UNITED STATES DEPARTMENT OF AGRICULTURE

FARM SERVICE AGENCY

DRAFT

Programmatic Environmental Assessment for Implementation of the Amended Conservation Reserve Enhancement Program Agreement for Missouri

November 2006

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COVER SHEET

Proposed Action: The U.S. Department of Agriculture (USDA) Farm Service Agency (FSA) proposes to implement the amended Conservation Reserve Enhancement Program (CREP) agreement for the State of Missouri. CREP is a voluntary land conservation program for agricultural landowners.

Type of Statement: This programmatic environmental assessment (PEA) was prepared in accordance with the *National Environmental Policy Act* (42 *United States Code* parts 4321 et seq., 2000), the Council on Environmental Quality implementing regulations (40 *Code of Federal Regulations* parts 1500 et seq., 2006), and *Environmental Quality and Related Environmental Concern—Compliance with the National Environmental Policy Act* (7 *Code of Federal Regulations* parts 799 et seq., 2006). This analysis is programmatic in nature and does not address individual site specific impacts, which would be evaluated for individual CREP contracts prior to approval.

Lead Agency: USDA FSA

Cooperating Agencies: USDA, Natural Resources Conservation Service

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Comments: Once this PEA is finalized, a Notice of Availability will be printed in newspapers within the vicinity of the CREP area. FSA will provide a public comment period prior to any FSA decision regarding the proposed action.

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EXECUTIVE SUMMARY

This programmatic environmental assessment identifies the possible environmental consequences resulting from implementation of the amended Conservation Reserve Enhancement Program agreement for the State of Missouri. The assessment process is designed to inform decision makers and the public about the potential environmental effects of the proposed action and to ensure public involvement in the process. The process will help decision makers take into account all environmental factors when making decisions related to the proposed action.

This programmatic environmental assessment has been prepared by the United States Department of Agriculture Farm Service Agency in accordance with the requirements of the *National Environmental Policy Act* (42 *United States Code* parts 4321 et seq., 2000), the Council on Environmental Quality implementing regulations (40 *Code of Federal Regulations* parts 1500 et seq., 2006), and *Environmental Quality and Related Environmental Concern—Compliance with the National Environmental Policy Act* (7 *Code of Federal Regulations* parts 799 et seq., 2006).

Purpose and Need for the Proposed Action

The purpose of this action is to implement Missouri's amended Conservation Reserve Enhancement Program agreement to reduce pesticides, nutrients, and sediments from entering the reservoirs that supply public drinking water by restoring vegetation to areas currently used for agricultural production. Under the amended agreement, eligible farm land would be planted in grasses, shrubs, and trees.

The Missouri Conservation Reserve Enhancement Program is needed to:

- Improve drinking water quality
- Protect public health
- Enhance wildlife habitat
- Promote soil and water conservation.

Proposed Action and No Action Alternatives

This programmatic environmental assessment documents the analysis of the proposed action and no action alternatives. The proposed action would remove up to 40,000 acres from agricultural production and establish approved conservation practices on the land. Eligible land would be cropland and marginal pastureland located within designated watersheds that surround public drinking water supplies in 79 Missouri counties.

The proposed action would provide participants with annual rental payments for the 14 to 15 year contract period. Participants would receive annual incentive payments of 15–20 percent of the base rental rate for specific conservation practices. In addition, the State would issue a one-time signing incentive payment equal to 150 percent of the annual base rental payment of the contract and the United States Department of Agriculture would provide a one-time incentive payment for hydrology restoration, a one-time signing incentive payment, and a one-time practice incentive payment. Participants would be compensated for 75 percent of conservation practice establishment costs and up to 75 percent of all other eligible soil and water structural conservation practices needed in each watershed.

Under the no action alternative, eligible lands would not be removed from agricultural production and the proposed conservation practices would not be implemented. Contracts for lands enrolled under Missouri's existing Conservation Reserve Enhancement Program agreement would remain unchanged.

The Farm Service Agency has identified the proposed action as the preferred alternative because it is the alternative that would satisfy the purpose and need for the proposed action.

Summary of Environmental Consequences

It is expected that there would be both beneficial and temporary minor adverse impacts associated with implementation of the amended Missouri Conservation Reserve Enhancement Program agreement, which would increase the total acreage of the existing agreement and provide additional land and conservation practices. A summary of the potential impacts is given in Table ES–1.

Table ES–1. Summary of potential impacts from implementation of the proposed action and no action alternatives.

Resource	Proposed Action	No Action
Biological Resources	• Increased quality and abundance of wildlife and fisheries habitats, including those used by protected species • Establishment of migration corridors for wildlife • Reduced habitat fragmentation • Increased health and persistence of fish populations • Increased vegetation diversity • Beneficial impacts to wildlife, fisheries, and vegetation • Beneficial impacts to 25 of 30 protected species; no or negligible impact to remaining species with appropriate mitigation measures in place • Temporary adverse impacts due to human disturbance and increased sedimentation.	• Increased loss, degradation, and fragmentation of habitats; fewer potential benefits to habitats in areas under existing contracts • Decreased health and persistence of fish populations, fewer potential benefits to fish in areas under existing contracts • Continued alteration and depletion of native vegetation, fewer potential benefits to vegetation in areas under existing contracts.
Cultural Resources	• Potential for encountering both recorded and unidentified archeological and architectural sites and traditional cultural properties • Actions to be reviewed with the Missouri State Historic Preservation Office on a site specific basis • No anticipated impact to cultural resources.	• Continuation of farming not expected to impact resource • Potential adverse impacts if agricultural practices occur on previously undisturbed lands.
Water Resources	• Reduced pesticides, nutrients, and other pollutants in surface water, groundwater, and wetlands • Reduced sedimentation • Greater rates of aquifer recharge	• Continued degradation of surface water, groundwater, and wetlands due to pesticide, nutrient, and sediment runoff; fewer potential benefits to surface water, groundwater, and wetlands in areas under existing contracts.

Resource	Proposed Action	No Action
	• Improved function of floodplains • Beneficial impacts to surface water, groundwater, wetlands, and floodplains.	
Soil Resources	• Reduced water and wind erosion • Stabilization of soils and topography • Temporary increase in erosion during implementation.	• Continuation of current rates of erosion and changes in topography, fewer potential benefits to soil resources in areas under existing contracts.
Air	• Increased vegetation would reduce erosion and absorb pollutants • Beneficial impacts to local air quality • Temporary, minor adverse impacts during implementation activities.	• No change to existing conditions.
Recreation	• Slight potential benefits to recreation from improved water quality and wildlife habitat.	• No change to existing conditions.
Human Health and Safety	• Reduced pollution in public waters used for recreation • Reduced potential for consumption of contaminated water and game (e.g., fish) • Reduced exposure from pesticide application • Beneficial impacts to human health and safety.	• Continued risk to human health and safety from pollution of public waters and pesticide application, fewer potential benefits to human health and safety in areas under existing contracts.
Socio-economics	• Positive net present value for program • Implementation would create total net present value of $4.0 million over 15 years • Increased recreation opportunities may generate economic activity.	• Socioeconomic conditions would continue to follow current trends.
Environmental Justice	• Installation and maintenance of conservation practices may create new positions • Conservation Reserve Enhancement Program payments may generate additional non-farm employment within the community.	• No change to existing conditions.
Other Protected Resources	• Slight potential benefits to National Natural Landmarks and wilderness areas from improved water quality and wildlife habitat.	• No change to existing conditions.

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CONTENTS

FIGURES

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ACRONYMS AND ABBREVIATIONS

BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
BMP	best management practice
BOD	biochemical oxygen demand
CCC	Commodity Credit Corporation
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
CP	conservation practice
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSR	*Code of State Regulations*
DDT	dichloro-diphenyl-trichloroethane
EO	Executive Order
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FEMA	Federal Emergency Management Agency
FR	*Federal Register*
FRPP	Farm and Ranch Land Protection Program
FS	Forest Service
FSA	Farm Service Agency
FWS	Fish and Wildlife Service
FY	fiscal year
GIS	geographical information system
GRP	Grassland Reserve Program
LMBV	largemouth bass virus

MDC	Missouri Department of Conservation
MDHSS	Missouri Department of Heath and Senior Services
MDNR	Missouri Department of Natural Resources
MSHPO	Missouri State Historic Preservation Office
NAAQS	National Ambient Air Quality Standards
NEPA	*National Environmental Policy Act*
NNL	national natural landmark
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSFHWAR	*National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*
PEA	programmatic environmental assessment
PIP	practice incentive payment
PM	particulate matter
ROI	region of influence
SIP	signing incentive payment
TCP	traditional cultural property
TMDL	total maximum daily load
USACE	U.S. Army Corps of Engineers
USC	*United States Code*
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WHIP	Wildlife Habitat Incentives Program
WRP	Wetlands Reserve Program

1.0 INTRODUCTION

The *Agreement between the U.S. Department of Agriculture Commodity Credit Corporation and the State of Missouri Concerning the Implementation of a Conservation Reserve Enhancement Program* was signed into effect on September 15, 2000 (Appendix A). The U.S. Department of Agriculture (USDA) Farm Service Agency (FSA) proposes to implement the amended Conservation Reserve Enhancement Program (CREP) agreement for the State of Missouri (Appendix B).

This programmatic environmental assessment (PEA) has been prepared to analyze the potential environmental consequences associated with the proposed action and the no action alternatives in accordance with the *National Environmental Policy Act* (NEPA) (42 *United States Code* [USC] parts 4321 et seq., 2000), the Council on Environmental Quality (CEQ) implementing regulations (40 *Code of Federal Regulations* [CFR] parts 1500 et seq., 2006), and *Environmental Quality and Related Environmental Concern—Compliance with the National Environmental Policy Act* (7 CFR parts 799 et seq., 2006). This analysis is programmatic in nature and does not address individual site specific impacts, which would be evaluated for individual CREP contracts prior to approval.

1.1 Background

FSA was established during the reorganization of USDA in 1994. The mission of FSA is to:

> "…ensure the well-being of American agriculture and the American public through efficient and equitable administration of agricultural commodity, farm loan, conservation, environmental, emergency assistance, and domestic and international food assistance programs." (FSA 1997)

The Conservation Reserve Program (CRP) was established under Title XII of the *Food Security Act of 1985* (16 USC part 3831, 1996). The purpose of CRP is to cost-effectively assist owners and operators in conserving and improving soil, water, and wildlife resources on their farms and ranches. Highly erodible and other environmentally sensitive acreage, normally devoted to the production of agricultural commodities, is converted to a long-term resource conservation cover. CRP participants enter into contracts for periods of 10 to 15 years in exchange for annual rental payments and cost-share assistance for installing certain conservation practices (CPs).

The *Farm Security and Rural Investment Act of 2002*, commonly known as the *2002 Farm Bill*, authorizes CRP through 2007 and raises the overall enrollment cap to 39.2 million acres (16 USC part 3831, 1996). The *Conservation Reserve Program Final Programmatic Environmental Impact Statement* contains a detailed analysis of the impacts of implementing CRP nationwide, including the CREP component (FSA 2003a).

The Secretary of Agriculture initiated CREP in 1997. CREP is authorized pursuant to the *Federal Agriculture Improvement and Reform Act of 1996* and is a subset of CRP (7 USC parts 7201 et seq., 1998). This program is based on the continuous CRP model (i.e., producers can sign up anytime provided their operation is located within an area covered by a CREP proposal) but differs in four important ways (FSA 2004):

- CREP is targeted to specific geographic areas and designed to focus CPs on addressing specific environmental concerns.

- CREP is a partnership between USDA, State and/or tribal governments, other Federal and State agencies, environmental groups, wildlife groups, and other stakeholders who have an interest in addressing particular environmental issues.

- CREP is results-oriented, and requires States to establish measurable objectives and conduct annual monitoring to measure progress toward implementation of those objectives.

- CREP is flexible, within existing legal constraints, and may be adapted to meet local conditions.

This voluntary program uses financial incentives to encourage farmers and ranchers to enroll in contracts of 10 to 15 years in duration to remove lands from agricultural production. The two primary objectives of CREP are to:

- Coordinate Federal and non-Federal resources to address specific conservation objectives of a State and the Nation in a cost-effective manner.

- Improve water quality, erosion control, and wildlife habitat related to agricultural use in specific geographic areas.

CRP and CREP are administered by FSA in cooperation with the Natural Resources Conservation Service (NRCS) and the Missouri Department of Conservation (MDC). FSA is the lead agency in the development of this PEA.

1.1.1 Regulatory Compliance

This PEA has been completed as part of the NEPA process and is in compliance with CEQ and FSA implementing regulations (40 CFR parts 1500 et seq., 2006; 7 CFR parts 799 et seq., 2006). The intent of NEPA is to protect, restore, and enhance the human environment through well-informed Federal decisions. The following non-exclusive list of higher-tier executive orders (EOs), acts, and relevant decision and guidance documents apply to actions undertaken by Federal agencies and form the basis of the analysis presented in this PEA (see Appendix C for summaries):

- *Clean Air Act* (42 USC parts 7401 et seq., 1999)

- *Clean Water Act* (33 USC parts 1251 et seq., 2000)

- *Endangered Species Act of 1973*, as amended (16 USC parts 1531 et seq., 1988)

- EO 11514, *Protection and Enhancement of Environmental Quality* (35 *Federal Register* [FR] 4247, 1977)

- EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 32, 1995)

- *National Historic Preservation Act of 1966*, as amended (16 USC part 470, 2000).

1.2 Purpose and Need for Action

The purpose of this action is to implement Missouri's amended CREP agreement to reduce pesticides, nutrients, and sediments from entering the reservoirs that supply public drinking water by restoring vegetation to areas currently used for agricultural production. Under the amended agreement, eligible farm land would be planted in grasses, shrubs, and trees. The specific pesticides targeted for reduction under the proposed action are atrazine and glyphosate.

The Missouri CREP is needed to:

- Improve drinking water quality

- Protect public health
- Enhance wildlife habitat
- Promote soil and water conservation.

1.3 Objectives

CREP agreements are designed to meet specific regional conservation goals and objectives related to agriculture. The proposed agreement with Missouri is focused on improving water quality and promoting soil and water conservation on agricultural lands within watersheds that supply public drinking water. The amended Missouri CREP agreement would intend on enrolling up to 40,000 acres of cropland and marginal pastureland within watersheds that surround public drinking water supplies. These designated watersheds encompass all or parts of the following 79 counties:

- Adair
- Andrew
- Audrain
- Barry
- Barton
- Bates
- Benton
- Boone
- Butler
- Caldwell
- Callaway
- Carter
- Cass
- Cedar
- Chariton
- Christian
- Clay
- Clinton
- Crawford
- Dade
- Dallas
- Daviess
- DeKalb
- Dent
- Douglas
- Franklin
- Gasconade
- Gentry
- Greene
- Grundy
- Harrison
- Henry
- Hickory
- Howard
- Iron
- Jackson
- Jasper
- Jefferson
- Johnson
- Knox
- Lafayette
- Lawrence
- Linn
- Macon
- Madison
- Maries
- Marion
- Mercer
- Monroe
- Montgomery
- Newton
- Nodaway
- Osage
- Perry
- Pettis
- Phelps
- Pike
- Polk
- Pulaski
- Putnam
- Ralls
- Randolph
- Reynolds
- St. Clair
- St. Francois
- St. Louis
- Ste. Genevieve
- Schuyler
- Scotland
- Shannon
- Shelby
- Stone
- Sullivan
- Taney
- Texas
- Vernon
- Washington
- Wayne
- Webster

Agricultural pollution have contributed to a decline in the water quality of the associated watersheds so that county residents are now being adversely impacted by increased levels of pesticides, nutrients (i.e., nitrogen and phosphorus), and sediments in their drinking water.

Under the proposed CREP agreement, farmers and ranchers would voluntarily enter into contracts with the Federal government for 14 to 15 years, agreeing to remove portions of their land from agricultural production and plant them to grass, shrubs, and trees. Removing land from production would decrease the use of pesticides and nutrients, and establishing vegetation would decrease erosion and overland flow. These actions would result in less pesticides, nutrients, and sediments entering waterways within the designated watersheds and, ultimately, public drinking water supplies.

The exact location of parcels that might be enrolled in CREP is not known at this time; therefore, this PEA considers the region of influence (ROI) to be those portions of the watersheds of concern that lie within the 79 counties previously listed (Figure 1).

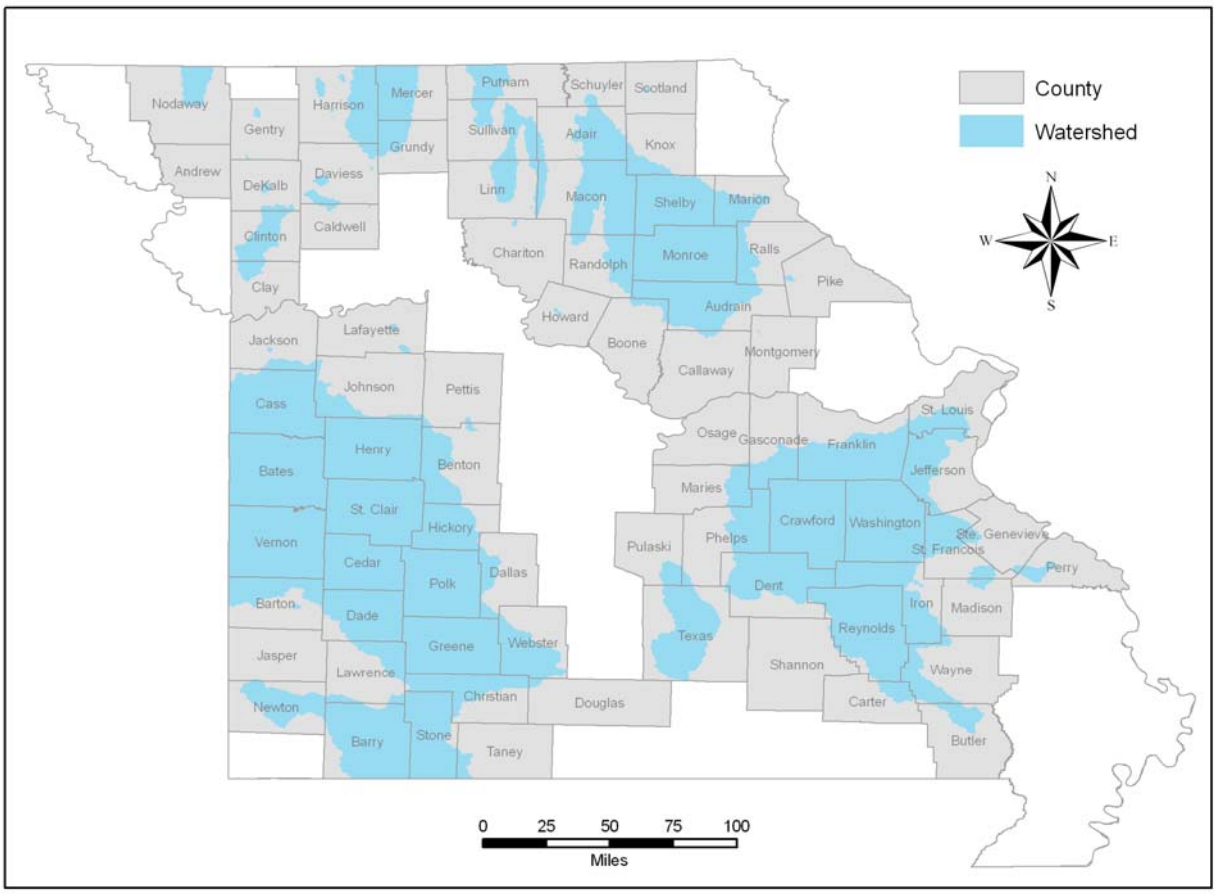

Figure 1. Portions of Missouri watersheds proposed for CREP enrollment (i.e., the ROI).

The specific goals and objectives for the amended Missouri CREP agreement include the following:

- Reduce the annual occurrence of atrazine in public drinking water supplies by 40,000 pounds and glyphosate by 80,000 pounds
- Lower the annual input of nitrogen to public drinking water supplies by 3.2 million pounds and phosphorus input by 2.2 million pounds
- Eliminate the inflow of sediment to public drinking water supplies by 320,000 tons annually by conserving soil and water on agricultural land
- Reduce or maintain soil erosion on agricultural lands to below the soil loss tolerance level for soils present.

The intended outcome of the Missouri CREP agreement is to enhance the ability of producers to enroll certain acreage under CRP where deemed desirable by USDA and the Commodity Credit Corporation

(CCC). CCC is a Federal entity within USDA that was created to stabilize, support, and protect agricultural income and prices.

1.4 Organization of the PEA

This PEA discloses the potential impacts of the proposed action and no action alternatives on affected environmental and economic resources. Chapter 1.0 provides background information relevant to the proposed action and discusses the purpose and need for the proposed action. Chapter 2.0 describes the proposed action and no action alternatives. Chapter 3.0 describes the baseline conditions (i.e., the conditions against which potential impacts of the proposed action and no action alternatives are measured) for each of the resource areas. Chapter 4.0 explains the potential environmental impacts to these resources. Chapter 5.0 provides an analysis of cumulative impacts and irreversible resource commitments. Chapter 6.0 describes mitigations to reduce potential impacts of the proposed action. Chapter 7.0 is a list of the preparers of this document, and Chapter 8.0 lists those persons and agencies contacted during the preparation of this document. Chapter 9.0 is a glossary of terms and Chapter 10.0 contains references used in the PEA.

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2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter describes the alternatives, which include the proposed action and no action alternatives. These two alternatives are compared in terms of their environmental impacts and ability to achieve the objectives listed in Section 1.3. FSA has identified the proposed action as the preferred alternative because it is the alternative that would satisfy the purpose and need for the proposed action.

2.1 Proposed Action (Preferred Alternative)

The preferred alternative would implement the amended Missouri CREP agreement by enrolling up to 40,000 acres of agricultural lands in watersheds that surround public drinking water supplies and encompass all or parts of the 79 counties listed in Section 1.3 (Figure 1). Once the CREP agreement is approved, landowners would enroll eligible lands in the program on a voluntary basis. As such, the exact location of parcels that might be enrolled is not known.

Eligible lands include cropland and marginal pastureland. Cropland must have been planted, or considered planted, to a crop in four of the six years between 1996 and 2001. If land is currently enrolled in CRP, that contract must expire before being eligible for CREP. Lands with existing contracts under the original Missouri CREP agreement may be eligible for additional contracts under the amended CREP agreement.

2.1.1 Established Conservation Practices

The following CPs are proposed for implementation under the amended Missouri CREP agreement:

- CP2—Establishment of Permanent Native Grasses
- CP4D—Permanent Wildlife Habitat, Noneasement
- CP8A—Grass Waterways, Noneasement
- CP10—Vegetative Cover, Grass, Already Established
- CP15A—Establishment of Permanent Vegetative Cover (Contour Grass Strips), Noneasement
- CP21—Filter Strips
- CP22—Riparian Buffer
- CP23—Wetland Restoration
- CP23A—Wetland Restoration, Non-Floodplain
- CP25—Rare and Declining Habitat
- CP29—Marginal Pastureland Wildlife Habitat Buffer
- CP30—Marginal Pastureland Wetland Buffer
- CP31—Bottomland Timber Establishment on Wetlands
- CP33—Habitat Buffers for Upland Birds.

These CPs would be installed on eligible land and according to rules in *Agricultural Resource Conservation Program for State and County Offices* (FSA 2003b). Installation and maintenance of CPs may include activities such as tilling, excavation, prescribed burning, pesticide application, and mowing. A detailed description of each practice is provided in Appendix D.

2.1.2 Financial Support to Land Owners

The preferred alternative would provide the participant with annual rental payments for the 14 to 15 year contract period at rates equal to those for non-irrigated land. Participants would also receive annual incentive payments of 20 percent of the base rental rate for CP8A, CP21, CP22, CP29, and CP30; and 15 percent for all other CPs. The State would issue a one-time signing incentive payment (SIP) equal to 150 percent (i.e., 10 percent per year for 15 years) of the annual base rental payment of the contract. In addition, USDA would provide a one-time incentive payment for hydrology restoration, a one-time SIP, and a one-time practice incentive payment (PIP). USDA and the State would cost share with landowners for 75 percent of the eligible practice establishment costs, and the State would compensate landowners up to 75 percent of all other eligible soil and water structural CPs needed in each watershed.

2.2 Scoping

2.2.1 Discussion

Scoping is a process used to help identify any issues that may affect environmental and social resources as a result of the proposed action, and to explore other possible ways of achieving objectives while minimizing adverse impacts. Regulatory agencies, tribal representatives, FSA specialists, and other interest groups were contacted to refine the project purpose and need, to designate resources of potential impact, and to develop preliminary alternatives.

Public involvement commenced on [TBD] with letters mailed to 109 persons and agencies. A list of those contacted is available in Chapter 8 of this document. These letters included a summary of the proposed action and alternatives and solicitation for comment. Two letters of response were received. Both letters supported the proposed action, stating it would reduce non-point source pollution and create and improve wildlife habitat.

2.2.2 Resources Considered but Eliminated from Analysis

CEQ implementing regulations require that issues which are not significant or which have been covered by prior environmental review be identified and eliminated from detailed study (40 CFR parts 1500 et seq., 2006). Accordingly, several resources have been eliminated from further analysis in this PEA either because they do not occur within the ROI identified in Section 1.3 (sole source aquifers, coastal zones, paleontological resources, wild and scenic rivers), or because they would not be impacted by the proposed action (noise, traffic and transportation). A brief discussion of these resources is provided in the following subsections.

Sole Source Aquifers

The U.S. Environmental Protection Agency (EPA) defines a sole source aquifer as one which supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. These areas have no alternative drinking water source which could physically, legally, and economically supply all those who depend upon the aquifer for drinking water (EPA 2006a, b).

Coastal Zones

There are no coastal zones in or near the ROI.

Paleontological Resources

Paleontological resources (e.g., fossils) may be considered part of the national natural, scientific, and educational heritage. There is currently no unified Federal policy regarding the treatment of paleontological resources outside of an archaeological context; however, various historic, cultural, or natural resource preservation statutes may apply to fossil resources on State and Federal lands.

Noise

Implementation of the proposed action would not permanently increase ambient noise levels. Noise levels may increase slightly during installation of CPs, but this increase would be temporary and would cease after installation.

Traffic and Transportation

The proposed action would have no impact to existing traffic and transportation conditions.

Wild and Scenic Rivers

Wild and scenic rivers are designated and protected under the Wild and Scenic Rivers Act (16 USC parts 1271–1287, 1968). These rivers must be preserved in their free-flowing conditions and, with their immediate environments, protected for the benefit of present and future generations.

2.3 Alternatives Eliminated from Analysis

No alternatives were eliminated from analysis.

2.4 Alternatives Selected for Analysis

2.4.1 Alternative A—Preferred Action

Alternative A, the preferred action, would implement the amended Missouri CREP agreement by enrolling up to 40,000 acres of cropland and marginal pastureland in the watersheds identified in Section 1.3. Specific CPs would be installed on eligible land to reduce levels of pesticides, nutrients, and sediments in public drinking water supplies. Participants would receive annual rental and incentive payments for the 14 to 15 year contract periods, as well as one-time incentive payments. Contracts for lands enrolled under Missouri's existing CREP agreement would remain unchanged[1].

