US Army Corps of Engineers
Kansas City District

Draft Environmental Impact Statement

Kansas River
Commercial Sand and Gravel Dredging

Proposed by Kansas Aggregates Producers Association:

Kaw Valley Companies, Inc.;
Holliday Sand & Gravel Company;
Master's Dredging;
Builder's Choice Aggregates;
and
LBB L.L.C.

October 2016

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List of Acronyms

$\mu g/m^3$	microgram(s) per cubic meter
A.D.	*anno Domini*
APE	area of potential effect
BMPC	Bowersock Mills and Power Company
BNSF	Burlington Northern Santa Fe
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO_2e	carbon dioxide equivalent
CSR	Code of State Regulations
CWA	Clean Water Act
DA	Department of the Army
dB	decibel
dBA	A-weighted decibels
DDT	dichlorodiphenyltricholoroethane
Dredgers	five dredging companies/applicants
EA	environmental assessment
EIS	environmental impact statement
EO	Executive Order
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFPA	Farmland Protection Program Act
FISH	Fishing Impoundments & Stream Habitats
FONSI	Finding of No Significant Impact
FR	Federal Register
GHG	greenhouse gas
I-435	Interstate Highway 435
I-70	Interstate Highway 70
IPD	implicit price deflator

IPSR	Institute for Policy and Social Research
KAPA	Kansas Aggregate Producers Association
KDHE	Kansas Department of Health and Environment
KDOT	Kansas Department of Transportation
KDWPT	Kansas Department of Wildlife, Parks and Tourism
K.S.A.	Kansas Statutes Amended
KWO	Kansas Water Office
L_{dn}	day-night level
L_{eq}	equivalent sound level
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
mg/L	milligrams per liter
mph	mile(s) per hour
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NOI	notice of intent
NO_x	oxides of nitrogen
PM	particulate matter
ppb	parts per billion
ppm	parts per million
RHA	Rivers and Harbors Act
RM	RM
RSMo	Missouri Revised Statutes
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
TMDL	total maximum daily load
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USC	United States Code
USCG	United States Coast Guard

USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WaterOne	Water District No. 1 of Johnson County, Kansas

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CHAPTER 1

Introduction

1.1 INTRODUCTION

Five dredging companies (Dredgers) have filed applications collectively as the Kansas Aggregates Producers Association (KAPA) with the United States Army Corps of Engineers (USACE), Kansas City District requesting Department of the Army (DA) authorization for the continuation of commercial dredging of sand and gravel (dredging) from the Kansas River. The proposed permits would authorize the Dredgers to hydraulic dredge sand and gravel from the bed of the Kansas River utilizing a suction head device driven by a barge-mounted pump. Each Dredger would pump the slurry of water, sand and gravel to a land-based facility for processing. There they would separate, sort, and stockpile the desired sand and gravel for sale. The waste water would be discharged into a settling basin where the sediments should settle out. The outfall would be discharged back to the river through a pipe or sluiceway.

1.2 REGULATORY AUTHORITY

The Kansas River is one of three rivers listed as navigable by the State of Kansas and is federally designated as a Navigable Water of the U.S. The USACE regulates dredging in Navigable Waters of the U.S. under authority of Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 United States Code [USC] 403), (hereinafter referred to as Section 10). The USACE also regulates the discharge of dredged or fill material into a water of the United States under Section 404 of the Clean Water Act (CWA) (33 USC 1344). The Final Rule for the Regulatory Programs of the Corps of Engineers at Title 33 of the Code of Federal Regulations part 323.3 (33 CFR 323.2) treats “dredged material” and “fill material” separately and distinctly even though the discharge of either type of material into a water of the U.S. can change the bottom elevation of that water of the U.S. The term “dredged material” means material that is excavated or dredged from waters of the U.S. (33 CFR 323.2(c)). The USACE has determined that the proposed dredging itself does not result in a discharge subject to regulation under Section 404. Dredge return water is regulated as a discharge of dredged material when it is in the form of runoff or overflow from a contained land or water disposal area (33 CFR 323.2 (d)(1)(ii)). However, the regulation at 33 CFR 323.2 (d)(2) identifies several activities that are specifically not a discharge of dredged material, including "(i) Discharges of pollutants into waters of the United States resulting from the onshore subsequent processing of dredged material that is extracted for any commercial use (other than fill). These discharges are subject to Section 402 of the CWA even though the extraction and deposit of such material may require a permit from the Corps or applicable State section 404 program." Therefore, return water discharged from onshore processing plants of these commercial sand and gravel dredging operations is considered a point source discharge subject to regulation under authority of Section 402. Therefore, the USACE regulates the proposed dredging only under Section 10 and not under Section 404.

1.3 NATIONAL ENVIRONMENTAL POLICY ACT

Issuance of the requested permits by the USACE is a discretionary federal action that requires an environmental review by the USACE in accordance with the provisions of the National Environmental Policy Act (NEPA). Unless a federal action is categorically excluded (NEPA Implementing Regulations; 40 CFR, Parts 1500 – 1508), NEPA regulations require preparation of a basic Environmental Assessment (EA) for government funded or authorized actions that would result in finding of no significant environmental impacts (FONSI) and an Environmental Impact Statement (EIS) for those actions that are likely to result in significant environmental impacts. In 1978, in response to concerns expressed by state and federal resource agencies and others, the USACE informed concerned agencies that its findings indicated that unrestricted dredging in the Kansas River had resulted in significant adverse impacts. In response to the USACE announcement, the United States Fish and Wildlife Service (USFWS) and the United States Environmental Protection Agency (USEPA) agreed to a proposal to indefinitely extend all dredging permits on the river until completion of the study and EIS. In 1990, USACE completed an EIS entitled, "*Final Regulatory Report and Environmental Impact Statement – Commercial Dredging on the Kansas River*" (1990 Kansas River Dredging EIS) (USACE, 1990a) and implemented the "*Regulatory Plan for Commercial Dredging on the Kansas River"* (Regulatory Plan) (USACE, 1990b). The Regulatory Plan contained restriction to limit dredging-related impacts to an acceptable level in order to ensure that authorized dredging would not result in significant impacts. Because of the dredging restrictions and degradation limits imposed by the Regulatory Plan, the USACE has based subsequent decisions (post 1990) to issue or deny Kansas River dredging permits on EAs that resulted in a FONSI.

However, on November 9, 2011, the USACE published a public notice requesting public comments regarding the reauthorization of the dredging permits as proposed by the Dredgers (USACE, 2011d). The USACE received various comments suggesting that an EIS should be prepared because of perceived impacts and the time elapsed since the 1990 Kansas River Dredging EIS was completed. The USACE determined that a thorough analysis was needed in accordance with NEPA regarding conditions and environmental effects associated with the proposed dredging permits. As a result of these comments, the Dredgers prepared the *Environmental Report: Kansas River Commercial Sand and Gravel Dredging* document in September 2013 (Habitat Architects, 2013). Subsequently, the USACE and USEPA informed the applicants in a letter dated April 15, 2014, which was issued after the agencies met with the Dredgers on March 27, 2014 to discuss the status of the draft EA, that the preparation of an EIS in compliance with NEPA would be required to authorize the permit renewals under Section 10 of the RHA of 1899 (33 USC 403). Therefore, the USACE decided to prepare an EIS for the proposed permit reauthorization.

This Draft EIS considers all known, relevant and available information, which includes:

- The 1990 Kansas River Dredging EIS and supporting documents;
- Survey data collected in accordance with the requirements of the Regulatory Plan;
- Reports and studies produced since 1990; and
- The 2013 Environmental Report, compiled by Habitat Architects on behalf of the Dredgers, used for completion of the draft EA.

1.4 COMMERCIAL DREDGING HISTORY AND BACKGROUND

The Kansas River is the second largest river, by volume of flow, in the State of Kansas. The river, its floodplain, and adjacent lands have developed into a major corridor for travel and commerce. Several of the state's largest communities and many smaller communities are located in or along the Kansas River corridor. Commercial dredging is an activity that has taken place on the river since the early 1900s. Sand and gravel produced from the Kansas River has been the primary source of high quality, low cost construction sand and gravel needed for the development of cities and counties sited along the river and for construction of state and federal transportation infrastructure located in and near the Kansas River corridor.

1.4.1 Overview of the Kansas River

The Kansas River is located in northeastern Kansas and derives its name from the Kanza or Kaw tribe of Native Americans. The river is approximately 170 miles long, beginning at the confluence of the Republican and Smokey Hill Rivers near Junction City, Kansas and ending at its confluence with the Missouri River in Kansas City, Kansas (Figure 1). The river has a relatively flat slope, dropping an average of less than 2 feet per mile in a river valley that averages 2.6 miles in width. The Kansas River transects or borders ten counties including Geary, Riley, Pottawatomie, Wabaunsee, Shawnee, Jefferson, Douglas, Leavenworth, Wyandotte and Johnson. These ten counties account for more than 40 percent of the state's population, with six of the state's ten largest cities located along the river's banks. The Kansas River drains approximately 60,000 square miles consisting mostly of agricultural land. The drainage area includes approximately 34,423 square miles in Kansas, 16,916 square miles in Nebraska and 8,775 square miles in Colorado (Brady, et al., 1998).

Average annual rainfall decreases significantly from east to west with approximately 38 inches of rainfall per year near Kansas City and approximately 18 inches per year near the City of Goodland. Of the approximately 60,000 square mile drainage basin, 44,870 square miles are located upstream of Fort Riley and produce approximately one-third of the flow at DeSoto, while the 14,886 square miles of drainage downstream of Fort Riley produce two-thirds of the flow at DeSoto (USACE, 2010).

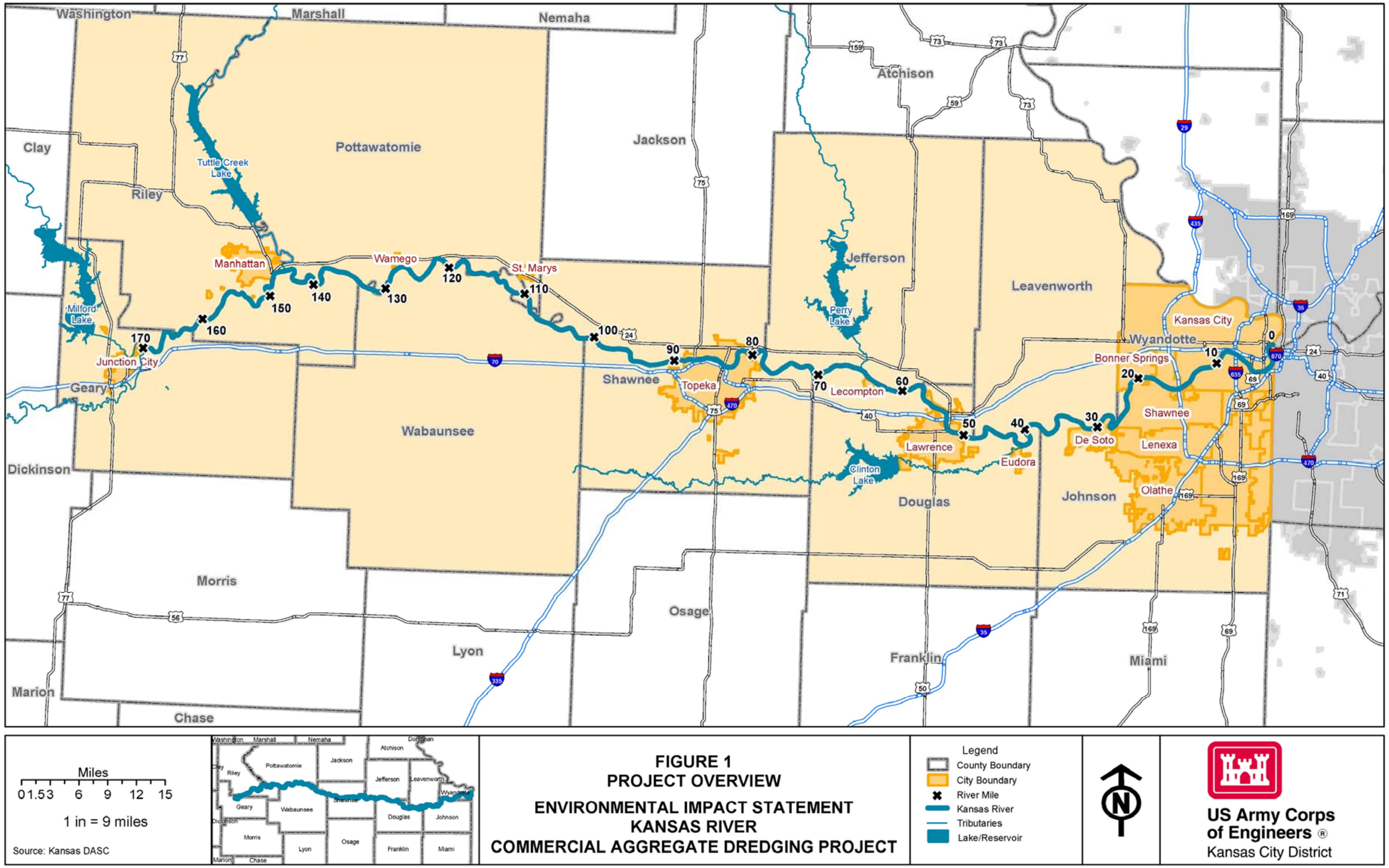

Figure 1 Project Area

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The Kansas River basin lies east of the Rocky Mountains in the Great Plains and Central Lowlands physiographic provinces. The river flows through what is known as the Stable Interior Region, an area near the center of the North American Plate that has not experienced any extensive geologic faulting, folding or mountain building in recent geologic time. The river flows through limestone, shale, and sandstone strata that have remained largely undisturbed since they were deposited beneath the Western Interior Seaway. Numerous tributaries flow into the Kansas River including the Big Blue River at Manhattan, Vermillion Creek between Wamego and Belvue, Cross Creek at Rossville, Soldier Creek at Topeka, the Delaware River at Perry, Stranger Creek at Linwood, Mill Creek at Maple Hill, and the Wakarusa River near Eudora. Smaller tributaries that drain highly urbanized areas along the Kansas River include Cedar Creek at DeSoto, Mill Creek at Shawnee, and Turkey Creek in Kansas City.

Eighteen federal reservoirs, operated by the USACE and the United States Bureau of Reclamation (USBR), impound water on all of the major tributaries to the Kansas River except Vermillion Creek, Mill Creek, Soldier Creek and Stranger Creek.

The Kansas River was nearly unknown as an artery of commerce prior to enactment of the Kansas-Nebraska Act, which established the Territory of Kansas. Shortly after the Act was signed into law on May 30, 1854, the first great influx of settlers arrived at Westport, Missouri and farther upstream at Fort Leavenworth, Kansas on steamboats traveling up the Missouri River. From the 1840s through the 1870s, the ridgelines along the southern side of the lower reach of the Kansas River were the beginnings of the Oregon, California and Santa Fe trails leading west from Kansas City. During this period of early overland travel to the far west, the Kansas River valley served as a corridor for travelers bound for the west with river crossings located at Papan’s Ferry in Topeka, further upstream at Uniontown across a rock bottom ford, and at another ford located near Fort Riley (Kansas Cyclopedia, 1912).

To support a growing population and to encourage commerce, the Kansas legislature of 1857 passed an Act to encourage navigation of the Kansas River. The Act established an organization, recognized as the Kansas River Navigation Company, for the purpose of employing one or more steamboats to navigate the Kansas River and its tributaries for the conveyance of passengers, towing boats, vessels or rafts, and the transportation of merchandise or other articles. Steamboats operated regularly on the river from Kansas City to Lawrence and Topeka, and sometimes as far west as Fort Riley. Riverboat traffic continued through the territorial period and into the early years of statehood, falling off rapidly in the early 1860s due to the difficulty of navigating the river during low flows and increasing competition from railroads. In 1864, the railroads successfully lobbied the Kansas legislature for passage of an Act that declared the Kansas, Republican, Smoky Hill, Solomon and Big Blue Rivers not navigable and authorized construction of bridges across the rivers. The Act was intended to remove competition that might develop if the rivers were left open to unobstructed navigation. In 1913, the Kansas legislature repealed the non-navigable status of the Kansas River and restored its navigable designation.

The Kansas River valley serves as a major transportation corridor within the state. The river provides sand and gravel for use in construction materials, water for public and commercial uses, and recreational opportunities such as fishing, canoeing and kayaking. Transportation networks include the Union Pacific Railroad along the north side of the river between Kansas City and Junction City, the Burlington Northern Santa Fe (BNSF) Railroad along the south side of the river between Kansas City and Topeka, Interstate 70, U.S. Highway 24, Kansas Highway 18, Kansas Highway 32, and Kansas Highway 10.

1.4.2 Overview of Kansas River Sand and Gravel Dredging Operations

Sand and gravel dredging operations on the Kansas River consist of two components, the in-river material harvesting component and the land-based material processing and delivery component. Dredging operations on the river involve the use of a hydraulic dredge to pump a slurry of sand, gravel and water to a land-based processing plant. The material is pumped from the dredge to the processing plant through a pipeline that either floats on or lies below the water surface. The dredge is moored against the river's current by cables attached to trees or other fixed structures located on the adjacent riverbanks.

The dredge provides a mounting platform for an engine driven centrifugal pump that is attached to a suction line mounted on an articulating arm (ladder) that lowers the line's suction head to the bed. The suction head is typically paired with either a chain-link cutter or a rotating circular cutter-head that loosens compacted sand and gravel deposits to aid the dredging process. The ladder pivots vertically to control the elevation (depth) of the suction head, which typically reaches a depth of 25 feet below the water surface (up to 65 feet with an extension). Material is harvested from the bed until the suction head comes into contact with resistant or undesirable materials such as bedrock or clay and silt deposits, or until the ladder has reached its maximum depth. The dredge mooring cables are manipulated with winches to move the dredge through a horizontal arc to provide a continuous supply of material for the suction head. The slurry pumped to the processing plant is typically 20 percent solids (sand and gravel) and 80 percent water. The characteristics of the excavated material can be highly variable; grain sizes can include small stones, coarse and fine gravels, sands of various sizes, and fine material.

The processing plant routes the incoming slurry through settling chambers or sorting screens to separate sand and gravel based on grain size. The sorted material is mixed, if necessary, to meet specifications for various construction uses, and is stockpiled for sale. The most common specifications are for concrete, asphalt and masonry mixes. Other materials produced in smaller quantities include dry sand (high-grade sand used in glass production), gravel for landscaping, and non-structural concrete mixes. The USACE's existing permit Special Conditions require routing the return water separated from the processed sand and gravel to a settling basin prior to its reintroduction to the river, in order to limit the volume of silt and other fine materials returned to the river.

Plant sites typically contain material sorting and dewater equipment, a system of overhead conveyors, stackers, loaders and other equipment for moving and stacking bulk materials, truck loading facilities, scales, fueling stations, equipment maintenance facilities, and an office. Plants are normally sited near improved roads with direct access to county, state, and federal highway systems for product transport. Dredges typically operate on the river from March through December or January and may operate through the winter months if mild weather persists.

1.4.3 History of Commercial Dredging

Commercial dredging on the Kansas River can be traced as far back as the early 1900s. Early dredging provided sand and gravel for a variety of commercial industries including general construction and road building. The sand and gravel historically needed along the Kansas River corridor has primarily come from the Kansas River, but has increasingly come from pit mines located in the Kansas River floodplain. The sand and gravel needed in the greater Kansas City Metropolitan Area is also provided by dredging in the Missouri River and in pit mines located in the Missouri River floodplain.

DA permits have historically been required, under Section 10, to dredge the Kansas River. Prior to the 1960s, the USACE did not generally view dredging on the river as being particularly detrimental to river channel stability. Beginning in the early 1960s, various entities maintaining structures (bridges, pipelines, etc.) within the river channel in the lower 22 miles of the Kansas River expressed concerns relating to channel degradation. Between the early 1960s and the late 1970s, various state and federal agencies began to examine the issue of declining bed elevations (hereinafter referred to as bed degradation) downstream of Bonner Springs.

In the mid-1960s, the Kansas Water Resources Board responded to concerns brought to its attention regarding increasing bed degradation in the lower Kansas River. They requested that the United States Geological Survey (USGS) prepare a report to address the apparent "serious degradation" of the channel downstream of Bonner Springs. In 1967, the USGS completed a report entitled, "*Kansas River, Bonner Springs to Mouth – Degradation of Channel*" (USGS, 1967). The report noted that the data reviewed indicated that the low discharge stage in an 11-mile-long reach between Turner Bridge and Bonner Springs (approximately RMs [RMs] 9.3 to 20), had lowered an average of 2.6 feet for the period 1952 to 1965. The report further noted that the 9.3-mile-long reach of river downstream of Turner Bridge (backwater of the Missouri River) also showed a decline in stage, which measured approximately 0.5 foot at the mouth of the river. The report states that the observed reduction in stage downstream of Bonner Springs could have been caused by such factors as increased reservoir regulation upstream, a change in channel capacity, a change in bed slope, a change in sediment load, improved flow characteristics downstream, or dredging. The report exams each of the possible causal factors and concludes that dredging is the most likely cause. The following statement regarding the future rate of bed degradation downstream of Bonner Springs was presented in the report (USGS, 1967):

> *"The rate at which degradation of the channel will continue and its ultimate extent, depend largely on how much sand and gravel are removed in the future and on changes in the frequency and magnitude of floods, bankfull flows, and low flows."*

In the early 1970s, the Atchison, Topeka and Santa Fe Railway Company expressed concerns regarding degradation of the bed in the vicinity of its bridge near RM 21 (the bridge no longer exists) at Bonner Springs. At the same time, a number of gas pipelines located in the bed downstream of RM 21 had become exposed because of bed degradation.

In 1978, in response to concerns expressed by state and federal resource agencies and others, the USACE informed concerned agencies that its findings indicated that unrestricted dredging in the Kansas River had resulted in significant adverse impacts. The USACE let the dredging permits expire in the spring of 1977, and did not renew them because of the controversy surrounding the dredging issue. In early 1978, the USACE and other involved agencies agreed to allow dredging to continue through April 1, 1979 while the issues were being evaluated. The single permit issued to reauthorize dredging immediately downstream of Bowersock Dam, was the first dredging permit on the river to contain an annual dredging limit (150,000 tons) that was intended to minimize bed degradation within a specified reach of the river.

In the fall of 1978, the USACE informed interested parties that it would prepare a fish study and an EIS that would address the impacts associated with dredging the Kansas River. In response to the USACE announcement, the USFWS and the USEPA agreed to a proposal to indefinitely extend all dredging permits on the river until completion of the study and EIS. In early 1979 the USACE indefinitely extended the permits, which remained extended until the USACE completed the Kansas River Dredging EIS in 1990.

