repercussions of no federal action. For the Plan-EIS, the No Action Alternative assumes USFWS, as the senior water right holder, will take the predictable action of filing a request to secure water with KDA-DWR. The No Action Alternative, then, evaluates the likely scenario that KDA-DWR will administer water rights consistent with its statutory authority under Kansas law to address USFWS’s request to secure water. Under the Plan-EIS No Action Alternative, junior water rights curtailment within Zone B (areas with a 20 percent or greater streamflow impact) would be completed initially and then KDA-DWR would

annually evaluate the effectiveness in securing Quivira NWR's water right. The junior water rights curtailment would result in all water rights within Zone B that are junior to Water Right File Number 7,571 to cease groundwater pumping (which consists of 810 water rights equivalents to 109,000 authorized irrigated acres). Adjustments in the level of regulation would occur based on an annual evaluation.

This section provides an overview of the economic analysis conducted on the alternatives proposed under the GMD #5 Plan-EIS. First the analysis evaluates a change in net farm income estimated to occur under the No Action Alternative and under two action alternatives. In this case, the No Action Alternative differs from existing conditions. Under existing conditions, junior water right holders are allowed to continue to utilize groundwater resources for irrigation purposes and Quivira NWR continues to have a water deficit. As described above, under the No Action Alternative groundwater pumping would cease in Zone B. Two action alternatives are also evaluated for changes in net farm income. This includes an Augmentation Wellfield and Groundwater Use Reduction Alternative and a Groundwater Use Reduction Alternative.

The analysis also evaluated the regional economic impacts associated with each of the alternatives. A regional model was developed to represent the economy in five Kansas counties (Pratt, Stafford, Kiowa, Edwards and Pawnee). The estimated changes in grain sales estimated in the net farm income analysis was used with the regional economic model to estimate changes in sales, employment, labor income and value added.

Changes in Net Farm Income

Methodology

The first step in the net farm income analysis was to describe the area of impact for the Plan-EIS. Each of the three alternatives (No Action and two action alternatives) impact a different response region as summarized in Table 2 and shown on Figure 1.

Table 2 Response Area Impacted under each Alternative.

Alternative	Response Region	Total Acres (Dryland and Irrigated)
Existing Conditions	Zone A	569,712
No Action	Zone B	312,902
Augmentation Wellfield and Groundwater Use Reduction	Zone D	113,074
Groundwater Use Reduction	Zone A	569,712

Because each of the alternatives impacts a different response region and the number of acres is not the same across the regions, it was necessary to normalize the impact analysis around Zone A, the largest of the three regions impacted. In other words, the impacts under each alternative are evaluated across the larger Zone A. Because the No Action Alternative includes the most likely course of events if the watershed plan was not executed, the impacts of the No Action Alternative are estimated relative to the existing conditions in Zone A. Then the impacts of the action alternatives are evaluated relative to the No Action Alternative. The following discussion outlines the methodology used to estimate changes in net farm income under each of the alternatives.