2.4.2 Alternative B—No Action

Alternative B, the no action alternative, would involve not implementing the amended Missouri CREP agreement. The goals for the amended agreement would not be met, and lands not enrolled under the existing CREP agreement would remain in agricultural production, resulting in the continued degradation of public drinking water supplies due to increased levels of pesticides, nutrients, and sediments.

Although benefits to lands enrolled under the existing CREP agreement would remain unchanged, there would be no added benefits from the expanded acreage and additional CPs proposed in the amended agreement.

[1] There are two CPs that may be implemented under the existing CREP agreement but that are not included as part of the amended agreement: CP1—Introduced Grasses and Legumes and CP3A—Hardwood Tree Planting.

2.5 Comparison of Alternatives

2.5.1 Identification of Geographical Boundaries

The proposed project area (i.e., ROI) is cropland and marginal pastureland in watersheds throughout Missouri that surround public drinking water reservoirs of concern (Figure 1). The amended Missouri CREP agreement would intend on enrolling up to 40,000 acres within these watersheds, encompassing portions of the 79 counties listed in Section 1.3. The only major town (i.e., town with population greater than 50,000) within the ROI is Springfield in Greene County (Missouri Spatial Data Information Service 2006).

2.5.2 Identification of Temporal Boundaries

Landowners participating in the Missouri CREP would enroll in 14 to 15 year contracts, obligating them to implement the proposed CPs in return for technical and financial assistance. Eligible contracts would be signed by [TBD], which would establish the year [TBD] as the temporal boundary for the purposes of this analysis. This same temporal boundary is used for the analysis of the no action alternative.

3.0 AFFECTED ENVIRONMENT

This chapter describes relevant existing conditions for the resources potentially affected by the proposed action and no action alternatives. In compliance with guidelines contained in NEPA and CEQ regulations, the description of the affected environment focuses on those aspects potentially subject to impacts. Resources within the ROI are analyzed by watershed or by county, depending on the spatial character of the available data.

3.1 Biological Resources

3.1.1 Wildlife and Fisheries

3.1.1.1Description

Wildlife and fisheries include terrestrial, avian, and aquatic species and the habitats in which they occur. The ROI for this resource analysis includes the 79 counties identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.1.1.2Affected Environment

3.1.1.2.1 Wildlife

MDC has authority to manage the game mammals, furbearing mammals, game birds, and non-game species of Missouri (MDC 2006a). MDC establishes the hunting regulations and seasons for game and furbearing species and has authority of over non-game species (i.e., species that are not hunted, fished, or trapped).The following is a summary of wildlife species that may be found within the ROI.

Game Mammals

There are four game mammal species in Missouri; white-tailed deer, rabbits, squirrels, and groundhogs (Table 1). White-tailed deer, which are currently widespread throughout Missouri, were nearly extirpated from the State in the late 1800s due to over-hunting. Consequently, deer season was closed in 1925 (MDC 1996a). In an effort to re-establish populations, white-tailed deer were imported from Michigan and also purchased from private citizens and then placed in refuges. These attempts were successful; since 1950, white-tailed deer have inhabited all Missouri counties (MDC 1996a).

A survey conducted in 2004 indicated that fertility, an overall indicator of population health and suitability of habitat, is good among Missouri white-tailed deer (MDC 2004a). This survey sampled 538 fawns, 337 yearlings, and 659 adult deer. Of the fawns sampled, 30 percent were pregnant and averaged 0.40 offspring. Pregnancy in the yearling deer population, which averaged 1.67 offspring, was 90 percent. A total of 94 percent of adult deer were pregnant and averaged 1.81 offspring.

The preferred habitat of white-tailed deer contains a variety of forage. These deer consume mostly browse, and the preferred browse in Missouri during spring and summer includes summer grape, red clover, Virginia creeper, Korean lespedeza, winter grape, American elm, dwarf sumac, and white oak acorn (MDC 2003a). The majority of this vegetation thrives in *edge areas*, which are areas where wooded lands or areas of thick vegetation meet open land. Disturbances, such as trail building or mowing, will encourage this vegetation to grow in areas to which they are native (MDC 2003a). Winter and fall deer habitat include forage areas of white oak acorn, black oak acorn, corn, buckbrush, sumac, grass, and sedge (MDC 2003a). Food, water, and cover are necessary components of habitat for white-tailed deer year-round.

Rabbit populations in the State are continually fluctuating due to the constant change in the amount of cover available in their habitat. The typical home range for the entire life span of a Missouri rabbit is 1–5 acres when habitat is good, and up to 15 acres when habitat is poor (MDC 1981a). Rabbit forage is based on seasonal availability. Throughout most of the year, preferred forage is bluegrass, white clover, and wheat; but rabbits also rely heavily on red clover, crabgrass, common chess, and timothy (MDC 1981a). In the winter, when snow decreases availability of forage, rabbits will browse on twigs, buds, and sprouts of vines, trees, and shrubs (MDC 1981a).

Table 1. Common and scientific names of game and furbearing mammals in the ROI.

Common Name	Scientific Name	Common Name	Scientific Name
Badger	*Taxidea taxus*	Beaver	*Castor canadensisis*
Bobcat	*Lynx rufus*	Coyote	*Canis latrans*
Deer, white-tailed	*Odocoileus virginianus*	Fox, gray	*Urocyon cinereoargenteus*
Fox, red	*Vulpes vulpes*	Groundhog	*Marmota monax*
Mink	*Mustela vison*	Muskrat	*Ondatra zibethicus*
Opossum	*Didelphis virginiana*	Otter, river	*Lutra canadensis*
Rabbit	*Sylvilagus sp.*	Raccoon	*Procyon lotor*
Skunk, spotted	*Spilogale putorius*	Skunk, striped	*Mephitis mephitis*
Squirrel	*Spermophilus sp.*	Weasel, long-tailed	*Mustela sp.*
Table source: MDC 2006b			

Squirrels are widespread in Missouri. The home range of squirrels is very small; this species may not travel more than 200 yards from any one tree during a season (MDC 1981b). Squirrel habitat includes mixed hardwood forests, of which oaks and hickories are dominant. Squirrels also thrive in urban areas where there are often large, ornamental oaks and hickories. Nests are located in cavities or forks of older trees that provide a buffer from the weather and protection from predators. Squirrels forage on hard and soft mast including nuts, fruits, buds, walnuts, corn, and acorns (MDC 1981b).

Groundhogs, also known as woodchucks, occur throughout most of the State and inhabit edge areas (MDC 1981c). Although often considered a nuisance species, groundhogs play an important part in local ecosystems. Groundhogs dig burrows in which they make their nests, and these abandoned burrows are often utilized for denning sites by a variety of species such as foxes, weasels, rabbits, skunks, and opossums (MDC 1981c).

Furbearing Mammals

Furbearing mammals in Missouri are the badger, beaver, bobcat, coyote, red fox, gray fox, mink, muskrat, opossum, raccoon, river otter, spotted skunk, striped skunk, and long-tailed weasel (Table 1). Although not common, badgers do occur in the State (MDC 1992). Badgers occupy areas that contain high densities of small mammals, such as mice, moles, and ground squirrels. This species often occupies open fields of grass, but may also be found around fence rows in agricultural areas (MDC 1992).

Beavers are herbivores and feed on leaves, the inner bark of trees, and twigs. This species build dams made of logs, mud, sticks, and rocks; these dams are constructed to create ponds in which the species makes dens. Dens are often built out of the sides of the pond banks with the entrance underwater. These dens are used for birthing and rearing areas (MDC 1992).

Bobcats are strict carnivores that feed primarily on rabbits, but they will also consume deer fawns, turkeys, and squirrels if available. The habitat of the bobcat includes areas of dense brush within cleared areas of forest. The species will also utilize brushy grasslands. Bobcats are not plentiful in Missouri.

Coyotes are abundant in Missouri (MDC 1992). Habitat is variable because this species adapts well to most landscapes and forages on many types of foods. Coyotes have been known to consume roughly 56 types of animals and 28 types of plants, as well as insects, lizards, and fruit (MDC 1992).

Missouri is home to the red fox and the gray fox. Both of these species are common within the State. Red foxes forage on a variety of things; including eggs, birds, snakes, fruit, insects, mice, and rabbits. This species primarily utilizes edge areas but can live in a variety of other habitats. Gray foxes inhabit wooded and brushy areas, as well as rock habitats. They forage on rabbits, rodents, insects, fruits, and sometimes corn.

Mink inhabit areas near streams, marshes, swamps, and lakes. Wintering areas include the roots of trees, rock piles, holes in waterway embankments, and bridge crossings. Mink mostly feed on aquatic species, such as fish and crayfish, but will also feed on small rodents, insects, snakes, and birds of upland ecosystems. Mink are relatively common throughout the State (MDC 1992).

Another common species of Missouri is the muskrat which inhabits aquatic areas and nest in dens made in the banks of slow running to still waters. Dens are selected based on the presence of vegetation in and around the waterway. Muskrats feed on the tubers and roots of aquatic plants and riparian vegetation. This species has also been known to feed on mussels and clams (MDC 1992).

Opossums have a varied diet, which allows them to thrive in most habitats. The species is opportunistic, and will feed on carrion, frogs, fish, snakes, bird eggs, snails, worms, rabbits, salamanders, fruits, and mice. The biggest limiting factor of opossum populations is the severity of the winter months. Populations of opossum are abundant in the State (MDC 1992).

Raccoons are omnivores that feed on fish, young rabbits, crayfish, birds, muskrats, sweet corn, plums, and mulberries (MDC 1992). Raccoons make dens in the hollows of trees, embankments, hay stacks, chimneys, and abandoned structures. Limiting factors of raccoon populations include distemper disease and harsh weather conditions (MDC 1992).

River otters occupy some areas of Missouri, but they are not abundant (MDC 1992). This species usually inhabits riparian areas of swamps, lakes, and slow moving rivers and streams. River otters feed on crayfish, fish, and frogs. Unregulated harvest diminished the numbers of river otters in Missouri; however, restoration efforts have increased the population in some portions of the State (MDC 1992).

The two species of skunk that occur in Missouri are the spotted skunk and the striped skunk. The spotted skunk is rare and being considered for endangered status by the State (MDC 1992). The striped skunk is omnivorous and uses a variety of habitats, although they are most suited to open farmlands and overgrown fields (MDC 1992). Skunks usually forage on insects, but are also known to consume frogs, bird eggs, berries, fruits, mice, and other small rodents.

Long-tailed weasels are very rare throughout Missouri and may not occur within the ROI (MDC 1992). The habitat of this species is often located close to farms, and they have been known to raid farms for chickens. They also forage on rats, moles, shrews, rabbits, and mice (MDC 1992). A limiting factor of long-tailed weasels, aside from natural predation, is their susceptibility to canine distemper (MDC 1992).

Game Birds

Missouri game birds include species such as turkeys, quails, pheasants, ruffed grouses, doves, woodcocks, rails, snipes, teals, coots, crows, ducks, and geese (Table 2).

Table 2. Common and scientific name for game birds in Missouri.

Common Name	Scientific Name	Common Name	Scientific Name
Bufflehead	*Bucephala albeola*	Canvasback	*Aythya valisineria*
Coot	*Fulica atra*	Crow	*Corvus brachyrhynchos*
Dove, Eurasian collared	*Streptopelia decaocto*	Dove, mourning	*Zenaida macroura*
Dove, white-winged	*Zenaida asiatica*	Duck, black	*Anas rubripes*
Duck, long-tailed	*Clangula hyemalis*	Duck, ring-neck	*Aythya collaris*
Duck, ruddy	*Oxyura jamaicensis*	Duck, wood	*Aix sponsa*
Gadwall	*Anas strepera*	Goldeneye, common	*Bucephala clangula*
Goose, cackling	*Branta hutchinsonii*	Goose, Canada	*Branta canadensis*
Goose, Ross	*Chen rossii*	Goose, snow	*Chen caerulescens*
Goose, white-fronted	*Anser albifrons*	Grouse, ruffed	*Bonasa umbellus*
Mallard	*Anas platyrhynchos*	Merganser, common	*Mergus merganser*
Merganser, hooded	*Lophodytes cucullatus*	Merganser, red-breasted	*Mergus serrator*
Pheasant, ring-neck	*Phasianus colchicus*	Pintail, northern	*Anas acuta*
Quail, bobwhite	*Colinus virginianus*	Rail, king	*Rallus elegans*
Rail, sora	*Porzana carolina*	Rail, Virginia	*Rallus limicola*
Redhead	*Aythya americana*	Scaup, greater	*Aythya marila*
Scaup, lesser	*Aythya affinis*	Scoter, black	*Melanitta nigra*
Scoter, surf	*Melanitta perspicillata*	Scoter, white-winged	*Melanitta fusca*
Shoveler, northern	*Anas clypeata*	Snipe, common	*Gallinago gallinago*
Teal, blue-winged	*Anas discors*	Teal, cinnamon	*Anas cyanoptera*
Teal, green-winged	*Anas crecca*	Turkey, wild	*Meleagris gallopavo*
Widgeon, American	*Anas americana*	Woodcock	*Scolopax minor*
Table source: MDC 2006b			

Wild turkeys can be found in all Missouri counties. The eastern wild turkey is native to the State but their numbers were once diminished due to the destruction of timberlands due to fire, logging, increased grazing operations, and market hunting (MDC 2004b). From 1925 to 1943, restocking efforts were made to enhance wild turkey populations throughout the State (MDC 2004b). Of the 114 Missouri counties, 101 have wild turkey populations as a result of these restocking efforts (MDC 2004b).

Wild turkeys require different habitats for different seasons. In colder months (i.e., October through March), wild turkeys prefer to inhabit areas of mature hardwood forest with a variety of oak trees (MDC 2004b). The most important food for wild turkeys in Missouri is acorns, which is a staple of their winter diet. Wild turkeys found in agricultural areas often rely on waste grains for winter food, and will scratch

through the snow to feed on them. Summer habitat normally consists of mowed fields, open woods, or grazed pastures (MDC 2004b). These areas have low plant cover that provides protection and are abundant in insects and seeds for forage. Mowing and moderate grazing of fields improves wild turkey habitat (MDC 2004b). Acorns are also an important source of food in the summer months. Unevenly-aged forests are often the best habitat for wild turkey, as they will continually supply acorns and other soft mast year-round. Water is an important component of wild turkey habitat year-round. This species will not use areas that do not have water readily available. Most wild turkeys nest close to a permanent water source. Nesting usually occurs on the edge of fields, trails, or hay patches. Hens will also nest in briar patches or brambles (MDC 2004b).

Bobwhite quail occur throughout Missouri. Population density is dependant on land use and weather, so it can fluctuate at any given time. Bobwhite quail feed on weed seeds, plants, and insects (Daily and Hutton 2003). Their habitat most often includes recently disturbed environments because these areas contain newer plant communities, such as grasses, legumes, annual weeds, and broadleaf plants (Daily and Hutton 2003). This species requires brushy cover and thrives in edge habitats.

Ring-necked pheasants occur mainly in northern Missouri, and they do occur within the ROI. This species thrives on grain crops located in agricultural areas. Diversified land patterns that include grain crops, hay, and grasslands, when located within 100 acres of each other, provide quality ring-necked pheasant habitat (MDC 1982). Nesting cover includes areas of standing herbaceous vegetation composed of dense, leafy plant communities. Wetlands, woodlands, and agricultural fields that are not plowed in the fall provide suitable winter cover.

Ruffed grouse occupy numerous habitats containing different successions of forest, depending on the season (MDC 2004c). Wintering ruffed grouse require dense stands of vegetation to provide thermal cover. Nesting habitat is usually within sparse vegetation so that visibility is not obscured and located close to brood areas (MDC 2004c). Brood areas are semi-open to allow for movement, cover, and the presence of insects. Drumming habitat is in open forested areas where visibility is good, but with enough canopy to give cover from avian predators. Drumming usually occurs on logs, but may also take place on rocks and stumps (MDC 2004c).

Doves, woodcocks, rails, snipes, and teals are considered migratory game birds in Missouri. There are three species of doves that inhabit the ROI: the Eurasian collared dove, the mourning dove, and the white-winged dove. These species are not year-round residents, as they do not winter in Missouri (MDC 2003b). Doves feed primarily on seeds and grains, but will sometimes consume fruits and insects. Habitat is varied and can include open grasslands, shrubs, trees, agricultural lands, pasturelands, orchards, and deserts (MDC 2003b).

Woodcock, also known in Missouri as timberdoodles, occur throughout the State during the spring season (MDC 2004d). The majority of woodcock are found on the eastern side of the State. Their habitat includes areas of scrub or shrub successional vegetation, and they often inhabit the shrubby edge area between woods and fields (MDC 2004d). Woodcock often breed in moist woodlands or thickets. This species uses its long bill to forage for worms and insects (MDC 2004d).

There are three species of rail found in Missouri: the king rail, the sora rail, and the Virginia rail. The king rail is rare in Missouri, and probably does not occur in the ROI. Sora rails occur in the ROI, but not in abundance (MDC 1996b). The Virginia rail has the potential to occur in the ROI, but may not be in abundance. Sora rails and Virginia rails inhabit areas of wet meadows, freshwater marshes, and swamps (MDC 1996b).

The common snipe winters in Missouri and may occur seasonally within the ROI. Their habitat includes areas of marshes, streambanks, wet meadows, bogs, and wet canals (Gott 2001). These areas must contain sufficient vegetation to supply protective cover and nesting areas. Common snipe feed mostly on worms, but will also consume insects, mollusks, crustaceans, berries, and seeds (Gott 2001).

The three species of teal that occur in Missouri are the blue-winged teal, the green-winged teal, and the cinnamon teal. All three species have the potential to occur within the ROI. Teal inhabit areas of marshes, lakes, pools, shallow streams, and ponds (U.S. Forest Service [FS] 2006). Teal require thick, emergent vegetation to provide cover from predators. Teal prefer to nest in meadows or fields (FS 2006).

Coots are transients and rare summer residents to Missouri. They may not occur within the ROI in any abundance (MDC 2004e). Coots occupy areas of lakes, rivers, marshes, and ponds that contain bulrush and cattails. They nest on large mounds of dead vegetation which they anchor to live vegetation, and these mounds often protrude above the water surface (MDC 2004e).

Crows can be found throughout most of the State, including the ROI. Crows inhabit a variety of environments including open woods, forests, farmlands, orchards, and some urban areas (MDC 2004f). Nests are made in trees or shrubs out of materials such as grass, feathers, twigs, moss, and bark (MDC 2004f).

There are roughly 31 species of ducks and geese that regularly inhabit Missouri, some of which may occupy the ROI (Table 2). Missouri lies within the Mississippi flyway. The Mississippi flyway route narrows through Missouri and Arkansas, which causes a large concentration of birds to go through these areas. Aside from a hunting permit, Missouri waterfowl hunters must obtain a migratory bird hunting permit and a migratory bird hunting and conservation stamp.

Non-Game Species

Missouri is home to numerous species of wildlife, including 65 mussels, 178 snails, 25 crayfish, 72 mammals, 78 reptiles, 398 birds, 216 fish, 48 amphibians, and over 20,000 insects (Stills 2006). The majority of these are considered non-game species. There are only six non-game species within Missouri that are not native to the State: the Eurasian tree sparrow, house sparrow, European starling, house mouse, black rat, and the Norway rat (MDC 2006c). Missouri uses funds from the State Wildlife Grants program to protect sensitive non-game species before they are at risk for becoming threatened or endangered (Low 2006). Since 2001, this program has contributed more than $7.3 million to Missouri's wildlife programs (Low 2006). Protecting non-game species does not always focus on the species themselves, but often on their declining habitat.

3.1.1.2.2 Fisheries

MDC manages and sets regulations for the roughly 216 fish species in Missouri. Approximately 208 of these may occur in the ROI (Appendix E) (MDC 2006c). Of those in the ROI, 14 species are caught for commercial sale and 59 species are considered game fish. One fish species, the striped mullet, is listed as an accidental occurrence (i.e., a species found outside of its known range). There are only four species of fish that are not native to Missouri; the bighead carp, common carp, grass carp, and silver carp. Of the 48 amphibians and 25 crayfish that occur throughout the State, 47 amphibians and 24 crayfish may be found in the ROI (MDC 2006c). There are also 13 species of mussels and two snails that occur in the ROI. There are eleven fish hatcheries within the State of Missouri that are managed by MDC. None of these hatcheries are located in the ROI, but they may supply fish to waters of the ROI.

Numerous waterways in the ROI have been impaired by activities associated with agricultural production, coal-mining operations, hydropower plants, and wastewater treatment plants. Several of these

impairments can be detrimental to aquatic wildlife. Atrazine and cyanazine, which are herbicides (i.e., pesticides used to kill or control vegetation) used in agriculture, accumulate in fish tissue and cause changes in fish biochemistry, behavior, and reproduction, and may occasionally cause fish mortality (Orme and Kegley 2006). Iron in acidic waterways can hydrolyze, becoming iron hydroxide. If left unchecked, this can cause fish kills due to the increased pH. Soluble iron can oxidize and create rust, which settles on fish gills and impedes respiration (Aquatext 2000).

Dissolved oxygen, the amount of oxygen gas dissolved in water, is required by fish and other aquatic species for respiration. Low dissolved oxygen content can cause fish stress and, in drastic cases, mass mortality. Low dissolved oxygen levels occur when oxygen consumption rates are higher than oxygen production rates (Francis-Floyd 2002). The amount of dissolved oxygen present can fluctuate due to several factors including light levels, the amount and rate of plant respiration and decay, water velocity, the depth of the water, amount of groundwater inflow, and seasonal temperature changes (Caduto 1990).

Excessive sedimentation can also decrease the amount of dissolved oxygen by reducing photosynthesis. Other effects of high sedimentation on fish include suffocation, burial of eggs or larvae, lack of clean gravel bedding areas, and reduced sight range (Berry et al. 2003). The severity of the effects varies according to fish species. Nutrient loading can also decrease dissolved oxygen content by stimulating a rapid growth response of aquatic plants (Klapproth and Johnson 2000).

Largemouth bass virus (LMBV) has been found in several Missouri waterways including Table Rock Lake, Lake of the Ozarks, Wappapello Lake, Lake Springfield, Harry S. Truman Reservoir, Bull Shoals Lake, and Norfork Lake (MDC 2005). LMBV affects the swim bladder of adult bass, so that the fish have difficulty in swimming and rise to the surface of the water. LMBV is not always fatal to bass, and some that have the virus may never show symptoms. There is no cure for LMBV. Although LMBV can be carried by other fish species, largemouth bass are the only species in which the virus causes this disease (MDC 2005). Ingesting infected fish is not known to cause illness to humans, other mammals, or birds.

3.1.2 Vegetation

3.1.2.1Description

Vegetation includes native and introduced plant species. The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.1.2.2Affected Environment

By definition, ecoregions are areas of relatively uniform ecological systems that have similar vegetation, climate, and geology.[2] Missouri is divided into seven Level III Ecoregions, of which five occur in the ROI. Ecoregions within the ROI are the Central Irregular Plains, Interior River Valleys and Hills, Mississippi Alluvial Plains, Ozark Highlands, and the Western Corn Belt Plains. These Level III Ecoregions are further subdivided into Level IV Ecoregions or, for the purposes of discussion in this analysis, *subregions* (Figure 2, Table 3). The potential natural vegetation of the subregions within the ROI as described by Chapman and others (2001) is discussed in the following subsections.

[2] A Roman numeral hierarchy is used to denote different levels of ecoregions (Woods et al. 2004). Level I Ecoregions are the broadest level and divide North America into 15 ecological regions. Level II Ecoregions divide North America into 52 ecological regions and Level III Ecoregions divide the continental U.S. into 104 ecological regions. Level IV Ecoregions are a further division of Level III Ecoregions. Within the hierarchy of ecoregions, each lower level is more specific in regards to vegetation, climate, and geology on a smaller scale. Level III and Level IV ecoregions are typically used to describe the ecological regions of individual States.

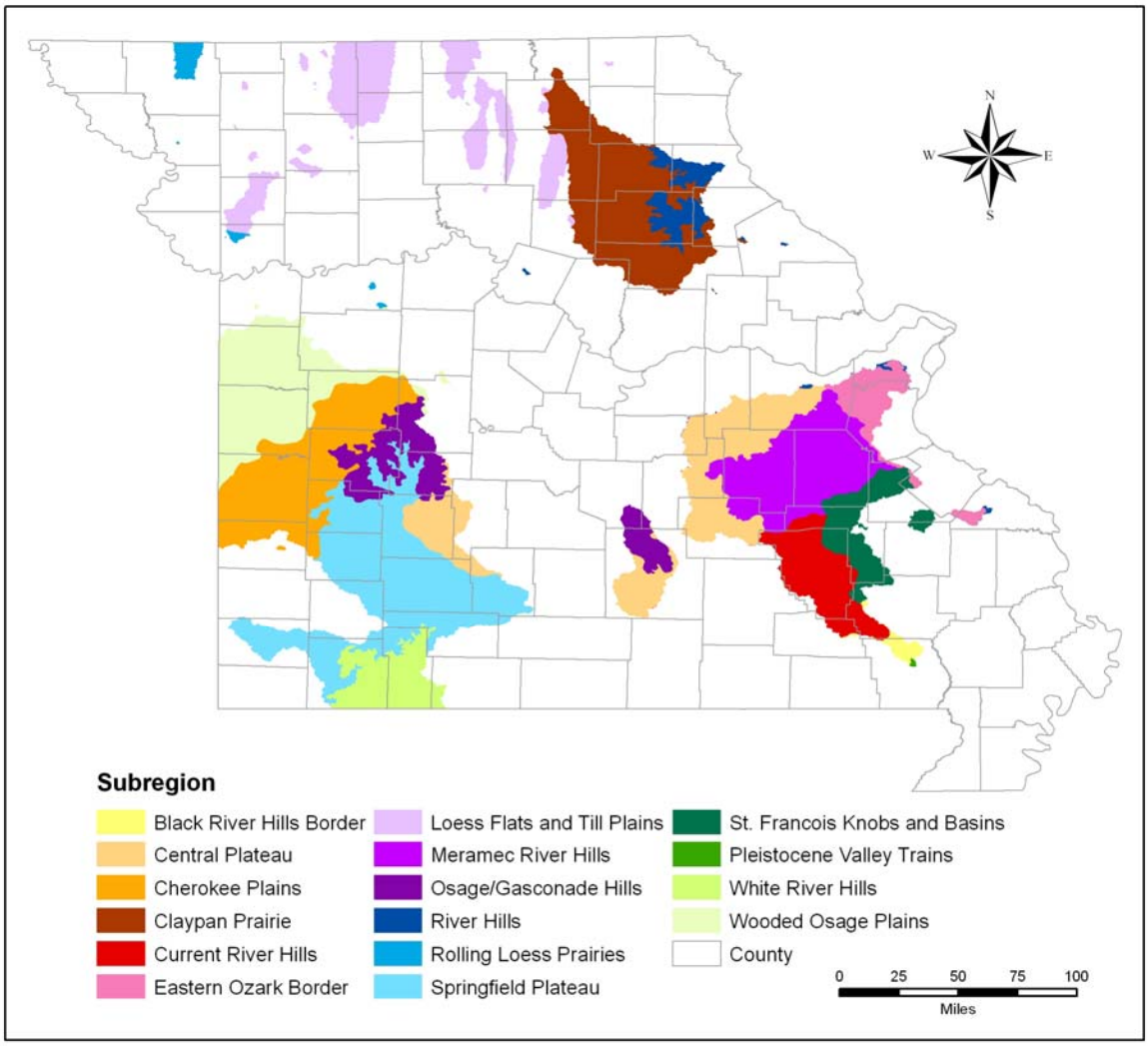

Figure 2. Subregions within the ROI.