In the spring of 1979, the USACE awarded a contract to the University of Kansas to evaluate the impact of dredging on fish populations in the lower Kansas River. The fisheries study was the first of many contracts awarded by the USACE to fully evaluate potential impacts associated with dredging. The USACE completed the Kansas River Dredging EIS in 1990, and concluded that continued unrestricted dredging in the river would result in significant and unacceptable environmental impacts. The Kansas River Dredging EIS concluded that the environmentally preferred alternative was the “Restricted Dredging Alternative”. The Restricted Dredging Alternative included implementation of a Regulatory Plan that contained restrictions to limit dredging-related impacts to an acceptable level in order to ensure that authorized dredging would not result in significant environmental impacts. The 1990 Kansas River Dredging EIS contains a list of the studies prepared to address the issues considered in the document and discussions relating to various study findings. The 1990 Kansas River Dredging EIS and its Regulatory Plan (Appendix A of the 1990 EIS) are available on the USACE website at: www.nwk.usace.army.mil/Missions/RegulatoryBranch.aspx.

Since 1991, the USACE has issued new permits in accordance with the restrictions contained in the Regulatory Plan, which resulted in a substantial reduction in the annual amount of material extracted from the river. The Regulatory Plan included various restrictions developed to minimize dredging-related impacts (i.e., a limit on the amount of future bed degradation that would be allowed, a limit on the annual amount of material that could be extracted from an individual dredging area, a limit on the cumulative annual amount of material that could be extracted from specified reaches of the river, and setback limits from riverbanks and sensitive structures such as bridge piers and pipelines buried in the bed). The Regulatory Plan divided the river into 4 unique reaches in order to develop and implement the restrictions needed to reduce dredging-related impacts to an acceptable level in each of those reaches. The four reaches are identified as:

- Reach 1 – RMs 0.0 to 21.2 near the former Atchison, Topeka and Santa Fe Railway Bridge at Bonner Springs (the bridge no longer exists);
- Reach 2 – RMs 21.2 to 48.0 downstream of Bowersock Dam;
- Reach 3 – RMs 48.0 to 51.8 at Bowersock Dam; and
- Reach 4 – RMs 51.8 to 170.4 at the confluence of the Kansas, Republican and Smokey Hill Rivers.

The maximum cumulative annual dredging rate established in the Regulatory Plan for any 15-mile-long segment of the river located in Reaches 2 and 4 (145.4 total RMs) was based on the observed response of the river channel in the Topeka area to the average annual dredging of approximately 40,000 tons of material per RM over a 20-year period. The reach of river through Topeka had degraded approximately 1 foot per decade; and it was assumed that a similar response would occur in most areas upstream of RM 21.2. The Topeka findings resulted in implementation of a restriction that limits the annual dredging rate to 750,000 tons within any 15-mile-long segment of the river in Reaches 2 and 4. The annual dredging rate was limited to 1,000,000 tons per year in Reach 1 (reduced from as much as 3,000,000 tons per year), and 150,000 tons per year in Reach 3 to limit the potential impact to Bowersock Dam. Table 1 summarizes the cumulative annual dredging rate restrictions implemented for the four unique reaches identified in the Regulatory Plan.

Table 1 Cumulative Total Annual Dredging Limits by River Reach

Reach	RMs	Annual Tonnage Limits
1	0.0 – 21.2	1,000,000 tons
2	21.2 – 48.0	750,000 tons / 15 miles
3	48.0 – 51.8	150,000 tons
4	51.8 – 170.4	750,000 tons / 15 miles

Based on available dredging location history, Reach 1 has historically been the most heavily dredged reach of the river. The total annual dredging quantities from this reach prior to 1991 may have exceeded 3,500,000 tons in some years. The majority of the dredging in Reach 2 has occurred since implementation of the Regulatory Plan and reauthorization of permits in 1991. Reach 3 has been dredged by the same family for 60 to 70 years and has experienced a relatively modest annual rate of removal, which may have exceeded 250,000 tons of material in some years. Historic dredging operations in Reach 4 can be traced back 50 to 60 years with annual dredging amounts ranging from 200,000 to 400,000 tons per dredge per year. Historic dredging in Reach 4 was concentrated in the Topeka area with a small number of dredge sites located in the Manhattan and Wamego areas. Dredging in the Topeka area has declined in the last 20 years. No dredging has occurred in the Kansas River near Manhattan or Wamego since reauthorization of permits in 1991.

Historic records are relatively complete regarding the locations and quantities of sand and gravel extracted from the river annually from 1991 to the present. Annual dredging records are less complete prior to implementation of the Regulatory Plan and reauthorization of dredging permits in 1991. Table 2 presents the total annual tonnage extracted from the Kansas River from 1960 through 2015.

Table 2 Total Annual Tonnage Extracted From the Kansas River

Year	Extracted (Tons)	Permitted (Tons)	Percent of Allowable Dredging
1960s (avg. annual)*	3,053,260	Unlimited	NA
1970s (avg. annual)*	3,197,216	Unlimited	NA
1980s (avg. annual)*	3,121,833	Unlimited	NA
1990	No Tonnage Available	Unlimited	NA
1991**	2,995,262	4,776,500	62.71
1992**	2,855,898	4,317,700	66.14
1993**	2,916,094	3,858,800	75.57
1994**	2,697,728	3,400,000	79.34
1995**	2,948,019	3,400,000	86.71
1996**	2,988,000	3,400,000	87.88

Table 2 Total Annual Tonnage Extracted From the Kansas River

Year	Extracted (Tons)	Permitted (Tons)	Percent of Allowable Dredging
1997*	2,777,860	3,400,000	81.70
1998*	2,455,930	3,400,000	72.23
1999**	2,490,472	3,400,000	73.25
2000**	1,847,536	3,400,000	54.34
2001**	2,046,058	3,400,000	60.18
2002**	1,615,920	3,400,000	47.53
2003**	1,847,155	3,400,000	54.33
2004**	1,667,449	3,400,000	49.04
2005**	1,349,510	3,400,000	39.69
2006**	1,721,524	2,700,000	67.51
2007**	1,323,163	2,200,000	60.14
2008**	1,118,093	2,200,000	50.82
2009**	1,228,509	2,200,000	55.84
2010**	940,061	2,200,000	42.73
2011**	994,387	2,200,000	45.20
2012**	1,244,027	2,200,000	56.55
2013**	1,184,255	2,200,000	53.82
2014**	768,798	2,200,000	34.94
2015**	509,145	2,200,000	23.14

* Extracted tonnage provided by the Kansas Department of Revenue – Planning and Research Records

** Extracted tonnage provided by the USACE, Kansas City District

NA = Not Applicable

1.4.4 Bed Degradation

The period from 1950 through the 1980s included significant natural and manmade events that influenced the morphology of the Kansas River. The flood of 1951 and the subsequent completion of the federal reservoir system on the river's major tributaries altered the dynamics of the river. In addition, bank stabilization structures were constructed along critical reaches of the river during this period to stabilize the channel. During this same period, the production of sand and gravel from the river was relatively high with cumulative annual dredging totals averaging more than 3,000,000 tons for the period 1960 to 1990, until comprehensive restrictions were imposed by the USACE in 1991.

The Regulatory Plan, implemented by the USACE in 1991, established a monitoring program to evaluate changes in bed elevations and overall channel stability in order to limit the impact of dredging on channel morphology, river ecology, manmade structures and other public interests. Survey monuments were established after completion of the 1990

Kansas River Dredging EIS to provide permanent cross-section survey locations at 1.5-mile intervals in two river areas that overlapped all dredging. Survey locations in “Survey Area 1” extend from RM 9.4 (near Turner Bridge at the normal upstream limit for Missouri River backwater) to RM 51.5 (approximately 1,500 feet downstream of Bowersock Dam). Survey locations located in “Survey Area 2” extend from RM 72.1 (approximately 10 miles downstream of Topeka) to RM 96.5 (approximately 10 miles upstream of Topeka). These survey locations at 1.5-mile intervals provide the basic information needed to monitor the general condition of each survey area. Additional survey locations are required at 1,000 to 1,500 foot intervals through and adjacent to each dredging area located within Survey Areas 1 and 2; and one monumented survey range is required 500 feet downstream of the Topeka water intake weir. Because there are already basic survey locations every 1.5 miles and the maximum length of a dredging area is 1.5 miles, no more than five additional survey locations would be required for each dredging area. The Regulatory Plan also requires the installation of survey locations for isolated dredging operations located outside of Survey Areas 1 and 2. The number and location of ranges located outside of Survey Areas 1 and 2 would be established on a case-by-case basis. No dredging operations have been located outside of Survey Areas 1 and 2 since implementation of the Regulatory Plan.

Establishing survey locations and surveying the cross-sections every 2 years is completed by an independent engineering firm contracted and paid by the Dredgers. The USACE evaluates the survey data and compares its findings against the baseline survey data collected in 1992, to identify changes in bed elevations. River channel widening is also evaluated through the survey data. The results of each survey are utilized to determine if existing permits and any proposed new permits are in compliance with the limits imposed by the Regulatory Plan. The primary criterion considered by the USACE in its compliance evaluation is the Regulatory Plan’s 2-foot limit on bed degradation through any 5-mile-long reach of river. The current Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet below the 1992 baseline elevations established for that reach will be closed to further dredging regardless of the cause for the decline in bed elevations (i.e., natural or dredging-induced degradation). The current Regulatory Plan further stipulates that a reach of river that has exceeded the degradation limit and been closed to dredging will not be reopened until its average bed elevation exceeds the established minimum for the reach and sufficient materials have accumulated to support renewed dredging for a reasonable period of time.

1.4.5 Dredging Areas Closed Prior to 2007 Permit Decision

The USACE has closed nine dredging areas since implementation of the Regulatory Plan in 1991 until the last permit decision was made in 2007. Each of those dredging areas was located in a 5-mile-long reach of river that was approaching or had reached an average of 2 feet of bed degradation. Six of the closed dredging areas were downstream of Bowersock Dam and the other three were upstream of Bowersock Dam. The actions taken by the USACE for the nine dredging areas included both termination of existing permits and denial of requested permits. All dredging areas closed to dredging prior the 2007 permit decision are listed below:

a. Dredging area closed to dredging in 2002
    - Kaw Sand Company – RMs 24.0 to 25.0
b. Dredging areas closed to dredging in 2003
    - Holliday Sand and Gravel Company – RMs 22.9 to 24.4
    - Kaw Sand Company – RMs 26.1 to 27.6
    - Holliday Sand and Gravel Company – RMs 29.2 to 30.2
    - Holliday Sand and Gravel Company – RMs 31.1 to 31.9
    - Kaw Sand Company – RMs 35.4 to 36.4
c. Dredging areas closed to dredging in 2006
    - Kansas Sand Company – RMs 84.5 to 85.8
    - Holliday Sand and Gravel Company – RMs 86.3 to 86.5
d. Dredging area closed to dredging in 2007
    - Meier’s Ready Mix – RMs 90.1 to 91.6

1.4.6 Current Dredging Areas

The USACE has reauthorized dredging on the Kansas River three times (1991, 1997 and 2007) since completion of the 1990 Kansas River Dredging EIS. In 2007, the USACE issued permits to five Dredgers to annually extract not more than a total of 2.2 million tons of sand and gravel from 11 areas on the river (Table 3, Figure 2, and Figure 3). Table 3 lists the dredging areas and quantities authorized to each Dredger by the USACE in 2007.

Table 3 Dredging Areas and Quantities Authorized in 2007

Authorized Dredging Areas (RMs)	Authorized Dredging Quantities (Tons)	Company
9.40 – 10.4 (**Reach 1**)	Cumulative Total Dredging Limit – 400,000 Tons[b]	Kaw Valley Companies, Inc.
12.8 – 13.9 (**Reach 1**)		
15.4 – 16.9 (**Reach 1**)		
18.65 – 20.15 (**Reach 1**)	Cumulative Total Dredging Limit – 600,000 Tons[b]	Holliday Sand & Gravel Company
20.55 – 20.6 (**Reach 1**)[a]		
21.0 – 21.15 (**Reach 1**)		
42.6 – 44.1 (**Reach 2**)	Cumulative Total Dredging Limit – 750,000 Tons[b]	Master's Dredging
47.1 – 48.0 (**Reach 2**)		
45.2 – 46.7 (**Reach 2**)		Penny's Aggregates
49.6 – 51.35 (**Reach 3**)	150,000	Penny's Aggregates
77.1 – 78.6 (**Reach 4**)	300,000	Victory Sand Mining & Dredging[c]

[a] The USACE's November 9, 2011 Public Notice does not identify the correct dredging areas for the Holliday Sand & Gravel Company. The Table above provides corrected dredging area locations.

[b] The Regulatory Plan limits any one dredge to no more than 300,000 tons per year.

[c] Shown as Builder's Choice Co. on Figure 3.

On May 25, 2012, the USACE informed Master's Dredging and Penny's Aggregate that the findings of the 2011 survey data showed that four of their dredging areas were located in 5-mile-long reaches of the river that had degraded an average of 2 feet below their 1992 baseline elevations. On December 27, 2012, the USACE notified the Dredgers that, in accordance with the Regulatory Plan, the four degraded dredging areas would be closed on May 25, 2013 and, in addition, the 2007 permits were being extended until December 31, 2013 to allow time to complete the permit evaluation process. As a result, on May 25, 2013, dredging in the four dredging areas at RMs 42.6 to 44.1 and 47.1 to 48.0 (Master's Dredging) and RMs 45.2 to 46.7 and 49.6 to 50.9 (Penny's Aggregates) stopped. Master's Dredging has no remaining areas open to dredging and Penny's Aggregates can dredge only at RMs 50.9 to 51.35 under their extended 2007 permit. In 2015, Master's Dredging withdrew all but one proposed permit location. On April 29, 2015, Penny's Aggregates withdrew their request for consideration of new DA permits under authority of Section 10 to authorize the hydraulic dredging of sand and gravel from the bed of the Kansas River. Their last active dredging permit on the river expired on October 21, 2015.

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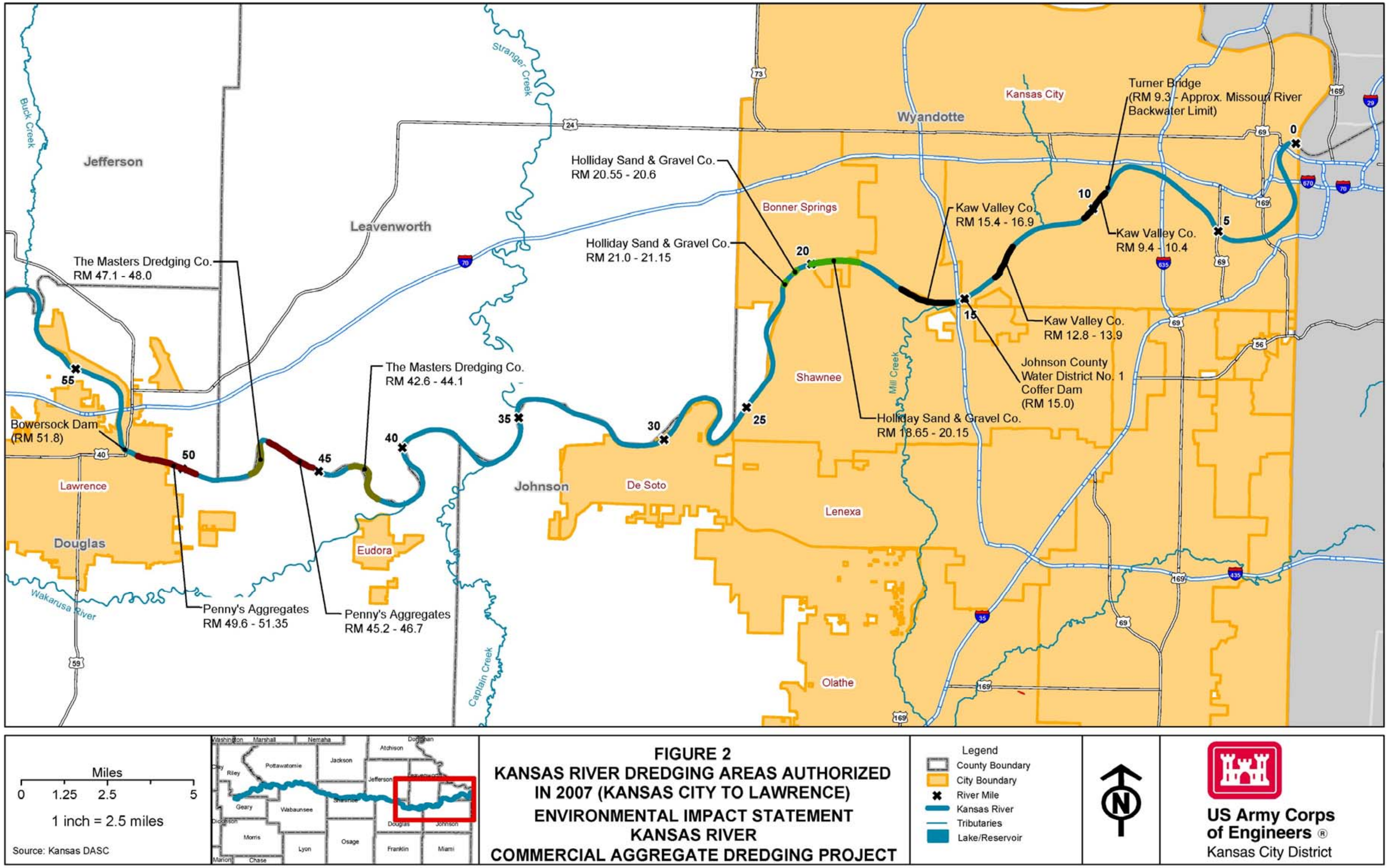

Figure 2 Kansas River Dredging Areas Authorized in 2007 (Kansas City to Lawrence)

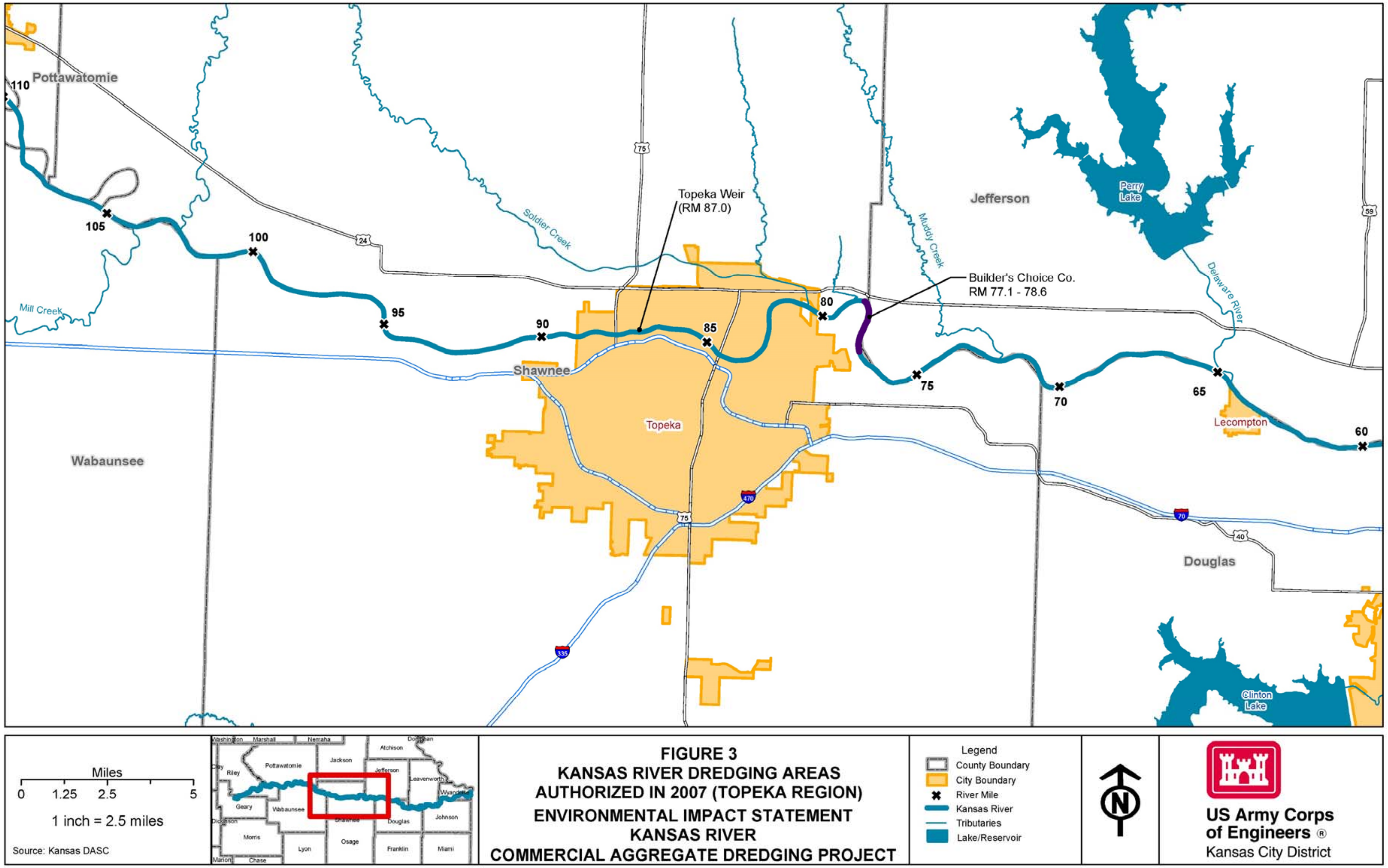

Figure 3 **Kansas River Dredging Areas Authorized in 2007 (Topeka Region)**

1.4.7 Processing Plant Sites

Each Dredger has a sand plant located near the areas permitted in 2007. Nine plants are currently located along the river to process, store and distribute dredged materials to area markets. Plants are sited adjacent to the river at locations that provide access to improved roads in order to accommodate the truck traffic essential to transport the materials from plant sites to area markets. Plant sites are generally permanent and may be active or inactive depending upon market needs, material availability and permit authorization status.

The Dredgers have a significant financial investment in the purchase of 5 to 15 acres of land, buildings, scales, conveyers, sorting towers, front loaders and other earth moving equipment, dredges, piping and more. The potential to dredge a given reach of river is determined largely by the distance that the operator can effectively pump the extracted material from the dredge to the plant site. This distance is governed by pumping/piping capacity, ability to establish booster pump sites on private property along the river, and on increased costs associated with booster pump energy usage and operator monitoring time at booster pump stations. Each sand plant serves a local market with an average market radius of 50 miles. The market served by a sand plant is generally limited by access to major transportation routes (availability of bridges crossing the Kansas River and local roadway restrictions) and by haul distance costs.

1.5 PURPOSE AND NEED

1.5.1 Project Purpose

The basic purpose of the Proposed Action is to supply sand and gravel required to support the region's construction and manufacturing needs. The Dredgers' purpose for the Proposed Action is to economically dredge sand and gravel from the Kansas River for commercial sale to a wide variety of construction markets generally located in or near metropolitan areas along the river. The purpose is based on a competitive requirement to produce a unique, high quality product at the lowest possible cost, in order to compete with other product sources to satisfy the projected regional construction market demand for these materials.

1.5.2 Project Need

Sand and gravel are essential components of concrete, asphalt, brick mortar, tile grout, landscape materials, and fiberglass production. These materials are used to construct local, regional, and interstate roads; public, commercial, and industrial facilities; and multi-family and residential housing. The dependence on Kansas River sand and gravel as a constituent of construction materials is pervasive in the regional economy (defined below in Section 3.5.3 as the primary market area), which includes the greater Kansas City Metropolitan Area, the Lawrence and Topeka areas, and many other Kansas communities.