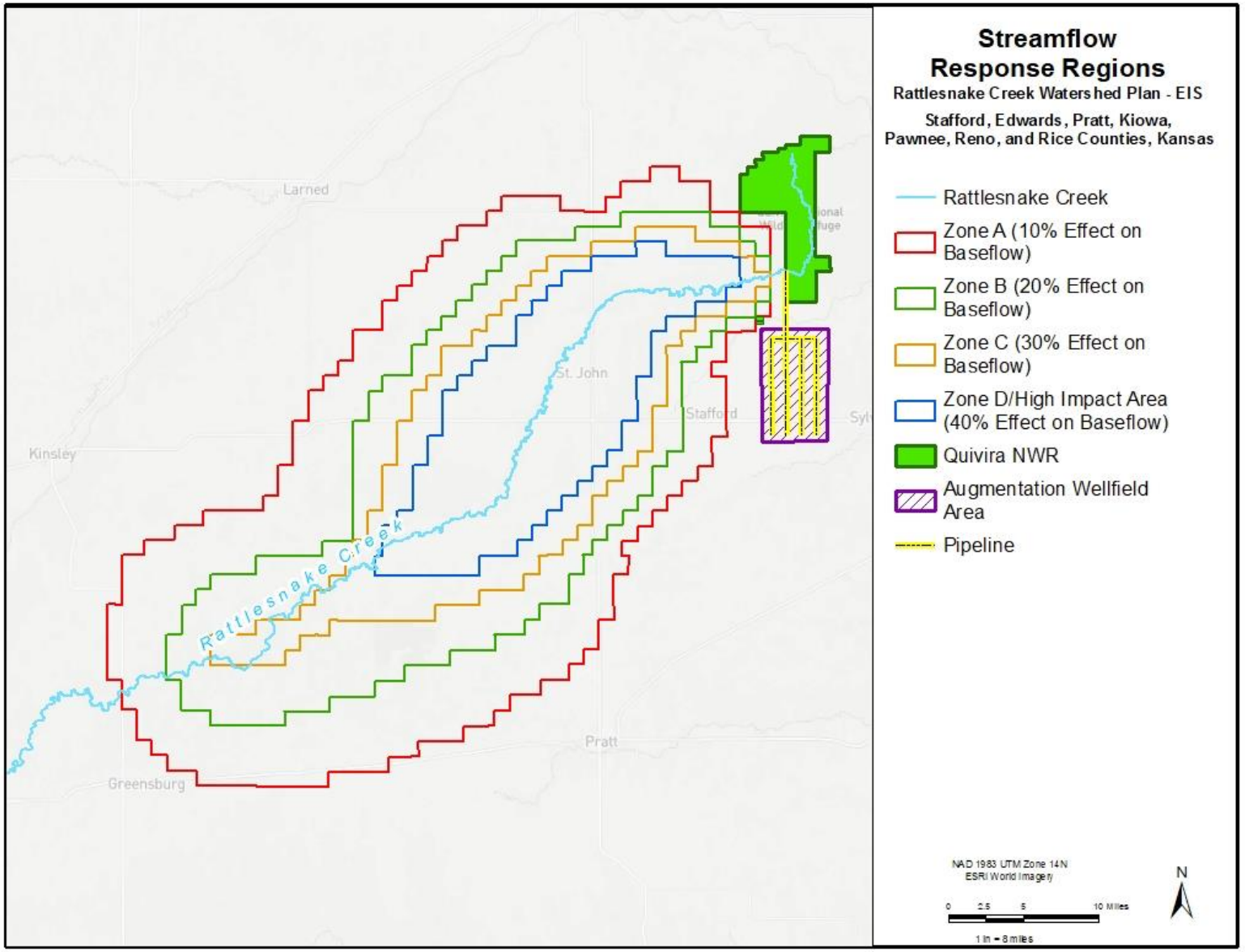

Figure 1. Streamflow Response Zones to Rattlesnake Creek at U.S. Geological Survey Zenith Gage (Plan – EIS Figure 1.4-3).

Crop Acreage Estimates

Crop acreage was estimated based on harvested acres by crop in the counties that fall within Zones A, B and D, respectively, using data from the 2022 Census of Agriculture.[1] Data for the harvested acres by crop in the counties encompassing the three zones are summarized in Table 3.

Table 3. Average Acres Harvested and Irrigated Acres by Crop in the Counties and in Zone A, Zone B and Zone D

	Corn	Cotton	Rye	Sorghum	Soybeans	Wheat	Totals
Counties in Zone A: Pratt, Stafford, Kiowa, Edwards, Pawnee Counties[1]							
Total	249,346	22,465	4,830	144,291	126,778	471,571	1,019,281
Dryland	100,417	15,516	4,830	134,866	59,764	438,600	753,993
Irrigated	148,929	6,949	0	9,425	67,014	32,971	265,288
Counties in Zone B: Pratt, Stafford, Kiowa, Edwards Counties[1]							
Total	201,295	22,465	4,830	87,284	111,426	371,987	799,287
Dryland	76,068	15,516	4,830	79,313	55,364	342,491	573,52
Irrigated	125,227	6,949	0	7,971	56,062	29,496	225,705
Counties in Zone D: Pratt and Stafford Counties[1]							
Total	118,426	21,016	4,830	49,133	67,744	258,052	519,201
Dryland	44,680	14,067	4,830	45,268	37,591	241,709	388,145
Irrigated	73,746	6,949	0	3,865	30,153	16,343	131,056
Estimated Average Irrigated Acres[1,2]							
Zone A	91,738	0	0	5,806	41,279	20,310	159,132
Zone B	51,642	0	0	3,287	23,119	12,164	90,212
Zone D	15,376	0	0	806	6,287	3,407	25,876
Estimated Average Dryland Acres							
Zone A	56,236	0	0	75,464	33,462	245,418	410,580
Zone B	30,752	0	0	31,893	22,333	137,713	222,690
Zone D	10,504	0	0	10,699	8,863	57,132	87,198

Sources

[1]USDA, 2022 Census of Agriculture.

[2]Kansas Department of Agriculture, Division of Water Resources, with Abt calculations.

[1]USDA, 2022 Census of Agriculture, Chapter 2, Table 25 - Field Crops. Accessed March 15, 2024. Available: USDA - National Agricultural Statistics Service - 2022 Census of Agriculture - Volume 1, Chapter 2: County Level Data

Based on information provided by the Kansas Department of Agriculture, Division of Water Resources, there are an average number of acres used for irrigated cropland is 159,132 acres in Zone A, 90,212 acres in Zone B and 25,876 acres in Zone D. Note that the average number of acres used for irrigation in each of these zones is well below the number of authorized acres that could be used for irrigation (see Table 4.10.4 in the Plan-EIS). The share of irrigated acres harvested in the counties falling within each zone was applied to these amounts to estimate the amount of acres of irrigated cropland for each crop within each zone. Dryland acres by crop type were estimated in a similar fashion with Zone A averaging 410,580 acres, Zone B 222,690 acres, and Zone D with 87,198 acres. These estimates are shown at the bottom of Table 3.