3.1.2.2.1 Central Irregular Plains

The Central Irregular Plains Level III Ecoregion contains four subregions that are located at least partially within the ROI: the Cherokee Plains, Claypan Prairie, Loess Flats and Till Plains, and Wooded Osage Plains.

The Cherokee Plains cover approximately 2,509 square miles of Missouri. This subregion runs from the southwestern portion of the State inland to south-central Missouri. Vegetation in the Cherokee Plains includes little bluestem—sideoats grama prairie, cordgrass wet prairie, and big bluestem—Indiangrass prairie. The lands within this subregion are primarily used for agricultural production; including the cultivation of winter wheat, soybeans, grain sorghum, corn, hay and other feed grains. Other land uses include coal mining and pasturelands.

Vegetation in the Claypan Prairie subregion includes little bluestem—sideoats grama prairie, big bluestem—sideoats grama prairie, and white oak dry woodland. Land is used for pasture and livestock production, and the cultivation of corn, feed grains, soybeans, and hay. The Claypan Prairie covers approximately 4,129 square miles of northeastern Missouri.

Table 3. Level III Ecoregions and subregions in the ROI.

Level III Ecoregion	Subregion	Counties
Central Irregular Plains	Cherokee Plains	Barton, Bates, Benton, Cedar, Dade, Henry, Pettis, St. Clair, Vernon
	Claypan Prairie	Adair, Audrain, Boone, Callaway, Knox, Macon, Marion, Monroe, Montgomery, Pike, Ralls, Randolph, Schuyler, Shelby
	Loess Flats and Till Plains	Adair, Caldwell, Chariton, Clay, Clinton, Daviess, DeKalb, Gentry, Grundy, Harrison, Howard, Linn, Macon, Marion, Mercer, Putnam, Randolph, Schuyler, Scotland, Shelby, Sullivan
	Wooded Osage Plain	Bates, Benton, Cass, Henry, Jackson, Johnson, Lafayette, Pettis, Vernon
Interior River Valleys and Hills	River Hills	Audrain, Franklin, Howard, Marion, Monroe, Montgomery, Perry, Pike, Ralls, Shelby, St. Louis
Mississippi Alluvial Plains	Pleistocene Valley Trains	Butler
Ozark Highlands	Black River Hills Border	Butler, Carter, Wayne
	Central Plateau	Crawford, Dallas, Dent, Franklin, Gasconade, Greene, Hickory, Maries, Osage, Phelps, Polk, Reynolds, Texas, Webster
	Current River Hills	Butler, Carter, Dent, Iron, Reynolds, Shannon, Texas, Wayne
	Eastern Ozark Border	Franklin, Jefferson, Perry, St. Francois, St. Louis, Ste. Genevieve
	Meramec River Hills	Crawford, Dent, Franklin, Iron, Jefferson, Phelps, Reynolds, St. Francois, Washington
	Osage/Gasconade Hills	Benton, Cedar, Franklin, Gasconade, Henry, Hickory, Maries, Osage, Phelps, Polk, Pulaski, St. Clair, Texas
	Springfield Plateau	Barry, Benton, Cedar, Christian, Dade, Douglas, Greene, Hickory, Jasper, Lawrence, Newton, Polk, St. Clair, Stone, Webster
	St. Francois Knobs and Basins	Iron, Madison, Reynolds, St. Francois, Ste. Genevieve, Washington, Wayne
	White River Hills	Barry, Christian, Douglas, Stone, Taney, Texas, Webster
Western Corn Belt Plains	Rolling Loess Prairies	Andrew, Clay, Lafayette, Nodaway

Table source: Chapman et al. 2001

The northern portion of Missouri is part of the Loess Flats and Till Plain subregion, covering approximately 16,976 square miles of land within the State. Vegetation consists of little bluestem—sideoats grama prairie, chinkapin oak woodland, and bur—oak woodland. Land uses within include agricultural production, mostly for the cultivation of soybeans, corn, feed grains, and hay.

Vegetation within the Wooded Osage Plains subregion includes little bluestem—sideoats grama prairie, oak woodland, cordgrass wet prairie, and big bluestem—Indiangrass prairie. Land uses are mainly the cultivation of winter wheat, grain sorghum, feed grains, soybeans, corn, and hay. The Wooded Osage Plains cover approximately 3,824 acres of land within central and western Missouri.

3.1.2.2.2 Interior River Valleys and Hills

The Interior River Valleys and Hills Level III Ecoregion contains one subregion that occurs within the ROI, the River Hills subregion. The River Hills cover approximately 6,993 square miles of land along the eastern border and center of Missouri. Vegetation is white—black oak woodlands, sugar maple—oak forests, and white oak forests. Land uses include feed grains and hay croplands on upland areas, pasturelands, woodlands, and areas of urban development.

3.1.2.2.3 Mississippi Alluvial Plains

The Mississippi Alluvial Plains Level III Ecoregion contains one subregion in the ROI, the Pleistocene Valley Trains. The Pleistocene Valley Trains subregion envelopes 2,940 square miles of southeastern Missouri. Vegetation within this subregion includes oak—sweetgum forests, overcup oak—water hickory forests, and tupelo—cypress swamp forests. Primary land use is for growing cotton, soybeans, and rice.

3.1.2.2.4 Ozark Highlands

The Ozark Highlands Level III Ecoregion contains nine subregions that are located within the ROI: the Black River Hills Border, Central Plateau, Current River Hills, Eastern Ozark Border, Meramec River Hills, Osage/Gasconade Hills, Springfield Plateau, St. Francois Knob and Basins, and White River Hills. The Black River Hills Border subregion is located in the southwest portion of the State. The Black River Hills Border subregion covers 1,079 acres of Missouri and contains vegetation such as shortleaf pine—oak woodlands, mixed oak—sweetgum forests, and post—black oak woodlands. Land uses are for pasture, recreation, and forestry.

The Central Plateau subregion covers 6,820 square miles of the upper southeast quadrant of the Missouri. This subregion is characterized by little bluestem—Indiangrass prairies, post-black jack oak woodlands, and black-scarlet oak woodlands. Land is used for pasture, cropland, forestry and fire clay production.

The Current River Hills subregion contains vegetation such as shortleaf pine—oak forests, black—scarlet oak woodlands and forests, and white oak forests. This subregion covers 3,114 square miles of land in southeastern Missouri. Land uses within this subregion include forestry and recreation, with some mining of zinc, copper, and manganese.

The Eastern Ozark Border vegetation is characterized by little bluestem—sideoats alkaline lades, post—blackjack oak woodlands, and white—black oak woodlands. The Eastern Ozark Border subregion covers 1,076 square miles of land within Missouri. Land uses are for pasturelands, woodlands, and some hay and forage croplands.

The Meramec River Hills subregion covers 1,176 acres of land within Missouri. Vegetation is predominantly shortleaf pine—oak forests, black—scarlet oak woodlands and forests, and white oak forests. Land uses within this subregion are forestry and recreation, with some mining of iron and barite.

The Osage/Gasconade Hills subregion covers approximately 5,040 square miles of central Missouri. Vegetation includes post—blackjack oak woodlands in the northern part of the State, and white oak forests and shortleaf pine—oak forests in the southern part. Land is used for recreation, pasture, and forestry.

The Springfield Plateau subregion covers approximately 4,933 square miles of southwestern Missouri. Vegetation consists of big bluestem—Indiangrass prairies, white—black oak forests, and post—blackjack oak woodlands. Historic land uses within this subregion include mining for lead and zinc. Current uses are for pastureland, woodlands, urban and suburban development, and limited cropland.

The St. Francois Knobs and Basins subregion is located in the southwestern portion of the State, covering 1,590 square miles of land. Vegetation within this subregion is post—blackjack oak woodlands and little bluestem prairies and glades in the valleys and basins. Land uses are mostly forestry, pasturelands, and grazing. Mining was once extensive in this area.

The White River Hills subregion is characterized by little bluestem—sideoats alkaline glades, post—blackjack oak woodlands, and white—black oak forests. This subregion covers approximately 3,512 square miles of land in the central portion of Missouri. Land uses within this subregion mostly include forestry and recreation, with some pasturelands in the eastern portion.

3.1.2.2.5 Western Corn Belt Plains

The Western Corn Belt Plains Level III Ecoregion contains one subregion that occurs within the ROI; the Rolling Loess Prairies. This subregion covers roughly 17,858 square miles of land from northwestern to central Missouri. Vegetation is predominantly bur—oak woodlands and big bluestem—Indiangrass prairie. Land use throughout the subregion is mainly used for cultivation of soybeans, corn, and other feed grains, as well as for some pasture and urban development.

3.1.3 Protected Species and Habitat

3.1.3.1Description

Protected species are those terrestrial, avian, and aquatic species designated by the U.S. Fish and Wildlife Service (FWS) as threatened, endangered, or candidate species under the *Endangered Species Act* (16 USC parts 1531 et seq., 1988). In addition, MDC determines the species listing status for the State. These species, which are listed in Missouri's *Code of State Regulations* (CSR) (3 CSR 10/4.111, 2005), are afforded protection within the State by the legal authority of the MDC. Critical habitats are specific geographic areas that are essential for conservation of a particular species and that have been formally designated by Federal rule. The ROI for this resource analysis includes the 79 counties identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.1.3.2 Affected Environment

FWS lists 31 species as threatened or endangered and 8 species as candidates for Federal listing, for a total of 39 species (Table 4) (FWS 2005a, 2006a). Threatened species include eight plants, three fish, and two birds. There are two plants, four mammals, two insects, two fish, six mussels, and two birds considered endangered. Candidate species for listing include two fish, one reptile, four mussels, and one amphibian.

Table 4. Protected species in Missouri.

Species	State Status	Federal Status	Species	State Status	Federal Status
Aster, decurrent false (*Boltonia decurrens*)	E	T	Bat, gray (*Myotis grisescens*)	E	E
Bat, Indiana (*Myotis sodalist*)	E	E	Bat, Ozark big-eared (*Corynorhinus townsendii ingens*)	E	E

Species	State Status	Federal Status	Species	State Status	Federal Status
Beetle, American burying (*Nicrophorus americanus*)	E	E	Bladderpod, Missouri (*Lesquerella filiformis*)	E	T
Cavefish, Ozark (*Amblyopsis rosae*)	E	T	Cavesnail, Tumbling Creek (*Antrobia culveri*)	E	C
Clover, running buffalo (*Trifolium stoloniferum*)	E	E	Curlew, Eskimo (*Numenius borealis*)	---	E
Darter, Arkansas (*Etheostoma cragini*)	---	C	Darter, Niangua (*Etheostoma nianguae*)	E	T
Dragonfly, Hine's emerald (*Somatochlora hineana*)	E	E	Eagle, bald (lower 48 States) (*Haliaeetus leucocephalus*)	E	T
Geocarpon minimum (no common name)	E	T	Hellbender, Ozark (*Cryptobranchus alleganiensis bishopi*)	E	C
Madtom, Neosho (*Noturus placidus*)	E	T	Mapleleaf, winged (*Quadrula fragosa*)	E	E
Massasauga, eastern (*Sistrurus catenantus catenatus*)	E	C	Milkweed, Mead's (*Asclepias meadii*)	E	T
Mucket, Neosho (*Lampsilis rafinesqueana*)	---	C	Mucket, pink (pearlymussel) (*Lampsilis abrupta*)	E	E
Mussel, scaleshell (*Leptodea leptodon*)	E	E	Orchid, eastern prairie fringed (*Platanthera leucophaea*)	E	T
Orchid, western prairie fringed (*Platanthera praeciara*)	E	T	Pearlymussel, Curtis (*Epioblasma florentina curtissii*)	E	E
Pearlymussel, Higgins eye (*Lampsilis higginsii*)	E	E	Plover, piping (except Great Lakes watershed) (*Charadrius melodus*)	---	T
Pocketbook, fat (*Potamilus capax*)	E	E	Pogonia, small whorled (*Isotria medeoloides*)	E	T
Pondberry (*Lindera melissifolia*)	E	E	Sculpin grotto (*Cottus sp.*)	---	C
Sheepnose (*Plethobasus cyphyus*)	E	C	Shiner, Topeka (*Notropis topeka*)	E	E
Sneezeweed, Virginia (*Helenium virginicum*)	E	T	Spectaclecase (*Cumberlandia monodonta*)	---	C
Sturgeon, pallid (*Scaphirhynchus albus*)	E	E	Tern, least (interior population) (*Sterna antillarum*)	E	E
Wolf, gray (lower 48 states except where XN) (*Canis lupus*)	---	E			

Table source: FWS 2006a

Status Codes: E = endangered, T = threatened, C = candidate, --- = not listed, XN = nonessential experimental population of a listed species.

Of the 39 species listed above, 30 have the potential to occur in the ROI. These are 10 threatened species, 12 endangered species, and 8 candidate species (Table 5). Although they are not afforded the same protection as threatened and endangered species, the effects of the proposed action on candidate species will be considered in this analysis.

Table 5. Protected species that may occur in the ROI.

Species	Counties of Occurrence	Species	Counties of Occurrence
Aster, decurrent false	Franklin, Pike	Bat, gray	Barry, Benton, Boone, Carter, Christian, Crawford, Dade, Dallas, Dent, Douglas, Franklin, Greene, Hickory, Iron, Jasper, Jefferson, Lawrence, Maries, Newton, Osage, Phelps, Pike, Pulaski, Ralls, Reynolds, St Louis, Shannon, Stone, Taney, Texas, Washington
Bat, Indiana	Adair, Andrew, Audrain, Boone, Caldwell, Callaway, Chariton, Christian, Clay, Clinton, Crawford, Daviess, DeKalb, Franklin, Gentry, Grundy, Harrison, Henry, Howard, Iron, Jefferson, Knox, Linn, Macon, Madison, Marion, Mercer, Monroe, Montgomery, Nodaway, Phelps, Pike, Pulaski, Putnam, Ralls, Randolph, St Francois, St Louis, Schuyler, Scotland, Shannon, Shelby, Stone, Sullivan, Taney, Texas, Washington	Bladderpod, Missouri	Christian, Dade, Greene, Lawrence
Cavefish, Ozark	Barry, Greene, Jasper, Lawrence, Newton, Stone,	Cavesnail, Tumbling Creek	Taney
Clover, running buffalo	Barry, Benton, Boone, Callaway, Carter, Cedar, Christian, Crawford, Dade, Dent, Howard, Madison, Maries, Phelps, St Louis, Taney, Texas, Vernon, Wayne,	Darter, Arkansas	Barry, Barton, Dade, Jasper, Lawrence, Newton
Darter, Niangua	Benton, Cedar, Dallas, Greene, Hickory, Osage, St Clair, Webster	Dragonfly, Hine's emerald	Dent, Iron, Phelps, Reynolds, Shannon, Wayne
Eagle, bald (lower 48 States)	Andrew, Benton, Boone, Butler, Callaway, Cedar, Chariton, Clay, Clinton, Crawford, Dent, Franklin, Gasconade, Grundy, Henry, Hickory, Howard, Jackson, Jefferson, Linn, Macon, Maries, Marion, Monroe, Montgomery, Osage, Perry, Phelps, Pike, Polk, Pulaski, Ralls, Reynolds, St Clair, St Louis, Ste Genevieve, Shannon, Taney, Texas, Vernon, Wayne	*Geocarpon minimum* (no common name)	Cedar, Dade, Greene, Henry, Lawrence, Polk, St Clair
Hellbender, Ozark	Carter, Dent, Douglas, Reynolds, Shannon, Texas	Madtom, Neosho	Jasper
Mapleleaf, winged	Franklin	Massasauga, eastern	Chariton, Jackson, Linn
Milkweed, Mead's	Adair, Barton, Benton, Cass, Cedar, Dade, Harrison, Henry, Iron, Pettis, Polk, Reynolds, St Clair, Vernon	Mucket, Neosho	Barry, Jasper, Lawrence, Newton

Species	Counties of Occurrence	Species	Counties of Occurrence
Mucket, pink (pearlymussel)	Butler, Cedar, Franklin, Gasconade, Jefferson, Osage, St Clair, St Louis, Wayne	Mussel, scaleshell	Crawford, Franklin, Gasconade, Jefferson, Maries, Osage, Pulaski, St Louis
Orchid, western prairie fringed	Harrison	Pocketbook, fat	Marion, Pike, Ralls
Pondberry	Butler	Sculpin grotto	Perry
Sheepnose	Crawford, Franklin, Jefferson, Marion	Shiner, Topeka	Boone, Daviess, Grundy, Harrison, Pettis, Putnam
Sneezeweed, Virginia	Shannon	Spectaclecase	Crawford, Franklin, Gasconade, Jefferson, Maries, Marion, Osage, Phelps, Pike, Pulaski, Ralls, St Louis
Sturgeon, pallid	Andrew, Boone, Callaway, Chariton, Clay, Franklin, Gasconade, Howard, Jackson, Lafayette, Montgomery, Osage, Perry, St Louis, Ste Genevieve	Tern, least (interior population)	Chariton, Perry
Table source: FWS 2005a			

Decurrent False Aster

Decurrent false aster is a perennial plant that inhabits floodplains and prairie wetlands that are moist and sandy in composition. This species relies on periodic flooding to reduce competition from other plants species in the same habitat. Populations of decurrent false aster may occur in the ROI within Franklin and Pike counties (FWS 2005a).

Excessive sedimentation, mainly due to agricultural practices, buries the seeds and smothers the seedlings, limiting reproductive spread. The reduction and degradation of prairie wetlands and floodplains is another factor limiting decurrent false aster. It has been found that occasional or sporadic farming may benefit this species to some degree by eliminating competing species (FWS 1997a).

Gray Bat

Gray bats are cave dependant species that utilize caves for roosting the entire year. Gray bat colonies migrate between winter caves and summer caves, which are selected to meet their seasonal requirements. Winter caves tend to be deep caves that are almost vertical and have the majority of the cavity below the lowest entrance to the cave (FWS 1982). Summer habitat for maternity colonies is caves that have domed ceiling or restricted rooms so that the combined body heat of the colony is trapped in the cave. These maternity caves are located by riparian areas to allow for close access to foraging areas. Gray bats feed almost exclusively in riparian areas on aquatic insects. There is no documentation of foraging areas located in riparian areas where adjacent forests have been cleared (FWS 1982). Of the 79 counties partially or entirely in the ROI, 31 contain gray bats (FWS 2005a)

Human disturbance, disturbance to cave habitat, impoundment of waterways, pesticides, and pollution are factors limiting this species (FWS 1982). Prolonged human disturbance, particularly a disturbance to maternity colonies, can be detrimental to the entire colony. Disturbance in the winter causes the expenditure of energy and fat supplies which cannot be recovered before spring emergence. Less than 5 percent of all caves located within the range of the gray bats fulfill their habitat requirements (FWS 1982). The impoundment of waterways that once flowed near utilized caves either causes the abandonment of the caves or longer daily migration to forage, leaving bats more susceptible to predation. A major component of the gray bat diet is aquatic insects; a large portion of which are mayflies,

stoneflies, and caddisflies (FWS 1982). These insects are extremely sensitive to water pollution. The limited abundance of these insects in riparian areas near gray bat caves may limit gray bat populations.

Indiana Bat

From approximately October to April, Indiana bats hibernate in caves or mines. These areas are chosen depending on the microclimate inside the cavity (FWS 1983). This species requires very low and stable temperatures during hibernation to conserve body fat. There are not many caves or mines that meet the wintering habitat requirements for this species. Little is known about the summer habitat requirements for Indiana bats. Maternity colonies in northern Missouri have been documented utilizing floodplains, riparian areas, and upland riparian forests during the summer season, but it has been questioned as to whether or not this is because these areas are often the only forests left after clearing for agriculture (FWS 1983). Forested riparian areas with trees that line each side and overhang the water are the primary foraging areas of Indiana bats. Forested riparian areas without overhanging vegetation are rarely used. Indiana bats feed largely on aquatic insects (FWS 1983).

Human disturbance during hibernation adversely affects this species. When hibernating bats are disturbed, their metabolism increases and they use valuable fat reserves that must last them through the entire winter. This often causes disturbed bats to leave the caves too soon, which usually results in the death of the bat (FWS 1983). Another limiting factor is the decline in habitat due to deforestation and channelization within the bats' range. Forested riparian areas are foraging areas for this species and may also be roost areas in the summer season.

Indiana bats occur in 47 counties within the ROI (FWS 2005a). Critical habitat has been designated for this species in five Missouri counties: Crawford, Franklin, Iron, Shannon, and Washington (32 FR 4001, 1967). All of these counties are in part or entirely within the ROI.

Missouri Bladderpod

Missouri bladderpod is an annual, herbaceous plant that occurs in primarily in limestone glades and open rocky areas. Historically, encroachment of woody vegetation and the introduction of non-native grasses are what led to concern for this species. Currently, roadside maintenance, poor glade management, and the conversion of land to pastures are threatening this species. A few bladderpod populations in Missouri are found along roadsides and may be destroyed due to mowing and the use of herbicides for weed control. The control of fire in glade habitats have led to the encroachment of woody vegetation and introduced grasses in these areas. Missouri bladderpods require open areas and does not compete well with these other vegetation types. Glade areas converted to cool season grasses for pastureland is also harmful to Missouri bladderpod populations (MDC 1995).

Missouri bladderpod populations occur in Christian, Dade, Greene, and Lawrence counties, all of which are partially or entirely within the ROI (FWS 2005a). Nearly all of the populations of Missouri bladderpod within the State occur on areas of private land (MDC 1995).

Ozark Cavefish

Ozark cavefish spend their entire lives in freshwater springs, cave streams, and underground water systems. These waterbodies will most likely have gravel bottoms or, in the case of pond environments, silt or sand bottoms. In Missouri, the Ozark cavefish may be found in Barry, Greene, Jasper, Lawrence, Newton, and Stone counties. All of these counties are in part or entirely within the ROI. Of the populations in Missouri, two are on public land and the rest occur on private land (MDC 1997a).

Water pollution, human disturbance, and alteration or destruction of habitat are the primary factors contributing to this species decline. The Ozark cavefish is dependant on good water quality. Urban and

agricultural runoff, such as that of livestock and poultry farms, has the potential to pollute waterways in which this species inhabits. Ozark cavefish that inhabit cave water systems rely on bat guano for food and nutrients. Human disturbance may cause bats to leave these caves, causing an important food source to be lost. Loss and alteration of habitat for the Ozark cavefish has occurred due to natural and human caused flooding, changes in water levels, and collapses of caves (MDC 1997a).

Tumbling Creek Cavesnail

The Tumbling Creek cavesnail is a small, pale snail that inhabits Tumbling Creek Cave in Taney County, Missouri. This species lives on the underside of rocks within this water system. Habitat requirements include little or no silt, and may be dependant on bat guano deposits (FWS 2002).

Though it is not certain, it is thought that contributing factors to the decline of this species are poor water quality and residential development. Increased erosion in and around the recharge area of the Tumbling Creek Cave causes high turbidity and siltation in the stream. Water quality may also be degraded due to the removal of streamside vegetation, poultry farming, livestock grazing, and urban runoff. Residential development around the Tumbling Creek Cave is expanding, which may also be affecting the species due to increased recreation and construction activities (FWS 2002).

Running Buffalo Clover

Running buffalo clover habitat includes moderately moist areas with some sunlight, where moderate disturbances such as grazing or mowing takes place periodically. Historically, this species was often found in edge areas between prairies and forests. Running buffalo clover is thought to have once been dependant on large grazing animals such as elk, deer, and bison for the dispersal of seeds and disturbance to the soil. Current populations of running buffalo clover are found on woodland lots, periodically mowed areas, and along streams and trails (FWS 2003a). Running buffalo clover occurs in 19 counties that lie partially or entirely within the ROI (FWS 2005a).

FWS has identified habitat loss, loss of bison, and the invasion of non-native plants as the most limiting factors affecting running buffalo clover. The loss of large groups of grazing animals has decreased land disturbance and seed dispersal. The clearing of land for agriculture and development has caused habitat loss and fragmentation. Fragmented habitat leads to small, isolated populations, which increases the chances of loss due to disease, inbreeding, and herbivory. The introduction of non-native plants has caused running buffalo clover to be out-competed in some areas (FWS 2003a).

Arkansas Darter

The habitat requirements of Arkansas darter include sandy or pebbled bottoms of pools in small, spring-fed streams. The species requires these pools to contain cool water and some aquatic vegetation (FWS 2004a). The Arkansas darter is not thought to be declining in number in Missouri, but is declining throughout the majority of its remaining range. Within the ROI, populations of Arkansas darter are known to occur in Barry, Barton, Dade, Jasper, Lawrence, and Newton counties (FWS 2005a).

The greatest limiting factor to Arkansas darters is the depletion of water due to agricultural needs. The depletion of spring-fed stream and marshes has forced the Arkansas darter to inhabit less favorable habits in which it is a poor competitor. This species does not thrive in habitats that contain a diversity of fish species (FWS 2004a).

Niangua Darter

Niangua darter habitat includes medium-sized creeks with fairly clear water. This species does not tolerate high levels of siltation or turbidity. They prefer clean gravel or rocky-bottomed creeks and are often found in shallow pools with moderate currents. When spawning, Niangua darters inhabit areas near

or in riffles. Females lay their eggs in clean gravel substrates. Niangua darters feed predominantly on stoneflies and mayflies (FWS 1989a).

Reservoirs adversely affect Niangua darter populations due to the flooding of stream habitats and the introduction of fish species to reservoirs that are not common to the tributary streams the darter inhabits (FWS 1989a). These introduced species may out-compete darters for food and habitat, and they may also prey on the darters. A population of Niangua darter once inhabited the Little Pomme de Terre River in Benton County until the Truman Reservoir was constructed and filled. Once the Little Pomme de Terre River became seasonally inundated, the darter population declined and is currently considered extirpated (FWS 1989a).

Critical habitat has been designated for Niangua darter in seven Missouri counties, five of which lie within the ROI. Critical habitat includes the Big Tavern Creek in Miller County, the Niangua River in Dallas County, the Pomme de Terre River in Greene County, Brush Creek in Cedar and St. Clair counties, and the Little Niangua River in Camden, Dallas, and Hickory counties (50 FR 113, 1985).

Hine's Emerald Dragonfly

Hine's emerald dragonflies are most often found in spring-fed marshes that are high in calcium carbonate, and sedge meadows that are located over dolomite bedrock. Because Hine's emerald dragonflies rely on spring-fed shallow water areas for breeding, changes in groundwater flow and loss of wetland habitat adversely affect this species (FWS 2006b). The use of pesticides and pollutant runoff also poses a threat to this dragonfly. Hine's emerald dragonfly populations occur in seven Missouri counties, five of which are portions of the ROI (FWS 2005a).