Kansas River sand and gravel is a unique product recognized for its exceptional quality and relatively low cost. The raw sand and gravel pumped from the river for processing contains very little waste materials and requires minimal cleaning and sorting. The largest use of sand and gravel in the region is for concrete and asphalt production, which requires material that meets varying specifications related to sand and gravel parent material type, size, shape, and hardness. The processed material meets the requirements necessary for the production of high-quality concrete and asphalt, as well as stringent requirements for fiberglass production, with minimal additional processing required such as blending of other sand and gravel.

1.6 ENVIRONMENTAL IMPACT STATEMENT OVERVIEW

This Draft EIS includes the following Chapters:

Chapter 1 – Introduction. This Chapter describes the purpose and need for the Project and the scope of the Draft EIS. The Chapter contains a brief summary of the history of the Kansas River, the commercial sand and gravel industry operating on the river, and USACE regulation of those activities.

Chapter 2 – Proposed Action and Alternatives. This Chapter discusses the current permit applications submitted by the Dredgers and describes the proposed activities. The Chapter discusses the No Action Alternative, the Action Alternatives, and other alternatives considered but not carried forward for detailed evaluation.

Chapter 3 – Affected Environment and Consequences. This Chapter includes a baseline discussion of the existing affected environment in and along the Kansas River. The Chapter also presents a discussion of the direct and indirect environmental consequences associated with the No-Action Alternative, the Proposed Action, and the reasonable alternatives considered.

Chapter 4 – Cumulative Impacts. This Chapter discusses the cumulatively impact of past, present, and reasonably foreseeable activities that the affected environment along combined with the incremental impact of the Proposed Action, the No-Action Alternative, and the reasonable alternatives considered.

Chapter 5 – Mitigation and the Regulatory Plan. This Chapter discusses potential mitigation, the existing Regulatory Plan, and revisions to the Regulatory Plan that could be implemented to refine the permit limitations and monitoring requirements contained in the Plan.

Chapter 6 – References. This Chapter provides a complete list of the references cited and resources reviewed during preparation of this report. The source material reviewed may not always be cited in the text but is included in the Chapter to show that it was reviewed as part of the discovery process in support of this document. Additional references may have been reviewed and inadvertently omitted. This is particularly true of website information where numerous resources may have been reviewed to help better shape the authors understanding of a particular subject.

Chapter 7 – Public and Agency Comments. This Chapter presents the public and agency comments received in response to the Public Notice issued for the proposed permits and the comments received in response to the USACE’s Draft Environmental Impacts Statement and public meetings for the proposed activities. This Chapter also includes responses to all pertinent public and agency comments received by the USACE.

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CHAPTER 2

Proposed Action and Alternatives

2.1 INTRODUCTION

This Draft EIS has been prepared in accordance with the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the NEPA (40 CFR, Parts 1500-1508). The NEPA implementing regulations place great weight on the evaluation of alternatives to a Proposed Action (40 CFR, Part 1502.14). Therefore, this Draft EIS includes a comprehensive discussion of the Proposed Action, the No-Action Alternative, and the Reasonable Alternatives to the Proposed Action.

The implementing procedures for the NEPA, in the USACE regulatory program guidance (33 CFR, Part 325: Appendix B), define the No-Action Alternative as one which results in no construction requiring a USACE permit. The implementing procedures state that those alternatives that are unavailable to the applicant, whether or not they require federal action (permits), should normally be included in the analysis of the no federal action (denial alternative). The evaluation of environmental consequences associated with the No-Action Alternative establishes a baseline for comparison of environmental impacts among all of the alternatives considered.

The implementing procedures state that only Reasonable Alternatives need to be considered in detail. The implementing procedures for the NEPA, in the USACE regulatory program guidance (33 CFR, Part 325; Appendix B), defines Reasonable Alternatives as those alternatives that are feasible. It further states that such feasibility must focus on the accomplishment of the underlying purpose and need (of the applicant or the public) that would be satisfied by the proposed federal action (permit issuance). The identification of Reasonable Alternatives for the Proposed Action is based on the guidance provided in the referenced NEPA implementing regulations.

Other Alternatives are those alternatives initially considered but not carried forward for detailed study.

This chapter describes the range of alternatives considered in the evaluation of environmental consequences associated with the proposed activities. The range of alternatives includes:

- The Proposed Action;
- The No-Action Alternative;
- Reasonable Alternatives carried forward for detailed evaluation; and
- Alternatives identified but not considered feasible and not carried forward for further evaluation.

2.2 PROPOSED ACTION

The USACE has received permit applications from five companies to dredge sand and gravel from the Kansas River for commercial sale to market areas located along the river. The Proposed Action involves issuance of five DA permits under authority of Section 10 to authorize the hydraulic dredging of sand and gravel from the bed of the Kansas River utilizing a suction head or cutter-head dredges mounted on barges. Dredgers have requested authorization to dredge a total of 1,900,000 tons of material annually from eight individual dredging areas that have a collective total of 9.5 RMs (Table 4, Figure 4, and Figure 5). The permits, if issued, would be subject to and would not exceed the restrictions and limitations imposed by the Regulatory Plan established by the USACE in 1990. Under the Regulatory Plan, 3,150,000 tons would be the most that could be extracted because of restrictions concerning the rate of sand and gravel extraction from specified reaches of the Kansas River and by any one dredge. Four of the five companies are currently authorized to dredge sand and gravel from the river under authority of permits issued in 2007. Those permits were scheduled to expire on December 31, 2013 but have been extended in accordance with the Regulatory Plan until completion of the EIS. One of the companies, Penny’s Aggregates submitted a request to withdraw their permit applications for operations near RM 45.2-46.7 and 49.6-51.35 prior to formulation of the EIS. Another company, LBB L.L.C. has not previously been authorized to dredge in the Kansas River. Table 4 summarizes the eight proposed dredging areas and quantities of material requested by the Dredgers.

Table 4 Summary of Requested Dredging Areas and Quantities

Requested by Dredgers			Regulatory Plan Constraints				
Company	**Requested Dredging Areas (River Miles)**	**Requested Quantities[a] (Tons)**	**Current Status of Requested Dredging Area**	**2013 Maximum Bed Elevation Change from 1992 Baseline within 5-Mile Range Intersecting the Requested Dredging Area**	**Portion of Requested Dredging Area in a Degraded 5-Mile-Reach**	**Reach Limit (Tons)**	**Potential Quantities per Regulatory Plan**
Kaw Valley Companies, Inc.	9.4 – 10.4	400,000	Open	-1.31	None	Reach 1 1,000,000	1,000,000
	12.8 – 13.9		Open	-1.31	None		
	15.4 – 16.9		Open	0.01	None		
Holliday Sand & Gravel Company	18.65 – 20.15	300,000	Open	-1.24	None		
	20.55 – 21.15	300,000	Open	-1.64	None		
Master's Dredging	26.1 – 27.1	300,000	Closed	-2.34	Partial	Reach 2 750,000 tons in any 15-mile-long section	1,250,000
No dredging requested in Reach 3	None	None	None	None	None	Reach 3 150,000	150,000
Builders Choice Aggregates	77.1 – 78.6	300,000	Open	-1.19	None	Reach 4 750,000 tons in any 15-mile-long section	750,000
LBB, LLC	89.7 – 91.0	300,000	Closed	-1.42	None		
						Total	**3,150,000**

[a] The Regulatory Plan limits any one dredge to no more than 300,000 tons per year.

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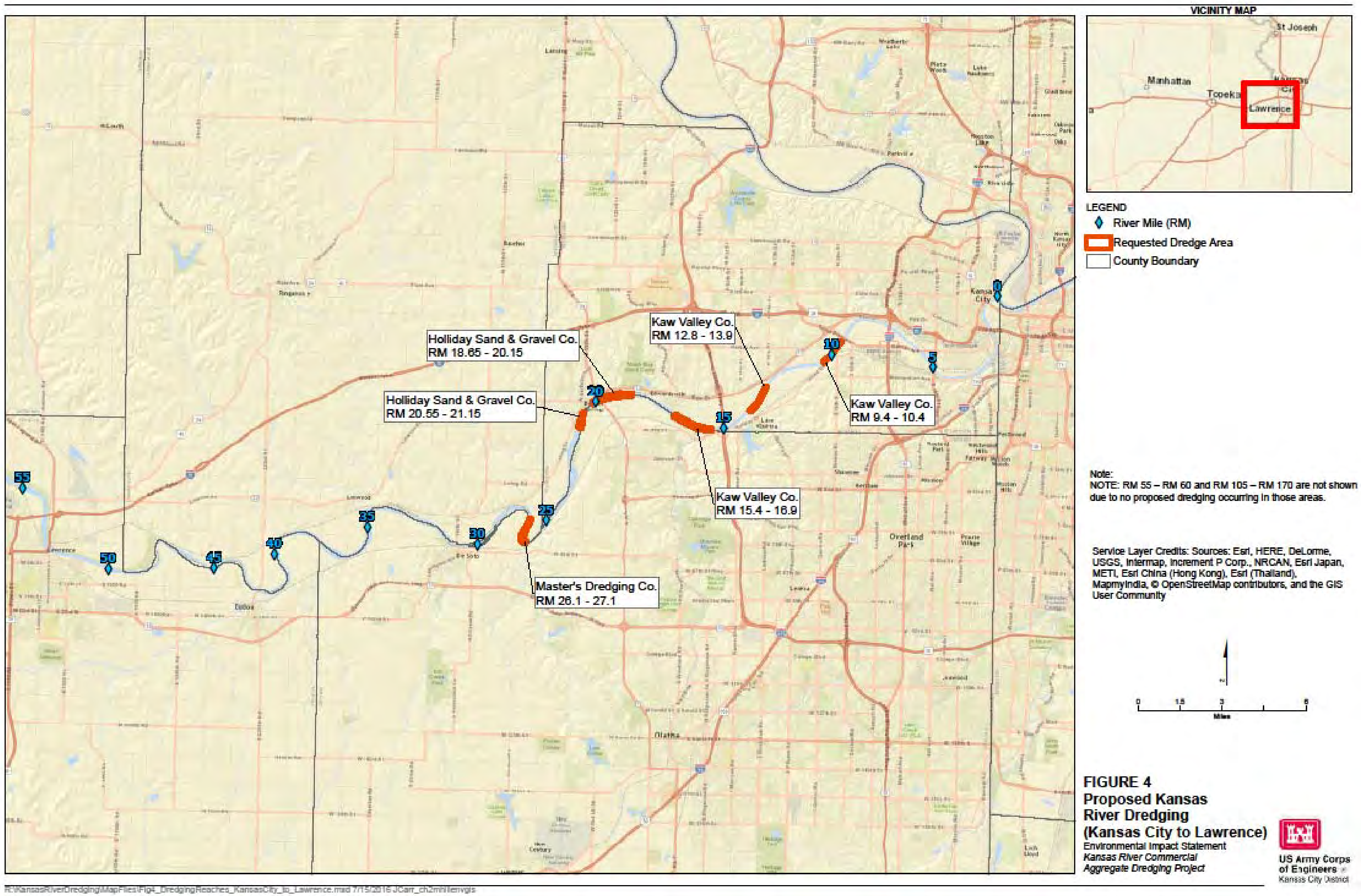

Figure 4 Proposed Kansas River Dredging (Kansas City to Lawrence)

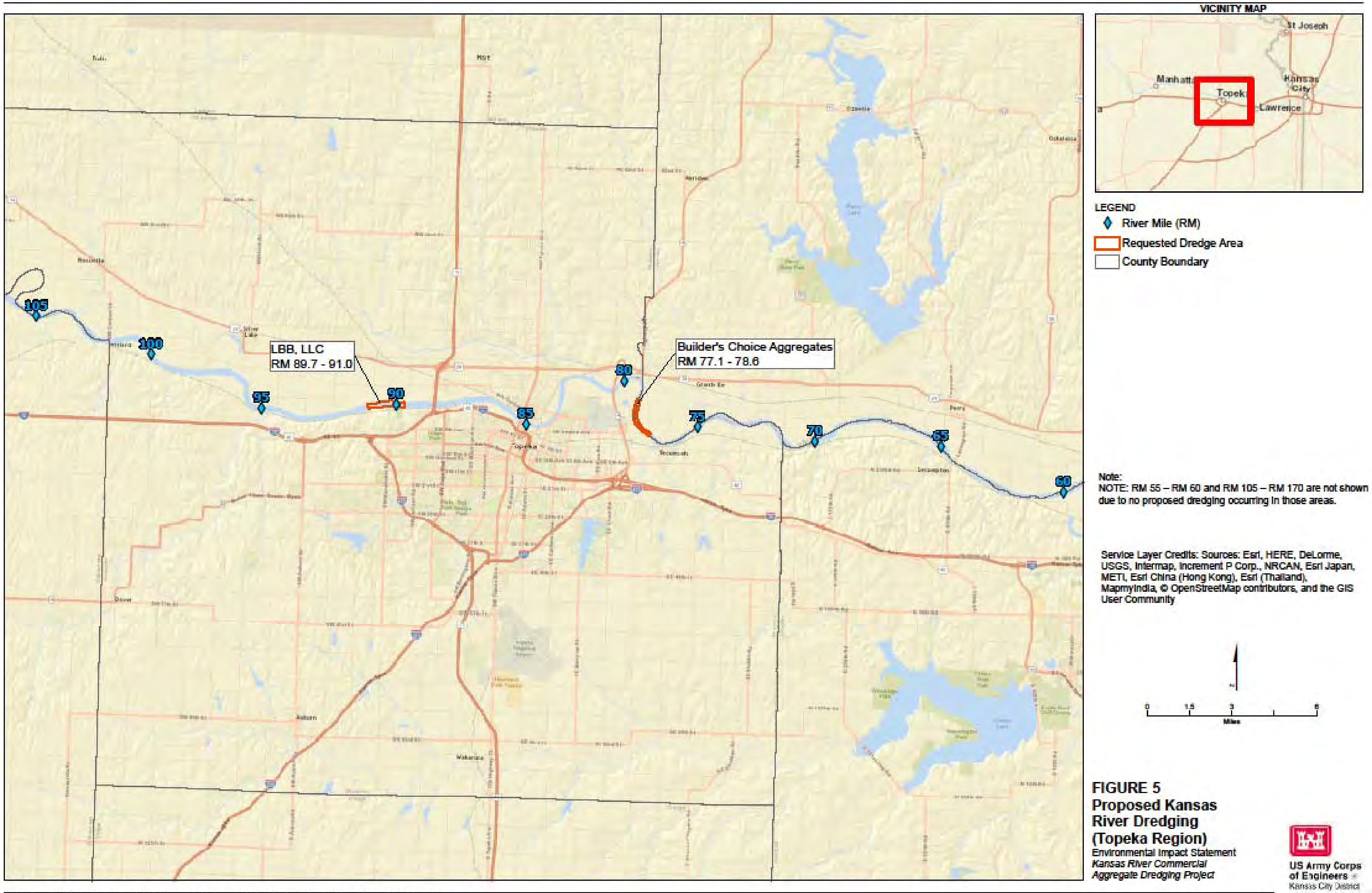

Figure 5 **Proposed Kansas River Dredging (Topeka Region)**

None of the eight requested dredging areas are located within 5-mile-long reaches of river that have degraded an average of 2 or more feet below the baseline elevations established in 1992. Under the terms of the Regulatory Plan any portion of requested dredging areas located within 5-mile-long reaches of the river that have degraded an average of 2 feet or more below the 1992 baseline elevations for those reaches, cannot be dredged at this time but have the potential to be reopened to dredging in the future, if bed elevations increase sufficiently. However, Table 4 shows that none of the eight dredging areas requested are located in degraded reaches.

Penny's Aggregates initially submitted permit applications for dredging on the Kansas River at three locations near RM 40.7-42.1, RM 45.2-46.7 and RM 49.6-51.35. In April of 2015, the applicant requested that all of these permit applications be withdrawn from further consideration. The applications were withdrawn in May of 2015 and the company was advised that dredging must cease in October of 2015 at the one remaining area of dredging reauthorized by the 2007 permit and located between RM 50.9-51.35.

Master's Dredging originally requested reauthorization of dredging that were previously authorized in 2007. After most of Master's Dredging's dredge areas were closed in May 2013 due to excessive bed degradation (see Section 1.4.5 for more detail), they only requested authorization of one dredging area (RMs 26.1 – 27.1) that is not more than 2 feet lower on average than in 1990.

LBB L.L.C. has requested authorization to dredge in an area that had been closed due to excessive degradation but has since aggraded and is now less than 2 feet lower on average than in 1990. Builder's Choice Aggregates would operate from a processing plant they have already established with a dredge pit on the floodplain north of the river, while LBB L.L.C. would operate from the existing processing plant it owns on property south of the river.

2.3 NO-ACTION ALTERNATIVE

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. The existing dredging permits were authorized by the USACE in 2007, with an expiration date of December 31, 2012. The USACE extended these existing permits to allow time to complete its public interest review and EIS.

Denial of the requested permits and termination of all existing dredging on the Kansas River would impact the sand and gravel Dredgers operating on the river, as well as those business interests (ready mix, glass production, etc.) that depend on sand and gravel produced from the river. After existing stockpiles of Kansas River sand and gravel are exhausted, the Dredgers would be unable to satisfy market demand and contract requirements for customers whose business models are dependent on a steady source of high quality Kansas River sand and gravel. The No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand. The development of alternative sources of sand and gravel would result in substantive direct and indirect effects associated with floodplain pit dredging and/or land-based quarry operations within the region, as well as the production and transportation of sand and gravel from regions located outside the Kansas River valley. It should be noted that Proposed Action and the Reduced Limit Alternative (described in Sections 2.2 and 2.4, respectively) would partially rely on alternate sources of sand and gravel to meet regional demand.

2.3.1 Alternate Sources of Sand and Gravel

Under the No-Action Alternative, the elimination of commercial sand and gravel production from the Kansas River would require material to be obtained from alternate sources. Historically, sand and gravel dredged from the Kansas River and local reaches of the Missouri River have provided the majority of the sand and gravel used in the region's markets (use of Missouri River sand is primarily limited to the Kansas City metropolitan area market).

Dredging from the Kansas River supplied approximately 2.8 million tons of sand and gravel annually to regional construction markets from 1991 to 1999, and approximately 1.4 million tons annually from 2000 to 2014. The reduction in the annual quantity of material extracted from the river since 2000 has primarily been due to a reduced market demand, which has been especially impacted by a depressed construction industry over the last 5 years. Four distinct types of sand and gravel production have been identified as reasonable and feasible alternative sources of sand and gravel to replace material currently dredged from the Kansas River. Those sources include:

- Sand and gravel dredged from the Missouri River;

- Pit mines flooded with groundwater (dredge pits) located in the Kansas and Missouri River floodplains; and
- Crushed rock manufactured from limestone quarries.

The suitability, availability, and cost of production and transportation for these alternative material sources vary widely.

2.3.1.1 Missouri River Dredging Operations

Although sand and gravel dredged from the Missouri River is similar to Kansas River sand and gravel, it is generally viewed as a somewhat lower quality product due to the presence of lignite. Lignite is a form of brown coal that is present in relatively small quantities in sand and gravel dredged from both the Missouri River and its floodplain. The mineral is soluble and friable and is detrimental when present in cement mixes intended for finishing applications, since it can induce voiding and pitting of finished surfaces. Processing of sand and gravel dredged from both the Missouri River and its floodplain includes removal of lignite for some applications; however, such processing does not entirely remove the mineral from the final product.

Although Missouri River sand and gravel are a suitable substitute for Kansas River sand and gravel, Missouri River dredging operations do not have the capacity to replace the loss of sand and gravel from the Kansas River if the No-Action Alternative is selected. In 2011, the USACE evaluated the potential impacts associated with commercial dredging on the Missouri River in the Missouri River Commercial Dredging EIS (USACE, 2011a). The USACE concluded in that EIS that dredging had contributed to significant bed degradation in the Kansas City area. That EIS also evaluated alternative sources of sand and concluded that other sources, including Kansas River sand (as authorized at that time), could replace part of the Missouri River sand supplied to the Kansas City metropolitan area market. The Missouri River Commercial Dredging EIS resulted in a decision to implement annual dredging limits for commercial dredging operations on the Missouri River in the Kansas City Metropolitan Area (Kansas City Segment – RMs 357 to 391). The allowable dredging tonnage allowed in this segment was reduced 79 percent from the annual average extraction of 2,520,000 tons of material for the years 2004 through 2008, to a final phased in limit of 540,000 tons annually, beginning in 2014. At the same time, the quantities allowed in both the downstream Waverly Segment (RMs 250 to 357) and the upstream St. Joseph Segment (RMs 391 to 498) were increased by 40 percent and 163 percent respectively.

The resulting combined final 2014 phased in limit for all three reaches near the Kansas City metropolitan market area (RMs 250 to 498) results in an annual reduction of 1,122,540 tons of material available to both dredging companies and ultimately consumers. The combined total average annual quantity of sand and gravel extracted from the three reaches from 2004 through 2008 was 3,662,540 tons; and the final total phased in limit for the three reaches in 2014 was 2,540,000 tons annually. However, the permits were reevaluated in 2015 and renewed for the 2016 - 2020 period with revised amounts for the Waverly and St. Joseph segments. Capital Sand Company, Inc. requested the following tons over the 5 year period from the Waverly segment (a phased ramp up from the 370,000 annual tons authorized by the 2011 DA Permit): 370,000 in 2016, 452,500 in 2017, 535,000 in 2018, 617,500 in 2019, and 700,000 in 2020 (USACE, 2015). Holliday Sand and Gravel Company requested the following tons over the 5 year period from the Waverly segment (a phased ramp up from the 770,000 annual tons authorized by the 2011 DA Permit): 770,000 in 2016, 847,000 in 2017, 924,000 in 2018, 1,001,000 in 2019, and 1,078,000 in 2020 (USACE, 2015). Conversely, the St. Joseph's segment has a reduced authorized annual tonnage from 860,000 annual tons authorized by the 2011 DA Permit to 330,000 annual tons in the renewed permit (USACE, 2015). The Missouri River Dredgers do not currently have the infrastructure in place needed to extract the increased amount allowed in the Waverly segment, but even if they expand their operations, they could not dredge enough sand and gravel from the Missouri River under the current permits to meet the historical demand of the Kansas City Metropolitan Area. The No-Action Alternative would result in the cessation of Kansas River dredging and could increase the demand for Missouri River sand and gravel within the limits of the existing Missouri River commercial dredging permits but does not include or propose the modification or addition of any permits for Missouri River commercial dredging. The Missouri River Commercial Dredging EIS (USACE, 2011a) fully evaluated the environmental impacts of the currently authorized Missouri River commercial dredging permits, therefore, Missouri River commercial dredging is not further evaluated in Chapter 3. The Missouri River Commercial Dredging EIS may be downloaded at: http://www.nwk.usace.army.mil/Missions/RegulatoryBranch/MissouriRiverCommercialDredging.aspx.