Because cotton and rye comprise such a small percentage of irrigated acreage in each of the zones (less than 5 percent), these crops were not included in the evaluation of alternatives. The analysis focuses on the dominant crops that are irrigated in the area – corn, soybean and wheat. In addition, because sorghum is a significant crop for dryland operations, it also was included in the analysis. To account for all irrigated and dryland acreage, the cotton and rye acreage was distributed between corn and soybeans for irrigated acres and wheat and sorghum for dryland acres. The acre estimates used for the analysis are shown in bottom half of Table 3.

Price, Cost, and Yield Data

Abt used enterprise level data published by the Kansas Farm Management Association to estimate changes in net farm income from each of the alternatives. The enterprise data provides five year (2017-2022) average estimates for yields and costs for the crops in question for the North Central region of Kansas (Table 4). For crop prices, Abt used the state-level normalized prices (ERS, 2023).

For corn and soybeans, irrigated production has a higher net return than dryland production as improved yields more than offset higher production costs. Costs were not available for irrigated wheat or sorghum production, so it was assumed all wheat and sorghum crops were grown using dryland techniques.

Table 4. Selected Crop Budget Indicators for Farmland in South-Central Kansas, 2023

Indicator	Corn	Soybeans	Wheat***	Sorghum
Yield per Acre				
Dryland	116.00	41.83	51.36	100.00
Irrigation	192.00	59.91	*NA*	*NA*
Units	*bu/acre*	*bu/acre*	*bu/acre*	*bu/acre*
Cost per Acre				
Dryland	$462.76	$347.12	$259.98	$311.51
Irrigation	$702.00	$457.46	*NA*	*NA*
Normalized Price per Bushel*	$4.16	$9.85	$4.83	$4.09
Net Return per Acre**				
Dryland	$19.80	$64.91	($11.91)	$97.38
Irrigation	$96.72	$132.65	*NA*	*NA*

Source: Kansas Farm Management Association.

**Source: USDA, Economic Research Service.*

***Abt calculations using crop budget data (price per unit minus cost per unit).*

****Wheat production costs are for rotating wheat.*

NA = Not available.

Crop Scenarios

Because of the uncertainty associated with how individual farms would react to changes in access to water for irrigation, four scenarios were developed. The four scenarios are designed to simulate a range of possible cropping patterns and production technique changes and related farm income changes. Each of the scenarios estimated under the three alternatives are summarized in Table 5.

Table 5. Crop Scenarios

Scenario	Scenario Description
No Action Alternative	
Existing Conditions	No change in irrigated and dryland crop acreage in Zone A.
Scenario A*	All irrigated acres shift to dryland acres for the same crops.
Scenario B*	Shift from irrigated corn to dryland wheat. Soybeans assume a shift from irrigated to dryland sorghum.
Scenario C*	Shift from irrigated soybeans to dryland wheat. Corn acreage assumes to shift from irrigated to dryland.
Scenario D*	Shift from both irrigated corn and soybeans to dryland sorghum.
Augmentation Wellfield and Groundwater Use Reduction Alternative	
Existing Conditions	No change in irrigated and dryland land use in Zone A.
Scenario A	Shift irrigated crops to dryland on 2,292 acres, split between corn and soybeans
Scenario B	Shift in 1,147 acres from irrigated corn to dryland wheat. For soybeans, 1,146 of the irrigated crop acres shift from irrigated to dryland sorghum.
Scenario C	Shift in 1,147 acres from irrigated soybeans to dryland wheat. For corn, 1,146 of the irrigated crop acres shift from irrigated to dryland.
Scenario D	Shift 2,292 acres, split between corn and soybeans from irrigated to dryland sorghum.
Groundwater Use Reduction Alternative	
Existing Conditions	No change in irrigated and dryland crop acreage in Zone A.
Scenario A	60% of the irrigated crop acres shift from irrigated to dryland. The remaining 40% of acreage stays in irrigation.
Scenario B	Shift in 60% of the acreage from irrigated corn to dryland wheat. For soybeans, 60% of the irrigated crop acres shift from irrigated to dryland sorghum, while the remaining 40% of crops remain irrigated.
Scenario C	Shift in 60% of the acreage from irrigated soybeans to dryland wheat. For corn, 60% of the irrigated crop acres shift from irrigated to dryland, while the remaining 40% of crops remain irrigated.
Scenario D	Shift in 60% of the acreage from both irrigated corn and soybeans to dryland sorghum.