Bald Eagle

Bald eagles are a riparian dependant species. They are frequently found in or near riparian areas where they forage on waterfowl and fish. Some eagles will inhabit terrestrial environments and feed on carrion or small game. Nesting bald eagles are predominantly associated with lakes, rivers, or coastal areas. Breeding areas consist of large trees and cliffs and, rarely, on the ground. Bald eagle populations occur in 49 of the counties that lie within the ROI (FWS 2005a).

The most limiting factor to this species is loss of habitat. Increased development and the modification or destruction of wild lands has had a cumulative adverse effect on this species. Human disturbance also affects this species and has been documented as the reason for some reproductive failure in breeding areas. Historically, the decline of the bald eagle was linked to dichloro-diphenyl-trichloroethane (DDT), a commonly used pesticide prior to 1972. The presence of DDT caused eggshells to be very thin, which caused the eggs to break when females began to incubate them. This resulted in a significant and rapid decline in bald eagle populations.

Geocarpon minimum

Geocarpon (sometimes referred to as Earth fruit) are small, annual plants that occupy areas of sandstone glade outcrops. This species grows on the base of slightly tilted rocks in sandy or gravelly depressions formed by seep waters. Within the ROI, geocarpon populations are known in Cedar, Dade, Greene, Henry, Lawrence, Polk, and St. Clair counties (FWS 2005a).

Threats to geocarpon include conversion of glade habitats to pasture, lack of periodic grassland fires, and the use of off-road vehicles. The conversion of glades to pasturelands increases sedimentation in depression areas where geocarpon grow. This increase in sedimentation allows the encroachment of other vascular plant species, most of which can out-compete geocarpon. Periodic fires would also reduce the amount of competition to geocarpon; however, most fires are not allowed to burn. Because many

geocarpon populations are located in open and accessible areas, the uses of off-road vehicles have caused a loss of habitat for this species and also directly crush plants (MDC 2004g).

Ozark Hellbender

Ozark hellbenders are aquatic salamanders that are mostly found under large rocks within fast moving streams in the Ozark Plateau. This species prefers areas with little temperature change within the water systems (FWS 2006c). Ozark hellbender populations are known to occur in Carter, Dent, Douglas, Reynolds, Shannon, and Texas, all of which are partially or wholly within the ROI (FWS 2005a).

The decline of Ozark hellbender populations within Missouri have been attributed to loss or modification of habitat due to impoundments, mining, sedimentation, and the disturbance to nest sites due to recreational activities. Impoundments fragment Ozark hellbender habitat, not allowing migration to and from separate populations. Isolated populations are more susceptible to local extinction. Mining increases sedimentation within streams which may smother nesting sites. Mining also adversely affects crayfish populations, which is the primary prey of Ozark hellbenders. The disturbance to nest sites due to recreational use of inhabited waterways may lead to nest abandonment. In addition to this, recreational watercraft that bumps or dislodges large rocks may kill or injure this species (FWS 2006c).

Neosho Madtom

Neosho madtoms are small catfish that live under rocks within stream riffles or runs. This species needs habitat of clear waterways with loosely packed gravel bottoms. Neosho madtoms feed on caddisflies, mayflies, dipterans, and midges; all of which require good water quality. In Missouri, Neosho madtoms inhabit only five to seven stream miles within the Spring River in Jasper County (MDC 1997b, FWS 2005a).

Neosho madtoms are vulnerable to natural weather patterns such as drought and flood, habitat disturbance, and pollution. Habitat is often lost or degraded due to dams and impoundments, sand and gravel removal, and agricultural runoff (MDC 1997b).

Winged Mapleleaf

Winged mapleleafs are freshwater mussels that reside in waterways with riffles and clean gravel, sand, or rubble bottoms. Waterways containing winged mapleleafs must have good water quality and low turbidity. Known populations of winged mapleleafs are located in the Bourbeuse River in Franklin County (FWS 2004b, 2005a).

Within the entire range of winged mapleleafs, only one population occurring in Arkansas is reproducing. A single catastrophic event could eliminate this population, leaving only unviable populations. In Missouri, agriculture and local industry are abundant in areas where winged mapleleafs occur. These activities may destabilize river embankments and increase sedimentation. Winged mapleleafs are also adversely affected by pesticides and chemical pollutants (FWS 2004b).

Eastern Massasauga

Habitat for the eastern massasauga rattlesnake includes areas of shallow wetlands and the upland habitats that are adjacent to wetlands. Wetland habitat types can include sedge meadows, swamp forests, peatlands, and marshes. Upland habitat types can include areas such as prairies, old fields, and savannas. Habitat use is seasonal (FWS 2004c). Within the ROI eastern massasaugas are known to occur in Chariton, Jackson, and Linn counties (FWS 2005a).

The major limiting factor to eastern massasauga is the loss, modification, or destruction of habitat. Wetland loss and degradation due to agricultural practices, both in the past and present, limits this

rattlesnake. The loss of habitat also causes habitat fragmentation, so that the seasonal movement between habitats becomes longer and more treacherous for the species. The eastern massasauga is susceptible to road mortality and predation during migration periods. In addition, the more fragmented the habitat, the more likely genetic diversity is to become less dynamic within individual populations (FWS 2004c).

Mead's Milkweed

Mead's milkweed requires full sun to partial shade. It is typically found in tallgrass prairies, which are mesic to somewhat dry areas that support vegetation adapted to fire and drought. In Missouri, the majority of the Mead's milkweed is found on private lands (FWS 2003b).

The loss or disturbance of tallgrass prairie has adversely affected the genetic diversity and reproductive success of this species. Small, fragmented areas of habitat do not hold many plants, so these populations lose genotypes and fail to reproduce (FWS 2003b). Within the ROI, Mead's milkweed populations are known to occur in Adair, Barton, Benton, Cass, Cedar, Dade, Harrison, Henry, Iron, Pettis, Polk, Reynolds, St. Clair, and Vernon counties (FWS 2005a).

Neosho Mucket

The Neosho mucket is a large mussel that burrows in the gravel substrate of stream riffles and runs. The current within these waterways will be moderately swift and the substrate loose. This species is known to occur in Center and Indian Creeks, which run through the counties of Barry, Jasper, Lawrence, McDonald, and Newton. All of these counties but McDonald occur partially or entirely within the ROI (FWS 2005a, b).

Reduction of habitat due to impoundments, sedimentation, and pollutants, is adversely affecting this species. Neosho muckets will not inhabit areas of impounded water. Impounding waterways once suitable for this species also causes fragmentation of Neosho mucket habitat. Excessive sedimentation levels adversely affect all mussel species due to suffocation and a reduction in juvenile recruitment. Mining, cattle grazing, construction activities, and agriculture have increased sedimentation entering waterways within the habitat of the Neosho mucket. Pesticides, heavy metals, and excessive nutrients may also adversely affect Neosho muckets (FWS 2005b).

Pink Mucket

Pink muckets are three to five inch mussels that inhabit large streams with cobble, gravel, and sand beds. Adequate water levels for pink mucket range from one inch to five feet in depth. This species occurs in twelve Missouri counties, nine of which lie within some portion of the ROI (MDC 1997c, FWS 2005a).

The most common threat to pink mucket within Missouri is loss, alteration and degradation of habitat. Dredging activities and sand and gravel mining alter the substrate of waterways, increase sedimentation, and may kill some pink mucket during the time of these activities. Though it is not clear what effects pesticides and other pollutant runoffs have on pink mucket in particular, degraded water quality affects most aquatic species adversely (MDC 1997c).

Scaleshell Mussel

Scaleshells are small freshwater mussels that inhabit areas of medium sized and large rivers with good water quality and gravel or sand bottoms. Scaleshells burrow in the sand and gravel bottoms with the partially open shells exposed. This species forages by siphoning particles from the water. Scaleshells occur in Crawford, Franklin, Gasconade, Jefferson, Maries, Osage, Pulaski, and St. Louis counties; all of which lie partially or entirely within the ROI (FWS 2004d, 2005a).

Pollution, sedimentation, dams, and impoundments are current threats to scaleshell mussel populations. Because scaleshells stay in one place within water systems, they cannot escape pollutants, but are left to absorb them. Strong contaminants may either directly cause mortality or limit reproduction. Excessive sedimentation may suffocate scaleshell mussels as the sediment settles. Increased sedimentation also interferes with scaleshell feeding. Because scaleshell mussels cannot inhabit areas of still water, the building of dams or impoundments reduces scaleshell habitat and fragments existing habitat. Fragmentation may lead to decreased migration to other populations, resulting in die off of isolated populations (FWS 2004d).

Western Prairie Fringed Orchid

Habitats of western prairie fringed orchids are tallgrass prairies, sedge meadows, bottom prairies, and wet uplands (MDC 2004h). This orchid requires direct sunlight and will persist in areas that are moderately disturbed, such as lightly grazed lands, mowed lands, or rotationally burned lands. Western fringed prairie orchids are known to occur in Harrison County, part of which occurs in the ROI (FWS 2005a).

MDC has identified four factors affecting the decline of western prairie fringed orchid. These are the loss of habitat due to the conversion of tallgrass prairies to agricultural, residential, and commercial development; incompatible land management practices such as haying during the period the orchid disperses seeds; the use of pesticides; and over collecting (MDC 2004h).

Fat Pocketbook

The preferred habitat of fat pocketbook, a freshwater mussel, includes large river systems where there is flowing water and stable substrate. Though there is some conflicting information on the subject, it is considered that the most likely habitat for fat pocketbook within these large rivers is areas that have a bottom that is a mixture of sand, silt, and clay (FWS 1989b). Within the ROI, fat pocketbooks are known to inhabit portions of Marion, Pike, and Ralls counties (FWS 2005a).

Impoundments, increased irrigation, and dredging for flood control adversely affect this species. These activities have altered or decimated suitable fat pocketbook habitat. Another limiting factor is pollution from agricultural and industrial runoff entering waterways. Polluted waters cause toxins to build up in the tissue of fat pocketbook, which eventually results in death (FWS 1989b).

Pondberry

Pondberry is a medium-sized shrub that occurs in areas of poorly drained, swamp-like depressions. These swampy depressions are often associated with sand dunes and are typically submerged under water throughout the spring season. Pondberry is only found on these depressional areas, and not on the higher sand dunes. This species does not compete well with plants that require full light and is often found in shaded understories. In Missouri, pondberry occurs in Ripley and Benton counties; Benton County lies within the ROI (MDC 1998, FWS 2005a).

Pondberry habitat alteration or degradation in Missouri is commonly caused by logging and agricultural activities. Unauthorized logging activities diminished pondberry populations in the past. Activities associated with agricultural water supply, such as ditch drainage systems, remove water from potential pondberry habitat (MDC 1998).

Grotto Sculpin

Grotto sculpin inhabit cave streams and utilize pools and riffles with moderate flow. These fish prefer the pools and riffles to be low to moderate in depth. They utilize a variety of substrates and have been found on silt, cobble, rock rubble, solid bedrock, and gravel bottoms. Grotto sculpin forage on invertebrates (FWS 2004e). Known occurrences of grotto sculpin have been recorded in Perry County (FWS 2005a).

Present factors affecting the persistence of grotto sculpin are loss or degradation of habitat, predation, and pollution. Pollution, resulting in the loss or degradation of habitat, may be the most limiting factor affecting this species. Dye trace studies have been performed in Missouri to investigate pollutants entering cave streams that hold grotto sculpin. These studies confirmed that ammonia, nitrite and nitrate, chloride, and potassium from surrounding agricultural lands were entering these streams at a rate high enough to decimate aquatic wildlife. Mass mortality of grotto sculpin has occurred in Missouri caves due to point source pollution (FWS 2004e).

Sheepnose

Sheepnose are a medium-sized mussel that occurs in larger stream systems. This species inhabits shallow areas with moderate to swift currents. Prime stream habitat will have course sand or gravel bottoms; however, suitable habitat may have mud, cobble, or boulder covered bottoms. Sheepnose mussels often inhabit the same general location within streams their entire life. Within the ROI, sheepnose are thought to occur in Crawford, Franklin, Jefferson, and Marion counties (FWS 2005a, c).

As is the case with most mussels, threats to sheepnose include the loss or modification of habitat due to impoundments, water pollution, and sedimentation. Sheepnose mussels cannot inhabit areas of still water, so the construction of impoundments removes potential habitat for this species. The concentration of pollution, long-term or acute, may result in mussel mortality. Pollution is especially harmful to juvenile mussels when directly ingested. Excessive sediment entering waterways causes turbidity. Sedimentation and turbidity are known to adversely affect mussels by clogging gills, interfering with feeding, and change in bottom substrate (FWS 2005c).

Topeka Shiner

The habitat of the Topeka shiner includes small prairie streams (or in areas of former prairies). Within these streams, Topeka shiners inhabit pools of clean water with little to no turbidity. The preferred substrates are sand or clean rock and gravel. Most of the streams inhabited by this species flow year-round, but some may not. These streams must be supplied enough groundwater seepage for the fish to survive. Within the ROI, Topeka shiners have the potential to occur in Boone, Daviess, Grundy, Harrison, Pettis, and Putman counties (FWS 1997b, 2005a).

Topeka shiner populations are adversely affected by increased sedimentation and turbidity entering waterways due to the removal of riparian and upland vegetation. This species is reliant on good water quality and habitat. Pollution runoff from adjacent lands into streams containing Topeka shiner reduce the viability of this species. Because of their need for areas of high water quality, these fish are often used as indicator species to determine the general health of aquatic habitat (FWS 1997b).

Virginia Sneezeweed

Virginia sneezeweed is a perennial wetland flower found in seasonally flooded limestone ponds. Habitat includes poorly drained, acidic soils. FWS indicates that this flower can be found in Shannon and Howell counties in Missouri (FWS 2005a). Shannon County is located partially within the ROI. Threats to Virginia sneezeweed include residential development, off-road vehicle use, agricultural activities, logging, and the filling or draining of wetland associated habitat (FWS 1999).

Spectaclecase

The spectaclecase inhabits large rivers and utilizes a variety of substrates, including boulder, cobble, gravel, sand, and mud bottoms. Spectaclecase prefer outside river bends and other habitats that are sheltered from the main flow of the river current. The species rarely moves, and may die from remaining in the same spot even when there is drought. Spectaclecase are known to occur in twelve counties that lie within the ROI (FWS 2004f, 2005a).

The main reason for the decline of spectaclecase is loss or degradation of habitat. Suitable habitat has been deteriorating due to the building of impoundments, channelization, pollution, and sedimentation. Impoundments are considered to be the main cause of habitat loss (FWS 2004f).

Pallid Sturgeon

Habitat for the pallid sturgeon includes large, free-flowing rivers that contain warm water and high turbidity. Within these river systems, pallid sturgeons utilize areas of chutes, backwaters, islands, sandbars, floodplains, and main channel waters as macrohabitats. Historically, the Missouri and Mississippi Rivers, where pallid sturgeon can be found, were in a constant state of change. Due to human development, these rivers are now less dynamic. Impoundments built on the Missouri and Mississippi Rivers have blocked the seasonal flood flows which once stimulated spawning migrations of pallid sturgeon. This species prefers sand bottoms as substrate, but has also been found on gravel and rock substrate. Pallid sturgeon can be found in fifteen counties that are within the ROI (FWS 1993, 2005a).

The chief factor limiting pallid sturgeon is the destruction and loss of habitat due to modification of the major river systems of which it inhabits. Habitat destruction has reduced reproduction, growth, and survival of this species. On the Missouri River, approximately 36 percent of the habitat historically utilized by the pallid sturgeon has been lost due to the construction of dams, 40 percent has been channelized, and 24 percent has been changed significantly due to the alteration of water flows by the dam. The construction of these dams has also blocked migration routes and eliminated important nursery areas. The impoundments on the Missouri River have caused a 66 percent reduction of sedimentation entering the Mississippi River. Most aquatic species are not tolerant of high sedimentation; however, the pallid sturgeon relies on rivers with high turbidity to reduce predation. The pallid sturgeon is essentially sightless from evolving in rivers with high turbidity levels. High turbidity provided the species with cover while moving from one area to another. The reduction of sedimentation has caused water clarity to increase significantly which leaves the pallid sturgeon, lacking the eyesight to spot predators from a distance, more susceptible to predation during the juvenile stage (FWS 1993).

Least Tern—Interior Population

Habitat of the least tern includes riverine and shallow water areas. Nesting areas, which usually contain less than 20 percent vegetation, and are located on beaches, islands, peninsulas, sandbars, sand pits, gravel bars within wide rivers, and salt flats around lake shores. Nesting areas are usually located near foraging areas and on substrates consisting of gravel, stones, sand, and shells. Nesting takes place when river flows are high and small areas of habitat are exposed. Within the ROI, populations of least term are known to frequent Chariton and Perry counties (FWS 1990, 2005a).

Habitat loss is the main factor for the decline of this species. Channelization, irrigation, and the construction of impoundments have decimated the majority riverine habitat necessary for least tern nesting. Areas that are suitable are often washed away after nesting has taken place when impoundments release water and raise the water level above the elevation of the nesting spot. Human disturbance in the form of recreational areas in suitable least tern habitat also limits this species (FWS 1990).

3.2 Cultural Resources

3.2.1 Archaeological Resources

3.2.1.1Description

Archaeological resources are locations and objects from past human activities. The ROI for this resource analysis includes the 79 counties identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.2.1.2Affected Environment

American Indians, fur traders, German and other European immigrants, and African Americans freed by the Civil War settled Missouri and left their unique print on the landscape. The rich cultural history of Missouri is illustrated by the thousands of archaeological sites found throughout the State. As of 2004, approximately 350,000 cultural resources had been identified across the State, including more than 7,000 prehistoric and historic archaeological sites. One hundred and eighteen of these sites are listed in the National Register of Historic Places (NRHP) (Missouri State Historic Preservation Office [MSHPO] 2004). MSHPO is currently developing a geographic information system (GIS) database that will eventually include all of the sites in Missouri, and so far includes over 6,000 sites (Nichols 2006). Of the 79 counties included in the ROI, 50 counties have had their sites recorded in the database and sites within the other 29 counties are in the process of being reviewed (Table 6).

Table 6. Number of archaeological sites in the counties of the ROI.

County	Sites	County	Sites	County	Sites	County	Sites
Adair	265	Dallas	47	Lafayette	NA	Ralls	52
Andrew	NA	Daviess	41	Lawrence	35	Randolph	NA
Audrain	26	DeKalb	29	Linn	67	Reynolds	49
Barry	NA	Dent	NA	Macon	154	St. Clair	279
Barton	27	Douglas	51	Madison	NA	St. Francois	35
Bates	NA	Franklin	NA	Maries	NA	St. Louis	590
Benton	599	Gasconade	32	Marion	140	Ste. Genevieve	94
Boone	365	Gentry	24	Mercer	25	Schuyler	19
Butler	118	Greene	303	Monroe	NA	Scotland	18
Caldwell	NA	Grundy	11	Montgomery	66	Shannon	63
Callaway	NA	Harrison	NA	Newton	NA	Shelby	NA
Carter	134	Henry	NA	Nodaway	NA	Stone	502
Cass	34	Hickory	147	Osage	26	Sullivan	83
Cedar	NA	Howard	142	Perry	47	Taney	NA
Chariton	NA	Iron	122	Pettis	NA	Texas	NA
Christian	446	Jackson	274	Phelps	NA	Vernon	NA
Clay	123	Jasper	NA	Pike	143	Washington	NA
Clinton	11	Jefferson	257	Polk	54	Wayne	NA
Crawford	116	Johnson	NA	Pulaski	NA	Webster	24
Dade	23	Knox	107	Putnam	69		

Table source: Nichols 2006

NA = Data not yet available in GIS database

3.2.1.2.1 Prehistoric Periods (12,000 B.C.–1700 A.D.)

Missouri is often called the "Gateway to the West" and has served as the center for settlement, transition, and development since prehistoric times. Studies in paleoecology, ethnography, history, and archaeology

have resulted in a better understanding of over 12,000 years of human land use and culture in Missouri. Archaeologists organize this information chronologically based on time, diagnostic artifacts or artifact assemblages from the archaeological record, and the environmental conditions that affected human adaptation to the landscape. The following are brief summaries of the time periods related to cultures of what is now the State of Missouri.

Early Man Period (Pre–12,000 B.C.)

Some archaeologists believe one Missouri site in Daviess County predates the Clovis period as evidenced by stone tool technology. Other archaeologists question if the site has been correctly dated and interpreted.

Paleoindian Period (12,000–8,000 B.C.)

This period is characterized by a nomadic population settlement pattern and small bands who hunted large game for subsistence. Clovis and Folsom fluted points used for hunting have been discovered in a variety of Missouri sites. Their locations indicate that populations used major stream valleys. At the Kimmswick site located in Jefferson County, fluted points were found in direct association with mastodon bones.

Dalton Period (8,000–7,000 B.C.)

The Dalton Period marked a transition between the large game hunting of the Paleoindian cultures and the hunting-foraging of the Archaic period. Climate changes resulted in changes to plant and animal communities and new diet and hunting strategies. The Dalton serrated point with beveled edges is an important technological marker of this period. Studies indicated these points may have been used as knives to butcher deer. Another distinctive woodworking tool, called a Dalton adze, also characterizes this period. The existence of tools such as mortars, manos, grinding slabs, cupstones, and hammerstones indicate plant food processing.

Early Archaic Period (7,000–5,000 B.C.)

This period marked new reliance on hunting-foraging traditions and dry climate floral and faunal species for subsistence. Many new tool shapes and forms mark this time period. They include the Graham Cave side notched, Hidden Valley stemmed, Rice lobed, Rice contracting stemmed, Rice lanceolates, and St. Charles notched points.

Middle Archaic Period (5,000–3,000 B.C.)

Continuation of warm, dry climate conditions mark this period. Forests receded while the prairies expanded. Deer herds decreased and small mammals such as birds, fish, and rabbits provided a greater amount of the diet. Tool technologies include the Jakie stemmed, Big Sandy, and full grooved which is a variety of ground stone axe.

Late Archaic Period (3,000–1,000 B.C.)

Climate changes brought back forest animals and plants to areas that were prairie in the Middle Archaic Period. New stone tool technologies from this period used for cooking include Nebo Hill lanceolate, Sedalia lanceolates, Smith basal notched, Table Rock stemmed, Stone square stemmed, Big Sandy notched, Etley, and Afton points. Three-quarter groundstone axes are another hallmark. Pottery vessels were manufactured for the first time.

Early Woodland Period (1,000–500 B.C.)

Some new tool technology occurred during this time period. One example of innovation and change is the Black Sand incised ceramics found in the northern half of the State.

Middle Woodland Period (500 B.C.–400 A.D.)

Widespread social and technological changes occurred during this time in Missouri, as well as in Illinois and Ohio. New stone tool types appeared including Snyders, Mankers, Ensor, Castroville, Frio, Gary, and Dickson. Pottery production also changed to include tempering with grit or grog. Some potteries had stamped designs or were decorated with cordage and small reed impressions and incised lines. Pottery and small animal and human figurines were made of clay.

Late Woodland Period (400–900 A.D.)

Pottery decoration and design declined during this period and arrow points appeared as a significant new technology. The changes in technology, burial practices, and pottery may suggest that several distinct tribes existed across the State.

Mississippian Period (900–1700 A.D.)

Settlement began to occur in the form of permanent villages that became large towns. The towns were fortified and included temple mounds, plazas, and astronomical observations. Symbols of wealth included embossed copper plats and conch shells. Immigration into the Missouri area began during the 13th and 14th centuries as evidenced by distinctive pottery and stone tools. Today these tribes are called the Osage and Missouri.

3.2.1.2.2 Protohistoric (1250–1700 A.D.) and Historic Periods (1700 A.D.–Present)

The protohistoric period was marked by contact between American Indians and Europeans. Major changes in American Indian culture occurred as a result of this contact.

Immigrant Period (1700–1830 A.D.)

New immigrant groups arrived in the State during this time period. They included additional American Indians tribes (Kickapoo, Delaware, Shawnee, Miami, Peoria, and Potawatomies), Euro-Americans (French, Spanish, and English), and free and slave Africans-Americans. Euro-American settlements sprang up at Fort Orleans, Ste. Genevieve, St. Louis, and St. Charles. The Treaties of 1808 and 1825 caused the migration of the Osage from Missouri to Kansas and, eventually, Oklahoma. Missouri was admitted as a slave-holding State in 1820.

Flint-lock rifles for hunting and defense appeared, as did copper and iron kettles for cooking. China and glass bottles have also been found from this time period but were rare.

New State Period (1820–1860 A.D.)

Immigrants from Germany arrived and settled the central part of the State and Mormons and non-Mormons had a brief but intense conflict in the northwest. Agriculture replaced fur trapping in rural Missouri.

Imported china, including pearlware and whiteware, and mold-blown glass bottles became more common in both rural and urban areas. Newspapers and photographers recorded events in the larger towns.

Civil War (1860–1865 A.D.)

Most Missouri citizens sided with the Confederacy during the war and thousands of refugees fled for protection to St. Louis, a major center for the Federal Government. Hundreds of skirmishes were fought across the State and private homes were destroyed around Kansas City and sections of the Ozarks. Federal fortifications were constructed at St. Louis, Rolla, Jefferson City, and Springfield. Major battles were fought at Wilsons Creek, Pilot Knob, Lexington, Carthage, and Westport.

Gilded Age (1860–1890 A.D.)

Although infrastructure repair was slow after the war, many freed African-Americans came to the State and increased the populations of St. Louis and Kansas City. Elaborate theaters, homes, businesses, and religious centers were constructed and the Eads Bridge was finished across the Mississippi River in St. Louis.

Modern Period (1900 A.D.–Present)

Urban and rural areas experienced a decline as populations shifted to suburbia. Gas and kerosene lanterns were replaced by electric lights and interstate highways connected major urban centers within and outside of the State. The Gateway Arch was constructed in St. Louis (Environmental Research Center of Missouri 2000, Missouri Archaeology Society 2006).

3.2.2 Architectural Resources

3.2.2.1Description

Historic architectural resources are standing structures that are usually over 50 years of age and of significant historic or aesthetic value. The ROI for this resource analysis includes the 79 counties identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.2.2.2Affected Environment

Missouri has nearly 1,600 architectural resource listings in NRHP representing over 20,000 buildings, structures, objects, and sites. More than 100 new listings were added in 2006 for nearly 750 properties. The vast majority of listings are buildings and structures such as schools, churches, homesteads, mills, libraries, and businesses representing themes from the lifestyles and cultures of American Indians and Euro-American exploration and settlement. Most occur within the ROI in the form of individual listings and historic districts. Thirteen of the most historically significant properties are listed as National Historic Landmarks (Table 7). Several National Historic Landmarks and NRHP properties occur within the city of St. Louis; however, the city and St. Louis county split in 1876 and the city is not included in the ROI (MSHPO 2004, 2006).

Table 7. Properties within the ROI listed in NRHP.