2.3.1.2 Floodplain Mining

Floodplain mining, for purposes of this report, is defined as commercial sand and gravel production operations that are located in a floodplain outside of a river channel. Floodplain sand and gravel mining operations can be located in dredge pits flooded with ground water such as those found in both the Kansas and Missouri River floodplains (Figure 6) or in dry mines such as those found along the Arkansas River (dry mining operations located in the Arkansas River floodplain are discussed, below, in Section 2.5, Other Alternatives Considered).

Floodplain mines in Kansas are regulated by the Kansas State Conservation Commission under the Surface Mining Land Conservation and Reclamation Act (Kansas Statutes Amended [K.S.A.] 49-601 through 624, K.A.R. 11-9-1 through 8) as administered by the Kansas Department of Agriculture, Division of Conservation. In Missouri, floodplain mines are regulated by the Missouri Department of Natural Resources (MDNR) under the Land Reclamation Act (Missouri Revised Statutes [RSMo] 444.770, 444.772 and 444.778, 10 Code of State Regulations [CSR] 40-10.050(14)). Active floodplain mines are not normally considered waters of the U.S. and are generally excluded from regulation by the USACE. However, dredge pit mining activities that result in the placement of fill material in wetlands or other waters of the U.S. are subject to regulation by the USACE under authority of Section 404 of the CWA.

Kansas River Floodplain Pit Dredging Operations

Pit dredging operations located in the Kansas River floodplain require a license from the Division of Conservation and a plan detailing how the site will be reclaimed after completion of dredging Activity. Pit dredging operations are sited in areas with shallow groundwater, which allows use of a hydraulic dredge for the dredging of sand and gravel from a pit flooded with ground water. Pit dredging requires the land to be cleared of vegetation and undesirable overburden typically consisting of silt and clay. The vegetation is burned or removed from the site and the overburden is normally stockpiled for reuse during reclamation of the depleted dredge pit. After the overburden is removed, a small pit is excavated below the water table, which then allows placement of a floating dredge in the pit. Once the dredge is established in the pit, it hydraulically dredges marketable sand and gravel deposits in the same manner as dredging operations on the river. The floating dredge pumps a slurry of water, sand, and gravel through a pipe to a land-based processing plant where the material is dewatered and sorted by particle size. Water extracted from the slurry is routed back to the dredge pit. The sorted sand and gravel is moved by conveyers and loaders to stockpiles where the materials are stored until they are loaded on to trucks and transported to customers. Pit dredging operations typically consist of a dredge, settling chambers or sorting screens, earth-moving equipment, loaders, conveyor systems, and weight scales. Buildings located on the site may include equipment maintenance structures, fueling stations, and offices.

After a dredge pit's sand and gravel deposits are depleted, the site must be reclaimed in accordance with a project reclamation plan filed with the Division of Conservation. Reclamation includes refilling dredged areas, spreading the stored overburden or equal amount of topsoil over the refilled areas, grading to establish appropriate contours, reestablishing vegetation, and removing all equipment from the site. The dredge pits may remain as open water bodies if approved by the Division of Conservation.

The development of additional dredge pits in the Kansas River floodplain, to replace sand and gravel sources lost if the current requested permits are denied, would depend on the ability of companies to identify and acquire suitable properties, and to secure federal, state, county and local approval, where required. The success of such an undertaking (securing approval, and acquiring and developing a site) would be dependent upon resolution of the issues described below (Booker Associates, 1986):

- Approvals (permits and zoning) must be granted by federal, state, county and local governments, where necessary. Potential issues include traffic, safety, noise, air quality, water quality, impacts to riparian habitat, loss of farmland, disturbance to rural communities located on truck routes, disturbance to plant site neighbors, and more.
- Properties must contain suitable gradations of sand and gravel in sufficient quantities to sustain production for a minimum of 10 to 12 years, due to the cost and years involved in securing dredge pit sites. The minimum acreage to support the operation with an estimated 12-year production period at an average of 300,000 tons per year would equal 61 acres (Booker Associates, 1986).
- Material overburden (waste material) on a typical site should not exceed 20 feet in thickness but can vary depending upon the depth of marketable materials.
- Properties must be located within a reasonable distance of area markets, and must be located near improved roads (roads and bridges suitable for heavy truck traffic) with linkage to highways necessary to reach market areas.

- Properties must be owned by entities willing to sell and must be available at competitive land prices that allow for profitable operations.

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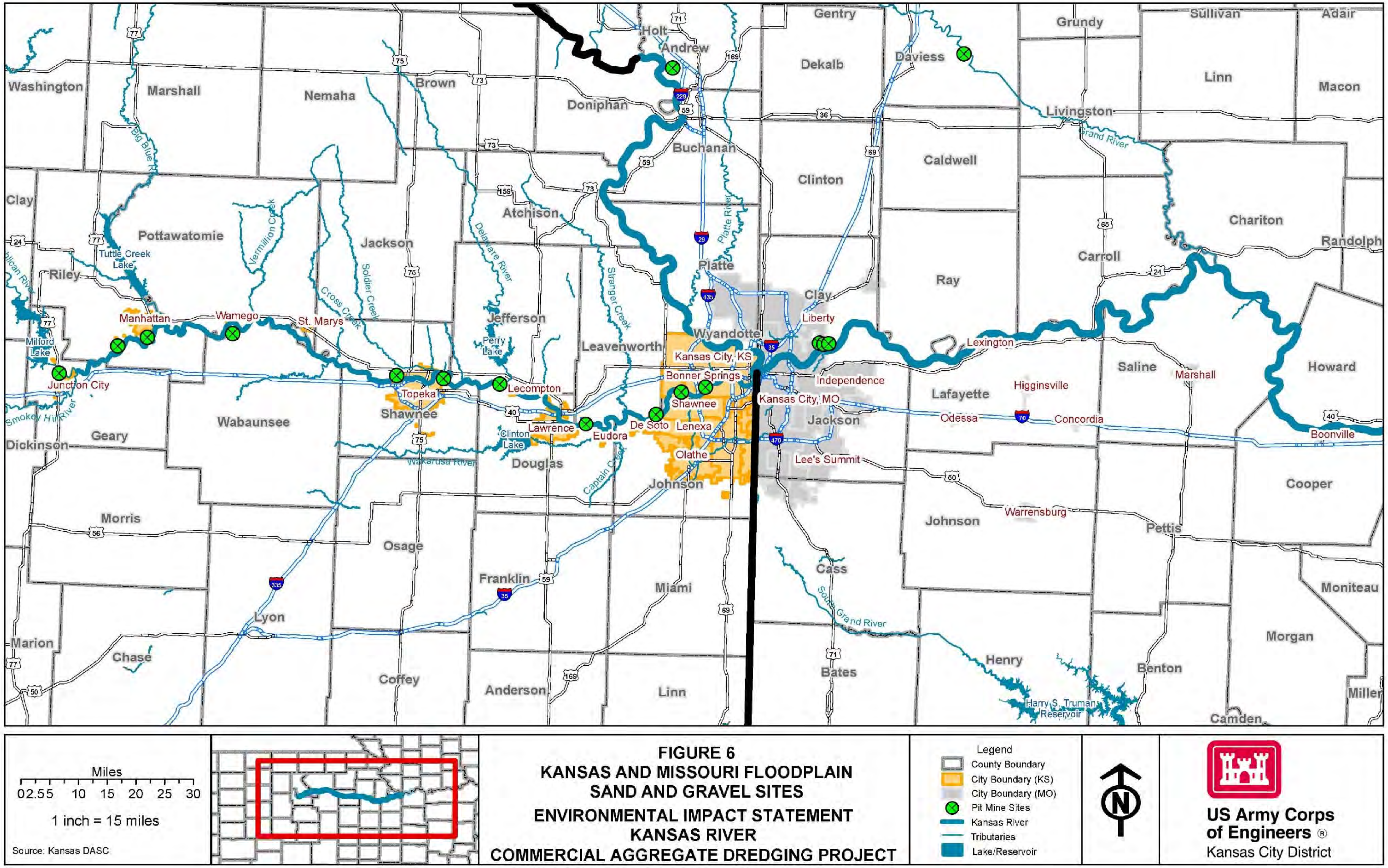

Figure 6 Kansas and Missouri Floodplain Sand and Gravel Sites

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A total of fifteen dredge pits have historically operated in the Kansas River floodplain, which include some current pit dredging operations. These dredge pits have been located near the cities of Eudora, Perry, Bonner Springs, DeSoto, Linwood, Topeka, St. Marys, Manhattan, and Edwardsville. Eleven dredge pits currently operate in the Kansas River floodplain between Junction City and Kansas City, Kansas. Approval for two additional dredge pits proposed to be located between Bonner Springs and Lawrence are currently being pursued by Kansas River Dredgers. Past attempts to secure approvals to open three new floodplain dredge pits have been denied local permits or the efforts have been abandoned by Dredgers since 1992, due to excessive cost, land use restrictions, or opposition from special interest groups, neighboring property owners, counties and communities. Resistance to new dredge pits has been high for the last 30 years; and that resistance has increased over time. Based on the experiences of dredging companies over the last 30 years, opposition to developing pit dredging operations in the floodplain is especially high in the majority of the counties and communities located downstream of Topeka (Topeka to Kansas City, Kansas). According to the Dredgers, a period of three to 5 years, or more, is typical for project permitting and development (assuming required federal, state, county and local agency approvals can be secured). Based on Dredger experiences, the development of pit dredging operations has a much higher probability of success upstream of River Mile 90 (west of Topeka) than in downstream areas. The potential for successful development of pit dredging operations decrease as one moves downstream from Topeka and into the Kansas City Metropolitan Area. The floodplain is narrower in downstream reaches, land prices increase and competition among land uses intensifies, especially in areas downstream of Bowersock Dam at Lawrence (RM 51.8). Competing interests include:

- Demand for farmland; industrial and commercial development in the reaches downstream of Bowersock Dam and the general unavailability of suitable land in the Kansas City Metropolitan Area (RMs 0.0 to 22) due to high industrial and commercial demand;
- Rural and urban community concerns such as potential impacts to well field water quality, and local traffic impacts and noise issues on truck routes; and
- Traffic and noise issues for residential properties located near plant sites.

In conclusion, if the No-Action Alternative is selected, it is likely that some additional pit dredging operations could be located in the Kansas River floodplain, especially in reaches located upstream of Topeka, given sufficient time and financial incentive for Dredger companies to obtain suitable land and to secure the required authorizations. Market demand in the Manhattan and Topeka areas could probably be met with current or potential future pit dredging operations. However, due to the limited success with past efforts to obtain suitable land, and county and local approvals, it is unlikely that a sufficient number of pit dredging operations could be established in the river reaches located downstream of Topeka to fully replace the sand and gravel currently supplied by the Kansas River in those areas. As stated in Section 2.5.3 below, transporting other sources of material more than 100 miles to replace materials lost, if the No-Action Alternative is selected, is not considered to be a reasonable alternative.

It should be noted that sand and gravel deposits dredged from the floodplain are a finite (nonrenewable) resource. Therefore, as dredge pits are depleted overtime and new resources are required, the difficulty in securing additional properties and the required zoning and other approvals would most likely become greater.

Missouri River Floodplain Pit Dredging Operations

A total of three Missouri River floodplain pit dredging operations are located within 100 miles of the Kansas City Metropolitan Area. Pit dredging on the Missouri River floodplain is similar to pit dredging on the Kansas River floodplain. Startup issues for Missouri River pit dredging are also similar to those experienced in the Kansas River floodplain. Over the past decade, two dredge pits have started operating on the Missouri River floodplain in the Kansas City Metropolitan Area south of Liberty, Missouri and one smaller pit (1 acre in size) is located approximately 7 miles north of St. Joseph, Missouri. Three additional new dredge pits, first proposed in 2007 in the Kansas City Metropolitan Area have been unable to obtain the required county, levee district, or local approvals. Based on this history, it is assumed that in the long term some additional dredge pits could be developed in the Missouri River floodplain within a reasonable distance of the Kansas City Metropolitan Area. However, in the short-term dredge pits capacity may be insufficient to fully replace the sand and gravel previously produced by Kansas River dredging, if the No-Action Alternative is selected. Although Missouri River floodplain sand and gravel deposits are similar to Kansas River sand and gravel, they are generally viewed as a somewhat lower quality product due to the presence of lignite. As discussed in Section 2.5.3 below, transporting other sources of material more than 100 miles to replace materials lost, if the No-Action Alternative is selected, is not considered a reasonable alternative.

2.3.1.3 Crushed Limestone

Crushed (manufactured) gravel is produced from quarries located along the Kansas River valley, where native limestone rock is excavated and crushed to form coarse sand and gravel. Typically, only small quantities of sand are produced as a byproduct of the crushing process. Quarry operations typically use backhoes and front-end loaders to excavate suitable limestone deposits. After removal of overburden the rock is excavated in layers or benches, which creates a pit that becomes deeper as each layer of rock is removed. This technique creates a large open pit typically bounded by high vertical walls. The excavated stone is placed in mechanical sorting equipment, which segregates the material by size. Oversized material is crushed to create the desired sand and gravel particle sizes needed to meet customer needs.

The use of manufactured sand and gravel for concrete and other similar construction purposes is relatively limited based on the abundance of other better suited materials, such as quartz sand and gravel mined from the Kansas River. Manufactured sand and gravel is more friable than Kansas River sand and gravel and will not meet many concrete paving and other construction specifications due to its relative weakness. In addition, manufactured sand is not generally conducive to finishing applications due to the angular nature of the material. However, coarse manufactured sand and gravel is a highly desirable product for asphalt production due to its angular shape. It is assumed that manufactured sand and gravel could provide some additional resources if dredging were terminated on the Kansas River. However, it is unlikely that manufactured sand and gravel could fully replace sand currently dredged from the Kansas River due to its inability to satisfy specifications of many industries.

2.4 REDUCED LIMIT ALTERNATIVE

In accordance with the implementing procedures for the NEPA in the USACE regulatory program guidance (33 CFR, Part 325: Appendix B), this Draft EIS has identified an additional reasonable alternative that could potentially satisfy the underlying purpose and need for the Proposed Action.

The Reduced Limit Alternative would establish a maximum cumulative annual dredging limit of 1,670,000 tons of material for all dredged reaches of the Kansas River. This restriction would limit the total annual amount of material dredged from the river to the average annual amount of sand load transported through the river system. The total annual dredging limit of 1,670,000 tons of material would be further limited by river reach as follows:

- No more than 1,260,000 tons of material could be extracted annually between RM 168.9 at Fort Riley and RM 126.9 at Wamego);
- No more than 1,210,000 tons of material could be extracted annually between RM 126.9 at Wamego and RM 63.8 at Lecompton;
- No more than 1,370,000 tons of material could be extracted annually between RM 63.8 at Lecompton and RM 31.0 at DeSoto; and
- No more than 1,670,000 tons of material could be extracted annually between RM 31.0 at DeSoto and the confluence of the Kansas and Missouri Rivers.
- The cumulative annual dredging limit of 1,670,000 tons of material would be the combined total dredging allowed from the four reaches described above.

The Reduced Limit Alternative is based on the long-term average annual sand load estimates developed at four locations on the river by Simons, Li, and Associates in their 1984 report entitled, "*Analysis of Channel Degradation and Bank Erosion in the Lower Kansas River*." As described on page 4.22 of the Simons, Li and Associates report (1984), the average annual sand yield was determined based on synthesized 1935 to 1974 flow duration curves and suspended sediment data collected at the USACE and USGS gauging stations located at Fort Riley (RM 168.9), Wamego (RM 126.9), Lecompton (RM 63.8) and DeSoto (RM 31.0). The average annual sand yields were determined to be:

- Fort Riley (RM 168.9) = 1,260,000 tons/year
- Wamego (RM 126.9) = 1,210,000 tons/year[1]
- Lecompton (RM 63.8) = 1,370,000 tons/year

1. The 1,210,000 ton average annual sand load estimate shown at Wamego is less than the 1,260,000 ton sand load estimate shown upstream at Fort Riley. The Simons, Li and Associates Report (1984) presents a discussion of the effect of bed material characteristics and lake construction on the sand yield at Wamego.

- DeSoto (RM 31.0) = 1,670,000 tons/year

The 1,670,000-ton annual maximum dredging limit for the Kansas River system would be imposed in addition to the current restrictions contained in the USACE's Regulatory Plan. In that way, the restriction would be somewhat redundant in an attempt to limit dredging operations beyond the natural expected recruitment of sand foreseen by Simons, Li, and Associates in their 1984 report. The methodology and scope of factors necessary to obtain and evaluate accurate average annual sand yields based upon, among other factors, flow duration curves and suspended sediment data would require more elaborate study than the fairly straightforward measurement of river cross-sections currently used to monitor bed elevations for the Regulatory Plan. The 2-foot limit on bed degradation presently stipulated in the Regulatory Plan would remain as the primary mechanism to limit dredging-related impacts to an acceptable level. The proposed 1,670,000 ton total annual dredge limit for the Kansas River system was according to historical records exceeded by as much as 100 percent (1984), and consistently exceeded by 50 percent until 2001. The 1,670,000 proposed limit was exceeded in all years but 1998 during the period of 1984 through 2001. The proposed limit was also exceeded again in 2003 and 2006, but has not been exceeded since 2006 according to extraction records through 2015. The latest period of record for extraction and inferred total need for raw materials from 2006 to present has likely been influenced by a downturn in demand from both residential and commercial businesses in response to a slowing overall economy. Total extraction over the last 15 years (2001-2015) has averaged 1,405,650 tons, just slightly less than the total limit that would be allowed by this alternative.

2.5 OTHER ALTERNATIVES CONSIDERED

Other Alternatives are those alternatives initially considered but not carried forward for detailed study based on a determination that they are not reasonable or feasible.

2.5.1 Sediment Budget for Each Individual Dredging Area on the Kansas River

In response to the November 2011 Public Notice, the 2015 Public Notice, and 2015 EIS public scoping process, the USACE received several comments recommending that it develop a sediment budget that would account for sediment transport, erosion, and deposition in the Kansas River. The commenters believe that a sediment budget could be developed that would determine how much sediment could be sustainably extracted from the river on a reach-by-reach basis. In a way, this proposed plan is another variation of the average annual sand load estimates developed “at four locations on the river by Simons, Li, and Associates in 1984 and described in the previous section (Section 2.4 Reduced Limit Alternative). A sediment budget is a predictive model of the amount of available material within the river based on a number of historic environmental variables. The actual amount of material available that could be sustainably dredged could vary significantly from year to year based on changes in environmental conditions, especially drought, flooding, bank erosion and Kansas reservoir releases. Annual or biannual monitoring of the environmental variables would be required to adjust the sediment budget for each river reach, make decisions and inform producers regarding allocation of the resource between dredging companies. This level of uncertainty regarding the short-term availability of raw material would have serious consequences regarding a dredging company ability to enter into contractual obligations with customers and also have ripple effects upon subsequent consuming businesses. In the end, a sediment budget would only be a predictive tool that could sometimes be wrong or inaccurate, would lead to a cumbersome process involving more complex evaluation factors and add more subjectivity to the process than bed elevation surveys.

Initial consideration of this alternative identified the following concerns:

- A sediment budget would require a large amount of data for many environmental variables. There are not enough gauging stations on the Kansas River to collect the required data. The initial development of a sediment budget would be complex and expensive.
- Annual adjustments of a sediment budget to reflect the most recent conditions would require costly annual or biannual monitoring of environmental conditions.
- Annual adjustments of authorized dredging limits to reflect adjustments of sediment budgets would increase uncertainty for Dredgers and markets regarding material supply. Production limits and market supplies could vary widely from one monitoring period to the next due to short-term bed load increases/decreases resulting from the influence of wet/dry years on the river's flow regime.
- Because a sediment budget could not prevent bed degradation with absolute certainty, continued monitoring of bed elevations and the associated costs of that work would still be required.

- Implementing such a plan to evaluate and readjust dredging limits on an annual/biannual frequency for each dredging area in addition to the monitoring already required by the Regulatory Plan would impose a significant new and unnecessary financial burden on the Dredgers and an additional administrative regulatory burden on the USACE.

The complexity, expense, market uncertainty, and regulating agency burden associated with implementation of a sediment budget, and the necessity to continue the monitoring requirements provided in the Regulatory Plan have resulted in a conclusion that this alternative is not reasonable and would provide little additional protection to the resource. Therefore, this alternative has not been carried forward for detailed study.

2.5.2 Dredging in Kansas Reservoirs

Sedimentation and the resulting loss of water storage capacity in flood-control reservoirs located in the Kansas River basin, in Kansas, has become an increasing issue of concern for the state. In several comments received in response to the November 2011 public notice regarding the proposed reauthorization of Kansas River dredging permits, dredging in reservoirs was proposed as a potential alternative to dredging the Kansas River as a source of sand and gravel. According to the proponents of this alternative, commercial sand and gravel dredging operations could harvest sand and gravel from sediment deposits in the reservoirs with the added benefit of restoring their lost water storage capacity. The sand and gravel dredged from the reservoirs would be sold to area markets to replace those materials currently produced from the Kansas River.

The Kansas Water Office (KWO) has determined that based on a comparison of pre-impoundment and 2007-2010 reservoir surveys, approximately 10,472 acre-feet of sediment has accumulated in Clinton Reservoir since it was constructed in 1977 (KWO, 2009). Utilizing the following conversion factor (1 cubic yard of silt equals 1.35 tons - similar to the conversion for wet soil), Clinton Reservoir has approximately 16,894,827 tons of accumulated sediment. The other federal reservoirs in the Kansas River basin were built 10-30 years earlier than Clinton Reservoir and have accumulated even more sediment (Table 5).

Table 5 Accumulated Sediment in Five Federal Reservoirs in the Kansas River Basin

Reservoir	Year Built	Original Capacity (acre-feet)	Recent Survey Year	Recent Survey Capacity (acre-feet)	Accumulated Sediment (acre-feet)[a]	Accumulated Sediment (tons)[b]	Estimated Tons of Sand Available[c]
Clinton Reservoir	1977	129,171	2009	118,699	10,472	16,894,827	675,793
Kanopolis Reservoir	1944	73,200	2007	48,378	24,822	40,046,160	1,601,846
Milford Reservoir	1964	415,403	2009	373,152	42,251	68,164,947	2,726,598
Perry Reservoir	1966	243,220	2009	200,004	43,216	69,721,813	2,788,873
Tuttle Creek Reservoir	1963	425,312	2009	257,014	168,298	271,520,770	10,860,831
						Total	**18,653,941**

[a] KWO, 2009

[b] 1 acre-foot = 43,560 square feet; 1 cubic yard = 27 square feet; 1 cubic yard of silt is approximately 1.35 tons

[c] Assumed sand comprises 4 percent of the sediment (KWO, 2009)

According to the Reservoir Bathymetric and Sediment Surveys completed by the KWO between 2007 and 2010 (KWO, 2013), sand comprises approximately 2 to 4 percent of the sediment that has accumulated in Kansas reservoirs since their construction. In comparison, the Kansas River bed material typically consists of 90 to 95 percent (or more) sand and gravel. Assuming the best case scenario for reservoir sand extraction at the higher 4 percent sand content accumulated in all five combined federal reservoirs, approximately 18,653,941 tons of the total sediment would be sand suitable for concrete or asphalt.