**Scenarios that switch from irrigated to dryland techniques include changes in acreage, yields, and production costs.*

For each of the crop scenarios under the alternatives, farm income is estimated by multiplying estimated irrigated and dryland acres by estimated yield per acre for each crop. Farm production costs

are estimated by multiplying estimated irrigated and dryland acres by production cost per acre for each crop. Finally, net farm income is estimated by subtracting production costs from crop revenues. The No Action Alternative scenarios were compared to existing conditions, and the action alternative scenarios are then compared to No Action Alternative scenarios to identify estimated changes in net farm income.

No Action Alternative: Estimates of Impacts on Net Farm Income

Table 6 presents the estimated change in net farm income under the No Action Alternative relative to existing conditions. Under the No Action Alternative, it is assumed that KDA-DWR will administer water rights which will lead to the curtailment of all junior water rights within Zone B (810 water rights resulting in 109,000 irrigated acres). The top half of the table shows the total net farm income under existing conditions (no change in irrigation) and each of the crop scenarios under the No Action Alternative. The second half of the table shows the difference between existing conditions and each of the four crop scenarios. Under all No Action Alternative scenarios, annual net farm income declines relative to existing conditions, ranging from a reduction of $781 thousand (-3.5%) to $7.3 million (-32.7%). The smallest reduction in net farm income occurs under Scenario D which shifts irrigated corn and soybeans to dryland sorghum. The largest decline in net farm income occurs under Scenario C, which shifts irrigated corn to dryland and irrigated soybeans to dryland wheat. The average annual reduction across all crop scenarios is $5.0 million (-22%) relative to existing conditions.

Table 6. Changes in Net Farm Income under the No Action Alternative

Alternative/Scenario	Corn	Soybeans	Wheat	Sorghum	Total
Existing Conditions	$9,986,323	$7,647,718	($3,165,138)	$7,913,940	$22,382,843
Scenario A	$6,014,044	$6,081,445	($3,165,138)	$7,913,940	$16,844,292
Scenario B	$4,991,539	$4,580,888	($3,780,252)	$10,165,252	$15,957,428
Scenario C	$6,014,044	$4,580,888	($3,440,514)	$7,913,940	$15,068,358
Scenario D	$4,991,539	$4,580,888	($3,165,138)	$15,194,062	$21,601,352
Difference from Existing Conditions					
A Difference	($3,972,278)	($1,566,273)	$0	$0	($5,538,551)
% Change	-39.8%	-20.5%	0.0%	0.0%	-24.7%
B Difference	($4,994,784)	($3,066,830)	($615,114)	$2,251,313	($6,425,415)
% Change	-50.0%	-40.1%	19.4%	28.4%	-28.7%
C Difference	($3,972,278)	($3,066,830)	($275,376)	$0	($7,314,485)
% Change	-39.8%	-40.1%	8.7%	0.0%	-32.7%
D Difference	($4,994,784)	($3,066,830)	$0	$7,280,122	($781,491)
% Change	-50.0%	-40.1%	0.0%	92.0%	-3.5%
Average Annual Change in Net Farm Income for All Crop Scenarios					**($5,014,986)**
Average % Change					**-22%**

Augmentation Wellfield and Groundwater Use Reduction Alternative: Estimates of Impacts on Net Farm Income

Table 7 summarizes the estimated impact of the Augmentation Wellfield and Groundwater Use Reduction Alternative on annual net farm income. The top half of the table shows the total net farm income under existing conditions (no change in irrigation) and each of the crop scenarios under the Augmentation Wellfield and Groundwater Use Reduction Alternative. The second section of the table shows the difference between existing conditions and each of the four crop scenarios for the Augmentation Wellfield and Groundwater Use Reduction Alternative. The third section of the table shows the difference in net farm income under the No Action Alternative (Table 7) and the Augmentation Wellfield and Groundwater Use Reduction Alternative. Relative to the No Action Alternative, the Augmentation Wellfield and Groundwater Use Reduction Alternative shows an increase in net farm income under all the crop scenarios, with Scenario C showing the largest increase (69.8%) and Scenario D the smallest increase (3.3%). The average annual increase in net farm income across all the crop scenarios under the Augmentation Wellfield and Groundwater Use Reduction Alternative relative to the No Action Alternative is $4.9 million or a 36% increase. All scenarios compared to existing conditions show a slight decline in annual net farm income due to the water right retirements in Zone D.

