DRAFT

SUPPLEMENT TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT

Prepared for the:

REALLOCATION OF WATER SUPPLY STORAGE PROJECT: JOHN REDMOND LAKE, KANSAS

VOLUME I

JUNE 2002

United States Army Corps of Engineers; Tulsa District
1645 South 101 East Avenue
Tulsa, Oklahoma 74128-4609

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Prepared By:

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EXECUTIVE SUMMARY

John Redmond Dam was initially authorized as the Strawn Dam and Reservoir under the Flood Control Act of May 17, 1950. The intent of design and construction was to provide flood control, water conservation, recreation, and water supply for communities along the Neosho River in southeastern Kansas. The John Redmond Project is also operated for wildlife purposes. Up to the time of construction the Neosho River had flooded 57 times in 34 years of recorded history. The project was renamed John Redmond Dam and Reservoir by an act of congress in 1958, to posthumously honor John Redmond, publisher of the *Burlington Daily Republican* newspaper, and one of the first to champion the need for flood control and water conservation along the Neosho River.

Dam construction by the U.S. Army Corps of Engineers (USACE) was undertaken between 1959 and 1964, at a site west of Burlington, Kansas. Water storage began during September 1964, collecting drainage from an approximately 3,015-square mile drainage basin. John Redmond Dam lies below Marion Dam, constructed on the Cottonwood River (a tributary to the Neosho River), and Council Grove Dam, also constructed on the Neosho River and is the integral component of this flood control system. Uncontrolled drainage to the John Redmond Dam includes approximately 2,569-square miles below the upper two dams. Below John Redmond Dam to the Grand Lake O' the Cherokees in Oklahoma, an additional 3,285-square miles of uncontrolled drainage releases water to the Neosho River.

To perform the functions described above, John Redmond Reservoir contains three types of water storage that are separated by zones from the top to the bottom of the lake: flood control pool, conservation pool, and inactive storage. The upper zone provides 574,918 acre-feet of flood control storage and is reserved to contain floodwaters; it otherwise remains empty and is managed for agriculture, wildlife habitat, and recreation under the Otter Creek State Wildlife Area, Flint Hills National Wildlife Refuge, and USACE authorities. The intermediate zone or conservation pool provides 50,501 acre-feet of storage for water supply, water quality, and space to contain sediment. The lowest zone of inactive storage has filled with sediment. The pools, dam structure, agricultural land, wildlife habitat, and recreation sites are contained within approximately 29,801 acres.

The State of Kansas and the federal government entered into a water supply agreement in 1975, for 34,900 acre-feet of water storage annually and at the design life of the project (CY 2014). The water is provided to the Cottonwood and Neosho River Basins Water Assurance District Number 3 and the Wolf Creek Nuclear Generating Station. District Number 3 includes 21 municipal and industrial water users. Water supply storage was to occur within the conservation pool when maintained at the surface elevation of 1,039.0 feet. Studies by the USACE have determined that sediment is accumulating in the conservation pool and is reducing the amount of water stored there. The amount of water storage reduction predicted by calendar year (CY) 2014 is approximately 25 percent, or 8,725 acre-feet of water supply.

The USACE has been directed by Congress to conduct a study to reallocate water supply storage, an action that would fulfill the water supply agreement. This Supplemental Environmental Impact Statement (SEIS) addresses the water supply storage reallocation project. The SEIS was prepared by the U.S. Army Corps of Engineers in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. § 4332 (1994)) (NEPA) and the Council on Environmental Quality (CEQ) Regulations for Implementing the Provisions of NEPA (40 C.F.R. Parts 1500-1508).

Purpose and Need for the Action

The purpose and need of the proposed federal action is to make an equitable redistribution of the storage remaining between the flood control pool and conservation pools due to uneven sediment distribution. Sediment has been collecting mainly in the conservation pool, thereby reducing the conservation pool faster than was designed while the flood control pool has not received as much sediment and has retained more storage than it was designed to retain. The reallocation does not guarantee the water storage volume contracted to the KWO per the 1975 agreement, but makes an equitable redistribution of the remaining storage. The project area is defined as the John Redmond Dam and Reservoir site and the Neosho River to near the Oklahoma border or approximately 190 river miles of the approximately 350-mile long Neosho River.

The purpose of this SEIS is to assess potential significant environmental impacts of water storage reallocation and the higher conservation pool elevation. As addressed under CEQ regulations, an environmentally preferred alternative is identified in Chapter 2.0. For purposes of the NEPA analysis, direct environmental consequences or impacts are those associated with the USACE water storage reallocation actions and the No Action Alternative; indirect environmental impacts are associated primarily with an alternative to dredge sediments; and cumulative environmental impacts are associated with other activities in the drainage basin. The USACE will consider all environmental impacts identified in the SEIS in its decision process before issuing a Record of Decision.

The USACE, acting as the lead agency, will use the SEIS in its consideration of water storage reallocation. A mitigation monitoring and reporting program will be required for reporting or monitoring mitigation measures that are adopted and will become a condition of project approval. This SEIS is intended to provide decision makers, responsible agencies, and citizens with enough information on the potential range of environmental impacts to make decisions on the alternatives analyzed in the document.

Other project-related studies have been or are being undertaken, including the preparation of the Flint Hills National Wildlife Refuge Comprehensive Conservation Plan, SUPER modeling performed for the John Redmond Sediment Redistribution Study; United States Geological Survey (USGS) studies of channel widening and low-volume dams; a Biological Assessment of the proposed action and alternatives to threatened or endangered species identified as present in the project area; annual census for waterfowl and raptor populations; and research performed to study the distribution, abundance, and life history of threatened or rare fish and mussel species.

The SEIS process is designed to involve the public in federal decision making. Opportunities to comment on, and participate in, the process were provided during preparation of this draft

SEIS early in 2001. Comments from citizens and agencies were solicited to help identify the primary issues associated with the water storage reallocation project. Public meetings and workshops were held as part of the water storage reallocation process to obtain comments on the alternatives under consideration and to identify favorable elements or offer differing opinions. The public input, as well as feedback from the appropriate resource and permitting agencies, will be used to evaluate the alternatives and environmental impacts prior to final decisions.

Scoping Process

The purpose of scoping is to identify potential environmental issues and concerns regarding water storage reallocation. The scoping process for the SEIS included public notification via the *Federal Register*, newspaper advertisements, direct mail, and two public meetings and workshops. The USACE considered comments received during the scoping process in determining the range of issues to be evaluated in the SEIS.

In accordance with NEPA requirements, a Notice of Intent (NOI) to prepare a SEIS was published in the *Federal Register*. The USACE received 17 comment forms, letters, electronic mail, and a petition during the scoping period in response to the NOI and public meetings. These written comments addressed the reallocation agreement, flood control storage loss, dredging, dam safety, wildlife management and wildlife habitat improvement, recreation, and an area of driftwood accumulation in the Neosho River that is locally dubbed the logjam. A more detailed summary of the written scoping comments is included in Chapters 1.0, 7.0, and Appendix A.

As part of the SEIS scoping process, the USACE held public meetings in Burlington and Chetopa, Kansas (March 29, 2001and April 5, 2001, respectively). The public meetings or workshops were designed to inform citizens about the water storage reallocation alternatives and to solicit public participation and comments. In addition to these meetings, another meeting was held with the Neosho Basin Advisory Committee on March 16, 2001. Two written comments were received during the meetings, however, attendees could obtain comment forms to fill out and return at a later date. Because of the scoping meetings and receipt of written comments, an alternative to dredge sediments from the conservation pool was also evaluated per the following summary of alternatives.

Proposed Alternatives

Alternatives studied for water storage reallocation included: no action, raise the conservation pool elevation by two feet, raise the conservation pool by two feet incrementally, and dredge the sediments from the conservation pool.

Under the no action alternative, the dam and reservoir would be operated as currently and there would be insufficient water supply storage at the design life to meet contractual agreements. This alternative provides the benchmark or project baseline to compare the magnitude of environmental effects of the other alternatives.

The preferred alternative is to reallocate water storage in the conservation pool by two feet in a single pool raise. Raising the water stored from elevation 1,039.0 feet to 1,041.0 feet would achieve the water storage obligation. However, the current water supply agreement with the KWO allows for conservation pool adjustments of 0.5 feet.

Another alternative is to reallocate water storage in the conservation pool by two feet in increments of 0.5-foot, 0.5-foot, and one-foot. Raising the water stored from 1,039.0 feet to 1,041.0 feet would achieve the water storage obligation. However, the current water supply agreement with the KWO allows for conservation pool adjustment of 0.5 feet.

A final alternative is to dredge sediments from the conservation pool and forego a raise in the pool elevation. Potential dredging activities could be mechanical or hydraulic, the latter producing much larger quantities of spoil. Dredging requires identification of a disposal site, haul roads and routes, and possible long-term disposal site maintenance.

The SEIS provides a description of existing environmental conditions in the Neosho River drainage including John Redmond Dam and Reservoir. Existing conditions are described for the following resource categories: geology, soils, hydrology, water resources, biological resources, air quality, aesthetics, prime or unique farmlands, socioeconomic resources, cultural resources, and hazardous, toxic, or radiological wastes.

Environmental Consequences

The SEIS evaluates potential environmental consequences of the water storage reallocation alternatives. The report compares potential environmental impacts with NEPA and CEQ impact significance thresholds for each of the environmental resource categories described under Section 3.0 “Description of the Affected Environment.” The environmental consequences of the alternatives described above are summarized in Table ES-1.

Table ES-1. Summary of Potential Significant Environmental Consequences and Mitigation Measures

Environmental Resource	No Action Alternative	Dredge John Redmond Lake Alternative	Phased Pool Storage Reallocation Alternative	Proposed Action: Storage Reallocation
Geology and Soils	No insignificant or significant impacts; no mitigation measures would be required.	Long-term, insignificant or significant adverse depending upon mitigation.	Long-term insignificant adverse; no mitigation would be required.	Long-term insignificant adverse; no mitigation would be required.
Hydrology and Water Resources	Long-term significant adverse; mitigation measures would be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Short-term insignificant or significant adverse; mitigation measures may be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Long-term insignificant adverse; no mitigation measures would be required.
Biological Resources	No insignificant or significant impacts; no mitigation measures would be required.	Long-term insignificant beneficial; no mitigation measures would be required. Short-term insignificant and long-term significant adverse; mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse, and long-term significant beneficial and adverse; mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse, and long-term significant beneficial and adverse; mitigation measures would be required.
Air Quality	No insignificant or significant impacts; no mitigation measures would be required.	Short-term insignificant adverse impacts; mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.
Aesthetics	No insignificant or significant impacts; no mitigation measures would be required.	Short- and long-term insignificant adverse; mitigation measures may be required.	Short-term insignificant adverse; no mitigation measures would be required.	Short-term insignificant adverse; no mitigation measures would be required.
Prime or Unique Farmlands	No insignificant or significant impacts; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.
Socioeconomic Resources	Long-term insignificant adverse; no mitigation measures would be required. Short- and long-term significant adverse; mitigation measures would be required.	Short-term significant beneficial and short-term insignificant adverse; no mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse; no mitigation measures would be required. Short and long-term significant beneficial and adverse; mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse; no mitigation measures would be required. Short and long-term significant beneficial and adverse; mitigation measures would be required.
Cultural Resources	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.

Environmental Resource	No Action Alternative	Dredge John Redmond Lake Alternative	Phased Pool Storage Reallocation Alternative	Proposed Action: Storage Reallocation
Hazardous, Toxic, or Radiological Wastes	No insignificant or significant impacts; no mitigation measures would be required.	Short-term insignificant adverse; no mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.
Cumulative Impacts	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.

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1.0 PURPOSE AND NEED FOR THE ACTION

1.1 Introduction

This Supplemental Environmental Impact Statement (SEIS) addresses the Water Supply Storage Reallocation Project for John Redmond Lake (JRL), Kansas, and the proposed alternatives. The SEIS has been prepared by the United States Army Corps of Engineers, Tulsa District (USACE) in accordance with the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. § 4332 (1994).

The USACE project manager operates the John Redmond Dam and Reservoir under the direction of the Operations Division, Tulsa District. It is a multi-purpose dam project filled in 1964 and authorized for flood control, water supply, water quality, recreation, and fish and wildlife habitat. In addition to site management by the USACE, leases have been signed with other federal (United States Fish and Wildlife Service) and state (Kansas Department of Wildlife & Parks) agencies to provide land management for the Flint Hills National Wildlife Refuge (FHNWR) and the Otter Creek Wildlife Area (OCWA) (USACE 1976).

The John Redmond Dam is located on the Neosho River, about three miles north and one mile west of Burlington, Kansas (KS) (Figure 1-1). Other communities in the vicinity of the dam and reservoir include New Strawn, Hartford, Neosho Rapids, Jacob's Landing, and Ottumwa, KS. Downriver effects on the Neosho River to the vicinity of Grand (Pensacola) Lake (Lake O' the Cherokees) are also examined in the SEIS. The Neosho and Spring Rivers join near Miami, Oklahoma (OK) to form the Grand River, approximately ten miles upriver of Grand (Pensacola) Lake (GRDA 2001) (Figure 1-1).

The State of Kansas and the federal government entered into a water supply agreement at JRL to provide water for the Cottonwood and Neosho River Basins Water Assurance District Number 3 (CNRB) and the Wolf Creek Generating Station (WCGS). The CNRB includes 12 cities and four industrial water users (Lewis, pers. com. 2001). An estimated 34,900 acre-feet of storage remaining after 50 years of sedimentation (design life = Calendar Year [CY] 2014) forms the basis of the 1975 agreement (USACE 1976). Water storage was to occur within the conservation pool at the 1,039.0-foot elevation; however, recent Tulsa District Office studies have determined that sediment has been deposited unevenly within JRL, both for the predicted amount and location of sediment deposition. The sediment is accumulating in the conservation pool while the flood control pool has experienced less than predicted sedimentation rates (Figure 1-2).

1.2 Purpose and Need for Action

The purpose of the proposed federal action is to provide an equitable redistribution (reallocation) of water storage between the flood control and conservation pools of JRL and for NEPA compliance to determine the potential significant environmental impacts of the reallocation. The need for the proposed federal action is because the USACE has been directed by congress to provide the redistribution due to the uneven sediment deposition, which has resulted in an approximately 25 percent reduction in the JRL water supply capacity at design life. Most of the sediment deposition has been below the top of the current conservation pool that lies at elevation 1,039.0 feet.

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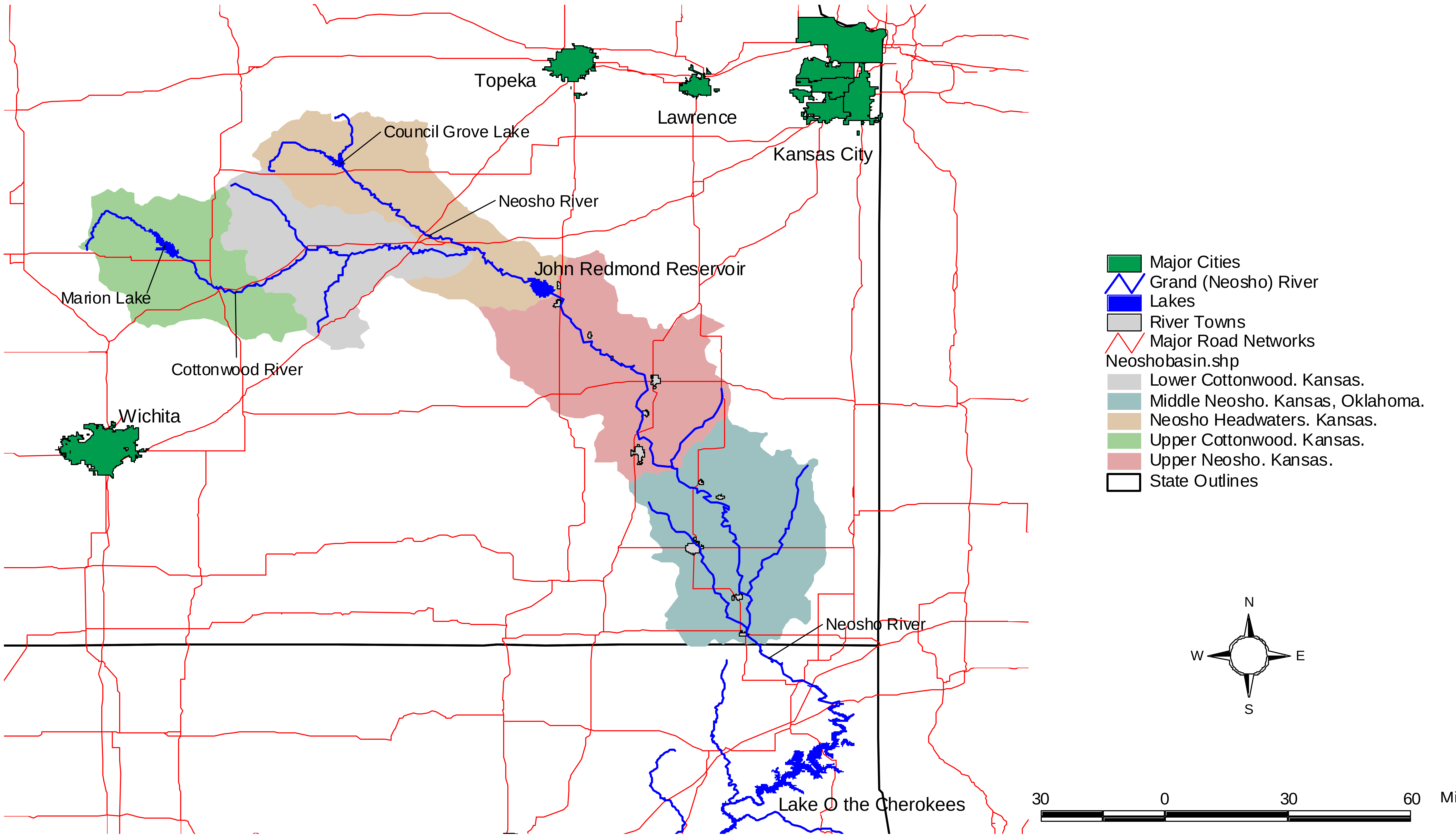

Figure 1-1. Location Map for John Redmond Dam, Lake, and the Neosho River to the Grand (Lake O' the Cherokees) Reservoir

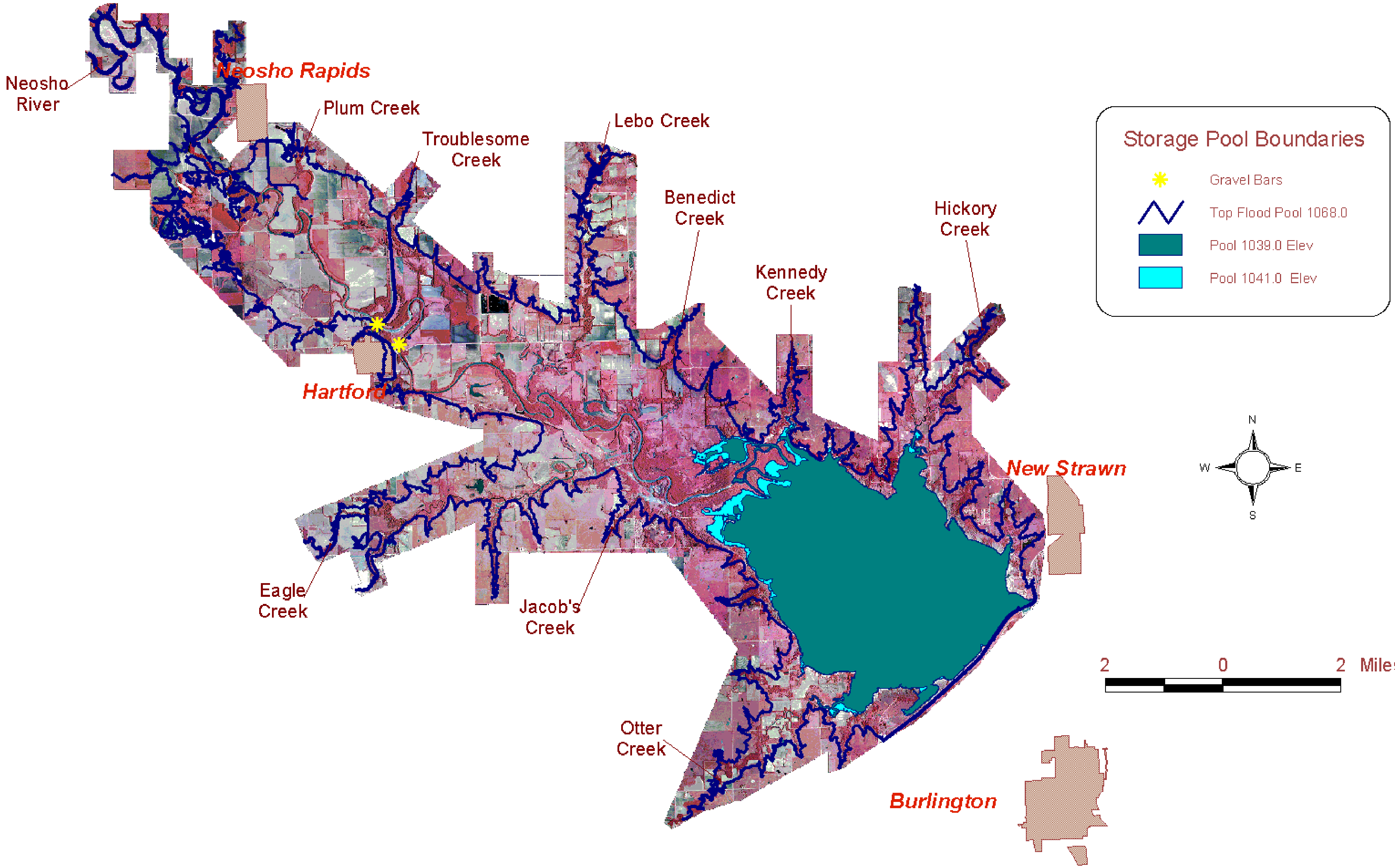

Figure 1-2. John Redmond Lake Site
Conservation and Flood Control Storage Pool Boundaries

For the purpose of the SEIS, the project area is defined as the JRL site, including all leased lands of FHNWR (18,545 acres) and OCWA (1,472 acres), and the Neosho River to near Grand Lake, OK. The JRL site, including leased lands, covers approximately 29,801 acres and the Neosho River downstream of John Redmond Dam is approximately 190 river miles (Figure 1-1).

The USACE will use the SEIS in its consideration of reallocation of water storage per the request of congress. As required under the Council on Environmental Quality (CEQ) Regulations (40 CFR § 1502.14 (e)), a preferred alternative is identified in Chapter 2.0 “Description of Proposed Action and Alternatives.” For purposes of the NEPA analysis, direct environmental consequences/impacts, both positive and negative, are those associated with the USACE water storage reallocation and the No Action Alternative; indirect environmental impacts are associated primarily with an alternative to dredge sediments; and cumulative environmental impacts are associated with other activities in the drainage basin.

1.3 Public Information and Involvement

The Environmental Impact Statement (EIS) process is designed to involve citizens in federal and local decision making. As required by CEQ regulations for implementing NEPA (40 CFR 1500–1508), the USACE provided for an early and open scoping process to determine issues to be addressed and those considered significant to concerned citizens, organizations, and agencies. Public involvement opportunities to date include the SEIS notification process, the Notice of Intent (NOI) and the opportunity to comment on the NOI, and interagency and public scoping meetings. The public input, as well as feedback from resource and permitting agencies, will be used to evaluate the alternatives and environmental impacts prior to making final decisions. Sections 1.3.1 and 1.3.2 provide more information on the public coordination process. Additionally, public hearings will be held on the Draft SEIS (DSEIS) following the requisite comment period.

1.3.1 Public Information and Involvement

The purpose of scoping is to identify potential environmental issues and concerns regarding the water storage reallocation project. The scoping process for the SEIS included public notification via the *Federal Register*, newspaper advertisements, direct mail, and two public meetings. The USACE considered comments received during the scoping process in determining the range of issues to be evaluated in the SEIS.

In conformance with the requirements of NEPA (40 CFR 1501.7), a NOI to prepare the SEIS for the JRL Reallocation Study, Kansas, was published in the *Federal Register* on April 7, 2001 (Appendix A). Alternatives to be evaluated were identified in the NOI as the No Action, and two alternatives to raise the lake's conservation pool water level by two feet to accommodate for sediment buildup. Significant issues to be addressed in the SEIS were identified as potential impacts to:

- The Flint Hills National Wildlife Refuge;
- Recreation and recreational facilities;
- Structures of the dam;

- Fish and wildlife resources within, above, and below the lake;
- Downstream flows on the Neosho River; and
- Other impacts identified by the public, agencies, and USACE studies.

The scoping period ended on June 1, 2001.

Two public scoping meetings were held in conjunction with the NOI. The first meeting was held on March 29, 2001, in Burlington, KS, and the second meeting was held on April 5, 2001, in Chetopa, KS. In addition to these public scoping meetings, another meeting was held with the Neosho Basin Advisory Committee on March 16, 2000.

The purpose of these meetings was to inform the public of the upcoming water supply reallocation study and to allow citizens an opportunity to comment on the proposed two-foot raise in the conservation pool water level at JRL. An advertisement for the scoping meetings was placed in the *Coffey County Republican* newspaper on March 14, 2001. Press releases were sent to 47 newspapers, and radio and television stations for publication or announcement (Appendix A). Copies of the presentation and handout materials are also included in Appendix A.

1.3.2 Summary of Public Involvement

Burlington, Kansas

Thirty individuals representing the public, county agencies, and state agencies attended the scoping meeting held in Burlington, KS. Only two written comments were received at the meeting, but attendees could also obtain comment forms to fill out later and return by mail. The following is a synopsis of the concerns expressed by attendees of the Burlington, KS meeting:

- Remove the logjam at Jacob's Creek.
- Cut a channel around the logjam.
- Logjam creates a higher pool in the upper reaches of the lake.
- Removal of the logjam would permit water to enter the conservation pool.
- Include seasonal pool management plan in the reallocation study.
- Keep riffles at Hartford clean for madtom habitat.
- Concern for flooding Neosho madtom habitat.
- Operations Division should clean out logjam, as done in early years.
- Logjam is causing increased flooding off USACE property upstream of JRL, around flood pool lands, and upstream to Emporia, KS.
- Determine if the increased conservation pool limit Kansas Department of Wildlife and Parks (KDW&P) seasonal pool manipulation plans.
- Raising the conservation pool will adversely impact the KDW&P OCWA Management Area (1,600 acres) and make it flood more frequently.
- More damage to crops due to increased flooding because of conservation pool raise.
- Animals are being forced out of their habitat because of higher water levels (i.e., increasing crop damage and increasing car/deer accidents).

- Stream bank caving caused from the way the USACE operates JRL, losing cushion of extra flood control storage.
- Should build detention ponds above JRL to trap sediment as was promised before JRL was built.
- Build Cedar Point Lake like the USACE was supposed to.
- Increase in conservation pool will increase the duration and frequency of flooding on easement lands.
- K-130 bridge increases backwater effects.
- High pools isolate non-easement lands preventing farmers from harvesting crops.

The USACE has also received a petition (2001, specific date unknown) signed by 101 individuals from Jacobs Creek, Burlington, Emporia, Hartford, and Neosho Rapids, KS. The petition requests the removal of a logjam 0.9 miles east of the Jacobs Creek (Strawn) boat ramp. The petitioners state that the logjam is causing road and property flooding (Appendix A).

Chetopa, Kansas

Thirty individuals representing farmers, pecan growers, the City of Chetopa, and a representative from Congressman Coburn's office attended the meeting in Chetopa, KS. Most attendees were in opposition to any action that would result in a reduction of flood-control storage, no matter how slight. No written comments were received at the meeting, but attendees could obtain comment forms to fill out later and return by mail. The following is a synopsis of the concerns expressed by attendees of the Chetopa, KS meeting:

- There has been an increase in stream bank caving on the Neosho River caused by the way the USACE operates JRL for flood control.
- The flood pool is already insufficient.
- A loss of flood control in JRL will increase the duration and frequency, flooding lands downstream on the Neosho River.
- The only real solution to sedimentation in the lake is dredging the reservoir.
- JRL's only purpose is flood control — all other uses are subservient to flood control or are extraneous.
- The only reason the USACE wants to raise the water level is for the duck hunter.

The USACE received 17 comment forms, letters, and electronic mail during the scoping period in response to the NOI and/or public meetings. The content of the comments, similar to the concerns expressed at the public meetings, are summarized below and are presented in Table 1-1:

- Three generally for the two-foot raise in water level.
- Nine opposed due to loss of flood-control storage.
- Three stated that the lake should be dredged.
- One stated that a raise in the water level would make the dam unsafe.
- Two noted that wildlife management and habitat improvement should be a key part of the project.

- Two noted that habitat would be negatively impacted.
- Two noted that the project would improve recreational opportunities.
- One was opposed to the project because it was being done strictly to benefit recreation.
- Three stated that the logjam needs to be removed.

1.4 Environmental Setting

1.4.1 Climate and Topography

The JRL project area is influenced by a continental climate with average annual precipitation of approximately 35 inches in the vicinity of Emporia, KS, 40 inches at Chanute, KS, and 43 inches at Miami, OK (USACE 1996, NRCS 1982, NOAA 2001). Precipitation is heaviest from late spring through early summer, with about 75 percent falling during the growing season. Temperatures range from below zero (-30^{o} F was recorded historically at Chetopa, KS) to above 100^{o} F (117^{o} F was recorded historically at Columbus, KS) and the winds are predominantly from the south averaging approximately 12 mph (FHNWR 2000, NRCS 1990 and 1985). Evaporation rates ranged from approximately 73 inches during normal years to approximately 111 inches during drought years in the vicinity of Emporia, KS (USACE 1996).

The topography is that of a broad flood plain within low, rounded hills. The hills result from generally westerly to northwesterly dipping strata that create resistant bend and irregular cuesta-like ridges (FHNWR 2000). The broad, shallow Neosho River Valley is the most prominent topographical feature on the landscape. The maximum relief is about 225 feet in the dam and reservoir area, with most of the site ranging from approximately 1,020-foot elevation near the South Recreation Area below the dam to approximately the 1,100-foot elevation west of Neosho Rapids, KS, within the northwestern-most flood pool boundary. The lowest elevations are downriver near the Lake O' the Cherokees (Grand (Pensacola) Lake) where the Grand (Pensacola) Lake surface elevation lies at approximately 742 feet (GRDA 2001).

The Neosho and Spring Rivers join to form the Grand River, approximately ten miles southeast of Miami, OK. The Grand River receives drainage from tributaries on the western slopes of the Ozark Mountains. The river channel varies from one to two miles in width and flows through rolling hills topography (GRDA 2001).

Table 1-1. Written Scoping Comments

Letter No.	Agency/Organization/ Individuals	Comment	Where Discussed in the EIS – Section	Page
1	Kevin Wellnitz Neosho Rapids, KS	Raising the conservation pool would lead to more frequent flooding of longer duration, which would lower property values.	3.3 3.8.3 3.8.4 4.3	3-3 to 3-16 4-5 to 4-8 3-65 to 3-68 3-68, 69
		Maintenance below the bridge north of Hartford on K-130 is poor. Trees are growing under the bridge obstructing water flow causing water on the west side of K-130.	3.8.4 4.8.6	3-68, 69 4-25
2	Robert Withrow Chetopa, KS	Opposed to raising the conservation pool that would result in loss of flood storage.	3.3 3.8.3 3.8.4	3-3 to 3-16 3-65 to 3-68 3-68, 69
3	Jane Bicker Chetopa, KS	Opposed to raising the conservation pool that would result in loss of flood storage.	3.3 3.8.3 3.8.4	3-3 to 3-16 3-65 to 3-68 3-68, 69
4	Jeff Jackson Columbus, KS	Opposed to raising the conservation pool that would result in loss of flood storage.	3.3 3.8.3 3.8.4	3-3 to 3-16 3-65 to 3-68 3-68, 69
5	Linda Jackson Chetopa, KS	Opposed to raising the conservation pool that would result in loss of flood storage.	3.3 3.8.3 3.8.4	3-3 to 3-16 3-65 to 3-68 3-68, 69
6	Irene & David Elmore Chetopa, KS	Opposed to raising the conservation pool that would result in loss of flood storage.	3.3 3.8.2 3.8.3 3.8.4	3-3 to 3-16 3-60 to 3-65 3-65 to 3-68 3-68, 69
7	Delbert Johnson Oswego, KS	It would be cheaper to dredge the lake than the cost of resulting flood damage.	4.8.1	4-18
		A higher water level would make the dam unsafe.	1.4.3	1-10, 11
8	Henry Bell Chetopa, KS	Release the water from John Redmond when it begins to rain to prevent additional flooding after a flood.	3.3.2 3.3.3	3-6 to 3-9 3-10 to 3-16
		Opposed to raising the pool for hunting and boating.	3.4.6 3.8.2	3-47 to 3-50 3-61 to 3-65

Letter No.	Agency/Organization/ Individuals	Comment	Where Discussed in the EIS – Section	Page
9	Jack Dalrymple Miami, OK	The flood pool is already insufficient. The Corps has had to make releases in excess of channel capacity. Reducing flood storage capacity would further exasperate the situation resulting in a negative impact downstream.	3.3.2 3.3.3 3.8.2	3-6 to 3-9 3-10 to 3-16 3-61 to 3-65
		Compensating for sedimentation in the conservation pool sets a dangerous precedent. The only solution is dredging.	2.3 3.3 4.8.1	2-2 3-3 to 3-16 4-18
10	W. P. Zimmerman Welch, OK	Any raise in the lake level will decrease flood control. Dredge the sediment.	2.3 3.3 3.8.3 3.8.4 4.8.1	2-2 3-3 to 3-16 3-65 to 3-68 3-68, 69 4-18
11	W.K. Nielsen Emporia, KS	Encourage raising the level of the conservation pool.	Comment Noted.	
12	No name	Neosho madtom habitat will be flooded.	3.4.5	3-43, 44
13	Deborah Wistrom Hartford, KS	Raising the lake level will not stop the existing logjam problem.	3.3.2 3.3.6	3-10, 20, 21 3-25
	Leonard Jirak Hartford, KS	Include pool management for fish and wildlife. Riffles below Hartford need to be periodically flushed to ensure good habitat for madtom.	3.3.3 3.3.6 3.4.4	3-10, 20, 21 3-25, 26 3-39, 40
	Bob Culbertson New Strawn, KS	Manage pool levels with drawdowns for wildlife on a regular basis.	2.5 3.3.2 3.4.4 3.4.5 5.1	2-3 3-9 3-38 to 3-40 3-43, 44 5-2
14	Larry Bess Emporia, KS	Fishing has deteriorated over the past several years due to reduction of riffle areas and silting. Raising the lake level will result in more silt.	3.3.3 4.8.3	3-16 to 3-21 4-21, 22
15	Ron Casey Hartford, KS	The logjam is causing the banks to erode and drop more trees, making the logjam bigger.	3.3.3 3.3.6 3.4.4	3-10, 30, 21 3-25 3-39, 40
		The current lake level is not deep enough to boat on.	3.8.2 3.8.3	3-63 to 3-65 3-67, 68
16	Terry Emmons Hartford, KS	The lake level should be raised 2 to 3 feet.	Comment Noted	
		Clear the logjam to allow easier movement of the fish, and for boating access.	3.3.3 3.3.6 3.4.4	3-10, 20, 21 3-25, 26 3-39, 40
17	Ben Cuadra Waverly, KS	Supports the raising of the pool to increase boating access.	3.8.2 3.8.3	3-63 to 3-65 3-67, 68

1.4.2 Land Ownership and Land Management in the Planning Area

Most of the lands of the Neosho River flood plain downstream of John Redmond Dam are privately owned. Approximately 29,801 acres of land are owned by the USACE; this land is upriver from and includes John Redmond Dam and outlet structures. The USACE project manager operates the dam and reservoir under the direction of the Operations Division, Tulsa District. The principal regulation/management issue identified historically was riverbank erosion that occurs after periods of high flows in the Neosho River below the dam. To minimize any riverbank erosion, releases are decreased as slowly as possible to slow the rate of fall in the river stage, since this erosion has been attributed to the fast rate of fall from natural and regulated flows (USACE 1996). However, recent research determined that aside from localized channel widening, there was little post-dam construction change in bank-full channel width on the Neosho River below John Redmond Dam (Juracek 1999).

The USACE maintains six public-use areas, five of which have recreation parks providing camping, picnic areas, drinking water, and sanitary facilities (USACE 1996). Additional recreation facilities present on USACE-managed lands include five boat ramps, an overlook, and a swimming beach. In addition to site management by the USACE, leases have been signed with the U.S. Fish and Wildlife Service (USFWS) and KDW&P to provide land management for the FHNWR and OCWA.

FHNWR was established in 1966 and consists of approximately 18,545 acres located on the upriver portion of JRL (FHNWR 2000). The refuge is managed primarily for migratory waterfowl and shorebirds. OCWA was established in 1966 and consists of approximately 1,472 acres adjacent to FHNWR and the southeast portion of John Redmond Dam. This wildlife area is managed primarily for big game and upland species: white-tailed deer, wild turkey, mourning dove, bobwhite quail, cottontail rabbit, and squirrel.

Permitted activities on the FHNWR include wildlife observation, hiking and sightseeing, photography, boating, picnicking, camping, fishing, hunting, wild food gathering, and fish bait collection. Interpretive trails are present and include Dove Roost Trail and the Headquarters Trails. OCWA provides wildlife observation, sightseeing, photography, boating, fishing, and hunting opportunities.

1.4.3 Project Development History

The project was authorized as the Strawn Dam and Reservoir under the Flood Control Act of 17 May 1950 (Public Law 516, 81st Congress, Chapter 188, 2nd Session) (USACE 1976). It was to provide flood control, water conservation, recreation, and water supply. The project was renamed John Redmond Dam and Reservoir by an Act of Congress (Public Law 85-327, 85th Congress, HD 3770, 15 February 1958). Construction of John Redmond Dam began in June 1959, and final water storage began during September 1964 (USACE 1976 and 1996).

John Redmond Dam (Figure 3-12, Section 3.6) is an integral component of a three-dam and reservoir system that includes Council Grove Reservoir, also on the Neosho River, and Marion Reservoir on the Cottonwood River (USACE 1976). The drainage area occupied by all three dams is 3,015 square miles, of which 2,569 square miles below Council Grove and

Marion Reservoirs is uncontrolled and drains directly to JRL. The following data and Table 1-2 presents the post-construction JRL baseline. Specific physical data describing the dam (USACE 1996), include:

- Earthfill Dam Structure: 20,740 feet long (not including spillway); dam top = 1,081.5 feet National Geodetic Vertical Datum (NGVD); maximum height = 86.5 feet above the Neosho River bed; crest width = 35 feet 7 inches.
- Spillway: located near left abutment; concrete chute, gated ogee weir; crest elevation = 1,033.0 feet NGVD; length = 560 feet; control = 14 (40 ft. x 35 in.) tainter gates; hoists are individual electric motors.
- Outlet Works: two 24-inch circular pipes for low flow; one 30-inch circular pipe for water supply; invert elevation = 1,015.5 feet NGVD; invert placed through left abutment of spillway; control = motor-operated butterfly valves for low flows and manually-operated gate valves.
- Land Acquisition: taking line is semi-blocked to elevation 1,063.0 feet; easement is elevation 1,073.0 feet or limits of backwater envelope curve.

Table 1-2. Project Elevations, Surface Areas, and Storage Volumes (Source: USACE 1996)

Project Feature	Elevation in Ft. NGVD	Surface Area in Acres	Storage Volume in Acre-Ft.[1]	Spillway Capacity (cfs)
Top of Dam	1081.5	58,187	1,171,000	732,000
Maximum Pool	1074.5	43,106	807,941	575,000
Surcharge Pool	1073.0	41,111	748,977	542,000
Flood Control Pool	1068.0	34,331	574,918	430,000
Conservation Pool	1039.0	8,084	50,501	25,000
Spillway Crest	1033.0	4,801	9,980	0
Inactive Pool	1020.0	0	0	–
Streambed – Dam	995.0	–	–	–
Flood Control Storage	1039.0 – 1068.0	–	524,417	–
Conservation Storage	1020.0 – 1039.0	–	50,501	–

(1) Based on runoff from uncontrolled drainage area of 2,569 mi^2 (top of dam = 8.55 in. and spillway crest = 0.11 in. of precipitation). Based on 2000 resurvey date.

1.5 Relevant Federal, State, and Local Statutes, Regulations, and Guidelines

The SEIS has been written in compliance with recognized federal and state guidelines, regulations, and statutes presented as Table 1-3. Further identification and descriptions of applicable environmental laws and regulations are presented in Section 6.0.

Table 1-3. Relevant Laws and Regulations

Environmental Law or Regulation	General Description
National Environmental Policy Act of 1969, as amended (NEPA)	Requires the disclosure of the environmental impacts of any major federal action.
Council on Environmental Quality Regulations, Implementing NEPA	The CEQ was established by NEPA and consists of three members appointed by the president to 1) analyze and interpret environmental trends and information, 2) appraise programs and activities of the federal government under NEPA, 3) be aware of and responsive to the scientific, economic, social, aesthetic, and cultural needs and interests of the nation, and 4) formulate and recommend national policies to promote the improvement of the quality of the environment.
Clean Water Act of 1977, as amended	Provides the principle framework for national, state, and local efforts to protect water quality, including protection of wetlands.
Executive Order 11988 of 1977, Flood Plain Management	Federal agencies are directed to consider the proximity of their actions to or within flood plains, to 1) reduce the risk of flood damage, 2) minimize the impacts of floods on human safety, health, and welfare, and 3) restore and preserve the natural and beneficial values served by flood plains.
Kansas Administrative Regulations 28-16-28c, Surface Water Quality Standards	General provisions state that no degradation of water quality by artificial sources shall be allowed that would have harmful effects on threatened or endangered aquatic life in a critical habitat.
Executive Order 11990 of 1977, Protection of Wetlands	Requires federal agencies to minimize or avoid wetland destruction, loss, or degradation and to preserve and enhance natural and beneficial wetland values.
Endangered Species Act of 1973, as amended	Requires federal agencies that fund, authorize, or implement actions to avoid jeopardizing the continued existence of federally listed, threatened, or endangered species, or destroying or adversely affecting their critical habitat.
Clean Air Act of 1970, as amended	Provides the principle framework for national, state, and local efforts to protect air quality.
Kansas Administrative Regulations 28-19-17, Prevention of Significant Deterioration of Air Quality	Applies to the construction of major stationary sources and major modifications of stationary sources in areas of the state designated as attainment areas or unclassified areas for any pollutant under the procedures prescribed under the federal Clean Air Act of 1970, as amended.

Environmental Law or Regulation	General Description
Antiquities Act of 1906	Authorizes the scientific investigation of antiquities on federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.
National Historic Preservation Act of 1966, as amended	Establishes as policy that federal agencies are to provide preservation of the nation's prehistoric and historic resources, and establishes the National Register of Historic Places.
Archaeological Resources Protection Act of 1979, as amended	Protects materials of archaeological interest from unauthorized removal or destruction and requires federal managers to develop plans and schedules to locate them.

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 Introduction

The proposed water supply storage reallocation project for JRL and alternatives to the proposed action are described in this section. NEPA requires that an EIS objectively evaluate a reasonable range of alternatives that are practical or feasible from a technical and economic perspective, and based on common sense (46 FR 18026, as amended, 51 FR 15618). All of the alternatives evaluated herein meet the basic project goal of providing 34,900 acre-feet of water storage in the conservation pool of JRL.

In 1975, the State of Kansas and the federal government entered into a water supply agreement at JRL to provide water for the CNRB and the WCGS. The CNRB includes 21 municipal and industrial water users (Lewis, pers. com. 2001).

Construction of John Redmond Dam began in June 1959, and final water storage began during September 1964 (USACE 1976 and 1996). John Redmond Dam is an integral component of a three-dam and reservoir system that includes Council Grove and Marion Reservoirs. The three structures provide flood control, water supply, water quality, recreation and other benefits to the Neosho River Basin. The conservation pool of JRL was filled to its initial elevation of 1,036.0 feet during November 1964, and was raised to the current 1,039.0-foot elevation during April 1976. The CNRB and Western Resources, the operators of WCGS, have contracted with the State of Kansas for all the water supply storage in the reservoir (USACE 1996). The WCGS pumps water from the Neosho River below the dam structure to store in the Coffey County Fishing Lake, approximately three miles east of the John Redmond Dam. The remaining water users divert flows using low-elevation dams and/or pump the water from the river.

An estimated 34,900 acre-feet of storage remaining after 50 years of sedimentation (CY 2014) forms the basis of the 1975 agreement (USACE 1996). Water storage was to occur within the conservation pool (1,020.0 to 1,039.0-foot elevation); however, studies have determined that sediment has been deposited unevenly within JRL, both for the predicted amount and location of sediment deposition. The sediment is accumulating in the conservation pool while the flood control pool has experienced less than predicted sedimentation. The uneven sediment distribution has depleted storage available for water supply purposes and is infringing upon the water supply agreement obligations.

A recent Tulsa District water supply yield analysis indicated a 25 percent reduction in the water supply capacity at design life (CY 2014) because of the disproportionate sediment deposition. Most of the sediment deposition has been below the top of the current conservation pool (elevation 1,039.0 feet). The USACE has been directed by congress to study an equitable redistribution (reallocation) of water storage between the flood control and conservation pools. Therefore, the USACE is evaluating the alternative actions described in this section to resolve the depleted water storage situation. The actions proposed to resolve the water storage issue at JRL are:

- Proposed (Preferred) Action: storage reallocation in a single pool raise
- Dredge John Redmond Lake
- Storage reallocation in a phased pool raise
- No Action

2.2 Proposed (Preferred) Action: Storage Reallocation in a Single Pool Raise

The water supply agreement with the Kansas Water Office (KWO) allows for pool adjustments in 0.5-foot increments. This alternative would raise the conservation pool from elevation 1,039.0-feet NGVD, to elevation 1,041.0-feet NGVD in a single pool raise. To achieve this raise requires only an adjustment of volume control or water elevation at the dam structure.

The Single Pool Raise Alternative would achieve the project goal for storage volume in the conservation pool and is preferred by the USACE.

2.3 Dredge John Redmond Lake

This alternative would remove enough sediment from the conservation pool to provide water supply storage at the existing 1,039.0-foot elevation NGVD.

Potential dredging activities are classified as mechanical and hydraulic; mechanical dredging typically uses hoppers to dig and remove sediments (USEPA 2001). Hydraulic dredging uses a great deal of water to create suction to remove sediments and generates a much greater volume of dredged material that must be disposed or otherwise used. Dredging activities require transportation of the dredged materials to a site or sites approved for their reuse or disposal. Sediments may be used for beneficial purposes or disposed in a landfill. To be used for beneficial purposes, sediments would require an analysis of particle size and sampling for hazardous constituents.

Dredging sediments would achieve the project goal for storage volume in the conservation pool at a lower elevation for the short term; however, sediments would redeposit over time.

2.4 Storage Reallocation in a Phased Pool Raise

The water supply agreement with the KWO allows for pool adjustment in 0.5-foot increments. This alternative would raise the conservation pool from elevation 1,039.0 feet NGVD to elevation 1,041.0 feet NGVD using a phased approach. The first phase would raise the conservation pool elevation to 1,040.0 feet NGVD, the second to 1,040.5 feet NGVD, and the final to elevation 1,041.0 feet NGVD. To achieve this raise requires only adjustments of volume control or water elevation at the dam structure.

The Phased Pool Raise Alternative would achieve the project goal for storage volume in the conservation pool.

2.5 No Action Alternative

The No Action Alternative evaluated in the SEIS is in compliance with NEPA (40 CFR § 1502.14(d)). No Action may be defined as the continuation of an existing plan, policy, or procedure, or as failure to implement an action. The No Action Alternative also provides a benchmark to compare the magnitude of the environmental effects of the various alternatives.

Under the No Action Alternative, the current operating plan for JRL remains in effect with its existing sedimentation and water storage issues. Sediment will continue to accumulate in the conservation pool in lesser amounts in the flood control pool, reducing the water supply capacity at design life by approximately 25 percent. Storage available for water supply purposes in JRL have been depleted by the uneven distribution of sediment such that the water supply agreement obligations with the KWO cannot be met.

With existing conditions, the JRL site will continue to experience wide fluctuations of water levels between flood events and periods of drought. The proposed water level management plan prepared for October 1, 2001 through September 30, 2005 (Le Doux 2000), would remain in effect and would allow an approximately:

- 3-month raise to the 1,041.0-foot elevation (mid-October through mid-January),
- 5.5-month lowering to the 1,039.0-foot level (mid-January through June), and
- 3.5-month lowering to the 1,037.0-foot level (July through September).

2.6 Alternatives Considered but Eliminated

There were no other alternatives considered for developing this supplement to the Final Environmental Impact Statement (FEIS) written in 1976.

2.7 Environmentally Preferable Alternative

NEPA requires that a preferred alternative be identified. The No Action Alternative would have no significant unmitigatible impacts and, for the purposes of NEPA, would be the environmentally preferable alternative. However, the No Action Alternative would be inconsistent with the water storage agreement between the State of Kansas and the federal government. The agreement requires a redistribution of the remaining storage to equitably reallocate the storage between the flood control and conservation pools.

To satisfy the stated Purpose and Need for the project, NEPA requires that the SEIS include a presentation of the alternatives in comparative form to define the issues and to provide a clear basis for choice among options by decision makers and citizens. Table 2-1 lists potential significant impacts and corresponding mitigation measures for each alternative.

Table 2-1. Summary of Potential Significant Environmental Consequences and Mitigation Measures (see page ES-2, Purpose and Need for the Action).

Environmental Resource	No Action Alternative	Dredge John Redmond Lake Alternative	Phased Pool Storage Reallocation Alternative	Proposed Action: Storage Reallocation
Geology and Soils	No insignificant or significant impacts; no mitigation measures would be required.	Long-term, insignificant or significant adverse depending upon mitigation.	Long-term insignificant adverse; no mitigation would be required.	Long-term insignificant adverse; no mitigation would be required.
Hydrology and Water Resources	Long-term significant adverse; mitigation measures would be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Short-term insignificant or significant adverse; mitigation measures may be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Long-term insignificant adverse; no mitigation measures would be required.
Biological Resources	No insignificant or significant impacts; no mitigation measures would be required.	Long-term insignificant beneficial; no mitigation measures would required. Short-term insignificant and long-term significant adverse; mitigation measures would required.	Short- and long-term insignificant beneficial and adverse, and long-term significant beneficial and adverse; mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse, and long-term significant beneficial and adverse; mitigation measures would be required.
Air Quality	No insignificant or significant impacts; no mitigation measures would be required.	Short-term insignificant adverse impacts; mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.
Aesthetics	No insignificant or significant impacts; no mitigation measures would be required.	Short- and long-term insignificant adverse; mitigation measures may be required.	Short-term insignificant adverse; no mitigation measures would be required.	Short-term insignificant adverse; no mitigation measures would be required.
Prime or Unique Farmlands	No insignificant or significant impacts; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.
Socioeconomic Resources	Long-term insignificant adverse; no mitigation measures would be required. Short- and long-term significant adverse; mitigation measures would be required.	Short-term significant beneficial and short-term insignificant adverse; no mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse; no mitigation measures would be required. Short and long-term significant beneficial and adverse; mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse; no mitigation measures would be required. Short and long-term significant beneficial and adverse; mitigation measures would be required.
Cultural Resources	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.