To produce 300,000 tons of sand from a reservoir dredging operation annually (similar to a typical Kansas River dredging operation) with waste material (mostly silt) averaging 96 percent, 7,200,000 tons of waste material is produced annually (7,500,000 tons of raw silt – 300,000 tons of sand produced = 7,200,000 tons of waste materials). Even for Kanopolis Reservoir (with the highest percent of sand identified in any Kansas reservoir), approximately 2,300,000 tons of total material would have to be dredged to produce 300,000 tons of marketable sand.

State and federal agencies would likely not allow approximately 7,200,000 tons of waste materials to be returned to a reservoir each year and that action would also defeat the goal of removing the material from the reservoir. The waste materials would need to be disposed of on lands adjacent to the particular reservoir being dredged. The upland disposal of this amount of waste would equate to spreading the material more than 10 feet deep across 330 acres of land annually to match the materials extracted by one dredging operation in the Kansas River producing little to no waste material. The removal of sand from the waste materials prior to upland disposal would cause the dredged material to become even more poorly drained and less beneficial or desirable for agricultural use. The material is hard to handle due to the consistency and special measures would need to be taken to adequately dry down the slurry prior to transport or the material has to be placed in a large confinement pit to dispose of it. The waste material virtually has no value and cannot normally be sold or in most cases even given away free. If landowners willing to accept the waste material could not be found, the purchase of land would be necessary for this alternative. Assuming a minimum value of $2,500 per acre for nonproducing agricultural land, the cost of acquiring a 330 acre upland disposal site would exceed $825,000 annually. This cost assumes 330 acres of land suitable for an average deposition of 10 feet of fill material could be acquired and other necessary permits would be granted by federal, state or local governments (e.g., Section 404 wetlands, Federal Emergency Management Agency [FEMA] floodplain fill). Lands suitable for the deposit of an additional 10 vertical feet of fill material tend to be lowlands normally containing high percentages of wetlands, located in floodplains or floodways or previous mining pits. The estimated initial cost of just acquiring the land for the waste disposal alternative would add $2.75 per ton to the cost of sand and gravel harvested by this method.

The dredging and processing equipment currently used by commercial dredging operations on the Kansas River would not be adequate to process the total raw material volumes required for reservoir dredging operations. The proposed alternative would require significant investment in larger dredges, pumps, land-based processing equipment, bulk material loaders, etc., in order to process approximately 95 percent more material to produce the same quantity of material currently dredged from the Kansas River.

If the dredging and processing equipment currently used on the Kansas River could do the job, the dredging and processing alone would cost from about 8 to 25 times as much as dredging and processing sand and gravel from the Kansas River (8 to 25 times more total material from reservoirs would need processing as compared to river dredging processing to produce 1 ton of marketable sand). The cost to process 1 ton of raw material from the Kansas River ranges from $4.50 to $7.00 (see Chapter 3, Section 3.6). In 2007, Dr. Jerry deNoyelles of the Kansas Biological Survey provided the Delaware River Watershed

Restoration and Protection Strategy organization with cost estimates to dredge accumulated silt from Perry Reservoir. Dr. deNoyelles estimated that the cost to dredge the reservoir would range from $3.50 to $5.00 per cubic yard ($2.60 to $3.70 per ton). In 2013, Dr. Craig Smith of Fort Hays University made a presentation at the 2013 Dam Safety Conference where he noted the estimated cost to dredge Tuttle Creek Reservoir would be $6.28 per cubic yard ($4.65 per ton). Based on the average of these cost estimates it will cost about $4.50 to process 1 ton of raw material from reservoirs. Based on an average of 4 percent sand per ton of material dredged from reservoirs the cost per ton of material dredged from reservoirs would be about $112.50 per marketable ton of sand. Even at the highest percent of sand identified in any reservoir, it would cost about $36.00 per marketable ton of sand.

Based on the required scale and increased cost of dredging, processing, waste material disposal, and transportation operations, the USACE has concluded that dredging accumulated sediment in reservoirs solely for the reason of extracting marketable sand and gravel is not economically feasible or reasonable. Therefore, this alternative has not been carried forward for detailed study.

2.5.3 Smaller Rivers in Kansas and Missouri, and the Arkansas River Floodplain

For purposes of this Draft EIS, potential alternative sources of sand and gravel (bulk materials acquired for resale by local distributors serving Kansas River area markets in Manhattan, Topeka, Lawrence, Kansas City, etc.) that are located more than 100 miles from those market areas are not considered reasonable alternatives due to transportation costs. Assuming a minimum price of $5.00 per ton of sand from alternative sources such as smaller Kansas streams and floodplains, and a haul distance of 100 miles (haul cost $0.15 per ton mile) the delivered price to market area distributors would be $20.00 per ton ($5.00 + $15.00 = $20.00). The current price of sand for market area customers in Topeka and areas west of Topeka is near $5.00 per ton, and ranges from $8.00 to $9.00 per ton for customers in the Kansas City area and west to Lawrence. Therefore, the cost of alternative sources of material transported 100 miles to local area distributors would quadruple market area prices in Topeka and areas west of Topeka, and would more than double market area prices in the Kansas City area and west to Lawrence. This alternative is therefore not considered a reasonable alternative based upon cost.

The following potential sources of sand and gravel have been considered:

- The Neosho, Cottonwood, Walnut, Republican, and Big Blue Rivers in Kansas;
- The Gasconade, Osage, Grand, Thompson, Platte, and Pomme de Terre Rivers, and Ozark streams in Missouri;
- Dry mining operations located along the Arkansas River floodplain; and
- Other small sand and gravel production operations located outside the Kansas River valley.

Sand and gravel mining operations on the Neosho, Cottonwood, and Walnut Rivers and their tributaries, in Kansas could potentially serve some Kansas River area markets west of Lawrence. However, these operations are relatively small, generally produce gravel with very little sand, and typically serve local rural markets. Larger rivers such as the Republican and Big Blue could potentially provide sand and gravel to market areas west of Topeka. However, in-stream dredging operations on these rivers are limited since area markets are primarily served by dredge pit mining operations. Sand and gravel mining operations on the Gasconade, Grand, and Osage Rivers, in Missouri are located more than 100 miles from the Kansas City Metropolitan Area and have little potential to serve Kansas River area markets. In addition, sand and gravel production from Missouri sources is likely to experience a significant increase in future demand, to offset recent production losses from the Missouri River due to implementation of significantly reduced annual dredging limits in 2011 by the USACE. Other small river systems in Missouri including the Platte, Grand, Pomme de Terre, and Thompson Rivers as well as Ozark stream mining operations are typically small (less than 5,000 tons annually), generally produce gravel with very little sand, and have little potential to serve Kansas River area markets. Dry sand and gravel mining operations found along the Arkansas River floodplain in Kansas are located more than 100 miles from Kansas River area markets and have little potential to serve those markets. Other small sand and gravel mining operations (not mentioned above) are located on and along Kansas and Missouri streams, but due to size, transportation and material restrictions have little potential to serve Kansas River area markets.

The potential sources of sand and gravel discussed above have been considered and determined not to be reasonable or feasible alternatives due to their limited production capacity and/or distance from Kansas River area markets. Therefore, these alternatives have not been carried forward for detailed study.

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CHAPTER 3

Affected Environment and Environmental Consequences

3.1 INTRODUCTION

Chapter 3 provides a description of the affected environment (the environment of the areas to be affected by the alternatives under consideration) and the potential environmental consequences of the Alternatives carried forward for detailed study including the Proposed Action. The discussion of environmental consequences is primarily focused on the Kansas River and its floodplain but does consider a larger geographic area for several topics (Infrastructure - Transportation and Economics and Demographics). The majority of the information presented for each topic in this Chapter is summarized from previously published studies and reports. The studies and reports referenced in this Chapter are available on the USACE website at www.nwk.usace.army.mil/Missions/RegulatoryBranch.aspx.

Topics discussed in this Chapter include:

- Section 3.2 Geology and Geomorphology
- Section 3.3 Land Use
- Section 3.4 Infrastructure
- Section 3.5 Economics and Demographics
- Section 3.6 Water Resources
- Section 3.7 Recreation
- Section 3.8 Wetlands
- Section 3.9 Floodplains

- Section 3.10 Terrestrial and Aquatic Resources
- Section 3.11 Federally Listed Species
- Section 3.12 Cultural Resources
- Section 3.13 Noise
- Section 3.14 Air Quality
- Section 3.15 Climate Change

Each topic in this Chapter is presented in a format that describes the affected environment followed by a discussion of potential environmental consequences including direct and indirect impacts. Cumulative impacts are discussed in Chapter 4. Potential mitigation measures, intended to offset adverse environmental impacts, are discussed in Chapter 5.

The evaluation of environmental consequences in this Chapter generally follows the criteria described below:

- No-Action Alternative: For purposes of this Report, the discussion of potential impacts associated with the No-Action Alternative is limited to potential impacts that would occur if the No-Action Alternative were selected. These include the potential impacts of not dredging in the Kansas River as well as the potential Impacts associated with additional Missouri River dredging operations, additional floodplain pit mining operations, and additional limestone quarry operations that might provide the needed sand and gravel.
- Direct Impacts: Direct impacts are impacts that are caused by the proposed and alternative actions and would occur at the same time and place (40 CFR § 1508.8).
- Indirect Impacts: Indirect impacts are impacts that are caused by the proposed and alternative actions and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems (40 CFR § 1508.8). In this situation, projected changes in the river channel and bed degradation are examples of indirect impacts

3.2 GEOLOGY AND GEOMORPHOLOGY

3.2.1 Affected Environment

This Section describes the geology and geomorphology of the Kansas River basin, including major uses of the river and the history of channel modifications and management. Physiographic provinces, geologic structure stratigraphy, geologic history and soils of the Kansas River basin were previously presented in the 1982 Burns and McDonnell report entitled, *Cumulative Impacts of Commercial Dredging on the Kansas River – A Social, Economic and Environmental Assessment.* The Burns and McDonnell report was found to be the most comprehensive available resource for this Section. Its information remains valid for purposes of this document.

3.2.1.1 Physiographic Provinces of the Kansas River Basin

The Kansas River drainage system includes not only the Kansas River proper but that of the Smokey Hill and Republican Rivers and their tributaries (Figure 7).

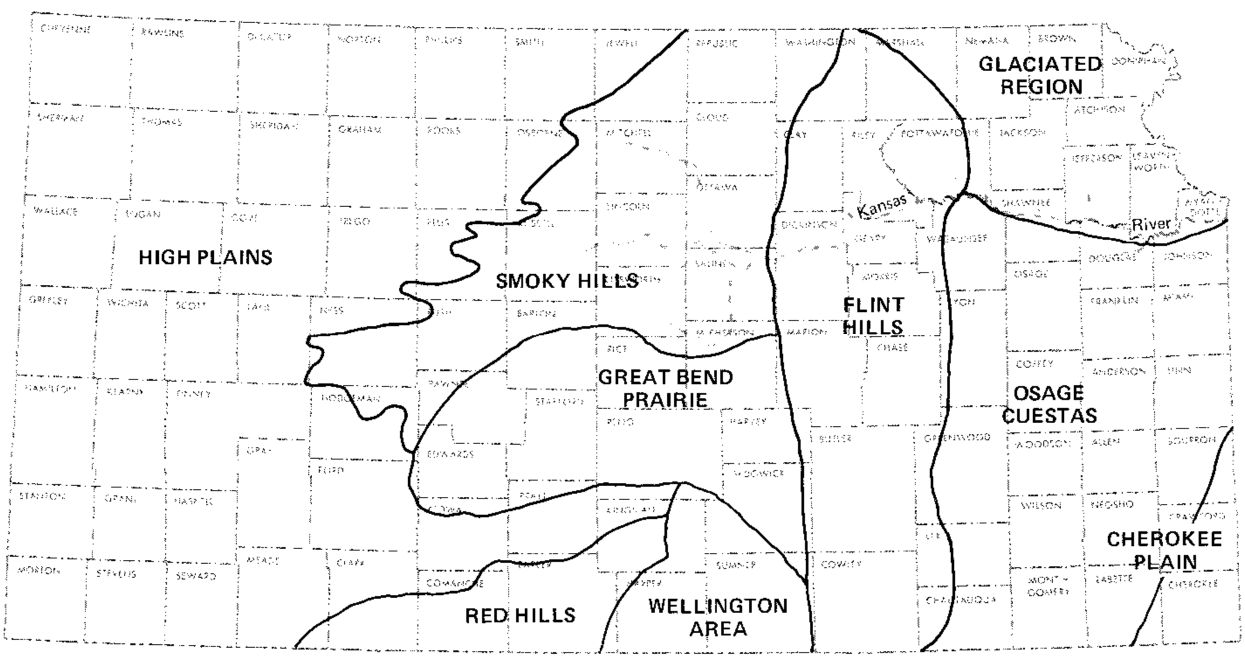

Figure 7 Physiographic Provinces of the Kansas River Basin

Source: Museum of Natural History, University of Kansas "Amphibians and Reptiles in Kansas," 1974.

The following description applies to the total drainage area and is abstracted from Frye and Leonard (1952).

The surface of the State of Kansas generally rises to elevations between 700 and 1,000 feet, National Geodetic Vertical Datum (NGVD) in the east and to elevations exceeding 4,000 feet in the west near the Colorado state line. Rainfall belts also show a graduation from east to west with normal rainfall in excess of 40 inches per year in the southeast and 15 to 20 inches per year in the west. The pre-Pleistocene area geology changes from Pennsylvanian and Permian rock formations in the east, to Cretaceous rock in the central region, and Pliocene rock in the western region.

High Plains

The High Plains include approximately one-third of the area of Kansas. They occur in the western part of the state and extend into contiguous parts of Oklahoma, Colorado, and Nebraska. The High Plains constitute a plateau bounded by distinct scarps on the east and west. Their eastern limit is defined by the prominent scarp of the Fort Hays limestone (Niobrara formation, Cretaceous) for a distance of 150 miles northeastward from Finney County.

The topography of the broad interfluves in the High Plains section is monotonously regular with a regional eastward slope of approximately 10 feet per mile. In much of the region, the surface is underlain by late Pleistocene silt deposits and locally by wind-blown sand resting on earlier Pleistocene deposits or Pliocene Ogallala formation. Much of the High Plains upland surface is not drained by integrated surface channels. The two most sizable drainage systems (Whitewoman Creek and Bear Creek) are not integrated with any through-flowing streams.

The Arkansas River is the only Kansas stream that completely crosses the High Plains region from a source in the Rocky Mountains, but is not connected to the Kansas River basin. In striking contrast, the Smoky Hill River, which originates on the plains surface in Colorado and is part of the headwaters for the Kansas River, occupies a valley 15 to 20 miles wide, cut in Cretaceous bedrock.

Erosion by lateral stream planation is effective in a very small part of the region and, since much of the upland surface lacks integrated surface drainage, erosion along defined stream channels is relatively small. On the flat uplands, even sheet erosion is of relatively small importance. The persistent mantle of wind-blown silt is subject to shifting during periods of excessive drought.

Smoky Hills

The Smoky Hills section in the north-central part of the state flanks the scarp of the High Plains on the east. The topography of the eastern part of the section is dominated by irregular hills held up by discontinuous lenticular sandstones in the Cretaceous Dakota formation. This area is well-drained with moderate to coarse-textured mature topography. The stratigraphic evidence suggests that dissection proceeded throughout the Pleistocene Epoch.

Flint Hills

The Flint Hills Upland, extending in a north-south belt across the state from the Nebraska state line in Marshall County to the Oklahoma state line in Cowley County, effectively separates the Central Lowlands from the Great Plains. The Flint Hills are classed within the Central Lowlands because of their genetic and geologic similarities to the Osage Cuesta Plains to the east. In fact, the Flint Hills can be described as a series of prominent cuesta scarps and dip slopes developed on resistant cherty limestones of early Permian age (primarily Wreford, Florence, Fort Riley, and Herington). The east face of the upland typically consists of a series of stratigraphically controlled benches, and the western part of the upland in some places is a relatively smooth series of dip slopes on the Florence, Fort Riley, and Herington limestones that terminate westward under an alluvial veneer. The western limit of this upland is drawn at the termination of the dip slope where it joins the plain developed on Permian shales or Tertiary, Quaternary, or Cretaceous sediments. In strong contrast to the Great Plains of central and western Kansas, the Flint Hills have been a positive element of the topography, subject to subareal erosion since mid-Tertiary time or earlier. The Kansas River is the only through-flowing stream that crosses the Flint Hills Upland. Its course is the result of Kansan glaciation.

Osage Cuesta Plans

The Osage Cuesta Plains include the region south of the Kansas River Valley, east of the Flint Hills, and northwest of the scarp of the Fort Scott limestone. This scarp marks the westward limit of the Cherokee Plain. The cuestas of the Osage section have much similarity to the Flint Hills except in magnitude. They are developed on limestones of Pennsylvanian and earliest Permian age and are separated by plains developed on the intervening shales.

Dissected Till Plains

The Dissected Till Plains in the northeast present topography unlike any other part of the state. This section presents a view quite similar to adjacent parts of Missouri and Nebraska and southern Iowa. The section is bounded on the south by the broad and distinctive Kansas River valley, which marks the general southern limit of the Kansas till, and on the west by the sharp diminution in thickness of Kansas till at the edge of the Flint Hills. In northern Marshall County, the Dissected Till Plains transgress the Flint Hills Upland and contact the Great Plains section at the Nebraska state line. Here, thick Kansas till overlaps the Flint Hills belt from the northeast, and from the west Cretaceous sediments overlap the Permian rocks as far as the Herington limestone. Except in some divide areas, the topography of the Dissected Till Plains section is well drained, moderately fine-textured, mature, and is a well-rounded rolling surface. For the most part, it is developed in glacial till with Pennsylvanian or Permian rock exposed along the lower parts of the deeper valleys. In northeastern Doniphan County, thick loess deposits impart a distinctive character to the topography; but elsewhere in the section the thin loess deposits veneer rather than modify the surface developed on Kansas till.

3.2.1.2 Geological Setting

The Kansas River basin is located predominantly on the eastern flank of a syncline. This structure, which was formed by the down-warping of a great thickness of sedimentary rocks, stretches from Canada to Texas and from approximately the Mississippi River to the Rocky Mountains. Due to this structure, rock units which are exposed at the surface near the mouth of the Kansas River are covered by younger sediments as one moves upstream and can be found only at great depths in western Kansas. These same rock units, however, are again exposed at the surface just in front of the Rocky Mountains, indicating that the geologic structure is composed of two limbs that dip in opposite directions. The topographic surface of the Kansas River basin slopes downward to the east, in contrast to the attitude of the underlying rock layers.

Despite their participation in the mid-continent syncline, rock layers in the Kansas River basin are not greatly disturbed. The strata dip to the west at rates of 20 to 60 feet per mile. An observer at an individual outcrop would describe the strata as essentially horizontal. The area for the most part is seismically stable and surface faults are a rarity. The geologic structure has its greatest influence on the pattern of bedrock exposures, which in turn influences the physiography of the basin. Outcrops of rock units are parallel to the synclinal axis, which is oriented in a north-south direction. Consequently, the bedrock outcrop pattern of the Kansas River basin resembles a series of north-south trending bands. Physiographic provinces generally follow a similar trend.

The syncline was formed at the same time as the Rocky Mountains and the rock layers disturbed at that time have been relatively stable throughout the succeeding geologic periods. Rock units younger than Mesozoic are not involved in the folding. These younger units are the Ogallala formation, which forms the High Plains section of western Kansas, and the Pleistocene deposits which can be found throughout the Kansas River basin, but which dominate the landscape in northeastern Kansas. These units overlie the older rocks without regional dip or folding.

3.2.1.3 Stratigraphy

The oldest rocks exposed in the Kansas River basin are Pennsylvanian. These rocks form the surface in most of the eastern one-fourth of Kansas and underlie the glacial drift in northeastern Kansas. The individual lithologic units that comprise the Pennsylvanian rocks are normally less than 25 feet in thickness and are found in more or less uniformly alternating sequences of shale, limestone, sandstone and coal (53 seams) termed "cyclothems." The aggregate thickness of Pennsylvanian rocks in Kansas is about 3,100 feet.

Rock of Pennsylvanian age, in normal sequence, is overlain by those of Permian age. The outcrop of Permian age rock coincides with the Flint Hills section and lies west of and parallel to the Pennsylvanian outcrop. Permian rock forms the valley walls of the Kansas River proper from near the western Shawnee County line to the confluence of the Smoky Hill and Republican Rivers at Junction City. The lower portion of Permian age rock resembles the Pennsylvanian except that it contains fewer coals. The upper rock layers of the Permian sequence, however, contain salt and gypsum beds. Both gypsum and salt are mined in Kansas. Salt from upper Permian beds is the most common source of chlorides in rivers in the Kansas River basin.

West of the Permian Outcrop in central Kansas and southern Nebraska is the exposure of Cretaceous rock, which directly overlie the Permian Outcrop. Rocks of Jurassic and Triassic periods are missing over large parts of the area due to erosion. Cretaceous rock units consist of vari-colored clays, siltstones and sandstones of the Dakota formation and alternating beds of limestone, chalk and shales assigned to other formations. Cretaceous rock is about 2,750 feet in aggregate thickness and has been divided into eight formations. The Dakota serves as a groundwater reservoir (aquifer) in areas as far separated as North Dakota and Oklahoma. The Chalk and Limestone formations, particularly the Niobrara have yielded especially fine specimens of fossil reptiles.

The last known invasion of marine water occurred during Cretaceous time. The Laramide Revolution that formed the Rocky Mountains occurred at the end of the Cretaceous period. Consequently, rocks younger than the Mesozoic-Cretaceous period are continental in origin and do not participate in the mid-continent synclinal structure.

Rocks of Tertiary age in the Kansas River basin are confined to one formation, the Ogallala. The Ogallala formation is composed of massive to cross-bedded, gravel, sand and silt, locally cemented with calcium carbonate. The Ogallala covers the western one-third of Kansas and the eastern one-half of the Colorado plains. It extends from the Texas Panhandle to Nebraska. The formation has been greatly reduced by erosion since its initial deposition and is thought to have originally extended from the foot of the Rockies to the Flint Hills of eastern Kansas in one, continuous, tabular mass.

Geologic materials of Pleistocene age are widely distributed but discontinuous across the Kansas River basin. The deposits are not marine in origin and include glacial, lacustrine (lake), fluvial (river) and eolian (wind) deposited sediments. Ice-transported sediments occur only in northeastern Kansas, whereas stream-laid deposits occur generally throughout the state in stream valleys. Wind-laid deposits occur throughout the state, but are most extensive in northern and western areas. Wind-blown silt (loess), is the most widespread deposit and forms the immediate surface material over approximately one-half the area of the basin. Much of the fertile topsoil has been developed from Quaternary alluvium and loess. Lacustrine deposits are most commonly associated with the ice-lain deposits in northeastern Kansas.