Table 7. Changes in Net Farm Income under the Augmentation Wellfield and Groundwater Use Reduction Alternative

Alternative/Scenario	Corn	Soybeans	Wheat	Sorghum	Total
Existing Conditions	$9,986,323	$7,647,718	($3,165,138)	$7,913,940	$22,382,843
Scenario A	$9,898,131	$7,570,042	($3,165,138)	$7,913,940	$22,216,975
Scenario B	$9,875,429	$7,495,625	($3,165,138)	$8,025,589	$22,231,506
Scenario C	$9,898,131	$7,495,625	($3,178,794)	$7,913,940	$22,128,901
Scenario D	$9,875,429	$7,495,625	($3,192,451)	$8,137,238	$22,315,841
Difference from Existing Conditions					
Scenario A	($88,192)	($77,676)	$0	$0	($165,868)
% Change	-0.9%	-1.0%	0.0%	0.0%	-0.7%
Scenario B Difference	($110,894)	($152,093)	$0	$111,649	($151,337)
% Change	-1.1%	-2.0%	0.0%	1.4%	-0.7%
Scenario C Difference	($88,192)	($152,093)	($13,657)	$0	($253,942)
% Change	-0.9%	-2.0%	0.4%	0.0%	-1.1%
Scenario D Difference	($110,894)	($152,093)	($27,313)	$223,298	($67,002)
% Change	-1.1%	-2.0%	0.9%	2.8%	-0.3%
Difference from No Action					
Scenario A	$3,884,086	$1,488,597	$0	$0	$5,372,683
% Change	64.6%	24.5%	0.0%	0.0%	31.9%
Scenario B Difference	$4,883,890	$2,914,737	$615,114	($2,139,664)	$6,274,078
% Change	97.8%	63.6%	-16.3%	-21.0%	39.3%
Scenario C Difference	$3,884,086	$2,914,737	$261,720	$0	$7,060,543
% Change	101.1%	101.6%	-9.6%	0.0%	69.8%
Scenario D Difference	$4,883,890	$2,914,737	($27,313)	($7,056,824)	$714,490
% Change	97.8%	63.6%	0.9%	-46.4%	3.3%
Average Annual Change in Net Farm Income for All Crop Scenarios Relative to the No Action Alternative					**$4,855,448**
Average % Change					**36%**

Groundwater Use Reduction Alternative: Estimates of Impacts on Net Farm Income

Table 8 presents the estimated change in net farm of the Groundwater Use Reduction Alternative. The top half of the table shows the total annual net farm income under existing conditions (no change in irrigation) and each of the crop scenarios under the Groundwater Use Reduction Alternative. The second section of the table shows the difference between existing conditions and each of the Groundwater Use Reduction Alternative for the four crop scenarios. The third section of the table shows the difference in net farm income under the No Action Alternative (Table 6) and the Groundwater Use Reduction Alternative. Relative to the No Action Alternative, the Groundwater Use Reduction Alternative shows a decline in annual net farm income under all crop scenarios, with Scenario C showing the largest decline (-13.5%) and Scenario D the smallest decline (-1.0%). Relative to the No Action Alternative, the average annual decrease in net farm income across all the crop scenarios for the Groundwater Use Reduction Alternative is $1.4 million (-9%). All scenarios compared to existing conditions show a large decline in annual net farm income.

Table 8. Changes in Net Farm Income under the Groundwater Use Reduction Alternative

Alternative/Scenario	Corn	Soybeans	Wheat	Sorghum	Total
Existing Conditions	$9,986,323	$7,647,718	($3,165,138)	$7,913,940	$22,382,843
Scenario A	$4,921,218	$5,640,327	($3,165,138)	$7,913,940	$15,310,347
Scenario B	$3,617,407	$3,717,161	($3,949,478)	$10,799,302	$14,184,391
Scenario C	$4,921,218	$3,717,161	($3,518,070)	$7,913,940	$13,034,248
Scenario D	$3,617,407	$3,717,161	($3,165,138)	$17,211,604	$21,381,034
Difference from Existing Conditions					
Scenario A	($5,065,105)	($2,007,391)	$0	$0	($7,072,496)
% Change	-50.7%	-26.2%	0.0%	0.0%	-31.6%
Scenario B Difference	($6,368,915)	($3,930,558)	($784,341)	$2,885,362	($8,198,452)
% Change	-63.8%	-51.4%	24.8%	36.5%	-36.6%
Scenario C Difference	($5,065,105)	($3,930,558)	($352,932)	$0	($9,348,595)
% Change	-50.7%	-51.4%	11.2%	0.0%	-41.8%
Scenario D Difference	($6,368,915)	($3,930,558)	$0	$9,297,664	($1,001,809)
% Change	-63.8%	-51.4%	0.0%	117.5%	-4.5%
Difference from No Action					
Scenario A	($1,092,827)	($441,118)	$0	$0	($1,533,945)
% Change	-18.2%	-7.3%	0.0%	0.0%	-9.1%
Scenario B Difference	($1,374,132)	($863,728)	($169,226)	$634,049	($1,773,036)
% Change	-27.5%	-18.9%	4.5%	6.2%	-11.1%
Scenario C Difference	($1,092,827)	($863,728)	($77,556)	$0	($2,034,110)
% Change	-18.2%	-18.9%	2.3%	0.0%	-13.5%
Scenario D Difference	($1,374,132)	($863,728)	$0	$2,017,542	($220,317)
% Change	-27.5%	-18.9%	0.0%	13.3%	-1.0%
Average Annual Change in Net Farm Income for All Crop Scenarios Relative to the No Action Alternative					**($1,390,352)**
Average % Change					**-9%**