Environmental Resource	No Action Alternative	Dredge John Redmond Lake Alternative	Phased Pool Storage Reallocation Alternative	Proposed Action: Storage Reallocation
Hazardous, Toxic, or Radiological Wastes	No insignificant or significant impacts; no mitigation measures would be required.	Short-term insignificant adverse; no mitigation measures would required.	No insignificant or significant impacts; no mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.
Cumulative Impacts	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.

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3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Introduction

This chapter sets forth the Affected Environment of the proposed action and describes the present physical conditions within the area of the proposed action. The area, or region of influence, is defined for each environmental issue based upon the extent of physical resources that may be affected directly or indirectly by the proposed action and appropriate guidelines of regulatory agencies or common professional practice. Table 3-1 summarizes the environmental issues and associated region of influence described in the Affected Environment sections of the SEIS.

Table 3-1. Environmental Issues and Region of Influence

Environmental Issue	Region of Influence
Geology and Soils	Pool raise area and downriver effects
Hydrology and Water Resources	Pool raise area and downriver effects
Biological Resources	Pool raise area, disposal areas, and downriver effects
Air Quality	Pool raise area and disposal areas
Aesthetics	Pool raise area and disposal areas
Prime or Unique Farmlands	Pool raise area, disposal areas, and downriver effects
Socioeconomic Resources	Pool raise area, disposal areas and downriver effects
Cultural Resources	Pool raise area, disposal areas, and downriver effects
Hazardous, Toxic, or Radiological Wastes	Pool raise area, disposal areas, and downriver effects

Section 3.0 of the SEIS describes the baseline conditions for each environmental resource against which the potential impacts of the proposed action will be compared. Generally, the baseline used for the analysis of environmental impacts under NEPA reflects the conditions present during the year 2000. The original sediment analysis conducted to determine rates and location of accumulation in JRL was performed during 1963 and resurveys were completed in 1974, 1983, 1991, and 1993 (USACE 1996).

3.2 Geology and Soils

3.2.1 Geology

JRL lies among low, rounded hills. The topography is a result of generally westerly to northwesterly dipping strata that creates resistant bend and irregular cuesta-like ridges (FHNWR 2000). The Neosho River Valley and most of the JRL site is composed of Holocene, Post-Kansan alluvium and is bordered by the Pennsylvanian – Virgilian, Waubansee Group on the western end and the Shawnee Group on the eastern end of the site (O'Connor 1953; Merriam 2000). Both the Waubansee and Shawnee Groups are sedimentary exposures, which were deposited in shallow seas and swamps approximately 300 million years ago (FHNWR 2000). Some very small exposures of Tertiary terrace deposits are present at the western end of the conservation pool of the reservoir, above the northern flood plain boundary of the Neosho River (Merriam 2000).

To the west of JRL in the Flint Hills Region are formations of the Permian Period, deposited approximately 250 million years ago (FHNWR 2000). A portion of the sediments deposited as Holocene alluvium along the Neosho River within the JRL project area were eroded from these Permian Formations. The alluvial deposits have been further described as cherty gravel, cobble, and sand with small amounts of boulders and mud present (Obermeyer et al. 1997). Gravel-sized alluvium was most commonly observed along the Neosho River above and below John Redmond Dam and Lake.

3.2.2 Soils

Soils formed within the JRL site and the project area (Table 3-2) are relatively shallow, silty loam and silty, clay loams that are fertile, but low in organic matter and phosphoric acid (FHNWR 2000). Soils form through the physical and chemical weathering of parent material (SCS 1982), and the characteristics of soil thus formed are determined by the:

- physical and mineral composition of the parent material,
- climate under which the soil material has accumulated and existed since accumulation,
- plant and animal life on the soil,
- relief, or topography, and
- length of time the soil forces have acted upon the soil material.

The soil type and amount has been determined for the zone that occurs between reservoir elevation 1,039.0 and 1,041.0. Approximately 570 acres of the soils and the non-soil cover of surface water are present and are listed in Table 3-2.

Table 3-2. Soil Descriptions and Amount Present Between the 1,039.0 ft. and 1,041.0 ft. Elevation Zone of JRL

Soil Type	Acreage	Description
(AeD) Apperson – Dennis Silty Clay Loams, 1–4% slopes	0.15 a	Apperson formed in material weathered from Pennsylvanian Period limestone bedrock; Eram from shale bedrock.
(Db) Dennis Silt Loam, 1–4% slopes	10.23 a	Formed in material weathered from Pennsylvanian Period shale bedrock.
(De) Dennis Silty Clay Loam, 2–5% slopes	8.87 a	Formed in material weathered from Pennsylvanian Period shale bedrock.
(Eb) Eram Silt Loam, 1–3% slopes	0.03 a	Formed in material weathered from Pennsylvanian Period shale bedrock.
(Ec) Eram Silt Loam, 3–7% slopes	0.59 a	Formed in material weathered from Pennsylvanian Period shale bedrock.
(Er) Eram – Collinsville Complex, 4–15% slopes	4.29 a	Eram formed in material weathered from Pennsylvanian Period shale; Collinsville from sandstone bedrock.
(Es) Eram – Schidler Silty Clay Loams, 4–15% slopes	0.93 a	Eram formed in material weathered from Pennsylvanian Period shale bedrock; Schidler from limestone bedrock.
INT	31.05 a	Unknown.

Soil Type	Acreage	Description
(Kb) Kenoma Silt Loam, 1–3% slopes	10.99 a	Formed in old alluvial sediment deposited in the Tertiary and Quaternary Periods, on high terraces and uplands.
(La) Lanton Silty Clay Loam	10.99 a	Formed in recent, loamy alluvial sediment deposited in the Quaternary Period, on floodplains and low terraces.
(Oc) Orthents, Clayey	12.75 a	Surface soil and part or all of the subsoil have been removed and used as fill material in roads, etc.
(Os) Osage Silty Clay Loam	21.98 a	Formed in recent, clayey alluvial sediment deposited in the Quaternary Period, on floodplains and low terraces.
(Ot) Osage Silty Clay	251.50 a	Formed in recent, clayey alluvial sediment deposited in the Quaternary Period, on floodplains and low terraces.
(Sa) Summit Silty Clay Loam, 1-4% slopes	10.26 a	Formed in material weathered from Pennsylvanian Period shale bedrock.
(Vb) Verdigris Silt Loam	62.12 a	Formed in recent, loamy alluvial sediment deposited in the Quaternary Period, on floodplains and low terraces.
(W) Water	118.22 a	Standing water.
(Wo) Woodson Silt Loam	14.97 a	Formed in old alluvial sediment deposited in the Tertiary and Quaternary Periods, on high terraces and uplands.

Source: Soil Surveys of Coffey and Lyon Counties, KS (SCS 1982; SCS 1981) and USACE 2001.

Flood plain soils of the Neosho River below John Redmond Dam are primarily Verdigris silt loam, Verdigris soils—channeled, Osage silty clay loam, Dennis silt loam, Lanton silt loam, and Hepler silt loam to the southern project boundary in OK (NRCS 1982a, 1972, 1978, 1982b, 1990, 1985, 1973). All of these soils are addressed under Section 3.7 "Prime or Unique Farmlands."

3.3 Hydrology and Water Resources

3.3.1 Introduction

The Neosho River is one of the many alluvial rivers draining the semiarid western United States. Approximately 200 tributary streams and creeks deliver water to the Neosho River as it traverses the Neosho Basin in Kansas (KSWR 1999). From its source in the Flint Hills region of east-central Kansas, the Neosho River flows southeasterly for 314 miles to the Kansas border with Oklahoma and drains about 5,973 square miles. Approximately 34 miles south of the border, the Neosho and Spring Rivers join at Grand Lake O' the Cherokees, then flow as the Grand River an additional 130 miles to the confluence with the Arkansas River (Figure 1-1).

Annual precipitation across the Neosho Basin ranges from approximately 30 inches in the northwestern portion (Flint Hills) to approximately 43 inches in the southeastern portion (Miami, OK). The average annual precipitation in the region above John Redmond Dam is approximately 32.5 inches per year. A majority, 71.4 percent of the precipitation falls from April through September, including the major storms of record (Table 3-3) (USACE 1996). Major storm duration averages are approximately six days in the vicinity of John Redmond Dam.

Table 3-3. Major Storms: January 1922 Through December 1994, John Redmond Dam (Source: USACE 1996)

Inclusive Dates	Average Basin Rainfall (in.)	Inclusive Dates	Average Basin Rainfall (in.)
09–15 Mar 1922	4.12	12–18 May 1957	5.08
14–24 May 1923	5.37	12–19 Jul 1959	5.35
03–11 Jun 1923	5.77	30 Sep-05 Oct 1959	4.86
11–15 Sep 1926	4.60	25–31 Oct 1960	4.47
30 Sep-04 Oct 1926	4.57	20–24 Jul 1961	4.70
12–19 Apr 1927	4.41	12–14 Sep 1961	4.26
12–20 Jun 1927	5.94	28 May-03 Jun 1962	6.26
12–16 Aug 1927	5.44	19–25 Sep 1962	5.31
01–05 Jun 1928	4.82	15–19 Nov 1964	4.10
15–17 Nov 1928	5.50	03–10 Jun 1965	7.00
09–11 Jul 1929	4.63	17–21 Sep 1965	4.40
11–17 Nov 1931	5.04	16–24 Jun 1967	7.26
04–08 Jul 1932	5.34	23–26 Jul 1968	4.50
04–09 Sep 1937	4.82	08–20 Jun 1970	4.70
02–06 May 1938	4.51	30 Jun-06 Jul 1971	4.53
19–23 May 1938	5.53	23–30 Jul 1971	4.30
15–16 Aug 1938	4.11	07–19 Jul 1972	5.15
31 May-02 Jun 1941	5.05	03–11 Mar 1973	4.99
01–06 Sep 1941	4.26	21–28 Sep 1973	7.52
16–24 Jun 1942	6.12	16–21 May 1977	4.16
03–05 Sep 1942	5.45	16–24 Jun 1977	4.02
25 May-03 Jun 1950	4.24	08–18 Oct 1985	4.29
09–19 Jul 1950	6.60	27 Sep-04 Oct 1986	4.21
27 Apr-01 May 1951	4.17	16–24 Jul 1992	4.49
09–13 Jul 1951	11.25	07–12 May 1993	4.66
01–06 Sep 1951	4.51	18–22 Jul 1993	7.53
21–27 Sep 1955	5.08		

Prior to 1964, the Neosho River flooded 57 times over a period of 34 years, which prompted many public requests to the USACE for flood protection. The largest of the floods occurred in 1951 and had physical effects on the Neosho River channel that remain observable today (Juracek et al. 2001 and Juracek 2000). The result of petitions for flood protection was the planning of four dams and the design and construction of three dams, e.g., Marion (Cottonwood River) and Council Grove and John Redmond (Neosho River) (Figure 1-1). The Cottonwood River is a major tributary to the Neosho River and the fourth dam, at Cedar Point, was authorized on the Cottonwood River but never constructed (USACE 1976). The project is a part of the authorized seven-reservoir system in the Neosho and Grand Rivers Basin in Kansas and Oklahoma. The associated dam projects in Oklahoma include Pensacola (Grand Lake O' the Cherokees), Fort Gibson, and Markham Ferry (USACE 1976).

Marion Lake has a total storage capacity of 145,500 acre-feet; 59,900 acre-feet are available for storage of floodwater from an approximately 200-square mile drainage basin. Council Grove Lake has a total storage capacity of 114,300 acre-feet; 76,000 acre-feet are available for storage of floodwater from an approximately 246-square mile drainage basin. John Redmond Lake has a total storage capacity of 807,941 acre-feet; 574,918 acre-feet are available for storage of floodwater from an approximately 3,015-square mile drainage basin, with 2,569-square miles uncontrolled below the Marion and Council Grove dams. Downriver from John Redmond Dam to the Kansas border are 2,958-square miles of uncontrolled drainage, with additional uncontrolled drainage from the border to Pensacola Reservoir (Grand Lake O' the Cherokees). All of the lakes provide flood control, maintenance of downstream water quality, water supply storage, recreation, and fish and wildlife habitat.

John Redmond Dam and Reservoir is the integral component of the upper Neosho River system, lying approximately 180 miles downriver from its source, and located at river mile 343.7. This site is approximately three miles northwest of Burlington, KS (Figure 1-2). The dam structure is 20,740 feet long with an average height above the Neosho Valley floor of 60 feet. The lake at the top of the conservation pool is approximately three miles wide at its maximum width. It then extends northwesterly, upriver from the dam, approximately eleven miles for the entire length of the flood control pool.

Water management systems, of which storage and flood control reservoirs form an important part, greatly change the natural flow regime of rivers as well as the properties of the water. The extent of these changes is determined by: 1) the relative size and function of a reservoir, 2) the hydrologic regime of the inflows, 3) the release condition, 4) the geomorphological condition of the reservoir, and 5) the quality of the inflow water.

One management tool used by the USACE to operate the complex hydrology of JRL is the SUPER computer program (SUPER). SUPER simulates the regulation of the multipurpose reservoir system on a daily basis and performs an economic analysis of the simulation. SUPER is capable of modeling specific water scenarios for JRL, but it does so in context of the entire reservoir system. SUPER has been used to model the affect of reallocating flood control storage to water supply storage at John Redmond Dam. The results are used to meet contractual water supply requirements through the year 2014, the end of the original project economic life (USACE 1976). In the various analyses performed using SUPER, the control points were: John Redmond Dam outflow, river gages at Iola and Parsons, KS, and the River gage at Commerce, OK.

The SUPER model was used to simulate regulation of a multi-purpose reservoir system on a daily basis and to perform an economic analysis of the simulation (Hula 1990). The simulation assumed all reservoirs were in place for the entire period of record and that each reservoir operated based on specific operational criteria. The period of record for the Arkansas River system model used was 56 years (January 1940–December 1995). Reallocation to conservation pool elevation 1,041.0 feet accounted for a small amount (3.18%) of the flood pool and resulted in only slight increases in the outflows. For larger flood events there was virtually no difference in pool levels and operations, and only slight differences were observed for smaller flood events. These differences were considered minimal (SUPER 2001).

Flood Plain Discussion

Juracek (1999) determined that overall channel response to the altered stream flow regime and sediment load introduced below John Redmond Dam was minor. There was some localized channel widening, but little post-dam change in bank-full channel width. This is likely attributable to a substantial reduction in the magnitude of the post-dam annual peak flows in combination with the resistance to erosion of bed and bank geologic exposures and vegetated shoreline (Juracek 1999). The channel may also have been over-widened historically by a series of large floods prior to dam construction.

Another factor determining the limited downstream effects of John Redmond Dam is a series of twelve diversion/overflow dams from Burlington to Chetopa, KS (Figure 3-1). The overflow dams were built in the 1930s and 1950s for water supply for downriver towns. The predominant effect of these structures, following construction, was channel widening in the geomorphic-response zone that extends about 1,000 feet below the dams (Juracek 1999). With the increased energy from higher velocity water flowing over the dams, a more erosive power is developed. When a resistant channel bottom is present the riverbanks become the immediate erosion target.

3.3.2 Precipitation Data Collection and Monitoring

As part of the effort to operate John Redmond Dam, the USACE maintains a system of data collection (hydrometeorological stations) and reliable communications networks with the United States Geological Survey (USGS) and the National Weather Service (NWS). The important river gaging stations on the Cottonwood and Neosho Rivers are equipped with automated gages with Data Collection Platforms (DCP) (USACE 1996). Data recorded at the DCPs are transmitted to the Hydrology-Hydraulics branch computer through a system of satellites and downlinks. River gages are a source of data used to forecast inflows into JRL and are located near Florence and Plymouth, KS on the Cottonwood River and near Dunlap and Americus, KS on the Neosho River. River gages used to regulate flows downriver from the dam are located near Burlington, Iola, Chanute, and Parsons, KS, and Commerce, OK. All of the automated river gages are maintained by the USGS, who periodically record stream flow measurements to develop accurate rating curves.

With the primary objectives of John Redmond Dam, flood releases are made in accordance with the predicted inflow volume, the predicted runoff from the uncontrolled basin drainage area downriver, and the downriver regulating stage/flow restraints at the gaging stations seen in Table 3-4. Automated precipitation gages, connected to a DCP that records and transmits the precipitation data along with the stage data, are located at all of the automated river gaging stations along the Cottonwood and Neosho Rivers (USACE 1996). In addition, automated precipitation stations with DCPs are located above JRL near Durham, Diamond Springs, Cassoday, Matfield Green, Cottonwood Falls, and Neosho Rapids; they are also located on the dams at Marion, Council Grove, and John Redmond.

Figure 3-1. Location of Neosho River Basin, Study Area, and Overflow Dams (Juracek 1999)

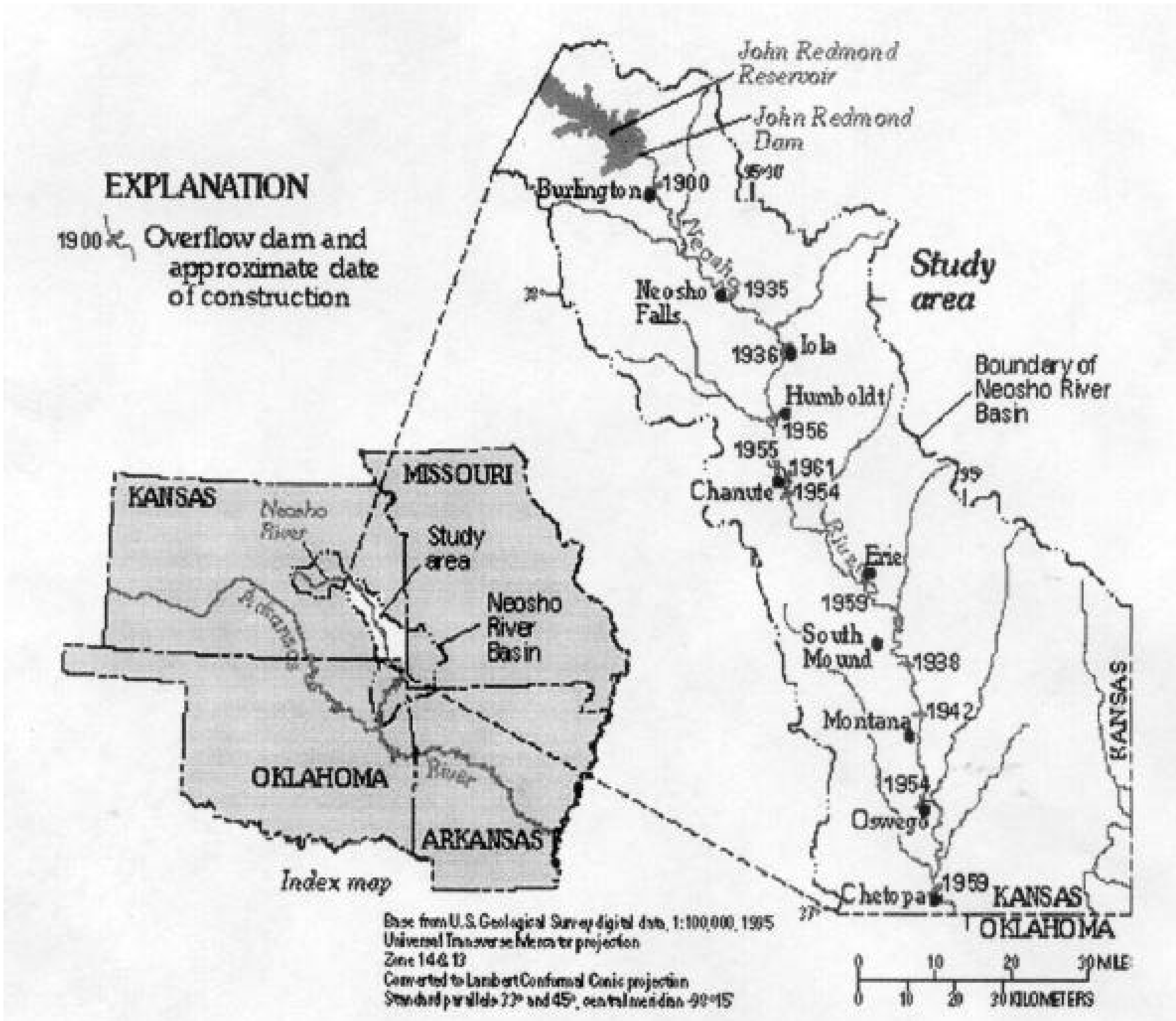


Table 3-4. Regulating Stages and Discharges (Source USACE 1996)

Station	River	Regulating Lakes	Regulating Stage (ft.)	Discharge (cfs)
Burlington	Neosho	John Redmond	23.0	14,000
Iola	Neosho	John Redmond	19.0	18,000
Chanute	Neosho	John Redmond	22.0	18,000
Parsons	Neosho	John Redmond	19.0	17,000
Commerce	Neosho	John Redmond	15.0	22,000

The NWS maintains a network of local rainfall observers throughout the Neosho River Basin, who report on a daily basis, and weather stations at the Marion, Council Grove, and John Redmond project offices monitor precipitation, evaporation, wind speed and direction, and temperature (USACE 1996). The local reports are entered into the Automated Field Observing Station (AFOS) computer network by the NWS. JRL pool elevations are monitored by an automated gage and a recording chart located on the dam structure. The DCP connected to the gage transmits precipitation and pool elevations to a satellite receiver; automated pool data are verified using both a wire weight gage and a staff gage located at the dam structure.

The AFOS data (precipitation, river, and pool gage readings) are available for direct access by the USACE District Office, Hydrology-Hydraulics Branch via the Data Output Message Satellite (DOMSAT) downlink. Reporting criteria for pertinent precipitation and river gaging stations (Table 3-5) are used to place these data into the District Office database (USACE 1996). Site-specific data from JRL (precipitation, evaporation, wind speed and direction, and sky conditions) are collected, recorded, and reported to the District Office daily.

Table 3-5. Reporting Criteria for Pertinent Stations (Source: USACE 1996)

Station	Report Received By	Report Timing
Rainfall Stations		
▪ Airport Stations	NWS	6-hour rainfall as of 6:00 a.m., 12:00 noon, 6:00 p.m., and 12:00 midnight
▪ USACE Dams	USACE	Rainfall Reports: 1) 8:00 a.m., 2) 1:00 p.m. when 0.50 in. or more of precipitation has occurred since 7:00 a.m. or continued rain since the 8:00 a.m. report, 3) 7:00 p.m. when 0.50 in. or more of precipitation has occurred since 7:00 a.m. and no 1:00 p.m. report was made, or if it has continued to rain since reporting at 1:00 p.m., 4) report at once the occurrence of 2.00 in. or more of precipitation that occurs during a period of 6 hours or less.
▪ Automated Gages	DCP	Hourly or As Needed
▪ Observer Stations	NWS	7:00 a.m. and every 6 hours, as directed by the NWS
River Gaging Stations		
▪ Cottonwood River, Florence	DCP	Hourly or As Needed
▪ Cottonwood River, Plymouth	DCP	Hourly or As Needed
▪ Neosho River, Dunlap	DCP	Hourly or As Needed
▪ Neosho River, Americus	DCP	Hourly or As Needed
▪ Neosho River, Burlington	DCP	Hourly or As Needed
▪ Neosho River, Iola	DCP	Hourly or As Needed
▪ Neosho River, Chanute	DCP	Hourly or As Needed
▪ Neosho River, Parsons	DCP	Hourly or As Needed
▪ Neosho River, Commerce	DCP	Hourly or As Needed

Automation of hydrometeorological data from lake, river, and precipitation gaging stations occurs through using DCPs, in the following steps:

- DCPs transmit hourly and random data to the Geostationary Operational Environmental Satellites (GOES) satellite;
- Data are down-linked from the GOES to the National Oceanic and Atmospheric Administration (NOAA) central computer;
- Data are retransmitted from NOAA to the DOMSAT satellite;
- Data are down-linked from the DOMSAT satellite to USACE Hydrology-Hydraulics Branch computer network in Tulsa;
- DCP data are processed in Tulsa and entered into the database used for regulation of the district reservoir systems;
- Local observer rainfall data are received automatically from the AFOS network using a dedicated line to the Tulsa River Forecast Center;
- Data are automatically encoded into the USACE Tulsa database to be used to forecast river flows and reservoir inflows; and
- Weather forecasts, river forecasts, radar depictions, and ancillary weather information is received automatically from the AFOS network.

Based on the precipitation monitoring and data analyses, hydrologic and flood forecasts are made to determine if and when releases should be made. The Hydrology-Hydraulics Branch of the USACE, Tulsa, OK, is responsible for this forecasting. The NWS, with assistance from the USACE, forecasts the river stages.

Water Level Management

Major changes to the water control plan have been approved historically (at the request of the State of Kansas) to allocate pool levels for the benefit of fish and wildlife habitat (Le Doux 2000). The USACE currently attempts to manage water levels of the JRL conservation pool (as well as possible on a case-by-case basis) to provide benefits for migrating shorebirds, waterfowl, and the fishery, and also to protect the operational structures. In a typical year the proposed Water Level Management Plan would: 1) raise the lake level from 1,037.0 feet to 1,041.0 feet (between 1–15 OCT); 2) lower the lake level from 1,041.0 feet to 1,039.0 feet (15 JAN); lower the lake level from 1,039.0 feet to1,037.0 feet (15 JUN–10 JUL); and maintain the lake level at 1,037.0 feet (10 JUL–1 OCT). The initial conservation pool elevation provides benefits to fish and waterfowl by flooding shoreline vegetation, the initial decrease serves to protect operational structures and shoreline vegetation from ice damage, and the second decrease provides benefits to migrating shorebirds, allows the growth of shoreline and mudflat vegetation, reduces shoreline erosion, and improves water quality/clarity.

The reallocation and establishment of a new, higher conservation pool elevation would not preclude consideration of seasonal pool plans for fish and wildlife as done currently. Any reasonable seasonal water level manipulation plan would be considered on a case-by-case basis by the USACE. However, further encroachment into the flood pool is unlikely due to excess loss of flood control storage.

3.3.3 Surface Water

Basic Surface Water Inflow

The average yearly runoff or inflow into JRL is 1,054,800 acre-feet, calculated from the period of record from 1922–1994, which includes 42 years of pre-operation data and 30 years of post-operation data (USACE 1996). A monthly and annual breakdown of estimated flows (in acre-feet) at John Redmond Dam for the same period of record is shown in Table 3-6. Figure B-1 (Appendix B) shows the flow duration curve depicting inflows and outflows for JRL (USACE 1996). The upriver dams at Marion and Council Grove regulate slightly less than 15 percent of the total inflow into JRL.

Prior to 1964, the Neosho River flooded 57 times and subsequent flooding has occurred to the present year. Table 3-7 presents a list of the major Neosho and Cottonwood River floods. Upriver from JRL are the gaging stations along the Cottonwood River, the Neosho River at Council Grove Reservoir, and the Neosho River at Americus, KS. Downriver gaging stations are located on the Neosho River at Burlington, Iola, and Parsons, KS, and Commerce, OK.

Near the upper end of the reservoir, north of Jacob's Creek Landing, an inflow debris field dubbed locally as the logjam has formed in the channel of the Neosho River at a point where the river flow is divided into two channels around an island. River flows slow sufficiently in this reach to allow floating driftwood carried from upstream to be captured by other driftwood and debris already deposited in this 3/8 mile-long site. This logjam is an impediment to boaters desiring access from the reservoir directly up the river to other launching facilities. Under certain conditions it may also represent an impediment to fish movement between the river and reservoir.

As mentioned previously, the JRL water elevation level is maintained based on the entire reservoir system needs, the immediate upriver and downriver conditions, and the effort to manage the water level for all entities at the reservoir. Using the analyses with the SUPER program model for defining year 2014 conditions by maintaining conservation pool elevation level at 1,039.0 feet or changing it to the proposed alternative elevations of 1,040.0 feet, 1,040.5 feet, and 1,041.0 feet NGVD, it can be observed that the percent of time that pool elevations will be equaled or exceeded is indiscernible between the four water elevation levels. Figure B-2 (Appendix B) shows the exceedence frequency in percent of years of maximum day (peak) elevations at JRL for each scenario in the year 2014. In this analysis, there is no difference based on the beginning elevations of 1,039.0 feet, 1,040.0 feet, 1,040.5 feet, or 1,041.0 feet.

Table 3-6. Estimated Monthly and Annual Flows in Acre-Feet—Regulated by Council Grove Dam Since August 1963 and Marion Dam Since October 1967; John Redmond Reservoir (Source: USACE 1996)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1922	1,450	3,900	238,200	446,500	106,200	29,820	112,200	27,830	3,300	1,800	47,800	7,850	1,026,850
1923	5,370	3,510	12,850	8,580	114,100	473,300	141,700	10,540	13,920	48,770	21,470	22,680	876,790
1924	12,980	21,660	77,810	59,360	78,760	29,460	44,190	48,080	22,110	17,000	11,930	6,190	429,530
1925	27,990	16,580	11,960	82,700	22,370	78,770	8,230	1,310	13,180	7,830	41,690	7,300	319,910
1926	9,360	6,890	7,350	85,500	32,060	15,480	2,190	8,580	463,500	326,000	37,170	27,880	1,021,960
1927	28,980	22,530	129,800	565,600	222,500	267,200	34,800	284,400	127,500	112,900	15,140	13,410	1,824,760
1928	15,630	49,710	51,730	105,300	72,890	383,100	108,000	52,190	15,390	19,080	496,700	140,300	1,510,020
1929	143,100	60,550	60,680	180,900	265,900	131,300	240,200	46,400	11,880	10,720	11,210	7,850	1,170,690
1930	4,920	27,500	11,420	26,490	163,500	49,410	6,760	5,610	21,110	4,970	18,130	113,600	453,420
1931	5,550	6,040	21,720	32,630	43,220	32,080	5,840	1,470	5,050	1,450	266,000	54,740	475,790
1932	36,450	28,550	27,270	33,260	30,200	123,900	218,100	14,240	7,730	3,940	3,310	4,400	531,350
1933	3,820	3,040	5,900	64,020	92,970	4,590	7,650	12,570	21,820	4,380	1,340	4,230	226,330
1934	2,020	1,520	3,980	20,530	74,130	14,920	1,280	250	4,490	3,340	38,160	7,080	171,700
1935	14,510	7,250	4,020	5,420	413,200	294,900	18,350	19,430	35,060	97,260	193,900	25,650	1,128,950
1936	23,920	8,970	6,710	3,300	42,430	5,190	700	60	4,950	20,800	2,310	8,620	127,960
1937	38,820	103,100	62,520	41,840	99,250	86,830	14,040	8,500	37,680	1,370	1,340	1,590	496,880
1938	1,460	4,700	28,310	47,460	706,100	300,600	30,750	37,080	16,730	3,660	9,990	4,840	1,191,680
1939	4,370	3,390	8,910	18,740	24,290	27,210	4,660	25,820	1,570	666	282	662	120,570
1940	1,160	2,600	5,340	48,540	46,820	14,210	1,270	5,310	27,010	1,480	27,230	20,650	201,620
1941	184,700	38,470	27,650	80,020	79,520	476,700	50,360	160,100	350,600	915,300	200,900	79,960	2,644,280
1942	39,100	53,170	59,600	210,800	93,440	303,500	52,260	83,760	220,800	114,600	30,340	156,000	1,417,370
1943	76,240	65,540	30,460	23,580	328,700	305,600	49,830	9,930	5,130	22,580	5,480	12,630	935,700
1944	17,820	17,780	307,500	964,300	283,800	101,200	49,890	94,740	33,110	97,150	46,390	435,600	2,449,280
1945	39,880	49,770	221,700	704,200	215,200	183,500	124,700	122,400	169,500	167,000	19,220	14,890	2,031,960
1946	134,000	41,150	81,930	87,750	44,330	127,900	19,160	7,830	43,230	11,950	20,670	36,890	656,790
1947	16,260	7,890	242,300	475,000	107,000	227,800	19,650	7,810	10,680	4,370	3,530	25,600	1,147,890
1948	11,800	28,970	147,500	29,020	79,540	116,700	643,900	37,070	70,790	8,200	9,340	7,910	1,190,740
1949	212,900	292,900	75,640	112,400	217,300	80,530	87,400	18,150	11,550	42,950	9,360	8,680	1,169,760
1950	16,940	8,510	9,690	21,210	64,820	128,300	347,900	403,200	71,410	27,900	12,280	11,340	1,123,500
1951	9,480	18,840	36,650	70,410	468,300	406,300	2,029,000	139,500	445,500	84,930	59,980	31,620	3,800,510
1952	31,540	20,760	184,500	238,300	103,100	37,080	10,140	13,040	4,180	2,450	4,400	5,580	655,070
1953	4,890	4,090	9,120	7,820	29,890	8,390	5,620	1,480	500	320	590	1,420	74,130
1954	1,320	1,450	2,130	1,730	10,490	38,660	800	2,130	40	790	90	80	59,710
1955	350	3,460	1,470	11,550	16,810	16,480	24,020	4,230	21,730	20,960	460	400	121,920
1956	610	1,170	630	10,330	21,230	950	150	5,850	0	0	0	0	40,920
1957	0	0	820	66,460	346,700	176,900	43,690	4,220	20,930	34,350	44,790	15,500	754,360
1958	18,140	31,450	255,900	104,800	85,680	110,600	277,400	48,740	81,000	35,010	34,630	14,360	1,097,710
1959	16,830	27,620	26,320	69,000	280,400	49,820	235,600	26,690	23,330	178,400	26,750	27,010	987,770
1960	65,820	103,700	304,200	120,500	73,470	74,180	18,100	80,480	59,480	167,300	77,020	71,520	1,215,770

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1961	23,860	85,590	240,700	236,950	615,400	102,400	138,200	25,360	186,800	146,900	258,800	56,060	2,117,020
1962	145,300	185,400	125,900	46,470	97,340	266,600	62,180	24,630	365,700	93,330	35,670	29,040	1,477,560
1963	37,290	21,550	71,150	22,380	21,230	42,950	41,770	4,230	8,490	9,360	3,710	3,350	287,460
1964	4,460	4,270	3,880	86,820	46,970	98,220	6,380	6,350	8,590	2,220	93,770	32,300	394,230
1965	21,030	19,750	105,700	80,350	22,770	762,800	91,520	14,710	271,600	10,360	8,990	21,960	1,431,540
1966	25,270	32,470	26,940	71,140	31,050	49,960	7,810	17,320	5,290	940	2,360	3,150	273,700
1967	4,310	2,870	4,330	35,250	10,660	515,970	92,470	31,700	95,310	285,530	55,000	40,670	1,174,070
1968	33,820	20,620	19,470	102,970	98,960	103,640	144,790	32,270	9,560	108,490	104,450	68,390	847,430
1969	56,160	77,420	144,910	326,370	277,200	396,340	262,090	31,190	58,880	122,000	49,890	72,000	1,874,450
1970	34,400	20,780	23,970	290,470	76,800	298,770	24,030	10,410	54,300	87,540	18,300	19,040	958,810
1971	57,760	86,050	78,060	22,260	132,260	495,610	306,400	57,140	14,790	10,100	95,750	67,510	1,423,690
1972	31,690	21,120	15,070	42,920	264,430	20,510	95,640	21,740	24,100	6,890	20,720	48,990	613,820
1973	202,830	265,490	786,570	320,400	230,320	78,140	37,920	19,860	424,440	571,850	137,590	210,630	3,286,040
1974	159,330	64,000	146,840	148,240	171,830	172,820	17,330	28,380	66,350	41,180	142,220	49,130	1,207,650
1975	74,800	152,320	123,100	147,890	64,910	427,950	70,350	25,720	23,690	10,860	10,560	19,140	1,151,290
1976	9,330	7,160	8,780	97,570	148,880	86,100	41,070	5,630	3,860	5,330	4,800	4,190	422,700
1977	4,040	4,070	4,110	7,650	192,380	370,870	191,510	71,100	104,190	42,100	121,480	28,370	1,141,870
1978	12,830	77,190	203,850	32,250	73,500	46,580	31,240	5,510	5,250	80,000	6,320	4,430	578,950
1979	6,490	47,300	208,400	82,100	37,700	183,600	260,400	30,500	8,550	8,880	81,420	15,470	970,810
1980	21,790	65,020	193,780	230,880	31,140	79,640	22,510	8,930	970	8,690	3,620	10,410	677,380
1981	3,920	2,180	5,830	4,920	58,330	151,430	161,840	60,190	57,650	61,700	273,760	86,220	927,970
1982	106,630	162,780	111,890	36,000	378,270	340,750	81,840	18,000	8,190	6,800	6,620	15,930	1,273,700
1983	11,400	46,020	57,390	535,340	322,290	250,820	80,860	8,520	5,980	8,870	36,340	38,900	1,402,730
1984	41,970	37,870	446,650	420,580	180,440	177,860	27,460	7,740	3,520	10,930	31,430	77,280	1,463,730
1985	53,470	250,130	108,540	87,050	203,530	506,610	39,360	242,640	174,470	724,550	200,580	96,310	2,687,240
1986	57,130	97,460	42,290	131,330	169,950	29,300	192,770	60,060	188,190	419,420	39,160	68,330	1,495,390
1987	55,430	119,590	477,230	166,280	98,310	91,120	107,960	78,290	37,070	19,420	40,800	116,490	1,407,990
1988	48,100	23,500	46,190	248,130	43,140	19,930	22,710	4,010	5,260	2,860	4,680	4,470	472,980
1989	5,750	4,740	6,660	4,650	22,850	77,550	36,100	150,210	85,490	33,820	15,270	11,010	454,100
1990	17,950	36,890	174,350	80,330	252,300	246,150	16,660	18,250	8,920	5,060	9,220	6,940	873,020
1991	8,670	5,260	6,050	20,870	59,550	46,810	16,860	1,290	5,480	2,250	5,430	8,830	187,350
1992	8,730	9,560	116,290	47,800	21,280	123,870	454,910	140,130	19,420	16,540	342,510	291,170	1,592,210
1993	143,800	164,930	216,790	259,890	968,530	107,700	953,260	140,730	131,700	35,900	24,200	23,900	3,171,330
1994	17,360	13,790	16,760	133,530	99,070	43,440	25,880	11,760	6,840	4,170	23,400	10,310	406,310
Mean	38,734	47,039	98,228	135,533	152,386	166,386	126,775	45,144	68,169	77,106	56,988	42,422	1,054,910
Max	212,900	292,900	786,570	964,300	706,100	762,800	2,029,000	403,200	463,500	915,300	496,700	435,600	3,800,510
Min	0	0	630	1,730	10,490	950	150	60	0	0	0	0	40,920

Table 3-7. Major Floods for Period of Record, John Redmond Dam (Source: USACE 1996)

Cottonwood River at Florence			Cottonwood River at Cottonwood Falls (a)			Cottonwood River at Plymouth			Neosho River at Council Grove (c)			Neosho River at Americus (c)			Neosho River at Burlington (d)		
Date	Stage (ft)	Flow (cfs)	Date	Stage (ft)	Flow (cfs)	Date	Stage (ft)	Flow (cfs)	Date	Stage (ft)	Flow (cfs)	Date	Stage (ft)	Flow (cfs)	Date	Stage (ft)	Flow (cfs)
05-30-62	21.55	8,600	05-28-35	15.24	10,600	06-05-65	35.70	57,500	07-05-32	30.90	28,500	06-22-67	28.17	10,700	09-13-61	31.53	26,200
06-03-62	23.61	11,100	05-23-38	17.24	12,000	06-09-65	35.43	50,800	06-11-38	35.30	50,000	10-08-67	27.52	9,900	10-11-61	24.50	12,400
09-23-62	23.71	11,400	09-08-41	21.08	21,600	09-22-65	32.86	13,500	07-09-41	24.00	12,100	06-27-69	28.30	10,900	11-03-61	29.04	17,700
09-25-62	22.21	8,900	10-20-41	21.35	35,800	06-22-67	33.74	21,800	10-20-41	37.13	65,900	05-23-71	27.70	10,100	02-01-62	29.48	18,300
07-12-63	21.71	8,400	04-23-44	22.50	61,200	10-07-67	33.23	16,800	06-19-42	25.80	16,100	09-27-73	27.76	10,200	03-23-62	23.65	11,700
06-05-65	25.38	15,300	04-16-45	22.13	54,200	04-27-69	34.26	25,500	06-16-43	28.20	24,400	10-11-73	27.74	10,200	06-01-62	30.00	19,000
06-10-65	27.57	46,400	09-20-45	(b)	12,900	06-27-69	34.48	27,200	04-22-44	24.37	17,600	06-25-77	27.31	9,600	06-03-62	25.42	13,200
09-21-65	22.28	8,800	09-30-45	(b)	20,500	04-19-70	33.05	16,000	05-03-44	30.00	33,800	06-05-85	26.80	12,700	09-28-62	31.36	24,800
06-21-67	26.33	19,400	12-05-45	(b)	40,200	06-20-70	33.15	16,600	08-26-44	23.12	12,300	10-10-85	27.43	17,000	06-08-65	27.49	16,000
10-08-67	24.02	11,000	06-19-46	19.72	15,900	06-03-71	34.03	23,600	12-04-44	25.10	19,500	05-09-93	26.95	13,700	07-14-67	22.70	11,700
04-27-69	24.27	11,500	04-14-47	16.44	11,300	07-05-71	32.99	15,500	04-16-45	26.15	22,600	07-22-93	27.84	17,400	10-12-67	23.18	12,000
05-23-71	24.79	12,600	07-20-48	23.30	78,000	03-11-73	33.59	19,700	05-02-48	23.48	16,500	07-30-93	27.27	15,300	06-22-71	22.78	11,700
03-11-73	24.67	12,300	01-24-49	19.49	11,200	09-27-73	33.54	19,300	07-20-48	28.70	29,900				05-05-72	22.27	12,400
04-21-74	26.61	28,600	07-10-50	(b)	12,500	10-11-73	34.72	34,400	05-01-51	26.55	18,600				05-29-73	25.40	15,300
06-17-75	28.03	56,000	08-01-50	19.73	15,700	06-19-75	33.64	20,100	06-07-51	28.27	23,000				10-11-73	24.29	14,300
04-29-76	23.90	10,800	05-01-51	20.35	18,400	06-25-75	33.16	16,300	07-11-51	36.29	121,000				06-27-75	22.81	12,900
06-20-77	23.20	8,600	06-09-51	19.12	14,700	06-23-77	33.12	16,000	09-04-51	27.00	19,700				07-04-77	23.08	13,400
10-31-79	22.77	10,500	06-30-51	22.68	65,200	06-09-79	33.32	16,800	05-16-57	22.70	12,300				05-17-93	26.41	16,600
11-01-81	21.39	9,100	07-11-51	36.84	196,000	07-05-79	33.07	14,500	05-22-61	33.35	40,400				08-03-93	23.23	13,400
03-19-84	23.69	10,600	09-05-51	17.32	12,000	05-12-82	33.09	14,700	06-29-69	20.34	6,600						
09-22-85	25.37	14,300	05-17-57	19.73	15,600	03-19-84	33.11	15,500	05-22-71	15.53	3,700						
10-10-85	26.92	29,400	05-18-59	20.61	27,200	06-25-85	33.53	17,900	09-30-73	14.64	3,300						
03-18-87	23.24	9,900	05-06-61	30.43	13,400	08-23-85	33.67	19,000	06-30-77	14.27	3,400						
06-12-89	23.39	8,500	05-23-61	31.82	20,200	10-10-85	35.45	58,200	08-04-93	14.25	3,200						
06-08-90	21.98	7,500	06-04-62	29.68	11,700	10-03-86	33.44	17,600									
07-24-92	21.49	7,300	09-24-62	31.63	18,900	03-01-87	33.11	15,500									
11-20-92	23.84	9,300	06-05-65	32.11	24,700	07-24-92	32.75	13,500									
05-09-93	27.85	52,800	06-10-65	33.00	39,600	11-20-92	33.31	19,800									
07-07-93	24.49	10,400	09-21-65	31.20	15,500	05-10-93	35.00	46,900									
07-15-93	26.23	14,000	06-21-67	32.16	28,700	07-06-93	33.21	18,700									
			10-07-67	30.74	13,700	07-22-93	33.75	24,800									
			06-27-69	32.76	40,200												

(a) From 2-12-35 to 6-27-60, datum 13.21 ft. lower. Discontinued 6-71. (b) No recorded stage. (c) Regulated by Council Grove Dam since 10-1964. (d) Regulated by John Redmond Dam since 9-1964.

A simulation of a flow-year like 1993 was prepared for the conservation pool elevation scenarios (1,039.0 feet, 1040.0 feet, 1,040.5 feet, and 1,041.0 feet) in the year 2014, using the SUPER model. Figure B-3 (Appendix B) shows the elevation hydrograph for JRL using the 1,039.0-foot and 1,041.0-foot conservation pool elevations for clarity in viewing the results. Raising the conservation pool elevation to 1,041.0-foot NGVD results in only slight changes for the year 1993 and for 2014. At lower conservation pool elevations, small differences can be observed, however, as the water level rises in the conservation pool, the lake volume increases at a faster rate, thus minimizing the starting elevation differences.

Another simulation with SUPER was to project the conservation storage and flood control storage volumes based on lake area/elevation surveys, including data from the year 2000 (Table 3-8). This table illustrates the effects on storage volumes in the year 2014 for the four conservation pool elevation scenarios (1,039.0 feet, 1,040.0 feet, 1,040.5 feet, and 1,041.0 feet). From this simulation, it can be deduced that approximately 3.18 percent of the flood pool will be reallocated.

Table 3-8. John Redmond Sediment Redistribution Study (Source: USACE 1996)

	Existing Conditions SUPER Run AX00X02 TOC=1,039.0 ft. Yr2014 EAC Table	Modified Conditions SUPER Run A00X03 TOC=1,040.0 ft. Yr2014 EAC Table	Modified Conditions SUPER Run A00X04 TOC=1,040.5 ft. Yr2014 EAC Table	Modified Conditions SUPER Run A00X05 TOC=1,041.0 ft. Yr2014 EAC Table
Conservation Storage	40,096 ac-ft	47,838 ac-ft	52,126 ac-ft	56,414 ac-ft
Flood Control Storage	511,729 ac-ft	503,987 ac-ft	499,699 ac-ft	495,410 ac-ft

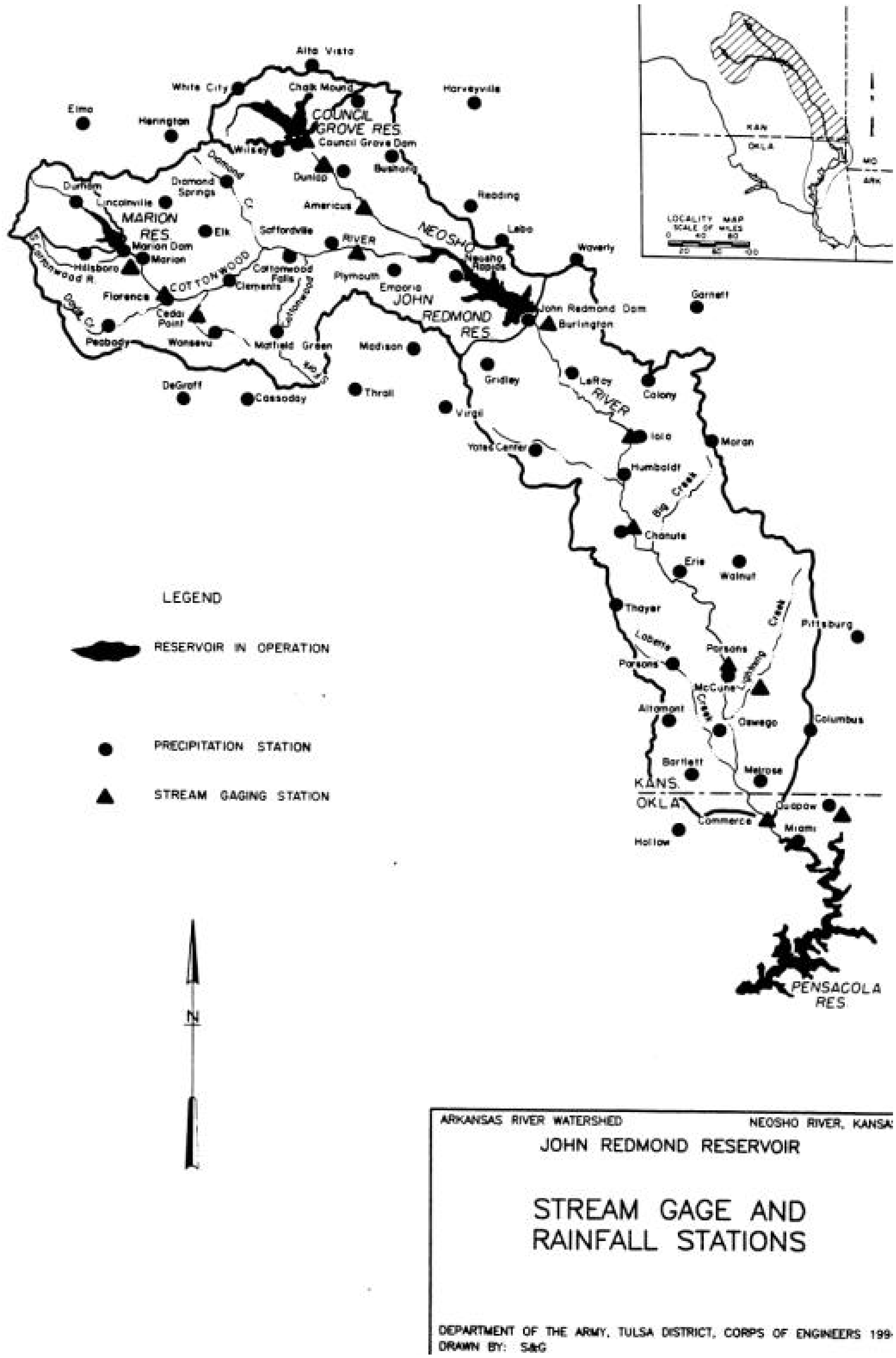
TOC=Top of Conservation Pool; ac-ft=acre-feet.

Basic Surface Water Outflow

Following the construction and operation of John Redmond Dam in 1964, the flow regime of the Neosho River reach downriver from the dam has changed considerably. Controlled releases from the dam have decreased the magnitude of peak discharges and increased the magnitudes of the low discharges (Studley 1996). Studley (1996) used three gaging stations below the dam (Strawn/Burlington, Iola, and Parsons) to prepare research. As seen in Figure B-4 (Appendix B), the annual peak discharges are considerably less following dam implementation. The effect of uncontrolled drainage upriver from Iola and from Parsons is readily seen.

One factor considered in John Redmond Dam releases is the slow recession of downriver flows because of the 1.2-foot/mile slope of the river channel. From the John Redmond Dam, it requires approximately two hours of water travel to reach the Burlington gaging station 5.3 miles downriver, 24 hours to reach the Iola gaging station 56.3 miles downriver, 60 hours to reach the Parsons gaging station 139.6 miles downriver, and 84 hours to reach the Commerce, OK gaging station 190.2 miles downriver. Figure 3-2 illustrates the location of USGS streamflow-gauging stations in the Neosho basin.