Beginning about one million years ago, for reasons unknown, the entire planet was subjected to a series of prolonged thermal minima which caused continental glaciers to form and move southward over long distances. Four glacial advances are recognized. Glaciation resulted in worldwide lowering of sea levels and cycles of erosion and deposition on the continents. At the beginning of each glaciation, there was a sharp reduction in both chemical weathering and soil formation and a pronounced acceleration of stream erosion. From approximately the mid-glacial to the early part of the next interglacial stage, a cycle of deposition occurred, marked by a sequence of coarse to fine-grained sediments in the stream valleys. The glaciers themselves transported very large amounts of heterogeneous materials and left it as a blanket, often several hundred feet thick, over the landscapes from which they retreated. The effects of glaciation extended far beyond the actual limits of the glaciers themselves since one of the characteristics of glacial periods is a general increase in precipitation. In addition, melt waters from the glaciers carried a large volume of sand, silts, and gravels into regional drainage systems to be deposited many miles from the source. Many of these deposits exist today.

The Kansas River basin landscape is for the most part a product of erosion and deposition during the Pleistocene Epoch and has evolved to its present aspect by pulses of accelerated erosion and sedimentation during each of the glacial periods of the Pleistocene. In the Tertiary Period, the Kansas River basin was truly a plain. Early in the Pleistocene Epoch, valley deepening occurred along major streams in all parts of the study area. The relative incompetence of streams in the western third of Kansas left broad areas undissected but in the eastern part virtually all of the area was eroded and in the central Kansas valley incision exceeded 200 feet. In the Flint Hills Upland and Osage Cuesta Plains, each succeeding glacial period produced an episode of downcutting of diminishing intensity. In the Dissected Till Plains section, the influence of glaciations overpowered all other factors. The post-glacial history of this region has been primarily dissection of glacial till, deepening of valleys, and relatively minor alluviation of valleys.

The net effect of Pleistocene events on the Kansas River basin landscape has been a strong increase in topographic relief and the placement of deposits that contain large amounts of ground water, sand and gravel, volcanic ash, and some ceramic raw materials.

The surface soils, the most valuable single mineral resource in the study area, are almost entirely a product of processes operating during the Pleistocene Epoch.

3.2.1.4 Soils in the Kansas River Valley

Floodplain soils associated with the Kansas River and its tributaries are derived from alluvium. The alluvium consists of water-laid deposits of silt, clay, and sand and gravel and has been modified in the past by natural phenomena such as channel migration and flooding. Other soils include those formed from the weathering of local parent material and eolian deposits transported to the area by wind.

Soils in the Kansas River Valley consist of sandy riverwash in and immediately adjacent to the river channel and the deep, nearly level silt and sandy loams of the first and second bottoms in the floodplain. The first bottom is next to the stream and is subject to periodic inundation, sometimes more than once a year. The second bottom represents the higher terraces above the first bottom, which are less frequently inundated. Soil associations in the valley are primarily Eudora-Kimo in the eastern reach (e.g., Johnson and Douglas Counties) and Eudora-Haynie-Sarpy types in the western reach (e.g., Riley and Geary Counties).

The floodplains and low terraces of the eastern Kansas River tributaries (Wakarusa and Delaware Rivers, and Soldier Creek) have deep, nearly level silty clay loam soils of the Kennebec-Wabash Reading association. Soils of the near-western Kansas River tributaries (Big Blue and Republican rivers) are of the Eudora-Haynie-Sarpy type with the Sarpy series very common in the first bottoms. Riverwash is also found in these areas, especially in the Republican River corridor.

The floodplains of the far-western Kansas River tributaries, the Smoky Hill, Saline, and Solomon Rivers, are characterized by the deep, nearly level calcareous silt and clayey loams of the Humbarger-Muir and Roxbury-New Cambria-McCook soil associations with the latter occurring mostly along the Solomon River. The soils of these areas are generally less sandy than those found in the Kansas River floodplain. In upland areas of the Kansas River corridor, relatively shallow, sloping, clayey soils will be found. The Flint Hills area in portions of Riley, Geary, Pottawatomie, and Wabaunsee Counties is covered with cherty limestone soils of the Sogn, Summit, and Florence types.

The very sandy, unstable riverwash soils and steeply sloping soils adjacent to and occurring on streambanks are best used to support native vegetation and develop wildlife habitat. Low-lying, poorly drained, clayey soils typical of old meander scars have limited agricultural potential and are also more suited for native vegetation. Floodplain alluvial soils of the first and second bottoms having sandy silt, silt-loam profiles, can be cultivated and when irrigated, high crop yields are possible. These soils are well suited for tree growth and wildlife development in areas where periodic inundation hinders agricultural uses.

3.2.1.5 River Geomorphology

The Kansas River basin occupies portions of northeast Colorado, southern Nebraska and nearly the entire northern half of Kansas. The Kansas River basin lies between the Platte and Nemaha basins on the north and the Arkansas and Marais de Cygnes (Osage) basins on the south. The total drainage area of the Kansas River basin is approximately 61,440 square miles. It is approximately 480 miles long and averages about 140 miles in width with the major axis of the basin orientated in an east-west direction (Kansas Board of Agriculture, 1944). Of the 61,440 square miles, the 44,870 square miles of drainage located upstream of Fort Riley only produces one-third of the total flow at DeSoto, while the remaining 14,886 square miles of drainage located downstream of Fort Riley produce two-thirds of the flow at DeSoto. The average rainfall across the Kansas River basin varies drastically from east to west, which results in the upper watershed contributing a smaller portion of runoff than the lower watershed. At Kansas City, the average rainfall is approximately 38 inches per year, while the average rainfall near Goodland, Kansas is approximately 18 inches per year.

The Smoky Hill and Republican Rivers join at Junction City, Kansas to form the Kansas River proper. The Kansas River flows easterly for a distance of approximately 170 miles to its confluence with the Missouri River at Kansas City, Kansas. The principal tributary, in addition to the Smoky Hill and Republican Rivers, is the Big Blue River, which originates in southern Nebraska, unlike the other two rivers, which have their origin in eastern Colorado. The Big Blue joins the Kansas River near Manhattan, Kansas. Other, smaller tributaries, which enter the Kansas River below Manhattan are Vermillion Creek, near Wamego; Cross and Mill Creeks, near Rossville; Soldier Creek at Topeka; Delaware River, near Perry; Wakarusa River, at Eudora; and Stranger Creek, near Linwood.

The Kansas River has been formed primarily by glacial activity over the last 600,000 years. The approximate bed elevation at the mouth of the Kansas River is 700 feet, NGVD and is near 1,030 feet in elevation at the confluence of the Smokey Hill and Republican Rivers in Junction City. The average top width of the Kansas River channel is approximately 480 feet near the confluence of the Smokey Hill and Republican Rivers, approximately 800 feet between Perry and the Water District No. 1 of Johnson County, Kansas (WaterOne) weir, and approximately 460 feet downstream of the WaterOne weir. The Kansas River is a dynamic fluvial system that transports a relatively large volume of sediment. The bed material of the river (primarily sand and gravel) is homogeneous along its entire length and has a mean grain diameter between 0.4 and 2.0 millimeters.

Channel Modifications

According to a report entitled *Analysis of Channel Degradation and Bank Erosion in the Lower Kansas River* (Simons, Li, and Associates, 1984) several natural and man-induced modifications to the river continue to change the river channel and flow characteristics. These manmade features affect aggradation/degradation and lateral erosion along the channel. Major activities affecting the river’s channel include:

- Changes in the stage-discharge relation on the Missouri River at Kansas City due to the Missouri River navigational channel and bank stabilization project (Simons, Li, and Associates, 1984).
- Construction of Bowersock Dam at Lawrence. Bowersock Dam is the largest obstruction on the river. It serves to create a standing pool for one of Lawrence's municipal water intakes and creates a head for Bowersock Mills and Power Company (BMPC). BMPC operates the only hydroelectric power station in Kansas: a 7 megawatt (MW), low-impact hydropower facility (U.S. Energy Information Administration, 2013). The dam functions as a grade control structure and prevents changes in bed elevations downstream of the dam from affecting bed elevations upstream of the structure.
- Construction of the WaterOne weir. The weir was constructed to divert river water to the WaterOne municipal water supply intake located on the right descending bank of the river just downstream of the Interstate Highway 435 (I-435) Bridge. The weir functions as a grade control structure and prevents changes in bed elevations downstream of the weir from affecting bed elevations upstream of the structure.

- A low head weir exists just downstream of Topeka that diverts water to the Westar Energy-Tecumseh Energy Center. The Tecumseh power plant is a 242 MW facility powered by low-sulfur coal.
- The city of Topeka maintains a dam that diverts water to the right descending bank of the river to a municipal water supply intake. The weir functions as a grade control structure and prevents changes in bed elevations downstream of the weir from affecting bed elevations upstream of the structure.
- A set of river training structures upstream of Topeka near RM 120 at Belvue, Kansas, direct the deepest part of the river flows toward the Jeffery Energy Center water intake structure located along the left descending bank of the Kansas River.
- Manmade bank and channel protection structures such as riprap blankets, hardpoints, dikes and jetties (i.e., channel training structures near Eudora, Kansas). The placement of these structures prevents or reduces lateral channel migration.

The most substantial impact in recent history to the morphology of the Kansas River occurred as a result of the 1951 flood. The flood event dramatically altered the river system. The post-flood channel was straighter and the cross-sectional area much larger than before the flood. Since that event, and in combination with flow changes due to reservoir construction and release rates, the river is steadily changing to regain equilibrium (Simons, Li, and Associates, 1984).

The Kansas River upstream of Bowersock Dam has a relatively stable morphology, with the exception of the Topeka area (Simons, Li, and Associates, 1984). The 2011 survey data indicates that 1 to 2 feet of riverbed degradation has occurred within the Topeka area since the 1992 baseline survey. The river channel in the Topeka area has been hardened and narrowed with flood-control works, making it difficult to separate the impact of those improvements from impacts of other activities such as dredging. Based on long-term gaging station data and the survey data collected since the 1992 baseline survey, the river channel downstream of Bowersock Dam appears to be less stable than the areas monitored upstream of the dam. Although the river below the Bowersock Dam has experienced more intense dredging over time than the river above the dam, it has also been subject to the influence of more manmade and natural control structures than the upper river, and is subject to Missouri River backwater. Control structures below Bowersock Dam (RM 51.8) include channel training structures near Eudora (approximately RM 43.4.); jetties near the

Eudora bridge (approximately RM 42.4); riprap, jetties, hardpoints and metal jacks, especially near railroad right-of-way between Eudora and Bonner Springs (approximately RMs 40 and 24); a natural, nearly 1-mile-long, rock and cobble bar that spans the river near Bonner Springs (approximately RMs 22.8 to 21.8), the WaterOne weir (approximately RM 15.0); a natural rock deposit that spans the majority of the channel (approximately RMs 12.2 to 12.4); and Missouri River backwater (approximately RMs 0 to 9.3, during normal flows).

Reservoirs

Eighteen reservoirs have been built in the Kansas River watershed since 1949. The reservoirs are primarily operated for flood control purposes. A total of 49,400 square miles (80 percent) of the total drainage area (61,440 square miles) is controlled by reservoirs. These reservoirs affect the movement of materials through the Kansas River by modifying the natural discharge pattern. The regulation of discharge patterns by the dams decreases the frequency of both very high and very low flows, while increasing the frequency of discharge events between the two extremes. Lowering the peak flood discharge rate also lowers the volume of sediment moved during a given event. The presence of the reservoirs causes the river to transport a higher percentage of fine-grained materials than would occur without the influence of reservoirs (Brady, et al., 1998). The increase in fine-grained material in the Kansas River is in part a result of the sediment trapping efficiency of the reservoirs. Trapping of sediments by the reservoirs and the release of relatively clean water can cause downstream bed and bank erosion as the discharge water tries to restore its sediment load to satisfy its sediment-carrying capacity. According to Simons, Li & Associates (1984); Brady, et al. (1998); and the USGS (1967); effects of bed and bank erosion, associated with relatively clear water released from reservoirs, is primarily confined to the tributaries located immediately downstream of the reservoirs and not the Kansas River.

Tributaries of the Kansas River

Major tributaries to the Kansas River include the Smoky Hill River, Republican River, Big Blue River, Vermillion Creek, Cross Creek, Mill Creek, Soldier Creek, the Delaware River, the Wakarusa River, and Stranger Creek. A literature review of the influence of the Kansas River on the channel stability in these first order tributaries (those that form a confluence with the Kansas River) was completed as part of this Draft EIS. The review was intended to address potential impacts (head-cutting and bank destabilization) within the downstream reach of such tributaries due to declines in bed elevations in the Kansas River. Resources could not be identified that correlated stage or bed elevation declines along the Kansas River as an influence on channel stability within the tributaries. However, the USGS in cooperation with the United States Department of Interior and the Kansas Department of Transportation (KDOT) found that channel-bed lowering had occurred downstream from most of the large reservoirs located on Kansas River tributaries. According to the USGS report, the net decrease ranged from less than 1 foot to slightly more than 9 feet (Juracek, 2001).

Hydrology

The USACE completed a report entitled "*Hydrologic and Geomorphic Changes on the Kansas River"* (USACE, 2010) that assessed the hydrologic and geomorphic changes to the Kansas River from 1985 to 2009 as a supplement to the channel morphology study completed by Simons, Li, & Associates in 1984. The flow volume and stage-discharge measurements in the 2010 USACE report are summarized below. These measurements were taken from USGS monitoring data from five active gage stations located along the Kansas River (Figure 8), which are operated and maintained by the USGS. The data are available at http://waterdata.usgs.gov/ks/nwis/.

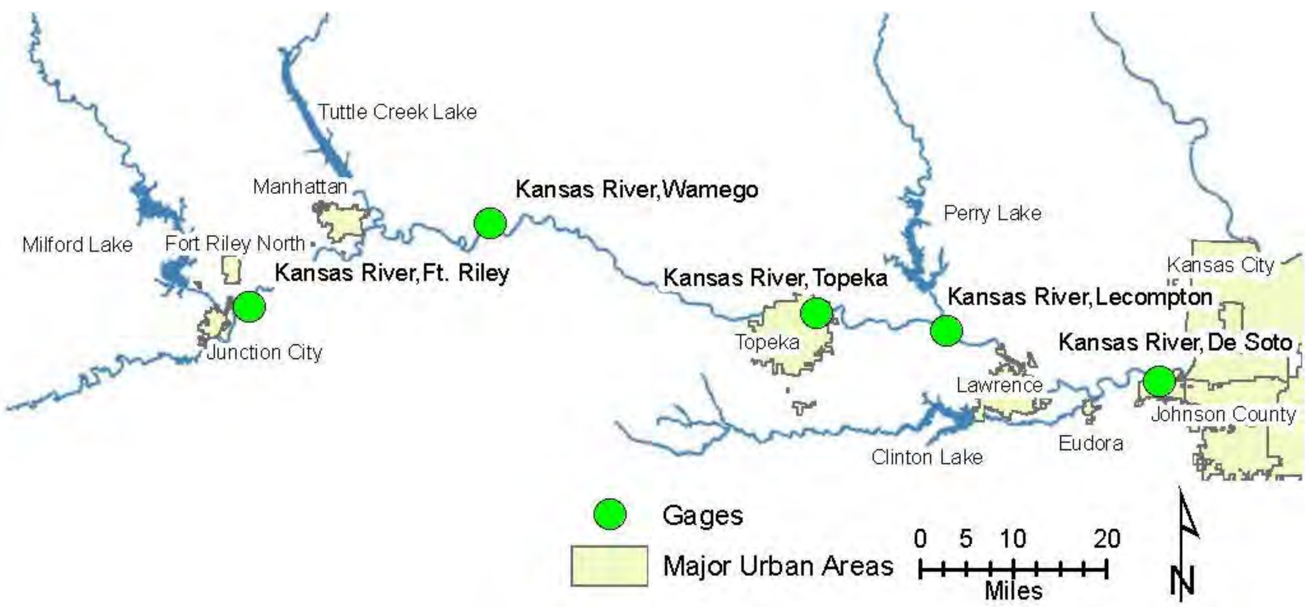

Figure 8 **Kansas River Gage Locations**

Flow Volume

The average annual flow, calculated by averaging daily flow values during a given year, is a measure of the volume of stream flow. In an unchanging watershed, natural variation in annual precipitation leads to large variations in the average annual flow, but the many-year average remains relatively constant. Urbanization and other land use changes may alter the value about which the average annual flow fluctuates. Water withdrawals for irrigation, human consumption, power generation, and industrial use cause the average to decrease. Evaporation from reservoirs may affect flow volumes. Most other natural and human-induced channel changes, including levee construction, bed degradation, and channel migration, do not usually have a major effect on flow volumes.

When all available water years were considered, gages at Fort Riley, Wamego, and Topeka in the upper river showed slight upward trends in annual average flow volumes. The gages at Lecompton and DeSoto showed more definite upward trends in annual average flow volumes. When the available water years were broken up based on apparent differences, average annual flow in the Kansas River was lower from 1918 to 1939 than from 1940 to 2009. There appears to be no increase or decrease in the average annual flow in the Kansas River from 1940 to 2009. Milford Reservoir, Tuttle Creek Reservoir, Perry Reservoir, and Clinton Reservoir do not appear to affect the total flow volumes in the Kansas River. This is expected as the chief purpose of these reservoirs is to alter the timing of the flows, not the total volume of flow.

The amount of material transported by a sand-bed river is highly dependent upon the volume of flow and the velocity of the water, which need to produce enough energy to carry the erodible material from the channel bed and banks through the system. Based on the USGS DeSoto gage station data from 1968 to 2012, the average mean flow at DeSoto, the most downstream gage on the Kansas River, was approximately 8,000 cubic feet per second (cfs) for that period. Of the 45 years of data, 19 years exceeded the average mean flow of 8,000 cfs, while 26 years were less than the average mean flow. Those years that met or exceeded the average mean flow would be expected to have provided a greater material recharge to the bed in downstream areas, versus those years that produced less than the average mean flow. A notable exception to this expectation would be flood years, which may have resulted in a scouring action through the river system due to significant increases in flow velocities. Conversely, those years that produced flows that were less than the average mean flow would be expected to carry less material throughout the river system, which would result in a reduction in the material available to recharge the bed in downstream areas. The years 1973 and 1993, were noted as having exceptionally high average mean flows due to flooding, while the years of 1988, 1991, 2000, 2002, 2003 and 2006 exhibited exceptionally low average mean flows consistent with long periods of dry to drought-like conditions (Putnam, Perry, and Wolock, 2008).

Flow Duration

A flow-duration curve reports the percent of the time that a given daily flow is met or exceeded. The 40 percent flow is the flow which, on the average, is exceeded 146 days per year (0.4*365 days = 146 days). The flow-duration structure for a river drives the sediment transport regime and remains relatively independent of the channel morphology. Factors that affect the volume of flow, such as irrigation withdrawals, or the timing of flows, such as detention and releases from reservoirs, can influence the flow-duration curves. The anticipated effect of flow regulation is to decrease the frequency of flood flows and low flows and increase the frequency of intermediate flows.

Flow-duration curves in the 2010 USACE report shows that the flow-duration structure of the Kansas River has changed in the past 100 years. The floods and droughts are less severe, but the intermediate flows have increased. The attenuation of the floods and droughts can be attributed to the operation of major federal reservoirs. The increase in the intermediate flows seen in the post-reservoir period is mostly a factor of the drought of the 1920s and 1930s. When these dry years are excluded from the analysis, the changes in intermediate flows are less pronounced. The flow data at the Fort Riley gages show a different pattern than the other gages. At Fort Riley, floods and low intermediate flows have decreased in the post-reservoir period, droughts have remained unaffected, and high intermediate flows have increased. Why the hydrology at this site differs from the other sites on the Kansas River is not readily apparent. A possible link between changes in the flow-duration structure and changes in the geomorphology of the Kansas River would require a sediment transport analysis that was beyond the scope of the 2010 USACE report or this Draft EIS.

Geomorphology

In order to assess the 170-mile-long Kansas River, Simons, Li & Associates (1984) divided the river into eight reaches based on hydrologic controls and other factors. A qualitative description of each of these reaches can be found in the 1984 Simons, Li & Associates report. The same eight reaches have been used in subsequent studies, including the most recent evaluation of Kansas River channel bed and bank conditions (USACE, 2010).

Qualitative Assessment

Based primarily on field reconnaissance that took place on July 19, 20, and 21, 2010, the USACE made a qualitative assessment of the river. High flows during this visit (10,900 to 13,100 cfs at Fort Riley) aided navigation and access to the full length of the river, but submerged many lower elevation features such as sand bars, braided channels, in-stream structures, etc. Accordingly, this assessment concentrated on bank features – erosion, accretion, angle, height, and vegetation. The qualitative assessment from the 2010 USACE report is summarized below:

- Reach 1 contains the lower 12.2 miles of the river. The reach is characterized by a narrow channel with little to no floodplain. In many places, low, vegetated banks have formed on sediment deposits on the riverside of riprap embankments and floodwalls. The river morphology within this reach is substantially influenced by Missouri River backwater.

  One dredging area (RMs 9.4 to 10.4) is currently authorized within this reach and the same dredging area is requested under the Proposed Action.

- Reach 2 contains the river segment between RM 12.2 and the WaterOne weir at RM 15. The majority of the reach is characterized by gently sloped, non-eroding banks with the exception of the area immediately downstream of the weir, which has very high, vertical, eroding banks. The channel downstream of the WaterOne weir is noticeably narrower than upstream of the weir.

  One dredging area (RMs 12.8 to 13.9) is currently authorized within this reach and the same dredging area is requested under the Proposed Action.

- Reach 3 contains the river segment between RMs 15 and 21.5. The bed in this reach is generally accreting.

Four dredging areas (RMs 15.4 to 16.9, 18.65 to 20.15, 20.55 to 20.6, and 21.0 to 21.15) are currently authorized within this reach and three dredging areas (RMs 15.4 to 16.9, 18.65 to 20.15, and 20.55 to 21.15) are requested under the Proposed Action.

- Reach 4 contains the river segment between RM 21.5 and Bowersock Dam at RM 51.8. This reach is primarily characterized by a narrowing channel due to accretion along the banks; although a few places are noted with eroding banks along the outside of river bends. This reach has been structurally enhanced with bank armoring and placement of various in-stream structures to protect the banks and narrow the channel. Vegetation has become established along many of the accreted areas adjacent to the riverbanks.

One dredging area (RMs 26.1 – 27.1) within this reach has been requested under the Proposed Action.

- Reach 5 contains the river segment between Bowersock Dam at RM 51.8 and RM 76. A small stretch of the reach between RMs 71 and 74 is experiencing cutting (lateral migration) along the outer bank and deposition along the inner bank. The remainder of the reach is characterized by highly vegetated, sloped banks, which in most areas are stabilized by riprap.

No dredging areas are currently authorized within this reach and no dredging areas are requested under the Proposed Action.

- Reach 6 contains the river segment between RM 76 and the Willard Bridge at RM 101. The banks are primarily lined with riprap that has become overgrown with vegetation. Land accretion (primarily on the inside of river bends) is common throughout this reach. The Topeka weir is located within this reach near RM 87. The weir serves as a grade control structure protecting downstream erosion from migrating upstream. A flood control levee has been constructed along the left descending riverbank between RMs 86.5 and 85.3. This reach of channel is highly depositional with channel narrowing on the side opposite of the levee. The heavy deposition along the levee continues downstream creating a well-defined area of land accretion within the reach.