County	Number of Properties	NRHP Property and Location
Callaway	1	Westminster College Gymnasium, Fulton
Clay	1	Watkins Mill, near Excelsior
Jackson	5	Fort Osage Historic District, Sibley Liberty Memorial Monument, Kansas City Mutual Musicians Assoc. Building, Kansas City Harry S. Truman Historic District, Independence Harry S. Truman Farm Home, Grandview
Linn	1	Gen. John J. Pershing Boyhood Home, Laclede
Marion	1	Mark Twain Boyhood Home, Hannibal
Pike	1	Champ Clark House, Bowling Green
St. Louis	1	White Haven House, Grantwood Village
Ste. Genevieve	2	Louis Bolduc House, Ste. Genevieve Ste. Genevieve Historic District, Ste. Genevieve
Table source: MSHPO 2006		

3.2.3 Traditional Cultural Properties

3.2.3.1Description

Traditional cultural properties (TCPs) hold importance to American Indians and other groups for the continuing practice of traditional culture. Any of the properties may meet the criteria for inclusion in NRHP and this determination of eligibility (36 CFR parts 800.3–800.13, 2006) is a requirement of Federal and State environmental assessment processes before the initiation of ground disturbance or alteration of a landscape or structure. The ROI for this resource analysis includes the 79 counties identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.2.3.2Affected Environment

There are no TCPs within the ROI listed in the NRHP. However, there is one TCP that has been determined eligible for listing. It is a pool at Brooklyn Falls located in Harrison County. The Brooklyn Falls pool has functioned as a religious baptismal site since as early as the 1850s (Environmental Research Center of Missouri 2000, Nichols 2006).

3.3 Water Resources

3.3.1 Surface Water

3.3.1.1Description

Surface water includes rivers, streams, and lakes, including those designated as impaired. The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.3.1.2Affected Environment

Every 2 years States must compile as list of waterbodies within their jurisdiction that do not meet the water quality standards established by Section 303(d) of the *Clean Water Act* (33 USC parts 1251 et seq., 2000). These lists, which identify impairments to each waterbody, are commonly known as *303(d) lists*. Once the list is complete, each jurisdiction must then determine priority rankings for these waters and establish total maximum daily loads (TMDLs) for each. A TMDL is the maximum amount of pollutants a waterway can receive daily and still meet water quality standards (EPA 2005). Not all impaired waters are included in the 303(d) list. For example, impaired waters may be excluded from the list if: they have control measures already in place; they are impaired by a condition not caused by a specific pollutant (e.g., channel modification); or they have a completed an EPA-approved TMDL for all relevant pollutants.

Due to revisions in the methodology used to develop 303(d) lists, Missouri's most recent EPA-approved list is that from 2002. A draft 2004/2006 list is under review and may be submitted to EPA for approval no sooner than March 7, 2007 (Missouri Department of Natural Resources [MDNR] 2006a). There are significant changes between the 2002 303(d) list and the draft 2004/2006 303(d) list; therefore, this analysis will consider impaired waterbodies in the ROI from both lists (Appendix F).

The 2002 303(d) list identifies 207 impaired waterbodies statewide, of which 79 are located at least partially within the ROI (MDNR 2004a). The draft 2004/2006 303(d) list identifies 82 impaired waterbodies, 40 of them in the ROI (MDNR 2006b). The decrease in impaired waters is not necessarily indicative of improved water quality, but rather a change in the methodology as previously mentioned.

Waterways within the ROI are impaired due to the presence of the following pollutants (MDNR 2004a, 2006b):

- Mercury
- Volatile suspended solids
- Low dissolved oxygen
- Biochemical oxygen demand (BOD)
- Ammonia (as ammonia-nitrogen)
- Non-volatile suspended solids
- Metals (i.e., lead, zinc, cadmium, iron, and manganese)
- Sulfate
- pH
- Chloride
- Nutrients
- Atrazine
- Cyanazine
- Gas supersaturation
- Fish trauma
- Sediment
- Fecal coliform

The most common impairments are high levels of mercury, volatile and non-volatile suspended solids, low dissolved oxygen, and metals (MDNR 2004a, 2006b).

Mercury is found in waters within the ROI due to atmospheric deposition. Mercury is a naturally-occurring metal that is released through processes such as the weathering of rock and soil. It also enters the environment through human activities including the combustion of fossil fuels, metal smelters, concrete manufacturing, municipal landfills, sewage, metal refining operations, and chloralkali plants (EPA 2006c). Because mercury can vaporize, it enters the atmosphere and is deposited globally in precipitation. Mercury can also be converted by microbes into its organic form, methylmercury, which can be accumulated by aquatic life. This is of significant concern because mercury, a neurological and developmental toxin (and possible carcinogen), tends to be magnified through the food chain and poses a health risk to humans who consume fish with elevated mercury levels (MDNR 2004b, EPA 2006c). Methylmercury has been found in the tissue of fish in Missouri including catfish, carp, crappie, trout, walleye, and largemouth bass. The Missouri Department of Heath and Senior Services (MDHSS) issued a statewide fish consumption advisory in 2006 due the presence of methylmercury (MDHSS 2006). Most of the mercury in fish sampled in the State comes from sources outside of Missouri via atmospheric deposition (MDNR 2006a).

The draft 2004/2006 303(d) list does not include mercury impairments. This decision to exclude mercury is based on fish sampling that indicates mercury contamination may be a statewide problem. MDNR is concerned that including only those waterbodies with available data may create a misconception that only those waters are affected (MDNR 2006a). Likewise, listing all of Missouri's waters as impaired by mercury may cause the public to feel that all fish taken from Missouri waters are unsafe to eat (MDNR 2006a). Excluding mercury from the draft 2004/2006 list is a significant factor affecting the decrease in impaired waters from 2002, as that list attributes approximately one-fifth of all impairments in the ROI to mercury.

The occurrence of volatile suspended solids, low dissolved oxygen, BOD, and ammonia impairments in the ROI can be attributed to wastewater treatment plants. Volatile suspended solids (i.e., suspended algae and sewage sludge) are harmful to aquatic life because they can settle to the bottom of streams and smother natural substrates, aquatic invertebrate animals, and fish eggs (MDNR 2004c). High organic enrichment reduces the amount of dissolved oxygen present to support aquatic life (MDNR 2004d). BOD is an indicator of this organic enrichment. Ammonia is a common by-product of wastewater treatment. In sufficient concentrations, it is toxic to fish and other aquatic species and can also remove dissolved oxygen from water (MDNR 2004d).

Mining operations and abandoned mining lands are the predominant contributors to non-volatile suspended solids, metals, sulfate, and pH impairments in the ROI. Non-volatile suspended solids and metals such as lead and zinc may enter waterways through the erosion of mine tailing piles. Non-volatile suspended solids damage aquatic habitats by smothering natural substrates (MDNR 2004e). Lead and zinc accumulate in fish and other aquatic species. Zinc is an essential nutrient to aquatic and terrestrial organisms, but can be highly toxic in excess (MDNR 2004e). Lead poses a health risk to humans that consume contaminated fish. In humans, lead primarily affects the nervous system, blood cells, and metabolism processes for Vitamin D and calcium, and can also adversely affect the developing human fetus during pregnancy (MDNR 2004e). Sulfide minerals are found in coal and surrounding rock. When these minerals are exposed to air (e.g., through mining activities), they oxidize and dissolve in water. Sulfates may also form sulfuric acid, which lowers the pH of the water. Freshwater aquatic life cannot tolerate either high levels of sulfate or acidic water (MDNR 2004f, g).

Metal impairments may also be attributed, to a lesser extent than from mining activities, to a metal smelter site in Iron County. Lead, zinc, and cadmium enter waterways via fallout from smokestack emissions, fugitive dusts, and drainage from waste piles (MDNR 2006c). These metals are all potentially toxic to aquatic life. Human overexposure to cadmium for relatively short periods of time can cause nausea, vomiting, diarrhea, muscle cramps, salivation, sensory disturbances, liver injury, convulsions, shock, and renal failure (EPA 2006d). Lifetime overexposure has the potential to damage kidney, liver, bone, and blood (EPA 2006d).

Iron and manganese are other metals listed as impairments to waters in the ROI. Although they do not pose any human health hazards, they can affect the taste and appearance of drinking water, stain dishes and clothing, and accumulate as mineral deposits in pipelines and equipment (MDNR 2005a). Iron and manganese commonly enter streams as the water flows through soil and rock that contain these minerals.

Chloride is another impairment listed in the ROI that does not pose a human health hazard but can affect the taste of drinking water. Chloride originates from natural sources, sewage and industrial effluents, and urban development. The majority of chloride in the ROI is due to urban runoff. Excessive amounts of chloride have the potential to increase rates of corrosion of the metal in distribution systems, thereby increasing metals in the water supply (World Health Organization 2003).

The presence of excessive nutrients in the ROI is primarily due to agricultural fertilizers and animal manure (MDNR 2006d). Although nutrients are a necessary component of water ecosystems, excessive amounts stimulate a rapid growth response of aquatic plants, such as algae blooms and aquatic weeds (Klapproth and Johnson 2000, U.S. Geological Survey [USGS] 2006). Algae blooms occur naturally, but with more frequency and severity in the presence of nutrients (NRCS 1994). The algae cause an increase in bacteria and other decomposers, and these deplete the dissolved oxygen supply of the water (USGS 2006). The death of large algal populations can create an unpleasant taste and odor to the water.

Atrazine and cyanazine are herbicides that have been used in Missouri to control broadleaf weeds in corn and grain sorghum. These chemicals are present in waters in the ROI due to runoff from agricultural production areas. Atrazine, considered a possible human carcinogen, is still commonly used as an herbicide (MDNR 2004h). Cyanazine, a chemical similar to atrazine that is relatively persistent in the environment, was banned from use in 1999 after being linked to adverse health effects including respiratory distress, cerebral palsy, and impaired fetal development (MDNR 2004h). Cyanazine is also classified as a possible human carcinogen (MDNR 2004h).

Gas supersaturation and fish trauma occur, although they are not common, in waters in the ROI. Truman Dam and Table Rock Dam are the primary sources of these impairments. Water that becomes supersaturated with atmospheric gases as it drops from the dam to the lake can result in fish injury or

death from gas bubble disease (MDNR 2004i). High flow conditions and very turbulent waters just below the dams can cause physical injury to fish (MDNR 2004i). These dams may also cause low dissolved oxygen content when they release deep de-oxygenated water (MDNR 2004i).

Sedimentation occurs naturally in waterways; however, excessive sedimentation impairs waterways by causing increased turbidity. Turbidity is the clarity of the water, and increased turbidity reduces the amount of light that penetrates the water. This in turn reduces photosynthesis, which is required to produce oxygen. High rates of sediment deposition in the ROI are due to streambank erosion and sheet erosion from agricultural lands (MDNR 2006e).

The presence of fecal coliform in the ROI is primarily attributed to fecal contamination by wildlife, particularly geese (MDNR 2006f). Other contributors are bacterial contamination from springs, human fecal contamination from leaking sewers and septic tanks, and livestock fecal contamination (MDNR 2006f).

3.3.2 Groundwater

3.3.2.1Description

Groundwater refers to subsurface hydrologic resources such as aquifers that are used for domestic, agricultural, and industrial purposes. The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.3.2.2Affected Environment

Groundwater resources in Missouri vary greatly across the State. For this analysis, groundwater will be described by province (i.e., an area defined by factors including groundwater quality, geology, aquifer characteristics, and aquifer boundaries). There are eight groundwater provinces in Missouri. The ROI lies within six of these provinces, two of which are north of the Missouri River and four which are south of the Missouri River (Table 8) (MDNR 2006g). Approximately 12 percent of potable groundwater in the State is located north of the Missouri River, which includes the Northeast Missouri and Northwest Missouri groundwater provinces. Thick alluvial deposits in both of these provinces can yield large volumes of good quality water and are significant sources of water for agriculture and public water supply. Bedrock aquifers in the Northeast Missouri Groundwater Province and preglacial valleys filled with glacial drift in the Northwest Missouri Groundwater Province are also important sources of potable water.

Table 8. Groundwater provinces in the ROI.

Groundwater Province	County
Northeast Missouri	Adair, Audrain, Boone, Callaway, Howard, Knox, Macon, Marion, Monroe, Montgomery, Pike, Ralls, Randolph, Schuyler, Scotland, Shelby
Northwest Missouri	Andrew, Caldwell, Chariton, Clay, Clinton, Daviess, DeKalb, Gentry, Grundy, Harrison, Linn, Mercer, Nodaway, Putnam, Sullivan
Salem Plateau	Barry, Benton, Butler, Carter, Crawford, Dallas, Dent, Franklin, Gasconade, Greene, Henry, Hickory, Iron, Jefferson, Maries, Osage, Perry, Pettis, Phelps, Polk, Pulaski, Reynolds, St. Clair, St. Francois, St. Louis, Ste. Genevieve, Shannon, Stone, Taney, Texas, Washington, Wayne, Webster
Springfield Plateau	Barry, Barton, Bates, Benton, Cedar, Christian, Dade, Douglas, Greene, Henry, Hickory, Jasper, Jefferson, Johnson, Lawrence, Newton, Pettis, Polk, St. Clair, St. Louis, Stone, Taney, Vernon, Webster

Groundwater Province	County
West-Central Missouri	Barton, Bates, Cass, Henry, Jackson, Johnson, Lafayette, St. Clair, Vernon
St. Francois Mountains	Iron, Madison, Reynolds, St. Francois, Ste. Genevieve, Washington, Wayne
Table source: MDNR 2006g	

Groundwater provinces south of the Missouri River include the Salem Plateau, Springfield Plateau, West-Central Missouri, and St. Francois Mountains groundwater provinces (MDNR 2006g). The Salem Plateau Groundwater Province supplies about 46.6 percent of the Missouri's potable groundwater and contains the largest and most extensive groundwater resources in the State. Most of the communities and essentially all of the rural residents in this province rely on groundwater.

The Springfield Plateau Groundwater Province contains approximately 24.5 percent of usable groundwater in Missouri and is extensively used as a private water supply source in that region (MDNR 2006g). Groundwater quality in the Salem Plateau and Springfield Plateau groundwater provinces are generally very good; however, the geology of these areas make the groundwater especially susceptible to contamination. The weathering of bedrock creates pathways for rapid groundwater recharge, so proper land use and waste disposal practices in these regions must be carefully monitored.

The West-Central Missouri Groundwater Province contains about 0.24 percent of groundwater resources in the State (MDNR 2006g). Potable groundwater in this region is typically difficult to obtain and the water quality is marginal.

The St. Francois Mountains Groundwater Province is one of the most difficult areas within the State to develop groundwater supplies (MDNR 2006g). The geology is predominantly igneous rock, which is nearly impermeable except where fractured. There are a few minor areas in the province that are composed of sedimentary rock and able to provide modest yields to private wells.

3.3.3 Wetlands

3.3.3.1Description

Wetlands are defined by the U.S. Army Corps of Engineers (USACE) as areas that are characterized by a prevalence of vegetation adapted to saturated soil conditions. Wetlands can be associated with surface water or groundwater and are identified based on specific soil, hydrology, and vegetation. The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.3.3.2Affected Environment

The 1987 USACE Wetland Delineation Manual (USACE 1987) provides guidelines to identify and delineate wetlands. For regulatory purposes under the *Clean Water Act*, wetlands are defined as:

> "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." (33 CFR part 328.3, 2006)

At one time, there were approximately 4.5 million acres of wetlands in Missouri (NRCS 1999). Most of these wetlands have been converted to agricultural cropland, drained and filled for municipal expansion,

or degraded due to channelization. As a result, only 13 percent of historic wetlands remain today (NRCS 1999).

There are eight types of wetlands in Missouri that may also occur in the ROI. These are marshes, sinkhole ponds, shrub swamps, bottomland forests, oxbow lakes and sloughs, riparian areas, bottomland prairies, and groundwater seeps (MDNR 2005b).

3.3.4 Floodplains

3.3.4.1Description

In this analysis, floodplains are defined as 100-year floodplains, which are designated by the Federal Emergency Management Agency (FEMA) as those low-lying areas that are subject to inundation by a 100-year flood (i.e., a flood that has a 1 percent chance of being equaled or exceeded in any given year). The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.3.4.2Affected Environment

In general, a floodplain can be defined as a flat area located adjacent to a stream channel that provides natural storage for water overflow during or after a storm event. EO 11988, *Floodplain Management*, requires that Federal agencies:

> "…take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains..." (42 FR 26951, 1979)

Riparian land may be enrolled under the Missouri CREP agreement, so it is expected that some of the eligible land would be located within floodplains. In addition, land must be located within a 100-year floodplain to be eligible for CP31 (Bottomland Timber Establishment on Wetlands). Floodplain type (e.g., 100-year floodplain) cannot be determined without an exact site location and a FEMA floodplain map; therefore, site specific evaluations would be conducted prior to enrollment into CREP to determine if the site is within a 100-year floodplain.

3.4 Soil Resources

3.4.1 Topography

3.4.1.1Description

Topography is the general configuration of a land surface, including relationships between position and relief of natural and anthropogenic features. For the purposes of this analysis, topography is described by physiographic province. A physiographic province is a region with distinctive geographical features, such as mountain ridges or lowlands. The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.4.1.2Affected Environment

The three major physiographic provinces in Missouri are the Central Lowland, the Ozark Plateaus, and the Mississippi Alluvial Plain (National Park Service [NPS] 2000, Hauck and Harris 2006). The Central Lowland encompasses the north and west portions of the State and the Ozark Plateaus cover the south portion of the State. The Mississippi Alluvial Plain, located in the extreme southeast corner of Missouri, is outside of the ROI.

The Central Lowlands consist of gentle rolling hills with wide valleys incised by rivers. The topography was shaped by glaciers that stretched south to the Missouri River. Elevations in this region range between 450 and 1,000 feet above sea level. The Ozark Plateaus are characterized by deep, narrow valleys separated by sharp ridges, with elevations between 1,000 and 1,600 feet above sea level.

Sinkholes are important features of Missouri topography. A sinkhole is a depressed area that is usually formed when carbonate rocks just below the land surface dissolve over time by slightly acidic groundwater, or when underlying caves collapse. They can range in size from several square feet to hundreds of acres horizontally, and can extend for hundreds of feet vertically (Van Dyke 2003). Sinkholes can collapse, presenting a significant hazard if the collapse occurs in a developed area. Human activities, such as those that alter natural hydrologic conditions, can trigger sinkhole collapses. Sinkholes are known to occur in the following 38 counties within the ROI (MDNR 2006h):

- Barry
- Benton
- Carter
- Cedar
- Christian
- Crawford
- Dade
- Dallas
- Dent
- Franklin
- Gasconade
- Greene
- Henry
- Hickory
- Iron
- Jefferson
- Lawrence
- Madison
- Maries
- Marion
- Newton
- Osage
- Perry
- Phelps
- Polk
- Pulaski
- Ralls
- Reynolds
- St. Clair
- St. Francois
- St. Louis
- Shelby
- Stone
- Taney
- Texas
- Washington
- Wayne
- Webster

3.4.2 Soil

3.4.2.1Description

Generally speaking, soil is the unconsolidated mineral or organic material found on the land surface capable of supporting plant growth. Soils are classified based on the physical and chemical properties of their horizons[3]. For this analysis, soils are described by ecological subregion as defined in Section 3.1.2.2 (Figure 2, Table 9) (Chapman et al. 2001, University of Idaho 2006). The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.4.2.2Affected Environment

Soils in the ROI include alfisols, ultisols, mollisols, inceptisols, and entisols. Alfisols are relatively fertile and tend to be very productive for both agriculture and silviculture. Alfisols are common to every subregion within the ROI.

Table 9. Common soils in the ecological subregions of the ROI.

Subregion	County	Order	Common Soil Series
Black River Hills Border	Butler, Carter, Wayne	Alfisols, Ultisols	Captina, Clarksville, Wilderness
Central Plateau	Crawford, Dallas, Dent, Franklin, Gasconade, Greene, Hickory,	Alfisols, Mollisols,	Agnos, Arkana, Captina, Clarksville, Doniphan, Gassville,

[3] A soil horizon is a layer of soil that can be distinguished from adjacent layers based on characteristics such as texture, color, chemical composition, etc.

Subregion	County	Order	Common Soil Series
	Maries, Osage, Phelps, Polk, Reynolds, Texas, Webster	Ultisols	Gepp, Goss, Lebanon, Moko, Union, Viraton
Cherokee Plains	Barton, Bates, Benton, Cedar, Dade, Henry, Pettis, St. Clair, Vernon	Alfisols, Inceptisols, Mollisols, Ultisols	Barco, Barden, Bolivar, Collinsville, Dennis, Hector, Mandeville, Parsons
Claypan Prairie	Adair, Audrain, Boone, Callaway, Knox, Macon, Marion, Monroe, Montgomery, Pike, Ralls, Randolph, Schuyler, Shelby	Alfisols	Armstrong, Leonard, Lindley, Mexico, Putnam
Current River Hills	Butler, Carter, Dent, Iron, Reynolds, Shannon, Texas, Wayne	Alfisols, Ultisols	Captina, Clarksville, Doniphan, Gepp, Goss, Macedonia, Tonti
Eastern Ozark Border	Franklin, Jefferson, Perry, St. Francois, St. Louis, Ste. Genevieve	Alfisols, Ultisols	Bucklick, Caneyville, Gatewood, Goss, Hildebrecht, Jonca, Lily, Loring, Minnith, Poyner, Weingarten
Loess Flats and Till Plains	Adair, Caldwell, Chariton, Clay, Clinton, Daviess, DeKalb, Gentry, Grundy, Harrison, Howard, Linn, Macon, Marion, Mercer, Putnam, Randolph, Schuyler, Scotland, Shelby, Sullivan	Alfisols, Mollisols	Adair, Armster, Armstrong, Gara, Goss, Grundy, Kilwinning, Lagonda, Lamoni, Pershing, Shelby, Snead
Meramec River Hills	Crawford, Dent, Franklin, Iron, Jefferson, Phelps, Reynolds, St. Francois, Washington	Alfisols, Ultisols	Captina, Coulstone, Doniphan, Goss, Hobson, Reuter, Wilderness
Osage/Gasconade Hills	Benton, Cedar, Franklin, Gasconade, Henry, Hickory, Maries, Osage, Phelps, Polk, Pulaski, St. Clair, Texas	Alfisols, Mollisols, Ultisols	Bardley, Bucklick, Caneyville, Captina, Clarksville, Doniphan, Gasconade, Gatewood, Goss, Niangua
Pleistocene Valley Trains	Butler	Alfisols, Entisols, Mollisols	Clana, Dubbs, Dundee, Gideon, Lilbourn, Maldin, Sharkey, Sikeston, Wardell
River Hills	Audrain, Franklin, Howard, Marion, Monroe, Montgomery, Perry, Pike, Ralls, Shelby, St. Louis	Alfisols, Inceptisols, Mollisols	Bardley, Cedargap, Gasconade, Goss, Hatton, Haymond, Keswick, Lindley, Menfro, Winfield
Rolling Loess Prairies	Andrew, Clay, Lafayette, Nodaway	Alfisols, Mollisols	Colo, Exira, Higginsville, Knox, Marshall, Sharpsburg, Shelby, Sibley
Springfield Plateau	Barry, Benton, Cedar, Christian, Dade, Douglas, Greene, Hickory, Jasper, Lawrence, Newton, Polk, St. Clair, Stone, Webster	Alfisols, Inceptisols, Ultisols	Bolivar, Clarksville, Creldon, Doniphan, Goss, Hector, Hoberg, Keeno, Scholten, Tonti, Viraton, Wilderness
St. Francois Knobs	Iron, Madison, Reynolds, St.	Alfisols,	Bucklick, Captina, Clarksville,

Subregion	County	Order	Common Soil Series
and Basins	Francois, Ste. Genevieve, Washington, Wayne	Ultisols	Crider, Delassus, Fourche, Irondale, Killarney, Syenite, Wilderness
White River Hills	Barry, Christian, Douglas, Stone, Taney, Texas, Webster	Alfisols, Mollisols, Ultisols	Arkana, Bardley, Captina, Clarksville, Doniphan, Gassville, Mano, Moko, Nixa, Ocie
Wooded Osage Plains	Bates, Benton, Cass, Henry, Jackson, Johnson, Lafayette, Pettis, Vernon	Alfisols, Entisols, Mollisols	Deepwater, Dockery, Greenton, Hartwell, Kenoma, Pershing, Polo, Sampsel, Snead
Table source: Chapman et al. 2001			

Ultisols are the second most common soil to the ROI, occurring in 10 of the 16 subregions (Table 9). Ultisols are strongly leached and acidic soils with relatively low native fertility. Clays accumulate in the subsurface horizon and soils often display a strong yellowish or reddish color resulting from the presence of iron oxides.

Mollisols, also common to the ROI, can be found in nine of the subregions (Table 9). This soil is typical of grassland ecosystems and is characterized by a thick, dark surface horizon. Mollisols are rich in organic materials and thus very productive agriculturally.

Less widespread in the ROI are inceptisols and entisols. Inceptisols exhibit minimal horizon development and can occur in a wide range of ecological settings. They occur in the Cherokee Plains, the River Hills, and the Springfield Plateau subregions. Entisols, found in the Pleistocene Valley Trains and Wooded Osage Plains, are very diverse. They develop in unconsolidated parent material and usually lack genetic horizons except an A horizon.

3.5 Air

3.5.1 Description

Although the *Clean Air Act* (42 USC parts 7401 et seq., 1999) is a Federal law, States are generally responsible for implementing the Act. Each State is required by EPA to develop a State Implementation Plan that contains strategies to achieve and maintain National Ambient Air Quality Standards (NAAQS). NAAQS establish limits for six criteria pollutants: ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, lead, and particulate matter (PM). Areas that violate air quality standards are designated as non-attainment areas for the relevant pollutants. Areas that comply with air quality standards are designated as attainment areas for relevant pollutants.

The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.5.2 Affected Environment

MDNR is responsible for ensuring that the air quality within Missouri meets or is better than the levels required by Federal and State standards. MDNR operates an air quality network to ensure that the air within the State meets NAAQS. This network consists of 100 air monitoring instruments at 33 sites throughout the State that monitor the air for ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, lead, PM_{10} (PM less than 10 microns in diameter), and $PM_{2.5}$ (PM less than 2.5 microns in diameter) (MDNR 2006i). Several of the monitoring sites are located within the ROI (Table 10).

In 2006, areas surrounding the city of St. Louis were cited as non-attainment areas for ozone, lead, and $PM_{2.5}$ (EPA 2006e). These pollutants reached into the counties of Franklin, Jefferson, St. Louis, and St. Charles. There are currently no other non-attainment areas within the State (EPA 2006e).

Table 10. Air quality monitoring sites in the ROI.

Pollutant Monitored	Location of Monitoring Site (By County)
Ammonia	Mercer, Sullivan
Carbon Monoxide	Greene
Hydrogen Sulfide	Mercer
Lead	Iron
Nitrogen Dioxide	Cedar, Greene, St. Francois
Ozone	Cedar, Greene, Monroe, St. Francois, St. Louis
$PM_{2.5}$	Cedar, Greene, Maries, Monroe, St. Francois, St. Louis
PM_{10}	Greene, Monroe
Sulfur Dioxide	Greene, Iron, Monroe
Table source: MDNR 2006j	

3.6 Recreation

3.6.1 Description

Recreational resources are those activities or settings, natural or anthropogenic, designated or available for recreational use by the public. In this analysis, recreational resources include lands and waters used by the public for hunting, fishing, wildlife viewing, hiking, canoeing, and other water-related activities. The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.6.2 Affected Environment

There are numerous lands available for recreational use throughout Missouri including 12 national parks, 49 State parks, 34 historic sites, 168 natural areas, 10 national wildlife refuges, and 1 national fish hatchery. The ROI includes portions of 79 of 114 counties in Missouri, so it is expected that a significant number of these recreational areas may be located within or in close proximity to the ROI.