Figure 3-2. Locations for U.S. Geological Survey Streamflow-Gaging Stations Downstream from John Redmond Dam.



Another factor in alluvial basins like the Neosho River Basin is that reaches of streams with steep banks are in a continual state of erosion. The USACE mitigates flow-enhanced erosion of the riverbanks by overtly slowing the rate of release after a precipitation event to slow the rate of fall in the river stage.

Discharges are rarely as low as were experienced prior to construction of the dam, because of the need to provide adequate water supply and water quality for downriver users. This is accomplished by maintaining an average annual minimum flow of 30 cfs at Chanute, 40 cfs at Iola, and 50 cfs at Parsons, KS. Low flow releases are made during dry periods in order to meet minimum flow requirements. The minimum flow requirements range from 21 cfs (November–March) to 48 cfs (July–August), or an average of 30 cfs annually at Chanute, KS (USACE 1996).

Outflow duration was analyzed using SUPER to determine the effect of conservation pool elevation raise at the year 2014. Figures B-5, B-6, B-7, and B-8 (Appendix B) are semilog plots of the percent time that discharge durations will be equaled or exceeded for the four conservation pool scenarios of 1,039.0 feet, 1,040.0 feet, 1,040.5 feet, and 1,041.0 feet. Differences among the scenarios were indiscernible, even though the amount of discharge increases downriver because of unregulated inflow. Similarly, there is no discernible difference in the SUPER analysis results of the exceedence frequency of maximum day discharge (peak daily flow) simulation for the year 2014 between the above-listed scenarios (Figures B-9, B-10, B-11, and B-12) (Appendix B).

Another simulation of a flow year like 1993 was prepared for the John Redmond outflow and the three downriver gaging stations. Figures B-13, B-14, B-15, and B-16 (Appendix B) show the discharge hydrographs at these stations using the 1,039.0-foot and 1,041.0-foot conservation pool elevations for clarity in viewing the results. For lower discharge rates, slight differences between the two scenarios may be observed.

Surface Water Quality

River/Stream

The State of Kansas established a stream chemistry monitoring program that currently operates 158 permanent/146 rotational monitoring stations/sites statewide (KDH&E 2000). Placement of many sampling stations on smaller order streams in 1990 facilitated a more thorough analysis of rural and agricultural effects to surface water quality. The State of Kansas and the USGS share sampling stations and duties and an example of water quality output is seen in Appendix B. The program objectives are to provide timely and scientifically defensible information on the physical, chemical, and bacteriological condition of flowing waters in Kansas; intended uses are:

- Compliance with water quality monitoring and reporting requirements of 40 CFR 130.4 and Sections 106(e)(1), 303(d) and 305(b) of the Federal Clean Water Act;
- Evaluation of waterbody compliance with the provisions of the Kansas surface water quality standards (K.A.R. 28-16-28b *et seq.*);
- Identification of point and nonpoint sources of pollution contributing most significantly to documented water use impairments;

- Documentation of spatial and temporal trends in surface water quality resulting from changes in prevailing climatic conditions, land use and land cover, natural resource management practices, wastewater treatment plant operations, and other phenomena;
- Development of scientifically defensible environmental standards, waste water treatment plant permits, and waterbody/watershed pollution control plans and Total Maximum Daily Load (TMDL); and
- Evaluation of the effectiveness of pollution control efforts and waterbody remediation/restoration initiatives implemented by the department and other natural resource agencies and organizations.

Sampling frequency currently reflects a bimonthly schedule for permanent monitoring sites and one year out of every four years for rotational monitoring sites.

In a water quality study of reservoir sediments at Cheney Reservoir (Pope 1999 and Mau 2001), it was theorized that phosphorous concentrations near dam structures, under anoxic conditions, could result in phosphorus releases into the water column and negative effects to the drinking water supply. Silt and clay particles, which distribute near dams, provide the adsorption mechanism for phosphorus and many trace elements.

Wildhaber et al. (2001) obtained water quality measurements in the Neosho River above JRL and below the dam. They found that water temperature was cooler by approximately $3^{o}C$ above the dam ($24.74^{o}C$) than below ($27.58^{o}C$). Turbidity was also higher above the dam (57.0 NTU) than downriver of the dam (27.17 NTU), but the pH was nearly the same (8.37 above vs. 8.47 below). Dissolved oxygen increased downriver of the dam (4.66 mg/l vs. 5.62 mg/l); however, conductivity, alkalinity, and hardness were all higher above the dam structure. In addition, species of catfish were more common above JRL than below the dam ($45.40/100m^2$ vs. $25.66/100m^2$).

The Kansas Department of Health and Environment (KDH&E) has classified the Neosho River downstream from Council Grove Reservoir and the Cottonwood River as special aquatic life use waters (USFWS 1991). Further defined, these are waters that contain unique habitat types and biota, or species that are listed as threatened or endangered in Kansas. The general provisions of the Kansas surface water quality standards (K.A.R. 28-16-28c) state, in part: "… no degradation of water quality by artificial sources shall be allowed that would result in harmful effects on populations of any threatened or endangered species of aquatic life in a critical habitat…" A variance may be issued by KDH&E, however, if "important social and economic development" is impaired (USFWS 1991).

Water quality concerns have been documented for most of the surface water entering JRL, including contaminants (FHNWR 2000). Consumption advisories are issued most years for the Neosho River due to chlordane compound concentrations in fish. During the 1970s, several fish kills were related to runoff from confined livestock feedlots. Investigations by the USFWS, Kansas Field Office, identified PCB, atrazine, and heavy metals, including lead, mercury, and arsenic in biota samples, along with lead in sediment samples (FHNWR 2000). Lead, zinc, and cadmium may lower populations of benthic macroinvertebrates used as food sources by some fish species (Wilhaber et al. 1998). In most aquatic systems, concentrations of trace metals in suspended sediment and the top few centimeters of bottom sediment are far greater than concentrations of trace metals dissolved in the water column (Horowitz 1985).

Reservoir/Lake

Land use and human activities can have considerable effects on water quality in a downstream reservoir (Pope 1998). Constituents such as suspended sediment, nutrients (species of nitrogen and phosphorus), pesticides, and major metals and trace elements may have detrimental effects on reservoir water quality through increased sedimentation, accelerated eutrophication, reduced light penetration, potentially harmful effects to human health and aquatic organisms, and a general decrease in recreational value.

Physicochemical conditions were sampled and recorded for JRL during its initial five summers of impoundment, 1964–1968 (Prophet et al. 1970). In general, the differences between successive years of individual physicochemical factors were not significant, but most factors exhibited significant changes during 1968, as depicted in Table 3-9. JRL was considered unique at the time of this study, because of the periodic enrichment by feedlot wastewater, which resulted in low dissolved oxygen, high ammonia, high fecal coliform bacteria levels, and periodic fish kills. In addition, JRL waters did not become thermally stratified because it was shallow (1.9 m average depth) and the water was easily mixed by wave action (Prophet et al. 1970).

Table 3-9. Summer Means of Selected Physicochemical Conditions Near Outlet of JRL (June – August) (Concentrations in mg/l)

Year	Specific Conductance	HCO_3	O_2	PO_4	NO_3	Ca	Na	K
1964	467	138.0	5.9	0.28	0.46	40.8	9.1	3.7
1965	456	144.5	6.2	0.35	0.55	40.1	10.4	4.5
1966	448	152.1	6.8	0.08	0.29	53.4	16.5	4.6
1967	378	143.3	6.2	0.46	0.99	42.5	17.7	6.1
1968	348	131.9	7.4	0.33	0.90	29.6	6.7	4.0

Source: Prophet et al. 1970.

The State of Kansas established a lake and wetland water quality monitoring program (KDH&E 2000) to provide reliable information on the physicochemical and biological characteristics of publicly-owned water bodies; the information is used for:

- Compliance with the water quality monitoring and reporting requirements of 40 CFR 130.4 and Sections 106(e)(1), 303(d), and 305(b) of the Federal Clean Water Act;
- Evaluation of waterbody compliance with the Kansas surface water quality standards (K.A.R. 28-16-28b *et seq*.);
- Identification of point and nonpoint sources of pollution most significant to water use impairments in publicly-owned lakes and wetlands;
- Documentation of spatial and temporal trends in surface water quality resulting from changes in land-use patterns, resource management practices, and climatic conditions;
- Development of scientifically defensible environmental standards, wastewater treatment plant permits, and waterbody/watershed pollution control plans; and
- Evaluation of the efficacy of pollution control efforts and waterbody remediation/restoration initiatives implemented by the department and other agencies and organizations.

A total of 119 waterbodies were included in the lake and wetland water quality monitoring network during 2000. This number will change over time as new lakes are constructed and older lakes are dewatered or replaced by more accessible and/or suitable candidate sites (KDH&E 2000).

Water quality samples are taken from selected sites at JRL, analyzed on a periodic basis, and published (USACE 1996). The USGS maintains a national stream-quality accounting network station on the Neosho River near Parsons, KS, where specific conductance, pH, and temperature are recorded bimonthly. Samples are also taken at this site for chemical, biological, and sediment analysis. The USGS also collects and analyzes periodic samples for specific conductance, pH, and temperature on the Neosho River at Americus, Burlington, and Iola, KS. These data are published in the *Water Resources Data, Kansas Annual Report*. Neosho River water quality is considered good, requiring only basic treatment for industrial or municipal use (USACE 1996).

Surface water is also sampled monthly below John Redmond Dam near the WCGS make-up screen house (KDH&E 2000). These samples are taken as controls to compare water quality with that of the Coffey County Fishing Lake, discharge cove, and the spillway. Radiological analyses of samples included gross alpha, gross beta, tritium (H^3), and gamma isotopes.

Sediment Transport

Dams are known to affect river systems, generally decreasing the distribution of sediments and altering the hydrologic regime, physical habitat, and water quality downriver (various authors in Wildhaber et al. 2000). The rate of loss of storage for a given reservoir is dependent on the rate of erosion of the drainage basin. According to de Noyelles (pers. com. 2001), JRL is one of the most rapidly silting Kansas reservoirs. Pope (1999) and Mau (2001) described the results of analyzing 13 bottom-sediment cores from Cheney Reservoir (south-central Kansas). The cores were analyzed for percent moisture, bulk density, percent sand and silt/clay, and total phosphorus. For selected sites, cores were also analyzed for pesticides, polychlorinated biphenyls, and major metals and trace elements.

Sedimentation patterns and sediment particle sizes were not uniformly distributed in Cheney Reservoir (Pope 1999 and Mau 2001). Most sedimentation occurred in or near the original river channel, most sand-size sediment particles were deposited in the upstream part of the reservoir, and silt- and/or clay-size particles were more widely distributed across the reservoir. Some results from this sampling effort were:

- Mean annual sediment deposition occurred at 209 acre-feet/year (0.22 acre-feet/year/square mile of drainage area), resulting in 27 percent filling of the conservation pool versus the 34 percent design estimate.
- Silt/clay sediment fraction is deposited in larger quantities closer to the dam than further upstream in the reservoir, resulting in larger phosphorus concentrations near the dam (94 mg/kg upstream vs. 710 mg/kg near the dam).
- Total phosphorus, which ranged from 94–674 mg/kg, was statistically related to silt- and/or clay-size particles, and mitigation would require reducing the annual distribution of phosphorus in the watershed or control the movement of silt- and/or clay-sized particles from the watershed.

- There was an increasing trend in total phosphorus concentrations, probably related to an increase in fertilizer sales which doubled between 1965–96, and to livestock production.
- DDT, DDD, DDE, and dieldrin were present in detectable concentrations; DDE was detected in all samples, ranging from 0.31–1.30 mg/kg. Some possibility of bioaccumulation (insecticides becoming concentrated in the food chain) exists.
- The acetanilide herbicide metochlor was detected in 22 percent of samples; herbicides may have little long-term water quality implications for aquatic organisms.
- Arsenic, chromium, copper, and nickel were present in concentrations where adverse effects to aquatic organisms occasionally occur.

The water entering JRL is turbid, carrying silt and sediments from tributary drainages and from agricultural land upriver. A large amount of sediment is delivered to JRL as a result of erosion from riverbanks, construction sites, and farmlands within the watershed. Over 25 percent of the original conservation storage has been filled with sediment, although little change has resulted in flood storage (USACE 1996).

Thirty sedimentation ranges established upriver from the dam are measured periodically. Both endpoints of each range are identified with permanent markers of known vertical and horizontal positions and all are surveyed periodically to compute sediment deposition; the last measurement occurred during 1993 (USACE 1996).

Sediment particle sizes in the Neosho River, above and below the dam, were calculated using the Fredle Index (geometric mean adjusted for distribution of particle sizes). It was determined that this index was lower above the dam than downriver from the dam (5.52 vs. 7.82). Although not significantly different, this index indicates that more evenly distributed substrate sizes occur upriver from the lake, and a shift to the predominance of larger gravel below the dam may be occurring. This increased coarseness of the substrate is considered a common effect of dams (Wildhaber et al. 2000).

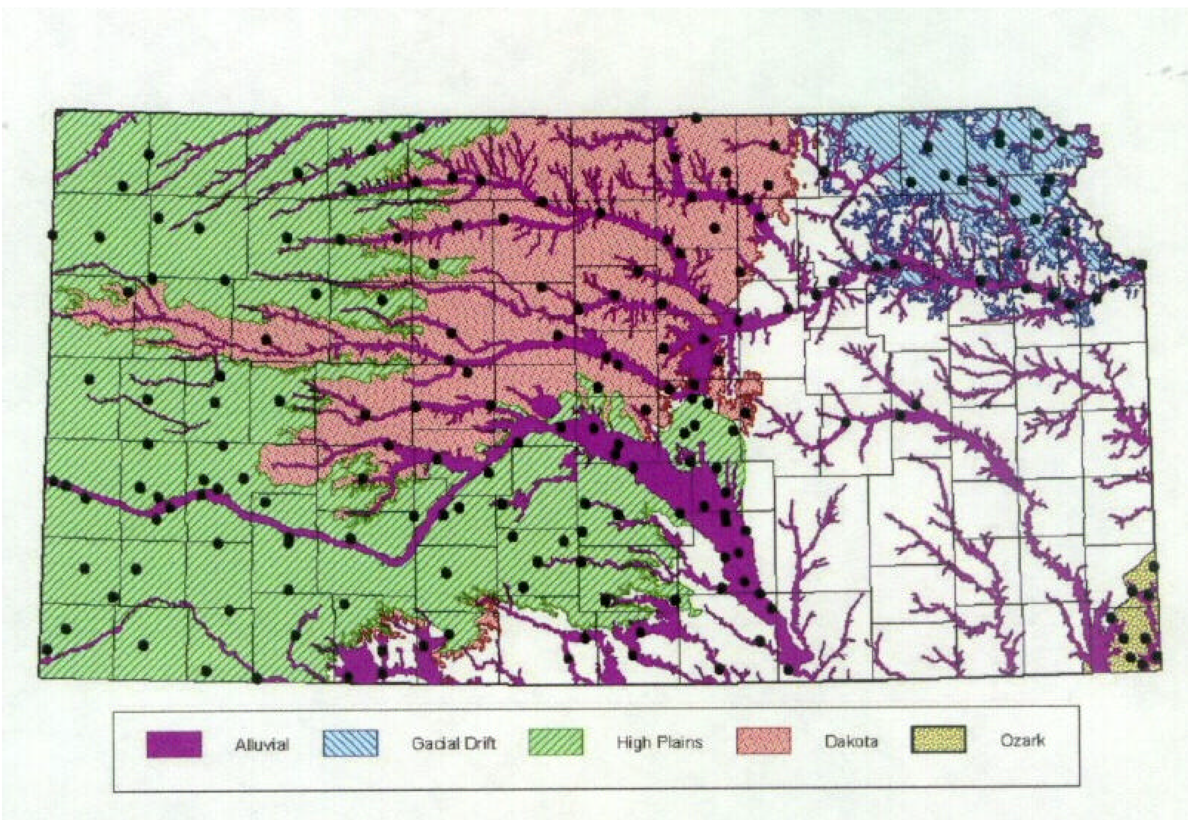
Removal of the logjam, described in Section 3.3.6 would likely result in a navigable channel from JRL to the upriver portions of the Neosho River. This action could also result in the downcutting and transport of sediments currently stored around and among the debris in the channel, as described by Beschta (1979). Following logjam removal on an Oregon stream, Beschta (1979) calculated that more than 5,000 m^3 of sediment along a 250m reach was eroded downstream by streamflow during the first winter following debris removal. Debris dam removal within a second order stream in New Hampshire resulted in increased downstream export of dissolved matter by approximately 6 percent and particulate matter (both fine and coarse) of approximately 500 percent (Bilby 1981).

In low-gradient, meandering streams, large organic debris enters the channel through bank erosion, mass wasting (landslides), blowdown, and collapse of trees due to ice loading (Keller and Swanson 1979). Under natural conditions, woody debris is removed from stream channels by leaching, microbial decomposition, fragmentation by invertebrates, physical fragmentation, and downstream transport (Bilby and Bisson 1998). The relative importance of each of these processes varies with the size and flow volume of the stream. The presence of large woody debris in a stream facilitates deposition of sediment and accumulation of finer organic matter, and dramatic increases in sediment and organic matter export occur immediately following removal or disturbance of the debris (Bilby and Bisson 1998). For the Neosho River, removal of the logjam would result in a large quantity of the sediment residing there to be exported or transported into the conservation pool of JRL, further affecting water supply storage. A thorough analysis of this river reach would be warranted to determine sediment quantity and possible fate prior to logjam removal attempts.

3.3.4 Groundwater

Groundwater is a minimal resource along the Neosho River. One reason is the abundance of surface water and another is because the alluvium is shallow and lies on shale and limestone bedrock, which are not good aquifer materials (Figure 3-3). Flood plain alluvium near JRL averages approximately 26 feet in thickness and the water table is typically 10–15 feet below the land surface (USACE 1991). Although a few wells have been drilled in the northwest area, most groundwater use in the Neosho Basin occurs in Crawford and Cherokee Counties, east of the Neosho River (Figure 3-3) where the western extremity of the Ozark aquifer pinches out in the state.

Figure 3-3. Map of Major Aquifers and Location of All Wells (Source BEFS Groundwater Quality Monitoring Network)



Groundwater Quality

The State of Kansas established a cooperative groundwater monitoring program between the USGS and the KDH&E in 1976 (KDH&E 2000). The program objectives are to provide reliable information on groundwater quality for use in the identification of temporal and spatial trends in aquifer chemistry associated with: 1) alterations in land-use patterns, 2) advances in land treatment methods and other resource management practices, 3) changes in groundwater availability or withdrawal rates, and 4) variations in regional climatic conditions. Initially the USGS performed sample collection and data interpretation, while sample analyses were performed by KDH&E. In 1990, KDH&E assumed all operational and managerial aspects of the Kansas groundwater quality monitoring program. The basic sampling network was left intact, but several improvements were made, as follows:

- Legal descriptions were reviewed for all network sites;
- Wells were tagged with a unique site identification number; and
- The Kansas Water Database (electronic repository for groundwater quality data) was updated to reflect changes and corrections to the list of monitoring well locations.

Sampling frequency currently reflects a two-year rotational sampling schedule in which half of the network was sampled each year. The sampling network now includes a maximum of 200 wells used for public water supply, rural/domestic water supply, irrigation, livestock watering, industrial water supply, groundwater monitoring, or a combination of these uses (KDH&E 2000). Data are reported on an aquifer basis; the aquifers were delineated in a digital format by the Kansas Geological Survey (KGS) and the USGS. Only three groundwater monitor wells are located in the upper Neosho River Basin (Figure 3-3).

A maximum, annual total of samples collected and analyzed includes: 1) inorganic chemistry – 100; 2) pesticide – 100; volatile organic compounds (VOC) – 25; radionuclide – 25, and radon – 10. The VOC and radiological samples are collected on an eight-year rotational schedule. Groundwater quality data are periodically reviewed and analyzed, then entered into the Kansas Water Database and the USEPA Storage and Retrieval (STORET) database (KDH&E 2000).

3.3.5 Water Rights

The State of Kansas has established a Water Marketing Program (WMP) to contract with water supply customers (KWO 1996). Several significant events converged during the 1950s leading to the creation of the WMP:

- Floods of 1951, followed by the 1952–1957 drought;
- Creation of the Kansas Water Resources Board (KWRB now KWO) (1955), with responsibility for water resources planning, water policy development, and coordination of water-related activities at all levels of government;
- Federal Water Supply Act (1958) passage with provisions allowing non-federal entities to add water supply storage space to planned flood control structures; and
- Kansas voter approval (1958) of a constitutional amendment allowing Kansas to financially participate in the development of flood control works or works for the conservation or development of the state’s water resources.

Under the KWRB, the 1961 Kansas legislature passed a Concurrent Resolution (H.C.R. 5) allowing the state to provide assurances to the federal government for repayment of costs for add-on water supply storage in Council Grove (18,200 acre-feet), Marion (31,930 acre-feet), and JRL (27,450 acre-feet), among others (KWO 1996). The estimated yield capability of this storage space during periods of prolonged drought for these three reservoirs is 29.66 million gallons per day (mgd), with 19.9 mgd assigned to JRL (KWO 1996).

The quantity of water obligated to purchasers is based upon an estimate of the quantity of water that can be expected to be withdrawn from storage with a two percent chance of shortage during a drought, having a statistical chance of occurrence once every 50 years (KWO 1996). A yield analysis was conducted on JRL and the recalculation results were as follows:

- Sediment deposition differs significantly from that expected during project design;
- Flood control pool has excess capacity and the conservation pool has diminished capacity;
- The diminished storage capacity of the conservation pool can be recovered – a lower yield results until corrective measures are taken;
- The two percent chance yield has been recalculated to be 19.9 mgd (formerly calculated to be 26.5 mgd) for the original water supply pool purchased from the USACE to serve the WMP;
- The portion of the water supply pool purchased in 1985 (Memorandum of Understanding [MOU] with the USACE) was calculated to yield 7.3 mgd; and
- The USACE has been directed by Congress to conduct a study to determine the feasibility of a pool raise to restore storage lost to sedimentation.

To date, withdrawals for water supply storage have not had a major effect on the operation of John Redmond Reservoir (USACE 1996). All of the water supply storage is contracted by the State of Kansas, and the WCGS has contracted from the state all of the water in the storage to use for cooling and other uses. The state has also formed water assurance districts with downriver communities in anticipation of purchasing additional water supply storage in the reservoir to release for downriver water supply during drought periods.

Within the JRL flood pool, above John Redmond Dam, the USFWS holds rights to 4,574 acre-feet of water under Approved Certificates of Appropriation (FHNWR 2000). These rights are of two types, e.g., natural flow diversion (3,102 acre-feet) and pumping (1,472 acre-feet) for recreational purposes, which include fish and wildlife. These water rights are used to provide water to constructed and naturally-occurring wetlands within the refuge. Water rights for flows in the Neosho River, downriver from John Redmond Dam, are issued by the Division of Water Resources, Kansas State Board of Agriculture (USACE 1996). Currently, irrigation and recreation use comprise 10 percent of the water rights (5 percent each), municipalities have rights to 14 percent, and industrial use is 76 percent of the water rights held at JRL (USACE 1996). The active water right holders downriver from John Redmond Dam, as of 1996, are listed in Table 3-10.

Table 3-10. Active Water Right Holders

Water User – Location	Use	Amount (cfs)	Amount (acre-feet/year)
City of Chetopa – Chetopa, KS	Municipal	1.12	233
City of Oswego – Oswego, KS	Municipal	1.79	636
Dickinson Farms – Labette County	Irrigation	3.12	230
Joe Sprague – Labette County	Irrigation	3.34	285
Carroll Sprague – Labette County	Irrigation	2.69	119
Larry Sprague – Labette, County	Irrigation	3.34	98
KS Gas & Electric Co. – Labette County	Industrial	61.3	2,027
KS Ord. Plant – Labette County	Industrial	1.54	868
RWD #6 Crawford, Co. – Labette County	Municipal	0.51	92
June Carson – Labette County	Irrigation	5.79	192
Wayne Brunenn – Labette County	Irrigation	1.48	107
National Farms Feedlot – Labette County	Industrial	16.22	313
City of Parsons – Parsons, KS	Municipal	14.04	2,305
Big Islands Farms – Neosho County	Recreation	20.05	80
Gertrude J. Richards – Neosho County	Irrigation	1.78	35
KS D of Wildlife & Parks – Neosho County	Recreation	15.60	200
P & S Land Company – Neosho County	Irrigation	2.23	100
Beachner Brothers – Neosho County	Irrigation	6.68	551
James Chappell – Neosho County	Irrigation	6.68	92
Charles Gouvion – Neosho County	Recreation	0.67	4
KS D Wildlife & Parks – Neosho County	Recreation	28.74	3,000
City of St. Paul – St. Paul, KS	Municipal	0.67	156
Patrick A. Johnson – Neosho County	Irrigation	2.23	100
City of Erie – Erie, KS	Municipal	2.63	424
Thayer Insurance Agency – Neosho County	Irrigation	5.35	400
R. W. Hudson – Neosho County	Irrigation	3.34	128
Taylor Brothers – Neosho County	Irrigation	2.23	127
Kenneth Casper – Neosho County	Irrigation	3.99	180
City of Chanute – Chanute, KS	Municipal	9.36	2,718
Ash Grove Cement Co. – Allen County	Industrial	8.91	850
Monarch Cement Co. – Allen County	Industrial	1.11	0
City of Humboldt – Humboldt, KS	Municipal	2.56	676
John Works – Allen County	Irrigation	11.83	689
Jack McFadden – Allen County	Irrigation	5.35	286
Charles Sutherland – Allen County	Irrigation	1.54	82
City of Iola – Iola, KS	Municipal	6.13	1,718
PWWSD #5 Iola – Iola, KS	Municipal	1.84	615
RWD #6 Woodson Co. – Woodson County	Municipal	1.03	215
City of Leroy – Leroy, KS	Municipal	0.52	75
Clarence Parmely – Coffey County	Irrigation	4.81	79
Kenneth Crofts – Coffey County	Irrigation	2.51	39
Forrest Robrahn – Coffey County	Irrigation	0.88	27
City of Burlington – Burlington, KS	Municipal	3.34	911
KS Gas & Electric Co. – Coffey County	Industrial	170.00	53,916
KSD Wildlife & Parks – Coffey County	Recreation	26.74	150
Total Irrigation	21 Users		3,946
Total Industrial	6 Users		57,974
Total Municipal	13 Users		10,774
Total Recreation	5 Users		3,434
Grand Total	45 Users		76,128

The Kansas Gas & Electric Company (KG&E) holds the only water contract through KWO to support operation of WCGS (53,916 acre-feet); the remainder of water rights holders are members of the CNRB (3,500 acre-feet) (KWO 1996).

Water Assurance Districts were formed under the Water Assurance Program Act of 1986 (K.S.A. 82A. 82a-1330 *et seq*.), which gives the KWO authority to enter into contracts with the federal government for storage space to be used for water assurance. It was under this act that the CNRB was formed (KWO 1996). Ten thousand acre-feet of water were purchased under this act, 3,500 acre-feet were from JRL.

3.3.6 Logjam

A drift logjam up to 3/8 mile in length occurs in the Neosho River, near the Jacob's Landing site, above JRL. The logjam has formed above an island in the Neosho River, which causes the river to fork into two channels (Figure 3-4). This logjam has attracted local attention in favor of removal, and was the topic of comments obtained during public meetings held in Burlington, KS. Although the logjam does not contribute to downriver flooding, it is quite large and was considered cost prohibitive to remove (FHNWR 2000).

Local citizens attempted removal of the logjam by burning during the summer of 1999, but the wet wood would not carry the fire (FHNWR 2000). The accumulated debris at the site is considered economically unfeasible to remove by demolition or mechanical means. The Neosho River may eventually form a new channel around this location, south of the existing channel (Jirak, pers. com. 2001).

Figure 3-4. Logjam Area Upriver of John Redmond Lake

Some effects of the logjam, or large woody debris accumulation in the Neosho River north of Jacob's Creek Landing and west of the reservoir, have been identified and include:

- An impediment to navigation by boat between the lake and upriver sites;
- Slowing or dissipation of Neosho River flows resulting in some backwater formation;
- Diversion of water over the access road to the Jacob's Creek Landing boat ramp during high-flow events for the Neosho River;
- Aggradation (raising) of the riverbed due to accumulation of sediment; the sediments also serve to anchor the logjam into the river bed;
- Dropping of sediments within the John Redmond flood control pool rather than the conservation pool;
- Formation of a structure resistant to erosion, much like a geologic feature might be;
- Future island formation or formation of a cut-off oxbow when sediment deposition is sufficient; and
- A source for driftwood to accumulate and possibly float into the reservoir and against the dam structure during flood events.

In addition to the observed effects listed above, the following research would benefit any potential logjam removal analysis: 1) determination of other, similar examples of large woody debris accumulation for other reaches of the Neosho River and the effect, 2) study the effects of raising the reservoir water level to 1,041.0 feet on debris accumulation and navigation at the logjam site, 3) an economic analysis of logjam removal, hauling, storage, and disposal versus other alternatives, such as opening a new, more direct channel into the reservoir, and 4) examination of different forms of large woody debris management, including upriver prevention measures.

3.4 Biological Resources

Biological resources include the vegetation, wetland, wildlife, fisheries and aquatic resources, and the endangered, threatened, and candidate species present in the vicinity of JRL. In addition, a national wildlife refuge and a Kansas wildlife management area are present within JRL project lands and are summarized under this report section.

Several biological surveys have been completed at JRL and in the project region. A countywide plant species list and description of plant communities was prepared for FHNWR during 1999 and published in 2000. Additionally, lists of avifauna, mammals, and herpetiles have been prepared by the refuge or by the Kansas Natural Heritage Inventory (KNHI), and were published for FHNWR during 2000. Waterfowl and raptor census data are taken at JRL annually/bimonthly between the months of October and March by the KDW&P (Appendix C). Fishery data for the Neosho madtom and other catfish were collected during the late 1990s for the Neosho River upstream and downstream of the dam and reservoir during a number of years and published during 2000. Similarly, data for freshwater mussels was collected during the mid-1990s for the Neosho River upstream and downstream of the dam and reservoir and published during 1997.

3.4.1 Vegetation Resources

Plant species have been inventoried for Coffey and Lyon Counties, and number 776 (KNHI in FHNWR 2000). Many of these species grow in the variety of vegetation types that also serve as wildlife habitat within the JRL project area, including woodland, shrubland, and herbaceous (terrestrial and aquatic) plant communities (Figure 1-2). The terrestrial herbaceous communities are comprised of native and introduced grasslands in addition to agricultural crops and fallow cropland that supports weedy annual forbs and grasses. Forested, shrub-scrub, and emergent wetland and aquatic plant communities are discussed in Section 3.4.2.

The JRL project area lies within the Prairie Division–Forest-steppes and prairies ecoregion province (formerly the Prairie Parkland Province), Osage Plains section (Bailey 1997). The lowest elevations support riparian woodlands along the Neosho River and its tributaries and the JRL shoreline, upland woodlands on adjacent slopes and hills, and tall- and mid-grasses on open sites of the higher elevations. Shrubs are invading some grasslands where land management practices are not sufficient to prevent their establishment. These sites will eventually support predominantly shrub and woodland species, unless stewardship practices such as hand grubbing, mowing, controlled burning, or herbicide application are employed.

Woodlands

Riparian woodlands are characterized as a bottomland hardwood type (Elm-Ash-Cottonwood Woodland). These stands are dominated by American elm, green ash, eastern cottonwood, black willow, black walnut, sycamore, silver maple, burr oak, box-elder, and hackberry. They are lowland sites, typically have heavy soils with poor surface drainage, and are located along the Neosho River (both up- and downstream of the dam and reservoir), on the shoreline of JRL, and along Otter, Buffalo, Jacobs, Eagle, Plum, Troublesome, Lebo, Benedict, Kennedy, and Hickory Creeks (Figure 1-2). The aerial photo signature for riparian woodlands in Figure 1-2 consists of a closed canopy that is reddish to reddish-brown to dull orange color, with a pebbly texture.

Downriver from John Redmond Dam, most of the flood plain vegetation that has become established along the Neosho River and its major tributaries can be described as the riparian woodland type. When observed during a site field visit and on black-and-white aerial photography of the countywide soil surveys (NRCS 1982a, 1972, 1978, 1982b, 1990, 1985, and 1973), it is a closed-canopy forest type extending the length of the Neosho River (Figure 3-5). The type occupies islands and point bars and first and second terraces along the river. Islands, point bars, and first terraces are dominated by eastern cottonwood, silver maple, box-elder, and black willow, while slightly higher elevation second terraces support eastern cottonwood, green ash, American elm, black walnut, hackberry, and burr oak. It is common to observe seedlings and saplings of these trees in the forest understory, in addition to the eastern red cedar.

Figure 3-5. Neosho River, Chanute, KS

In Cherokee and Neosho Counties, and nearer the Oklahoma border, farmers have selected for pecan trees to grow on the second and upper first terraces of the Neosho River. Growth of pecan trees is encouraged, while other tree and shrub species are regularly removed to allow for the maximum production of nuts and effective gathering when they mature. Mature pecans are shaken from trees mechanically and recovered from the ground surface with mechanical pickers, or from materials laid over the ground surface to catch the nuts such as tarpaulins.

Upland woodlands occupy drier sites adjacent to riparian woodlands, including slopes and hillsides. They are typically characterized as Oak-Hickory Woodland. Upland woodlands are dominated by burr oak, northern red oak, pin oak, shagbark hickory, and shellbark hickory. On the driest sites, bitternut hickory, chinquapin oak, Osage orange, redbud, and eastern red cedar are the common tree species. Wooded upland sites typically have good surface and internal drainage because of their topographic location on slopes. Some north-facing slopes are dominated by red oak and are considered a unique, Ozarkian Woodland (Minnerath, pers. com. 2001). Perhaps the best example of this type occupies a portion of the Eagle Creek drainage (Figure 1-2). The aerial photo signature for upland woodlands (Figure 1-2) consists of a closed canopy that is dull brownish-red in color, with a pebbly texture. It is also likely that the Ozarkian Woodland type is present along some drainages downriver and tributary to the Neosho River, including the Spring River and Lightning Creek drainages.

As an adjunct to a raccoon denning survey in the FHNWR, Gehrt et al. (1990) collected riparian tree data. Using a point-quarter sampling methodology for trees greater than 30 cm diameter at breast height (dbh), the tree species distance from the point, and dbh were recorded. The relative dominance, relative density, basal area, and number of trees per hectare were calculated. Hackberry was the dominant tree species over 30 cm dbh, along with silver maple, green ash, white oak, American elm, sycamore, and mulberry. Riparian woodlands at the FHNWR supported 159 trees per hectare with a basal area of 28.2 m^2/ha. The dbh for eastern cottonwood averaged 50.2 cm, sycamore 115 cm, and silver maple 57.0 cm.

Shrublands

Shrublands occur as patches and stands along drainages, the reservoir shoreline, upper margins of wetlands, and as invasive species of grasslands. Flood plain shrublands growing along the riverbanks are dominated by buckbrush, greenbriar, dogwood, American plum, and the liana, wild grape. The reservoir shoreline and upper wetland margins are characterized by buttonbrush and seedling black willow and eastern cottonwood. A few stands of seedling silver maple were also observed, having become established on upper wetland margins. Invasive shrub species of upland grasslands include species of sumac and sapling trees, particularly eastern red cedar.

Downriver of the John Redmond Dam, shrublands occupy recently scoured islands, point bars, and riverbanks (Figure 3-6). On these sites, which are disturbed during flood events, sandbar willow, rough dogwood, and buttonbrush invade rapidly and form stands of shrubs up to 15 feet tall. On some sites, silver maple, eastern cottonwood, and black willow seedlings make up a significant portion of the shrub canopy cover. As the shrubs mature the stands are gradually replaced by black willow, silver maple, and eastern cottonwood trees. The aerial photo signature for shrublands (Figure 1-2) is a dull orange to reddish-brown color and a brushy texture containing individual pebbles where small black willow or eastern cottonwood trees are present.

Figure 3-6. Neosho River Island, Chanute, KS

Grasslands

Grasslands of the project area are predominantly introduced and exotic within the project site mid- and lowland areas and are dominated by smooth brome, Kentucky bluegrass, and meadow fescue. A few stands of mostly native grass species occupy approximately 225 acres along the northern and southern boundary fence lines (FHNWR 2000). These grasslands are composed of tall and mid-grass species and are considered Tallgrass Prairies as described by McGregor et al. (1986). Grass species commonly associated with dry, upper slopes, hills and ridges are mostly mid-grasses, including little bluestem, sideoats grama, purpletop, and Indian-grass. Lower, more mesic slopes and swales support the tall grasses—big bluestem, broomsedge bluestem, Kentucky bluegrass, silver bluestem, switchgrass, and witchgrass.

Only small patches of grassland were observed along the Neosho River downriver of John Redmond Dam. These occurred on steep, southerly exposed banks and in canopy breaks, where disturbances for road and power line maintenance activities had occurred (Figure 1-2). Some pasture grasses had been planted to support grazing livestock on a few sites above the primary flood plain.

The aerial photo signature for grasslands (Figure 1-2) is predominantly pink to pinkish-red and smooth textured. A few pebbly-roughened areas may be present where shrubs and small trees have begun to invade the grasslands. Where grasslands have been recently mown, the color signature becomes white to light pink and is smooth-textured, depending on the amount of regrowth that has occurred.

The KDW&P attempted planting approximately 100 acres of native grasses in the OCWA (Barlow, pers. com. 2001). To date, approximately half of this acreage remains, the rest of the plantings failed due to flooding because of the flood control function of the dam. Figure 3-7 shows a herbaceous association dominated by weedy forbs at OCWA.

Figure 3-7. John Redmond Open Area and Woodland

Several large areas of landscaping also support introduced grasslands within the JRL project area. These are irrigated plantings and are used for recreation sites and as aesthetic plantings around buildings. Typically, landscaped grasslands are planted to Kentucky bluegrass and Bermuda grass. Along the Neosho River below John Redmond Dam, landscaped grasslands and gardens have been introduced in some local parks, such as the one shown for the City of Burlington in Figure 3-8.

The aerial photo signatures for introduced and maintained grasslands range from dull pink to light red and the texture is very smooth due to regular mowing. Individual pebbles and groups of pebbles appear where trees and shrubs have been introduced as landscape plantings and as shade trees. These grassland signatures are often interrupted with the white signatures of roads, trails, and campsites.

Agricultural Land

Approximately 4,298 acres of croplands are available for lease on the FHNWR, 400 acres on the OCWA, and 400 acres on USACE land. The typical crops planted on leased agricultural lands are corn, wheat, and soybeans. Currently, the USACE acreage is not leased because the land is too often flooded and the costs associated with driftwood removal are too high (Fry, pers. com. 2001). Similarly, the lease for the OCWA acreage is nearly up and a crop has been harvested only about two of every five years (Barlow, pers. com. 2001). Currently, 14 farmers lease approximately 3,700 acres of the available land within the FHNWR (Gamble, pers. com. 2001).

Downriver from John Redmond Dam, agricultural fields occupy the upland along nearly the entire 190-mile corridor. For much of the corridor, riparian forests form a narrow to broad belt along the river, intercepting runoff from adjacent agricultural land, but at a few sites fields are farmed to nearly the river's edge (Figure 3-9). The aerial photo signatures for agricultural lands range from pink to deep red and a smooth texture for fields planted to crops such as soybeans and wheat (Figure 1-2), while cornfields and fallow lands with tall, annual weeds appear reddish to orange and slightly roughened.

Figure 3-8. Neosho River, Burlington, KS

Figure 3-9. Agricultural Field Next to the Neosho River

In addition to agricultural leases, mudflats are sometimes aerially seeded with millet to provide forage for fish and wildlife. During 2000, approximately 700 acres of mudflats were aerially seeded (Gamble, pers. com. 2001).

Downriver from John Redmond Dam, pecan plantings and orchards have been established in the flood plain of the Neosho River and other flood plain and upland sites in southeastern Kansas (Reid 1995). The scoping meeting held in Chetopa, KS (USACE 2001) resulted in several comments from pecan growers concerning effects of flood water on pecan production in the area.

Generally, pecan trees will grow without irrigation when an average of 30 inches of precipitation is available, but ample water throughout the growing season is necessary for good tree growth and regular nut production (Reid 1995). Good soils for pecan production are characterized by a clay loam to sandy loam texture, good internal drainage, and a static water table that ranges from 10–25 feet below the soil surface (Reid 1995). Nut production can be negatively affected by: 1) mild drought conditions, resulting in smaller nuts (spring drought) or poor kernel filling (summer drought), 2) severe drought conditions, resulting in nut abortion, premature defoliation, and a decrease in the following year's nut crop, and 3) extended periods of seasonal flooding, resulting in early leaf-fall from stressed trees.

Pecan orchards and groves consist of the tree canopy and an understory of cool-season grasses that are regularly mowed. Pecan nuts ripen in late September to early October, dry on the tree during October, and fall or are shaken from the trees and collected mechanically from the mowed ground cover (Reid 1995).

Exotic Plant Species

Several exotic plant species are present in the project area; two targeted for control and occurring within JRL lands are Johnson grass and Sericea lespedeza (FHNWR 2000 and Jirak, pers. com. 2001). State and county law mandates control of exotic plant species (FHNWR 2000). Typically, control efforts incorporate mowing and farming, although biological controls are being investigated. Pesticide and herbicide use are restricted in the Neosho River flood plain within the refuge and an integrated pest management approach is taken, using farm management practices, prescribed burning, and chemical application where appropriate (FHNWR 2000).

3.4.2 Wetland Resources

Wetlands of JRL consist of natural wetlands (approximately 123 acres) that have become established upriver from the reservoir in abandoned oxbows of the Neosho River and deeper flood plain depressions (that are now known as lakes) (FHNWR 2000). Wetlands also persist along the shoreline of the reservoir and at the base of John Redmond Dam, where shallow water support emergent and aquatic types, which have been introduced into FHNWR. Wetlands occupying the area between the 1,039-foot and 1,041-foot contours are shown on Figure 3-10 and have been classified under the USFWS-National Wetland Inventory, as follows:

- L1UBHh – Lacustrine, Limnetic, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded.
- L2USAh – Lacustrine, Littoral, Unconsolidated Shore, Temporarily Flooded, Diked/Impounded.
- PEMAh – Palustrine, Emergent, Temporarily Flooded, Diked/Impounded.
- PFOAh – Palustrine, Forested, Temporarily Flooded, Diked/Impounded.
- PSSA – Palustrine. Scrub-Shrub, Temporarily Flooded.
- PSSAh – Palustrine, Scrub-Shrub, Temporarily Flooded, Diked/Impounded.
- R2UBHx – Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Excavated.

Figure 3-10. Representative Wetlands at JRL

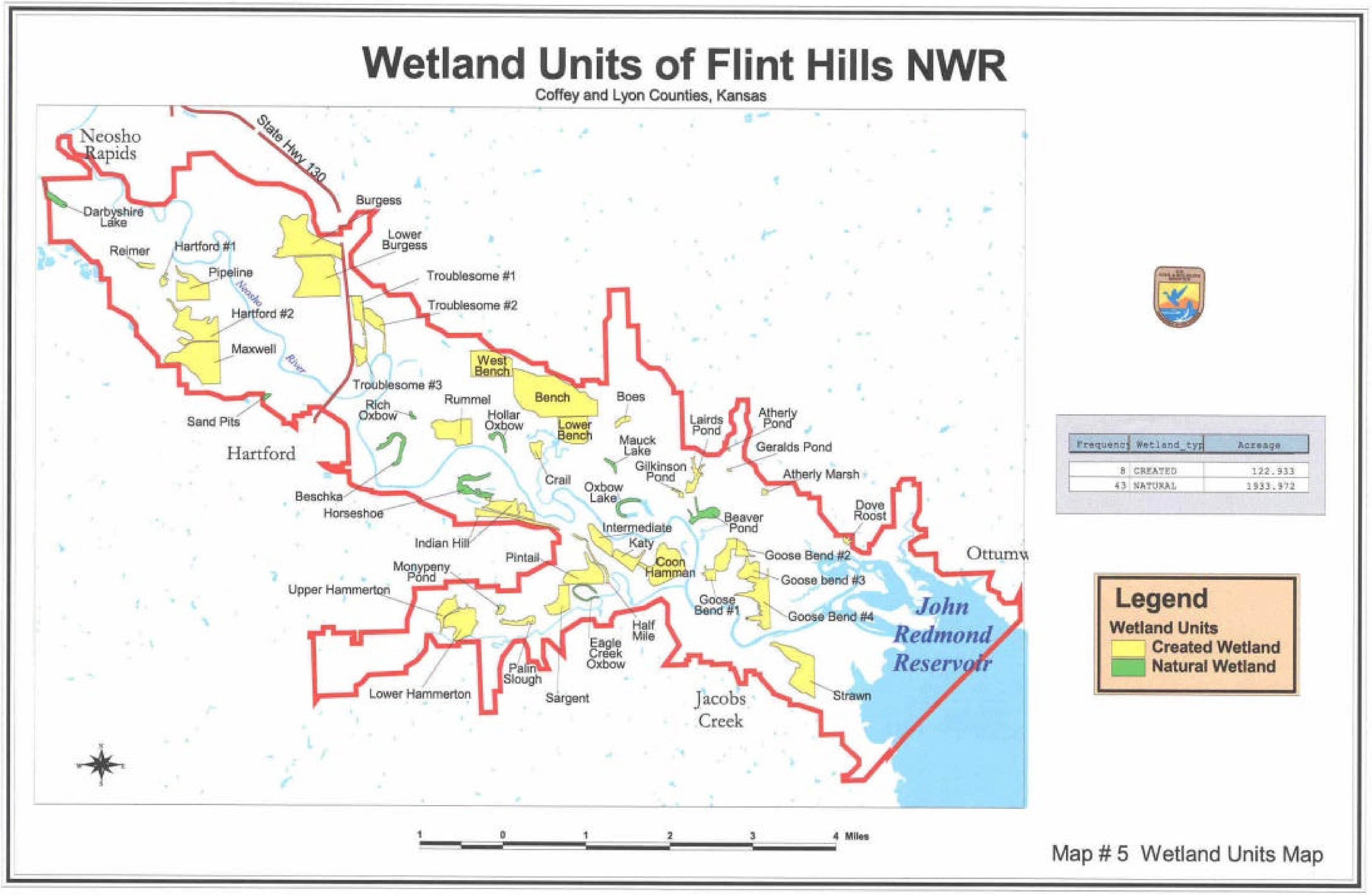
Forty-three wetland units totaling approximately 1,934 acres have been created on the FHNWR using a dike and levee system and pumping or natural flow diversion water rights that equal 4,574 acre-feet. Two wetland units, Strawn and Goose Bend #4, lie in relatively close proximity to the upper shores of JRL (FHNWR 2000). The hydrology supporting wetlands within JRL and along the Neosho River is predominantly surface water that inundates sites during high water periods or is pumped into constructed, shallow impoundments. Figure 3-12 illustrates the location of the Strawn and Goose Bend #4 wetland units as well as the other wetland units at FHNWR.

Natural wetland communities support species of sedge, flatsedge, spike-rush, bulrush, rush, and grasses such as prairie cordgrass, switchgrass, and rice cutgrass (FHNWR 2000). An aquatic component is typically present in wetlands of the JRL project area and includes swamp smartweed, pondweed species, duckweed, bladderwort, arrowhead, water plantain, and hornwort. A fringe of willow and buttonbush shrubs is typically present on upper wetland margins.

Wetlands established in the wetland units and in shallow coves of the reservoir are dominated by swamp smartweed, in addition to other smartweed species, bulrush, cattail, spike-rush, and sedge (Figure 3-11). Some stands of seedling silver maple, eastern cottonwood, and black willow were also present. On the reservoir drawdown zones, weedy annuals such as cocklebur, foxtail grass, and barnyard grass are common species. Reservoir drawdown zones are sometimes aerially seeded with millet to provide waterfowl and fisheries forage (Gamble, pers. com. 2001).

Downriver from the dam, wetlands on the Neosho River banks and on islands in the river are predominantly shrub-scrub and dominated by species of willow and buttonbush shrubs, and sapling black willow, silver maple, and eastern cottonwood trees. Herbaceous species, including bulrush, cattail, and spikerush are commonly observed. In areas of ponded water such as oxbows, aquatic species including smartweed and duckweed are common.

Figure 3-11. Smartweed in Wetland Unit



Source: USFWS 2000

Figure 3-12. Wetland Units of the Flint Hills National Wildlife Refuge.

3.4.3 Wildlife Resources

The JRL project area supports a wide variety of bird, herpetile, and mammal species. FHNWR (2000) lists 294 species of birds, including 90 species that are known to nest on the refuge. Species lists prepared for Coffey and Lyon Counties included 47 mammals and 58 herpetiles that likely occur within the JRL site.

The project site and region provides habitat for a variety of avifauna that use the upland, grassland, agricultural land, hardwood riparian stands, marshes, and flooded sloughs and ponds present. The peak of migration is April–May for passerine species, July–August for shorebirds, and November–December for waterfowl species. The JRL area avifauna provides a destination for conduct of both naturalist activities such as bird watching and for hunting waterfowl, turkey, northern bobwhite quail, and mourning dove.

One roost used by turkeys is known within the FHNWR adjacent to the Neosho River near Mauck Lake (Applegate, pers. com. 2001). This site is approximately two miles upriver from the 1,041.0-foot elevation, near the Lebo Creek confluence. There are likely to be additional turkey roosts within riparian habitats in the vicinity (Applegate, pers. com. 2001).

Northern bobwhite quail have been studied relative to their behavioral response or fate during flooding events in eastern Kansas (Applegate et al. in press). The effects of flooding to northern bobwhite quail populations was evaluated within the Cottonwood and Neosho River flood plains from 31 October to 2 November, 1998 (a period of 21 cm of rain in Lyon County, KS) during the third incident of overbank flooding in the decade. Nineteen Ninety-Three (1993), 1995, and 1998 were years of overbank flooding along these rivers. The results of the study (Applegate et al., in press) were:

- the mortality rate for marked northern bobwhite quail occupying flood plains; following flooding events, was estimated to be about ten times higher than for quail located on upland sites (0.22 vs. 0.02);
- individual quail, located by radio-collars, were found dead beneath flood debris and silt following the overbank flooding events (some marked birds were never relocated following the flood event and possibly were swept away by floodwaters);
- natural mortality was also higher (approximately 3x) for flood plain dwelling quail (0.36 vs. 0.10) possibly the result of displaced coveys being more susceptible to predation;
- coveys that did not go extinct following floods moved their range to avoid floodwaters (one covey as far as 0.4 km); and
- approximately 50 coveys of northern bobwhite quail could have been lost in Lyon County over the 130 km^2 area of flooded land and an unknown number of coveys were likely displaced.