One dredging area (RMs 77.1 to 78.6) is currently authorized within this reach and one additional dredging area (RMs 89.7 to 91.0) is requested under the Proposed Action.

- Reach 7 contains the river segment between the Willard Bridge at RM 101 and RM 148. This reach is characterized by tall, vertical, eroding banks; with the outside bends predominantly eroding and the inside bends being depositional. Areas with bank protection such as hard points, dikes, stone, etc. have become heavily vegetated.

  No dredging areas are currently authorized within this reach and no dredging areas are requested under the Proposed Action.

- Reach 8 contains the river segment between RM 148 and the confluence of the Kansas, Smokey Hill and Republican Rivers near RM 170. As in Reach 7, this reach is characterized by tall, vertical, eroding banks. At many locations, adjacent agricultural fields have been farmed or planted up to the edge of the riverbank.

  No dredging areas are currently authorized within this reach and no dredging areas are requested under the Proposed Action.

Extensive riprap and other rock bank protection structures placed along many reaches of the Kansas River have been overgrown with woody vegetation. This armoring combined with the vegetative growth has helped to restore and preserve sloping banks, and to stabilize the lateral alignment along much of the river channel. Those areas along the river that are characterized by high, vertical, eroding banks lack such stabilization. Some of these high, vertical banks had riparian vegetation on top that apparently had an insufficient strengthening influence on the toe of the bank to prevent erosion and bank failure. Many of the high, eroding banks occur adjacent to agricultural land where crops have been planted to the edge of the bank (USACE, 2010). The dredging reaches did not have higher, steeper, or more erosive banks. For the most part, they appeared to be actively accreting land.

Stage-Discharge Relationship

In their 2010 report, the USACE examined the relationship of stage levels (stage) and associated discharge volumes (discharge) at each of the five gages on the Kansas River to determine if there was an increase or decrease in bed elevations over time. Changes in the stage-discharge relationship over time can be indicative of geomorphic changes (Juracek & Fitzpatrick, 2009). A decrease in the stage-discharge relationship indicates that the channel conveys the same discharge at a lower elevation and is often assumed to correspond to a drop in the channel bed. Conversely, an increase in the stage-discharge relationship is assumed to indicate bed aggradation. While the abundance of stage-discharge data makes analyses of this type convenient and useful, the results are limited for two reasons.

First, while a drop in the stage for a given discharge could be caused by bed degradation, it could also be caused by an increase in channel width and decrease in the flow depth (no change in cross-sectional area) or increase in velocity with no drop in bed elevation (resulting in a decrease in cross-sectional area). Additional gage analysis (USACE, 2010) shows that the flow area and flow top width rating curves have not changed appreciably since 1960. This suggests that stage degradation on the Kansas River does in fact indicate bed degradation and not a decrease in flow depth.

Second, the long temporal record of USGS gages does not imply spatial applicability. The gage reflects hydraulic conditions (and by inference, geomorphic conditions) at a single location. A stage drop at the gage may indeed indicate a bed drop in the vicinity of the gage, but it does not necessarily reflect conditions ten miles upstream or downstream from the gage. Data from multiple gages should be used in conjunction with other geomorphic measurements.

The conclusions reached by the USACE in 2010, based on gage station survey data, are summarized below:

- Fort Riley gage – The stage-discharge relationship dropped approximately 3 feet from 1960 to 2005. This drop appears to have been caused by the 1973 flood, the high water in 1987, and the flood of 1993. The 1993 flood was the largest contributor to the noted degradation at the Fort Riley gage. Outside of these events, no degradation trend was evident. A slight rise in the stage-discharge relationship since 1995 may represent a new aggradation trend or may simply be an oscillation about a new equilibrium established by the 1993 flood.
- Wamego gage – The stage-discharge relationship depicted a downward trend between 1961 and 1993 that resulted in a change of approximately 0.5 foot. During the flood of 1993, the river stage dropped 1 foot, but rebounded over the next few years to the pre-1993 condition. No trend was noted since 2001.
- Topeka gage – The stage-discharge relationship has steadily decreased since 1961. The floods of 1993 and 2007 do not appear to have influenced the stage-discharge

relationship. The drop in river stage since 1961 is approximately 3 feet. The 1993 and 2007 floods do not appear to have influenced the stag-discharge relationship at Topeka.

- Lecompton gage – The stage-discharge relationship has fluctuated over time, but there is no trend in stage changes since 1941. No readily apparent changes were experienced at the gage station during the 1993 or 2007 floods.
- DeSoto gage – The stage-discharge relationship shows a steady decrease in stage of approximately 2 feet between 1972 and 1993 (pre-flood). The flood of 1993 resulted in a rapid 1.5-foot drop. Following the flood in 1993, the stage continued to decrease an additional 1 foot until 2000. There has been no significant trend reflecting either an increase or decrease in stage since 2000.

The USACE determined that the trend in decreasing stage, identified for several of the gage stations, occurred prior to 2000. Most of the gages have not shown a trend reflecting either an increase or decrease in stage since 2000 (USACE, 2010).

The Topeka and DeSoto gages are located near dredging reaches in which the USACE compared changes in dredged quantities and the stage of 5,000 cfs over time. Figure 9 shows the total extracted amount from 1999 to 2009 for each dredging reach on the Kansas River. Figure 9 indicates that the dredging reaches directly upstream and downstream of the DeSoto gage underwent very little and no dredging (respectively) from 1999 to 2009, which may explain the recent stabilization of the stage. Whether or not the increased dredging from 1973 to 1983 significantly contributed to the degradation seen in that period cannot be concluded from this analysis.

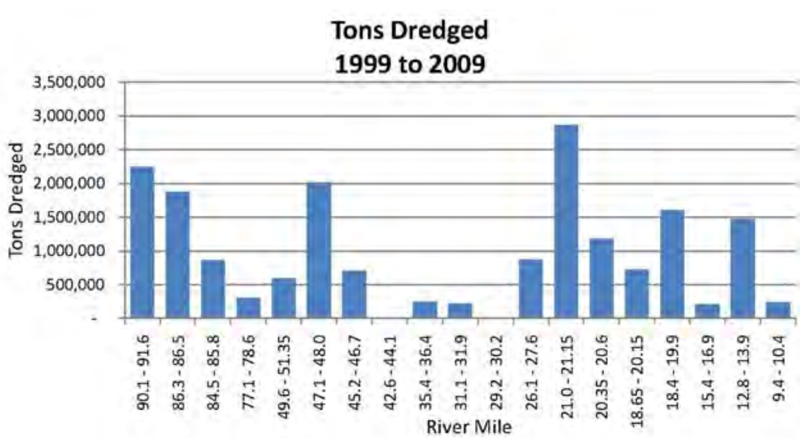

Figure 9 Total Dredged Quantities 1999 to 2009

Figure 10 depicts dredging quantities at RMs 9.4 to 22 (1977 to 1983) and RMs 9.5 to 22 (1999 to 2009) and the elevation of 5,000 cfs at the DeSoto gage (RM 31.1). The dredging quantities from 1973 to 1983 fluctuated between 1.5 and 4 million tons per year. In the same period, the stage of 5,000 cfs steadily decreased. From 1999 to 2009, dredging quantities decreased from 2 million tons per year to 1 million tons per year and the stage of 5,000 cfs remained essentially constant. The recent rates and locations of dredging have not caused stage degradation at the DeSoto gage.

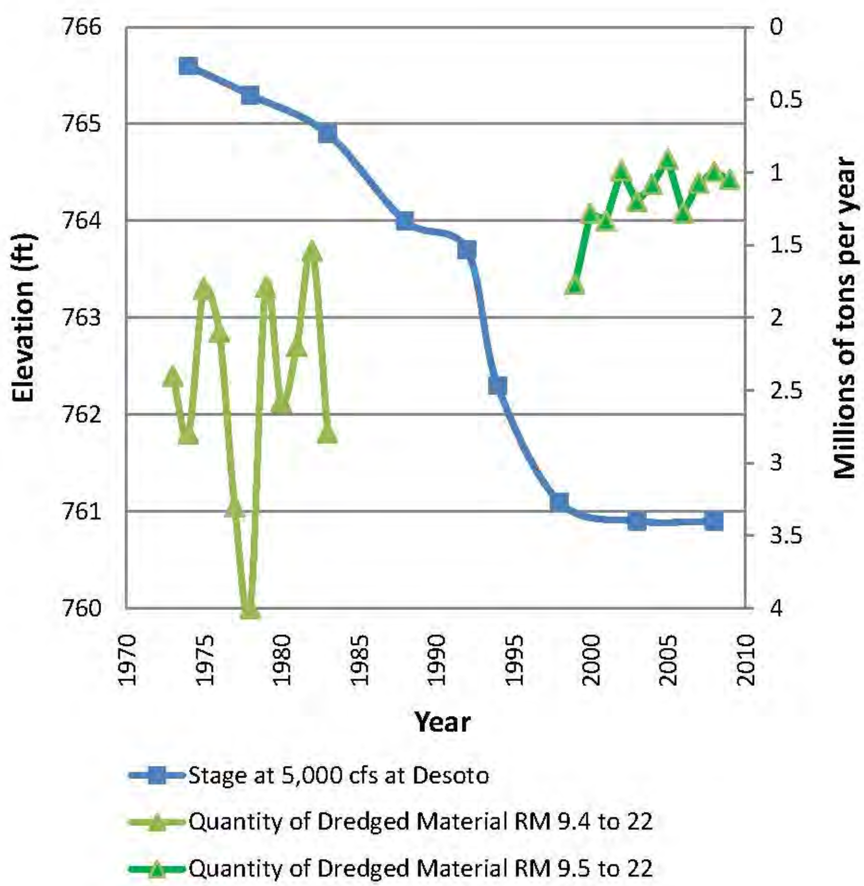

Figure 10 Stage at DeSoto and Dredging Quantities Over Time

Figure 11 presents dredging amounts at RMs 81 to 86 (1978 to 1983) and RMs 77.1 to 91.6 (1999 to 2009) and the elevation of 5,000 cfs at the Topeka gage (RM 81.2). Dredged amounts near Topeka have ranged from 0.1 to 0.8 million tons per year—significantly less than dredged amounts from Lawrence to Kansas City. The rate of stage degradation at Topeka has slowed from previous decades. The dredging rates near Topeka are less than

1 million tons/year, which are not that different from previous years. Figure 11 yields two plausible predictions. First, stage degradation at Topeka may continue at a very gradual rate, which suggests that current levels of dredging may be a contributing factor. Second, the degradation may have stopped; suggesting that dredging at the current rates may be sufficiently small not to noticeably affect the stage at Topeka.

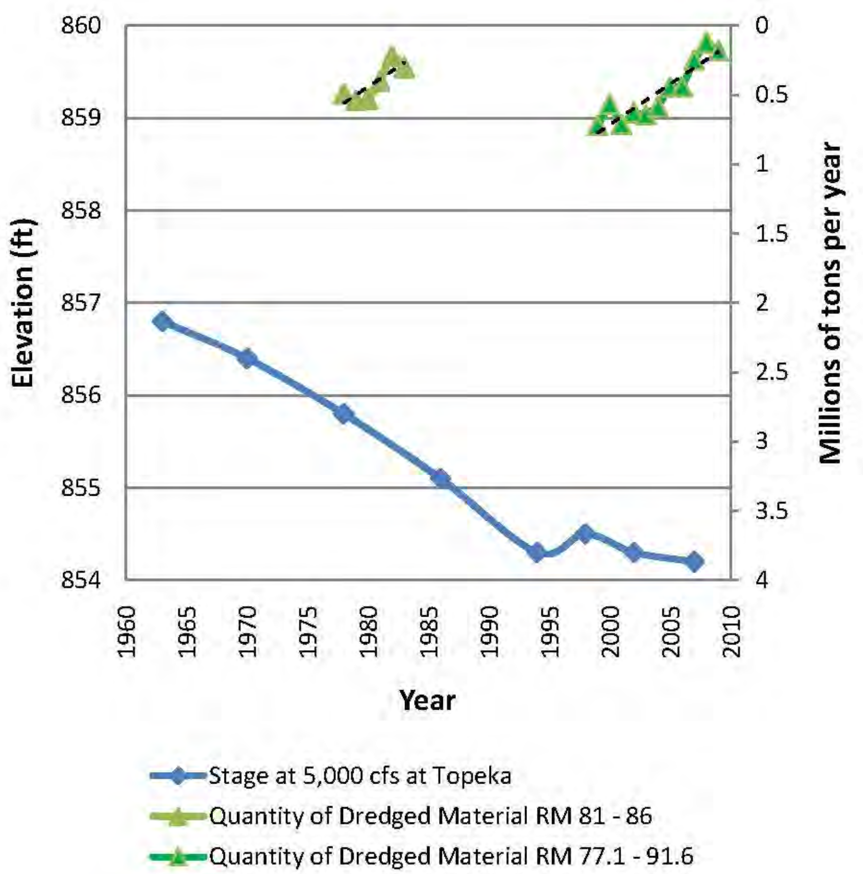

Figure 11 Stage at Topeka and Dredging Quantities Over Time

Cross-Sectional Changes

A sand-bed river is characterized by constant fluctuations of the bed. Bed forms, such as sand dunes, may be present at a sample location one year and absent the following year. Such changes in bed features can give the appearance of significant bed degradation when they are really just local variation. By averaging bed elevations measured at multiple points across a river cross-section and from multiple cross-section locations within a 5-mile reach, we get a better picture of the average bed elevation of that 5-mile reach that takes into account spatial and temporal variability. If the same cross-sections in a 5-mile reach are surveyed periodically, the average bed elevation for that 5-mile reach can then be compared to determine if bed elevations have changed. By looking at those averages over relatively long periods, we can determine if bed elevation changes are actual trends or simply fluctuations due to variation in weather, climate, or other factors.

As described in Chapter 1.4.4, the Regulatory Plan implemented by the USACE in 1991, established a monitoring program to evaluate changes in bed elevation and overall channel stability in order to limit the impact of dredging on channel morphology, river ecology, manmade structures and other public interests. Every two years, an independent engineering firm contracted and paid by the Dredgers surveys the established cross-sections. In 2007 and 2009, the KWO funded the collection of additional cross-section in stretches of the river not covered by the dredging cross-sections. The USACE used all these cross-sections to evaluate changes in bed elevations and width (USACE, 2010). In 2013, Habitat Architects completed an *Environmental Report on Kansas River Commercial Sand and Gravel Dredging* that included an evaluation of trends in bed elevations. The results of both evaluations are summarized below.

Bed Elevations

HABITAT ARCHITECTS ASSESSMENT

In their 2013 *Environmental Report on Kansas River Commercial Dredging*, Habitat Architects evaluated trends in bed elevations by comparing the cross-section survey data collected for four of the nine monitoring events (1997, 2003, 2007 and 2012), against the baseline survey data completed in 1992. The baseline data collection in 1992 and the four selected monitoring events are separated by an average of 5 years and reflect bed elevation trends over a 20-year period. The survey data was analyzed using the same process adopted by the USACE to determine the average change in bed elevations through a 5-mile-long reach of river when compared to the 1992 baseline elevations. For each of the four monitoring events, this method calculated the change in riverbed elevations between that year’s survey data and the 1992 baseline data at each of the cross-sections. The bed elevation change was then interpolated at 0.10-mile intervals between each pair of adjacent cross-sections. The bed elevation change for each of the cross-sections and 0.10-mile intervals were then averaged. Table 6 summarizes the findings of the analysis.

Table 6 Bed Elevation Trends in the Kansas River

Evaluation Criteria	Years 1992-1997	Years 1992-2003	Years 1992-2007	Years 1992-2012
Percent of River with Greater than 2 feet of Degradation	2.9	11.4	13.0	12.7
Percent of River with Greater than 1 foot of Degradation	25.7	32.5	35.3	39.8
Percent of River with Aggradation	41.4	33.9	30.5	29.3
Maximum Degradation (5-mile Reach)	-2.15 feet (RM 34.7 – 39.7)	-2.40 feet (RM 34.6 – 39.6)	-2.36 feet (RM 34.5 – 39.5)	-2.32 feet (RM 34.5 – 39.5)
Maximum Aggradation (5-mile Reach)	3.35 feet (RM 16.5 – 21.5)	2.63 feet (RM 14.9 – 19.9)	2.35 feet (RM 14.9 – 19.9)	2.48 feet (RM 14.9 – 19.9)

Note: The findings in Table 6 are limited to Survey Areas 1 and 2 (RMs 9.4 to 51.5 and 72.1 to 96.5, respectively).

The analysis by Habitat Architects (2013) indicates that the surveyed areas have experienced a net overall decline in bed elevations since establishment of the survey baseline in 1992. After 20 years of regulatory oversight under the provisions of the Regulatory Plan, the effects of aggradation/degradation within the surveyed areas are as follows:

- Less than 13 percent of the monitored area has reached 2 feet of degradation (less than 0.65 percent per year).
- More than 60 percent of the monitored area exhibits less than 1 foot of degradation.
- Approximately 30 percent of the monitored area has aggraded since baseline elevations were established in 1992.

The most degraded reach of river, within the monitored areas, is a 13.3-mile-long segment located between RMs 27.1 and 40.4. This segment of the river contains several features in addition to recent dredging that have likely contributed to declining bed elevations. Both the Union Pacific Railroad (located along the left descending bank of the river) and the BNSF Railroad (located along the right-descending bank of the river) have heavily armored long segments of the riverbank with riprap in this reach. In addition, the river channel within this reach has migrated into the rock bluffs along the south side of the river at several locations. Armoring of the riverbanks along with impingement of the channel with the rock bluffs, has limited lateral channel movement and appears to have caused the development of a relatively narrow, incised channel segment. Without the ability to widen the channel, the river appears to be in a process of incision in order to maintain sufficient capacity to discharge flows.

The most aggraded reach of the Kansas River, within the monitored areas, is a 12.9-mile-long segment located between RMs 12.8 and 23.7. This segment of river is located in the lower end of the river where sediments have a chance to accumulate as river velocities slow behind the WaterOne weir and the backwater of the Missouri River. The increase in bed elevations within this segment averages between 1 and 2 feet, when compared to the 1992 baseline elevations.

The following discussion utilizes the 2011 survey data to evaluate current bed elevations in the nine previously closed dredging areas listed above:

a. Lower River
   - Two of the six previously closed dredging areas (RMs 22.9 to 24.4 and 24.0 to 25.0) have aggraded and are not currently located in a 5-mile-long reach of river that has degraded an average of 2 feet.
   - Four of the six previously closed dredging areas (RMs 26.1 to 27.6, 29.2 to 30.2, 31.1 to 31.9, and 35.4 to 36.4) are currently either partially or entirely located within a 5-mile-long reach of river that has degraded an average of 2 feet or more. The 2009 survey data revealed that all four of these dredging areas had aggraded since their closure in 2003, and were no longer located within 5-mile-long river reaches that had degraded an average of 2 feet. However, the 2011 survey data found that all four of the dredging areas are currently located within 5-mile-long river reaches that experienced a decline in average bed elevations between the 2009 and 2011 survey data collections. The 2011 survey data did reveal that three of the four dredging areas (RMs 26.1 to 27.6, 29.2 to 30.2 and 31.1 to 31.9) are currently located in 5-mile-long reaches that have experienced an increase in average bed elevations since their closure in 2003.

b. Upper River
   - The three dredging areas previously closed to dredging in the Topeka area (RMs 84.5 to 85.8, 86.3 to 86.5 and 90.1 to 91.6) have all aggraded and are not

currently located within a 5-mile-long reach of river that has degraded an average of greater than 2 feet.

Based on the findings presented above, eight of the nine dredging areas previously closed to dredging are currently located in a 5-mile-long reach of river that has experienced an average increase in bed elevations since its initial closure. Only one of the nine dredging areas (RMs 35.4 to 36.4) is located in a 5-mile-long reach that has not aggraded since its closure. Five of the nine reaches have aggraded sufficiently such that they are no longer located in a 5-mile-long reach of river that has degraded an average of 2 feet below its 1992 baseline elevations.

It should be noted that the 2011 survey data collection occurred through late 2011 and early 2012, during an abnormally dry period, which resulted in minimal reservoir releases along the main stem of the Kansas River and low flows and reduced sediment transport through the river system. These circumstances have most likely resulted in the collection of lower survey cross-section elevations in dredged reaches than would be the case during a period of normal rainfall and associated higher sand recharge into dredged reaches.

USACE ASSESSMENT

A similar comparison to the bed elevation trends presented above was prepared by the USACE and in a 2010 report. The USACE completed their evaluation based on the available survey data collected from 1992 to 2009. This data was summarized based on the eight river reaches defined in the 1984 Simons, Li & Associates report. The reaches identified as 5, 7, and 8 do not contain any dredge sites and are not subject to the monitoring requirements provided in the Regulatory Plan. The USACE provided the following conclusions related to bed elevation changes within the river reaches identified as 1, 2, 3, 4, and 6 by Simons, Li & Associates (Figure 12).

- Reaches 1 and 2 (RMs 9 to 15) degraded slightly during the 1993 flood and continued to degrade until 2001. The bed has fluctuated between aggradation and degradation since 2001.
- Reach 3 (RMs 15 to 22) aggraded significantly during the 1993 flood and continued aggrading through 1997. It degraded from 1997 to 2005. By 2009, bed elevations had aggraded to 2003 levels.

- Reach 4 degraded 1 foot during the 1993 flood. The rate of degradation slowed following the flood and no appreciable bed change was noted between 2003 and 2007. As of 2009, bed elevations had rebounded to the 1997 levels.
- Reach 6 aggraded slightly as a result of the 1993 flood, and then degraded until 2003 when it began to fluctuate between aggradation and degradation until 2009.
- When all 1-mile segments are averaged together, there was no immediate effect from the 1993 flood, steady degradation until 2003, then fluctuation and a rebound to 2001 levels in 2009.
- At individual locations, degradation and aggradation are more pronounced and sustained.