Lands eligible for enrollment in CREP must be privately held, and the majority of recreational areas in Missouri are on public lands. There are some areas located on privately owned land (e.g., natural areas but these lands are typically protected to preserve their biological, geological, cultural, aesthetic, or historic values.

3.7 Human Health and Safety

3.7.1 Description

Human health and safety analyses can include an extensive array of issues. There are two issues that are significant and considered in detail in this analysis, the first of which is water pollution. Clean water is essential for human health and safety. As pollution levels rise, the risk to human health and safety increases. Illness can occur from coming in contact with polluted water, consuming polluted water, or

consuming wildlife that utilizes polluted water sources. The second issue is health and safety effects to agricultural workers performing pesticide application. Pesticides can pose serious consequences to exposed individuals, ranging from increased breathing rates to cancers. The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.7.2 Affected Environment

Water quality in the ROI has been adversely impacted by activities including mining operations, wastewater treatment, and agricultural production. Waterbodies throughout Missouri have been designated by the State and EPA as impaired due to excessive pollutants (Section 3.3), including several pollutants that have the potential to harm human health and safety. Those most at risk are individuals who use impaired waters for recreation (e.g., swimming), who consume fish from polluted waters, or who use polluted drinking water supplies.

Pollutants present in waterbodies of the ROI that pose a direct risk to human health and safety include mercury, lead, fecal coliform, and pesticides. Mercury is a neurological and developmental toxin and considered as a possible carcinogen (MDNR 2004b, EPA 2006c). Lead primarily affects the nervous system, blood cells, and metabolism processes, and can harm fetus development (MDNR 2004h). Both of these metals may accumulate in fish, posing a significant health risk to humans who consume contaminated fish. Fecal coliform indicate the presence of pathogens (e.g., bacteria, viruses, or parasites) which may cause illness in humans. Effects can range from gastrointestinal upset to severe illness such as septicemia or pneumonia in sensitive populations (Pontius 2002).

Atrazine, cyanazine, and glyphosate are pesticides used to control broadleaf weeds and grasses. Cyanazine was banned from use in 1999 due to adverse health effects linked with its use; however, it persists in the environment and is considered as a possible human carcinogen (MDNR 2004e). Atrazine and glyphosate are still commonly used as herbicides. Overexposure to atrazine for relatively short periods of time can cause congestion of heart, lungs and kidneys; low blood pressure; muscle spasms; weight loss; and damage to adrenal glands (EPA 2006d). Lifetime overexposure can result in weight loss, cardiovascular damage, retinal and some muscle degeneration, and cancer (EPA 2006d). Overexposure to glyphosate can cause congestion of the lungs and increased breathing rates in the short term, and kidney damage and reproductive effects in the long term (EPA 2006d).

3.8 Socioeconomics

3.8.1 Description

Socioeconomic analyses generally include investigations of population, income, employment, and housing conditions of a specific area. Socioeconomic issues that are significant and considered in detail in this analysis are non-farm and farm employment and income, farm production expenses and returns, agricultural land use, and recreation spending in the ROI. The ROI for this resource analysis includes the 79 counties identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.8.2 Affected Environment

The total population within the ROI was 4,073,027 people in 2000, which was a 9.9 percent increase from the population of 1990 (USCB 1990, 2000a). Approximately 70.4 percent of the total population was located in urban areas, with the other 29.6 percent in rural areas (USCB 2000a). These numbers changed by less than 1 percent from the 1990 values (USCB 1990).

3.8.2.1.1 Non-Farm Employment and Income

Between 1993 and 2002, the non-farm labor force within the ROI ranged from 1,944,501 in 1994 to 2,195,196 in 2001 (Bureau of Labor Statistics [BLS] 2006). Non-farm employment also ranged during this period from a low of 1,883,793 positions in 1993 to a high of 2,111,581 positions in 2000 (BLS 2006). The unemployment rate within the ROI varied from a high of 7.3 percent in 1993 to a low of 3.6 percent in 1999 (BLS 2006). Within the ROI, Wayne County has experienced the highest average non-farm unemployment rate for the period (12.4 percent), with the highest rate occurring in 1994 (22.4 percent) (BLS 2006).

Median household income in 1999 ranged significantly within the ROI. The highest median household income in the ROI was $50,532 in St. Louis County, and the lowest median household income was $20,878 in Shannon County (USCB 2000b).

3.8.2.1.2 Farm Employment and Income

As reported by the *2002 Census of Agriculture* (USDA 2004), there were 44,506 farm workers on 15,170 of the 77,248 farms within the ROI in 2002, accounting for a payroll of $175 million. In 1997, the total hired farm and contract labor costs were $146 million, which was 5.2 percent of total production costs. In 2002, the total hired farm and contract labor costs were $200 million, which was 6.6 percent of total production costs. Table G–1 of Appendix G lists the hired farm and contract labor costs per county within the ROI and labor costs as a percentage of total production costs.

Approximately half of farm cash receipts in Missouri are from livestock and livestock products (53 percent), while crops account for the other half (47 percent) (USDA 2006a). Missouri ranked second in the U.S. for hay (excluding alfalfa) and several livestock and livestock products including cattle operations in 2005 (USDA 2006b). The Bureau of Economic Analysis (BEA) (2006) reported a realized net farm income deficit of $124 million within the ROI in 2002. This was a decrease of 163.6 percent as compared to the 1992 net farm income. BEA (2006) also reported that total government payments to farms within the ROI were $251 million in 2002, an increase of 11.9 percent from 1992. Farm wages and perquisites in 2002 in the ROI were $156 million, which was a 15.4 increase from those in 1992. These costs were a significant contributor to the 104.6 percent reduction in net farm proprietors' income within the ROI from 1992.

3.8.2.1.3 Farm Production Expenses and Returns

In 2002, farm production expenses exceeded $3.51 billion within the ROI (BEA 2006). This was a decrease over the 1992 figure of $3.74 billion (adjusted to 2002 dollars) (BEA 2006). The average cost per acre within the ROI in 2002 was $141.36 (USDA 2004). This figure includes the cost per acre of $18.71 for agricultural chemicals inputs such as fertilizers and lime (USDA 2004). Average net cash return per farm within the ROI was $5,567 in 2002 (USDA 2004). The average net cash receipts per acre within the ROI in 2002 were $19.74 (USDA 2004). Table G–2 of Appendix G lists the average farm production expenses and return per dollar of expenditure in 2002 for each county in the ROI. The average value of land and buildings per farm in the ROI in 2002 was $401,802 and the average value of machinery and equipment per farm was $45,671. Values for each county in the ROI are provided in Table G–3 of Appendix G.

3.8.2.1.4 Agricultural Land Use

In 2002, there were 17,154,180 acres of land in the ROI in farms including cropland, pastureland and rangeland, and house lots, etc. (USDA 2004). This was an increase of less than 1 percent from 1997. Table 11 provides a list of the acreage for different agricultural land uses in the ROI in 1997 and 2002 and the percent change during that period.

In 1997, there were 1,625,624 acres in Missouri enrolled in either CRP or the Wetlands Reserve Program (WRP) (USDA 2004). Of that amount, 1,280,907 acres were located within the ROI. Five years later (in 2002), enrollment had decreased statewide to 1,418,874 acres, with a corresponding decrease in the ROI to 1,096,605 acres. As of August 2006, a total of 1,589,679 acres in Missouri were enrolled in CRP (FSA 2006). The average value of Missouri cropland in 2005 was estimated at $1,890 per acre (USDA 2006a).

Table 11. Agricultural land uses in 1997 to 2002 in the ROI and the percent change experienced during that period.

Land Use	Acres in 1997	Acres in 2002	Percent Change
Cropland [1]	13,122,134	12,483,720	-4.9
Pastureland and rangeland [2]	2,952,154	3,697,466	25.2
House lots, ponds, roads, wasteland, etc.	1,026,249	972,994	-5.2
CRP and WRP [3]	1,280,907	1,096,605	-14.4
Total Land in Farms [4]	17,100,537	17,154,180	0.3

Table source: USDA 2004

[1] Cropland includes all harvested cropland, cropland used for pasture or grazing, and other cropland.

[2] Pastureland and rangeland exclude cropland and wooded pastureland.

[3] Operations with land enrolled in CRP or WRP are counted as farms if they received $1,000 or more in government payments. Acreage from Pulaski and Shannon counties in 2002 and Taney County in 1997 withheld to avoid disclosing data for individual farms.

[4] Total land in farms is the sum of cropland, pastureland and rangeland, and house lots, etc.

3.8.2.1.5 Recreation Spending

According to the *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (NSFHWAR) (FWS and USCB 2001), more than 1.4 million individuals over the age of 16 participated in fishing and hunting-related activities in Missouri in 2001. In the same year, 1.8 million individuals participated in some sort of wildlife viewing (e.g. observing, photographing, or feeding wildlife).

Missouri waterways lured 1.2 million anglers to the State in 2001 for fishing related activities. Of this 1.2 million, 942,000 were State residents, and 272,000 were non-residents (FWS and USCB 2001). According to the NSFHWAR, total fishing related expenditures in 2001 were in the range of $746 million from resident and non-resident anglers. Of this amount, approximately $318 million was spent on trip-related expenditures, such as lodging, food, and transportation; while $396 million went to equipment expenditures, such as rods, reels, and fishing line. The remaining $32 million went to other related costs of angling, such as permits, licenses, and membership dues. The 2001 survey data indicates that the number of anglers living in and entering the State for fishing activities increased from the 1996 survey by roughly 6,000 individuals. Responses to the 2001 survey indicated that the most popular species among anglers were black bass, crappie, and sauger (FWS and USCB 2001).

Missouri resident and non-resident hunters totaled 489,000 in the 2001 survey. Residents accounted for 405,000 of those individuals; with non-residents accounted for 84,000 individuals. Hunting related expenditures contributed revenue of $425 million dollars to the State. Of this amount, trip-related expenses totaled $107 million, while equipment related expenses totaled $236 million. Other related hunting expenses contributed to $82 million of the total revenue. Comparison of the 1996 survey to the 2001 survey indicates a drop in hunters within or entering the State, with a difference of approximately

63,000 individuals. Responses to the 2001 survey suggest that there is a preference for hunting big game species. Survey results show that approximately 423,000 hunters preferred to hunt big game, 165,000 hunted small game, and 69,000 hunted migratory birds (some individuals hunted in more than one category)(FWS and USCB 2001).

According to the 2001 survey, wildlife-viewing activities in Missouri were enjoyed by roughly 2.5 million individuals. These activities generated revenue of $449 million dollars in Missouri in 2001. Trip-related expenses, such as transportation, food, and lodging, amounted to approximately $157 million; while equipment-related expenses, such as film, binoculars, and cameras, amounted to $276 million. Donations, contributions, memberships, and other related expenses contributed the remaining $16 million (FWS and USCB 2001).

3.9 Environmental Justice

3.9.1 Description

Populations of special concern are identified and analyzed for environmental justice impacts. EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires that Federal agencies:

> "…make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations...." (59 FR 32, 1995)

Race and ethnicity are two distinct categories of minority populations. A minority population can be described by either category, or by a combination of the two. Race as defined by the U.S. Census Bureau (USCB) includes White, Black or African American, American Indian or Alaskan Native, Asian, and Native Hawaiian or Other Pacific Islander (USCB 2001). Ethnicity is defined as either being of Hispanic or Latino origin and any race, or not of Hispanic or Latino origin and any race (USCB 2001). Hispanic or Latino origin is further defined as "a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race" (USCB 2001). A minority population can be described as being composed of a minority group and exceeding 50 percent of the population in an area, or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population (CEQ 1997a).

National poverty thresholds are measured in terms of household income and are dependent upon the number of persons within the household. Individuals falling below the poverty threshold are considered low-income individuals. USCB census tracts where at least 20 percent of the residents are considered poor are known as *poverty areas*. When the percentage of residents considered poor is greater than 40 percent, the census tract is considered an *extreme poverty area* (USCB 1995).

The ROI for this resource analysis includes the 79 counties identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.9.2 Affected Environment

As reported by USCB for year 2000 (2000a), demographics for the ROI population were 86 percent White, 10 percent Black or African American, less than 1 percent American Indian or Alaska Native, 1 percent Asian, less than 1 percent Native Hawaiian or Pacific Islander, and 2 percent all other races or combination of races. Hispanic or Latino of any race accounted for approximately 2 percent of the population. The ROI is not a location of a concentrated minority population.

The average individual poverty rate for the ROI in 1999 was 14.2 percent and varied from a high of 26.9 percent in Shannon County to a low of 5.5 percent in Clay County (USCB 2000b). The ROI would not be considered a poverty area because less than 20 percent of the residents overall are considered poor.

In 2002, Blacks or African Americans operated 191 farms within the ROI; American Indians or Alaskan Natives operated 490 farms; Asians operated 87 farms; Native Hawaiians or Pacific Islanders operated 26 farms; Spanish, Hispanic, or Latino persons operated 652 farms; and 380 farms were operated by persons reporting more than one race (USDA 2004). The ROI accounts for 72.8 percent of all minority-operated farms within Missouri, while these 1,826 farms account for less than 3 percent of the total number of farms within the ROI (USDA 2004).

3.10 Other Protected Resources

3.10.1 National Natural Landmark

3.10.1.1 Description

A national natural landmark (NNL) is an area designated by the Secretary of the Interior as being of national significance because it is an outstanding example of major biological and geological features found within the boundaries of the U.S. (36 CFR parts 62.1–62.9, 2006). The ROI for this resource analysis includes the 79 counties identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.10.1.2 Affected Environment

There are four NNLs in the ROI: Onondaga Cave, Taberville Prairie, Maramec Springs, and Marvel Cave (MDC 2006d, NPS 2006). Onondaga Cave and Taberville Prairie are both owned by the State and were designated as NNLs in 1980 and 1975, respectively. Onondaga Cave, located in Crawford County near the town of Leasburg, contains unusually large and varied cave formations. Taberville Prairie, just north of Taberville in St. Clair County, is one of the largest remaining tallgrass prairies.

Maramec Springs and Marvel Cave are privately owned. Maramec Springs is one of the largest springs in the Missouri Ozarks and was used as a source of water power for ironworks from 1826 to 1877. It is located just west of St. James in Phelps County and was designated as a NNL in 1971. Marvel Cave, near Branson in Stone County, is the deepest cave in Missouri. It was designated as a NNL in 1972.

3.10.2 Wilderness

3.10.2.1 Description

A wilderness area is federally owned land that has been designated by Congress for inclusion in the National Wilderness Preservation System under the *Wilderness Act of 1964* (16 USC parts 1131 et seq., 1964). As defined by this Act, wilderness is "…an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." Each designated wilderness area is protected and managed to preserve its natural conditions, without permanent improvements or human habitation. The ROI for this resource analysis includes those portions of watersheds identified in Section 1.3 that encompass the 40,000 acres proposed for enrollment in CREP.

3.10.2.2 Affected Environment

There are three designated wilderness areas in the ROI, all located within the Mark Twain National Forest and managed by FS (Wilderness.net 2006). Bell Mountain Wilderness was designated by Congress in 1980. This area contains 8,987 acres in Iron County. Piney Creek Wilderness, also designated in 1980,

encompasses 8,142 acres along the border of Stone and Barry counties. Paddy Creek Wilderness contains 7,019 acres in Texas County and was designated in 1983.

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter discloses the potential environmental consequences or impacts to resources described in Chapter 3 that may result from implementing the preferred alternative or no action alternative. As this analysis is programmatic and not site specific, resource impacts may not always be quantifiable. In compliance with guidelines contained in NEPA and CEQ regulations, each individual CREP agreement would require a site specific environmental evaluation to be completed by FSA.

4.1 Biological Resources

4.1.1 Wildlife and Fisheries

4.1.1.1Level of Impact

Significant impacts to wildlife and fisheries would include those actions that resulted in harming, harassing, or reducing those populations to the point they become imperiled or populations of concern, or reducing or adversely altering their habitat.

4.1.1.2Alternative A—Preferred

Implementation of the preferred alternative would result in long-term, beneficial impacts to both wildlife and fisheries within the ROI. Agricultural practices, both current and historical, have limited wildlife and fisheries populations within this area, displaced some species, and degraded and fragmented habitat. Removing acreage from agricultural production and implementing the proposed CPs would increase the quality and quantity of wildlife and fisheries habitat. During the implementation phase, temporary adverse impacts may occur due to human disturbance and increased sedimentation; however, the use of best management practices (BMPs) would ensure these impacts are negligible.

4.1.1.2.1 Wildlife

Though all of the proposed CPs would create and restore wildlife habitat, CP2, CP4D, CP10, CP22, CP23, CP29, and CP33 would most benefit avian and terrestrial wildlife species within the ROI. Implementation of CP2 (Establishment of Permanent Native Grasses) and CP10 (Vegetative Cover, Grass, Already Established) would benefit species such as quail, deer, rabbit, turkey, small mammals, and migratory song birds by offering food, nesting areas, and protective cover. Establishing and restoring native grasses would also benefit predators such as fox, coyote, and raptors by causing an influx of small mammals to these areas.

Implementation of CP2 and CP10 would benefit grassland nesting bird species such as dickcissels, Henslow's sparrow, horned larks, vesper sparrows, bobolinks, and grasshopper sparrows, which are declining significantly due to the loss and degradation of grassland habitat. The encroachment of woody vegetation on grasslands reduces habitat suitability by increasing predation and brood parasitism. Research indicates that predation and brood parasitism on grassland nesting species can be reduced by increasing the distance between grassland habitat and forest edge. One study reported that nests located less than 60 meters from forest edge were less successful than those located more than 60 meters from the edge (Burger et al. 1994). Other studies found that increased predation occurred at less than 50 meters from the forest edge (Gates and Gysel 1978, Winter et al. 2000). Therefore, if grassland nesting species are of concern to landowners participating in CREP, woody vegetation should not be planted adjacent to grasslands or areas where large tracts of grasses and legumes are to be established.

The establishment of permanent wildlife habitat (CP4D) may include the planting of grasses, legumes, forbs, shrubs, and trees. This vegetation would provide food, nesting areas, thermal cover, and protective cover for species of upland wildlife. Planting a variety of oak species would benefit deer,

turkey, and squirrels; while planting legumes would benefit quail, rabbits, and songbirds, as well as deer and turkey.

Implementation of CP22 (Riparian Buffer) and CP29 (Marginal Pastureland Wildlife Habitat Buffer) would benefit wildlife within the ROI by creating habitat and reducing fragmented habitat. Buffers would establish vegetation adjacent to water sources often frequented by resident and migratory wildlife, offering these species cover from predation and thermal cover in adverse weather. Woody vegetation would provide food, cover, and travel corridors for resident wildlife. Buffers 35–180 feet wide may be connected to pre-existing vegetation, such as windbreaks or shelterbelts, to maximize local forest habitat for wildlife (FSA 2003b). Riparian buffers could be planted in specific patterns and with vegetation types to benefit resident wildlife.

Wetland restoration (CP23) would restore the values and functions associated with wetland ecosystems. Wetlands are an important habitat component for waterfowl, shorebirds, and furbearing mammals. Millions of waterfowl use wetland areas for nesting, feeding, and brood rearing areas. Likewise, shorebirds such as yellowlegs, sandpipers, and dowitchers use shallow wetland areas for feeding and wading. Furbearing animals also thrive in wetland areas; particularly muskrats and beavers, which both feed on aquatic plants (Bowmaster and Young 2001).

CP33 (Habitat Buffers for Upland Birds) would benefit upland bird species such as bobwhite quail, wild turkey, pheasants, and ruffed grouse. Buffers would be located on edges of crop fields, allowing for protective cover during foraging. Habitat buffers provide valuable nesting, brood rearing, and escape corridors for upland birds. Diverse vegetation within the buffer would produce seeds and insects for food sources. Habitat buffers may also be utilized by species other than upland birds, including the white-tailed deer, squirrels, foxes, and coyotes. These species, as well as upland birds, could use these buffer areas as protective travel corridors between daily and seasonal habitats.

4.1.1.2.2 Fisheries

The preferred alternative would restore and enhance habitat for aquatic species by establishing vegetation to reduce sediment runoff. High sedimentation contributes to turbidity, which interferes with daily fish activities and the hatch of aquatic insects. Sediments suspended in turbid water can absorb sunlight, causing water temperatures to rise and reducing the ability of the water to hold dissolved oxygen. Therefore, reducing sediment runoff would decrease turbidity and water temperature and increase dissolved oxygen content. This would have a beneficial impact to the majority of freshwater species within the ROI that rely on clear, cold streams.

Establishing vegetation would also provide benefits to fisheries by reducing nutrient and pollutant runoff. High nutrient loading causes an excessive and rapid growth of aquatic plants, resulting in a decline in dissolved oxygen content of the water. Pollutants that enter waterways have a direct adverse impact to aquatic species.

Once they mature, riparian buffers would create an overstory canopy that would shade the waterway. This would allow the water to stay cooler and hold more dissolved oxygen. Eventually, downed and decaying trees from the buffers would provide detritus such as limbs, leaves, fruit, and insects from overhanging and submerged vegetation. Detritus can contribute as much as 75 percent of the organic food base in small streams (Welsh 1991). Submerged and downed vegetation would create pools, riffles, and gravel beds suitable for aquatic species habitat and spawning areas.

4.1.1.3Alternative B—No Action

Under the no action alternative, lands eligible for CREP enrollment would remain in agricultural production. Wildlife and fisheries habitat would continue to decline in quality and abundance and become more fragmented. Species would continue to be exposed to degraded water quality and harmful pollutants.

4.1.2 Vegetation

4.1.2.1Level of Impact

Significant impacts to vegetation would include those actions that resulted in removing or choking out unique or imperiled vegetation, or introducing vegetation that is invasive.

4.1.2.2Alternative A—Preferred

Implementation of the proposed CPs would result in a beneficial impact to vegetation resources within the ROI. CPs would enhance existing vegetation and restore vegetation that has been altered due to agricultural practices. Every CP proposed for the CREP agreement would involve planting some sort of vegetation—grasses, legumes, forbs, shrubs, trees— in areas otherwise devoid of vegetation.

4.1.2.3Alternative B—No Action

Under the no action alternative, the proposed CPs would not be implemented to enhance or restore vegetation. Lands eligible for enrollment would remain in agricultural production and native vegetation would continue to be removed for agricultural purposes.

4.1.3 Protected Species and Habitat

4.1.3.1 Level of Impact

Significant impacts to protected species and habitat would include any action that resulted in the harassment or loss of threatened, endangered, or candidate species or their defined habitat.

4.1.3.2 Alternative A—Preferred

Of the 30 federally listed and candidate species that may inhabit the ROI, 25 would benefit from implementation of the preferred alternative. There is potential for two species to be adversely impacted without appropriate mitigations in place. Three species would not be impacted at all. The most significant impacts are described in the following discussion and summarized in Table 12.

Impact—Improved Water Quality (Decreased Pollutants)

Implementation of the proposed CPs would improve water quality within and around the ROI by reducing pollutants in runoff. All of the protected species within the ROI are adversely affected at some level by water pollution and would benefit by improved water quality. However, there are 13 protected species in the ROI that are especially sensitive to water pollution.

Fish species that are most vulnerable to the effects of water pollution are the Ozark cavefish, grotto sculpin, and Topeka shiner. Hine's emerald dragonfly is also very vulnerable to pollutants. All seven species of mussels in the ROI are sensitive to poor water quality because they are filter feeders, meaning they filter out small particles from the water for food. This leaves the mussel vulnerable to the uptake of pollutants such as pesticides, sewage, fertilizers, and heavy metals. The gray bat and Indiana bat are indirectly affected by water quality because they feed on aquatic insects, caddisflies and mayflies, which cannot tolerate poor water quality. Improved water quality would allow these species to thrive and, in

turn, provide ample forage for the gray bat and Indiana bat. Benefits to these bats would be shared with the Ozark cavefish, as this species relies on bat guano for nutrients.

Impact—Decreased Sedimentation and Turbidity

Establishing vegetation in the form of trees, grasses, shrubs, and legumes would reduce the amount of sediment entering waterways. This would benefit fourteen protected species that occur in the ROI, and may adversely impact one.

Those protected species that would benefit from less sediment in the water include the Niangua darter, Neosho madtom, and Topeka shiner; three fish species that cannot tolerate high sedimentation or turbidity. Another species is the Tumbling Creek cavesnail, which can only inhabit areas with little to no silt and turbidity. Ozark hellbender populations would also benefit because high sedimentation may smother their nesting sites and cause mass mortality of potential offspring. All seven protected mussels would benefit from reduced sedimentation and turbidity, which interfere with filter feeding activities. Sedimentation can also smother juvenile mussels, leading to less recruitment.

Implementation of the proposed CPs may also benefit decurrent false aster and *Geocarpon minimum*, but to a lesser extent that those species previously mentioned. Establishing upland vegetation would result in less overland flow. Sediment deposits can bury the seeds of these plants, smothering the seedlings. Therefore, reducing sediment deposition in upland areas where these species reside would create a direct benefit to population recruitment.

The one species that may be adversely affected by the proposed CPs is the pallid sturgeon. This species relies on turbid waters to evade predators, and the CPs are expected to reduce sedimentation and turbidity. Many of the smaller tributaries that supply fine sediments to larger rivers inhabited by the pallid sturgeon are located in areas eligible for CREP enrollment. The extent to which sedimentation and turbidity would be reduced within these larger rivers as a result of the proposed action cannot be accurately quantified. However, it is unlikely that current pallid sturgeon habitat would change significantly in the short term due to CP implementation. Monitoring would help ensure that long-term effects to pallid sturgeon are avoided.

Impact—Increased Riparian Habitat

Riparian buffers would most benefit the gray bat, Indiana bat, and the bald eagle. All of these species use riparian habitat extensively for foraging areas. FWS notes that gray bat occurrences have not been found in riparian areas devoid of vegetation (FWS 1982). Forested riparian areas are the main foraging habitat of Indiana bats. Bald eagles are a riparian dependant species that use these areas for foraging and nesting.

Establishing riparian buffers may adversely impact the interior least tern because their habitat consists of bare or sparsely vegetated banks of rivers and lakes. Even if riparian buffers are not planted directly within least interior tern habitat, buffers near their habitat may reduce or eliminate their use of these areas or create an influx of avian and terrestrial predators. As interior populations of least tern are known to occur seasonally in Chariton and Perry counties, site specific surveys would be performed prior to CREP enrollment to determine if least terns occupy those areas. Areas determined to support this species would not be planted with riparian buffer vegetation, and hardwood trees would not be planted within the vicinity of nesting areas. This would minimize the potential for adverse affects to this species.