Raptors common to the area include the American kestrel, prairie falcon, northern harrier, red-tailed hawk, great-horned owl, barred owl, and wintering bald eagles. Although not strictly raptors, the turkey vulture and American crow are also common (FHNWR 2000). Passerine birds common to and nesting within JRL include the American goldfinch, eastern meadowlark, red-winged blackbird, northern cardinal, common yellowthroat, brown thrasher, northern thrasher, northern mockingbird, American robin, house wren, black-capped chickadee, barn swallow, horned lark, eastern kingbird, and red-bellied woodpecker among many other species (FHNWR 2000). The introduced European starling and house sparrow are also considered abundant passerine birds for the area.

Shorebirds common to JRL and vicinity include the killdeer, American avocet, herons, plovers, sandpipers, yellowlegs, dowitchers, gulls, and terns (FHNWR 2000). Common waterfowl species present during the fall migration include the mallard, teal (green-winged, cinnamon, and blue-winged), northern shoveler, common merganser, lesser scaup, redhead, wood duck, and American coot (KDW&P 2001). Commonly observed goose species include the Canada, Ross, snow, and white-fronted.

The numbers of waterfowl present through the season are variable, depending on habitat availability and quality. During the year 2000 migration, a total of approximately 48,600 geese and 48,000 ducks were counted on JRL (KDW&P 2001). During the year 1996 migration, approximately 103,000 geese and 236,000 ducks were counted (KDW&P 2001). Tabular summaries of additional waterfowl counts by year are presented in Appendix C. The primary use of JRL and the FHNWR by waterfowl is for resting and foraging during migration; little waterfowl nesting activity occurs in the area (Gamble, pers. com. 2001).

Herpetiles common to JRL and vicinity uplands include species such as Woodhouse's toad, box turtle, common garter snake, and species of skink (FHNWR 2000).

A variety of game and non-game mammals are present in the JRL site vicinity. The principal game mammals include the eastern cottontail, eastern fox squirrel, and white-tailed deer. Common furbearers present include the muskrat, raccoon, a few beaver, and the carnivores coyote, red and gray fox, mink, and species of weasel. The river otter has been reintroduced to the region and a few have been observed using the Neosho River (Gamble, pers. com. 2001).

Raccoon denning behavior and response to flooding has been studied along the Neosho River within the FHNWR (Gehrt et al. 1990 and 1993). Eighty-three percent of dens used by raccoons in the FHNWR were tree cavities (Gehrt et al. 1990). Cavities in silver maple and sycamore trees were the most commonly used by raccoons for den sites, and suitable trees occurred at a density of 5.5 trees/ha in the FHNWR. Extensive flooding (69 and 78 days) of the Neosho River Valley above John Redmond Dam did not force raccoons out of the flood plain or contribute to raccoon mortality (Gehrt et al. 1993). Rather, the partly arboreal raccoons remained within floodwaters and swam from tree-top to tree-top during these two flooding events at JRL.

White-tailed deer tended to remain within wooded habitat adjacent to flooded areas above John Redmond Dam, including using areas covered with shallow water (Fox, pers. com. 2001). Floods tend to concentrate deer in smaller areas of habitat, making them more vulnerable to hunters during the hunting season and to vehicle traffic (Jirak, pers. com. 2001). Fox (pers. com. 2001) stated that landowner complaints adjacent to FHNWR are minor, and recalled only one on record for a landowner on the northern boundary of the refuge. In this case, the deer were feeding in agricultural fields adjacent to a portion of FHNWR closed to hunting (Fox, pers. com. 2001).

The Kansas Department of Transportation (KDOT) maintains records of total deer-related vehicle accidents (DVA) by county and has calculated the DVA per billion miles traveled for each county (KDOT 2000a and b). The John Redmond Dam and Reservoir lies in the western half of Coffey County and the eastern half of Lyon County. Data for these counties show a 15-year total of 1,317 and 1,759 DVAs for Coffey and Lyon Counties, respectively. It is unknown how many of these accidents occurred in the vicinity of JRL or to what extent flood events played a role. Fox (pers. com. 2001) stated that many of the DVAs occur on paved highways with higher rates of speed and larger traffic volumes and most roads adjacent to JRL are earth-surfaced. KDOT (2000b) translates the data to approximately 600 and 337 DVAs per billion miles traveled for Coffey and Lyon Counties, respectively.

There is a trend in the data towards more DVAs for the 15-year period represented, 1985-1999 (KDOT 2000a). For the first eleven years, DVAs averaged 100 and 66 per year in Coffey and Lyon Counties, respectively. In the last four years, DVAs averaged 165 and 149 per year in Coffey and Lyon Counties, respectively; the cause of this increase in DVAs is unknown.

The JRL site lies in deer management unit 14 of the KDW&P statewide management plan (Fox, pers. com. 2001). White-tailed deer occupy the habitats of the JRL site and are affected by flood storage behind the dam. However, the deer tend to move to the edge of the flood pool when it is formed, even occupying some areas with shallow standing water (Fox, pers. com. 2001).

3.4.4 Fisheries and Aquatic Resources

Fish species have been listed for Coffey and Lyon Counties and number 68 (FHNWR 2000). Those common to JRL include the channel and flathead catfish, common carp, white bass, walleye, white crappie, and several species of sunfish (USACE 2001). Amphibians present in the aquatic system include the plains leopard frog, bullfrog, and tiger salamander. Common aquatic reptiles include the snapping turtle, map turtles, softshell turtles, and northern water snake.

The lake environment supports both sport and rough fish species, with gizzard shad as the predominant forage base for the sport fish. The population of walleye is considered to be in fair condition, and spawn among the rocks on the face of the dam. Typically, walleye spawn in one to four feet of water among riprap on the dam face (USFWS 2001). White crappie may spawn throughout the shallow portions of JRL, but their preferred location is in coves protected from wave action. White bass and channel catfish populations tend to be insensitive to moderately fluctuating water levels in the reservoir and wipers are primarily an open water fish species. Bigmouth and smallmouth buffalo, common carp, and the river carpsucker are rough fish present throughout JRL (USFWS 2001).

The JRL was recently studied to determine its effect within the Neosho River on the associated ictalurid (catfish) populations (Wildhaber et al. 2000). Comparative studies were conducted to determine differences in the Neosho River fishery above the reservoir and below the dam structure. Generally, more catfish were present above JRL than occurred below the dam (Table 3-11).

Table 3-11. Mean Density of Ictalurid Fish Species Captured Above JRL and Below John Redmond Dam, Kansas (Source: Wildhaber et al. 2000.)

Fish Species	Mean Density Above JRL	Mean Density Below Dam
Neosho madtom	$19.82/100m^2$	$5.64/100m^2$
Channel catfish	$34.31/100m^2$	$18.73/100m^2$
Stonecat	$4.61/100m^2$	$2.83/100m^2$
All catfish excluding Neosho madtom	$45.40/100m^2$	$25.66/100m^2$

Note: research was conducted at an average water depth - velocity of 0.33m - 0.34m/s above JRL and 0.38m - 0.35m/s below the dam.

Several attributes of the Neosho River were compared above and below the reservoir and dam (Wildhaber et al. 2000), including:

- Water temperature was cooler by approximately 3°C above the dam (24.74°C) than below (27.58°C);
- Turbidity was higher above the dam (57.0 NTU) than downriver of the dam (27.17 NTU);
- The pH was nearly the same (8.37 above and 8.47 below);
- Dissolved oxygen increased downriver of the dam (4.66 mg/l above and 5.62 mg/l below); and
- Conductivity, alkalinity, and hardness were all higher above the dam structure, but it was unknown if these factors limit ictalurid populations.

An analysis of sediments indicated the Fredle Index (geometric mean adjusted for distribution of particle sizes) was lower above the dam than downriver from the dam (5.52 vs. 7.82). Although not significantly different, this index indicates that more evenly distributed substrate sizes occur upriver from the reservoir, and a shift to the predominance of larger gravel below the dam may be occurring. This increased coarseness of the substrate is considered a common effect of reservoirs and could be a limiting factor for some fish populations (Wildhaber et al. 2000).

The logjam (Section 3.3.6) has been identified as an impediment to navigation from JRL up the Neosho River to upriver boat launching facilities. However, large woody debris has been beneficial in restoration efforts for fisheries, such as those along the Au Sable River (ASR) in Michigan (ASRWRC 1996). Tillma et al. (1998) determined that woody debris habitat and undercut banks were a positive influence on spotted bass density and biomass in Kansas streams. Gurnell et al. (1995) suggest avoiding the indiscriminant removal of coarse woody debris in favor of active management, because accumulations have an effect on hydrology, hydraulic properties, sediments, morphology, and biology of river channels. In particular, they stabilize and increase the biological productivity of river channels in forested catchments. However, Piegay and Landon (1997) proposed logjam removal be selectively performed on a Rhone River tributary in France to increase bedload (sediment) availability to repair an incising drainage.

In the ASR, a demonstration project to place woody debris was undertaken to provide habitat enhancement, food production, and erosion control. Historically, the ASR was not navigable because several reaches were so full of woody debris that the river seemed to disappear underground. These sites were used by early explorers, settlers, and Native Americans as natural river crossings (ASRWRC 1996). They were removed in the late 1800s and early 1900s so logs cut for timber could then be floated downriver to mills.

ASRWRC (1996) research has determined that logjams and debris complexes in rivers are vital for proper functioning of biological components of a stream, because physical aspects of the river have a strong influence on the biological components, as follows:

- Fallen trees alter the flow of stream current;
- Flows are typically directed away from riverbanks, which may be unstable;
- Organisms seek out areas of slower current for resting (living in faster currents consumes energy and affects survival);
- Submerged trees help the currents to scour deep holes used by fish for refuge and cover;
- Large deadfalls trap debris and slow transport of organic material (leaves, woody twigs, etc.) important to river organisms;
- Aquatic organisms live on organic material, e.g., bacteria, fungi, shredding macroinvertebrates (mayflies and caddisflies), collecting macroinvertebrates, predatory insect larvae (stoneflies and dragonflies), and fish;
- Burrowing organisms use the fibrous woody tissue in the logs; and
- Benefits realized from large woody debris include habitat variety, protective cover, feeding stations for invertebrates (crayfish), amphibians (frogs and toads), reptiles (turtles, snakes), fish, wading birds (herons), mammals (raccoon), and habitat for insects and fish species.

Hax and Golladay (1998) found that benthic macroinvertebrate populations recovered more rapidly in woody debris than on sediments following an engineered streamflow disturbance. They attributed this to the stability of the woody debris retained in debris dams, which became an important refuge and source of re-colonizing organisms. Bilby and Bisson (1998) report an increase in abundance and changes in composition of macroinvertebrates when wood is added to stream channels. Additionally, fish use large woody debris as cover.

3.4.5 Endangered, Threatened, and Candidate Species, Species of Special Concern, and Sensitive Communities

Six species, e.g., bald eagle, western prairie fringed orchid, Neosho madtom, Neosho mucket mussel, rabbitsfoot mussel, and Ouachita kidneyshell mussel, were listed as federal and Kansas endangered or threatened for the JRL project area (Table 3-12) (USFWS 2000 and KDW&P 2000). Additionally, two species were discussed in the FHNWR Comprehensive Conservation Plan (2000)—the peregrine falcon (federal-threatened) and flat floater mussel (Kansas-endangered). A Biological Assessment (BA) was prepared to address threatened, endangered, and candidate species listed by the U.S. Fish and Wildlife Service and the KDWP (Appendix D).

The KDH&E has classified the Neosho River (downstream from Council Grove Reservoir) and the Cottonwood River as special aquatic life-use waters (USFWS 1991). These are waters that contain unique habitat types and biota, or species that are listed as threatened or endangered in Kansas.

Table 3-12. Federally- and Kansas-Listed Species for the John Redmond Lake Project Area (Sources: USFWS 2000, KDW&P 2000, and KNHI 2001) (Appendices C and D)

Species	Status / Rank	Comments
Common Name (***Scientific Name***)	**Federal/Kansas/ Global**	**Source and Habitat**
Bald Eagle (*Haliaeetus leucocephalus*)	US – Threatened KS – Threatened G4/S1B, SZN	USFWS response letter. Transient use of larger trees in the vicinity of open water.
Peregrine Falcon *(Falco peregrinus)*	US – Threatened KS – Threatened G4/S1B, SZN	FHNWR management plan. Migrates through the JRL area, but does not nest.
Neosho Madtom (*Noturus placidus*)	US – Threatened KS – Threatened G2/S2	USFWS and KDW&P response letters. Use shallow riffles with loose/uncompacted gravel bottoms.
Western Prairie Fringed Orchid (*Platanthera praeclara*)	US – Threatened KS – Threatened G2/S1	USFWS response letter. Grows in tallgrass silt loam soils, moist sand prairies, or hay meadows with full sunlight.
Neosho Mucket Mussel (*Lampsilis rafinesqueana*)	KS– Endangered G2/S1	KDW&P response letter. Requires clean, in-stream gravel beds.
Rabbitsfoot Mussel (*Quadrula cylindrica cylindrica*)	KS– Endangered G3/S1	KDW&P response letter. Requires clean, in-stream gravel beds.
Ouachita Kidneyshell Mussel (*Ptychobranchus occidentalis*)	KS – Threatened G3G4/S1	KDW&P response letter. Requires clean, in-stream gravel beds.
Flat Floater Mussel *(Anodonta suborbiculata)*	KS – Endangered G5/S1	FHNWR management plan. Requires ponds, lakes, or sluggish mud-bottomed pools of creeks and rivers.

Rank: G2: Globally imperiled because of rarity; typically 6-20 occurrences, G3: Globally vulnerable because it is very rare and local throughout its range; typically 21-100 occurrences, G4: Globally apparently secure, uncommon but not rare, widespread; typically 100 occurrences or more. G5: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery. S1: State critically imperiled because of extreme rarity; typically five or fewer occurrences, S2: State imperiled because of rarity; typically 6-20 occurrences, SZN: Zero occurrences/non-breeding population, occurs during migration (KNHI 2001).

Bald Eagle (Haliaeetus leucocephalus)

The bald eagle is federally listed as threatened; however, it is under consideration for de-listing (*Federal Register* 1999). It is considered transient through the project area, but some nest initiation behavior has been observed on the FHNWR (Gamble, pers. com. 2001). Bald eagles are listed as common during the winter months and counts occur every other week from the latter half of October through the end of March (FHNWR 2000, Kraft and Culbertson, pers. com. 2001).

The total season counts have ranged from as few as one bald eagle in 1974, to as many as 280 in 1988. On average, 10 to 20 individual bald eagles use the JRL area at any one time (Culbertson, pers. com. 2001). Bi-weekly counts over the past 30 years have yielded no bald eagles observed (several periods), and as many as 104 individuals present in the latter half of February 1987 (KDW&P 2001). During the year 2000, 65 bald eagle observations were recorded during the season: four in late December, zero in early January, eight in late January, seven in early February, 29 in late February, 15 in early March, and two in late March (KDW&P 2001).

In approximately three of the last ten years, a pair (or possibly different pairs) of bald eagles performed nest initiation but rapidly abandoned the behavior (Gamble, pers. com. 2001). It is possible that these were young eagles as they did not complete nest construction or initiate breeding or egg-laying activities. A successful nest site was reported from near the Coffey County Fishing Lake and the WCGS (Culbertson, pers. com. 2001).

Typically, bald eagles use trees around JRL and along the Neosho River and its tributaries as perches for foraging, resting, and as roosts (Gamble, Kraft, and Culbertson, pers. com. 2001). When ice formed on JRL, bald eagles were observed resting directly on the ice where they consumed waterfowl and fish from an open portion of the lake (Culbertson, pers. com. 2001). Bald eagles may take fish and waterfowl directly, in addition to foraging or scavenging for dead or wounded animals.

Peregrine Falcon (Falco peregrinus)

The peregrine falcon is a federally- and Kansas-threatened raptor, proposed for federal de-listing, that passes through the project area during spring and fall migration but does not nest there (FHNWR 2000).

Western Prairie Fringed Orchid (Platanthera praeclara)

The western prairie fringed orchid (WPFO) is federally listed as threatened. The species may be found within unplowed mesic to wet-mesic prairies and sedge meadows on unglaciated, level to hilly sites, and on Pennsylvanian-age sediments covered with a thin, discontinuous mantle of loess residuum (USFWS 1996). The WPFO distribution in Kansas is generally north of JRL (Douglas, Franklin, Jackson, Jefferson, Leavenworth, Lyon, Osage, and Shawnee Counties) and the project area; the nearest population was known in the vicinity of Reading, KS in northeastern Lyon County (Freeman, pers. com. 2001). One historical report of the WPFO in Waverly Prairie of Coffey County was reported during 1969, but the prairie was converted to cropland, destroying the former WPFO habitat (Freeman and Brooks 1989).

In eastern Kansas, WPFO habitat was described as mesic to wet-mesic prairies, and in northeastern Kansas it was described as wet-mesic to mesic tallgrass prairie. Freeman (pers. com. 2001) stated that south of the Kansas River, the WPFO grows in mesic prairie (dominated by species of sedge, switchgrass, and big bluestem) and moist seeps that form along a contact of shale and limestone formations. The populations of WPFO in Kansas are small and none support greater than 50 individual plants (USFWS 1996). WPFO decline is principally attributed to the conversion of habitat to cropland.

The WPFO has not been documented within the JRL project boundaries. Habitat there is considered too dry to support the species (Minnerath, pers. com. 2001). There is no mesic tallgrass or wet meadow habitat between the 1039.0-foot and 1,041.0-foot elevation of the existing and proposed conservation pool (Minnerath, pers. com. 2001). Within the area of the flood control pool, a mesic prairie site of approximately 380 acres was identified near Neosho Rapids, KS, approximately three miles northwest of the northwestern-most project boundary and within the flood easement boundary. This site is dominated by prairie cordgrass and eastern gammagrass and represents potential habitat for the WPFO, although no plants have been observed (Minnerath, pers. com. 2001).

Neosho Madtom (Notorus placidus)

The Neosho madtom (NMT) is a federally- and Kansas-listed threatened species of catfish that occupies gravel bars and smaller areas of gravel in rivers of the Neosho Basin (USFWS 1991, Edds, pers. com. 2001). The current distribution of the NMT includes the Neosho River from Commerce, OK to extreme southeastern Morris County, KS; the Cottonwood River from its Neosho River confluence to central Chase County, KS; and the Spring River from its Neosho River confluence to western Jasper County, Missouri (MO) (USFWS 1991, NSRA 1996).

In the vicinity of John Redmond Dam, the NMT is thought to occupy gravel bars near Hartford, KS, approximately five miles upriver from the reservoir margin. The gravel bar that lies approximately 0.75 miles west of Neosho Rapids, KS was sampled in 1994 and supported the NMT (27 individuals were captured) (NSRA 1996). This location represents a permanent monitor site and has been sampled every year from 1991–2000 (Tabor, pers. com. 2001 and Wildhaber et al. 2000). The two gravel bars near Hartford, KS are located west of the State Highway (SH) 130 bridge and east of the Hartford Recreation Area loop road. Historic sampling (1950s through 1975) determined that two individual NMTs were present on the gravel bar west of the SH 130 bridge. The gravel bar east of Hartford, KS has yet to be sampled for NMTs (Shaw, pers. com. 2001).

Further upriver from Neosho Rapids, KS, the NMT has been collected at the following general locations: 1) Lyon County - 13.0 km, 11.0 km, 7.25 km, 5.25 km, and 2.5 km east of Emporia, Bridge Site at SH 99, Emporia water intake at the Prairie Street Bridge; 4.0 km west of Americus; 6.5 km north of Americus; and 2) Morris County - 1.0 km west of Dunlap, KS (NSRA 1996). In addition, eight collection sites have been identified for Lyon County and five for Chase County on the Cottonwood River above its confluence with the Neosho River (NSRA 1996).

Downriver from John Redmond Dam, the NMT has been found as near as Burlington, KS – City Park (NSRA 1996); however, there is a gradual increase in numbers of individual NMTs further from the dam to the Oklahoma border (Tabor, pers. com 2001). The NMT has been collected below the dam at the following general locations: 1) Coffey County - Burlington City Park, 2.0 km, 2.5 km, and 3.0 km east of Burlington, KS; 2) Woodson County - at Neosho Falls, and 1.5 km east of Neosho Falls; 3) Allen County - 2.0 km west of Iola, KS, and downriver of the Humboldt Dam; 4) Neosho County - 3.0 km east of Chanute, KS, southwest of Erie, KS, 2.0 km south of Erie, 4.0 km west of St. Paul, KS, 3.0 km and 5.0 km south of St. Paul, and 19.5 km northeast of Parsons, KS; 5) Labette County - 13.0 km east of Parsons, downriver of the Oswego Dam, 2.5 km east of Oswego, KS, and downriver of the Chetopa Dam; 6) Cherokee County - 19.5 km west of Columbus, KS, and on Lightning Creek 20.0 km west of Columbus; and 7) Ottawa County - OK; 10.0 km and 7.5 km west of Commerce, OK, and 7.0 km and 5.0 km west of Miami, OK (NSRA 1996).

NMTs are small, measuring less than three inches (approximately 38-78 mm) in length (Bulger et al. 1998), and occupy riffles or portions of riffles (Wildhaber et al. 2000). Young-of-the-year tended to use areas with slower flow, lower substrate compaction, and shallower depths than did adults (Bulger et al. 1998). These catfish burrow into the substrate during the day and emerge to feed in the late afternoon through evening hours (USFWS 1991). NMTs feed at night on larval insects found among the gravel and pebbles (Cross and Collins 1995 in Wildhaber et al. 2000). Other madtom species that share the gravel bar habitat favored by NMTs include the slender madtom, stonecat, brindled madtom, and freckled madtom (USFWS 1991). Young-of-the-year channel and flathead catfish have also been found in this riffle habitat, in addition to species of minnows and darters (USFWS 1991).

Some NMT habitat features were summarized by Natural Science Research Associates (NSRA) (1996) from various studies, and a mean habitat range was determined as follows: 1) water depth = 17-20 cm to 46.3 cm; 2) water velocity = 10.0 cm/s to 50.0 cm/s at substrate level and 25.8 cm/s to 46.2 cm/s at 0.6 m depth; 3) water temperature = $1^{o}C$ to $29^{o}C$; 4) dissolved oxygen = undetermined (minimum value <6 mg/l); 5) turbidity = undetermined; 6) substrate material = 8.0 mm to 40.0 mm and 65–69 percent gravel/pebble; 7) density of occurrence = $0.6\text{-}2.0/10m^2$ (winter-spring) and $2.5\text{-}6.0/10m^2$ (summer-fall); and 8) overall density = $0.3\text{-}1.2/10m^2$ (winter-spring) and $0.8\text{-}2.0/10m^2$ (summer-fall).

Based on samples collected throughout the year and research conducted by Bulger et al. (1998), the highest numbers of NMTs occur in riffles during daylight hours in late summer/early fall when young-of-the-year are believed to have recruited to the population (Wildhaber et al. 2000). Research further suggests that NMTs have a short life cycle (possibly annual) with young-of-the-year appearing with adult collections about the same time the adults begin disappearing from collections (Wildhaber et al. 2000). They probably spawn during the period of highest discharge during the summer (USFWS 1991).

Bulger et al. (1998) reported that most individuals spawned in their second summer (Age I individuals) and very few, if any, survived to spawn at Age II. Also, Bulger et al. (1998) observed the development of genital papillae and other external morphological characteristics in breeding adults. Courtship behavior was observed and included the carousel and tail curl, similar to behavior observed in other madtom species. Two successful spawning events were studied in the laboratory, and the NMT females produced 32 and 30 eggs, respectively (Bulger et al. 1998). Only two eggs survived, but these hatched in eight days and produced young that were 13.0 mm and 14.0 mm in length. In two earlier studies, a NMT female produced 63 eggs in a flow aquarium at Emporia State University (Pfingsten and Edds 1994) and another produced approximately 60 eggs (Wilkenson and Edds 1997). Bulger et al. (1998) suggested that the small clutch size may be due to time of season (second clutch production) or stress related to the experimental environment.

Neosho Mucket Mussel (Lampsilis rafinesqueana)

The Neosho mucket mussel (NMM) is a Kansas-listed endangered species and is under consideration for listing as a candidate species by the USFWS, an action that may occur during the year 2001 (Mulhern, pers. com. 2001). The NMM occupies gravel bars in the Neosho, Spring, and Verdigris Rivers (Obermeyer et al. 1997). The overall distribution of

NMMs shows regional endemism to the Arkansas River system, including the Neosho, Spring, Elk, Illinois, and Verdigris basins of Kansas, Missouri, Oklahoma, and Arkansas.

The NMM occupies shallow riffles and runs (mean depth 15.0-33.7 cm) across gravel bars, with stable and moderately compacted substratum, predominantly gravel with a minimum of silt. The mussels prefer riffles and runs with relatively clear, flowing water (Miller, pers. com. 2001). Gravel bar stability is usually the result of some stabilizing force in the river, such as bedrock exposed along the river edge or bedrock on the river bottom (Miller, pers. com. 2001). The NMM is a bradytictic breeder; the females attract hosts with a mantle lure (Obermyer et al. 1997). Potential larval hosts for the NMM include smallmouth and largemouth bass.

The NMM is probably extirpated from the Neosho River above JRL (Tabor, pers. com. 2001), and was not located there by Obermyer et al. (1997) with the exception of some weathered shells. Downriver from the John Redmond Dam, 32 living NMMs and some weathered dead shells were located. The living individuals occupied 6 of 21 sites surveyed and were greater than 20 years old based on counts of annular rings. In contrast, 1,192 individual NMMs were collected in the Spring River and 77 in the Verdigris River (Obermyer 1997). In the Neosho River, the observed habitat used by NMMs had the following characteristics: depth = 39.6 cm; current speed = 16.0 cm/s and 27.0 cm/s (100 percent and 60 percent depths); substratum character = 41.3 percent gravel, 35.9 percent cobble, 14.9 percent sand, 4.4 percent boulder, and 3.3 percent mud; compaction rated 1.1 and siltation rated 1.4 (Obermyer et al. 1997).

Rabbitsfoot Mussel (Quadrula cylindrica cylindrica)

The rabbitsfoot mussel (RFM) is a Kansas-listed endangered species that occupies gravel bars in the Neosho and Spring Rivers (Obermeyer et al. 1997). The overall distribution of RFMs includes the Ozarkian and Cumberland faunal regions of 13 states, but it is most abundant in the Black River system of Arkansas (Obermeyer et al. 1997).

The RFM occupies shallow riffles and runs (mean depth 15.0–33.7 cm) across gravel bars, with stable and moderately compacted substratum, predominantly gravel with a minimum of silt. The mussels prefer riffles and runs with relatively clear, flowing water (Miller, pers. com. 2001). Gravel bar stability is usually the result of some stabilizing force in the river, such as bedrock exposed along the river edge or bedrock on the river bottom (Miller, pers. com 1997). The RFM is a tachytictic breeder whose larval hosts may include species of shiner (Obermeyer et al. 1997).

The RFM is probably extirpated from the Neosho River above JRL (Tabor, pers. com. 2001), and was not located there by Obermyer et al. (1997) with the exception of some weathered shells. Downriver from John Redmond Dam, two living RFMs and some weathered dead shells were located. A reproducing RFM population is known to occupy a gravel bar near Iola, KS (Miller, pers. com. 2001). In the Neosho River, the observed habitat used by RFMs had the following characteristics: depth = 12.5 cm; current speed = 27.5 cm/s and 38 cm/s (100 percent and 60 percent depth); substratum character = 60.0 percent gravel, 32.5 percent cobble, 7.0 percent sand, and 0.5 percent mud; compaction rated 1.0; and siltation rated 1.0 (Obermyer et al. 1997).

Ouachita Kidneyshell Mussel (Ptychobranchus occidentalis)

The Ouachita kidneyshell mussel (OKM) is a Kansas-listed threatened species that occupies gravel bars in the Spring, Verdigris, and Fall Rivers (Obermeyer et al. 1997). Only weathered dead shells were observed in the Neosho and Cottonwood Rivers by Obermeyer et al. (1997) and the species may be extirpated from the river. The overall distribution of OKMs includes the Arkansas, Black, Red, St. Francis, and White River systems in Arkansas, Kansas, Missouri, and Oklahoma.

The OKM occupies shallow riffles and runs (mean depth 15.0-33.7 cm) across gravel bars, with stable and moderately compacted substratum, predominantly gravel with a minimum of silt. The mussels prefer riffles and runs with relatively clear, flowing water (Miller, pers. com 2001). Gravel bar stability is usually the result of some stabilizing force in the river, such as bedrock exposed along the river edge or bedrock on the river bottom (Miller, pers. com. 2001). The OKM is a bradytictic breeder; the females attract potential hosts with a mantle lure (Obermeyer et al. 1997). Potential larval hosts include orangethroat, greenside, and rainbow darters.

Flat Floater Mussel (Anodonta suborbiculata)

The flat floater mussel (FFM) is a Kansas endangered species that was discussed as occurring in the Neosho River portion of the project area (FHNWR 2000). However, a research study with an extensive collection of mussels by Obermeyer et al. (1997) did not locate this species in the Neosho, Verdigris, or Spring Rivers. The FFM is considered locally abundant in the flood plain lakes, sloughs, and oxbows of the Mississippi and Ohio Rivers and their tributaries. Its habitat is described as ponds, lakes, or sluggish mud-bottomed pools of creeks and rivers (FMM 2001).

Sensitive Communities

The KDH&E has classified the Neosho River downstream from Council Grove Reservoir and the Cottonwood River as special aquatic life-use waters (USFWS 1991). The general provisions of the Kansas surface water quality standards (K.A.R. 28-16-28c) state in part: "… no degradation of water quality by artificial sources shall be allowed that would result in harmful effects on populations of any threatened or endangered species of aquatic life in a critical habitat…" The KDH&E could issue a variance, however, if "important social and economic development" is impaired (USFWS 1991).

In addition, the KDW&P (2000) stated: "The Neosho River immediately upstream from John Redmond Reservoir is Kansas-designated critical habitat for the Neosho madtom and Ouachita kidneyshell mussel. The Neosho River immediately downstream from the John Redmond Dam is designated critical habitat for the Neosho madtom, Ouachita kidneyshell mussel, and rabbitsfoot mussel. The Cottonwood River immediately upstream of John Redmond Reservoir is designated critical habitat for the Neosho madtom, Ouachita kidneyshell mussel, and the Neosho mucket mussel."

3.4.6 Wildlife Refuges and Wildlife Management Areas

Approximately 29,801 acres of land along the Neosho River are owned by the USACE from below John Redmond Dam to near Neosho Rapids, KS. In addition to overall site management by the USACE and direct management of approximately 9,784 acres, leases have been signed with the USFWS and KDW&P to provide land management for the FHNWR (18,545 acres) and OCWA (1,472 acres) (USACE 1976).

FHNWR was established in 1966 under the Fish and Wildlife Coordination Act of 1958 (16 U.S.C. § 644) and is located on the upriver portion of JRL, including the approximately upper one-third of the conservation pool (FHNWR 2000). The refuge is managed primarily for migratory waterfowl. Its specific management focus includes:

- Intensive use by ducks and geese during spring and fall migration;
- Intensive use by shorebirds during late summer migration;
- Farmlands managed on a share basis with area farmers — the refuge portion provides food for migrating waterfowl and resident wildlife;
- Numerous constructed ponds and shallow marshes provide additional waterfowl habitat;
- Closures are provided for waterfowl and bald eagle management; and
- Public access restrictions are incorporated during periods of intensive waterfowl use.

The breakdown of habitat types supported in the refuge are presented in Table 3-13.

Table 3-13. Acreage of Habitat Types within the Flint Hills National Wildlife Refuge.

Habitat Type	Acreage
Wetlands	4,572
Open Water	1,400
Riparian Wetlands	5,999
Cropland	3,917
Grassland	3,200
Woodland	2,400
Brushland	2,255
Administrative/Recreational	120
Total	**23, 863**

Source: USFWS 2002.

Further, the Refuge Recreation Act (16 U.S.C. § 460-1) states that a refuge may provide incidental fish and wildlife oriented recreational development, the protection of natural resources, and the conservation of endangered or threatened species. A Comprehensive Conservation Plan (CCP) (FHNWR 2000) has been prepared and will guide management decisions at FHNWR for the next 15 years. The following legislative mandates are provided under the Refuge Improvement Act of 1997 to guide CCP development:

- Wildlife has first priority in the management of refuges.
- Recreation or other uses are allowed if they are compatible with wildlife conservation.
- Wildlife-dependent recreation activities such as hunting, fishing, and interpretation will be emphasized.

Six overarching goals have been prepared to guide refuge management and meet the Refuge Improvement Act of 1997; these goals are:

1. To restore, enhance, and protect the natural diversity on the FHNWR, including threatened and endangered species, by appropriate management of habitat and wildlife resources on FHNWR lands and by strengthening existing and establishing new cooperative efforts with public and private stakeholders.
2. To restore and maintain a hydrological system for the Neosho River drainage by management of wetlands, control of exotic species, and management of trust responsibilities for the maintenance of plant and animal communities.
3. Provide opportunities for wildlife-dependent public access and recreational opportunities to include compatible forms of hunting, fishing, wildlife observation, photography, interpretation, and educational activities.
4. To protect, manage, and interpret cultural resources on the FHNWR for the benefit of present and future generations.
5. To strengthen interagency and jurisdictional relationships in order to coordinate efforts with respect to the FHNWR and surrounding area issues resulting in decisions benefiting fish and wildlife resources while at the same time avoiding duplication of effort.
6. Improve staffing, funding, and facilities that would result in long-term enhancement of habitat and wildlife resources in the area of ecological concern, and support the achievement of the CCP goals and the goals of the National Wildlife Refuge System.

To support the goals, several objectives with measurable outcomes have been identified to guide FHNWR staff over the next 15 years. Completion of objectives depends on funding and annual staff size to address the following:

- Document existing flora and fauna of wetland, grassland, riparian, savanna, and wooded habitats through baseline surveys and monitor habitats affected by management activities.
- Continue to protect populations of endangered and threatened species and maintain or improve their habitats on FHNWR lands.
- Manage waterfowl in accordance with the North American Waterfowl Management Plan focusing on target species including the mallard, pintail, wood duck, and gadwall.
- Monitor population status of priority species of neotropical migratory birds, shorebirds, and other nongame migratory birds.
- Determine population objectives of key resident wildlife species and monitor the status of these species.
- Restore and maintain native species on FHNWR lands to re-establish native habitat communities through appropriate land management techniques and monitor re-establishment of native species as a result of restoration efforts.
- Re-establish native plants along the riparian areas of the Neosho River and its tributaries to benefit native aquatic and riparian communities of the Arkansas/Red River Ecosystem and monitor re-establishment of native species as a result of restoration efforts.
- Encourage research with universities and other institutions that would improve the biological database of the FHNWR or contribute to habitat restoration and management activities that are compatible with FHNWR goals and requirements of

the Refuge Act. These activities would be reviewed periodically by the USFWS and other representatives to evaluate the effectiveness for FHNWR needs.

- Improve water management to maintain and enhance 4,500 acres of current wetlands and restore another 600 acres of wetlands. Monitor and document habitat components through annual biological surveys of two to three key components (avifauna, vegetation, water quality, invertebrates, and fish).
- Develop and improve wildlife-compatible recreational opportunities on FHNWR lands that further citizen involvement and appreciation of the system. Through the completion and implementation of the Public Use Plan in tasks outlined in short-term and long-term phases, public use would increase 15 percent over the next five years and by 50 percent by the year 2015.
- Develop and implement educational and interpretive programs to increase citizen understanding of the natural resources of the FHNWR and issues within the Arkansas/Red River Ecosystem. Develop educational or interpretive programs specific to the FHNWR and initiate FHNWR participation in national education programs. Host various special events to offer the public an opportunity to participate in FHNWR activities.
- Initiate a variety of innovative outreach strategies to strengthen the existing FHNWR constituency and develop a broader base of public support in east-central Kansas. Create and develop one outreach product and/or publication to generate interest in the refuge over the next five years. Increase community presentations, community involved habitat restoration projects, and FHNWR staff representation at public events.
- Work with the community to develop an organization or avenue for receipt of private funding to subsidize environmental education programs, habitat restoration projects, or other community-based efforts benefiting wildlife habitats on FHNWR lands by the year 2010.
- Document, map, and monitor archaeological sites on current FHNWR lands and future acquisitions through a baseline archaeological survey and monitor known sites for disturbance or deterioration. Incorporate information about the archaeology of the area into one educational or interpretive product or program by the year 2005.
- Strengthen partnerships with the USACE and other private stakeholders within the community, KDW&P, and other public agencies that are mutually beneficial and would ultimately benefit the fish and wildlife resources of the FHNWR and surrounding lands.
- Provide the personnel needed to accomplish the goals of the CCP through the addition of specific staff specialists and programs that encourage community volunteers.
- Provide a safe, efficient, and productive work environment for FHNWR employees and a safe infrastructure for visitors.

OCWA was established in 1966 and is located on the southeastern boundary of FHNWR and the southeastern portion of John Redmond Dam. This state wildlife area is managed primarily for big game and upland species, e.g., white-tailed deer, wild turkey, mourning dove, bobwhite quail, cottontail rabbit, and squirrel. Its specific management focus includes:

- Farmlands managed on a share basis with area farmers — the wildlife area portion provides food for resident upland game animals and migrating waterfowl;

- Fishing access and management, particularly for channel and flathead catfish, walleye, white bass, white crappie, and sunfish;
- Introduction of native ground cover for restoration sites, particularly tallgrass prairie species; and
- Day use recreation.

Permitted activities on the FHNWR include wildlife observation, hiking and sightseeing, photography, boating, picnicking, camping, fishing, hunting, wild food gathering, and fish bait collection. Interpretive trails are present and include Dove Roost Trail and the Headquarters Trails. OCWA provides wildlife observation, sightseeing, photography, boating, fishing, and hunting opportunities. The boundaries of these wildlife areas, in relation to the John Redmond Lake, are depicted in Figure 3-13

3.5 Air Quality

Air pollution is generated from many different sources including stationary (factories, power plants, smelters, dry cleaners, degreasing operations, etc.), mobile (cars, trucks, trains, airplanes, etc.), and naturally occurring (windblown dust, volcanic eruptions, etc.) (USEPA 2001). The Federal Clean Air Act of 1970 (CAA) (43 U.S.C. § 7401 *et seq*., as amended in 1977 and 1990) provides the principle framework for national and state efforts to protect air quality and requires the adoption of National Ambient Air Quality Standards (NAAQS) to protect the public health, safety, and welfare from known or anticipated effects of air pollution. Amendments to the CAA require the U.S. Environmental Protection Agency (USEPA) to promulgate rules to ensure that federal actions conform to the appropriate state implementation plan. These requirements are known as the General Conformity Rule (40 C.F.R. § 51.100 *et seq*. and § 93.100 *et. seq*.).

Federal agencies responsible for an action must determine if the action conforms to pertinent guidelines and regulations that control or maintain air quality in the region. Certain actions are exempt from conformity determination, including those actions associated with transfers of land or facilities where the federal agency does not retain continuing authority to control emissions associated with the properties. Federal actions may also be exempt if the projected emission rates would be less than the specified emission rate threshold known as *de minimis* limits.

NAAQS have been established by the USEPA, Office of Air Quality Planning and Standards (OAQPS), for six criteria pollutants that are deemed to potentially impact human health and the environment. These include: 1) carbon monoxide (CO); 2) lead (Pb); 3) nitrogen dioxide (NO_2); 4) ozone (O_3); 5) particulate matter <10 microns (PM_{10}); and 6) sulfur dioxide (SO_2). Ozone is not emitted directly into the air, but is formed when sunlight acts on emissions of nitrogen oxides and volatile organic compounds (USEPA 1998).

The primary and secondary NAAQS concentrations are presented in Table 3-14. Primary standards are also known as health effects standards, which are set at levels to protect the most susceptible individuals in the human population (very young, very old, and those with respiratory problems such as asthma) (USEPA 2001). Secondary standards, also known as quality of life standards, set limits to protect public welfare including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

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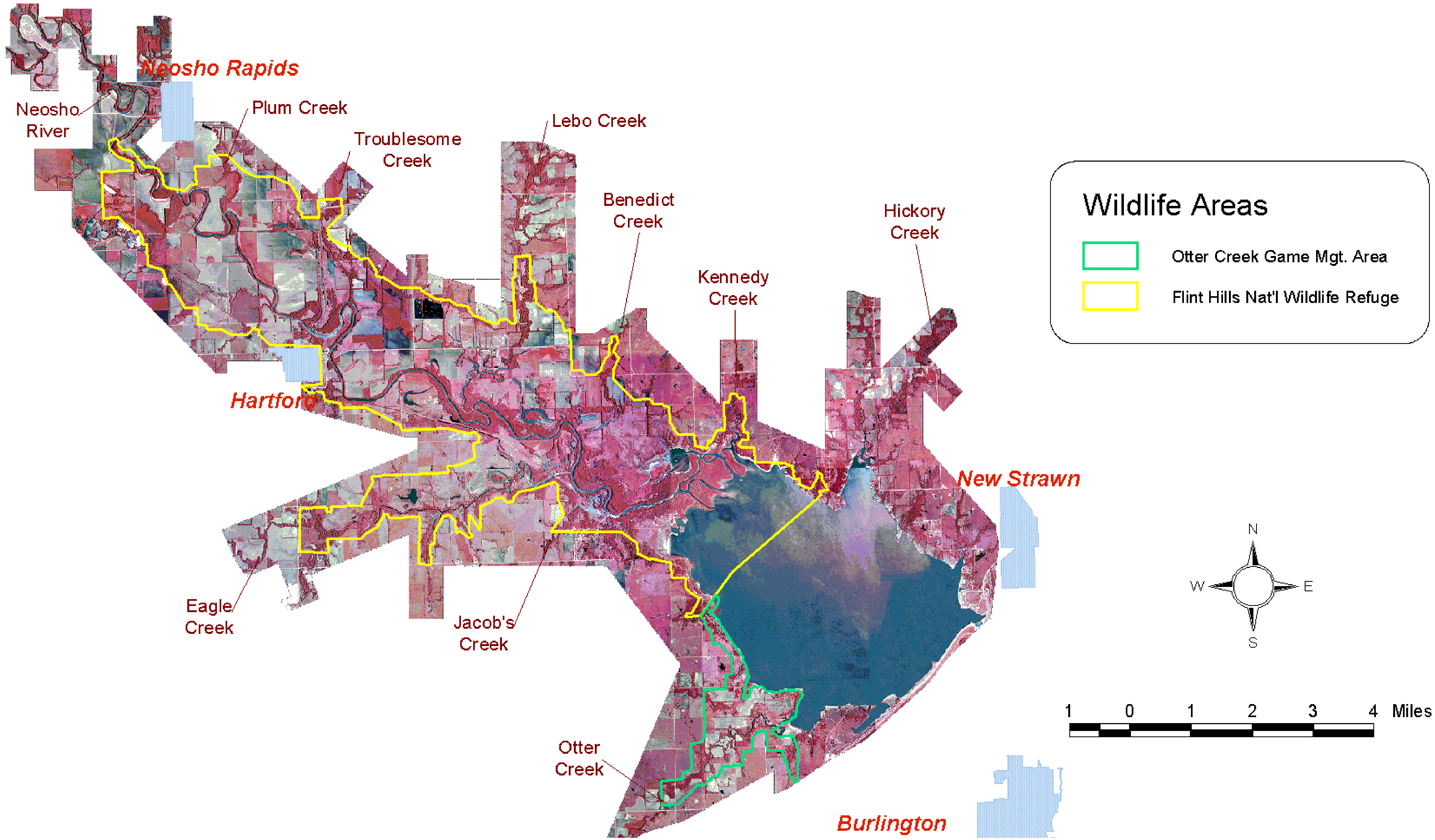


Figure 3-13. Approximate Boundaries of the Flint Hills National Wildlife Refuge and the Otter Creek Wildlife Management Areas.

Since both short- and long-term exposures are addressed, a single pollutant may have more than one primary standard.

The State of Kansas has adopted the federal standards under the Kansas Administrative Regulations (K.A.R.), Section 28-19-17a: Incorporation of Federal Regulations by Reference (KDH&E 2001). Under K.A.R. Section 28-19-17b (d), "National ambient air quality standard, national primary ambient air quality standard, and national secondary ambient air quality standard mean those standards promulgated at 40 CFR Part 50, as in effect on July 1, 1989, which are adopted by reference." Air monitoring is conducted at 27 sites within the state, which is considered somewhat more extensive than USEPA requirements (TCSG 2001). The federal and Kansas primary and secondary NAAQS are presented in Table 3-14.

Table 3-14. National and Kansas Ambient Air Quality Standards

USEPA and Kansas Ambient Air Quality Standards				
Pollutant	Averaging Time	Primary NAAQS	Secondary NAAQS	Kansas Standards
Nitrogen Dioxide	Annual (arithmetic mean)	0.053 ppm (100 µg/m^3)	0.053 ppm (100 µg/m^3)	0.053 ppm (100 µg/m^3)
Sulfur Dioxide	Annual (arithmetic mean)	0.03 ppm (80 µg/m^3)	NA	0.03 ppm (80 µg/m^3)
	24 hour Average	0.14 ppm (365 µg/m^3)	NA	0.14 ppm (365 µg/m^3)
	3 hour Average	NA	0.5 ppm (1300 µg/m^3)	0.5 ppm (1300 µg/m^3)
Carbon Monoxide	1 hour Average	35.0 ppm (40 mg/m^3)	NA	35.0 ppm (40 mg/m^3)
	8 hour Average	9.0 ppm (10 mg/m^3)	NA	9.0 ppm (10 mg/m^3)
Ozone	1 hour Average	0.12 ppm (235 µg/m^3)	0.12 ppm (235 µg/m^3)	0.12 ppm (235 µg/m^3)
Lead	Quarterly Average	1.5 µg/m^3	1.5 µg/m^3	1.5 µg/m^3
Particulate Matter (PM_{10})	Annual (arithmetic mean)	50 µg/m^3	50 µg/m^3	50 µg/m^3
	24 hour Average	150 µg/m^3	150 µg/m^3	150 µg/m^3

Source: USEPA NAAQS, http://www.epa.gov/airs/criteria.html. Note: NAAQS for ozone (8-hour average) and particulate matter ($PM_{2.5}$) have been developed but not yet legislated.

It is important to understand the terms exceedance and violation of a standard, as they are not interchangeable. An exceedance is any single value greater than the standard. A violation occurs when the limits for both concentration and frequency of occurrence, as established in the CAA and its amendments, are exceeded. According to *The Green Book*, the Emporia, KS area is in attainment for all criteria pollutants (USEPA 2001b).

Air quality has not been monitored by the KDH&E in the Emporia, KS area since the early to mid-1970s; at that time particulate matter was monitored (Gross, pers. com. 2001 and Stewart, pers. com. 2001). The current statewide monitoring network is focused on metropolitan areas where fine particulate matter and ozone tend to be more of a problem (Gross, pers. com.

2001). The WCGS is located adjacent to JRL and regularly monitors selected radionuclide levels in the air (KDH&E 2001b).

Radionuclides are monitored as part of the operation of the WCGS by weekly collection and laboratory analysis of continuous air samples taken at five locations on and in the vicinity of JRL (KDH&E 2001). The five sampling locations are: 1) Sharpe, 2) east of the Coffey County Lake dam, 3) Burlington, 4) New Strawn, and 5) Hartford (Figure 1-2). The site at Hartford serves as the control location for analysis and data interpretation. The major airborne isotope of concern is radioiodine (I^{131}) and it is tested using a flow rate of about 30 liters per minute (lpm) through 47 millimeter (mm)-diameter glass fiber particulate filters and 5 percent tri-ethylene di-amine impregnated carbon cartridges. In addition, gross beta and gamma isotopic analyses are performed on the same cartridges.

Airborne sample analyses indicated that no radionuclides attributable to WCGS operation were present above the lower limits of detection during State Fiscal Year (SFY) 2000 (KDH&E 2001). The highest gross beta activity observed was 0.092 picoCuries per cubic meter (pCi/m^3), due primarily to naturally-occuring Radon-222 (Rn^{222}) progeny, specifically the long-lived isotope Lead-210 (Pb^{210}) (KDH&E 2001). The range of gross beta activity was 0.010-0.092 pCi/m^3. For comparison, the range of gross beta activity recorded at the Hartford control site was 0.017–0.077 pCi/m^3. No gamma emitters attributable to WCGS operation were present above the lower limits of detection in any air particulate filters or charcoal cartridges evaluated.

3.6 Aesthetics

The general viewscape of the JRL project area is rural, consisting of wooded rolling hills, wooded drainages, open agricultural fields, farmsteads, towns, infrastructure elements (roads, parking lots, powerlines, property fencing, etc.), the Neosho River, and John Redmond Dam and Lake (Figure 1-2). The most visibly dominant features include John Redmond Dam and Lake and the pump facility for the WCGS, below the dam (Figure 3-14).

Figure 3-14. John Redmond Dam and Water Outtake at Wolf Creek Nuclear Power Plant

3.6.1 Visual Characteristics of the JRL Site and Surrounding Area

Features present within the JRL site include the large dam and reservoir on the southeastern portion. The dam is an earthfill structure nearly four miles long and is 86.5 feet higher than the Neosho River at its crest (USACE 1996). The reservoir covers approximately 9,490 surface acres under normal operation, but could cover as much as 40,220 surface acres or higher during a major flood (USACE 1976 and 1996). The reservoir shoreline is approximately 58 miles long under normal operation.

The community of Burlington, KS lies approximately three miles downriver from the dam, and New Strawn, KS is located approximately one mile northeast of the reservoir. West of the reservoir are the towns of Hartford and Neosho Rapids, KS which lie approximately five and seven miles upriver, respectively. A few structures are also present at Ottumwa, KS and at Jacob's Creek Landing, KS, both within approximately one mile of the reservoir shoreline. There are no direct views of the lake from these communities, because of the relatively flat land surfaces and medium-tall woodland vegetation.

The visual impression of Burlington is a small community with predominantly red brick office buildings and stores, and modest, family-oriented residential areas. Most residences have ample yards with landscaping and mature trees, and the yards become larger at the outskirts of town resembling small farms. Hartford, Neosho Rapids, and New Strawn are smaller residential communities with a minimum of businesses. The overall visual impression is one of modest, family-oriented towns, with large lawns and numerous trees to accent the urban landscape. Existing utilities such as electricity and telephone are provided via above-ground poles, which results in some visual clutter.

Available views onto a site are affected by distance, viewing angle, as well as the number and type of visual obstacles, both natural and human-made. Views can be from stationary areas such as campgrounds, or from mobile sources such as motor vehicles. Typically, views are analyzed as foreground (less than 0.25 miles), middle ground (0.25-3.0 miles), and background (more than 3.0 miles). Background views of John Redmond Dam and Lake would be very rare and may only be achieved from the corner of the dam structure.

Recreational facilities are scattered throughout the project site and include campgrounds, day use sites with boat ramps, and hiking/walking trails. Most of these sites have large parking areas, access roads, large grassy fields, and/or open agricultural fields, providing an expansive experience in an otherwise wooded environment. Many acres are leased to grow agricultural crops and the fields provide breaks in the tree-covered landscape of the Neosho River Valley. Agricultural fields that are not under cultivation, or fallow, become rapidly invaded by tall, coarse annual herbs in contrast to the row crops and alfalfa hay grown in cultivated fields. These recreational facilities and agricultural fields provide for clear, relatively unobstructed middle ground views across portions of the project area (Figure 3-15).