Reductions in Greenhouse Gas Emissions

Each of the alternatives discussed above have the potential to reduce greenhouse gas emissions with their implementation. This section estimates the monetary value of these reductions. The CO_2 emissions reductions for each alternative is estimated in Section 6.3 of the watershed plan. Those estimates are summarized again in Tables 9, 10, and 11 below. The analysis then applied the latest estimate of the social cost of carbon, obtained from the Interagency Working Group on Social Cost of Greenhouse Gases (IWG, 2021) to the emission reduction estimates to quantify this benefit of each alternative. The results are summarized below.

No Action Alternative

Table 9 shows the CO_2 emission reductions under the No Action Alternative relative to existing conditions. The alternative is expected to retire water rights within Zone B which will decrease annual CO_2 emissions by 58,000 metric tons. Applying the social cost of carbon to this reduction results in an annual benefit of $11.2 million.

Table 9. CO_2 Emissions Reductions with Water Right Retirements in Zone B under the No Action Alternative

	Diesel	Electricity	Natural Gas	Total
Carbon Dioxide Emissions Reduction (MT per Year)	7,903	5,548	44,967	58,418
Social Cost of Carbon ($/MT)(2024$)				$191.37
Benefit of reducing energy use				$11,179,482

Augmentation Wellfield and Groundwater Use Reduction Alternative

Under the Augmentation Wellfield and Groundwater Use Reduction Alternative, annual CO_2 emission reductions are estimated to be 1,435 MT with the retirement of 2,500 acre-feet of water rights. This would result in an annual benefit of $275,000 (Table 10).

Table 10. CO_2 Emissions Reductions with 2,500 Acre-Feet of Targeted Water Right Retirements under the Augmentation Wellfield and Groundwater Use Reduction Alternative

	Diesel	Electricity	Natural Gas	Total
Carbon Dioxide Emissions Reduction (MT per Year)	194	136	1,106	1,436
Social Cost of Carbon ($/MT)(2024$)				$191.37
Benefit of reducing energy use				$274,808

Groundwater Use Reduction Alternative

The annual CO_2 emissions reductions benefits for the Groundwater Use Reduction Alternative are summarized in Table 11. This alternative is expected to reduce CO_2 emissions by 61,700 MT with the retirement of up to 107,369 acre-feet of water rights. This equates to a $11.8 million annual benefit.

Table 11. CO_2 Emissions Reductions with 107,369 Acre-Feet of Water Right Retirements under the Groundwater Use Reduction Alternative

	Diesel	Electricity	Natural Gas	Total
Carbon Dioxide Emissions Reduction (MT per Year)	8,346	5,860	47,494	61,700
Social Cost of Carbon ($/MT)(2024$)				$191.37
Benefit of reducing energy use				$11,807,560

Regional Economic Assessment of Rattlesnake Creek Watershed Plan Alternatives

A regional economic assessment was conducted using the IMPLAN model of the Rattlesnake Creek Watershed Plan Alternatives. A regional model was developed to represent the economy in five Kansas counties (Pratt, Stafford, Kiowa, Edwards and Pawnee). Figure 2 below shows the baseline economic statistics from the IMPLAN model, using data representing the 2022 Economy. Table 12 shows the top 20 industries by Output (Sales) in the region. All analysis was done in 2024 dollars.

Figure 2. Baseline economic statistics from the IMPLAN model.