Impact—Increased Wetland Habitat

In general, establishing and restoring wetland would benefit most of the protected aquatic species within the ROI because wetlands act as nutrient sinks and help in the reduction of pollutants. There are six

particular species that would benefit significantly from the increase in wetland habitat that would be established by the proposed CPs. Decurrent false aster, western fringed prairie orchid, pondberry, and Virginia sneezeweed are plants that inhabit wetlands and associated areas. These species have been limited due to the loss and degradation of wetland habitat, so establishing wetland habitat with specific characteristics would be beneficial to them. For example, wetlands established in areas of sandy soils may create habitat for decurrent false aster and pondberry. Wetlands in upland areas may create habitat for the western fringed prairie orchid and, when wetlands overlie limestone, Virginia sneezeweed.

The other two species that would benefit from an increase in wetland habitat are the Hine's emerald dragonfly and the eastern massasauga. Hine's emerald dragonflies rely on wetlands for breeding areas, so fewer available wetlands and changes in groundwater have adversely impacted this species. Wetland habitats are particularly important for the over-wintering of eastern massasauga. This species cannot burrow for itself, and often uses crayfish burrows for over-wintering areas. Wetland draining and dredging is considered to be one of the most limiting factors affecting the eastern massasauga.

Impact—Decreased Water Temperature

The proposed CPs can lower water temperatures both by the shade created by riparian vegetation and by the reduction of sedimentation and turbidity. Lower water temperatures would benefit the Arkansas darter, as this species prefers to inhabit pools containing cool water. Pallid sturgeons, on the other hand, require warm, turbid waters and thus may be adversely impacted by cooler water temperatures. Pallid sturgeons inhabit large rivers, and the extent to which the water within these river systems would be cooled as a result of the proposed action cannot be accurately quantified. However, it is expected that, much like turbidity, water temperatures within current pallid sturgeon habitat would not change significantly due to CP implementation. Monitoring would help ensure that the extent of lower temperatures is negligible.

No Impact

CP implementation is unlikely to occur on land with populations of Missouri bladderpod, running buffalo clover, or Mead's milkweed. These species, which are extremely sensitive to disturbance, are federally listed and afforded protection under the *Endangered Species Act*.

Conclusion

The net impact to protected species within the ROI would be beneficial. With proper monitoring and mitigation practices, the potential for adverse impacts to the pallid sturgeon and least interior tern would be minimal.

Table 12. Impacts of the preferred alternative on protected species in the ROI.

Species	Effect of Proposed CPs	Overall Impact
Aster, decurrent false	Increased wetland habitat, decreased sedimentation	+
Bat, gray	Increased riparian habitat, decreased sedimentation (benefit insects on which this species forages)	+
Bat, Indiana	Increased riparian habitat, decreased sedimentation (benefit insects on which this species forages)	+
Bladderpod, Missouri	CP implementation unlikely at sites containing this species	0
Cavefish, Ozark	Decreased pollutants	+
Cavesnail, Tumbling Creek	Decreased sedimentation and turbidity	+

Species	Effect of Proposed CPs	Overall Impact
Clover, running buffalo	CP implementation unlikely at sites containing this species	0
Darter, Arkansas	Decreased water temperature	+
Darter, Niangua	Decreased sedimentation and turbidity	+
Dragonfly, Hine's emerald	Decreased pollutants, increased wetland habitat	+
Eagle, bald	Increased riparian habitat	+
Geocarpon minimum	Decreased sedimentation	+
Hellbender, Ozark	Decreased sedimentation	+
Madtom, Neosho	Decreased sedimentation and turbidity	+
Mapleleaf, winged	Decreased pollutants, sedimentation, and turbidity	+
Massasauga, eastern	Increased wetland habitat	+
Milkweed, Mead's	CP implementation unlikely at sites containing this species	0
Mucket, Neosho	Decreased pollutants, sedimentation, and turbidity	+
Mucket, pink	Decreased pollutants, sedimentation, and turbidity	+
Mussel, scaleshell	Decreased pollutants, sedimentation, and turbidity	+
Orchid, western prairie fringed	Increased wetland habitat	+
Pocketbook, fat	Decreased pollutants, sedimentation, and turbidity	+
Pondberry	Increased wetland habitat	+
Sculpin, grotto	Decreased pollutants	+
Sheepnose	Decreased pollutants, sedimentation, and turbidity	+
Shiner, Topeka	Decreased pollutants, sedimentation, and turbidity	+
Sneezeweed, Virginia	Increased wetland habitat	+
Spectaclecase	Decreased pollutants, sedimentation, and turbidity	+
Sturgeon, pallid	Decreased turbidity, decreased water temperature	0/-
Tern, least (interior population)	Increased riparian habitat	0/-
Impact codes: + = beneficial impact, - = adverse impact, 0 = no or negligible impact.		

4.1.3.3 Alternative B—No Action

Under the no action alternative, lands eligible for CREP enrollment would remain in agricultural production. Habitats used by protected species would continue to decline in quality and abundance. Species would continue to be exposed to degraded water quality and harmful pollutants.

4.2 Cultural Resources

4.2.1 Archaeological Resources

4.2.1.1Level of Impact

Significant impacts to archaeological resources would include those actions which resulted in: 1) directly or indirectly altering the characteristics of the property that qualify it as a historic cultural

resource; 2) causing destruction or damage to the property; 3) removing parts or all of the property from its historic location; 4) introducing any permanent atmospheric, audible, or visual elements that diminish the integrity of the historic property; 5) the neglect of a registered property; or 6) the disturbance of important religious sites or sites of cultural significance to American Indians or others.

4.2.1.2 Alternative A—Preferred

There is the potential that archaeological resources could be encountered during implementation of the preferred alternative. Activities that require any excavation to accomplish tasks associated with CP installation may impact recorded and unidentified archaeological resources.

As the Missouri CREP agreement does not address specific sites and Federal law precludes the release of specific information regarding locations of archaeological sites, detailed cultural resources information is not offered in this PEA (16 USC part 470, 2000). All actions would be reviewed with MSHPO during the planning and implementation phases of the proposed action. When specific areas that are to be enrolled in CREP are identified by legal description, a Class I literature search, as appropriate, would be conducted on these properties to determine if further investigation or mitigation would be warranted.

4.2.1.3 Alternative B—No Action

Under the no action alternative, agricultural practices that occur on lands within the ROI would continue. Though the continuation of farming and other agricultural practices on previously disturbed land would not be expected to impact archaeological resources, any change in these activities that would disturb previously intact areas may result in impacts to known or unidentified properties.

4.2.2 Architectural Resources

4.2.2.1 Level of Impact

Significant impacts to architectural resources would include those actions which resulted in: 1) directly or indirectly altering the characteristics of the property that qualify it as a historic cultural resource; 2) causing destruction or damage to the property; 3) removing parts or all of the property from its historic location; 4) introducing any permanent atmospheric, audible, or visual elements that diminish the integrity of the historic property; 5) the neglect of a registered property; or 6) the disturbance of important religious sites or sites of cultural significance to American Indians or others.

4.2.2.2 Alternative A—Preferred

There is the potential that architectural properties would be encountered during implementation of the preferred alternative. Activities associated with CP installation may impact recorded and unidentified architectural resources.

As the Missouri CREP agreement does not address specific sites, detailed cultural resources information is not offered in this PEA. All actions would be reviewed with MSHPO during the planning and implementation phases of the proposed action. When specific areas that are to be enrolled in CREP are identified by legal description, a Class I literature search, as appropriate, would be conducted on these properties to determine if further investigation or mitigation would be warranted.

4.2.2.3 Alternative B—No Action

Under the no action alternative, agricultural practices that occur on lands within the ROI would continue. Though the continuation of farming and other agricultural practices on previously disturbed

land would not be expected to impact architectural resources, any change in these activities that would disturb previously intact areas may result in impacts to known or unidentified architectural properties.

4.2.3 Traditional Cultural Properties

4.2.3.1Level of Impact

Significant impacts to TCPs would include those actions which resulted in: 1) directly or indirectly altering the characteristics of the property that qualify it as a historic cultural resource; 2) causing destruction or damage to the property; 3) removing parts or all of the property from its historic location; 4) introducing any permanent atmospheric, audible, or visual elements that diminish the integrity of the historic property; 5) the neglect of a registered property; or 6) the disturbance of important religious sites or sites of cultural significance to American Indians or others.

4.2.3.2Alternative A—Preferred

There is the potential that TCPs could be encountered during implementation of the preferred alternative. Activities to accomplish tasks associated with CP installation may impact eligible and unidentified TCPs.

As the Missouri CREP agreement does not address specific sites, detailed cultural resources information is not offered in this PEA. All actions would be reviewed with MSHPO during the planning and implementation phases of the proposed action. When the specific areas that are to be enrolled in CREP are identified by legal description, a Class I literature search, as appropriate, would be conducted on these properties to determine if further investigation or mitigation would be warranted.

4.2.3.3Alternative B—No Action

Under the no action alternative, agricultural practices that occur on lands within the ROI would continue. Though the continuation of farming and other agricultural practices on previously disturbed land would not be expected to impact TCPs, any change in these activities that would disturb previously intact areas may result in impacts to known or unidentified properties.

4.3 Water Resources

4.3.1 Surface Water

4.3.1.1Level of Impact

Significant impacts to surface water would include those actions that permanently increase runoff or pollutants entering rivers, streams, or lakes; adversely change water supply or storage; or cause violations of State or Federal laws or regulations.

4.3.1.2Alternative A—Preferred

Implementation of the preferred alternative would have long-term beneficial effects on surface water quality throughout the ROI. CREP implementation is expected to cause a decrease in agricultural acreage that would result in reduced runoff from agricultural pesticides, nutrients, and sediments. The proposed CPs would establish vegetation that would decrease the amounts of pollutants in runoff including sediments, nitrogen, phosphorus, glyphosate, chloride, fecal coliform, atrazine, and cyanazine. Other surface water impairments in the ROI are unlikely to be affected by the proposed action.

Vegetation stabilizes soils and traps sediments, resulting in less erosion and sedimentation. Woody roots can increase the resistance of streambanks and shorelines to erosion by high water flows and waves

(NRCS 2000a). Vegetation configured as filter strips (e.g., CP21) can effectively trap up to 95 percent of sediments depending on factors such as vegetation type, soil characteristics, slope, and width of the filter strip (Leeds et al. 1994).

Vegetation planted in riparian areas (e.g., CP22) can remove nitrogen through plant uptake or via transformation to its gas phase by anaerobic bacteria. The removal process appears to be more efficient for shallow groundwater than for surface water due to the residence time of water (i.e., the longer the water is in contact with plant roots and organic soils, the greater the potential for plant uptake and microbial activity) (Mayer et al. 2005). Studies of riparian buffers have demonstrated that wider buffers composed of forest vegetation species are typically more effective in removing nitrogen from surface water (Mayer et al. 2005).

Vegetation in filter strips may remove sediment-bound nutrients and pesticides, such as phosphorus and glyphosate, but with much less efficiency and with unknown consequences if the nutrients and pesticides are degraded or transformed into more mobile compounds (Leeds et al. 1994, EPA 2006d). Phosphorus and glyphosate can, however, be effectively reduced when vegetation decreases the velocity of overland flow. This decrease in velocity allows sediments and sediment-bound nutrients and pesticides to settle and soluble pollutants to be taken up by vegetation before they reach waterbodies (Leeds et al. 1994). In addition to reducing phosphorus and glyphosate, this would also be expected to decrease the amounts of sediment, chloride, and fecal coliform.

Vegetation reduces atrazine and cyanazine in surface waters by increasing runoff infiltration. Atrazine and cyanazine are relatively mobile in the environment because they dissolve readily in water and have low tendencies to adhere to soil particles (MDNR 2006k). Rather than being adsorbed by vegetation, they are broken down by microbes in the soil. Higher infiltration rates would result in increased amounts of pesticide dissipation. Researchers at Kansas State University studied the effectiveness of vegetation in reducing atrazine runoff (Devlin et al. 2000). They found that vegetative and riparian buffers can reduce atrazine runoff by 10 to 35 percent, provided that water flow is even across the buffer. Results of this study indicate that 90 percent of atrazine loss occurs in the water portion of runoff and 10 percent with the eroding soil particles.

The proposed action would not have a direct effect on those impairments due to dams or wastewater treatment plants, such as gas supersaturation, fish trauma, volatile suspended solids, low dissolved oxygen, BOD, and the presence of ammonia. However, the proposed CPs may help to mitigate the impacts of low dissolved oxygen, including that caused by BOD and ammonia. For example, the shade provided by established vegetation would cool water temperatures and increase the capability of the water to retain dissolved oxygen.

Non-volatile suspended solids, lead, zinc, cadmium, sulfate, and pH impairments (due to sulfates forming sulfuric acid) from mines and metal smelters are unlikely to be affected by the proposed action. These pollutants typically enter waterways through erosion and runoff. Unless CP vegetation was established between the source of the pollutants (e.g., mine tailing pile) and the waterway, contamination pathways would remain unchanged. It is unlikely that agricultural land eligible for CREP enrollment would be located in such areas.

The proposed action would not be expected to have any impact to the high levels of mercury, iron, manganese, and in the waterways of the ROI.

Installation and maintenance of CPs may involve the clearing of vegetation and some soil disturbance. These activities may result in high levels of sediment runoff, resulting in temporary adverse impacts to surface water quality. The use of silt fencing or similar mitigation practices would reduce these impacts (EPA 2006f).

4.3.1.3Alternative B—No Action

Under the no action alternative, water quality in the ROI would continue to be degraded by pesticides, nutrients, sediments, and other pollutants.

4.3.2 Groundwater

4.3.2.1Level of Impact

Significant impacts to groundwater would include those actions that permanently increase pollutants entering groundwater; adversely change water supply or storage; or cause violations of State or Federal laws or regulations.

4.3.2.2Alternative A—Preferred

Implementation of the proposed CREP agreement would result in beneficial effects on groundwater. A reduction of agricultural acreage in the ROI would decrease the amount of pollutants leaching into the groundwater. The proposed CPs would establish vegetative cover, which would slow the rate of rainwater flow over the land and allowing for greater rates of aquifer recharge. By improving surface water quality, the CPs would also help improve the quality of groundwater recharged by these surface waters.

4.3.2.3Alternative B—No Action

Under the no action alternative, groundwater resources in the ROI would continue to be subject many of the same impairments as those of surface waters including high levels of pesticides. Rates of groundwater recharge may decrease over time if vegetation is removed due to expanding agricultural practices.

4.3.3 Wetlands

4.3.3.1Level of Impact

Significant impacts to wetlands would include those actions that permanently diminish or degrade wetland resources.

4.3.3.2Alternative A—Preferred

Implementation of the preferred alternative would have a beneficial effect on wetlands in the ROI. CP23, CP23A, and CP31 are designed specifically for wetland restoration and would involve planting specific vegetation to support the natural function of the wetland area. Vegetation established by other CPs would reduce the amount of sediments and pollutants entering surface water and groundwater in the ROI, resulting in less sedimentation and pollution in adjacent wetlands.

The removal of some land from agricultural use may affect the number and size of artificial wetlands formed by anthropogenic features associated with agricultural activities such as reservoirs and drainage channels; however, this effect is expected to be minor.

4.3.3.3Alternative B—No Action

Under the no action alternative, wetlands in the ROI would continue to be subject to high levels of pesticides, nutrients, and sediments.

4.3.4 Floodplains

4.3.4.1Level of Impact

Significant impacts to floodplains would include those actions that cause destruction to or reduce the function of floodplains.

4.3.4.2Alternative A—Preferred

The preferred alternative would have a beneficial effect on floodplains. Implementation of CP31 (Bottomland Timber Establishment on Wetlands) would help preserve the integrity of floodplains by planting trees and shrubs to reduce sheet, rill, scour, and other erosion. All of the proposed CPs establish vegetation, which would help decrease streambank erosion and improve overall function of the floodplains. The preferred alternative is not expected to adversely alter the drainage, flow, or holding capacity of floodplains.

4.3.4.3Alternative B—No Action

Under the no action alternative, the present rates of erosion and the resulting overland flow of sediments would remain unchanged.

4.4 Soil Resources

4.4.1 Level of Impact

Significant impacts to earth resources would include those actions that erode or diminish unique topographical features or soil types, or permanently increase erosion and sedimentation.

4.4.2 Alternative A—Preferred

Long-term beneficial impacts to topography and soils are expected to occur under Alternative A. The proposed action would result in localized stabilization of soils and topography as a result of decreased erosion by water and wind. Implementation of the proposed CPs would establish permanent vegetation and manage and protect existing vegetation. Vegetation helps protect soils from water and wind erosion by decreasing overland flow, reducing the amount of bare ground exposed to water and wind, and disrupting the force of the wind on local soil particles (NRCS 2001). Erosion is of significant concern because it removes organic matter and nutrients from the soil, which can create less favorable conditions for plant growth or cause a shift to less desirable plant species (e.g., grass to shrub species) (NRCS 2001). Erosion also degrades soil structure, resulting in decreased rate of water infiltration (NRCS 2001).

Several CPs, including those for wetland restoration and grass waterways, may alter natural hydrologic conditions. Such an alteration has the potential to trigger a sinkhole collapse. This risk can be mitigated by conducting site specific surveys in areas where numerous sinkholes are known to exist.

Short-term disturbances to soils during implementation of CPs may include tilling or excavation, resulting in temporary increases in soil erosion. Maintenance activities such as prescribed burning may also result in temporary and localized increases in soil erosion.

4.4.3 Alternative B—No Action

Under the no action alternative, the current rates of erosion and the changes in topography resulting from erosion would continue.

4.5 Air

4.5.1 Level of Impact

Significant impacts to air quality would include those actions that: 1) cause or contribute to a violation of any national, State, or local ambient air quality standard; 2) expose sensitive receptors (e.g., residential areas, hospitals, daycare facilities, elder care facilities, elementary schools, parks, and outdoor restaurants) to substantially increase pollutant concentrations; or 3) cause emissions which exceed any significant criteria established by the State Implementation Plan.

4.5.2 Alternative A—Preferred

Implementation of Alternative A would result in the establishment of vegetation in the form of trees, shrubs, grasses, forbs, and legumes. Vegetation would minimize the amount of exposed soil, which would have a beneficial impact to local air quality. Vegetation would also remove pollutants from the air by absorption. Common pollutants that can be removed by vegetation include nitrogen oxides, sulfur oxides, particulates, and ground-level ozone (EPA 2006g). Implementation of the proposed CPs is not expected to provide significant impacts to air quality in the short term. However, as trees mature and are able to absorb more pollutants, slight benefits to local air quality may occur.

Implementation the proposed CPs may include activities such as tilling and installation of various structures. These activities may temporarily impact local air quality by increasing airborne particulates in the immediate area. This can be mitigated by watering exposed soil before and after work.

Prescribed open burning would release pollutants into the environment such as particulates, partially consumed fuel, liquid droplets, carbon monoxide, hydrocarbons, and nitrogen oxides. The quantity and distribution of these pollutants would depend on the type of vegetation that is being burned, the configuration of the burned material (material heaped or organized in rows), and the weather at the time of burning. Moderate prescribed burning would not likely have a significant impact to local air quality.

Installing various structures such as roads, firebreaks, and fences may require the temporary use of heavy-duty diesel construction vehicles. Primary emissions from construction vehicles include carbon monoxide and some particulates. The use of BMPs during construction activities would reduce the amount of emissions.

4.5.3 Alternative B—No Action

Under the no action alternative, existing air quality conditions would not change.

4.6 Recreation

4.6.1 Level of Impact

Significant impacts to recreational resources would include those actions that drastically change the quantity of lands used for public recreation, or that degrade any aspect of these lands such as aesthetics, fisheries, wildlife, or water quality.

4.6.2 Alternative A—Preferred

Recreational areas in the ROI are not eligible for CREP enrollment either because they are on public lands or, if they are on privately owned lands, because they are unlikely to meet the eligibility requirements as described in Section 2.1. However, implementation of the proposed action on nearby lands may provide slight benefits to recreation by improving water quality and enhancing wildlife

habitat, resulting in increased hunting, wildlife viewing, and fishing opportunities on nearby public lands.

4.6.3 Alternative B—No Action

Under the no action alternative, the current condition of water and lands used by the public for recreation would remain unchanged.

4.7 Human Health and Safety

4.7.1 Level of Impact

Significant impacts to human health and safety would include those actions that harm people or expose them to hazards.

4.7.2 Alternative A—Preferred

Implementing the preferred action would result in a beneficial impact to human health and safety in the ROI by improving the quality of drinking water supplies and reducing pesticide use on agricultural lands. The proposed CPs would establish vegetation to help remove potentially harmful pollutants from runoff. Vegetation is expected to reduce the amounts of pesticides and fecal coliform in waterways of the ROI, although it is unlikely to affect the current levels of mercury and lead. In addition, removing lands from agricultural production and enrolling them in CREP would result in reduced runoff from agricultural pesticides and fecal coliform from livestock.

Reducing the amount of lands from agricultural production would also reduce the amount of pesticide application. This would decrease the risk of exposure to agricultural workers who apply pesticides or who are present during the application.

4.7.3 Alternative B—No Action

Under the no action alternative, public drinking water supplies would continue to be degraded by agricultural pollutants that potential risks to human health and safety.

4.8 Socioeconomics

4.8.1 Level of Impact

Significant impacts to socioeconomics would include those activities which may induce changes in population density, growth rate, or patterns of land use.

4.8.2 Alternative A—Preferred

Implementation of the preferred alternative would result in a maximum of 40,000 acres of land being conserved for a period of 14 to 15 years. This would result in a positive net present value for the program.

This action would result in a maximum loss of 40,000 acres of agricultural land. In 2002, there were 44,506 farm workers on the 17,154,180 acres of farms within the ROI, accounting for a payroll of $175 million (USDA 2004). Removing 40,000 acres from agricultural production would decrease the land in farms to 17,114,180 acres and may result in the loss of 104 farm worker positions at an estimated cost of $409,375 per year when all 40,000 acres are under contract. The loss of these positions would account for less than 1 percent of the farm worker positions available in 2002. The loss of production on 40,000 acres would reduce the amount of total farm production expenditures, less hired

and contract labor, by $6.65 million per year, or approximately 0.22 percent of the total 2002 farm production expenditures (USDA 2004).

Based on average Missouri rental rates, CREP enrollment is estimated at an average of $90 per acre for the 40,000 acres proposed. Participants would also receive annual incentive payments of $18 per acre for CP8A, CP21, CP22, CP29, and CP30; and $13.50 per acre for all other CPs. The State would issue a one-time SIP for $135 per acre for all CPs. In addition, USDA would provide a one-time incentive payment for hydrology restoration, a one-time SIP of $100 per acre, and a one-time PIP of $170. Landowners would be compensated for 75 percent of CP establishment costs and up to 75 percent of all other eligible soil and water structural CPs needed in each watershed. Establishment costs vary from $0 for CP10 to $1,000 per acre for CP8A. The average CP establishment cost is $305 per acre. The total net present value is $4.0 million over 15 years (Appendix H).

Hines and others (1991) noted that enrolling lands into CRP adversely affected agricultural-based industries such as transportation and processing. The replacement of expenditures that would have supported local agriculture-related industries with CRP payments is often spent on other commodities within the local community. Impacts are generally greater where agriculture is the dominant economic activity and CRP enrollment is high.

There are non-market benefits associated with the implementation of CRP (Feather et al. 1999). For annual consumer surplus in Missouri, these would include an estimated $35.44 per acre for wildlife viewing, $6.24 per acre for pheasant hunting, and $2.45 per acre for freshwater recreation activities for a total consumer surplus per acre from CRP of $44.13. Total annual consumer surplus attributable to CRP for the U.S. equated to $13.45 or about 30 percent that of the consumer surplus generated by CRP activities in the North Eastern Region, which includes Missouri. It is expected that the proposed CPs would improve wildlife and fisheries habitat, which in turn may improve hunting, fishing, and wildlife viewing opportunities in the ROI. These increased opportunities may generate recreation-related economic activity within and around the ROI.

4.8.3 Alternative B—No Action

Under the no action alternative, CREP would not be implemented and socioeconomic conditions would continue to follow the trends associated with the ROI, Missouri, and North Eastern Region of the U.S.

4.9 Environmental Justice

4.9.1 Level of Impact

Significant impacts to environmental justice would include those activities in which low income or minority populations are adversely affected or unfairly compensated, or all affected individuals are not allowed equal access to the decision making process.

4.9.2 Alternative A—Preferred

This analysis demonstrates that overall the ROI is neither an area of concentrated minority population nor a poverty area, so there would be no impacts to environmental justice as a result of the proposed action.

The preferred alternative may generate other non-farm employment activities within the ROI. For example, the initial installation of CPs may create temporary jobs. CP maintenance activities required over the life of each CREP contract may also create positions that would take the place of those lost when lands are removed from production.

Research has shown that CRP rental payments are often spent on other commodities within the local community, replacing the farm expenditures that are lost when land is removed from production for CRP (Hines et al. 1991). Therefore, CREP payments may create additional non-farm employment within the community.

4.9.3 Alternative B—No Action

There would be no impacts to minority populations or low-income populations under the no action alternative.

4.10 Other Protected Resources

4.10.1 National Natural Landmark

4.10.1.1 Level of Impact

Significant impacts to NNLs would include any actions that alter the major biological or geological feature that merited the land for NNL designation.

4.10.1.2 Alternative A—Preferred

The proposed action is not expected to impact any NNL. It is unlikely that land within one of the four NNLs would be cropland or marginal pastureland eligible for CREP enrollment. CPs installed on agricultural land near an NNL may provide a slight benefit to the NNL by improving water quality and enhancing wildlife habitat.

4.10.1.3 Alternative B—No Action

Under the no action alternative, the current condition of NNLs would remain unchanged.

4.10.2 Wilderness

4.10.2.1 Level of Impact

Significant impacts to wilderness would include any actions that alter the natural condition of the land.

4.10.2.2 Alternative A—Preferred

Wilderness areas are not eligible for CREP enrollment because they are federally owned. Implementation of the proposed action on nearby private lands may provide a slight benefit to wilderness areas by improving water quality and enhancing wildlife habitat.

4.10.2.3 Alternative B—No Action

Under the no action alternative, the current condition of wilderness areas would remain unchanged.

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5.0 CUMULATIVE EFFECTS

5.1 Introduction

As defined by CEQ regulations:

> "Cumulative impact is the impact on the environment which 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 non-Federal') or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR part 1508.7, 2006)

CEQ guidance suggests that the first steps in assessing cumulative impacts involve defining the scope of the proposed action and other actions, and evaluating the nature of potential interactions between the actions (CEQ 1997b). Scope must consider geographic and temporal relationships between the proposed action and other actions. Actions overlapping with or in proximity to the proposed action would be expected to have more potential for a relationship than those more geographically separated. Similarly, actions that coincide even partially in time would tend to offer a higher potential for cumulative effects.

For the purpose of this analysis, the ROI is the portions of the watersheds of concern that lie within the 79 counties proposed for CREP enrollment and described in Section 1.3. The primary sources of information used to identify reasonably foreseeable future actions are public documents prepared by Federal, State, and local government agencies.