Figure 3-15. Views Across Fallow and Planted Agricultural Fields

3.6.2 Viewer Groups and Sensitivity

Visual sensitivity is dependent upon viewer attitudes, the types of activities in which people are engaged when viewing the site, and the distance from which the site will be seen. Overall, higher degrees of visual sensitivity are correlated with areas where people live, are engaged in recreational outdoor pursuits, or participate in scenic or pleasure driving. Conversely, visual sensitivity is considered low to moderate in industrial or commercial areas where the scenic quality of the environment does not affect the value of the activity.

Site visibility may also be affected by air quality, the measure of which involves human perception and judgment and has been described as the maximum distance that an object can be perceived against the background sky. Visibility is of value by citizens, although the value of good visibility is inherently subjective and difficult to quantify. Visibility can vary from clear to regional haze. There is no qualitative visibility standard for pristine and scenic rural areas, however, Section 169A of the CAA (1970, as amended), created a qualitative standard of the prevention of any future and the remedying of any existing impairment of visibility in mandatory Class I federal areas which impairment results from human-caused air pollution.

The expectation of many visitors to JRL is to fish in the lake, river, or nearby Coffey County Fishing Lake, or to seek hunting opportunities, particularly waterfowl. Therefore, these visitors are not considered to be sensitive viewers because of the nature of their recreational pursuits. There are views of the dam and reservoir from the surrounding area, particularly from the highway across the dam, the OCWA day use area, the dam site area (including Redmond Cove), and the Hickory Creek Area. Below the dam at Riverside East and Riverside West campgrounds, the view is of the dam structure, pumping station for WCGS, and the Neosho River. Many of the views from below the dam are at least partially obstructed by landscape plantings and tall trees.

Most views from the north and south access roads are of the woodlands growing along the Neosho River and its tributary drainages, with occasional glimpses of the lake and/or the dam structure. A full view of the lake and dam structure only occurs from shoreline sites or while boating on the lake surface. The dam, but not the lake, can be viewed from recreational sites downstream. Views from bridges across the Neosho River result in only short distances before the river meanders and is hidden by riparian woodlands.

3.7 Prime or Unique Farmlands

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture (USDA). It is of major importance in providing the national short- and long-range needs for food and fiber (SCS 1982). In Coffey and Lyons Counties, the principal crops grown on prime farmland are grain sorghum, wheat, soybeans, and corn (SCS 1981 and 1982). Approximately 70 percent of the soils in Coffey County meet the requirements for prime farmland (SCS 1982).

Prime farmland is defined (USDA 2000) as: "land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. Further, it could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. Slope ranges mainly from 0-6 percent."

Unique farmland is defined (NEPA 2001) as: "land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. Examples of such crops are citrus, tree-grown nuts, olives, cranberries, fruit, and vegetables." The soils supporting pecan orchards along the Neosho River would be an example of unique farmland.

The State of Kansas has further identified farmland of statewide importance (AFT 2001) and defined it as: "farmland, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable. Additional farmlands of statewide importance may include tracts of land that have been designated for agriculture by state law."

The common soils within JRL and along the Neosho River, fit the criteria for prime farmland, unique farmland, and farmland of statewide importance, e.g., Woodson silt loam, Verdigris silt loam, Summit silty clay loam (1-4percent slopes), Kenoma silt loam (1–3 percent slopes), Eram silt loam (1–3 percent slopes), and Dennis silt loam (1–4 percent slopes) are considered prime farmland (NRCS 1993). The Kenoma silty clay loam (1–3 percent slopes - eroded), and Dennis silty clay loam (2–5 percent slopes – eroded) soils are considered farmland of statewide importance (NRCS 1993). In addition, Osage silty clay, Osage silty clay loam, Lanton silty clay loam, and Hepler silt loam soils meet the prime farmland designation if they are drained (NRCS 1993).

For compliance with the Farmland Protection Policy Act (FPPA), this project was coordinated with the Natural Resources Conservation Service (NRCS) using a Farmland Conservation Impact Rating Form (AD 1006) (NRCS 1997). In a letter dated March 11, 2002 (Appendix E), the USDA-NRCS stated that the project is not affected by the FPPA. This means that prime or unique farmland, as defined by the FPPA, would not be affected by the project.

Within the JRL site boundary, approximately 5,098 acres of land are available for lease to be farmed under cooperative farming agreements with the USACE, FHNWR, and OCWA. Much of the land under farming agreements also meets prime farmland criteria. The number of acres potentially farmed under each management program, include 400 acres (USACE), 4,298 acres (FHNWR), and 400 acres (OCWA) (FHNWR 2000, Fry, pers. com. 2001, Barlow, pers. com. 2001). Because of flooding events along the Neosho River during the 1990s, successful farming of lower land tracts in the flood storage pool has occurred only about two of every five years.

3.8 Socioeconomic Resources

The assessment area for socioeconomic effects of the Proposed Action and alternatives includes Coffey and Lyon Counties in southeastern Kansas, and lands within the flood plain downriver from JRL. Potentially affected socioeconomic conditions include area economic and population conditions, land use, recreation ,and transportation. Activities in the Neosho River flood plain between JRL and Grand Lake could also be affected.

3.8.1 Economic and Demographic Trends and Conditions in Coffey and Lyon Counties

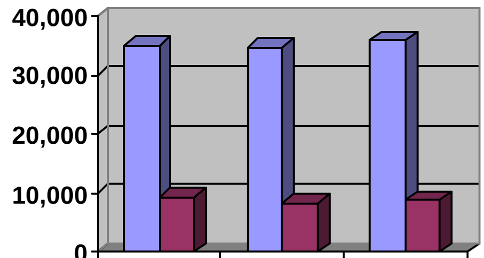
Population

Figure 3-16 displays recent U.S. Census population counts for Coffey and Lyon Counties. Between 1980 and 1990, Coffey County population fell by 10 percent. This decline in population was a result of the out-migration of construction workers after the completion of construction of the WCGS. According to the 2000 Census of Population and Housing, Coffey County had a year 2000 population of 8,741, about 7 percent lower than the 1980 population level, but about 4 percent higher than the 1990 level.

Lyon County also experienced a slight population loss between 1980 and 1990 (about 1 percent) but by 2000, county population (35,935) had increased to 2.4 percent above the 1980 level.

Burlington, the Coffey County seat, had a 2000 population of 2,790, about 32 percent of total county population. Emporia, the Lyon County seat, had a 2000 population of 26,760, about 74 percent of total county population.

Figure 3-16. Coffey and Lyon County Population: 1980 – 2000 (Source: KCCED 2001)



	1980	1990	2000
Lyon	35,108	34,732	35,935
Coffey	9,370	8,404	8,741

Economy

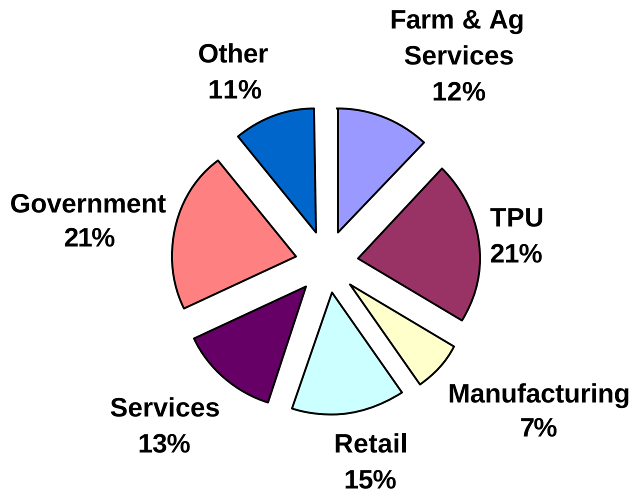
Coffey County

The U.S. Bureau of Economic Analysis (BEA) publishes estimates of full- and part-time employment by Standard Industrial Classification (SIC). These statistics reflect employment by place of work. Figure 3-17 shows Coffey County employment by major SIC sector, based on 1999 BEA statistics.

A community's economic base includes those industries and businesses that bring income into the community from other areas of the state, nation, and the world. The Coffey County economy is based on electric power generation, agriculture, and manufacturing. The tourism/ recreation industry also brings income into the county; most is spent in the retail and service sectors which also serve local residents.

The government sector is the largest employer in Coffey County, with 1,239 jobs in 1999. Almost 91 percent of government jobs were in local government, including school district employment. Employment statistics for the WCGS, the largest private employer in the county, is included in the transportation and public utilities (TPU) sector. BEA does not display Coffey County TPU sector data for 1999, because the number of employers in that sector is relatively few. Based on extrapolation of 1996 data (CCED undated), the TPU sector had an estimated 1,229 jobs in 1999. Of that total an estimated 900 were employed at the WCGS (Hotaling 2001).

Figure 3-17. 1999 Coffee County Employment Percentages by Major Sector



(Source: BEA 2001)

TPU = Transportation and Public Utilities. TPU estimated based on 1996 covered employment data.

The retail and services sectors provided 15 percent and 13 percent of total employment, respectively. In 1999 Coffey County per capita retail sales were $6,718, about 78 percent of the average for the State of Kansas (US Census Bureau 2001).

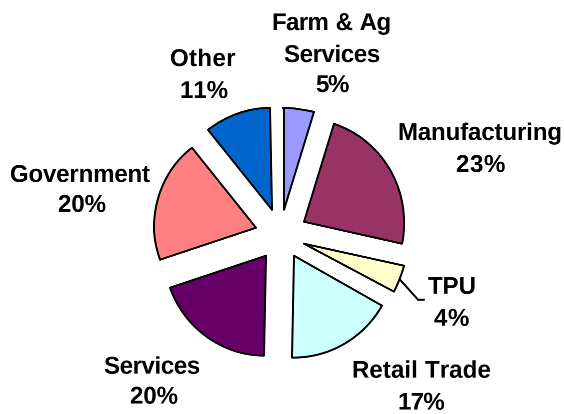
The combined farming and agricultural services sectors comprised about 12 percent of total 1999 BEA employment in the county. Between 1990 and 1997, the total number of farms in the county declined from 610 to 560. However, the total acres farmed increased from 345,000 to 354,000, the average farm size increased from 566 acres to 632 acres, and the total acres harvested increased from 181,010 to 188,800. The real value per acre of crops harvested increased from $87.36 in 1990 to $170.70 in 1997 (both years presented in 1990 dollars) (KSU 1999).

During 1999, Coffey County had a per capita personal income of $21,416, which was 80 percent of the statewide average (BEA 2001).

Lyon County

Figure 3-18 displays 1999 employment statistics for Lyon County. Manufacturing is the largest sector in the county and includes a major meat packing plant, a major baked goods plant, and firms that manufacture automotive and industrial products, among others. The government sector includes Emporia State College, which is also a major employer (RDA undated). The retail and service sectors provide slightly larger percentages of employment in Lyon County, reflecting its larger population and Emporia's position as a regional trade center. In 1999, retail sales per capita in Lyon County were $8,399, about 97 percent of the statewide average for that year (U.S. Census Bureau 2001).

Figure 3-18. 1999 Lyon County Employment Percentages by Major Sector



(Source: BEA 2000)
TPU = Transportation and Public Utilities

Farming and agricultural services provided about 5 percent of total Lyon County employment. In 1997, there were 850 farms in the county, 20 less than in 1990. As with Coffey County, the total acres farmed increased, from 485,000 in 1990 to 487,000 in 1997. Correspondingly, the average size of farms also increased from 557 to 573 acres. The total acreage harvested grew from 169,900 acres in 1990 to 176, 750 acres in 1997, and the real value of crops harvested grew from $104.28 per acre to $159.30 per acre (KSU 1999).

During 1999, Lyon County had a per capita personal income of $22,388, which was 84 percent of the statewide average for Kansas (BEA 2001).

3.8.2 Land Use

The assessment area for land use includes lands associated with the JRL and surrounding areas.

Lands Associated with JRL

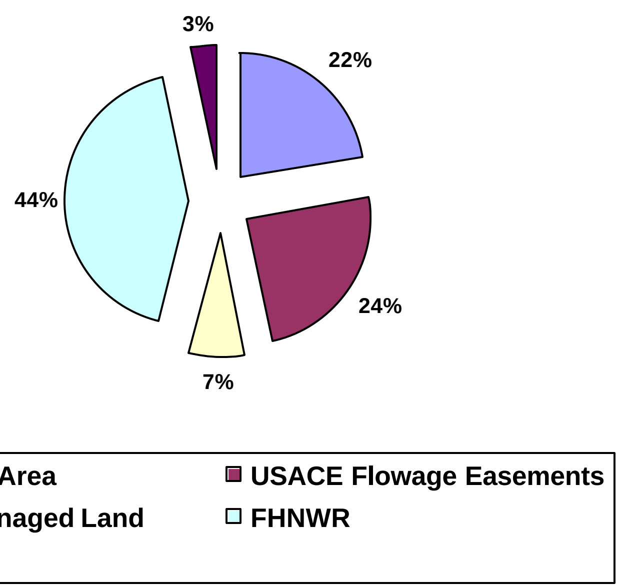
The JRL complex includes the lake, dam, and associated lands and flowage easements, the FHNWR, and the OCWA. The land area of each of these facilities is displayed in Table 3-15. The percentage of each of the total project area is shown in Figure 3-19.

Table 3-15. JRL Land Area (Source: USACE 2001(a), USFWS 2000)

USACE			USFWS	KDW&P
JRL Water Area[1]	Flowage Easement	Land	Flint Hills NWR	Otter Creek
9,710 acres	10,505 acres	3,160 acres	18,545 acres	1,472 acres

[1]Acreage at 1039 msl conservation pool level.

Figure 3-19. Land Percentages by Managing Agency or Category (Source: USACE 2001a, USFWS 2000)



John Redmond Lake

The USACE holds fee title to approximately 29,801 acres of land associated with JRL, and has flowage easements on an additional 10,502 acres. The USACE manages JRL (9,710 acres at the current conservation pool level of 1039 msl) and 3,160 acres of adjacent land.

JRL was developed for flood control, water supply, water quality, and recreation purposes. The reservoir and associated lands are also managed for wildlife objectives. USACE lands associated with JRL include lands designated for intensive and low-density recreation use and wildlife management. There are six developed public-use areas on USACE-managed land, including five that have recreation parks providing camping (recreational vehicle, tent, and trailer), picnic areas, drinking water, and sanitary facilities (USACE 1996). Additional recreation facilities present on USACE-managed lands include an overlook facility, parking areas, trails, a swimming beach, and five boat ramps.

USACE lands include approximately 400 acres of land that has been leased for agricultural purposes in the past. Currently, the land is not leased because of frequent flooding and the difficulty in removing the resultant wood debris (Simmons, pers. com. 2001).

Flint Hills National Wildlife Refuge

The FHNWR, located on the upper portion of JRL, consists of 18,545 acres owned by the USACE, which is leased and managed by the USFWS under a cooperative agreement. The total land area is 25 percent wetlands (4,572 acres), 8 percent open water (1,400 acres), 3 percent riparian wetlands on the Neosho River and associated creeks (5,999 acres), 17 percent grasslands (3,200 acres), 13 percent woodlands (2,400 acres), 12 percent brushlands (2,255 acres), 21 percent croplands (3,917 acres) and 0.6 percent administrative and recreational roadways (120 acres) (FHNWR 2000).

The FHNWR is managed primarily to benefit migrating and wintering waterfowl in the Central Flyway. A variety of management practices are used to provide food and cover for waterfowl, shorebirds, neotropical migrants, and native species. The refuge also provides habitat for white-tailed deer, wild turkey, bobwhite quail, and an assortment of other mammals, birds, reptiles and insects.

Public use activities currently permitted at FHNWR include wildlife observation, hiking, photography, sightseeing, boating, picnicking, camping, fishing, wild food gathering, and hunting. Fish bait gathering is allowed for personal use and firewood gathering is allowed by permit. Public facilities on FHNWR include parking areas, boat ramps, hiking trails, and an observation tower (FHNWR 2000).

Currently, the USFWS maintains 3,917 acres of croplands on FHNWR, which is leased to 14 cooperative farmers. The USFWS share of crops ranges from 10 percent in flood-prone areas to 45 percent on higher ground. The land is difficult to lease because it floods frequently in low-lying areas, and removing the resulting wood debris is expensive and time consuming (Gamble, pers. com. 2001).

Otter Creek Wildlife Area

The USACE has licensed the KDW&P to manage the 1,472-acre OCWA. Otter Creek is managed primarily for upland game species, including bobwhite quail, mourning dove, wild turkey, cottontail rabbit, squirrel, and white-tailed deer. The OCWA also provides fishing access and management, particularly for channel and flathead catfish, as well as wildlife observation, sightseeing, photography, boating, and hunting opportunities. There are no developed facilities on OCWA. Interpretive trails are present and include the Dove Roost Trail and the Headquarters Trails (Barlow, pers. com. 2001).

Approximately 400 acres of the OCWA is available for agricultural leases, but these lands have been flooded about three out of every five years in recent times. During productive years, the KDW&P leaves approximately 25 percent of the crop in the field to provide forage for wildlife. The cropland is becoming more difficult to lease, and the KDW&P may convert a portion of the cropland to natural grasses for wildlife cover and forage.

Land Use on Adjacent Areas

Coffey County adopted the John Redmond Reservoir Plan for Land Use and Transportation about the time JRL was first constructed. The land immediately outside the boundary of the USACE land is zoned agricultural, which allows for a wide variety of land use (Zurn, pers. com. 2001). Other nearby land use within Coffey County includes an airstrip and several small cemeteries. The Coffey County communities of New Strawn (2000 population 425) and Ottumwa (2000 population unknown) are all located within close proximity to JRL.

A portion of the FHNWR lies within Lyon County. Most Lyon County land in the vicinity of FHNWR is zoned agricultural, except for a quarry and several parcels in conservation easements. The Lyon County communities of Hartford (2000 population 500) and Neosho Rapids (2000 population 274) are located adjacent to FHNWR (Borst, pers. com. 2001, Post, pers. com. 2001).

Recreation Activities

Recreation resources exist on JRL, FHNWR, and OCWA. In all areas, sightseeing and fishing, primarily for channel and flathead catfish, are the recreation activities that generate the greatest number of year-round visits. Although the KDW&P has had recent success in maintaining a population of hybrid white bass/wiper, maintaining a sportfish population on JRL has proven difficult, because young fish are flushed downstream on an annual basis (Kostinec et al. 1996). Fishing visitation has declined in recent years because several more attractive (in terms of sportfish populations and water quality) fishing alternatives have been developed in the vicinity of JRL. These include the Coffey County Fishing Lake and several municipal lakes. Although the presence of these lakes has generally reduced fishing activity on JRL and adjacent lands, it has resulted in an increase in camping activity in JRL campgrounds, because camping facilities are not available at these alternative lakes.

During the fall, hunting, primarily for waterfowl and upland game, is a major recreation activity on JRL, FHNWR, and OCWA. Wildlife observation, particularly birding, is increasing as a recreation activity on these facilities. A number of trails that support wildlife observation activities have been developed on both JRL lands and FHNWR. The KDW&P encourages the use of a water management plan for JRL that promotes habitat and forage for waterfowl and shorebirds (Jirak, pers. com. 2001). Water sports are not a major activity on JRL, because of the shallow depth of the lake and quality (turbidity) of the water.

Table 3-16 displays visitation statistics by management area for 1998 through 2000. Recreation visits have been increasing in all areas except OCWA. The decrease in OCWA use may be the result of increased fishing opportunities elsewhere in the area.

Table 3-16. Annual Visits, By Management Area 1998–2000 (Source: USACE a, USFWS, KDW&P)

	1998	1999	2000
USACE JRL	17,012	21,507	32,372
USFWS FHNWR	35,030	37,000	52,000
KDW&P OCWA	30,635	21,672	10,675
Total	82,677	80,127	95,047

Recreation Activities on JRL

Table 3-17 displays seasonal percentages of recreation use by major activity for JRL. Totals for all activities are greater than 100 percent because some visitors engage in more than one recreation activity per visit. Sightseeing is the major recreation activity on JRL during all seasons, ranging from 45 percent to 65 percent of total visits during the period. Fishing is the second most popular activity ranging from 23 percent to 39 percent of total visits, except during winter, when hunting is the second most popular activity, totaling 34 percent of all visits (USACE 1999–2000).

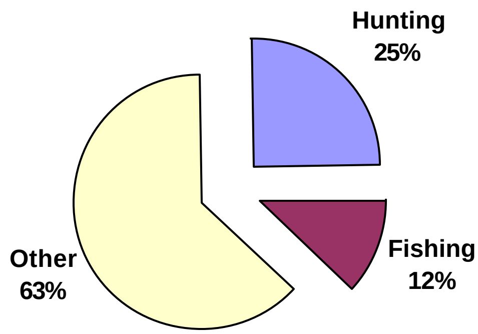
Table 3-17. Seasonal Percentage Recreation visits by Activity: Spring 1999 through Summer 2000. (Source: USACE Tulsa District 1999-2000)

	Camp	Picnic	Boat	Fish	Hunt	Water Ski	Swim	Other	Sight-See
Spring 1999	2.49%	8.26%	0.08%	23.28%	7.03%	0%	0%	6.19%	63.87%
Summer 2000	17.28 %	11.11%	2.24%	32.74%	0%	0.13%	9.12%	5.41%	46.66%
Fall 2000	0.0%	5.12%	0.96%	39.22%	8.63%	0.0%	0.0%	5%	45.32%
Winter 2000	0.0%	2.19%	0.02%	18.13%	35.28%	0.0%	0.0%	1.18%	49.68%

Recreation Activities on FHNWR

Recreation facilities are discussed in Section 3.8.2, Figure 3-20 displays the percentage of each of the major recreation uses on FHNWR for 2000. Other activities, which include wildlife viewing, generate the most recreation visits for FHNWR. Hunting and fishing are also major activities. In years when the water level plan has been implemented, or in years when natural conditions allow for lowered water levels in the spring followed by raised water levels in the fall, both bird watching and waterfowl hunting visits increase dramatically (Jirack, pers. com. 2001, Kostinec et al. 1996).

Figure 3-20. FHNWR Percentage of Recreation use by Type: 2000



(Source: Gamble 2001b)
Other includes wildlife viewing, walking, driving, photography, visitor's center, etc.

Recreation Activities on OCWA

Most visitors to OCWA engage in wildlife viewing, hunting, or fishing activities. Of those visitors who either fish or hunt, an estimated 60 percent of visitors hunt and the remaining 40 percent engage in fishing, primarily for channel catfish along Otter Creek. The white bass spring run also generates a number of fishing visits (Barlow, pers. com. 2001).

3.8.3 Economic Effects of John Redmond Lake

The economic effects of JRL include those associated with flood control, water storage and supply, and recreation. Other economic effects include employment and the procurement of local goods and services for the operation and maintenance of the reservoir and associated facilities, which would not be affected by the Proposed Action or alternatives and are not considered in this assessment.

Flood Control

JRL provides flood protection for lands along the Neosho/Grand River below the dam. While the dam does not prevent all flooding, it substantially reduces the amount of flooding downstream (USACE 1996).

The economic value of flood control is calculated as the dollar amount of damage prevented. As of September 2000, the cumulative total of flood damage prevented by the reservoir and dam since the project became operational is estimated to be $281 million (Sullivan, pers. com. 2001).

Water Storage and Supply

JRL provides water storage for two programs operated by the KWO: the Water Marketing Program and the Water Assurance Program (KWO 1996). These programs are operated by the KWO to ensure that an adequate supply of water is developed, managed, and maintained to meet, as nearly as possible, the long range water supply needs of municipal and industrial water users within Kansas.

Wolf Creek Nuclear Generating Station

Under the Water Marketing Program, the KWO is contracted for an annual 9,672 million gallons per year (MGY) of water supply at JRL, for use by KG&E in supplementing the cooling lake at WCGS. This supplemental source of water is necessary because evaporation in most years is greater than inflow in the WCGS cooling lake (Lewis 2001a). KG&E pays $0.10 per thousand gallons of water, based on a formula that requires payment for 50 percent of the allotment at the beginning of the contract year and subsequent payment for water used over that amount on a per thousand gallon basis. Over the past four years, KG&E has paid the minimum annual amount of $483,600. In other years, however, KG&E has used as much as 74 percent of the total allotment (Buttenhoff, pers. com. 2001).

Cottonwood and Neosho River Basins Water Assurance District Number 3

The Water Assurance Program provides supplemental water to a number of municipal and industrial users. The Kansas Water Assurance Program was developed to meet the needs of municipal and industrial water supply users whose needs could not be economically and institutionally met by other means. During periods of drought, natural stream flow may be significantly reduced. Municipal and industrial water users along a stream who hold appropriation rights to the natural flow may find their ability to use the surface water is severely limited, at a time when their demand for water is at its highest. Many of these users are located below federal lakes.

The CNRB was formed on August 31,1993. The contract and operations agreement with this district were signed on August 28, 1996. There are 21 municipal and industrial members of this district including:

- City of Council Grove
- City of Cottonwood Falls
- City of Emporia
- City of Hartford
- City of Burlington
- City of Leroy
- Woodson County Rural Water District No. 01
- Public Wholesale Water Supply District No. 5
- City of Iola
- City of Humboldt
- Monarch Cement
- Ash Grove Cement
- City of Chanute

- City of Erie
- City of St. Paul
- City of Parsons
- Crawford County Rural Water District No.6
- Kansas Army Ammunition
- Kansas Gas and Electric
- City of Oswego
- City of Chetopa

Each of these customers, except the cities of Council Grove, Cottonwood Falls, Emporia, and Hartford, are hydrologically below JRL. There are no other major reservoirs in this reach of the river to supplement flows during periods of drought. In addition, groundwater is only available in limited quantities within the alluvial valley. These 16 municipalities and industries located downriver from JRL are directly dependent upon water provided from assurance storage during times of low streamflow (Lewis, pers. com. 2001).

Members receive water supply service through releases from storage in Marion, Council Grove Lakes, and JRL. The district pays the state for costs associated with the storage space for 10,000 acre-feet of water in these lakes and reservoirs. The JRL stores 3,500 acre-feet of the total, for which CNRB is paying the state $291,370 in ten annual installments. In addition to these costs, the district makes annual payments for operation, maintenance, and repairs associated with the storage space dedicated to district use, and an annual cost for administration and enforcement (KWO 1996).

Recreation

The JRL and associated facilities (OCWA and FHNWR) provide a variety of recreation opportunities including fishing, hunting, wildlife viewing, hiking, camping, and boating. Each of these activities results in economic activity in the study area and elsewhere in the state. Over 29,100 angler days per year of angler use occurs on the river between Council Grove and John Redmond, and 63,900 angler days of use between the John Redmond Lake and the Kansas-Oklahoma State line. Both reaches are considered to have an excellent sport fishery, especially for catfish. The principal fishing areas are limited, and generally restricted to, adjacent towns, road crossings, low ware or overflow dams, and reservoir tailwaters (USFWS 2002),

Two documents have recently provided estimates of the economic effects of recreation visits to JRL and nearby facilities. The USFWS, KDW&P, and USACE prepared a study on the economic impact of water level management for the JRL (Kostinec et. al. 1996). That study, based on previous studies of the economic contributions of bird and waterfowl recreation (Southwick Associates 1995), estimated that each hunting trip contributed $162 to the economy. In 1996, this estimate yielded an economic value of $3,240,000 for wildlife-related recreation trips, according to the study. Many shorebird watching and waterfowl hunting visits to JRL are made by out-of-area and out-of-state visitors, particularly in years when natural conditions or implementation of the water level management plan results in large numbers of migrating birds (Hotaling, pers. com. 2001, Jirak, pers. com. 2001).

Coffey County Economic Development (CCED) estimates that overnight visitors to nearby Coffey County Fishing Lake spend $100 per day, and day visitors spend $30 per day (CCED undated). Although fishing generates a substantial number of visits to JRL, FHNWR, and OCWA, most fishing visits are believed to be associated with catfish and hybrid bass, and most are made primarily by local residents. The Coffey County Fishing Lake and several nearby municipal lakes are believed to attract the bulk of out-of-area visitors (Jirak, pers. com. 2001).

3.8.4 Lands Within the Flood Plain Downriver from JRL

Lands within the flood plain along the Neosho River from JRL to Grand (Pensacola) Lake are largely privately held and primarily in agricultural use. Agriculture is a major land use and economic activity throughout the Neosho/Grand River Basin. The alluvial soils within the flood plain, which support row crop production (primarily corn and soybeans), livestock grazing, timber production, and pecan orchard cultivation, play a key role in area productivity (G/NRBC 1996, Kilgore, pers. com. 2001).

Flooding in the Neosho River basin occurs primarily on agricultural lands and riparian woodlands within the flood plain. Flooding occurs during high rainfall/runoff events in the basin between JRL and Grand (Pensacola) Lake, when high rainfall/runoff events are combined with channel capacity or lower releases from JRL, or when greater than channel capacity releases are passed downstream from JRL to avoid risk of project failure. In recent years, inundation of portions of the flood plain has occurred, on average, about once a year according to local estimates (Kilgore, pers. com. 2001, Newkirk, pers. com. 2001).

Flooding effects on crops have ranged from major to minimal, depending on the water depth, duration, and time of year that the inundation occurred. Other effects of flooding include bank caving, channel degradation, loss of soil, and movement of nutrients, fertilizer, and pesticides. Flooding affects agricultural lands, water quality, and aesthetic and recreational resources along the river (G/NRBC 1996). There are no known studies of the effects of flooding on the agricultural economy in the Neosho River Basin between JRL and Grand (Pensacola) Lake (Fogleman, pers. com. 2001, Kilgore, pers. com. 2001).

When flooding occurs on the Neosho River below JRL, four houses located northeast of the City of Burlington in Coffey County are routinely affected. During severe floods, basements of some businesses and homes within Burlington are also flooded. Riverbank caving is also a concern in Burlington. During the November 1998 flood, a dike and road east of the city were threatened. A portion of a road within the city has been relocated due to riverbank caving, and a riverbank reconstruction project is currently planned to stabilize a portion of the Neosho River (Newkirk, pers. com. 2001).

Neosho Basin Pecan Orchards

The land area used for pecan orchards in Kansas increased from under 3,000 acres in 1982 to almost 6,000 acres in 1997, nearly doubling during the 15-year period (Coltrain et al. 1999). Pecan trees are best suited to deep alluvial soils, therefore, pecan orchards are typically found in flood plains (Reid 1995). An estimated 80 percent of Kansas pecan orchards are located along the Neosho River and its tributaries below JRL. The greatest number of orchards are located in Cherokee and Neosho Counties, with substantially smaller numbers in Labette, Montgomery, Chataqua, Wilson, Crawford, Allen, Bourbon, Woodson, and Coffey Counties (Reid, pers. com. 2001). Pecan trees in the Neosho Basin are generally native trees, which have volunteered rather than been planted in areas (orchards) from which other species have been removed.

Pecan orchards are susceptible to flooding at two times during the year. Pecan harvest occurs in November, December, and January when pecans are shaken from trees and collected using rubber-finger sweeps. Water moving through the orchards during harvest can wash the nuts away and wet soils can damage the nuts.

Pecan orchards are also susceptible to flooding during the growing season. During the spring and summer, periods of relatively mild flooding (frequent or extended periods of relatively low water levels) can damage trees and affect crops. Saturated soils during this period inhibit the ability of the trees to absorb oxygen and water from the soil. Short periods of saturation will result in leaves that yellow and fall prematurely, destroying or damaging the current year crop and potentially affecting the crop in the subsequent season. Longer-term exposure to saturated soils can result in the loss of the tree (Reid, pers. com. 2001).

Table 3-18 displays Kansas pecan production and value for 1993 through 1999. The dramatic drop in production in 1998 was the result of flooding along the Neosho River that occurred during the harvest season of that year (Reid, pers. com. 2001).

Table 3-18. Kansas Pecan Production and Value: 1993–1999 (Source: USDA 1992–1999)

	1993	1994	1995	1996	1997	1998	1999
Utilized Production (1,000 lbs.)	1,800	3,600	500	200	4,200	50	5,000
Value of Production ($1,000)	$900	$3,672	$460	$196	$2,814	$44	$3,400

[1]Utilized production is the amount sold plus the quantities used at home or held in storage.

Transportation

JRL and associated facilities are located about eight miles south of I-35. SH 75, located one mile east of JRL, provides access to the area from the north and south. SH 130 provides access from I-35. A variety of Coffey and Lyon County roads provide access to JRL, FHNWR, and OCWA.

USACE-, USFWS-, and KDW&P-maintained roads provide access within these facilities. Certain roads within these facilities are inundated during periods when the USACE is required to impound waters to prevent downstream flooding (Gamble, pers. com. 2001).

During scoping, a concern was noted for the bridge on SH 130 north of Hartford, regarding trees under the bridge restricting water flow. KDOT reviewed this bridge in the field and believes that maintenance on the bridge is adequate. This bridge is scheduled to be replaced in 2006 or 2007 (Adams, pers. com. 2001).

3.9 Cultural Resources

As a major waterway in the Central Plains, the entire Neosho River Valley can be classified as an area of high sensitivity for the location of archaeological remains (Hofman, Logan, and Adair 1996:203-220). This section describes prehistoric and historic cultural remains that have been recorded: 1) on USACE property around JRL at elevations of 1,035.0–1,045.0 feet; and 2) within 20 meters of the Neosho River banks from John Redmond Dam to Grand (Pensacola) Lake (Miami SE USGS Quad).

3.9.1 Cultural History Sequence

The following regional chronology, after Rust (2001a), is adopted in the SEIS:

- Paleoindian 12,000 to 8500 BP
- Mesoindian 8500 to 2500 BP
- Plains Woodland 2000 to 1000 BP (AD 1 to 1000)
- Plains Village AD 1000 to 1600
- Protohistoric AD 1500 to 1825
- Historic AD 1825 to present

To aid in comparing divergent cultures and sequences in the Central Plains, Hofman, Logan, and Adair recommend the use of general adaptation types to characterize prehistoric cultural traditions (1996:203–220):

Paleoindian

Specialized, large-game hunting by small bands of hunter-gatherers was the adaptation type associated with this period. Signature stone tools are unnotched projectile points of fluted or lanceolate type, often found in contexts where mammoth or bison remains also occur. Structural remains are poorly understood, the probable result of a mobile lifestyle and the use of perishable construction materials. Three main complexes identified within this period are Clovis or Llano (12,000–10,600 BP), Folsom or Lindenmeier (10,900–10,100 BP), and Plano or Dalton (10,500–8000 BP).

Mesoindian

Plant foraging was an important subsistence strategy of hunter-gatherer groups in this period, and was associated with increased seasonal variability of resources during the mid-Holocene Hypsithermal. Repeated occupation of sites, features such as rock-lined hearths and roasting pits, and grinding tools reflect intensive plant processing and the cyclical exploitation of resources. Bison were hunted on a smaller scale than previously, with greater reliance on small mammals, mussels, and fish. Stone tools were often thermally cured, and included distinctive stemmed and notched projectile points. The Mesoindian period is traditionally divided into Early (8500–6500 BP), Middle (6500–4500 BP, and Late (4500–2500 BP) periods.

Plains Woodland

Archaeologists in Kansas use the term Early Ceramic to describe Woodland cultural components. Incipient horticulture was the adaptation type associated with this period, marked by the introduction of cultigens in the Central Plains. Evidence for semi-permanent villages, increased reliance on wild and domestic plants, widespread use of ceramics, and elaborate burials reflect the more sedentary lifestyle of Woodland cultures. Small game remained essential in subsistence. Tool assemblages are distinguished by small, corner-notched projectile points, which suggest invention of the bow and arrow.

Plains Village

Horticulture, supplemented by hunting and gathering, was the adaptation type associated with Village societies. Gardening tools were recognized in artifact assemblages, along with triangular arrowpoints for hunting and pottery types that in Kansas serve to denote this period as the Middle Ceramic. Villager cultures are often identified in lowland terraces of waterways where gardening was viable. The Pomona culture variant is associated with watersheds in southeastern Kansas. Distinguishing traits include shell-tempered pottery and a scarcity of cultigen remains such as maize, possibly reflecting less dependence on farming than in other Villager cultures (Logan 1996:123–125; Brooks 1989:88-89).

Protohistoric

This period was defined by transitory contacts of European explorers in the Central Plains, substantiated by little or no historical documentation. Lifeways were subsumed under the Plains Village adaptation type, but distinctive Late Ceramic archaeological complexes were identified, including the Great Bend aspect with sites in south-central Kansas. Great Bend manifestations likely represent the proto-Wichita villages encountered by Francisco Coronado in 1541 (Hofman 1989:93–95). Proto-Wichita sites are also identified in north-central Oklahoma (Bell, Jelks, and Newcomb 1967).

Historic

The Reservation Period (1825-1900) was marked by the displacement and resettling of Native American tribes throughout the greater study region. Between 1825 and 1835 reserves were established for the Osage and New York Indians in southeast Kansas. The Cherokee Nation was created in northeastern Oklahoma in 1828, soon thereafter incorporating the Quapaw and Seneca tribes. After the Civil War the area was further divided into reserves for the Peoria, Ottawa, Wyandotte, and others. From 1838 to 1871 the Neosho Agency held jurisdiction over all tribes but the Cherokee (Harris 1965). Between the 1830s and 1850s Anglo-Americans legally occupied tribal lands to operate mission schools, trading posts, ferries, mills, and blacksmith shops (Tracy 1970:174–177; Harris 1965:42–43).

The early part of the American Period (1850-present) is marked by increasing Anglo-American land speculation and enhanced military supply lines through the study region that connected Fort Gibson, Fort Scott, and Fort Leavenworth during the Civil War. Pioneer settlement of homesteads and towns began in earnest in southeastern Kansas during the 1860s following the removal of Native American tribes to Oklahoma. This trend was somewhat delayed in northeastern Oklahoma where the Cherokee Nation maintained a loose hold on sovereignty. By the 1890s, however, towns such as Miami and Ottawa were firmly rooted (Benedict 1922; Nieberding 1983).

3.9.2 Previous Investigations

Forty-eight archaeological sites have been recorded over the past 30 years in the area of potential effects (1035.0–1045.0-foot elevation) around JRL (Table 3-19). Comprehensive investigations have been published in: *Appraisal of the Archaeological Resources of the John Redmond Reservoir* (Witty 1961), *Salvage Archaeology of the John Redmond Lake* (Witty 1980), *Archaeological Investigations in the John Redmond Reservoir Area* (Rogers 1979), *Archaeological Investigations at John Redmond Reservoir, East-Central Kansas, 1979* (Thies 1981), and *John Redmond Reservoir Historic Properties Management Plan* (Anonymous 1997). More recently, a Phase II shoreline survey was undertaken by e^2M in 2000 with results presented in *An Archaeological Survey of John Redmond Reservoir* (Rust 2001a). The survey was followed by Phase III test excavation and evaluation of selected sites by e^2M in 2001 (Rust 2001b).

A review of Historic Preservation Management Plan (HPMP) Database files prior to the e^2M fieldwork indicated that 27 of the 47 sites had been destroyed, mitigated, or deemed insignificant. Site revisitation during the Phase II survey determined that an additional 15 sites had been destroyed (in most cases by flooding) or currently lacked evidence of significance. Six sites, three of which were discovered in 2000, were the focus of Phase III investigations in 2001. Historic sites 14CF101, 14CF102, 14CF103, and 14CF105, and prehistoric sites 14CF311 and 14CF313 (these last two now defined as one site) are considered eligible for nomination to the National Register of Historic Places (NRHP). Site 14CF104 was tested and considered ineligible.

Thirty-one sites have been recorded in the area of potential effects downstream of JRL (Table 3-20). These were inventoried during record searches at Kansas State Historical Society Center for Historical Research in Topeka, the Oklahoma Archaeological Survey in Norman, and the State Historic Preservation Office in Oklahoma City. State archaeological site and survey forms were collected from these agencies, along with locations of properties indicated on historical General Land Office (GLO) maps of Kansas (1878) and Oklahoma (1898). Archival research was undertaken at the Kansas State Historical Society Archives, the Kansas Collection at the University of Kansas in Lawrence, and the Western History Collection at the University of Oklahoma in Norman. Only one comprehensive survey has yet been undertaken in the area of effect: *An Assessment of Prehistoric Cultural Resources of the Neosho (Grand) River Valley* (Schmits 1973). Unlike the JRL sites, many of the downstream sites lack recent first-hand assessment.

The six JRL and 31 downstream sites are briefly described below under the appropriate period. General locational information for these 37 sites may be found in the Cultural Resources Appendix G, Exhibit A.

Table 3-19. Sites Around John Redmond Lake

Site	Status	Reference
14CF027	Not Significant	Rogers 1979
	Destroyed	HPMP 1997
14CF037	Not Significant	Rogers 1979
	Destroyed	HPMP 1997
14CF041	Not Significant	Rogers 1979
	Destroyed	HPMP 1997
14CF047	Not Significant	Rogers 1979
	Destroyed	HPMP 1997
14CF101	Eligible	Rust 2001b
14CF102	Eligible	Rust 2001b
14CF103	Eligible	Rust 2001b
14CF104	Ineligible	Rust 2001b
14CF105	Eligible	Rust 2001b
14CF302	Destroyed	Rust 2001a
14CF303	Destroyed	Rust 2001a
14CF311	Eligible	Rust 2001b (forthcoming)
14CF313	Eligible	Rust 2001b
	South extension of current 14CF311	Wilmeth 1960 (KSHSSR)
14CF314	Not Significant	Witty 1961
	Destroyed	HPMP 1997
14CF319	Not Significant	Theis 1979 Wilmeth 1960 (KSHSSR) Rust 2001a
14CF320	Not Significant	Wilmeth 1960 (KSHSSR)
	Destroyed	Theis 1979 HPMP 1997
14CF321	Not Significant	Witty 1961
	Destroyed	HPMP 1997
14CF324	Destroyed	Rust 2001a
14CF325	Not Significant	Witty 1961 HPMP 1997
	Destroyed	Rust 2001a
14CF326	Destroyed	Rust 2001a
14CF327	Not Significant	Witty 1961 Theis 1983 (KSHSSR) HPMP 1997
14CF330	Mitigated	Witty 1980
	Destroyed	Rust 2001a
14CF331	Mitigated	Witty 1980 HPMP 1997
14CF333	Not Significant	Witty 1961 Rust 2001a
14CF343	Destroyed	HPMP 1997
14CF350	Not Significant	Theis 1979 HPMP 1997

Site	Status	Reference
14CF351	Not Significant	Maul 1979 (KSHSSR) HPMP 1997 Rust 2001a
14CF352	Not Significant	Theis 1981 HPMP 1997
14CF353	Not Significant	Theis 1981
	Destroyed	HPMP 1997
14CF354	Destroyed	HPMP 1997
14CF355	Destroyed	HPMP 1997
14CF356	Not Significant	Theis 1981 HPMP 1997
14CF357	Not Significant	Theis 1981 Rust 2001b
14CF360	Not Significant	Theis 1981
	Destroyed	HPMP 1997
14CF361	Not Significant	Theis 1981
	Destroyed	HPMP 1997
14CF362	Not Significant	Theis 1981 HPMP 1997
14CF363	Not Significant	Theis 1981 HPMP 1997
14CF364	Not Significant	Theis 1979
	Destroyed	HPMP 1997
14CF365	Not Significant	Theis 1981
	Destroyed	HPMP 1997
14CF369	Not Significant	Rust 2001b
14CF389	Not Significant	Theis 1981 HPMP 1997
14CF390	Not Significant	Theis 1981
	Destroyed	HPMP 1997
14CF391	Not Significant	Theis 1981 HPMP 1997
14CF1316	Not Significant	Theis 1981 HPMP 1997
	Destroyed	Rust 2001a
14CF1318	Not Significant	Theis 1981 HPMP 1997
	Destroyed	Rust 2001a
14CF1329	Not Significant	Theis 1983 (KSHSSR)
	Destroyed	HPMP 1997
14CF1335	Destroyed	Rust 2001a
14CF1336	Destroyed	Rust 2001a
KSHSSR = Kansas State Historical Society Site Report		

Table 3-20. Sites Downriver of John Redmond Dam

SITE (N-S BY COUNTY)	Reference	SUMMARY DESCRIPTION
14CF8	Schmits 1973	Prehistoric: hearths in riverbank
14CF9	Schmits 1973	Prehistoric: lithic and burned stone deposit in riverbank
14CF10	Schmits 1973	Prehistoric: lithic and burned stone deposit in riverbank
14CF11	Schmits 1973	Prehistoric: mussel and charcoal deposit in riverbank
14CF12	Schmits 1973	Prehistoric: lithic and animal bone deposit in riverbank
14CF13	Schmits 1973	Prehistoric: lithic and burned earth deposit in riverbank
14AN6	Schmits 1973	Prehistoric: animal bone and lithic deposits in riverbank
14NO6	Schmits 1973	Prehistoric: hearths and lithic deposits in riverbank
14NO7	Schmits 1973	Prehistoric: pottery and animal bone deposits in riverbank
14NO8	Schmits 1973	Prehistoric: bone and burned earth deposit in riverbank
14NO9	Schmits 1973	Prehistoric: hearth in riverbank
14NO10	Schmits 1973	Prehistoric: mussel and charcoal deposits in riverbank
14NO11	Schmits 1973	Prehistoric: lithic scatter on top of riverbank Historic: nails, glass, china on top of riverbank
14NO376	KSHSSR 1976	Prehistoric: hearths and bison bone in riverbank
14NO398	KSHSSR 1994	Prehistoric: burials and lithics in riverbank
14LT9	Schmits 1973	Prehistoric: lithic deposit in riverbank
14LT10	Schmits 1973	Prehistoric: lithic and charcoal deposits in riverbank
14LT11	Schmits 1973	Prehistoric: hearth and burned earth deposit in riverbank
14LT12	Schmits 1973	Prehistoric: mussel and charcoal deposit in riverbank
14LT355	KSHSSR 1991	Prehistoric: hearth and lithic deposit in riverbank
14CH60	Schmits 1973	Prehistoric: lithic and charcoal deposit in riverbank
14CH61	Schmits 1973	Prehistoric: lithic and burned stone deposit in riverbank
14CH62	Schmits 1973	Prehistoric: described as thin occupation level in riverbank
GLO 1	GLO Map 1898	Historic: sawmill
GLO 2	GLO Map 1898	Historic: structure
Bridge 1	King 1993	Historic: Pratt-type bridge, 1901
Bridge 2	King 1993	Historic: mixed truss type bridge, 1916
OHSS-OT10	Oklahoma Historical Society 1958	Historic: Pooler Ferry
GLO 3	GLO Map 1898	Historic: Berry Ferry
GLO 4	GLO Map 1898	Historic: structure
GLO 5	GLO Map 1898	Historic: structure
KSHSSR = Kansas State Historical Society Site Report		

3.9.3 Prehistoric Resources

Two prehistoric sites (now combined as one) were identified within the area of potential effects around JRL. Twenty-three prehistoric sites were identified in the area of potential effects downstream. [Note: In the discussion, KSHSSR = Kansas State History Society Site Report.]

Paleoindian

Although potential for the discovery of Paleoindian sites in alluvial settings of the Central Plains is great (Hofman, Logan, and Adair 1996:208), components of this period are not reported within the areas of potential effects. Twelve prehistoric sites on the Neosho River bank are, however, of unassigned date.

Mesoindian

JRL site 14CF311/313 yielded Mesoindian surface artifacts (side-notched projectile points, thermally cured cherts) in addition to later prehistoric lithic and ceramic artifacts. Part of the site area is overlain by historic activity. Limited subsurface testing was negative, but the extent of the surface material shows potential for a large, possibly long-term occupation area (Rust 2001b, Witty 1961, KSHSSR 1960).

Nine sites on the Neosho River bank are believed to be of Mesoindian date, with an additional site designated as Mesoindian or Woodland. Sites 14CF12, 14CF13, 14NO6, 14LT9, 14CH60, and 14CH61 are all identified as occupation levels visible in riverbanks, occurring as charcoal layers with burned earth in association with Mesoindian stone tools, and sometimes animal bone (Schmits 1973). Limited test excavation was conducted at 14NO398, reported as a human bone bed in a riverbank context (KSHSSR 1994). The deposit contained burned stone, and is thought to be a secondary burial. A corner notched or stemmed projectile point is dated to Late Mesoindian or Plains Woodland. Sites 14CF8 (Schmits 1973), 14LT355 (KSHSSR 1991), and 14NO376 (KSHSSR 1976) are dated to the Late Mesoindian period. The first two sites consist of stone-lined hearths and stemmed projectile points discovered in riverbanks; the feature at 14LT355 produced a radiocarbon date of 3480 ± 70 BP. 14NO376 was exposed in a bank during channel straightening operations, and is described as two superimposed hearths, one associated with bison bone.

Plains Woodland (Early Ceramic)

One Woodland/Early Ceramic site is reported on the Neosho River bank, and one additional site is designated Mesoindian or Woodland. Site 14NO7 is described as six occupation levels of charcoal and burned earth visible in an eroding riverbank context. Cordmarked pottery was recovered from one level; another yielded burned animal bone (Schmits 1973). The secondary burial at 14NO398 is described under the above Mesoindian discussion.

Plains Village

In addition to Mesolithic artifacts, JRL site 14CF311/313 produced Pomona Villager lithics, including a drill fragment, and a potsherd (Witty 1961, Rust 2001b) The only site of this period known to have existed in the area of potential effects downstream, 14LT380, has been mitigated and destroyed (KSHSSR 1998).

Protohistoric

Protohistoric sites are not well documented in the JRL area (Rust 2001a:16). Downstream, a collector located two blue, glass beads (findspot 14LT600 in KSHSSR 1982) near the riverbank. Similar beads are described from Protohistoric contact contexts (Hofman 1989:95), but because the provenance of the finds would be difficult to verify and no other material is reported, the findspot is not deemed significant.

Unassigned Prehistoric Sites

Twelve sites on the Neosho River bank are not assigned to specific prehistoric periods, either because of a lack of diagnostic artifacts or uncertainties in classification. Sites 14CF9, 14CF10, 14CF11, 14AN6, 14NO8, 14NO9, 14NO10, 14NO11, 14LT10, 14LT11, 14LT12, and 14CH62 are described as single or multiple occupation levels of charcoal, burned earth, and burned stone containing (variably) animal bone, burned mussels, and stone artifacts including projectile points, scrapers, and flakes. Stone-lined hearths are identified at sites 14NO9 and 14LT11 (Schmits 1973).

3.9.4 Historical Resources

Four historic sites are identified in the JRL area of potential effects. Nine historic sites are recorded along the Neosho River banks, five of which were documented on 1898 GLO maps for Oklahoma. Sites discussed are organized according to historic adaptation types as presented by Lees (1996:140–49).

Resettled Native American Adaptation

Site OHHS-OT10 on the Neosho River bank was reported by the Oklahoma Historical Society (1958), and further discussed in Nieberding (1983:11, 267). Known as Pooler Ferry, the Neosho crossing was reportedly established in 1870 by Moses Pooler to serve those in Ottawa Reservation. The physical integrity of the site is not reported in either source. Pooler also established a trading post and post office in 1882 at his home site approximately half a kilometer to the northeast. Sites related to the lifeways of resettled Native Americans are poorly represented in the archaeology of the region (Lees 1996:144–45).