Table 12. Top Twenty Industries by Output (Sales) in the Study Area

IMPLAN Code	Description	Employ-ment	Labor Income	Output	Average Wages	Average Proprietor Income
154	Petroleum refineries	95	$8,717,832	$1,054,495,481	$89,181	$153,306
11	Beef cattle ranching and farming	1357	$111,003,429	$527,021,151	$47,885	$84,911
2	Grain farming	786	$75,036,356	$417,661,264	$56,384	$148,580
20	Oil and gas extraction	438	$7,758,389	$382,711,761	$99,908	$11,007
490	Hospitals	686	$53,665,380	$128,401,274	$76,299	$434,783
449	Owner-occupied dwellings	0	$0	$109,598,065		
400	Wholesale - Other nondurable goods	294	$20,940,619	$102,221,687	$71,326	$70,647
64	Other animal food manufacturing	77	$6,462,242	$101,934,576	$81,703	$135,363
1	Oilseed farming	30	$18,520,344	$77,960,234	$63,190	$673,125
542	Local govt, education	1151	$53,114,600	$69,854,552	$46,132	
36	Support activities for oil and gas operations	259	$15,653,573	$63,325,249	$84,835	$11,421
540	State govt, hospitals and health services	741	$47,200,175	$62,646,076	$63,671	
441	Banking	187	$12,807,988	$50,657,236	$73,789	($4,001)
447	Other real estate	306	$8,376,672	$50,371,059	$31,559	$27,054
89	Animal, except poultry, slaughtering	66	$5,478,248	$48,940,323	$56,677	$596,383
47	Electric power transmission and distribution	36	$4,346,028	$48,044,158	$133,778	($16,131)
541	* Employment and payroll of state govt, other services	648	$35,636,077	$46,149,136	$54,974	
510	Limited-service restaurants	443	$9,443,456	$42,894,529	$22,141	$15,664
413	Retail - Nonstore	251	$3,043,922	$40,876,392	$38,880	$5,285
35	Drilling oil and gas wells	112	$7,280,599	$40,715,594	$88,798	$12,054
417	Truck transportation	175	$14,402,469	$40,665,958	$67,802	$109,812

The IMPLAN sectors primarily affected by the alternatives include Grain Farming, Oilseed Farming, Electric Power, and State/local government.

The primary impact from the alternatives was in the grain production sector. We included soybean sales with the grain production sector for simplification because most farmers with soybeans also raise grains in rotation.

Table 13 summarizes the regional economic impacts of the No-Action Alternative which shows a reduction in grain sales of $41,206,000 annually from reduced access to irrigation. The reduction in grain sales under the No-Action Alternative represents approximately a 10% reduction compared to sales under existing conditions.

Table 13. Regional Economic Impacts of Reduced Grain Sales under the No Action Alternative

Impact	Employment	Labor Income	Value Added	Output
Direct	74.81	$7,403,034	$8,078,532	$41,206,166
Indirect	56.28	$3,127,423	$4,501,345	$12,410,176
Induced	22.85	$846,991	$1,959,488	$3,721,109
Total	153.94	$11,377,448	$14,539,365	$57,337,451
Multipliers	*3.74 Jobs Per $1M*	0.28	0.35	1.39

NOTE: The outputs reported in the table represent negative changes to the current economy.

The decrease in grain production leads to a reduction in farm employment of 75 jobs. As the decreased income ripples through the economy, the total job loss would be 153 jobs. This may be overestimated as we are not taking farms or land out of production, but just changing from irrigation to dryland production. The Value Added (profits) shows a $8 million loss to farm income, the multiplier effect in the local economy increases that to a $14.5 million loss in Value Added (profits). The initial $41 million decreased Output (sales) of grain increases to a $57 million loss in sales throughout the region.

Table 14 shows the regional economic impacts of the Augmentation Wellfield and Groundwater Use Reduction Alternative. Relative to the No Action Alternative, grain sales are expected to increase by $28.6 million, with fewer acres of irrigated crops converting to dryland crops. Employment is also expected to increase under this alternative, relative to the No Action Alternative, by 107 jobs.

Table 14. Regional Economic Impacts of Reduced Grain Sales under the Augmentation Wellfield and Groundwater Use Reduction Alternative

Impact	Employment	Labor Income	Value Added	Output
Direct	52	$5,132,422	$5,600,735	$28,567,668
Indirect	39	$2,168,199	$3,120,720	$8,603,804
Induced	16	$587,207	$1,358,486	$2,579,794
Total	107	$7,887,828	$10,079,942	$39,751,266
Multipliers	*3.74 Jobs per $1M*	0.08	0.11	0.43

NOTE: The outputs reported in the table represent changes from the No Action Alternative.

With the Augmentation Wellfield and Groundwater Use Reduction Alternative**,** the Operations, Maintenance, and Replacement costs will be roughly $900,000 per year (Table 15). These expenditures also have regional economic effects which were estimated using IMPLAN. About $693,000 will be increased electricity needed for the new pumps, and the remaining $207,000 in operations and well support activities. We modeled the electricity sales in IMPLAN Sector 47, and the other activities in IMPLAN Sector 19. Much of the electricity is imported into the region so local output only goes up by $414,000. These are positive impacts to the local community but will be paid for by local irrigation district expenses.

Table 15. Regional Economic Impacts of OM&R under the Augmentation Wellfield and Groundwater Use Reduction Alternative

Impact	Employment	Labor Income	Value Added	Output
Direct	5.2	$258,073	$259,544	$414,228
Indirect	0.1	$8,874	$53,827	$111,151
Induced	0.57	$21,344	$49,147	$93,418
Total	5.87	$288,291	$362,519	$618,797
Multipliers	*6.52 Jobs per $1M*	0.32	0.40	0.69

Construction expenses under the Augmentation Wellfield and Groundwater Use Reduction Alternative are also expected to have a one-time positive regional economic impact (Table 16). The $27.7 million in construction expenses were categorized into the most relevant IMPLAN sectors and run separately. Since most materials (pipe, pumps, motors, electrical components, poles, etc.) were not produced in the local area, but imported in, there will be a small direct impact to the local economy from construction.