5.2 Past, Present, and Reasonably Foreseeable Actions

The Missouri NRCS manages the implementation of several programs that are focused on conserving and enhancing natural resources within the State. These programs are summarized in the following subsections to demonstrate the types of past, present, and reasonably foreseeable future actions that may occur in the ROI.

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program intended to promote agricultural production and environmental quality as compatible national goals. EQIP provides technical and financial assistance for farmers and ranchers to implement structural and management CPs on agricultural lands. Missouri received over $23 million in funding for 2,003 contracts in fiscal year (FY) 2005 (NRCS 2006a, b).

Farm and Ranch Land Protection Program

The Farm and Ranch Land Protection Program (FRPP) is a voluntary program that helps landowners keep their lands in agricultural production and protects historic sites on these lands (NRCS 2006c). FRPP provides matching funds to State, local, tribal, and qualified non-profit entities with existing farmland protection programs to purchase conservation easements on agricultural lands. In FY 2005, Missouri was allocated $966,461 for this program and 485 acres were enrolled (NRCS 2006a, d).

Grassland Reserve Program

The Grassland Reserve Program (GRP) is a voluntary program that allows landowners to restore and protect grasslands on their property, while still maintaining these areas for grazing (NRCS 2006e). GRP emphasizes support for grazing operations, plant and animal biodiversity, and grasslands most vulnerable to conversion to cropland, urban development, or other uses. Missouri received $3.5 million in FY 2005 to fund GRP on 13,136 acres statewide (NRCS 2006a, f).

Wetlands Reserve Program

WRP is a voluntary program that encourages farmers and ranchers to restore and protect wetlands. This program provides financial and technical assistance to landowners so they are able to restore agricultural land back to its former wetland condition. Eligible lands are enrolled in permanent easements, 30-year easements, or restoration cost-share agreements (NRCS 2006g). Missouri received 12.5 million in funding for WRP in FY 2005 and enrolled 6,768 acres (NRCS 2006a, h).

Wildlife Habitat Incentives Program

The Wildlife Habitat Incentives Program (WHIP) is a cost-share program that assists landowners in creating high quality habitat to support wildlife populations of national, State, tribal, and local significance. NRCS and local conservation districts work with landowners to develop plans for establishing upland, wetland, riparian, or aquatic habitat areas on their properties (NRCS 2006i). Land enrolled in CRP, WRP, GRP, and other specified programs are not eligible for enrollment in WHIP (NRCS 2004). In FY 2005, Missouri was allocated $540,945 and enrolled 4,615 acres in WHIP (NRCS 2006a, i).

5.3 Cumulative Effects Matrix

When considered in combination with other past, present, and reasonably foreseeable future actions, the incremental impact of the proposed action is expected to result in net beneficial impacts to biological resources, water resources, soil resources, air, and human health and safety in the watersheds proposed for CREP enrollment and in waters downstream (Table 13). No adverse cumulative impacts to any other resource discussed in Chapter 3.0 are expected.

Table 13. Cumulative effects matrix.

Resource	USDA Programs: EQIP, FRPP, GRP, WRP, and WHIP	Cumulative Effects when combined with the Proposed Action
Biological Resources	The majority of these programs incorporate practices that provide restoration and enhancement of wildlife and fisheries habitat, vegetation, and water quality in their overall goals. These programs provide long-term beneficial impacts to biological resources.	The proposed action would enhance and restore wildlife and fisheries habitat and vegetation within the ROI. When combined, the proposed action and USDA programs would result in cumulative impacts that benefit wildlife and fisheries, vegetation, and protected species.
Cultural Resources	There is potential for cultural resources to be impacted when these programs are initiated on previously undisturbed ground. MSHPO review of all proposed actions prior to implementation helps to ensure that cultural resources are protected and preserved.	The proposed action has the potential to impact cultural resources. Consultation with MSHPO would be conducted prior to implementation activities to ensure cultural resources are not adversely impacted. Because the proposed action and USDA programs both require MSHPO consultation, no cumulative impacts to cultural resources would be expected.
Water Resources	Several of these programs are designed to improve water resources by planting shrubs, trees, and grasses in riparian areas and on floodplains to reduce pollution runoff to surface water and to allow for greater rates of groundwater recharge. WRP specifically restores and enhances degraded wetlands. These programs contribute long-term beneficial impacts to	The focus of the proposed action is on improving water quality in the ROI. The amount of pesticides, nutrients, and sediments entering waterways would be reduced by planting grasses, trees and shrubs. Vegetation would also help improve rates of groundwater recharge and floodplain function. When combined, the proposed action and USDA programs

Resource	USDA Programs: EQIP, FRPP, GRP, WRP, and WHIP	Cumulative Effects when combined with the Proposed Action
	water quality.	would result in cumulative impacts that benefit water resources.
Soil Resources	The majority of these programs establish vegetation on erodible lands as a practice to achieve their overall goal. This increases soil stability and reduces erosion, proving long-term beneficial impact to soil resources.	Implementation of the proposed action would involve planting permanent vegetation, which would benefit local soil resources. When combined, the proposed action and USDA programs would result in cumulative impacts that benefit soil resources.
Air	The programs which restore and enhance vegetation and reduce local soil erosion may indirectly improve air quality.	Vegetation planted under the proposed action would improve local air quality by reducing soil erosion and absorbing air pollutants. When combined, the proposed action and USDA programs would result in cumulative impacts that benefit air quality.
Recreation	These programs are implemented on private lands, so benefits to areas used by the public for recreation are limited. However, there may be slight benefits to this resource in the form of improved wildlife and fisheries habitat, which may result in increased hunting, wildlife viewing, and fishing opportunities on nearby public lands. Improved aesthetics also benefit recreation.	The proposed action would be implemented on private lands, but may also benefit wildlife and fisheries habitat on nearby public lands. When combined, the proposed action and USDA programs may result in cumulative impacts that benefit recreation.
Human Health and Safety	The programs which improve water resources by reducing pollution runoff are likely to benefit human health and safety.	The proposed action would improve the quality of public drinking water supplies by reducing runoff of potentially harmful pollutants. When combined, the proposed action and USDA programs would result in cumulative impacts that benefit human health and safety.
Socioeconomics	The majority of these programs provide incentives focused on providing for more environmentally-sound farming and land use practices. Implementation of the CPs and expenditure of the incentives produce positive economic benefits, in addition to the economic benefits resulting from more environmentally-sound farming and land use practices.	The proposed action would provide incentives and rental payments which may offset some farm job losses. When combined with other USDA programs, the cumulative impact is expected to be negligible.
Environmental Justice	The majority of these programs provide incentives and/or education opportunities focused on providing for more environmentally-sound farming and land use practices. This may produce new opportunities for workers in pursuing job prospects that support these types of practices.	The proposed action would potentially provide new employment opportunities that support more environmentally-sound farming and land use practices. When combined with other USDA programs, the cumulative impact may be increased employment opportunities and a more stable work environment.

Resource	USDA Programs: EQIP, FRPP, GRP, WRP, and WHIP	Cumulative Effects when combined with the Proposed Action
Other Protected Resources	The programs which improve water quality and enhance wildlife habitat may provide slight benefits to nearby NNLs and wilderness areas.	The proposed action would improve water quality and wildlife habitat. These benefits may be shared by nearby NNLs and wilderness areas. When combined, the proposed action and USDA programs may result in slight cumulative impacts that benefit NNLs and wilderness areas.

5.4 Irreversible and Irretrievable Commitment of Resources

As required by NEPA, any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented must be identified in environmental analyses. Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the effect that this use may have on future generations. Irreversible commitments are those that consume a specific resource that is renewable only over a long time period. Irretrievable commitments are those that consume a specific resource that is neither renewable nor recoverable for use by future generations. No irreversible or irretrievable resource commitments are expected from implementation of the proposed action.

6.0 MITIGATION MEASURES

6.1 Introduction

CEQ requires that all relevant reasonable mitigation measures that could improve a project should be identified, even if they are outside the jurisdiction of the lead agency or the cooperating agencies (40 CFR parts 1500 et seq., 2006). This serves to alert agencies or officials who can implement these extra measures, and to encourage them to do so. As this analysis is programmatic in nature and does not address exact locations, it is understood that detailed mitigation measures would be addressed on a site specific basis.

6.2 Roles and Responsibilities

As a part of the individual CREP contract approval process, consultation with the appropriate agencies would be conducted to reduce or eliminate potential impacts to resources identified in this PEA. For example, NRCS would provide technical expertise in the implementation of CPs. FWS would provide guidance to ensure that actions do not jeopardize or destroy protected species or their habitat. MSHPO would review actions to minimize potential impacts to cultural resources.

6.3 Mitigations

This chapter presents mitigation measures that would be used to avoid or lessen impacts to resources including biological, cultural, water, soil, and air.

Biological Resources

- Based on findings from numerous studies, woody vegetation should not be planted within 60 meters of current grasslands or areas to which large tracts of native grasses and legumes are to be established (Gates and Gysel 1978, Burger et al. 1994, Winter et al. 2000). This will help protect grassland nesting species from brood parasitism and predation.

- Areas planted with native grassland vegetation and filter strips may require mowing to stimulate vegetative growth. Mowing should take place before or after the nesting time for ground-nesting birds, which varies among species.

- As riparian buffers mature, periodic harvesting of some trees may be necessary. Such harvests may temporarily disrupt daily migration patterns of resident wildlife. The use of BMPs would help ensure these impacts would be minor and temporary.

- Human disturbance for maintenance procedures of wetland-related CPs should be minimal during the presence of waterfowl. Regular human disturbance may cause waterfowl to relocate to other areas, lowering the productivity of these species or abandonment of young broods. Screened buffer zones may be used to minimize disturbance to these species during maintenance procedures (NRCS 2000b).

- Some pesticides may be used during implementation of the CPs. Pesticides would be pre-approved by the governing Federal agency of the specific site and applied strictly according to label directions to minimize the threat to biological resources within the area.

- Long term, periodic monitoring of pallid sturgeon should be conducted to ensure that the effects of reduced turbidity and cooler water temperatures are not adversely impacting this species or their habitat.

- Interior populations of least tern are known to occur seasonally in Chariton and Perry counties. Site specific surveys in these counties should be performed prior to CREP enrollment to determine if least terns occupy those areas. Areas determined to support this species should not be planted with riparian buffer vegetation, and hardwood trees should not be planted within the vicinity of known nesting areas.

- Areas that contain threatened, endangered, or candidate plant species should not be disturbed as these species have limited populations and are very sensitive to changes in the environment and to competition with other vegetation.

Cultural Resources

- MSHPO and any other State, Federal, and tribal agencies with cultural resources oversight should be consulted as each individual CREP contract is developed and implemented. This would indicate if any cultural resources are known within the ROI or if additional field inventories would be necessary.

- FSA and MSHPO should communicate with any participating tribes to integrate planning with cultural resource protection and mitigation of adverse impacts, as well as soliciting input on the identification and protection of any TCPs.

Water Resources

- Installation of CPs may involve the clearing of vegetation and some soil disturbance. These activities may result in high levels of sediment runoff, resulting in temporary adverse impacts to surface water quality. The use of filter fencing or similar measures would reduce these impacts.

Soil Resources

- Short-term disturbances to soils during implementation of CPs may include tilling, excavation, or installation of various structures such as fences, breakwaters, and roads. These activities may result in temporary and localized increases in soil erosion. The use of silt fencing, filter fabric, or similar measures would reduce these impacts.

- CPs that alter natural hydrologic conditions have the potential to trigger a sinkhole collapse. Site specific surveys should be conducted prior to CP installation in areas where numerous sinkholes are known to exist.

Air

- Implementation of the proposed CPs may include activities such as tilling and burning. This may temporarily increase airborne particulates and other pollutants and adversely impact local air quality. Impacts would be minimized by measures such as watering exposed soil before and after tilling and burning in moderation and only in approved weather conditions.

- Installing various structures such as roads, firebreaks, and fences may require the temporary use of heavy-duty diesel construction vehicles. Primary emissions from construction vehicles include carbon monoxide and some airborne particulates. BMPs would be used during construction activities to reduce the amount of emissions.

7.0 LIST OF PREPARERS

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8.0 PERSONS AND AGENCIES CONTACTED

Table 14 lists the persons and agencies contacted during the scoping process for this PEA.

Table 14. Scoping list for the Missouri CREP PEA.

Name	Title	Agency
Addison, Cliff	Agent	Harrison County Farm Bureau
Baker, Aaron	Northeast Regional Vice President	Missouri Cattlemen's Association
Beard, Michael	Agent	Callaway County Farm Bureau
Bennett, Anita	Agent	St. Clair County Farm Bureau
Bergh, Bill	Private Lands Regional Supervisor	MDC, Northeast Regional Office
Berry, Phil	Agent	Randolph County Farm Bureau
Bess, Dennis	Agent	Madison County Farm Bureau
Blakey, Gary	Agent	Christian County Farm Bureau
Brander, Wolfgang	Tribal Program Coordinator	EPA, Region 7
Broermann, Dave	Agent	DeKalb County Farm Bureau
Brown, Chris	Agent	Adair County Farm Bureau
Brown, Ed	Private Lands Regional Supervisor	MDC, Kansas City Regional Office
Bruner, Phil	Agent	Andrew County Farm Bureau
Bryan, Larry	Agent	Johnson County Farm Bureau
Buckman, Stuart	Agent	Marion County Farm Bureau
Burch, Larry	Agent	Bates County Farm Bureau
Bybee, Travis	Agent	Hickory County Farm Bureau
Carter, Joe	Agent	Putnam County Farm Bureau
Chandler, Clint	Agent	Shelby County Farm Bureau
Childers, Doyle	Director	MDNR
Clark, Alan	Agent	Adair/Schuyler County Farm Bureau
Clifton, Bob	Agent	Newton County Farm Bureau
Close, Joe	Agent	Pettis County Farm Bureau
Conn, Wade	Northeast Resource Forester	MDC
Cook, Kenya	Agent	Shannon County Farm Bureau
Coon, Quenten	Agent	Grundy County Farm Bureau
Corner, Debra	Agent	Greene County Farm Bureau
Cox, Marcia	Agent	Mercer County Farm Bureau
Cummings, Ron	Agent	Cass County Farm Bureau
Cunningham, Bob	Private Lands Regional Supervisor	MDC, Ozark Regional Office
Davault, Jim	Agent	Gasconade County Farm Bureau

Name	Title	Agency
Dewitt, Bob	Private Lands Regional Supervisor	MDC, Central Regional Office
Draper, Tom	Ozark Forestry Regional Supervisor	MDC
Donnelle-Brown, Mary	Agent	Benton County Farm Bureau
Doyen, Mike	President	Missouri Audubon Society
Folsom, Terri	Chapter Coordinator	Sierra Club, Ozark Chapter
France, Tom	Center Director	National Wildlife Federation, Northern Rockies Natural Resource Center
Galloway, Marty	Agent	Boone County Farm Bureau
Garner, Cindy	Southwest Urban Forester	MDC
Garvey, Joe	Southeast Forestry Regional Supervisor	MDC
Gibson, Zac	Agent	Jefferson County Farm Bureau
Harris, Susan	State Director	The Nature Conservancy
Hayes, Shawn	Agent	Polk County Farm Bureau
Haynes, Darla	Agent	Douglas County Farm Bureau
Hillermann, Bob	Agent	Franklin County Farm Bureau
Iverson, Steve	Division Chief	USACE, Kansas City District Office
Jaco, Tony	Private Lands Regional Supervisor	MDC, Southeast Regional Office
Johnson, Carl	Agent	Vernon County Farm Bureau
Johnson, Kevin	Agent	Pulaski County Farm Bureau
Korte, Wayne	Agent	Montgomery County Farm Bureau
Lang, Paul	Agent	Macon County Farm Bureau
Leatherman, Lorren	Northwest Resource Forester	MDC
Long, Greg	Agent	Monroe County Farm Bureau
Long, Jimmie	Southwest Regional Vice President	Missouri Cattlemen's Association
Madry, Lisa	Regional Representative	National Wildlife Federation, Gulf States Natural Resource Center
McCulloch, Rocky	Agent	Barton County Farm Bureau
Medows, Chuck	Agent	Phelps County Farm Bureau
Miederhoff, Terry	Agent	Perry County Farm Bureau
Mitchell, Kathy	Agent	Dallas County Farm Bureau
Moncrief, Brad	Agent	Maries County Farm Bureau
Moore, David	President	Missouri Cattlemen's Association
Morris, Mike	Central Resource Forester	MDC
Morrison, Matt	Agent	Daviess County Farm Bureau

Name	Title	Agency
Moses, Althea	Environmental Justice Program Manager	EPA, Region 7
Nolting, Bob	Agent	Chariton County Farm Bureau
Oney, Bonham	Agent	Jasper County Farm Bureau
Palmer, John	Agent	Ralls County Farm Bureau
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Patton, Joe	Agent	Lawrence County Farm Bureau
Pender, Mark	Agent	St. Louis County Farm Bureau
Peterson, Ron	Agent	Gentry County Farm Bureau
Piccoli, Mario	Agent	Henry County Farm Bureau
Portell, Joyce	Agent	Washington County Farm Bureau
Raulston, Steve	Agent	Dent County Farm Bureau
Raney, Robert	Agent	Clay County Farm Bureau
Reid, Marla	Agent	Pike County Farm Bureau
Reno, Kyle	Private Lands Regional Supervisor	MDC, Northwest Regional Office
Rice, William W.	Action Regional Administrator	EPA, Region 7
Roby, Steve	Agent	Cedar County Farm Bureau
Runyon, George	Agent	St. Francois County Farm Bureau
Russell, Timothy	President	The Wildlife Society, Missouri Chapter
Sanders, Karen	Agent	Carter County Farm Bureau
Schafer, Josh	Agent	Osage County Farm Bureau
Schroeppel, Bob	Private Lands Regional Supervisor	Southwest Regional Office, MDC
Shelley, Greg	Agent	Scotland County Farm Bureau
Shrover, Josh	Kansas City Resource Forester	MDC
Smith, Kyle	Agent	Texas County Farm Bureau
Sparks, James	Northwest Regional Vice President	Missouri Cattlemen's Association
Spezia, Steve	Private Lands Regional Supervisor	MDC, St. Louis Regional Office
Steger, Doug	Agent	Jackson County Farm Bureau
Stephens, Alan	Agent	Caldwell Farm Bureau
Strong, Justin	Agent	Crawford County Farm Bureau
Swiney, Dan	Agent	Reynolds County Farm Bureau
Talbert, Jim	State Chairman	Missouri Ducks Unlimited
Tinnes, Mike	Agent	Stone County Farm Bureau
Todd, Gayle	St. Louis Resource Forester	MDC
Weiler, Ernie	Agent	Ste. Genevieve County Farm Bureau

Name	Title	Agency
Whited, Marty	Agent	Taney County Farm Bureau
Willard, Steve	Southeast Regional Vice President	Missouri Cattlemen's Association
Williams, David	Agent	Linn County Farm Bureau
Williams, Garry	Agent	Butler County Farm Bureau
Williams, Tony	Agent	Howard County Farm Bureau
Wilson, Larry	Agent	Iron County Farm Bureau
Woods, Michelle	Agent	Dade County Farm Bureau
Yarnall, Chad	Agent	Barry County Farm Bureau
Young, Mark	Agent	Webster County Farm Bureau
Young, Scott	Branch Chief, Environmental Programs Branch	USACE, Kansas City District Office
Yount, Kent	Agent	Nodaway County Farm Bureau
Zitelman, John	Agent	Lafayette County Farm Bureau

9.0 GLOSSARY

Agricultural Pollution—Wastes, emissions, and discharges arising from farming activities. Causes include runoff and leaching of pesticides and fertilizers; pesticide drift and volatilization; erosion and dust from cultivation; and improper disposal of animal manure and carcasses. Some agricultural pollution is point source (e.g., large feedlots), but much is non-point source, meaning that it derives from dispersed origins.

Algae Bloom—Rapid and flourishing growth of algae in and on a body of water.

Aquifer—An underground formation capable of storing and yielding significant quantities of water; usually composed of sand, gravel, or permeable rock.

Candidate Species—A species of plant or animal being considered for listing by the FWS as threatened or endangered due to declining numbers in all or part of its range.

Conservation—The management of human and natural resources to provide maximum benefits over a sustained period of time. Conservation practices focus on conserving soil, water, energy, and biological resources.

Conservation Practice—Any technique or measure used to protect soil and water resources for which standards and specifications for installation, operation, or maintenance have been developed.

Cost Sharing—Payments to producers to cover a specified portion of the cost of installing, implementing, or maintaining a conservation practice.

Cropland—A land use/land cover category that includes five components: cropland harvested, crop failure, cultivated summer fallow, cropland used only for pasture, and idle cropland.

Dissolved Oxygen—Amount of free oxygen found in water; most commonly used measurement of water quality.

Drumming—An act the male grouse performs to attract females in which the bird rapidly beats its wings while in a stationary position.

Easement—A landowner sells or surrenders the right to develop a portion of the property, usually in return for a payment or some other benefit.

Ecosystem—A level of organization within the living world that includes both the total array of biological organisms present in a defined area and the chemical/physical factors that influence the plants and animals in it; all biological and non-biological variables within a defined area.

Edge Area—An area of change from one distinct ecosystem to another distinct ecosystem (e.g., forest to field).

Endangered Species—A species of plant or animal that is federally designated as threatened with extinction throughout all or a significant portion of its range.

Erosion—The removal and loss of soil by the action of water, ice, gravity, or wind.

Ethnicity—A person either of Hispanic or Latino origin and any race, or not of Hispanic or Latino origin and any race.

Extreme Poverty Area—An area in which at least 40 percent of the residents are below the poverty threshold.

Farm Income—The earnings of a farming operation over a given period of time, measured by several factors: 1) Gross cash income is the sum of all receipts from the sale of crops, livestock, and farm-related goods and services, as well as all forms of direct payments from the government. 2) Gross farm income is the same as gross cash income with the addition of non-money income, such as the value of home consumption of self-produced food and the imputed gross rental value of farm dwellings. 3) Net cash income is gross cash income less all cash expenses such as for feed, seed, fertilizer, property taxes, interest on debt, wages to hired labor, contract labor and rent to non-operator landlords. 4) Net farm income is gross farm income less cash expenses and non-cash expenses, such as capital consumption, perquisites to hired labor, and farm household expenses. 5) Net farm income is a longer-term measure of the ability of the farm to survive as a viable income-earning business. 6) Net cash income is a shorter-term measure of cash flow.

Filter Strip—An area of vegetation, generally narrow and long, that slows the rate of runoff, allowing sediments, organic matter, and other pollutants that are being conveyed by the water to be removed.

Floodplain—The lowland that borders a stream or river and is found outside of the floodway. It is usually dry, but subject to flooding.

Flyway—A general term used to describe common migrating patterns among different bird species, based on definite geographic regions.

Groundwater—Water in the porous rocks and soils of the Earth's crust; a large proportion of the total supply of fresh water.

Herbicide—A type of pesticide used to kill or control vegetation.

Hispanic or Latino Origin—A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race.

Hydrology—The study of the distribution, movement, and chemical makeup of surface and ground waters.

Introduced Species—Species that have evolved elsewhere and have been transported and purposely or accidentally disseminated by humans. Other terms used to describe these species are alien, exotic, non-native, and non-indigenous.

Invasive Species—A species that is non-native to the ecosystem under consideration, and whose introduction causes or is likely to cause harm to the economy, environmental, or human health.

Low-Income—Individuals or households falling below the poverty threshold.

Mast—Fruits or nuts that are used as food by wildlife. Mast can be soft or hard. Examples of soft mast include most fruits, such as persimmon, dogwood seed, and black gum seed. Examples of hard mast include acorns, beach nuts, and hickory nuts.

Median Household Income—The income level which divides the income distribution of all of the households in a given area into two equal groups; half of the households having incomes above the median, and half having incomes below the median.

Minority Population—A population composed of a minority group and exceeding 50 percent of the population in an area or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population.

Mitigation—A method or action to reduce or eliminate adverse impacts.

Native Grasses—Various regional and national grasses that were original to particular areas of the U.S.; regional with regards to soils, acidity or alkalinity, climate, diseases, and symbiotic coexistence with other plants in the surrounding area.

Nutrient—Usually nitrogen or phosphorus. Excessive inputs of a nutrient of surface waters can over-enrich surface water, resulting in excessive algal growth and depletion of oxygen concentration. Sources of nutrients include runoff from fields and pastures, discharges from septic tanks and feedlots, and emissions from combustion.

Overland Flow— The flow of non-infiltrating precipitation over land surface toward stream channels (once water enters the stream or channel, it is considered runoff).

Ozone—A highly reactive molecule composed of three oxygen atoms. Environmentally, ozone is important in two completely separate contexts—one, as a naturally occurring screen of harmful radiation in the outer atmosphere (i.e., stratospheric ozone), and two, as a component of polluting smog formed from emissions resulting from human activities (i.e., urban smog). In the stratosphere 7 to 10 miles above the Earth, naturally occurring ozone acts to shield the Earth from harmful radiation.

Particulate Matter—Air pollutants, including dust, soot, dirt, smoke, and liquid droplets directly emitted into the air by sources such as factories, power plants, cars, construction activity, fires, and natural windblown dust.

Pastureland—A land use/land cover category of land managed primarily for the production of introduced forage plants for livestock grazing. This includes land that has a vegetative cover of grasses, legumes, and/or forbs, regardless of whether or not it is being grazed by livestock.

Pesticide—Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest (i.e., insects, animals, weeds, fungi, or microorganisms). The term pesticide refers to insecticides, herbicides, fungicides, and various other substances used to control pests.

Poverty Area—An area in which at least 20 percent of the residents are below the poverty threshold.

Poverty Thresholds—For statistical purposes (e.g., counting the poor population), USCB uses a set of annual income levels (poverty thresholds) that represent a Federal government estimate of the point below which a household of a given size has cash income insufficient to meet minimal food and other basic needs. They were developed in the 1960s, based largely on estimates of the minimal cost of food needs, to measure changes in the poor population. The thresholds differ by household size and are adjusted annually for overall inflation.

Race—Classification which includes White, Black or African American, American Indian or Alaskan Native, Asian, and Native Hawaiian or Other Pacific Islander.

Riparian Areas—Lands adjacent to rivers and streams that are influenced by flooding. They are considered transition zones between the aquatic and terrestrial ecosystem that are connected by direct land-water interaction.

Runoff—Non-infiltrating precipitation entering a stream or other conveyance channel.

Sediment—Any finely divided organic and/or mineral matter derived from rock or biological sources that have been transported and deposited by water or air.

Sedimentation—The process of depositing sediment from suspension in water.

Threatened Species—A species of plant or animal that is federally designated as likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Total Maximum Daily Load (TMDL)—A TMDL identifies the amount of a specific pollutant or property of a pollutant, from a point source ("end of the pipe"), a non-point source (from runoff), and natural background sources, including a margin of safety, that may be discharged to a waterbody and still ensure that the waterbody attains water quality standards.

Watershed—The land across and under which water flows on its way to a stream, river, lake, or other waterbody; the surface drainage area above a specified point on a stream.

Wetlands—Areas that are inundated or saturated with surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil, including swamps, marshes, bogs, and other similar areas.

Woodland—A land cover/land use category that includes wooded pastureland and wooded non-pastureland.

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