Transportation Adaptation

Pooler Ferry (OHHS-OT10) also holds broader relevance to historic transportation. The Old United States Military Trail, established in 1828 from Fort Leavenworth to Fort Gibson, crossed the Neosho River at this location. This same route was traversed by the first longhorn cattle drive through Indian Territory in 1867. Nieberding notes that “until recently, ruts made from the wagon trail wheels were still in evidence” at the crossing (1983:11,189). Another Neosho River ferry operation in Ottawa County, GLO 3, was marked on the 1898 GLO map as “Berry Ferry,” but supporting documentation has not yet been located. Also in Ottawa County are two bridges on USACE property that have been determined eligible for listing in the NRHP. Bridge 1 (ODT # 58E0062N4510004) is the oldest Pratt through-type bridge in Oklahoma, constructed by Midland Bridge & Iron Co. of Kansas City, Missouri (MO), in 1901. It originally functioned as a toll bridge, and was located at a traditional fording area known as the Turkey Track Trail, reputedly crossed by the Dalton Gang and other outlaws. The bridge was moved in 1921 to its present location at Stepps Ford. Bridge 2 (ODT # 58N4590E0160005) is a mixed truss type bridge, constructed by Missouri Valley Bridge & Iron Co. of Leavenworth, KS in 1916 (for bridges, see J. King 1993).

Industry Adaptation

Site GLO 1 in Craig County, OK was marked on the 1898 GLO map as a riverside sawmill in a rural setting. Small rural industries are poorly documented in the Central Plains generally (Lees 1996:149). One of the few sawmill publications is of Shawnee Mill in eastern Kansas, which served the Shawnee between 1835 and 1844 (M. King 1996). It is possible that the GLO 1 mill similarly operated for the Quapaw or Cherokee, but the GLO date makes it equally likely that it served a pioneer community. Three structures are indicated on the GLO immediately upstream; there is no indication if these represent Native or Anglo-American holdings. The physical integrity of the site is unverified.

Rural Settlement Adaptation

Four sites in this category have been investigated in the JRL area of potential effects (Rust 2001a: 41-56, Rust 2001b). Sites 14CF101, 14CF102, 14CF103, and 14CF105 lie within close proximity to each other and are remnants of the historic Otter Creek community (Pleasant Township), which was first settled in 1858. Phase III test excavations on the first three sites, all originally farmsteads, revealed *in situ* courses of stone foundation walls associated with deep deposits of artifacts. More than 2,000 artifacts were recovered from four excavated units. Preliminary analysis, combined with historical research and extensive oral interviewing of living descendants, suggest 14CF101 and 102 may date to circa 1860, and 14CF103 to the 1880s. 14CF105 preserves substantial surface remains, and an early phase probably also dates to the late 19th century.

Downriver sites in this category are: 14NO11 in Neosho County, KS; GLO 2 in Craig County, OK; and GLO 4 and GLO 5 in Ottawa County, OK. Only the first site is documented archaeologically as a surface scatter including nails, china, and glass on the top of the riverbank; the investigator was informed that a 19th century farmhouse once stood on the site. The GLO sites included here are in isolated settings and were unlabeled on the 1898 maps. Because non-residential facilities or services tend to be identified as such, it is likely that these represent farmsteads of Native American or Anglo-American holdings. Published examples of excavated 19th century farmsteads in Oklahoma are scarce (for a list of published historic sites, see Hays, Brooks, and Hofman 1989:101–105).

3.10 Hazardous, Toxic, or Radiological Wastes

This section describes existing conditions within the JRL project area with regard to potential environmental contamination on the site, or that may enter the site, via surface water and the sources of releases to the environment. Contaminant pathways have been identified by the USFWS (Blackford 1999 in FHNWR 2000) and radiological analyses are conducted by WCGS (KDH&E 2001), using portions of the JRL site as controls.

A recent Contaminant Assessment Process (CAP) was completed by the USFWS for FHNWR and radionuclides are monitored for the WCGS, including sites within and near JRL (FHNWR 2000, KDH&E 2001). The most likely pathways for contaminants to enter JRL are through runoff water and the activities associated with agriculture, flood control, and public recreation (Blackford 1999 in FHNWR 2000). Radionuclides could enter the JRL environment via air or water pathways (KDH&E 2001). The highways and roads, railroads, and oil and gas pipelines in the vicinity could also provide sources of contaminants to the project site.

Because the FHNWR is an overlay on the JRL flood control lands, flooding is common during the spring and fall seasons. On average, flooding of the FHNWR occurs as follows:

- Entire refuge flooded (95% of refuge lands), occurs one in ten years;
- Severe refuge flooding (75% of the refuge lands), occurs one in seven years;
- Moderate refuge flooding (50% of the refuge lands), occurs one in four years; and
- Minor refuge flooding (25% of the refuge lands), occurs annually.

Since establishment in 1966, the entire refuge (95%) has been flooded more frequently than one in ten years, e.g., 1973, 1985, 1986, 1993, 1995, 1998, and 1999 (Blackford 1999 in FHNWR 2000). Floodwater can bring contaminants to the project site and are a major contaminant pathway. Some sources of contaminants potentially carried in floodwater from the drainage basin include: 1) municipalities (Emporia, Neosho Rapids, Hartford, etc.,) which have sanitary sewage, automobile parts manufacturing, a slaughterhouse and meat packing plant, commercial bakery, dog food plant, and petroleum product storage facilities; 2) agricultural land where livestock feedlot runoff and chemicals used for fertilizer, weed control, and insect control are applied, and sediments are washed from fields, and 3) lead deposited historically through hunting and fishing activities.

A summary of contaminant issues identified in Blackford (1999 in FHNWR 2000) includes:

- Chlordane compound concentrations in fish sufficient to result in consumption advisories annually;
- Fish kills associated with livestock feedlot runoff during the 1970s;
- Biota samples containing levels of PCB, atrazine, heavy metals (lead, mercury, and arsenic);
- Sediment samples containing lead;
- Detection of strong chemical/pesticide odors by onsite personnel following precipitation events during the spring planting season;
- Surface water analyses that identified triazines, 2,4-D, and alachlor;
- All drainages are turbid; and
- Eagle Creek has documented heavy metal concentrations and a livestock feedlot is currently in operation on its banks, updrainage of JRL.

Environmental radiation data collection has occurred at the WCGS since 1984, one year prior to operation in 1985 (KDH&E 2001). The purpose of the operational environmental radiation surveillance program is to detect, identify, and measure any radioactive material released to the environment in effluents resulting from the operation of WCGS. Samples are taken of air; direct radiation monitoring; surface water; ground water; drinking water; milk; sediment and soil; fish, game animals, and domestic meat; and terrestrial and aquatic vegetation. The samples taken on the JRL project site are used as controls and are collected at Hartford, KS (air), JRL (aquatic vegetation, sediments), and the Neosho River below John Redmond Dam (fish, surface water). A total of 1,088 samples were collected during 2000 at WCGS (KDH&E 2001).

The results of direct radiation monitoring show no significant changes from preoperational data. Airborne sample analyses show no radionuclides attributable to the operation of WCGS were present above the lower limits of detection. Further, analyses of terrestrial vegetation, soil, milk, grain, and vegetable samples show no radionuclides present that are attributable to the operation of WCGS.

Elevated readings of radionuclides were determined for surface water, sediment, and fish (KDH&E 2001). The beta emitter tritium (H^3) concentration for water samples collected in Coffey County Lake was 16,678 picoCuries per liter (pCi/l) or 83 percent of the National Primary Drinking Regulation maximum contaminant level of 20,000 pCi/l. All other surface water, ground water, and drinking water samples collected show no radionuclides present attributable to the operation of WCGS.

Sediment samples have been excellent indicators for long-term buildup of fission and activation product activity levels in Coffey County Fishing Lake (KDH&E 2001). The highest activation product activity observed during 2000 was 816 ± 37 picoCuries per kilogram (pCi/kg)-dry Cobalt-60 (Co^{60}) from a Coffey County Fishing Lake bottom sediment sample. The highest fission product activity during 2000 was 680 ± 200 pCi/kg-dry Cesium-137 (Cs^{137}) from a Coffey County Fishing Lake shoreline sediment sample. Of 45 fish samples, two showed notable radionuclide concentrations. A composite sample of walleye collected at the Ultimate Heat Sink of Coffey County Fishing Lake resulted in 41 ± 16 pCi/kg Cs^{137}. The highest H^3 tissue concentration was 11,003 pCi/kg-wet in a smallmouth buffalo sample taken from the lake discharge cove. No other radionuclides attributable to WCGS operation were found. The regulatory limit set for a citizen in terms of projected dose equivalent, is 100 mrem/yr. Using the results for Co^{60} and Cs^{137} reported above, an averaged-sized man consuming 21 kg/year (46.2 lbs./year) of contaminated fish would receive a committed effective dose equivalent of 0.058 mrem, far below the regulatory limit (KDH&E 2001).

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4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This section examines potential environmental consequences of the proposed action and alternatives on the nine resource areas identified in the affected environment section of this document: geology and soils; hydrology and water resources; biological resources; air quality; aesthetics; prime or unique farmlands; socioeconomic resources; cultural resources; and hazardous, toxic, and radiological wastes. For each resource area, consideration is given to whether potential environmental consequences would result from the proposed action or alternatives and whether they are short term or long term, mild or significant, and adverse or beneficial. Consideration of potential cumulative effects is also presented.

As defined by NEPA, significant impacts are those that have the potential to significantly affect the quality of the human environment. “Human environment” is a comprehensive phrase that includes the natural and physical environments and the relationship of people to those environments (40 CFR 1508.14). Whether or not a proposed action “significantly” affects the quality of the human environment is determined by considering the context in which it will occur and the intensity of the action. The context of the action is determined by studying the affected region, the affected locality, and the affected interests within both. Significance varies depending upon the setting of the proposed action (40 CFR 1508.27). The intensity of an action refers to the severity of the impacts, both regionally and locally. The level at which an impact is considered significant varies for each environmental resource area.

The area, or region of influence for an action, is defined for each environmental resource based upon the areal extent that would be affected directly or indirectly by the proposed action. The determination of the region of influence is based upon guidance provided by regulatory agencies or professional judgment.

4.2 Geology and Soils

Geology and soil resources for an area consist of the surface and subsurface soils and bedrock, and their respective physical characteristics. Concerns relating to geology and soil resources include the impacts of an action that would result in geologic or soil related hazards, i.e., subsidence, land sliding, erosion, expanding or collapsing soils and bedrock, and seismic activity. In addition, the limiting of access to mineral resources, unique geologic features, or paleontological resources are also areas of concern.

Topography is the change in elevation over the surface of an area, and is generally the product of the geology and soil resources for a given area. Therefore, effects on topography are also included under this geology and soil resources section.

Table 4-1. Environmental Resources and Region of Influence

Environmental Resource	Region of Influence (No Action Alternative)	Region of Influence (Dredge John Redmond Lake)	Region of Influence (Phased Pool Storage Reallocation)	Region of Influence (Proposed Action: Storage Reallocation)
Geology and Soils	No region of influence.	Sediment disposal area.	John Redmond Lake and downriver effects.	John Redmond Lake and downriver effects.
Hydrology and Water Resources	John Redmond Lake.	John Redmond Lake and downriver effects.	John Redmond Lake and downriver effects.	John Redmond Lake and downriver effects.
Biological Resources	No region of influence.	Upriver, John Redmond Lake, and downriver effects.	Upriver, John Redmond Lake, and downriver effects.	Upriver, John Redmond Lake, and downriver effects.
Air Quality	No region of influence.	John Redmond Lake vicinity.	No region of influence.	No region of influence.
Aesthetics	No region of influence.	Sediment disposal area, John Redmond Lake, and downriver effects.	John Redmond Lake.	John Redmond Lake.
Prime or Unique Farmlands	No region of influence.	Sediment disposal area.	Upriver, John Redmond Lake, and downriver effects.	Upriver, John Redmond Lake, and downriver effects.
Socioeconomic Resources	Allen, Anderson, Bourbon, Cherokee, Coffey, Crawford, Labette, Lyon, Neosho, Wilson, and Woodson Counties, Kansas	John Redmond Lake vicinity, and Coffey and Lyon Counties, Kansas	Allen, Anderson, Bourbon, Cherokee, Coffey, Crawford, Labette, Lyon, Neosho, Wilson, and Woodson Counties, Kansas	Allen, Anderson, Bourbon, Cherokee, Coffey, Crawford, Labette, Lyon, Neosho, Wilson, and Woodson Counties, Kansas
Cultural Resources	John Redmond Lake, and downriver effects.	John Redmond Lake, and downriver effects.	John Redmond Lake, and downriver effects.	John Redmond Lake, and downriver effects.
Hazardous, Toxic, or Radiological Wastes	No region of influence.	Sediment disposal area, John Redmond Lake, and downriver effects.	No region of influence.	No region of influence.

No Action Alternative

Potential effects on geology and soil resources through the implementation of the No Action Alternative are precluded by the fact that the No Action Alternative for JRL does not involve any activities that would contribute to changes in existing conditions. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on geology or soil resources as a result of implementing the No Action Alternative.

Dredge John Redmond Lake

The two expected methodologies for dredging the conservation pool are the excavation and hauling of sediments offsite or siphoning of sediments to a location downriver of John Redmond Dam. Depending on the method selected for dredging activities, the Dredge John Redmond Lake Alternative would result in potential effects on geology and soil resources regarding the placement of dredge materials. If the disposal area is offsite, the selected location for the dredge materials would potentially bury geology or soil resources not identified under the Affected Environment section of this document; resulting in long-term, adverse effects, the significance of which would be dependent upon the geology or soil resource. The dredge method incorporating siphoning would not result in short- or long-term, insignificant or significant, beneficial or adverse effects on geology or soil resources. Over the long term, the siphon dredge method would be most similar to the natural sediment transportation effects of the Neosho River.

Phased Pool Storage Reallocation

As indicated in the Affected Environment section of this document, the JRL site is not in the vicinity of geologic or soil related hazards, i.e., subsidence, land sliding, erosion, expanding or collapsing soils and bedrock, and seismic activity. Nor are there any mineral resources, unique geologic features, or paleontological resources identified in the vicinity of JRL. The majority of the soils in the vicinity of the Neosho River valley are delineated as potentially unique or prime farmlands, and raising the JRL conservation pool would result in flooding approximately 405 acres of such soils (Figure 4-1).

However, the conservation pool is currently allowed to remain at the final phased pool storage-reallocation elevation of 1,041.0 feet above sea level for a period of at least three months annually, thereby compromising the use of these soils as unique or prime farmlands already. This was iterated by the USDA-NRCS as well, in their response to the FPPA coordination letter submitted for this project (Appendix E). In addition, these soils are currently being intermixed with sediments of the Neosho River due to wave action and flooding under the present JRL conditions.

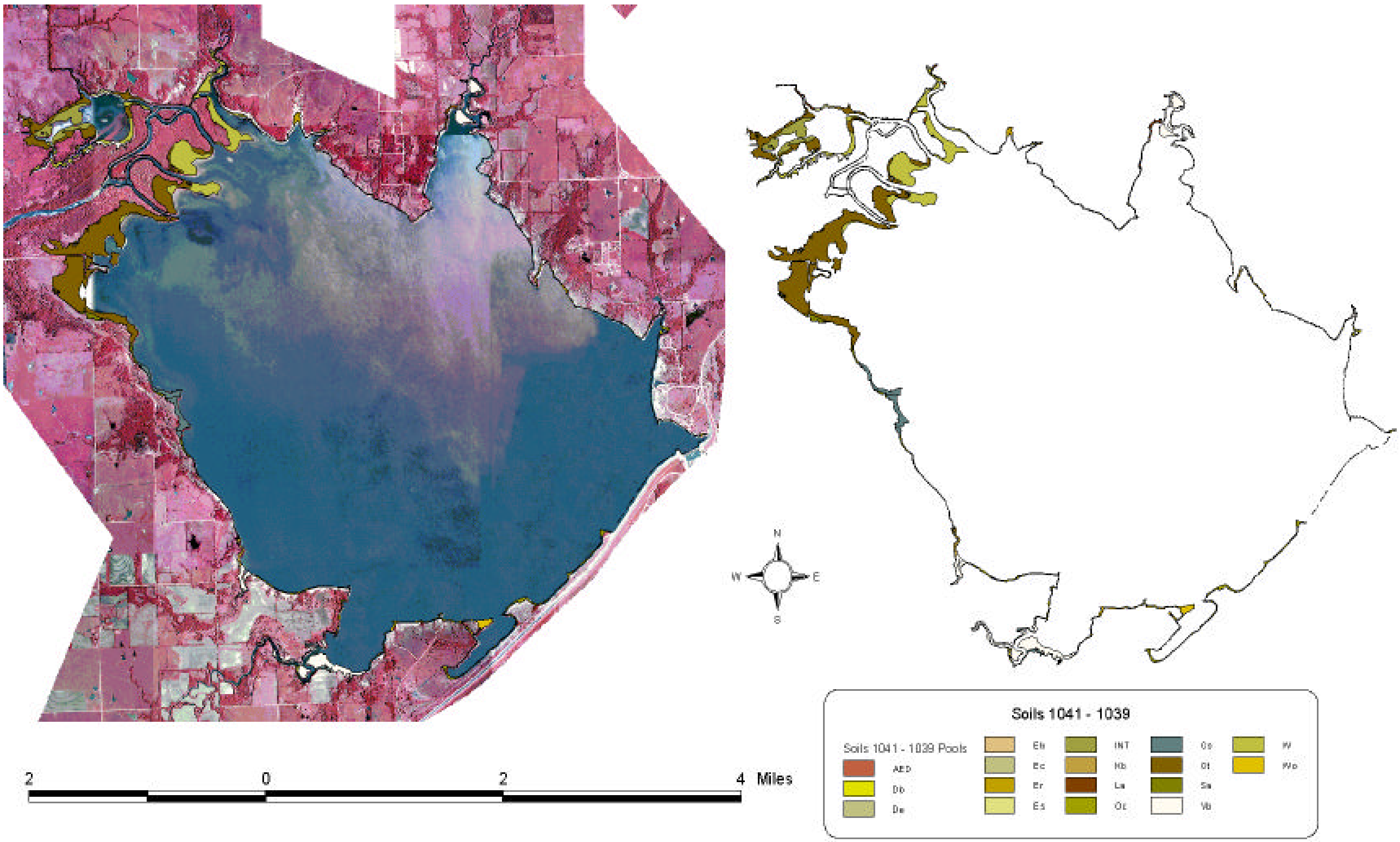

Figure 4-1. Soils Affected by the Pool Raise to 1,041.0 Feet

Potentially unique and prime farmland soils are located downriver of JRL in the Neosho River valley. The Phased Pool Storage Reallocation Alternative would reduce the flood control capacity of the John Redmond Dam by 3.18 percent, resulting in minor increased flooding of these soil resources; however, effects of the flooding of these soils would be negligible. Based on the nature of the geology and soil resources associated with the JRL site and vicinity, implementation of the Phased Pool Storage Reallocation Alternative would result in long-term, insignificant, adverse effects both within the conservation pool and downriver of JRL.

Proposed Action: Storage Reallocation

The Proposed Action: Storage Reallocation would result in the same geology and soil resources environmental consequences as the Phased Pool Storage Reallocation Alternative; therefore, this action would result in long-term, insignificant, adverse effects both within the conservation pool and downriver of JRL.

4.3 Hydrology and Water Resources

Hydrology and water resources for an area consist of the surface and ground water within a region. Environmental concerns pertaining to hydrology and water resources include the availability, quality, and quantity of surface and ground water; and control of floodwaters.

Hydrology and water resources issues identified during the scoping meetings and agency coordination included the following comments:

- The need to remove the logjam at the inlet of John Redmond Lake.
- Include seasonal pool management plan in the storage reallocation study.
- The way the USACE operates John Redmond Dam is causing riverbank erosion.
- Detention ponds should be built upriver from John Redmond Lake to trap sediments.

No Action Alternative

The potential effect on hydrology and water resources through the implementation of the No Action Alternative is a decrease in availability of surface water resources for the State of Kansas. Currently, the sediment load in JRL is as predicted; however, sediment has been inequitably distributed between the flood and conservation pools for the life of the John Redmond Dam project, resulting in a greater decrease in the conservation pool and ultimately, of the water supply storage capability of JRL. USACE has an agreement with the State of Kansas for water storage for industrial and municipal uses, and as the sediment continues to accumulate in the conservation pool at JRL, the storage capacity is diminishing, thereby reducing the availability of water for the State of Kansas. At the current sedimentation rate, the conservation pool at JRL will be unable to store enough water to meet the requirements of the State of Kansas by the end of the life of the dam. The inability of JRL to store adequate water volume would result in a long-term, significant adverse effect on water resources for the State of Kansas.

Dredge John Redmond Lake

The Dredge John Redmond Lake Alternative would potentially result in both beneficial and adverse effects on hydrology and water resources for JRL. The beneficial effect would be an increase in storage capacity of the dam thereby creating a greater availability of surface water resources for the State of Kansas and improved downriver flood control. This alternative would also allow the USACE to meet their water storage requirement as agreed to with the State of Kansas. In addition, by not increasing the conservation pool elevation, the John Redmond Dam would be able to maintain the maximum flood pool volume, minimizing downriver effects of flooding events on the Neosho River. The effects of implementing the Dredge John Redmond Lake Alternative would be considered long-term, insignificant and significant beneficial.

The potential adverse effect of the Dredge John Redmond Lake Alternative is the possibility of causing potential contamination of lake sediments to become waterborne. Due to the use of the reservoir as a waterfowl hunting management area, there is a potential for lake sediments to contain lead from shot, and because JRL lies within an agricultural region, there is the potential that the lake sediments contain residual contamination in the form of pesticides and fertilizers from runoff of agricultural lands. Dredging activities would disturb these sediments, thereby exposing buried or settled contaminants. If contaminated, the dredged sediments would result in a negative effect on the selected sediment disposal location. The two expected dredge alternatives are the excavation and hauling of sediments out of the conservation pool and the siphoning of lake sediments to a location downriver from JRL. Either dredge alternative would result in the inappropriate placement of potentially contaminated lake sediments. The Dredge John Redmond Lake Alternative would result in long-term, insignificant and significant, beneficial (storage capacity and flood control) and short-term, adverse (water contamination) effects. The significance of these effects would be dependant upon the contamination level of the sediments.

Phased Pool Storage Reallocation

One of the potential adverse effects on hydrology and water resources through the implementation of the Phased Pool Storage Reallocation Alternative is a reduction of flood control capabilities of the John Redmond Dam. Raising the elevation of the conservation pool to the 1,041.0-foot elevation reduces the current storage capacity of the JRL flood-control pool by 3.18 percent, causing downriver effects of flooding on the Neosho River to increase. However, based upon calculations performed by the USACE's SUPER computer program, the effects of downriver flooding as a result of raising the John Redmond Dam conservation pool elevation would be negligible (Affected Environment, Section 3.3). John Redmond Dam controls the surface water runoff from an approximately 3,015-square mile area. The Grand (Pensacola) Lake (Lake O' the Cherokees), downriver from John Redmond Dam, controls surface water runoff from an area of approximately 5,973-square miles, of which 2,958-square miles comes from uncontrolled drainage sources. Accordingly, approximately 50.5 percent of the surface water flowing to Grand (Pensacola) Lake comes through the John Redmond Dam and 49.5 percent comes from uncontrolled drainage sources. During a precipitation event in the Neosho River drainage basin, and assuming an even distribution of precipitation throughout, the flooding effects at Grand (Pensacola) Lake would receive an additional 1.61 percent of runoff if the JRL conservation pool was maintained at an elevation of 1,041.0 feet. This equates to an additional 0.19 inches per foot of floodwater increase in backwater elevation.

Historically, flooding on the Neosho River occurred with flooding of agricultural lands downriver of John Redmond Dam. The resultant downriver floods generally last approximately six days before the flood waters recede to non-flood conditions. Back water effects from Grand (Pensacola) Lake (downriver from JRL) floods an unknown amount of land during these flood events, some of which are used for agricultural purposes. The public perception is that without maximizing the flood-pool capacity of John Redmond Dam, the downriver flooding will continue to be of longer duration and potentially of greater magnitude; however, the increase in downriver flooding would be considered negligible as a significant portion of the flood water below JRL comes from uncontrolled sources. Therefore, the effects of loss in flood control capacity at the John Redmond Dam would be long-term, insignificant, and adverse.

Other potential effects of the implementation of the Phased Pool Storage Reallocation Alternative include effects on surface water quality and quantity, downriver erosion, sedimentation, and dam operations. Based upon the current water quality of the inflowing water to JRL compared to the outflow water quality, an increase in conservation pool elevation would likely result in a negligible reduction of outflow sediment load and an insignificant increase in temperature. A decrease in outflow sediment load would potentially increase the erosion capability of the Neosho River below JRL, causing greater channel incision and a reduction of fine sediments within the river channel. However, due to the out-flow sediment load reduction being negligible, the increased erosion capabilities would also be negligible. Effects on other water quality parameters within JRL would require a more intense hydrology study and would likely be found to improve negligibly. Currently, operation of John Redmond Dam involves the reduction in the conservation pool elevation during winter months from the 1,039.0 to 1,037.0 foot elevation to avoid ice damage to dam structures. An increase in conservation pool elevation to the 1,041.0-foot elevation would potentially result in damage to these structures, however, mitigation measures would likely address this issue.

A potential beneficial effect on hydrology and water resources through the implementation of the Phased Pool Storage Reallocation Alternative is an increase in the volume of water being stored at JRL. The USACE has an agreement with the State of Kansas to provide water storage for industrial and municipal uses annually, and as a result of raising the conservation pool, would be capable of meeting this water supply commitment through the life of the project (2014). There would be long-term, insignificant, adverse (flooding, impacts to dam structure, and increased downriver erosion capabilities), long-term, insignificant, beneficial (improved reservoir water quality), and long-term, significant, beneficial (increased water storage) effects on hydrology or water resources as a result of implementing the Phased Pool Storage Reallocation Alternative. Effects on the logjam would be negligible, but would likely result in increased sedimentation of the area as a result of elevated backwater effects.

Proposed Action: Storage Reallocation

The Proposed Action: Storage Reallocation would result in the same hydrology and water resources environmental consequences as the Phased Pool Storage Reallocation Alternative; therefore, this action would result in long-term, insignificant, adverse (flooding, impacts to dam structure, and increased downriver erosion capabilities), insignificant, beneficial (improved reservoir water quality), and significant, beneficial (increased water storage) effects on hydrology or water resources.

4.4 Biological Resources

Biological resources for the JRL area include vegetation resources or land cover types (Figure 4-2), i.e., woodlands, shrublands, and grasslands; wetland resources; wildlife resources; fisheries and aquatic resources; endangered, threatened, and candidate species, species of special concern, and sensitive communities; and wildlife refuges and wildlife management areas. Environmental concerns pertaining to biological resources include the disturbance, alteration, or destruction of wildlife and plant species and their habitat.

Biological Resources issues identified during the scoping meetings and agency coordination included the following comments:

- The need to preserve Neosho madtom habitat.
- Determine if the increased conservation pool limit KDW&P seasonal pool manipulation plans.
- Raising the conservation pool will adversely impact the KDW&P OCWA (1,600 acres) and make it flood more frequently.
- Animals are being forced out of their habitat because of higher water levels (i.e., increasing crop damage and increasing car/deer accidents).

In addition, the United States Fish and Wildlife Service prepared a Fish and Wildlife Coordination Act report (FWCAR) to address potential consequences of the proposed conservation pool raise. The FWCAR is provided in Appendix F. Finally, a Biological Assessment (BA) was prepared to address threatened, endangered, and candidate species listed by the U.S. Fish and Wildlife Service and the KDW&P (Appendix D).

No Action Alternative

Potential effects on biological resources through the implementation of the No Action Alternative are precluded by the fact that the No Action Alternative for JRL does not involve any activities that would contribute to changes in existing conditions. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on biological resources as a result of implementing the No Action Alternative.

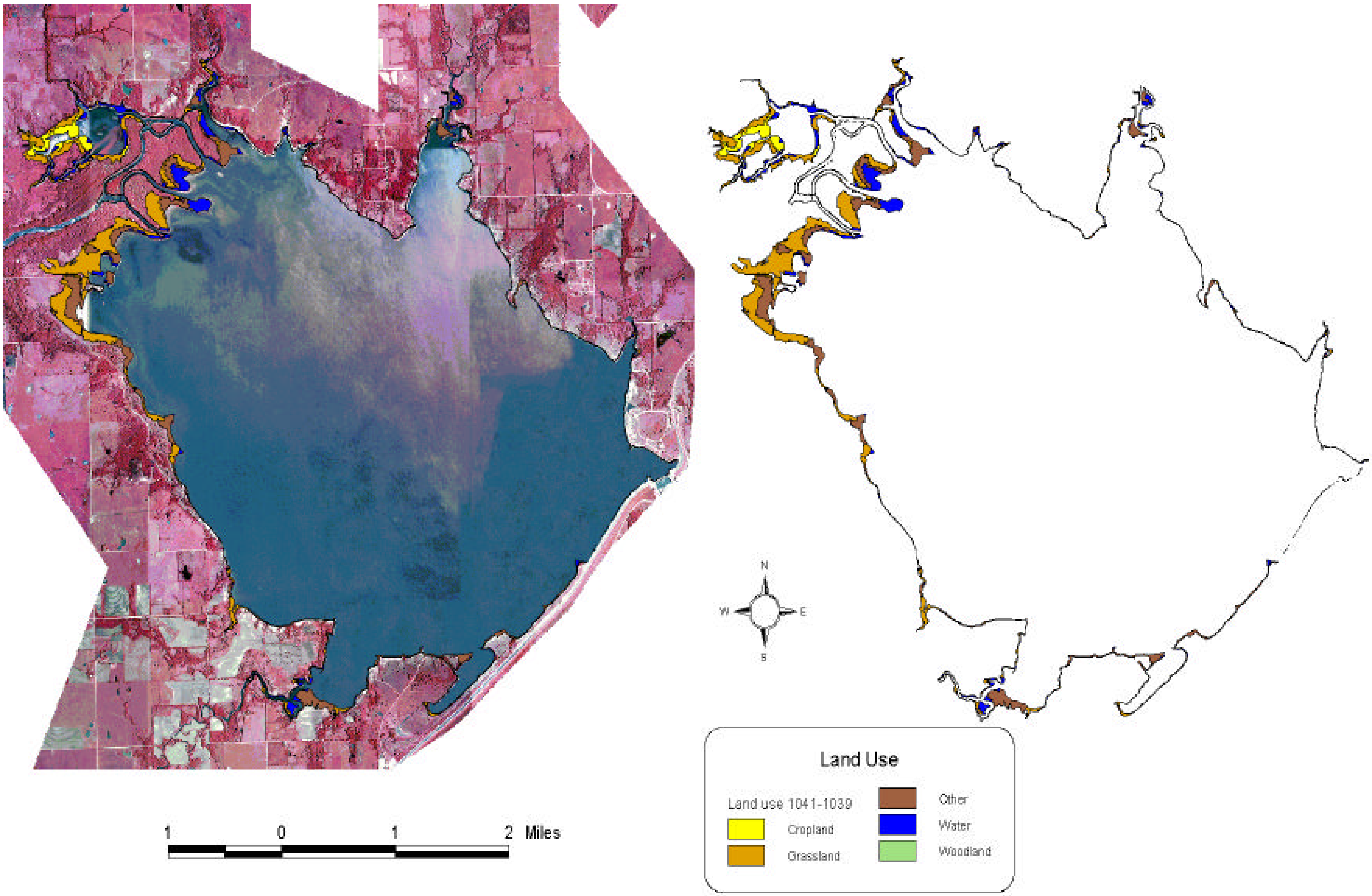

Figure 4-2. Land Cover Types Affected by the Pool Raise to 1,041.0 Feet.

Dredge John Redmond Lake

Potential effects on biological resources through implementation of the Dredge John Redmond Lake Alternative are both beneficial and adverse. The beneficial effect as a result of this alternative is the increased water storage capacity of JRL, which in turn would result in the availability of improved water quality and quantity for downriver releases during drought conditions in the region of the Neosho River. The ability to release better quality water and for a longer duration would substantially aid in the preservation of the fisheries and aquatic wildlife below John Redmond Dam, particularly the benthic macroinvertebrates. This effect is considered long-term, insignificant, and beneficial.

Potential adverse effects for this alternative include the disturbance of the bald eagle population that winters at JRL and other wildlife, redistribution of contaminants, potential for increased exposure risks to wildlife, and increased sediment load of the Neosho River below John Redmond Dam. Depending on the time of year the dredge activities are performed, either anticipated dredge alternative would have the potential to disturb the bald eagle population and other wildlife as a result of the presence and noises of human and heavy equipment activity. In addition, the lake would likely be drained to a significantly lower level to accommodate the excavation and haul dredge method, which would temporarily reduce the fish and waterfowl populations on which the bald eagles feed. Because JRL is not considered critical habitat for the bald eagle, this effect is considered short-term, insignificant, and adverse.

An additional adverse effect of this alternative is the potential to expose wildlife to contaminants that have possibly settled in the lake sediments. Possible contamination of JRL sediments includes pesticides and fertilizers from agricultural activities and lead shot from hunting activities. Disturbed sediments would release the contamination into the water, which could be adsorbed by vegetation and ingested by aquatic wildlife. Waterfowl are particularly susceptible to the accidental ingestion of lead shot, which can be fatal. Wildlife that feed on the vegetation, waterfowl, and aquatic species may also ingest toxins. This effect is considered short-term, insignificant, and adverse.

Dredging, through the siphoning of sediments to a location below JRL, would result in the same contamination-related adverse effects, but would also include adverse effects as a result of increased sediment load and potential contaminants in the Neosho River below John Redmond Dam. The increased sediment load would cover food sources and change riverbed substrate; thereby affecting spawning beds and benthic macroinvertebrate habitat. The Neosho madtom, Neosho mucket mussel, and the rabbitsfoot mussel occupy gravel beds below JRL and prefer gravel bars with minimal silt, and riffles and runs with relatively clear flowing water. Because this alternative would affect federally threatened and State of Kansas threatened and endangered species, this effect is considered long-term significant adverse.

The Dredge John Redmond Lake Alternative would have no short- or long-term, significant or insignificant, adverse or beneficial effects on the following biological resources: vegetation, wetland, terrestrial wildlife, and wildlife refuges and wildlife management areas.

Phased Pool Storage Reallocation

Vegetation resources would be adversely affected through the implementation of the Phased Pool Storage Reallocation Alternative, with the greatest effect being to wetland habitat and woodland types. Approximately 270 acres of wetland habitat (including moist soil units managed by FHNWR), 40 acres of grassland, 51 acres of cropland, and 195 acres of woodland would be inundated by the increase in the conservation pool elevation to the 1,041.0 foot elevation (Figure 4-2). Essentially, the wetlands, consisting of emergent and shrub-scrub vegetation, would be flooded and the new vegetation would become predominately aquatic. Because of the importance of wetlands to the ecological system, the net loss of wetland habitat in excess of one acre is regulated by the federal government, specifically by USACE, and must be mitigated. Therefore, the loss of up to 270 acres of wetland would be considered a long-term, significant adverse effect.

Depending upon the depth of water over the inundated grassland and cropland, these vegetation communities would be drowned and likely altered to either wetland or aquatic vegetation communities. Both the cropland and grassland vegetative communities are common in the vicinity of JRL and their loss would be considered long-term, insignificant, and adverse. The inundation of the flood plain woodland type would result in the drowning of trees and the creation of snags in either wetland or aquatic vegetation environments. Currently, existing snags would topple at a faster rate, from one to three years, due to the inundation from increased water depth and wave action. The newly created snags would stand for approximately five to eight years before toppling (based on observations of other USACE reservoirs). The lower shrubs and small trees associated with the woodlands would also be inundated resulting in additional vegetation loss. The effects on grassland, cropland, and woodland through the implementation of the Phased Pool Storage Reallocation Alternative would be considered short- and long-term, insignificant, adverse, with the potential to be long-term, significant, beneficial if wetland is created through the inundation of the cropland, grassland, and woodland.

Effects on wildlife resources through the implementation of the Phased Pool Storage Reallocation Alternative would result from the loss of terrestrial habitat and the increase in aquatic habitat. The loss of terrestrial habitat around the conservation pool of JRL would have a short-term, insignificant, adverse effect on large and small mammal populations; shore, upland game, and passerine bird populations; and reptiles, amphibians, and insects. Essentially, these wildlife populations would be affected by the decrease in acreage of habitat until new habitat is created, which would take approximately two to five years to develop and five to ten years to mature. Unless similar wildlife management techniques, such as pool elevation management, are employed after the implementation of the Phased Pool Storage Reallocation the shorebird habitat would be greatly reduced. The increase in aquatic habitat would have a short-term, insignificant, beneficial effect on waterfowl and bald eagles. The newly inundated aquatic environment would be rich in nutrients for approximately five to eight years creating an improved food source for fish and waterfowl.

In addition, the snags generated would provide additional shelter for the waterfowl. The bald eagles would benefit from increased populations of waterfowl and fisheries as a food source.

While there would be the toppling of existing snags that the bald eagles use for perches and roosts, there would be additional perching/roosting areas created through the inundation of existing woodlands. There would be no effect on terrestrial wildlife downriver from John Redmond Dam. Impacts on wildlife resulting from the implementation of the Phased Pool Storage Reallocation Alternative are considered short-term, insignificant, adverse and beneficial. There would be no short- or long-term, significant or adverse impacts to wildlife as a result of implementing the Phased Pool Storage Reallocation Alternative.

Effects on fisheries and aquatic resources would occur due to the increase in aquatic habitat generated through the implementation of the Phased Pool Storage Reallocation Alternative. The new aquatic habitat would be high in nutrients and provide shelter for fish and aquatic wildlife for approximately five to eight years (Jirak, pers. com. 2001). The effect on aquatic wildlife through implementation of the Phased Pool Storage Reallocation Alternative would be short–term, insignificant, and beneficial. The beneficial effect on fisheries and aquatic resources in the Neosho River below John Redmond Dam from implementing this alternative result from the increased water storage capacity of JRL This in turn would result in the availability of improved water quality and quantity for downriver releases during drought conditions in the region of the Neosho River. The ability to release better quality water and for a longer duration would substantially aid in the preservation of the fishery and aquatic wildlife below the John Redmond Dam, particularly the benthic macroinvertebrates. This effect is considered long-term, insignificant, beneficial.

As mentioned in the Affected Environment, Section 3-4, of this document, there are several federally and state listed, threatened and endangered species identified in the vicinity of JRL. These species include the bald eagle, peregrine falcon, Neosho madtom, western prairie fringed orchid, Neosho mucket mussel, rabbitsfoot mussel, Ouachita kidneyshell mussel, and flat floater mussel. Of these species, there is only documentation to support that the bald eagle, peregrine falcon, Neosho madtom, Neosho mucket mussel, and rabbitsfoot mussel are located within the affected environment of JRL. The other species have either been extirpated from the area or do not occur there. In addition, the peregrine falcon only passes through the project area during spring and fall migration but does not nest there (FHNWR 2000). Effects on the bald eagle from the implementation of the Phased Pool Storage Reallocation Alternative are short-term, insignificant, and beneficial, as a result of the increased waterfowl and fisheries food source. Effects on the Neosho madtom, Neosho mucket mussel, and rabbitsfoot mussel are associated mostly with the downriver effects on the Neosho River below JRL, and would include improved water quality and available quantity for release during drought conditions in the Neosho River valley. The impact on these species as a result of implementing the Phased Pool Storage Reallocation Alternative would be considered long-term, insignificant, and beneficial. Minor backwater effects to the Neosho madtom may occur.

Effects on wildlife refuges and wildlife management areas from implementing the Phased Pool Storage Reallocation Alternative are described under the vegetation, wildlife, fisheries and aquatic resources, and federally and state listed threatened and endangered species sections above, as they apply to the conservation pool and upriver from JRL. Therefore, the implementation of the Phased Pool Storage Reallocation Alternative would result in short-and long-term, insignificant, beneficial and adverse effects and long-term, significant, adverse effects.

Proposed Action: Storage Reallocation

Effects on biological resources through the implementation of the Proposed Action: Storage Reallocation Alternative would result in the same impacts as the Phased Pool Storage Reallocation Alternative. Essentially, this action would result in the inundation of woodland, cropland, grassland, and wetland, resulting in existing vegetation loss and establishment of new vegetation types, particularly aquatic and palustrine wetland vegetation. The impacts resulting from the proposed action are considered short- and long-term, insignificant, beneficial and adverse effects and long-term, significant, adverse effects.

4.5 Air Quality

Air quality for an area pertains to the condition of the ambient air whether the result of natural or man-made causes. Primary concerns regarding air quality are the impacts on ambient air quality conditions (NAAQS); impacts on attainment or non-attainment areas; and compliance with local, state, and federal implementation plans, including air emission permits.

No Action Alternative

Potential effects on air quality that would result from the No Action Alternative are precluded by the fact that the No Action Alternative for JRL does not involve any activities that would contribute to changes in existing air emissions. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on air quality as a result of the No Action Alternative.

Dredge John Redmond Lake

Depending on the method employed for dredging activities, the Dredge John Redmond Lake Alternative would result in potential short-term, insignificant, adverse effects on air quality. If the activities utilized to dredge JRL consist of the excavation and removal of sediments by hauling, there is the potential to generate particulate matter during the dredging and hauling activities. This potential is dependent upon the timing of the dredging activities and would result in the greatest effects during periods of low precipitation. Short- or long-term, significant, beneficial or adverse effects on air quality are not anticipated as a result of implementing the Dredge John Redmond Lake Alternative.

Phased Pool Storage Reallocation

Potential effects on air quality through the implementation of the Phased Pool Storage Reallocation Alternative are precluded by the fact that the Phased Pool Storage Reallocation Alternative for JRL does not involve any activities that would contribute to changes in existing air emissions. Short- or long-term, insignificant or significant, beneficial or adverse effects on air quality are not anticipated as a result of implementing the Phased Pool Storage Reallocation Alternative.

Proposed Action: Storage Reallocation

The Proposed Action: Storage Reallocation would result in the same air quality environmental consequences as the Phased Pool Storage Reallocation Alternative; therefore, this action would result in no short- or long-term, insignificant or significant, beneficial or adverse effects on air quality.

4.6 Aesthetics

Aesthetics for a location is the product of the appearance of an area to an individual and is highly subjective. Aesthetics are often measured by the visual characteristics of a site or the visibility a location may offer of another site. Potential impacts pertaining to aesthetics include effects of an action on aesthetic character and visual resources within a site or surrounding area. The methodology for determining the significance of an action's impact was based on the identification of sensitive viewsheds, review of site photographs, and evaluation of topographic alterations. Determination of the significance of an action is based on the extent of the alteration to landforms, vegetation, natural appearance, and the project's increased visibility.

No Action Alternative

Potential effects on aesthetics through the implementation of the No Action Alternative are precluded by the fact that the No Action Alternative for JRL does not involve any activities that would contribute to changes in existing site conditions. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on aesthetics as a result of implementing the No Action Alternative.

Dredge John Redmond Lake

The two expected methodologies for the dredging effort are the excavation and hauling of sediments offsite or siphoning of sediments to a location downstream of John Redmond Dam. Employment of the first expected dredging methodology would result in potential effects on aesthetics, particularly in the area of excavation and hauling activities and placement of dredge materials. Depending on the selected location for the excavated sediments, there would be a potential for effects on aesthetic character and visual resources through the changing of the topography in the vicinity of JRL. In addition, excavation and hauling activities would likely result in the temporary drainage of JRL, the creation of temporary haul roads, and the presence of heavy construction equipment and trucks. Dredging of sediments through siphoning could potentially result in the creation of a heavy sediment load in the Neosho River downriver from JRL, and would likely result in the creation of sandbars and changes in the river course. Effects on aesthetics through the implementation of the Dredge John Redmond Lake Alternative would be considered, but the sediment placement location and methodology would need to be reviewed. Short- or long-term, significant, beneficial or adverse impacts to aesthetics are not expected as a result of implementing the Dredge John Redmond Lake Alternative.

Phased Pool Storage Reallocation

Effects on aesthetic character and visual resources through the implementation of the Phased Pool Storage Reallocation Alternative would primarily be the result of the alteration to vegetation, particularly regarding inundation of the riparian woodlands near the inlet of JRL. Currently, the trees associated with this habitat are inundated for a period of approximately three months annually; however, an increase of the conservation pool elevation to the 1,041.0-foot elevation would result in the flooding of 195 acres of this woodland. As a result, inundated woodland stands would drown, leaving snags. These snags would stand for approximately eight to ten years before they would topple, thereby minimizing the impact to aesthetic character of the site. On a lesser scale, the lower shrublands, grasslands, and wetlands along the perimeter of JRL, with particular concentration near the inlet of the Neosho River, would also be inundated resulting in drowned vegetation; however, because this vegetation is less visible, this effect would be less of an impact on the aesthetic character of the site. Impacts resulting from the implementation of the Phased Pool Storage Reallocation Alternative are considered short-term, insignificant, and adverse. Short- or long-term, significant, beneficial or adverse impacts to aesthetics are not expected as a result of implementing the Phased Pool Storage Reallocation Alternative.

Proposed Action: Storage Reallocation

Effects on aesthetic character and visual resources through the implementation of the Proposed Action: Storage Reallocation would result in the same impacts as the Phased Pool Storage Reallocation Alternative. Essentially, this action would result in the inundation of woodlands, shrublands, grasslands, and wetlands, resulting in drowned vegetation. These impacts to aesthetics would be minimized in approximately eight to ten years when the snags would topple. The impacts resulting from this action are considered short-term, insignificant, and adverse. There would be no short- or long-term, significant or adverse impacts to aesthetics as a result of implementing the Proposed Action: Storage Reallocation.

4.7 Prime or Unique Farmlands

No Action Alternative

Potential effects on prime or unique farmlands through the implementation of the No Action Alternative are precluded by the fact that the No Action Alternative for JRL does not involve any activities that would contribute to changes in existing conditions. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on prime or unique farmlands as a result of implementing the No Action Alternative.

Dredge John Redmond Lake

The two expected methodologies for the dredging effort are the excavation and hauling of sediments offsite or siphoning of sediments to a location downriver of John Redmond Dam. Depending on the method selected for the dredging activities, the Dredge John Redmond Lake Alternative would result in potential effects on prime or unique farmlands; particularly in the area of the placement of dredge materials. Due to most of the Neosho River Valley being classified as prime or unique farmlands, the selected location for the dredge materials would likely bury prime or unique farmlands. The excavation and hauling of lake sediments would result in a long-term, insignificant, adverse effect because of the abundance of additional prime and unique farmlands in the area. The dredge method incorporating siphoning would not result in short- or long-term, insignificant or significant, beneficial or adverse effects on prime or unique farmlands.

Phased Pool Storage Reallocation

The majority of the soils in the vicinity of the Neosho River valley are delineated as potentially prime or unique farmlands, and raising the JRL conservation pool would result in flooding approximately 405 acres of such soils (Figure 4-1). However, currently the conservation pool is allowed to remain at the final phased pool storage-reallocation elevation of 1,041.0 feet above sea level for a period of at least three months annually. Therefore the use of these soils as prime or unique farmlands has already been compromised. This was iterated by the USDA-NRCS as well, in their response to the FPPA coordination letter submitted for this project (Appendix E). In addition, these soils are currently being intermixed with sediments of the Neosho River due to wave action and flooding under the present JRL conditions. In addition, these soils are currently being intermixed with sediments of the Neosho River due to wave action and flooding under the present JRL conditions.

Potentially prime or unique farmland soils are located downriver of JRL in the Neosho River Valley and the Phased Pool Storage Reallocation Alternative would reduce the flood control capacity of the John Redmond Dam by approximately 3.18 percent, resulting in a negligible increase in flooding of these soil resources. The effects of flooding these soils would be long-term, insignificant, adverse. Based on the nature of the prime or unique farmlands associated with the JRL site and vicinity, implementation of the Phased Pool Storage Reallocation Alternative would result in long-term, insignificant, and adverse effects downriver.

Proposed Action: Storage Reallocation

The Proposed Action: Storage Reallocation would result in the same prime or unique farmlands environmental consequences as the Phased Pool Storage Reallocation Alternative; therefore, this action would result in long-term, insignificant, adverse effects both within the conservation pool and downriver.

4.8 Socioeconomic Resources

Potential socioeconomic impacts of the Proposed Action and alternatives include effects on economic and demographic conditions, recreation, land use, transportation, and agricultural activities in the Neosho River basin below JRL.

Socioeconomic issues identified during scoping and agency coordination include the following:

- Potential damage to crops in the vicinity of JRL (both from the raised reservoir level and from wildlife forced out of FHNWR and OCWA);
- Isolation of farm lands near JRL resulting from increased inundation of easement lands;
- Damage to land and crops within the Neosho River flood plain below JRL associated with increased duration and frequency of flood events;
- Effects on recreation resources on JRL, FHNWR, and OCWA;
- Backwater effects on the SH-130 bridge north of JRL;
- Economic and land-use effects of dredging; and
- Effects on end-users of water sold to the KWO under the No Action Alternative.

4.8.1 Economic and Demographic Conditions

No Action Alternative

Under the No Action Alternative, the role played by JRL in local economic and demographic conditions would remain unchanged during normal rainfall years. However, during severe drought years, direct effects of the No Action Alternative would include potential loss of a portion of the water supply for the CNRB and for KG&E's Wolf Creek Nuclear Power Generation Station.

Continued siltation of JRL is expected to reduce the water supply capacity of the conservation pool by 25 percent at the 50-year design life of the reservoir. CNRB contracts for storage of 10,000 acre-feet in Marion Lake, Council Grove Lake, and JRL. JRL stores 3,500 acre-feet of the total. The reduction of 25 percent of JRL storage capacity at design life would represent a loss of about 9 percent of the district's total water storage allocation of 10,000 acre-feet (assuming constant supply levels in the other two lakes). The 21 municipalities and industries in the district are directly dependent upon water provided from assurance storage during times of low stream flow. In severe drought years, this 9 percent reduction in water storage could result in loss of water supply for communities, rural users, and industries in CNRB. Depending on the severity and duration of the drought, indirect impacts could include economic distress for commercial and industrial users, hardship for residential users, and a reduction in the amount of water available for fire suppression and other municipal purposes.

The conservation pool at JRL also stores an annual 9,672 MGY of water supply for use by KG&E in supplementing the cooling lake at its WCGS. This supplemental source of water is necessary because evaporation in most years is greater than inflow in the WCGS cooling lake. The loss of 25 percent of water storage would reduce the amount available to meet the WCGS water supply contract by a corresponding amount. Although WCGS has not used its full water allotment since filling the cooling lake, it has used as much as 74 percent (1991). The 25 percent reduction in water available for cooling purposes at WCGS could reduce KG&E's ability to operate the plant during years when additional water capacity is needed.

Effects of the No Action Alternative on area economic and demographic conditions would be short- or long-term, significant, and adverse depending on the severity and duration of a drought.