Table 16. Regional Economic Impacts of Construction under the Augmentation Wellfield and Groundwater Use Reduction Alternative

Impact	Employment	Labor Income	Value Added	Output
1 - Direct	8.64	$ 377,959	$ 501,062	$ 1,922,957
2 - Indirect	2.34	$ 130,251	$ 225,638	$ 540,123
3 - Induced	1.09	$ 40,482	$ 93,411	$ 177,481
Totals	12.08	$ 548,692	$ 820,111	$ 2,640,562

The construction impacts were then combined with the expected Design, Project Administration and Land Rights expenses to get total expenses from the Augmentation Wellfield and Groundwater Use Reduction Alternative (Table 17). Note that these are one-time impacts, whereas the above irrigation to dryland conversion and the OM&R impacts are annual impacts for the next 50 years.

Table 17. Regional Economic Impacts of Construction, Design, Administration and Land Rights Acquisition under the Augmentation Wellfield and Groundwater Use Reduction Alternative

Impact	Employment	Labor Income	Value Added	Output
Direct	39.07	$ 1,915,031	$ 2,354,757	$ 5,423,957
Indirect	5.40	$ 257,110	$ 425,058	$ 1,040,571
Induced	4.64	$ 172,704	$ 398,006	$ 756,400
Totals	**49.12**	**$ 2,344,844**	**$ 3,177,822**	**$ 7,220,928**

NOTE: The outputs reported in the table represent negative changes to the current economy.

Table 18 shows the regional economic impacts of reduced grain sales under the Groundwater Use Reduction Alternative relative to the No Action Alternative. The effects are similar to the No-Action Alternative with a slight increase in grain sales of $610 ,708 per year and an increase in 2 jobs.

Table 18. Regional Economic Impacts of Reduced Grain Sales under the Groundwater Use Reduction Alternative

Impact	Employment	Labor Income	Value Added	Output
Direct	1	$109,719	$119,730	$610,708
Indirect	1	$46,351	$66,713	$183,929
Induced	0	$12,553	$29,041	$55,150
Total	2	$168,623	$215,485	$849,786
Multipliers	*3.74 Jobs per $1M*	0.27	0.35	1.37

NOTE: The outputs reported in the table represent changes compared to the No Action Alternative.

Data Limitations

While estimates are based on the best available data, these data used may not accurately estimate future crop yields, prices, and production costs. Additionally, yield and production cost data are not available for irrigated wheat and sorghum in the South-Central Kansas region. Estimates assume that dryland and irrigated land share the same production costs and yields for wheat and sorghum. To the extent that dryland yields are lower than irrigated crop yields under the alternative scenarios, losses in net farm income may be larger than estimated. However, higher irrigation costs may partially or wholly offset losses due to lower yields.

The simplifying assumptions used in this analysis produce estimates that may represent a "worst-case" scenario for farm income. For example, estimates assume that shifts from irrigated to dryland production will reduce crop yields by 54.2% for corn, and 58.7% for soybeans. However, dryland yields may be higher than estimated for several reasons. Changes in farming practices (e.g., crop rotations) or differences in the allocation of crops other than those assumed here may generate higher yields than estimated. For example, farmers may shift production of corn and soybeans to less water-dependent crops, such as milo. Other factors, including the amount of precipitation in the region, and changes to more efficient irrigation techniques could result in higher than estimated yields and higher net farm income under the alternative scenarios.[2,3] There is also a possibility that some of the water rights could be restored in future years if stream flows increase. If that were to occur, some of the acres would again be irrigated leading to higher yields.

[2]For comparison, Deines et al. (2021) estimates that a 25% reduction in groundwater use (a smaller reduction relative to the alternative scenarios engaged here) at the Sheridan-6 LEMA reduced crop yields by 0.67% for corn, 1.21% for sorghum, 1.41% for soybeans, and 0.07% for wheat. For the same LEMA, Drysdale (2020) estimates a reduction in crop yields of 8% for corn and 4% for soybeans using different estimation techniques. Farmers impacted by the Sheridan-6 LEMA adopted changes in farming practices to reduce water use, which contributed to a non-linear relationship between reduced groundwater use and yields.

[3]For more information on the impact of changes in farm practices on yields and water use, see Presley (2012).

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BIG BEND GROUNDWATER MANAGEMENT DISTRICT #5

FINAL WATERSHED PLAN – ENVIRONMENTAL IMPACT STATEMENT

RATTLESNAKE CREEK WATERSHED

December 2025