Dredge John Redmond Lake

For this assessment, it is assumed that an amount of sediment equal to 25 percent of the 34,900 acre-feet of contracted water storage on JRL, or 8,725 acre-feet would be dredged. Cost estimates for the Dredge John Redmond Lake Alternative have not been prepared, but a KWO estimate of dredging costs from small lakes in South Dakota is $5,600 per acre-feet of sediment removed (Lewis, pers. com. 2001b). Using this estimate, a total cost of about $49 million could be anticipated for mechanical dredging of JRL. Actual costs could vary depending on such factors as economies of scale, dredging methods, location of the disposal area for dredged material, and composition of the sediment. If JRL sediment is found to contain hazardous substances, the cost of disposal could increase.

The Dredge John Redmond Lake Alternative would result in additional economic activity in Coffey and Lyon Counties, in terms of direct and indirect employment and income. Direct employment and income would occur if local contractors and/or workers were selected to perform portions of the dredging work. Indirect employment and income would result from local expenditures by dredging contractors and employees for goods and services.

Depending on the location of the sediment disposal site, the Dredge John Redmond Lake Alternative has the potential to affect land use and transportation conditions in Coffey and/or Lyon Counties. Dredging activities could negatively affect recreation activities on JRL, FHNWR, and OCWA by disturbing fish and wildlife and diminishing the quality of the recreation experience. A reduction in recreation visits would have a corresponding negative effect on the local tourism and recreation economy. These short-term impacts would be localized and cease upon completion of dredging activities. In the long term, impacts on recreation activities would be positive, as water depth to bottom of the lake would increase, providing additional boating access.

The effects of this alternative on area economic and population conditions would likely be beneficial although there could be some minor reduction in recreation-related spending in the county. If local contractors and employees were hired, this alternative would be significantly beneficial to the area economy in the short term. Over all, the Dredge John Redmond Lake Alternative would result in short-term, significant, beneficial effects on economic and demographic conditions

Storage Reallocation in a Phased Pool Raise

Raising the conservation pool in JRL in a phased pool raise culminating at 1,041.0 feet would more frequently flood some portions of the USACE-managed lands adjacent to JRL, FHNWR, and OCWA. Although this flooding may affect certain land uses and activities on these lands, the phased raise in the conservation pool level would not substantially affect economic and population conditions in Coffey and Lyon counties. None of the managing agencies would alter operating levels as a result of the Phased Pool Raise Alternative, although there may be some replacement of roads and facilities that would be more frequently inundated. Because the affected roads and facilities are routinely inundated at the 1,041.0-foot level and above during rainfall impoundment and implementation of the water level management plan, replacement of roads and facilities is anticipated to be relatively minimal. Consequently, the affect of the Phased Pool Storage Reallocation Alternative on area economic and demographic conditions would be long-term, insignificant, and adverse.

Proposed Action: Storage Reallocation

The effects of the Proposed Action: Storage Reallocation on local economic and demographic conditions would be identical to those of the Phased Pool Storage Reallocation Alternative at the culmination of the pool raise. Therefore, the Proposed Action: Storage Reallocation would result in long-term, insignificant, adverse effects on economic and demographic conditions.

4.8.2 Land Use

No Action Alternative

The No Action Alternative would not affect land-use conditions as described in Section 3.8.2. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on land use resources as a result of implementing the No Action Alternative.

Dredge John Redmond Lake

Under the Dredge John Redmond Lake Alternative, land use associated with JRL would remain similar to existing conditions with three possible exceptions. A relatively small portion of land would be required for a staging area during dredging operations. Staging operations would displace existing land use for the duration of dredging operations, after which the land would be reclaimed.

Mechanical dredging would require land for disposal of sediment and perhaps construction of a haul road. Neither a disposal site or haul route has been identified. Sediment disposal would displace existing land use for the duration of dredging activities and perhaps permanently, depending on the reclamation plan for the site.

Land use effects of the Dredge John Redmond Lake Alternative would be short-term, insignificant, and adverse. However, depending on composition of the sediment, and the selection of a disposal site and haul route, land-use effects could be long-term, significant, adverse. These impacts cannot currently be addressed.

Phased Pool Storage Reallocation Alternative

Based on an assessment of the Kansas Biological Survey (KBS) GIS database, the Phased Pool Storage Reallocation Alternative would routinely inundate an additional 556 acres of land surrounding JRL. This would be about 2 percent of the 29,801 acres of land owned by the USACE when the 1,041.0-foot conservation pool level is reached. At the conservation pool level of 1,041.0 feet, lands in the following categories would be inundated (Randolph, pers. com. 2001):

- 51 acres of croplands,
- 40 acres of grasslands
- 195 acres of woodland,
- 166 acres of water (ponds and streams),
- 270 acres of shrub-scrub, palustrine wetland, and aquatic plant communities.

The 405 acres of potentially farmable land was coordinated with the Natural Resources Conservation Service (NRCS) using a Farmland Conversion Impact Rating Form (AD-1006, 1997). Coordination with the NRCS is required under the Farmland Protection Policy Act (NRCS 1981). Correspondence for this coordination is presented in Appendix E.

Although the Phased Pool Storage Reallocation Alternative would result in long-term loss of these lands for recreation use, wildlife forage, and habitat, the loss represents only a marginal change over existing conditions. Historically, these lands have been routinely inundated for periods of up to several months during rainfall impoundment and during implementation of the JRL water level management plan. The affected land represents a relatively small amount of the total land area associated with JRL and given the existing frequency of flooding, these losses would be long-term, insignificant, and adverse.

The 51 acres of croplands affected by the Phased Pool Raise Alternative are routinely flooded under existing conditions and, therefore, are difficult to lease. Consequently, removal of these lands from crop production would not substantially affect farming income or economic conditions in the two-county area, and would only minimally reduce forage for wildlife.

However, lands adjacent to the 1,041.0-foot level, which are less frequently affected by rainfall impoundment and water level management actions may be more routinely flooded or flooded for slightly longer periods of time. Such events may temporarily affect the use of the land for wildlife forage and habitat and for recreation purposes. It also may result in an increase of the amount of cropland that is difficult to lease because of flooding. The Phased Pool Storage Reallocation Alternative would also inundate a boat ramp, parking area, and portions of an access road at the Jacob's Creek area.

Because the elevation of the flood pool would not be raised, land use on private lands adjacent to JRL, FHNWR, and OCWA would not be affected by implementation of the Phased Pool Storage Reallocation Alternative. However, raising of the conservation pool would result in a slight increase in frequency and duration of flooding of a portion of JRL flood easements. It may also slightly increase the frequency and duration of periods when farmers are unable to access lands because easements are flooded. Land-use impacts of the Phased Pool Storage Reallocation Alternative would be long-term, insignificant, beneficial, and adverse.

Proposed Action: Storage Reallocation

The land-use impacts of the Proposed Action: Storage Reallocation would be identical to the Phased Pool Storage Reallocation Alternative at the culmination of the pool raise; therefore, the effects would be long-term, insignificant, beneficial, and adverse.

4.8.3 Recreation

No Action Alternative

Potential effects on recreation resources associated with the No Action Alternative would be limited to a continued deterioration of boating conditions, as the depth to bottom in portions of the reservoir would continue to be reduced by siltation. The effect of the No Action Alternative on recreation resources would be long-term, insignificant, adverse.

Dredge John Redmond Lake

Impacts on recreation resources and activities would result from noise and activity in the vicinity of the dredge site, staging area, disposal site, and along the haul route. The noise and associated activities may displace wildlife and result in a diminished recreation experience for some users. Some recreation facilities and wildlife habitat could be temporarily displaced by the staging area, haul route, and sediment disposal site. The Dredge John Redmond Lake Alternative would have a short-term, insignificant, adverse effect on recreation resources.

Phased Pool Storage Reallocation Alternative

Recreation resources and activities under the Phased Pool Storage Reallocation Alternative would be similar to existing conditions with the following relatively minor exceptions:

- Larger numbers of fish may be present for the five to eight-year period following the water level raise because of improved habitat amongst the water-covered vegetation. The increase in fishing opportunities would be primarily limited to catfish, as other sportfish species may be affected by high flows during releases.

- Similarly, increased numbers of waterfowl species should be present on the lake during the fall, responding to improved habitat in the water-covered vegetation. The larger waterfowl population would likely attract more hunters.

- Shorebird watching activities could be adversely affected if the water level management plan does not include a reduction in water level during shorebird migration (July and August).

- The slight potential for more frequent inundation of lands adjacent to JRL could concentrate deer in the outer portions of FHNWR and OCWA, making them more vulnerable to hunters during hunting season and potentially more vulnerable to vehicle collisions at any time. It is also possible that displaced deer could forage on private lands, resulting in economic loss for farmers. Given the relatively small land area that would be flooded by the Phased Pool Storage Reallocation Alternative, these effects are anticipated to be minimal.

- The two-foot increase in depth to bottom at the culmination of the pool raise should make the lake somewhat more attractive to boaters.

- A boat ramp, parking lot, two dikes and outlet works, and portions of an access road in FHNWR would be inundated and unavailable for use.

The effects on recreation resources associated with the Phased Pool Storage Reallocation Alternative would be short-term, insignificant, beneficial, and adverse.

Proposed Action: Storage Reallocation

The effects of the Proposed Action: Storage Reallocation on recreation resources would be identical to those of the Phased Pool Storage Reallocation Alternative at the culmination of the pool raise. Therefore, the Proposed Action: Storage Reallocation would result in short-term, insignificant, adverse effects on recreation resources.

4.8.4 Economic Effects of John Redmond Lake

No Action Alternative

Under the No-Action Alternative the economic effects of JRL would be similar to the descriptions in Section 3.8, with the exception of those associated with water storage and supply. The diminished capacity of the conservation pool would mean that the USACE could not guarantee the fulfillment of its water storage and supply contracts with the KWO. In severe drought years, when full water supply commitments are required, the member communities, rural water districts, and industrial users in the CNRB could experience economic losses from the 9-percent reduction in committed water supply. KG&E could also experience economic losses associated with the 25-percent reduction in water to supplement the cooling lake at WCGS. The effects of the No Action Alternative on JRL would be short- or long-term, significant, and adverse depending on the severity and duration of a drought.

Dredge John Redmond Lake

The Dredge John Redmond Lake Alternative would increase economic activity in Coffey and Lyon counties from the expenditures associated with project cost (estimated at $49 million using costs from another project). The amount accruing to the local economy would depend on the number of local contractors and employees hired to perform portions of the project and on the amount of goods and services contractors and employees obtain from local vendors. These economic benefits could be offset by a reduction in recreation activities related to impacts of dredging activities on wildlife and on the recreation experience. However, in the aggregate, the effects of the Dredge John Redmond Lake Alternative would be short-term, significant, and beneficial.

Storage Reallocation in a Phased Pool Raise

Raising the conservation pool by two feet would result in a corresponding reduction in the capacity of the flood control pool. However, based on results of the USACE SUPER model, this reduction is estimated at less than 3.18 percent of total flood pool capacity (see Section 3.3.3). Although this reduction could contribute to slightly more frequent releases of water and releases of slightly longer duration, the USACE anticipates no discernable difference in discharge duration or in exceedence frequency of maximum day discharge between conservation pool elevations at 1,039.0, 1,040.0, 1,040.5, and 1,041.0 feet (see Section 3.3). In the case where releases from JRL combine with downstream rainfall and runoff to create flooding, the contribution of the reduction in flood control pool at JRL would be minimal. Consequently, the Phased Pool Storage Reallocation Alternative would minimally diminish the economic value of flood control in cases when releases at JRL are dictated by the design capacity of the facility. The reduction in flood control capabilities would have a long-term, insignificant, adverse affect on local economic conditions.

The Phased Pool Storage Reallocation Alternative would allow the USACE to continue to fulfill contractual obligations with the KWO for water storage and supply. Consequently, economic aspects of water storage and supply would remain as described in Section 3.8.4. This effect would be long-term, significant, and beneficial.

Because recreation resources, particularly waterfowl and fishing habitat, would be slightly enhanced for five to eight years under the Phased Pool Storage Reallocation Alternative, the beneficial economic effects of recreation activities would be negligibly increased during this short-term period. Therefore, the economic effects of the Phased Pool Storage Reallocation Alternative on JRL would be long-term, insignificant, adverse and short- and long-term, significant, beneficial, and adverse.

Proposed Action: Storage Reallocation

The economic effects of the Proposed Action: Storage Reallocation would be identical to those of the Phased Pool Storage Reallocation Alternative at the culmination of the pool raise. Therefore, the effects would be long-term, insignificant, adverse, and short- and long-term, significant, beneficial, and adverse

4.8.5 Land and Crops within the Flood Plain Downriver from JRL

According to the scoping record and subsequent interviews conducted for this assessment, the primary concern raised by residents downriver of JRL is the loss of flood pool capacity, which would result from a raise in the conservation pool level. Specific issues include: a concern for riverbank caving and resultant loss of land, increased duration and frequency of flooding associated with diminished flood pool capacity in JRL, and the resultant damage to crops and pecan orchards. Concern was also raised that any increase in the frequency and duration of flooding would exacerbate riverbank caving and flooding in and near the City of Burlington.

No Action Alternative

The No Action Alternative would not affect land or crops within the flood plain downriver from JRL because the conservation pool elevation would remain at the 1,039.0-foot level. The potential for flooding of lands within the flood plain between JRL and Grand (Pensacola) Lake would be unaffected by the No Action Alternative. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on land or crops within the flood plain downstream from JRL as a result of the No Action Alternative.

Dredge John Redmond Lake

The effects of the Dredge John Redmond Lake Alternative on lands within the flood plain between JRL and Grand (Pensacola) Lake would be negligible. Because the conservation pool elevation would remain at 1,039.0 feet, the potential for flooding would be unaffected by this alternative.

Storage Reallocation in a Phased Pool Raise

Raising the conservation pool elevation by two feet would result in a loss of less than 3.18 percent of flood pool capacity. The results of the USACE SUPER model runs used for this assessment indicate that although the amount of downstream discharge from JRL would increase, there would be no discernable difference in discharge duration or in exceedence frequency of maximum daily discharge between conservation pool elevations at 1,039.0, 1,040.0, 1,040.5, and 1,041.0 feet (see Section 3.3). Based on the USACE SUPER model findings, the contribution of the two-foot raise in the conservation pool to flood events would be minimal. Therefore, no significant adverse economic or land-use effects of the Phased Pool Storage Reallocation Alternative are anticipated to occur in the flood plain downstream of JRL. However, flooding of agricultural lands and pecan orchards will likely continue to occur under the Phased Pool Storage Reallocation Alternative (or any of the alternatives considered for this assessment).

The effects of the Phased Pool Raise Alternative on lands within the Neosho River flood plain would be considered long-term, insignificant, and adverse.

Proposed Action: Storage Reallocation

The effects of the Proposed Action: Storage Reallocation on lands in the flood plain between JRL and Grand (Pensacola) Lake would be identical to those of the Phased Pool Storage Reallocation Alternative at the culmination of the pool raise. Therefore, the effects would be considered long-term, insignificant, and adverse.

4.8.6 Transportation

No Action Alternative

The No Action Alternative would not affect existing area transportation conditions. Consequently, transportation conditions in and adjacent to JRL, FHNWR, and OCWA would remain essentially as they are today under this alternative. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on transportation conditions as a result of the No Action Alternative.

Dredge John Redmond Lake

The effects of the Dredge John Redmond Lake on area transportation conditions would be dependent on the dredging method and the selection of a sediment disposal site. If a disposal site on JRL, FHNWR, or OCWA lands were selected, roads internal to these facilities would be affected. If a disposal site on private lands were selected, the haul program could also affect county roads and state and federal highways. Affects of the haul program would include accelerated maintenance demands resulting from increased heavy truck traffic, and increased potential for accidents. The effects of this alternative on transportation conditions could occur both within and outside of federal lands, and would be short-term, insignificant, and adverse.

Storage Reallocation in a Phased Pool Raise

The elevation of the flood pool would remain unchanged; therefore, the Phased Pool Raise Alternative would not affect area highways and county roads, including the bridge on SH-130 north of JRL. Access roads within the affected 2 percent of federal lands (JRL, FHNWR and OCWA) would be flooded. Some roads immediately adjacent to the affected lands would be more frequently flooded during rainfall impoundment and implementation of water level management plans These effects would be long-term, insignificant, and adverse, with mitigation measures.

Proposed Action: Storage Reallocation

The effects of the Proposed Action: Storage Reallocation on area transportation conditions would be identical to those of the Phased Pool Storage Reallocation Alternative at the culmination of the pool raise. Therefore, the effects would be long-term, insignificant, and adverse, with mitigation measures.

4.8.7 Environmental Justice (EO 12898)

Executive Order (EO) 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" was published in the *Federal Register* (59 FR 7629) (1994). EO 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations (defined as those living below the poverty level).

The potentially affected areas for the Proposed Action and alternatives include Coffey and Lyon Counties, and counties in the Neosho River drainage below JRL, including Allen, Anderson, Bourbon, Cherokee, Crawford, Labette, Neosho, Wilson, and Woodson.

Table 4-2 displays minority and poverty status for the State of Kansas and potentially affected counties. The percentage of racial minorities in every affected county except Lyon County is well below the statewide average for minority populations. In Lyon County, the minority population is concentrated in the City of Emporia. In contrast, the percentage of people living below the poverty level in every affected county is greater than the statewide percentage.

The conclusion of this assessment is that none of the alternatives considered would result in significant adverse effect for human populations, with the possible exception of the Dredge John Redmond Reservoir alternative. This alternative could have adverse impacts if the sediments were found to contain hazardous components. Consequently, because adverse health or environmental consequences are not anticipated for any human populations under any alternative (with the possible exception of the Dredge John Redmond Lake Alternative), minority and low-income persons would not be disproportionately affected by the implementation of any of the alternatives contained in the assessment.

Table 4-2. Minority and Persons Living Below Poverty Level: State of Kansas and Counties in the Neosho River Watershed

	Percent Minority (2000)	Percent Below Poverty Level (1995)
State of Kansas	13.9	11.0
Allen County	5.2	15.3
Anderson County	2.6	12.9
Bourbon County	5.9	17.8
Cherokee County	7.7	17.5
Coffey County	3.0	10.3
Crawford County	6.7	16.9
Labette County	10.7	15.3
Lyon County	16.7	13.3
Neosho County	5.1	14.7
Wilson County	3.2	15.0
Woodson County	3.0	15.0

(Source: US Bureau of the Census: 2000 Decennial Census and Small Area Income and Poverty Estimates Program, February 1999)

4.8.8 Protection of Children (EO 13045)

EO 13045, “Protection of Children from Environmental Health Risks and Safety Risks,” was signed during 1997. The policy of the EO states that each federal agency:

1. Shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and

2. Ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

EO 13045 defines environmental health risks and safety risks as "… risks to health or to safety that are attributable to products or substances that the child is likely to come in contact with or ingest, such as the air we breathe, the food we eat, the water we drink or use for recreation, the soil we live on, and the products we use or are exposed to."

No health and safety impacts resulting from exposure to environmental contamination or hazardous materials have been identified for the No Action Alternative, Phased Pool Storage Reallocation Alternative, or Proposed Action: Storage Reallocation. The composition of JRL sediments is insufficiently known; therefore, the Dredge John Redmond Reservoir Alternative has the potential to expose contamination. Potential disposal sites and haul routes for the sediment have also not been identified. Therefore, it is not currently possible to assess potential effects of this alternative on the health of children.

4.9 Cultural Resources

This section addresses potential effects of the proposed action and alternatives on cultural resources located on the shoreline of JRL and on the Neosho River banks downstream of the lake. For evaluation purposes, the cultural resources under concern are subsumed under the category of "site" as defined by the NRHP: the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself possesses historic, cultural, or archaeological value regardless of the value of any existing structure (NRHP 1997).

Whether significance has been demonstrated or never assessed, the evaluation of impacts on cultural resources was made using NRHP criteria for eligibility (36 CFR 60.4). Eligible sites are those that:

- are associated with events that have made a significant contribution to the broad patterns of our history;
- are associated with the lives of persons significant in our past;
- embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; and/or
- have yielded, or may be likely to yield, information important in prehistory or history.

Adverse effects on cultural resources may include, but are not limited to (36 CFR 800.5 (2):

- physical destruction or damage to the property;
- alteration of the character of a property;
- neglect of a property which causes its deterioration; and/or
- transfer, lease, or sale of a property without enforceable conditions to ensure preservation.

Effects such as these are weighed against the criteria of eligibility to determine the significance of the impact. Consideration includes reasonably foreseeable short-term and long-term effects (36 CFR 800.5(a)(1)).

The primary concern for cultural resources on the JRL shoreline and the Neosho River banks downstream is ongoing and future erosion caused by flooding and bank caving. A number of downstream sites were reported as actively eroding by Schmits in 1973. The effects of recreational use and vandalism are considered, currently, to have minimal effect. Agriculture uses are, for the most part, conducted along the river corridor but away from the riverbanks and near-riverbank areas that support narrow to broad, linear riparian forests. Such practices are, therefore, considered to have minimal effect on cultural resources.

A total of 36 sites were identified within the areas of potential effects. Sites on the JRL shoreline include: 14CF101, 14CF102, 14CF103, 14CF105, and 14CF311/313. Sites on the Neosho River banks downstream are: 14CF8, 14CF9, 14CF10, 14CF11, 14CF12, 14CF13, 14AN6, 14NO6, 14NO7, 14NO8, 14NO9, 14NO10, 14NO11, 14NO376, 14NO398, 14LT9, 14LT10, 14LT11, 14LT12, 14LT355, 14CH60, 14CH61, 14CH62, Bridge 1, Bridge 2, OHHS-OT10, GLO 1, GLO 2, GLO 3, GLO 4, and GLO 5.

No Action Alternative

The No Action Alternative would not affect the present flow characteristics of the Neosho River below John Redmond Dam, and existing flows would eventually result in the destruction of at least some of the cultural resource sites downstream. There would be no short- or long-term, significant beneficial or adverse effects on cultural resources downstream from John Redmond Dam as a result of this alternative. Sites on the JRL shoreline would continue to suffer from erosion episodes to various degrees and over a long period of time would be destroyed. Potential effects of the implementation of the No Action Alternative are identified as long-term, insignificant adverse impacts downstream of John Redmond Dam, and long-term, significant, adverse impacts on JRL shoreline sites.

Dredge John Redmond Lake Alternative

The Dredge John Redmond Lake Alternative would not affect the present flow characteristics of the Neosho River below John Redmond Dam. Existing flows would eventually result in the destruction of at least some of the cultural resource sites downstream. There would be no short- or long-term, significant, beneficial or adverse effects on cultural resources downstream from John Redmond Dam as a result of this alternative. JRL shoreline sites would continue to suffer from erosion episodes to various degrees and over a long period of time would be destroyed. Dredging activities, transportation, and disposal of sediments may also adversely impact cultural resources on the JRL shoreline. Potential effects of the implementation of the Dredge John Redmond Lake Alternative are identified as long-term, insignificant adverse impacts downstream of John Redmond Dam, and long-term, significant, adverse impacts on JRL shoreline sites.

Phased Pool Reallocation Alternative

The Phased Pool Reallocation Alternative would not affect the present flow characteristics of the Neosho River below John Redmond Dam. The existing flows would eventually result in the destruction of at least some of the cultural resource sites downstream. There would be no short- or long-term, significant, beneficial or adverse effects on cultural resources downstream of the John Redmond Dam as a result of implementing the Phased Pool Storage Reallocation Alternative. JRL shoreline sites would experience short- and long-term, significant, adverse effects in the form of semi-permanent to permanent inundation and would most likely be destroyed as a result of the Phased Pool Storage Reallocation Alternative.

Proposed Action: Storage Reallocation

The Proposed Action: Storage Reallocation would result in the same cultural resource environmental consequences as the Phased Pool Storage Reallocation Alternative. There would be no short- or long-term, significant, beneficial or adverse effects on cultural resources downstream of John Redmond Dam. There would be short- and long-term, adverse effects on JRL shoreline sites in the form of semi-permanent to permanent inundation, and the sites would most likely be destroyed as a result of implementing the Proposed Action: Storage Reallocation.

4.10 Hazardous, Toxic, or Radiological Wastes

Environmental concerns pertaining to hazardous, toxic, or radiological wastes consist of impacts to storage and disposal of these materials; spill contingency, waste management, and pollution prevention; asbestos, radon, lead-based paint, PCBs, and radioisotopes; ordinance use and disposal; and storage tanks.

No Action Alternative

Potential effects on hazardous, toxic, or radiological wastes through the implementation of the No Action Alternative are precluded by the fact that the No Action Alternative for JRL does not involve any activities that would contribute to changes in existing conditions. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on hazardous, toxic, or radiological wastes as a result of implementing the No Action Alternative.

Dredge John Redmond Lake

Potential effects on hazardous, toxic, or radiological wastes through the implementation of the Dredge John Redmond Lake Alternative would be a result of the disturbance of lake sediments. As a result of the historic use of JRL as a hunting location for waterfowl there is a potential for lead contamination of the lake sediments. In addition, being located within an agricultural region, JRL has the potential of having pesticide and fertilizer contamination of sediments. This potential contamination could be disturbed, thereby, creating the ability for the lead to leach out of the lake sediments into the waters of JRL when it is refilled following the dredging activities. Also, waterfowl tend to accumulate lead pellets in their gizzard while foraging, resulting in death. There is also the potential that excavated sediments will contain lead and would affect the site selected for sediment disposal. The effects of implementing the Dredge John Redmond Dam Alternative on hazardous, toxic, or radiological wastes would be short-term, insignificant, adverse.

Phased Pool Storage Reallocation

Potential effects on hazardous, toxic, or radiological wastes through implementation of the Phased Pool Storage Reallocation Alternative are precluded by the fact that the Phased Pool Storage Reallocation Alternative for JRL does not involve any activities that would contribute to changes in existing conditions affecting these wastes. There would be no short- or long-term, insignificant or significant, beneficial or adverse effects on hazardous, toxic, or radiological wastes as a result of implementing the Phased Pool Storage Reallocation Alternative.

Proposed Action: Storage Reallocation

The Proposed Action: Storage Reallocation would result in the same hazardous, toxic, or radiological wastes environmental consequences as the Phased Pool Storage Reallocation Alternative; therefore, there would be no short- or long-term, insignificant or significant, beneficial or adverse effects on hazardous, toxic, or radiological wastes as a result of implementing the Proposed Action: Storage Reallocation.

4.11 Cumulative Impacts

Cumulative impacts on environmental resources result from incremental impacts of an action when combined with other reasonably foreseeable future actions. Cumulative impacts can result from individually insignificant, but collectively significant, actions undertaken over the same period of time by individuals or various agencies (federal, state, and local). In accordance with NEPA, consideration of cumulative impacts resulting from projects that are proposed, under construction, recently completed, or anticipated to be implemented in the near future is required.

Although growth and development are expected to continue in the vicinity of JRL, cumulative adverse impacts on resources would not be expected when added to the impacts of activities associated with the Proposed Action or Alternatives.

4.12 Comparison of Alternatives and Conclusion

Based upon the comparison of the Proposed Action and the Alternatives (Table 4-2), the environmentally preferred action is the No Action Alternative, where there is the least amount of environmental impacts. Dredging of John Redmond Lake would primarily result in short- and long-term, insignificant, adverse impacts depending upon the mitigation measures employed. Storage Reallocation, whether the Proposed Action or the alternative would primarily result in short- and long-term, insignificant, beneficial, and adverse effects and a long-term, significant effect that would require mitigation. Cumulative Impacts for the Proposed Action or Alternatives are also presented in Table 4-3 and indicate that there are no cumulative impacts as a result of the proposed action or alternatives.

Table 4-3. Summary of Potential Environmental Consequences

Environmental Resource	No Action Alternative	Dredge John Redmond Lake Alternative	Phased Pool Storage Reallocation Alternative	Proposed Action: Storage Reallocation
Geology and Soils	No insignificant or significant impacts; no mitigation measures would be required.	Long-term, insignificant or significant adverse depending upon mitigation.	Long-term insignificant adverse; no mitigation would be required.	Long-term insignificant adverse; no mitigation would be required.
Hydrology and Water Resources	Long-term significant adverse; mitigation measures would be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Short-term insignificant or significant adverse; mitigation measures may be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant and significant beneficial; no mitigation measures would be required. Long-term insignificant adverse; no mitigation measures would be required.
Biological Resources	No insignificant or significant impacts; no mitigation measures would be required.	Long-term insignificant beneficial; no mitigation measures would be required. Short-term insignificant and long-term significant adverse; mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse, and long-term significant beneficial and adverse; mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse, and long-term significant beneficial and adverse; mitigation measures would be required.
Air Quality	No insignificant or significant impacts; no mitigation measures would be required.	Short-term insignificant adverse impacts; mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.
Aesthetics	No insignificant or significant impacts; no mitigation measures would be required.	Short- and long-term insignificant adverse; mitigation measures may be required.	Short-term insignificant adverse; no mitigation measures would be required.	Short-term insignificant adverse; no mitigation measures would be required.
Prime or Unique Farmlands	No insignificant or significant impacts; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.

Environmental Resource	No Action Alternative	Dredge John Redmond Lake Alternative	Phased Pool Storage Reallocation Alternative	Proposed Action: Storage Reallocation
Socioeconomic Resources	Long-term insignificant adverse; no mitigation measures would be required. Short- and long-term significant adverse; mitigation measures would be required.	Short-term significant beneficial and short-term insignificant adverse; no mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse; no mitigation measures would be required. Short and long-term significant beneficial and adverse; mitigation measures would be required.	Short- and long-term insignificant beneficial and adverse; no mitigation measures would be required. Short and long-term significant beneficial and adverse; mitigation measures would be required.
Cultural Resources	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.	Long-term insignificant adverse; no mitigation measures would be required.
Hazardous, Toxic, or Radiological Wastes	No insignificant or significant impacts; no mitigation measures would be required.	Short-term insignificant adverse; no mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.	No insignificant or significant impacts; no mitigation measures would be required.
Cumulative Impacts	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.	No insignificant or significant cumulative impacts; no mitigation measures would be required.

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5.0 MITIGATION REQUIREMENTS

5.1 Introduction

The John Redmond, Marion, and Council Grove Dams were constructed in the upper Neosho basin as mitigation for uncontrolled flooding along the Cottonwood and Neosho Rivers (USACE 1976). The Neosho basin covers approximately 6,300-square miles, with 3,015-square miles draining through the reservoir system while 3,285-square miles are uncontrolled in Kansas and Oklahoma below John Redmond Dam (KWO 2001). The dam structures were introduced to decrease the intensity of flood peak flows and provide a more controlled and less damaging release of floodwaters downriver. All three dams were constructed following the heaviest flooding of the Neosho River on record, which occurred during 1951 (Juracek et al. 2001).

In the SEIS, mitigation refers to actions that allow project-related impacts, identified in Section 4.0, to be minimized or in some cases nullified. Mitigation is typically developed after all impacts have been identified; however, some mitigation measures may be identified earlier in the NEPA process. Mitigation measures must be feasible in order to receive consideration during the impact analysis process. Under Section 1508.20 of NEPA (1969), the description of mitigation includes:

1. Avoiding the impact altogether by not taking a certain action or parts of an action;
2. Minimizing impacts by limiting the degree of magnitude of the action and its implementation;
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
5. Compensating for the impact by replacing or providing substitute resources or environments.

Certain assumptions were considered relative to normal dam and reservoir operation by the USACE for flood control and other purposes before mitigation measures were developed. These assumptions included:

- The Neosho basin covers and drains approximately 6,300-square miles, approximately 3,015-square miles drains through John Redmond Dam and Reservoir, and approximately 3,285-square miles drain uncontrolled below John Redmond Dam.
- During flood events, the reservoir would fill above the proposed 1,041.0-foot elevation of the proposed raise and phased raise alternatives, and also above the 1,039.0-foot elevation of the dredging and no action alternatives. The higher level could be as much as 1,068.0 feet in elevation. A higher water level elevation would be held for an undetermined amount of time per each event and releases downriver would be made as determined under the Water Control Manual procedures (USACE 1996) and to reduce riverbank erosion downriver from John Redmond Dam. Several high water events are likely to occur during the course of a calendar year.

- During drought events, water would be released from the reservoir to accommodate water quality flows for municipalities and calls on contracted water storage downriver.
- A water level management plan would be reviewed and prepared annually, on an agreed upon time frame, to address USACE, USFWS, KWO, KDW&P, and other agency needs at the JRL site. This plan would address wildlife habitat needs, particularly during peak waterfowl and shorebird migration, and safety needs for the dam structure, such as ice build-up and damage during winter months.
- Sediments would continue to deposit in the reservoir, in approximately the same locations as currently, and would continue to reduce the storage capacity and flood control volume of the JRL through the design life of the project (CY 2014).
- Debris and sediments would continue to deposit in the flood control pool upriver of the conservation pool in the area known as the logjam.

The following sections present each resource area for which impacts were assessed.

5.2 Geology and Soils

Geology and soil resources in the project area would not receive additional impacts under the No Action Alternative.

Dredge John Redmond Lake

Geology and soils resources would be buried under a spoil pile of dredged material at the disposal site under the excavation and hauling scenario. Further, the soils may be classified as prime or unique farmland and are discussed under Section 5.7. Specific mitigation measures to be considered for the dredging alternative are:

- Survey potential disposal sites for important geologic and soils features and avoid using sites of high geologic and soils values.

Phased Pool Storage Reallocation and Proposed Action: Storage Reallocation

Geology and soils resources in the pool raise area would be inundated. Downriver soils may experience minor levels of increased flooding. Mitigation to reduce soil erosion downriver by decreasing releases as slowly as possible to slow the rate of fall in the river stage is currently in place (USACE 1996). No additional mitigation is proposed.

5.3 Hydrology and Water Resources

Hydrology and water resources would receive impacts related to all of the alternatives under consideration.

No Action Alternative

A decrease in water supply capacity due to sedimentation would result under the No Action Alternative. Under present conditions, this loss could not be mitigated, and adequate water would not be available during drought years. The SEIS evaluates three alternatives to mitigate this loss of water supply capacity under contract with the State of Kansas.

Dredge John Redmond Lake

Water storage sufficient to meet the needs of the State of Kansas would result from either method described for this alternative. Dredging sediments from JRL could disturb contaminants that become waterborne, causing wildlife exposure onsite and/or release downriver, causing exposure to water users and wildlife in the Neosho River below the dam. Sediment disposal sites may require selection based on siting studies because of the contaminant levels. Contaminated sediments are likely to contain lead from fishing weights and spent shot used historically for waterfowl hunting, agricultural pesticides and fertilizers washed from farm fields in the drainage basin, and municipal and industrial contaminants. Potential mitigation measures for this alternative could include the following:

- Conduct sediment sampling to determine the chemical composition and nature of any contaminants present;
- Determine proper timing for any release of sediment downriver;
- Separate the work area from active reservoir storage to the extent possible;
- Dewater sediments to the extent possible prior to hauling;
- Develop a dredging and disposal plan relative to the type and level of contaminants identified; and
- Determine the interaction of contaminants in the water column, the concentration, and the adequacy of downriver water treatment facilities to treat the water for domestic use.

Phased Pool Storage Reallocation and Proposed Action: Storage Reallocation

Water storage sufficient to meet the needs of the State of Kansas would result from this alternative. The mitigation discussion for hydrology and water resources for both of the pool raise alternatives would be the same and is presented here. The 3.18 percent reduction in flood control capacity at John Redmond Dam would result in long-term, adverse downriver hydrologic effects that are currently mitigated to the extent possible by flood flow storage and control at the dam, using the procedures presented in the Water Control Manual (USACE 1996). Because of the mitigation for flood flows currently in place, the adverse impact downriver is considered insignificant. Water quality effects associated with a water raise are not considered significant and mitigation is not recommended. The physical effect of ice formation against the dam structure could require mitigation, as follows:

- Lower the water level during the winter months to avoid ice formation and the resultant damage to structures, to the extent possible.

Effects on the logjam are considered negligible; however, the site should be monitored. Mitigation as a result of either pool raise alternative is not recommended.

5.4 Biological Resources

The site vegetation, wetlands, wildlife, fisheries, rare species, and management areas are currently affected because of flood storage events and water level management for wildlife resources at JRL. No significant impacts to the biological resources would occur nor would mitigation be required for the No Action Alternative. Biological resources would receive project-related impacts from the Dredge John Redmond Lake, Phased Pool Storage Reallocation, and Proposed Action: Storage Reallocation alternatives.

Dredge John Redmond Lake

Dredging sediments would result in additional water storage for the State of Kansas, which would result in improved water quality and quantity downriver, over the long term. This would benefit the downriver fishery and particularly the Neosho madtom, rabbitsfoot mussel, and Neosho mucket mussel, species of concern that occupy gravel bar habitats. In addition, dredging would avoid drowning shoreline vegetation, particularly woodland and wetland habitats. The dredging alternative would hold the lake elevation at 1,039.0 feet, which would have a negative effect on shorebird habitat. The unvegetated shoreline that currently exists between the 1,039.0 and 1,041.0-foot elevation would become vegetated with predominantly shrubs and trees, eliminating the open sand beaches and mudflats. This alternative eliminates backwater effects on two moist soil units managed by the FHNWR. A beneficial impact also occurs when the new shoreline vegetation is flooded to support waterfowl and fisheries habitat under the existing water level management plan.

Potential adverse impacts for the dredge alternative include temporary impacts to overwintering bald eagles and waterfowl, increased sediment load in the Neosho River below John Redmond Dam, and potential wildlife exposure to contaminates. Specific mitigation measures to be considered for the dredging alternative are:

- Avoid existing vegetation to the extent possible during dredging, hauling, and disposal operations, and revegetate disturbed sites with appropriate native vegetation following dredging activities;
- Survey disposal sites for rare species of plants and wildlife;
- Avoid existing wetlands during dredging, hauling, and disposal operations;
- Time sediment dredge and haul activities to avoid early morning and late afternoon periods for sensitive wildlife species; and
- Do not discharge sediments downriver during low flow periods.

Phased Pool Storage Reallocation and Proposed Action: Storage Reallocation

The mitigation discussion for biological resources for both of the pool raise alternatives would be the same and is presented here. Raising the water level of the conservation pool would result in additional water storage for the State of Kansas, which would result in better water quantity and quality downriver, over the long term. This would benefit the downriver fishery and particularly the Neosho madtom, rabbitsfoot mussel, and Neosho mucket mussel, species of concern that occupy gravel bar habitats. Shoreline vegetation would be inundated, including wetland habitat totaling approximately 270 acres, and backwater effects on the moist soil units managed by the FHNWR. The newly flooded shoreline vegetation would enhance both the fishery and waterfowl habitats of JRL for approximately five to eight years.

Potential impacts for the conservation pool raise alternatives include beneficial temporary impacts to overwintering bald eagles because of an increase of waterfowl and fish for forage. A loss of shorebird habitat would occur if the pool elevation is held during the summer migration. Specific mitigation measures to be considered for the pool raise alternatives are:

- Allow newly inundated grassland and agricultural land to revegetate to aquatic, wetland, and shoreline riparian communities, replacing and slightly increasing the amount of such habitat present;
- Reintroduce woodland species to abandoned agricultural land;
- Manage former moist soil units to support aquatic or semi-aquatic wetland types;
- Establish a water level management plan when possible, to expose shorebird habitat during the summer migration, and provide fishery habitat by allowing annual vegetation growth; and
- Control exotic plant populations and species using an integrated approach of manual control, mowing, prescribed burning, and chemical applications where appropriate.

Mitigation recommendations have been prepared by the USFWS (2001) and have been reviewed and discussed with the USACE. The recommendations prepared by the USFWS as part of the Fish and Wildlife Coordination Act report (Appendix F) included:

- The Strawn boat launching ramp and parking area be replaced/relocated above elevation 1,041.0-feet NGVD, but within the same general area to accommodate angler and hunter access as a cost of the project;
- The USACE replace the Strawn Flats and Goose Bend #4 dikes, outlet works, and pumping facilities (see Figure 3-12) at a site to be determined by the USFWS, but within FHNWR, as a cost of the project;
- The USACE initiate an Environmental Management Plan in the Neosho basin, integrating reservoir operations and management with conservation of and management of all natural resources within the basin with particular emphasis on providing protection and enhancement for species of concern;
- An annual water level management plan be jointly developed by all agencies involved and implemented;
- Provisions be made for post-development impact evaluations (follow-up studies) for potential wetland development immediately above elevation 1,041.0-feet NGVD; and
- Additional land be acquired (does not mean purchase as the only option) for the project and be made available to the USFWS or the KDW&P for wildlife management under terms of the existing cooperative agreement or license.

The USACE provided an analysis of the Fish and Wildlife Coordination Act Report (Appendix F) in order to address the recommendations made. The USACE responded to the recommendations as follows (responses listed in the order the recommendations were presented above):

- The USACE concurred stating that similar facilities (boat ramp and parking area) would be replaced and/or relocated to a suitable area jointly determined by the USFWS, USACE, and KDW&P;
- The USACE concurred stating that these facilities (Strawn Flats and Goose Bend #4 dikes, outlet works, and pumping facilities) would be replaced within the FHNWR;
- The USACE partially concurred, stating that such an initiative (Environmental Management Plan in the Neosho Basin) should be coordinated at the state level due to the many potentially interested parties (state and federal agencies, local interest groups, etc.);
- The USACE concurred stating that consideration would be given to developing a water level manipulation plan compatible with the new conservation pool and its operations; however, the Kansas Water Office and KDW&P would need to draft such a plan; and
- The USACE concurred stating that a GIS database has been developed that could be used to assess changes in wetland development.

5.5 Air Quality

Air quality would not receive further impacts under the No Action Alternative, Phased Pool Storage Reallocation, or Proposed Action: Storage Reallocation alternatives. Because the JRL area is in attainment for all criteria pollutants, mitigation is not required.

Dredge John Redmond Lake

Under the dredging alternative, mitigation measures to abate PM_{10} emissions (dust) would be required, particularly on haul roads, areas of excavation, and sediment disposal sites, and during periods of low precipitation. Airborne pollutants would also be generated from the exhaust of heavy dredging, excavating, hauling, and earth-moving equipment and vehicles driven to the site by workers. Potential mitigation measures that could be implemented include the following:

- Apply water as necessary to provide dust abatement from all actively disturbed sites, for all unpaved roads, parking lots, and staging areas, and sediment disposal area;
- Use electricity from powerlines/poles rather than temporary diesel or gasoline-powered generators;
- Reduce truck speeds to15 mph or less on all unpaved roads;
- Cover all trucks hauling dry sediments, silt, sand, or other loose materials and maintain at least two feet of freeboard;
- Revegetate temporary haul roads and sediment disposal sites with appropriate native vegetation to abate dust following the dredging project;

- Encourage ride-sharing or other forms of shared transportation to reduce worker vehicle emissions to the site; and
- Continue monitoring airborne radionuclide concentrations at the WCGS and vicinity per KDH&E sampling and emergency response protocols.

5.6 Aesthetics

Aesthetics as a resource would not receive further impacts under the No Action Alternative and mitigation would not be required.

Dredge John Redmond Lake

Dredging would result in the short-term presence of dredge, excavation, hauling and spreading equipment, private vehicles, and construction workers. This equipment and activity would be visible in the conservation pool from the John Redmond Dam road, the reservoir shoreline, a few other access points at sufficient elevation above the intervening trees (observation tower south of Ottumwa, etc.), and at the disposal site. During the late fall and winter the visual effect would be greater because of leaf drop from the deciduous trees growing along the drainages and the reservoir shoreline.

Some visitor experiences during this time frame would be negatively affected, particularly those seeking to observe different species of wildlife. White-tailed deer, upland gamebird, turkey, and waterfowl hunters would also experience a diminished visual perception of open space. Shorebirds could avoid the area during the summer migration. Dust generated from dredging and hauling activities could become noticeable to visitors and local citizens and would require abatement per the air quality sections of this report. Similar visual effects would result at any site selected for sediment disposal, storage, or application. Specific mitigations to be considered for the dredging alternative are:

- Time dredging activities to avoid the peak site visitation by sensitive user groups, shorebirds, and waterfowl, including consideration of high quality viewing and hunting hours, e.g., early morning and late afternoon, to the extent possible;
- Provide dust abatement as necessary, per the air quality section of the SEIS;
- Stage, maintain, and service equipment on an upland site outside of lake viewscape;
- Contour dredged spoil piles to reflect local topography; and
- Revegetate disturbed temporary haul roads and disposal areas using native vegetation to restore the viewscape.

Phased Pool Storage Reallocation and Proposed Action: Storage Reallocation

Little change to the existing viewscape would result with the slightly larger body of water stored behind the dam for both of these alternatives. However, the pool raise would result in a larger number of trees inundated and persisting as snags for the eight to ten years before they topple due to wave action. Shoreline vegetation and aquatic wetlands that become inundated would reestablish at higher elevations along the shoreline within the first two growing seasons. No mitigation measures are proposed to influence the site aesthetic values.

5.7 Prime or Unique Farmlands

Prime or unique farmlands would not receive further impacts under the No Action Alternative or either reallocation alternative (including the proposed action), and mitigation would not be proposed.

Dredge John Redmond Lake

Dredging sediments may result in long-term loss of prime or unique farmland, dependent on the method used and the location of the sediment disposal site and the size required per the volume of sediment. Specific mitigations to be considered for the dredging alternative are:

- Dispose sediments on land that does not fit the criteria for prime or unique farmland.

5.8 Socioeconomic Resources

Socioeconomic resources may receive impacts relative to each alternative, as described below. Social and economic effects related to precipitation events and present managed flows from John Redmond Dam and uncontrolled flows below the dam would continue into the foreseeable future. No beneficial or adverse effects would occur regarding Environmental Justice or Protection of Children for any of the alternatives assessed.

No Action Alternative

The principal socioeconomic impact under this alternative would be the inability of the USACE to fulfill contractual obligations to the KWO for water storage and supply . Under present conditions, this loss could not be mitigated, and adequate water would not be available during drought years. The SEIS evaluates three alternatives to mitigate this loss of water supply capacity under contract with the State of Kansas.

Dredge John Redmond Lake

Dredging sediments would result in additional water storage for the State of Kansas and increased economic activity in the vicinity, beneficial impacts requiring no mitigation. The principle adverse impacts of this alternative include transportation and land-use effects associated with the staging area, haul road, and sediment disposal site. Affects to recreation activities, such as hunting, could also occur under the dredge alternative. Specific mitigation measures to be considered for the dredge alternative are:

- Implement standard transportation and waste disposal operating procedures, including road safety and control of dust, noise, and vehicle emissions; and
- Limit hours and locations of operations during key recreation periods such as hunting season.

Phased Pool Storage Reallocation Alternative and Proposed Action: Storage Reallocation

The mitigation discussion for social and economic resources for both of the pool raise alternatives would be the same and is presented here. Elevating the water level of the conservation pool would flood a boat ramp, parking area, and portions of an access road on the FHNWR. In addition, the perception that raising the conservation pool elevation would result in increased frequency and duration of flooding of land and agricultural activities in the Neosho River flood plain downriver from JRL would occur. Specific mitigation measures to be considered for the two water raise alternatives are:

- Replace or restore flooded facilities;
- Monitor crops adjacent to JRL for any wildlife damage from water raise;
- Create an informational program to inform downriver agricultural interests when large releases are planned at JRL;
- Inform downriver parties and organizations how to receive informational program data;
- Conduct sessions at downriver locations to educate individuals and organizations concerning the USACE SUPER model and its predictive values relative to minimal downriver effects of a two-foot conservation pool raise; and
- Support KDOT planning for SH 130 bridge replacement in approximately five years.

5.9 Cultural Resources

In compliance with Section 106 of the National Historic Preservation Act and regulations issued by the Advisory Council on Historic Preservation (36 CFR Part 800), Federal agencies are required to consult with the State Historic Preservation Officer (SHPO) and the Advisory Council in the event that an undertaking may have an impact on historic or prehistoric sites. A Memorandum of Agreement (MOA) between the USACE, the Advisory Council on Historic Preservation, and the Kansas and Nebraska SHPO, is being drafted to determine appropriate actions and mitigation measures for cultural resources that may be discovered and/or affected during the course of the project. Appropriate mitigation measures for affected sites may include preservation in place for future study, recovery or partial recovery of site data through excavation, public interpretive display, or a combination of these measures.

No short- or long-term, significant, beneficial or adverse impacts are identified for sites downstream of the John Redmond Dam under the proposed action or alternatives. These sites are affected by ongoing erosion and flooding independent of the proposed or alternative actions. Mitigation measures are not required for these sites.

Section 110(a)(2), however, encourages the ongoing identification and evaluation of potentially significant resources under the jurisdiction of the agency. There are 31 potentially significant prehistoric and historic sites within the area of potential impact downstream of the dam. These sites are: 14CF8, 14CF9, 14CF10, 14CF11, 14CF12, 14CF13, 14AN6, 14NO6, 14NO7, 14NO8, 14NO9, 14NO10, 14NO11, 14NO376, 14NO398, 14LT9, 14LT10, 14LT11, 14LT12, 14LT355, 14CH60, 14CH61, 14CH62, Bridge 1, Bridge 2, OHHS-OT10, GLO 1, GLO 2, GLO 3, GLO 4, and GLO 5. Many of these sites have not been evaluated in 30 years; others have yet to be verified archaeologically. Bridges 1 and 2 of Ottawa County have already been determined eligible for the NRHP. A program of reconnaissance that includes verifying the physical integrity of these sites is recommended.

No Action Alternative

The potential for long-term, significant, adverse impacts on JRL shoreline sites 14CF101, 14CF102, 14CF103, 14CF105, and 14CF311/313 is identified under the No Action Alternative (Section 4.9 of the SEIS). Because this alternative does not address long-term water storage issues, it is likely that preservation in place will not be a realistic mitigation measure. Site data recovery would, ultimately, be needed to mitigate the effects of the No Action Alternative.

Dredge John Redmond Lake Alternative

The potential for long-term, significant, adverse impacts on JRL shoreline sites 14CF101, 14CF102, 14CF103, 14CF105, and 14CF311 is identified under the Dredge John Redmond Lake Alternative (Section 4.9 of the SEIS). Because this alternative does not address long-term water storage issues, it is likely that preservation in place will not be a realistic mitigation measure. Site data recovery would, ultimately, be needed to mitigate the effects of the No Action Alternative. Short-term mitigation measures would also entail avoidance of these sites during the dredging, transportation, and disposal of sediments from JRL.

Phased Pool Storage Reallocation Alternative

The potential for short- and long-term, significant, adverse impacts, likely resulting in the destruction of JRL shoreline sites 14CF101, 14CF102, 14CF103, 14CF105, and 14CF311, is identified under the Phased Pool Storage Reallocation Alternative. Site data recovery would be needed to mitigate the effects of the Phased Pool Storage Reallocation Alternative.

Proposed Action: Storage Reallocation

The potential for short- and long-term, significant, adverse impacts, likely resulting in the destruction of JRL shoreline sites14CF101, 14CF102, 14CF103, 14CF105, and 14CF311, is identified under the Proposed Action. Site data recovery would be needed to mitigate the effects of the Proposed Action.

As discussed in Section 3.9 of the SEIS, a Phase III investigation of the John Redmond shoreline sites was conducted in 2001. Pursuant to this work, these sites are currently being evaluated for NRHP eligibility, and a recommendation for Phase IV data recovery is anticipated (Rust 2001b). The criteria that will be used to nominate the JRL sites to the NRHP are briefly summarized in the Cultural Resources Appendix G, Exhibit B.

5.10 Hazardous, Toxic, or Radiological Wastes

No significant impacts from hazardous, toxic, or radiological wastes would occur, nor would mitigation be proposed for the No Action Alternative, phased pool storage reallocation, or proposed action. Monitoring of the WCGS and environs for radiological contamination would continue under the authority of the KDH&E for sample methodology, laboratory analysis, and response.

Dredge John Redmond Lake

Potentially hazardous materials such as petroleum products, coolants, and heavy metals could be introduced by heavy equipment used in the dredging, hauling, and disposal of sediments. Further, dredging activities may release hazardous or toxic materials, such as lead and pesticides, from sediments resulting in exposures to wildlife and humans. If sufficient quantities of hazardous or toxic materials are present, the dredged sediments may require special storage or treatment prior to hauling and disposal. Specific mitigations to be considered for the dredging alternative are:

- Store all fuel and lubricants out of the flood plain and service vehicles and equipment at a dedicated storage site;
- Prepare an adequate plan of operations including a spill control plan and a hazardous waste management plan that outlines disposal procedures, under the regulations of 40 CFR, CERCLA 1980 (42 U.S.C. 6901), or RCRA (42 U.S.C. 6901), as appropriate;
- Sample sediments to determine if disposal is an acceptable outcome of removal. Store sediments containing hazardous materials properly for the identified parameter; and
- Ensure personal protection equipment and site safety is adequate for any identified site hazards to dredge and haul personnel and to visitors.

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6.0 APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

Laws and regulations in place and addressed in this SEIS are presented in Table 6-1.

Table 6-1. Applicable Environmental Laws and Regulations

Environmental Law or Regulation	Description
National Environmental Policy Act of 1969	Requires the disclosure of the environmental impacts of any major federal action significantly affecting the quality of the human environment.
AGRICULTURE	
Farmland Protection Policy Act of 1981	Minimizes the extent to which federal programs contribute to the unnecessary conversion of farmland to non-agricultural uses.
AIR QUALITY	
Clean Air Act (1970), as amended	Provides the principal framework for national, state, and local efforts to protect air quality.
BIOLOGICAL RESOURCES	
Clean Water Act of 1977	Requires consultation with the USACE for major wetland modifications under Section 404.
Endangered Species Act of 1973	Requires federal agencies that fund, authorize, or implement actions to avoid jeopardizing the continued existence of federally-listed threatened or endangered species, or destroying or adversely affecting their critical habitat.
Executive Order 11990, Protection of Wetlands	Requires that federal agencies provide leadership and take actions to minimize or avoid the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.
Federal Noxious Weed Act of 1990	Requires the use of integrated management systems to control or contain undesirable plant species and an interdisciplinary approach with the cooperation of other federal and state agencies.
CULTURAL RESOURCES	
Antiquities Act (1906)	Authorizes the scientific investigation of antiquities on federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

Environmental Law or Regulation	Description
American Indian Religious Freedom Act (1978)	Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.
Archaeological and Historic Preservation Act (1974)	Directs the preservation of historic and archaeological data in federal construction projects.
Archaeological Resources Protection Act of 1979, as amended	Protects materials of archaeological interest from unauthorized removal or destruction and requires federal managers to develop plans and schedules to locate archaeological resources.
Executive Order 13007 Indian Sacred Sites (1996)	Directs federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.
Native American Graves Protection and Repatriation Act (1990)	Requires federal agencies and museums to inventory, determine ownership, and repatriate cultural items under their control or possession.
National Historic Preservation Act (1966), as amended	Establishes as policy that federal agencies are to provide preservation of the nation's prehistoric and historic resources, and establishes the National Register of Historic Places.
Protection of Historic and Cultural Properties (1986)	Provides an explicit set of procedures for federal agencies to meet obligations under the National Historic Preservation Act (NHPA), including the inventory of resources and consultation with SHPOs.
Executive Order 13007, Indian Sacred Sites	Requires that federal agencies accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites.
Executive Order 13084, Consultation and Coordination with Indian Tribal Governments (1998)	Requires that each federal agency have an effective process to permit elected officials and other representatives of Indian tribal governments to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities.

Environmental Law or Regulation	Description
Kansas Historic Preservation Act	Sets forth the policy for historic preservation and details procedures to be followed by state agencies in nominating properties to the Register and in dealing with undertakings affecting listed properties.
Kansas Antiquities Act	Prohibits unauthorized individuals, institutions, and corporations from excavating in, removing material from, vandalizing, or defacing any archaeological site or features on lands that are owned or controlled by the State, or any county or municipality.
Kansas Unmarked Burial Sites Preservation Act	Establishes procedures to be followed in dealing with discoveries of human remains and funerary objects associated with unmarked burial sites in Kansas.
HAZARDOUS WASTES	
Resource Conservation and Recovery Act	Principal source of regulatory control over the generation, storage, treatment, and disposal of hazardous wastes.
HYDROLOGY RESOURCES	
Clean Water Act of 1977	Requires consultation with the USACE for major wetland modifications under Section 404.
Water Quality Act of 1987, as amended	Establishes as policy restoration and maintenance of the chemical, physical and biological integrity of the nation's waters and, where attainable, to achieve a level of water quality that provides for the protection and propagation of fish, shellfish, wildlife, and recreation in and on the water.
SOCIOECONOMICS	
Executive Order 11988, Flood Plain Management	Requires federal agencies to take action to reduce the risk of flood damage; minimize the impacts of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by flood plains. Federal agencies are directed to consider the proximity of their actions to or within flood plains.
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations	Directs federal agencies to assess the effects of their actions on minority or low-income communities within their region of influence.

Environmental Law or Regulation	Description
Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks	Directs federal agencies to identify and assess environmental health risks and safety risks that may disproportionately affect children, and ensure that policies, programs, activities, and standards address disproportionately high environmental health and safety risks to children.
Farmland Protection Policy Act of 1981	Minimizes the extent to which federal programs contribute to the unnecessary conversion of farmland to non-agricultural uses.

7.0 ENVIRONMENTAL CONSULTATION AND COORDINATION

Federal, state, and local agencies were consulted prior to and during the preparation of this supplement to the EIS. Agencies were notified of plans for water storage reallocation by mail, by scheduled public meetings, by publication of a NOI announcing preparation of a Draft EIS as required by NEPA, and by two public scoping meetings. The agencies contacted are listed below.

7.1 Federal Agencies

Department of Agriculture
- Natural Resources Conservation Service

Department of Energy
- Wolf Creek Nuclear Generating Station

Department of the Interior
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

7.2 State Agencies

Emporia State University
Kansas Biological Survey
Kansas Department of Health and Environment
Kansas Department of Transportation
Kansas Department of Wildlife & Parks
Kansas State Historic Preservation Office
Kansas State Historical Society
Kansas State University Agricultural Extension
Kansas Water Office

7.3 Local Agencies

City of Burlington, Kansas
City of Chetopa, Kansas
Coffey County, Kansas
Lyon County, Kansas
Neosho River Committee

7.4 Project Mailing List

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8.0 REFERENCES

Adams, C. 2001. District Maintenance Engineer, Kansas Department of Transportation, District One. Personal communication with James Von Loh, Biologist, e^{2}M. August 29, 2001.

American Farmland Trust. 2001. Farming on the Edge, High Quality Farmland in the Path of Development – Kansas. http://www.farmlandinfo.org/cae/foe2/map/foe2ks.html

Applegate, R., C. Williams, and R. Lutz. In Press. The Effect of Flooding on Northern Bobwhites. Western North American Naturalist.

Au Sable River Watershed Restoration Committee. 1996. The Benefits of Large Woody Debris. Michigan Habitat Improvement Fund. http://www.mich.com/~anglers/rw26/rw26tb.htm

Barlow, S. KDW&P, Otter Creek Wildlife Area Manager. 2001. Personal Communication with J. Von Loh, e^{2}M Biologist. June 6, 2001.

_____. 2001. Personal communication with George Blankenship, Blankenship Consulting LLC. August 24, 2001.

Bell, R.E., E.B. Jelks, and W.W. Newcomb. 1967. *A Pilot Study of the Wichita Indian Archaeology and Ethnohistory*. Report submitted to the National Science Foundation.

Benedict, J.D. 1922. *Muskogee and Northeastern Oklahoma*. Chicago: S.J. Clarke Publishing Co.

Beschta, R. 1979. Debris removal and its effects on sedimentation in an Oregon Coast Range stream. Northwest Science 53: 71-77.

Bilby, R. 1981. Role of organic debris dams in regulating the export of dissolved organic and particulate matter from a forested watershed. Ecology 62: 1234-1243.

Bilby, R. and P. Bisson. 1998. Functioning and distribution of large woody debris. In River Ecology and Management. Naiman and Bilby, Eds. New York, Springer: 324–346.

Blackford, S. 1999. Final Contaminant Assessment Process Report for Flint Hills National Wildlife Refuge in FHNWR Comprehensive Conservation Plan. USFWS, Ecological Services, Kansas Field Office. Manhattan, KS.

Borst, L. 2001. Lyon County Zoning Administrator. Personal communication with George Blankenship, Blankenship Consulting LLC. September 4, 2001.

Brooks, R.L. 1989. "Village Farming Societies." In *From Clovis to Comanchero: Archeological Overview of the Southern Great Plains*, Jack L. Hofman et al. (eds.), pp. 71-90. Arkansas Archeological Survey Research Series No. 35. Fayetteville, AR.

Bulger, A., M. Wildhaber, and D. Edds. 1998. Population dynamics, reproductive biology and behavior of the Neosho madtom, *Noturus placidus* – a state and federally listed threatened catfish. Final Report to USACE-EASB, Tulsa District. Emporia State University and USGS-BRD Columbia Environmental Research Center. Emporia, KS and Columbia, MO.

Buttenhoff, Cheryl. Research Analyst, Kansas Water Office. 2001. Personal communication with George Blankenship, Blankenship Consulting LLC. August 27, 2001.

Coffey County Economic Development. Undated. Labor Availability page of the CCED website: http://www.coffeycountyks.org/ecodevo/labor.html

Coltrain, D., Nuefeld, L., Boland, M., Marr, C. 1999. Economic Issues with Specialty Crops. Publication No. MF-2427. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. August 1999.

Culbertson, B. KDW&P, Wildlife Biologist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 20, 2001.

Department of the Army; Tulsa District, Corps of Engineers. 1976. Final Environmental Statement. Operation and Maintenance Program: John Redmond Dam and Reservoir, Grand (Neosho) River, Kansas, Marion Lake, Cottonwood River, Kansas, and Council Grove Lake, Grand (Neosho River), Kansas. Tulsa, OK.

______. 1996. Grand (Neosho) River, Kansas: An Evaluation of Flooding from John Redmond Reservoir to the Kansas/Oklahoma State Line. December 1996.

______. 1999 –2000. John Redmond Activity Distribution Reports. Spring 1999 – Summer 2000.

Edds, D. Emporia State University, Aquatic Ecologist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. July 2, 2001.

_____. 2001. Emporia State University. http://www.emporia.edu/biosci/eddsbiol.htm

Egbert, S.L., D.L. Peterson, A.M. Stewart, C.L. Louver, C.F. Blodgett, K.P. Price, and E.A. Martinko. 2001. The Kansas GAP Land Cover Map – Final Report. KBS Report #98. University of Kansas. Lawrence, KS.

Executive Office of the President, Council on Environmental Quality. 1980. Prime and Unique Agricultural Lands and the National Environmental Policy Act. Washington, DC. http://ceq.eh.doe.gov/nepa/regs/exec81180.html

Federal Register. 1999. Endangered and Threatened Wildlife and Plants; proposed rule to remove the bald eagle in the lower 48 states from the list of endangered and threatened wildlife. Vol. 64, No.128, July 6. Washington, DC

Flint Hills National Wildlife Refuge. 2001a. USFWS, NWRS. http://ww.r6.fws.gov/REFUGES/FLINT/ and http://www.r6.fws.gov/REFUGES/FLINT/nwrmap21.GIF

_____. 2001b. Birding Information and Checklist. USFWS, NWRS. http://www.r6.fws.gov/REFUGES/FLINT/flint1.htm

_____. 2000. Comprehensive Conservation Plan. USFWS, Region 6. Research Management Consultants, Inc. Golden, CO.

Fogleman, S. 2001. Economist, Kansas State University Agricultural Extension, Southeast Area Office. Chanute Kansas. Personal communication with George Blankenship, Blankenship Consulting LLC. August 30, 2001.

Fox, L. KDW&P, Wildlife Biologist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. August 23, 2001.

Freeman, C. KBS, Botanist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 4, 2001.

Freshwater Mussels of the Midwest. 2001. *Anodonta suborbiculata* Say, 1831 – Flat Floater. http://www.inhs.uiuc.edu/cbd/musselmanual/page76_7.html

Fry, J. USACE, JRL Manager. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 6, 2001.

_____. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 1, 2001.

Gamble, J. FHNWR, Manager. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 12, 2001.

Gehrt, S., D. Spencer, and L. Fox. 1993. Locations of Raccoons During Flooding in Eastern Kansas. The Southwestern Naturalist, Volume 38, Number 4.

_____. 1990. Raccoon Denning Behavior in Eastern Kansas as Determined from Radio-Telemetry. Transactions of the Kansas Academy of Science. 93(3-4), pp. 71–78.

Grand/Neosho River Basin Committee. 1996. Final Report of the Grand/Neosho River Basin Committee. February 15, 1996.

Grand River Dam Authority. 2001a. Oklahoma's Public Power Resource, Who we are. http://www.grda.com/who/who.html

_____. 2001b. Grand Lake O' The Cherokees. http://www.grda.com/water/grand.html

Gross, T. 2001. Kansas Department of Health & Environment. Personal Communication with J. Von Loh (e^2M Senior Biologist) via electronic mail.

Gurnell, A., K. Gregory, and G. Petts. 1995. The Role of Coarse Woody Debris in Forest Aquatic Habitats – Implications for Management. Aquatic Conservation: Marine and Freshwater Ecosystems 5: 143-166.

Harris, F.H. 1965. "Neosho Agency 1838-1891." *Chronicles of Oklahoma* 43 (Spring):35-57.

Hase, C. KDW&P, Aquatic Ecologist. 2001. Personal Communiation with J. Von Loh, e^2M Biologist. May 30, 2001.

Hax, C. and S. Golladay. 1998. Flow disturbance of macroinvertebrates inhabiting sediments and woody debris in a prairie stream. American Midland Naturalist 139: 210-223.

Hays, J.S., R.L. Brooks, and J.L. Hofman. 1989. "Historical Archeology in the Southern Great Plains." In *From Clovis to Comanchero: Archeological Overview of the Southern Great Plains*, Jack L. Hofman et al. (eds.), pp. 101-110. Arkansas Archeological Survey Research Series No. 35. Fayetteville, AR.

Hofman, J.L. 1989. "Protohistoric Culture History on the Southern Great Plains." In *From Clovis to Comanchero: Archeological Overview of the Southern Great Plains*, Jack L. Hofman et al. (eds.), pp. 91-100. Arkansas Archeological Survey Research Series No. 35. Fayetteville, AR.

Hofman, J.L., B. Logan, and M. Adair. 1996. "Prehistoric Adaptation Types and Research Problems." In *Archeology and Paleoecology of the Central Great Plains*, Jack L. Hofman (ed.), pp. 203-220. Arkansas Archeological Survey Research Series No. 48. Fayetteville, AR.

Hotaling, John. 2001. Economic Development Director, Coffey County Economic Development. Personal Communication with George Blankenship, Blankenship Consulting LLC. September 10, 2001.

Hula, R.L. 1990. Regulated Flow Peak Discharge Frequency Estimates for Large Basins. Hydrology and Hydraulics Workshop, Hydrologic Studies in Support of Project Functions. Angel Fire, NM. Seminar Proceedings No. 23. pp. 19–37.

Jirak, L. KDW&P, Fisheries Biologist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 11, 2001.

_____. 2001. Fisheries Biologist, KDP&W. Personal communication with George Blankenship, Blankenship Consulting LLC. June 11, 2001.

Juracek, K. 1999a. Channel Stability of the Neosho River Downstream from John Redmond Dam, Kansas. USGS, in cooperation with the KWO. USGS Fact Sheet 088-99.

_____. 1999b. Geomorphic Effects of Overflow Dams on the Lower Neosho River, Kansas. USGS, in cooperation with KWO, Water Resources Investigations Report 99-4147.

Kansas Center for Community Economic Development. 2001. Kansas County Profile Reports for Coffey and Lyon counties.

Kansas Department of Health & Environment. 2001a. Kansas Administrative Regulations 28-19-17. Prevention of Significant Deterioration of Air Quality. Topeka, KS.

_____. 2001b. Wolf Creek Generating Station Environmental Radiation Surveillance Report, July1999-June 2000. Bureau of Air and Radiation, Radiation Control Program. Topeka, KS.

_____. 1999. WCGS Environmental Radiation Surveillance Report. Bureau of Air and Radiation, Radiation Control Program. Topeka, KS.

Kansas Department of Transportation. 2000a. Data for Number of Deer Related Vehicle Accidents per County. Topeka. KS.

_____. 2000b. Data for Number of Deer Related Vehicle Accidents per County; Deer Related Vehicle Accidents per Billion Miles Traveled in Each County. Topeka, KS.

Kansas Department of Wildlife & Parks. 2000. Letter with List of Threatened or Endangered Species for the project area. J. Phillips signatory.

Kansas Natural Heritage Inventory. 2001a. Explanation of Ranks and Status Codes. http://www.kbs.ukans.edu/ksnhi/database/t&e.htm.

_____. 2001b. Endangered, Threatened, and SINC Species of Kansas. http://www.kbs.ukans.edu/ksnhi/database/t&e.htm

Kansas State University Research and Extension, Department of Agricultural Economics, Office of Local Government. 1999. Situation and Trends: Coffey and Lyon counties. April 1999.

Kansas Surface Water Register, 1999. Kansas Department of Health and Environment. Division of Environment. Bureau of Environmental Field Services. Topeka, KS.

Kansas Water Office. 1996. Status Report 1996: State of Kansas Water Marketing Program, Water Assurance Program, Small Lakes Program. Topeka, Kansas.

_____. 2001. Neosho Basin. Basin Advisory Committees. http://www.kwo.org/bac/basins/neosho.html

Keller, E. and F. Swanson. 1979. Effects of large organic material on channel form and fluvial processes. Earth Surface Processes and Landforms 4: 361-380.

Kilgore, R. 2001. Agronomist, Kansas State University Agricultural Extension, Southeast Area Office. Chanute Kansas. Personal communication with George Blankenship, Blankenship Consulting LLC. August 31, 2001.

King, J.E. 1993. *Spans of Time: Oklahoma Historic Highway Bridges*. Texas Tech University: Center for Historic Preservation & Technology.

King, M.K. 1996. *Results of Phase III Archeological Investigations at the Shawnee Mill Site, 14JO365, Johnson County, Kansas*. Kansas State Historical Society Contract Archeology Series 14. Topeka, KS.

Kostinec et. al. 1996. Kostinec T, Assistant Manager, USFWS, Jirak, L. Fisheries Biologist KDPW, Culbertson, B., Wildlife Biologist, KDPW, Kraft, M., Waterfowl Biologist, KDWP, Rameriz, Marty, Park Ranger, USACE. Economic Impact Report: Water Level Management John Redmond Reservoir. 1996.

Kraft, M. KDW&P, Wildlife Biologist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 19, 2001.

Lees, W.B. 1996. "Historical Archeology in the Central Plains." In *Archeology and Paleoecology of the Central Great Plains*, Jack L. Hofman (ed.), pp. 140-149. Arkansas Archeological Survey Research Series No. 48. Fayetteville, AR.

Lewis, E. 2001a. Manager Hydrology and Evaluation Unit. Kansas Water Office. Personal communication with George Blankenship, Blankenship Consulting LLC. July 7, 2001.

_____. 2001b. Manager Hydrology and Evaluation Unit. Kansas Water Office. Personal communication with George Blankenship, Blankenship Consulting LLC. August 27, 2001.

_____. 2001c. Personal Communication with G. Blankenship, Consulting Socioeconomist to e^2M. July 9, 2001.

Logan, B. 1996. "The Plains Village Period on the Central Plains." In *Archeology and Paleoecology of the Central Great Plains*, Jack L. Hofman (ed.), pp. 123-133. Arkansas Archaeological Survey Research Series No. 48. Fayetteville, AR.

Mau, D. P. 2001. Sediment Deposition and Trends and Transport of Phosphorous and Other Chemical Constituents, Cheney Reservoir Watershed, South-Central Kansas. U.S. Geological Survey. Water-Resources Investigations Report 01-4085.

McGregor, R., T. Barkley, R. Brooks, and E. Schofield. 1986. Flora of the Great Plains. University Press of Kansas. Lawrence, KS.

Merriam, D. 2000. Geologic Map of Coffey County, Kansas. Kansas Geological Survey, Map M-59. Lawrence, KS.

Miller, E. KDW&P, Aquatic Ecologist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 18, 2001.

Minnerath, J. FHNWR, Botanist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 18, 2001.

Mulhern, D. USFWS, Aquatic Ecologist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. May 31, 2001.

NASS 2000. USDA Statistical Bulletin: Non-citrus Fruits and Nuts Summary Report (PNF-BB). National Agricultural Statistics Service, Agricultural Statistics Board, U.S. Department of Agriculture. July 2000.

National Wildlife Federation. 2001. Western Prairie Fringed Orchid, Science Facts. Keep the Wild Alive Campaign. http://www.nwf.org/wildalive/orchid/sciencefacts.html

Natural Science Research Associates. 1995. Summary of Collections of Neosho Madtoms (*Notorus placidus* Taylor). Hays, KS.

Newkirk, M. 2001. Coffey County Floodplain Coordinator and Zoning Administrator. Personal communication with George Blankenship, Blankenship Consulting LLC. August 31, 2001.

Nieberding, V. 1983. *The History of Ottawa County.* Marceline, MO: Walsworth Publishing Co.

NRHP (National Register of Historic Places). 1997. *How to Apply the National Register Criteria for Evaluation.* National Register Bulletin. U.S. Department of the Interior, Washington, D.C.

Obermeyer, B., D. Edds, C. Prophet, and E. Miller. 1997. Freshwater Mussels (Bivalvia: Unionidae) in the Verdigris, Neosho, and Spring River Basins of Kansas and Missouri, with Emphasis on Species of Concern. American Malacological Bulletin, Vol. 14(1): 41-55. Kansas Department of Wildlife and Parks and Emporia State University. Emporia, KS.

_____. 1996. Comparison of Sampling Methods for Assessing Freshwater Mussel Beds in the Neosho River, Kansas. Division of Biological Sciences, Emporia State University. Emporia, KS.

O'Connor, H. 1953. Part 1, Rock formations of Lyon County in Geology, mineral resources, and ground-water resources of Lyon County, Kansas. Kansas Geological Survey. Volume 12. Lawrence, KS.

Oklahoma Historical Society. 1958. "Oklahoma Historic Sites Survey." *Chronicles of Oklahoma* 36 (Fall):282-314.

Page, L. and B. Burn. 1991. A Field Guide to Freshwater Fishes; North America, North of Mexico. Peterson Field Guide Series. Houghton-Mifflin Company. Boston, MA.

Pfingsten, D. and D. Edds. 1997. Reproductive Traits of the Neosho Madtom, *Notorus placidus* (Pisces: Ictaluridae). Division of Biological Sciences, Emporia State University. Emporia, KS.

Piegay, H. and N, Landon. 1997. Promoting ecological management of riparian forests on the Drome River, France. Aquatic Conservation: Marine and Freshwater Ecosystems 7: 287-304.

Pope, L. M. 1998. Watershed Trend Analysis and Water-Quality Assessment Using Bottom-Sediment Cores From Cheney Reservoir, South-Central, Kansas. U.S. Geological Survey. Water-Resources Investigations Report 98-4227.

Post, G. 2001. Lyon County Assessor. Personal communication with George Blankenship, Blankenship Consulting LLC. September 4, 2001.

Prophet, C.W., J. Prather, N. Edwards. 1970. Comparison of Summer Water Quality Features in Three Grand River Reservoirs, Kansas. Kansas State Teachers College. Emporia, KS.

_____. 2000. Kansas Department of Health & Environment. Surface Water Monitoring Program. http://www.kdhe.state.ks.us/water/index.html

Randolph, J. 2001. USACE – Fish and Wildlife Biologist. Personal Communication with J. Von Loh, e^2M Biologist. October 17, 2001

Regional Development Association of East Central Kansas. Major Employers page of RDA website: http://65.30.12.165/econdev/page6.html

Reid, W. 1995. Kansas State University Horticulture Report MF-1025: Growing Pecans in Kansas. Agricultural Experiment Station and Cooperative Extension Service. Manhattan, KS. http://www.oznet.ksu.edu/library/hort2/Samplers/MF1025.htm

_____. 1995. Extension & Research Horticulturist. Growing Pecans in Kansas. Publication MF-1025. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. October 1995.

_____. 2001. Extension & Research Horticulturist, Kansas State University Agricultural Experiment Station and Cooperative Extension Service. Personal communication with George Blankenship, Blankenship Consulting LLC. August 21, 2001.

Rogers, R.A. 1979. *Archaeological Investigations in the John Redmond Reservoir Area, Kansas*. University of Kansas Museum of Anthropology, Lawrence, KS.

Rust, J.F. 2001a. *An Archaeological Survey of John Redmond Reservoir, Coffey County, Kansas*. DACA56-00-D-2013. Prepared for the U.S. Army Corps of Engineers, Tulsa District, Tulsa, OK.

_____. 2001b (forthcoming). *National Register Evaluation of Six Sites at John Redmond Reservoir, Coffey County, Kansas*. Prepared for the U.S. Army Corps of Engineers, Tulsa District, Tulsa, OK.

Sather, N., C. Freeman, L. Manske, J. Milton, L. Potts, and C. Hull-Sieg. 1996. Western Prairie Fringed Orchid Recovery Plan. USFWS, Region 3. Ft. Snelling, MN.

Schmits, L.J. 1973. *An Assessment of the Prehistoric Cultural Resources of the Neosho (Grand) River Valley and an Evaluation of the Impact of the Proposed Riverbank Stabilization Project*. DAW56-73-C-0240. University of Kansas Museum of Anthropology, Lawrence, KS.

Simmons, G. Park Ranger, John Redmond Project Office, Department of the Army; Tulsa District, Corps of Engineers. 2001a. Personal communication with George Blankenship, Blankenship Consulting LLC. June 11, 2001.

_____. 2001b. Personal Communication with George Blankenship, Blankenship Consulting LLC. June 18, 2001.

Stewart, J. 2001. Kansas Department of Health & Environment. Personal Communication with C. Vrabel (e^2M Geologist).

Sullivan, J. 2001. Economist, Department of the Army; Tulsa District, Corps of Engineers. Personal communications with George Blankenship, Blankenship Consulting LLC. August 22, 2001.

Tabor, V. USFWS, Aquatic Ecologist. 2001. Personal Communication with J. Von Loh, e^2M Biologist. June 27, 2001.

Taylor, G. Undated. Improving Native Pecan Groves. Oklahoma State University. Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources.

The Council of State Governments. 2001. State Air Quality Programs Survey 1999, Executive Summary. http://www.statesnews.org/clip/policy/air_survey.htm

Thies, R.M. 1981. *Archaeological Investigations at John Redmond Reservoir, East-Central Kansas, 1979*. Kansas State Historical Society, Lawrence, KS.

Tillma, J., C. Guy, and C. Mammoliti. 1998. Relations among habitat and population characteristics of spotted bass in Kansas streams. N.A. Journal of Fisheries Management 18: 886-893.

Tracy, V. 1970. "The Indian in Transition: The Neosho Agency 1850–1861." *Chronicles of Oklahoma* 48 (Summer):164-183.

Triplett, J. 2001. Chairman, Grand/Neosho River Committee. Personal communication with George Blankenship, Blankenship Consulting LLC. August 29, 2001.

Unio Gallery. 2001. Ptychobranchus occidentalis Ouachita kidneyshell. http://courses.smsu.edu/mcb095f/gallery/ouachita/kidneyshell.htm

United States Army Corps of Engineers. 2001a. Tulsa District Lake Information: John Redmond Reservoir, Kansas. http://www.swt.usace.army.mil/template/recreat/OPSField.CFM

_____. 2001b. Grand-Neosho River Basin. http://www.swt-wc.usace.army.mil/grand-neosho.html

_____. 2001c. John Redmond Lake. http://www.swt-wc.usace.army.mil/JOHN.lakepage.html and http://www.swt.usace.army.mil/template/recreat/OPSField/OPSField.CFM

_____. 2001d. SUPER Modeling done for the John Redmond Sediment Redistribution Study. Tulsa District. Tulsa, OK.

_____. 2001e. Great Lakes Region Fact Sheets, Corps Programs & Authorities. http://www.lrd.usace.army.mil/gl/fact.htm

_____. 1997. USACE Historic Properties Management Plan for the John Redmond Area. Tulsa, OK.

_____. 1996. John Redmond Dam and Reservoir, Neosho River, Kansas, Water Control Manual. Tulsa District. Tulsa, OK.

U.S. Census Bureau 2001. US Census Bureau: State and County Quick Facts. July 3, 2001.

United States Department of Agriculture. 1993. Kansas Important Farmland Legend. Soil Conservation Service. Salina, KS.

_____. 1992–99. National Agricultural Statistics Service Statistical Bulletin Number 950. Noncitrus Fruits and Nuts: Final Estimates by States, 1992–97 and 1997–99. http://usda.mannlib.cornell.edu/reports/general/sb/B9501298.txt

_____. Natural Resources Conservation Service. 2000. Prime Farmland, Lyon County, Kansas. KS-FOTG Notice: 262. Section II: Cropland Interpretations. Salinas, KS.

_____. Natural Resources Conservation Service. 1997. Form AD-1006 Farmland Conversion Impact Rating. Washington, DC.

_____. Soil Conservation Service. 1993. Kansas Important Farmland Legend, Prime Farmland and Farmland of Statewide Importance, Coffey County, Kansas. KS-FOTG Notice: 210. Section II: Soil and Site Information. Salinas. KS.

_____ in Cooperation with Kansas Agricultural Experiment Station. 1978. Soil Survey of Allen County, Kansas. Washington, DC.

_____. 1985. Soil Survey of Cherokee County, Kansas. Washington, DC.

_____. 1982a. Soil Survey of Coffey County Kansas. Washington, DC.

_____. 1990. Soil Survey of Labette County, Kansas. Washington, DC.

_____. 1981. Soil Survey of Lyon County, Kansas. Washington, DC.

_____. 1982b. Soil Survey of Neosho County, Kansas. Washington, DC.

_____. 1972. Soil Survey of Woodson County, Kansas. Washington, DC.

_____. 1973. Soil Survey of Craig County, Oklahoma. Washington, DC.

U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Measurement Division. 2000. Table CA25. 1999 Full-Time and Part-Time Employment by Industry.

U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System. 2001. BEARFACTS: Coffey and Lyon, Kansas, 1998-99. August 2001.

United States Environmental Protection Agency, Office of Air Quality Planning and Standards. 2001a. National Ambient Air Quality Standards. http://www.epa.gov/airs/criteria.html.

_____. 2001b. Welcome to the Green Book: Nonattainment Areas for Criteria Pollutants. http://www.epa.gov/air/oaqps/greenbk/index.html.

_____. 2001c. Pollution Prevention/Environmental Impact Reduction Checklist for Dredging. http://es.epa.gov/oeca/ofa/pollprev/dredge.html

_____. 1998. 1997 National Air Quality: Status and Trends. http://www.epa.gov/oar/aqtrnd97/brochure/sixprin.html.

United States Fish and Wildlife Service. 2000. Letter with List of Threatened or Endangered Species for the Project Area. W. Gill signatory.

_____. 2001. Draft Fish and Wildlife Coordination Act Report. Kansas Field Office. Manhattan, KS.

_____. 2002. Final Fish and Wildlife Coordination Act Report. Kansas Field Office. Manhattan, KS.

_____. Flint Hills National Wildlife Refuge Comprehensive Conservation Plan. Lakewood, CO. September 2000.

_____. 2000. Fish Tales: Saving the Madtom Catfish, Gravel Paves the Road to Recovery. K. Gleason, Mountain-Prairie Region, No. 3. http://www.r6.fws.gov/feature/fishtales3.htm. Lakewood, CO.

_____. 2000. Aquatic Resources of Concern in Oklahoma. http://ifw2es.fws.gov/oklahoma/TEAQUAT12.htm

United States Geological Survey. 2001. Zebra Mussel (*Dreissena polymorpha*). http://nas.er.usgs.gov/zebra.mussel/docs/sp_account.html

_____. 1997. Neosho Madtom (*Notorus placidus*). http://ifw2es.fws.gov/oklahoma/madtom.htm

Wenke, T.L., M.E. Eberle. 1991. Neosho Madtom Recovery Plan. Natural Science Research Associates. USFWS, Region 6. Denver, CO.

Wildhaber, M. USGS, Aquatic Ecologist. 2001. Personal Communication with J. Von Loh, e^{2}M Biologist. May 31, 2001.

Wildhaber, M., V. Tabor, J. Whitaker, A. Allert, D. Mulhern, P. Lamberson, and K. Powell. 2000a. Ictalurid Populations in Relation to the Presence of a Main-stem Reservoir in a Midwestern Warmwater Stream with Emphasis on the Threatened Neosho Madtom. Transactions of the American Fisheries Society, 129: 1264-1280.

Wildhaber, M., A. Allert, C. Schmitt, V. Tabor, D. Mulhern, K. Powell, and S. Sowa. 2000b. Natural and Anthropogenic Influences on the Distribution of the Threatened Neosho Madtom in a Midwestern Warmwater Stream. Transactions of the American Fisheries Society, 129:243-261.

Wildhaber, M., A. Allert, C. Schmitt. 1999. Potential Effects of Interspecific Competition on Neosho Madtom (Notorus placidus) Populations. Journal of Freshwater Ecology, Volume 14, Number 1.

Wildhaber, M., A. Allert, C. Schmitt, V. Tabor, D. Mulhern, and K. Powell. 1998. Both Contaminants and Habitat Limit Neosho Madtom (*Notorus placidus*) Numbers in the Spring River, a Midwestern Warmwater Stream Affected by Runoff from Historic Zinc and Lead Mining. Fish Response to Toxic Environments, C. Kennedy and D. Mackinlay, International Congress on the Biology of Fish. Baltimore, MD.

Wilkinson, C., D. Edds, J. Dorlac, M. Wildhaber, C. Schmitt, and A. Allert. 1996. Neosho Madtom Distribution and Abundance in the Spring River. The Southwestern Naturalist, Volume 41, Number 1.

Williams, G. and G. Wolman. 1984. Downstream Effects of Dams on Alluvial Rivers. Geological Survey Professional Paper 1286. U.S. Government Printing Office. Washington, DC.

Witty, T.A., Jr. 1961. *Appraisal of the Archaeological Resources of the John Redmond Reservoir, Coffey and Lyon Counties, Kansas*. Kansas State Historical Society Appraisal, Topeka, KS.

_____. 1980. *Salvage Archaeology of the John Redmond Lake, Kansas*. Anthropological Series No. 8. Kansas State Historical Society, Wichita, KS.

Zurn, J. Coffey County Zoning Administrator. 2001. Personal communications with George Blankenship, Blankenship Consulting LLC. August 16, 2001.

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9.0 ACRONYMS AND ABBREVIATIONS

AD	Ano Domani
AFOS	Automated Field Observing Station
ASI	Area Susceptibility to Inundation
ASR	Au Sable River
BA	Biological Assessment
BEA	U.S. Bureau of Economic Analysis
BEFS	Bureau of Environmental Field Services
BP	Before Present
Ca	Calcium
CAA	Clean Air Act
CAP	Contaminant Assessment Process
CCED	Coffey County Economic Development
CCP	Comprehensive Conservation Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CFS	Cubic Feet Per Second
CNRB	Cottonwood and Neosho River Basins Water Assurance District Number 3
CO	Carbon Monoxide
Co^{60}	Cobalt-60
Cs^{137}	Cesium-137
CY	Calendar Year
DCP	Data Collection Platform
DOA	Department of the Army
DOMSAT	Data Output Message Satellite
DSEIS	Draft SEIS
DVA	Deer-Related Vehicle Accidents
e^2M	engineering-environmental Management, Inc.
EAC	Elevation Above Channel
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973
FEIS	Final Environmental Impact Statement
FFM	Flat Floater Mussel
FFPA	Farmland Protection Policy Act
FHNWR	Flint Hills National Wildlife Refuge
FR	Federal Register
GIS	Geographic Information System
GLO	General Land Office
GOES	Geostationary Operational Environmental Satellites
GRDA	Grand River Dam Authority
G/NRBC	Grand/Neosho River Basin Committee
H^3	Tritium
HCO_3	Carbonate
HPMP	Historic Preservation Management Plan

I^{131}	Radioiodine
JRL	John Redmond Lake (Reservoir)
K	Potassium
K.A.R.	Kansas Administrative Regulations
KBS	Kansas Biological Survey
KDH&E	Kansas Department of Health & Environment
KDOT	Kansas Department of Transportation
KDW&P	Kansas Department of Wildlife & Parks
KG&E	Kansas Gas and Electric
KGS	Kansas Geological Survey
KNHI	Kansas Natural Heritage Inventory
K.S.A.	Kansas Statutes, Anotated
KS	Kansas
KSHSSR	Kansas State History Society Site Report
KSU	Kansas State University
KSWR	Kansas Surface Water Register
KWO	Kansas Water Office
KWRB	Kansas Water Resources Board
L1UBHh	Lacustrine, Limnetic, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded
L2USAh	Lacustrine, Littoral, Unconsolidated Shore, Temporarily Flooded, Diked/Impounded
MO	Missouri
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
Na	Sodium
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969, as amended
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NMM	Neosho Mucket Mussel
NMT	Neosho Madtom
NO_2	Nitrogen Dioxide
NO_3	Nitrate
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSRA	Natural Science Research Associates
NTU	Nephelometric Turbidity Units
NWR	National Wildlife Refuge
NWS	National Weather Service
O_3	Ozone
OAQPS	Office of Air Quality Planning and Standards
OCWA	Otter Creek Wildlife Area

OK	Oklahoma
OKM	Ouachita Kidneyshell Mussel
Pb	Lead
Pb^{210}	Lead-210
PCB	Polychlorinated Biphenyl
PEMAh	Palustrine, Emergent, Temporarily Flooded, Diked/Impounded
PFOAh	Palustrine, Forested, Temporarily Flooded, Diked/Impounded
PSSA	Palustrine. Scrub-Shrub, Temporarily Flooded
PSSAh	Palustrine, Scrub-Shrub, Temporarily Flooded, Diked/Impounded
PM_{10}	Particulate Matter <10 microns
PO_4	Phosphate
RCRA	Resource Conservation and Recovery Act
R2UBHx	Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded, Excavated
RFM	Rabbitsfoot Mussel
RM	River Mile
Rn^{222}	Radon-222
RWSS	Reallocation of Water Supply Storage Project
SCS	Soil Conservation Service
SE	Southeast
SEIS	Supplement to the Environmental Impact Statement
SFY	State Fiscal Year
SH	State Highway
SHPO	State Historic Preservation Officer
SIC	Standard Industrial Classification
SO_2	Sulfur Dioxide
STORET	Storage and Retrieval (of Water-Related Data)
SUPER	USACE Suite of Computer Programs
TMDL	Total Maximum Daily Load
TOC	Top of Conservation Pool
TPU	Transportation and Public Utilities
US	United States
USACE	United States Army Corps of Engineers, Tulsa District
U.S.C.	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WCGS	Wolf Creek Nuclear Generating Station
WMP	Water Marketing Program
WPFO	Western Prairie Fringed Orchid

UNITS OF MEASUREMENT

°C	Degrees Celsius
ac-ft.	Acre-feet
cm	Centimeter
cm/s	Centimeters per second
lbs	Pounds
lbs/year	Pounds per year
lpm	Liters per minute
kg/year	Kilograms per year
km	Kilometer
m^2	Square meters
m^3	Cubic meters
mg/l	Milligrams per liter
mg/m^3	Milligram per cubic meter
MGD	million gallons per day
MGY	million gallons per year
mg/kg	Milligrams per kilogram
mm	Millimeter
mrem/yr	Millirem per year
MSL	Mean Sea Level
$\mu g/m^3$	Micrograms per cubic meter
pCi/l	PicoCuries per liter
pCi/kg	PicoCuries per kilogram
pCi/m^3	PicoCuries per cubic meter
ppm	Parts per million
trees/ha	Trees per hectare

10.0 GLOSSARY

Aesthetics	The visual perception of beauty and feeling of well being experienced by a site visitor.
Agriculture	The science or practice of cultivating the soil and producing crops, and in varying degrees the preparation and marketing of the resulting products.
Alkalinity	Soluble mineral salts present in natural water or arid soils.
Alluvium	Clay, silt, sand, gravel, or similar material deposited by running water.
Alternatives	Viable choices or courses of action that achieve the project purpose and need.
Ambient Air Quality	The atmospheric concentration of a specific compound (amount of pollutants in a specified volume of air) at a particular location, determined by the way wind patterns, precipitation patterns, and chemical reactions affect pollutants in the atmosphere.
Ambient Air Quality Standards	Standards established on a state or federal level that define the limits for airborne concentrations of designated criteria pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, lead) to protect public health with an adequate margin of safety (primary standards) and public welfare including plant and animal life, visibility, and materials (secondary standards).
Aquatic Species	Species adapted to life in standing or flowing water.
Archaeology	The scientific study of material evidence such as tools and buildings remaining from past human life and culture.
Attainment Area	An area that meets the National Ambient Air Quality Standards for a criteria pollutant under the Clean Air Act or that meets state air quality standards.
Avifauna	The inclusive term for all bird species.
Baseline (benchmark)	The physical and operational condition of John Redmond Dam, reservoir, and the Neosho River floodplain to near Grand Reservoir in Oklahoma, upon which future conditions are compared. For NEPA purposes the baseline year is 2000.
Bradytictic Breeder	Mussel species that attract potential hosts using a mantle lure.
Candidate Species	Species for which the USFWS has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.
Cobble	Large, rounded rocks found on riverbeds and gravel bars.

Conductivity	A numerical expression of the ability of a water sample to carry an electric current.
Conservation Pool	Stored water used to supply downriver water rights, provide water quality flows, provide wildlife habitat, and support recreation interests.
Contaminant Pathway	Method or route by which a receptor is exposed to contamination.
Contamination	The degradation of naturally occurring water, air, or soil quality either directly or indirectly as a result of human activities.
Council on Environmental Quality	Established by NEPA, consists of three members appointed by the president. CEQ regulations describe the process for implementing NEPA, including preparation of environmental assessments and environmental impact statements, and timing and extent of public partcipation.
Cultural	The nonbiological and socially transmitted system of concepts, institutions, behavior, and materials by which a society adapts to its effective natural and human environment; and similar or related assemblages of approximately the same age from a single locality or district, thought to represent the activities of one social group.
Cultural Resources	Includes any object, site, area, building, structure, or place that is archaeologically or historically significant, or that exhibits traditional cultural value, e.g., properties sacred to Native Americans or other ethnic groups. The definition includes assets significant in the architectural, scientific, engineering, economic, agricultural, educational, social, political, military, or cultural annals of the area.
Cumulative Impacts	The combined effects resulting from all programs occurring concurrently at a given location.
Dead Storage	Water pooled below the discharge elevation through a dm.
Detention Ponds	Constructed depressions used to capture flows, dissipate water energy, and contain sediments.
Developed	Land, lot, parcel or area that has been built upon or where public services have been installed prior to residential, commercial, or industrial construction.
Direct Impact	Effects resulting solely from the proposed action.
Disposal	Transfer of sediments from a lakebed to another site.
Diversity	The number of animal and plant species present within a habitat.
Dredge	Remove or displace sediments by mechanical means to deepen channels or water bodies such as lakes or bays, typically for navigation purposes.
Drought	A long period with no rain.

Ecoregion Province	Ecosystems of regional extent; an area of large size where there is a distinctive association of interconnected biological and environmental features.
Effluent	Waste material discharged into the environment.
Emergent Species	Wetland plant species that grow from standing or flowing water and also from saturated soils.
Endangered Species	Species of animal or plant formally listed by the USFWS as endangered.
Environmental Impact Statement	A detailed informational document required of federal agencies by NEPA for major projects or legislative proposals significantly affecting the environment. A tool for decision-making, the EIS describes the positive and negative effects of the undertaking and lists alternative actions.
Environmental Justice	The examination of project-induced disproportionate human health or environmental adverse impacts upon minority and low-income populations. Federal agencies are required to examine environmental justice impacts pursuant to Executive Order 12898.
Exotic Species	Non-native species of animals or plants.
Extirpated	No longer present in previously occupied habitat.
Fallow	Unplanted agricultural land, usually in a rest-rotation cropping plan.
Federal Register	Official publication of government announcements and decisions.
Flood Plain	The area adjacent to a river expected to be inundated in a 100-year flood.
Flood Control Pool	Area where floodwater is stored upriver of a dam, to be released in a controlled manner to reduce the peak flow.
Gamma Analysis	A measurement of radiation.
Gravel	Medium-sized particles, intermediate between sand and cobbles.
Gross Beta Analysis	A measurement of radiation from a high-speed electron or positron undergoing decay.
Ground Water	Water in subsurface areas, collected due to porous an permeable geologic formations, that supplies wells and springs.
Habitat	The place or environment where a plant or animal normally grows or lives.
Hazardous Material	A substance or mixture of substances that poses a substantial risk or potential risk to human health or the environment.

Hazardous Waste	A waste or combination of wastes that, because of quantity, concentration, or physical, chemical, or infectious characteristics, may either cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness; or may pose a substantial hazard or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.
Herpetiles	Species of amphibians and reptiles, inclusive.
Historic Resources	A period after the advent of written history dating to the time of the first Euro-American contact in an area. Also refers to items primarily of Euro-American manufacture.
Hydrology	The properties, circulation, and distribution of water on or below the earth's surface.
Ictalurids	Species of catfish.
Impacts	An assessment of the meaning of changes in all attributes being studied for a given resource; an aggregation of all the adverse effects, usually measured using a qualitative and nominally subjective technique.
Integrated Pest Management	An approach to exotic plant species invasions using farm management practices, prescribed burning, chemical application, and biological controls among others.
Introduced Species	Typically non-native species raised or grown for income.
Invasive Species	Non-native or native species that are aggressive and tend to dominate sites as in a monoculture. These species typically require management controls.
Lead Agency	The federal agency with primary responsibility for preparing an EIS.
Leased Land	Land with a legally binding agreement in place for management, an example being cropland.
Lithic	Of, related to, or being a stone tool.
Loam	A soil that consists of varying proportions of clay, silt, and sand.
Logjam	Area of the Neosho River where tree debris has settled out because of low flow velocity.
Long-term Impacts	Impacts that would occur over an extended period.
Low-elevation Dams	In-channel water diversion structures that are usually less than ten feet high and typically used to direction flows for irrigation or municipal water supply.
Mesic	Moist sites or species adapted to moist sites.
Mitigation	A method or action to reduce or eliminate program impacts.

Native Americans	Individuals, bands, or tribes who trace their ancestry to indigenous populations of North America prior to Euro-American contacts.
Native Vegetation	Indigenous plant life that occurs naturally in an area without agriculture or cultivation applications.
Notice of Intent	A notice, required under NEPA, that is prepared by the federal lead agency and published in the Federal Register, immediately after deciding that an EIS is necessary. The NOI briefly describes the proposed action and alternatives, explains the scoping process and the opportunity to participate in scoping meetings, and lists the contact person within the lead agency.
Passerine Species	The group of birds commonly known as songbirds.
pH	An expression of the hydrogen ion concentration, indicating acidity or alkalinity.
Pool Raise	Storing additional water in the conservation pool, allowing water to back to a higher level behind the dam structure.
Potable Water	Water suitable for drinking.
Radionuclides	Isotopes that emit waves or particles.
Raptor	Birds of prey, including eagles, hawks, owls, and falcons.
Reallocation	Adding stored water to the conservation pool, with a small reduction of capacity for flood storage.
Recreation	The pursuit of leisure time for personal refreshment and relaxation.
Recruitment	Add to the population by producing offspring.
Riffles	Turbulent water resulting from a high rate of flow through a shallow area of a river channel with a congregation of larger particles (boulders, gravel) in the substratum.
Riparian	Pertains to the features on the bank of a natural watercourse.
River Bank Erosion	The sloughing or caving of river bank soils into the water in the course of natural meandering or during flood events.
Runoff	The non-infiltrating water entering a stream or other conveyance channel shortly following a precipitation event.
Scoping	Process for determining the range of issues that should be addressed prior to implementation of a proposed action.
Sediment	Rock or mineral fragments weathered from existing rock. It is transported by wind, water, ice, or gravity and deposited in unconsolidated layers.
Sedimentary Exposures	Rock formed when soft sediment is hardened or lithified.

Shorebirds	The group of wading birds including gulls, stilts, sandpipers, plovers, egrets, and herons, among others.
Short-term Impacts	Impacts that occur over a relatively brief period of timeand are of short duration.
Significance	The importance of a given impact on a specific resource as defined under CEQ regulations.
Silt	Individual mineral particles that range in diameter from the upper limit of clay (0.002 mm) to the lower limit of fine sand (0.05 mm).
Site	The location of past cultural activity; a defined space with more or less continuous archaeological evidence. A specific area.
Soil	A natural, three-dimensional body at the earth's surface. Soil is capable of supporting plants and has properties resulting from climate, living matter, relief, and parent material.
Socioeconomics	Involves a combination of economic and social factors.
Surface Water	All water naturally open to the atmosphere and all wells, springs, or other collectors that are directly influenced by surface water.
Tachytictic Breeder	Mussel species that release larvae generally in the water to find and attach to host fish gills.
Terrestrial	Species that live or grow on land.
Threatened Species	Plant and wildlife classifications that could become endangered in the foreseeable future.
Toxic	Harmful to living organisms.
Turbidity	A measurement of suspended particles or sediment.
Waterfowl	The group of birds including ducks, geese, swans, and coots.
Water Level Management Plan	A determination of water elevations and timing to enhance fish and wildlife habitat within a site.
Water Quality	Physical and chemical condition of water that includes temperature, specific conductance, and pH among others.
Watershed	The entire land area that collects and drains water into a river or River system.
Water Storage	Water pooled behind a dam for beneficial use.
Water Supply Reallocation	Raising the elevation of stored water in the conservation pool while slightly reducing the amount of flood pool storage capacity.
Water Supply Yield Analysis	Determination of storage volume in the conservation pool after subtracting the amount of sediment present.

Wetland	Areas that are inundated by surface or ground water for a long enough period of time each year to support, and do support under natural conditions, plants and animals that require saturated or seasonally saturated soils.

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This section contains the list of personnel contributing to SEIS production and presents pertinent information concerning the organizations, project responsibilities, and experience level.

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