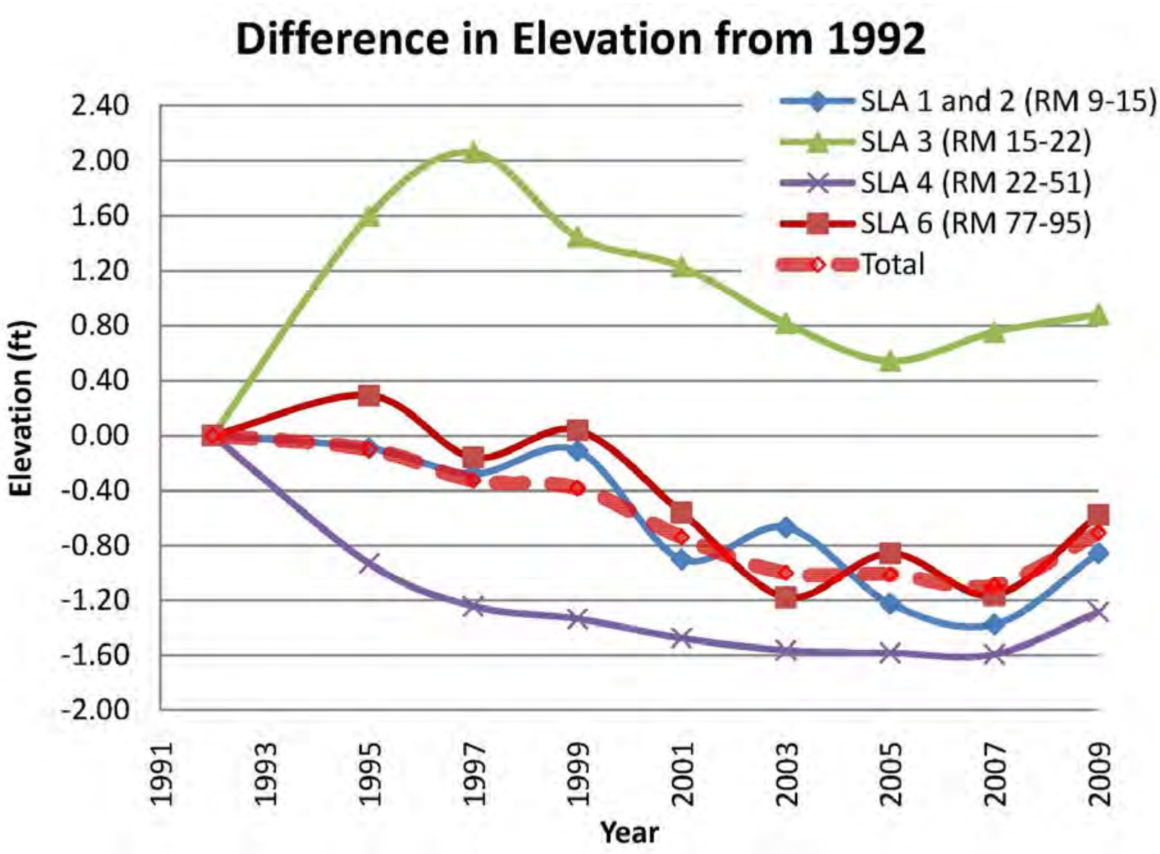

Figure 12 Elevation Changes with Time

Figure 13 and Figure 14 show the change in elevation from 1992 to 1995 and 1995 to 2009, respectively. These figures include all cross-sections that were surveyed in both the starting and ending year (1992 and 1995 or 1995 and 2009, respectively).

Channel Width

A river channel may widen or narrow in any given year. Channels typically widen through mass-wasting processes. This often occurs following a flood, when banks are saturated and the water level in the channel has dropped. Channels narrow through the process of bar formation, trapping and deposition of sediments, and re-vegetation. The relationship between bed degradation and channel width changes is complex. In some reaches, degrading beds create high, unstable banks that are prone to mass wasting. However, bed degradation also reduces the frequency of inundation of point bars, which accelerates the establishment of stabilizing vegetation.

These are not changes in the top width of the active channel, but rather the width of the channel at the baseline stage level.

Figure 15 shows the river width changes from 1992 to 1995, which also includes the effects resulting from the 1993 flood. Figure 16 presents the width changes from 1995 to 2009. As seen in Figure 15, from RMs 13 to 21 the channel narrowed as a result of the 1993 flood. Overall, the river widened from RMs 22 to 51, though channel narrowing did occur at some locations. No cross-sections are available from RMs 52 to 77. From RMs 77 to 99, some locations experienced mild narrowing or widening while others did not appreciably change.

From 1995 to 2009, channel narrowing continued from RMs 12 to 14, and channel widening continued at many locations from RMs 20 to 22. From RMs 32 to 48 the river is narrowing at the meander inflections and widening at the meander bends—a characteristic response of a river reforming its structure following a disturbance. River miles 45 to 48 experienced significant channel narrowing. As before, bank erosion may be present in otherwise narrowing reaches and channel narrowing may be present in otherwise widening reaches. No cross-sections are available from RMs 52 to 77 (SLA Reach 5) or upstream of RMs 97 (SLA Reaches 7 and 8).

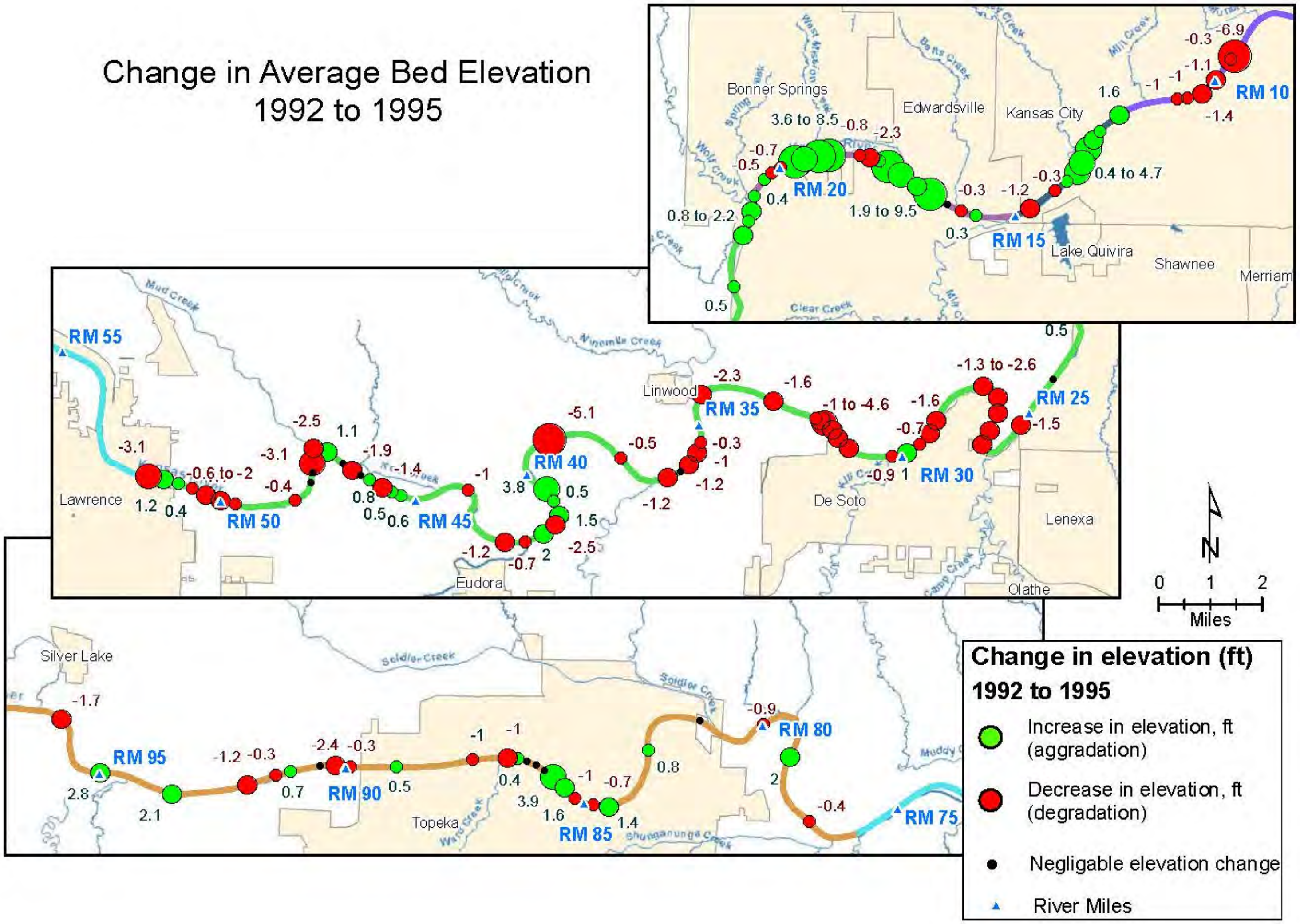

Figure 13 **Change in Average Bed Elevation from 1992 to 1995**

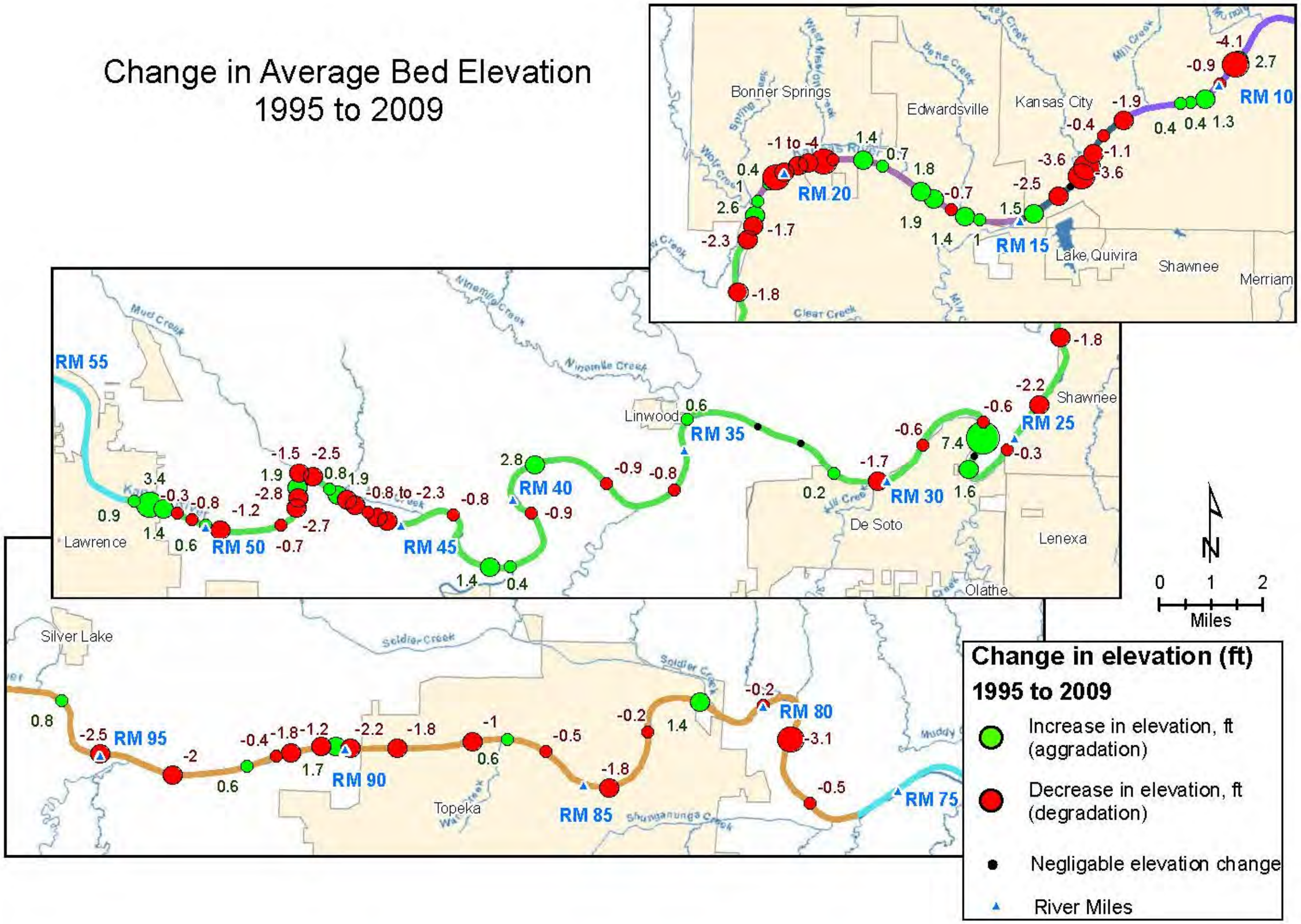

Figure 14 **Change in Average Bed Elevation from 1995 to 2009**

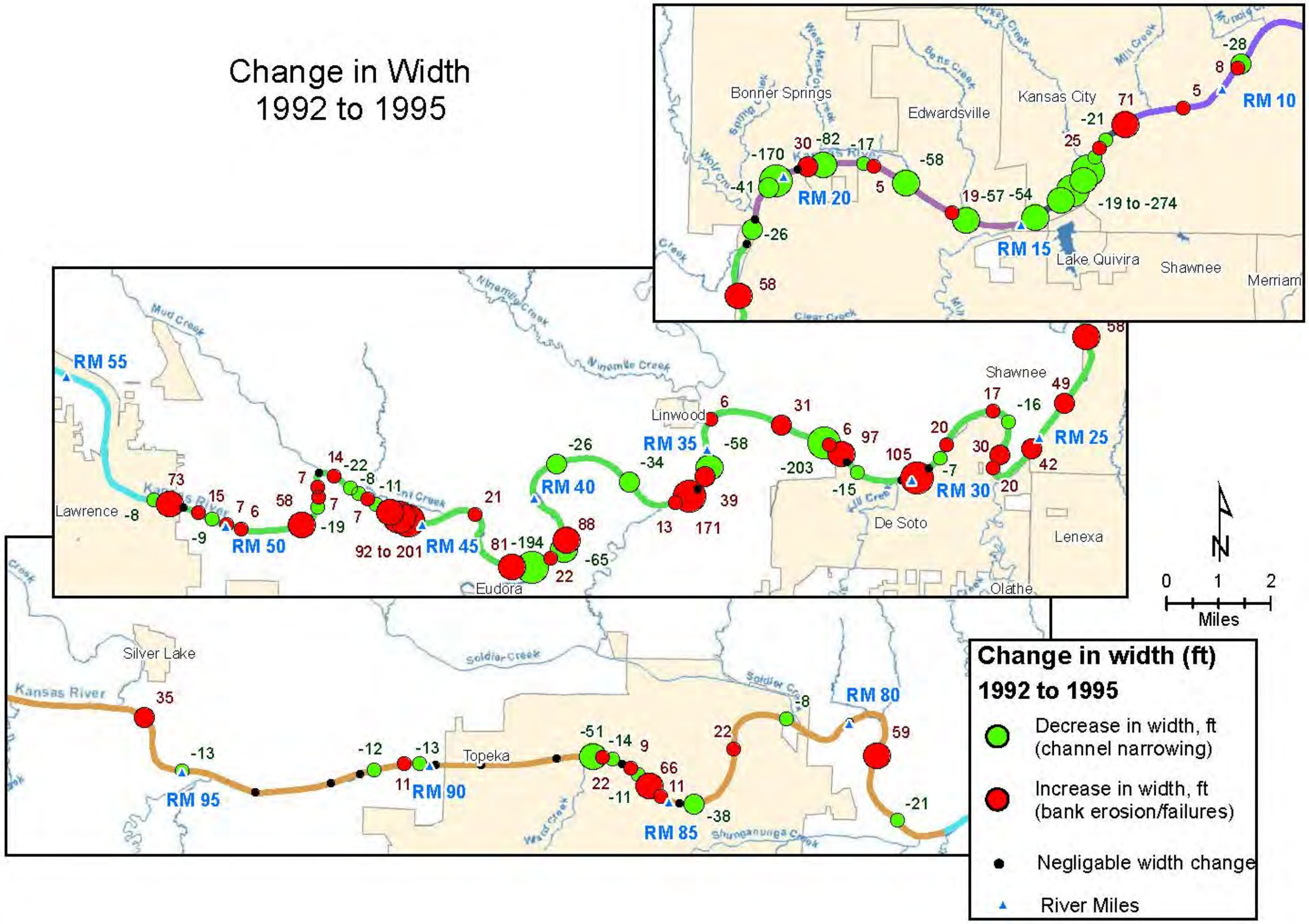

Figure 15 Channel Width Response to the 1993 Flood

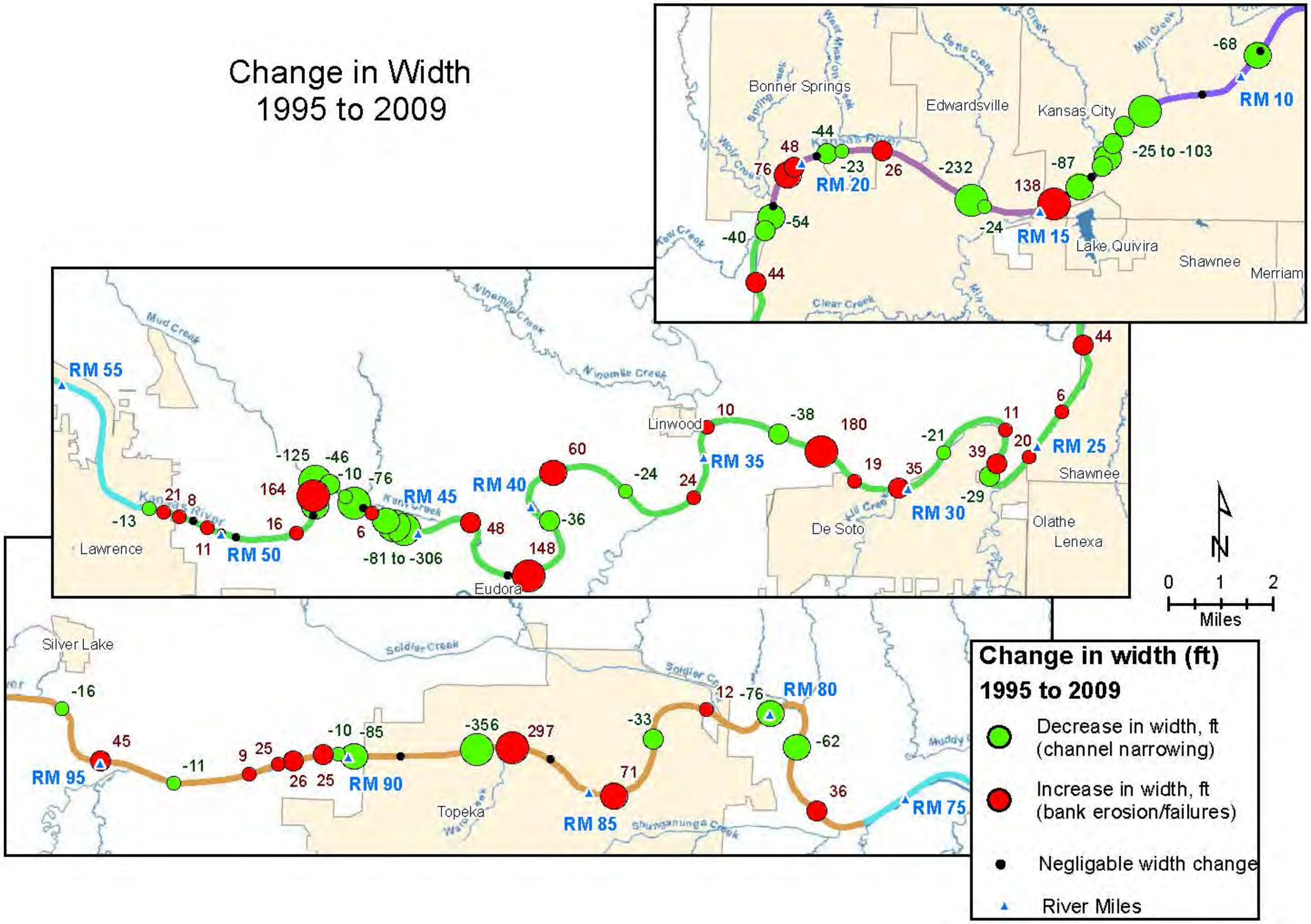

Figure 16 Channel Width Change from 1995 to 2009

Summary

Success or failure of the Regulatory Plan is primarily measured by the amount of bed degradation or aggradation that has occurred since implementation of the Plan, and by the USACE's commitment to enforce the restrictions presented in the Plan. Under the Regulatory Plan, the USACE implemented dredging restrictions that consisted of criteria developed to limit dredging-related impacts to an acceptable level. The Regulatory Plan states: *"The restrictions are intended to limit those impacts to a level which will have only minor effects on the morphology and ecology of the river and on public and private interests located in and along the river."* The Regulatory Plan established 2 feet as the maximum allowable reduction in bed elevations before secondary impacts would exceed acceptable levels. A review of 1) the survey data collected since implementation of the Regulatory Plan in 1991; 2) the bed elevation trending analysis prepared as part of this Report; and 3) the 2010 USACE report on the hydrologic and geomorphic changes in the Kansas River indicate that the Regulatory Plan has worked as intended.

3.2.2 Environmental Consequences

Environmental consequences associated with impacts to geomorphology are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.2.2.1 Proposed Action

Direct Impacts

Potential direct impacts to the geomorphology of the Kansas River are primarily related to localized impacts associated with individual dredging operations. The extraction of riverbed materials by dredging operations results in a localized decrease in riverbed elevations at the dredge site. The localized holes created by dredging activities appear to refill rapidly in the river after cessation of dredging activities. The 2010 USACE report noted that in a high sediment transport system such as the Kansas River, the dredge hole will refill quickly if dredging is stopped. This statement is further supported by the findings of the 2009 report entitled, *Fish Community Response to Habitat Alteration: Impacts of Sand Dredging in the Kansas River* (Fischer et al., 2012), that noted that the high mobility of sand allows for a quick recovery of degraded areas in a sand bed system. Fischer et al. (2012) documented that after dredging operations were halted at a dredge site located upstream of the town of Edwardsville, the dredge hole completely filled with sediment within a month. The USACE's

Regulatory Plan and Kansas River dredging permit contain restrictions to limit localized impacts associated with dredging activities. Restrictions developed to limit direct impacts to river geomorphology include separation of adjacent dredging operations, setback distances from riverbanks, and setback distances from islands. Based on the regulatory restrictions imposed on dredging activities by the USACE, direct impacts to river geomorphology are not anticipated to be significant.

Indirect Impacts

The Proposed Action is authorization to dredge 3,150,000 tons of material annually from the river. The quantity of material extracted over the last 14 years has ranged between approximately 1,000,000 and 2,000,000 tons, with an average near 1,500,000 tons per year. Potential indirect impacts to the geomorphology of the Kansas River are primarily related to riverbed degradation, changes in surface water elevations, and riverbank instability. Indirect impacts to river geomorphology could develop over a relatively long period and could result in tertiary impacts to bank protection structures, pipelines, bridges and other infrastructure as a consequence of riverbed degradation and riverbank failure.

The Topeka and DeSoto gages are located near dredging reaches. Changes in the stage/discharge relationship over time were presented in Section 3.2.1.5 River Geomorphology – State-Discharge Relationship. Figure 10 shows quantities dredged below the DeSoto gage and the elevation of 5,000 cfs at the DeSoto gage from 1977 through 2009. The dredging quantities from 1973 to 1983 fluctuated between 1.5 and 4 million tons per year. In the same period, the stage of 5,000 cfs steadily decreased. From 1999 to 2009, dredging quantities decreased from 2 million tons per year to 1 million tons per year and the stage of 5,000 cfs remained essentially constant. The rates and location of dredging since 1993 have not caused river stage elevations to drop at the DeSoto gage (USACE, 2010). Figure 11 shows quantities dredged near the Topeka gage and the elevation of 5,000 cfs at the Topeka gage from 1978 through 2009. Dredged amounts near Topeka have varied from 0.1 to 0.8 million tons per year—significantly less than dredged amounts from Lawrence to Kansas City.

The rate of stage degradation at Topeka has slowed from previous decades. It is apparent from this analysis that the levels of dredging of the Proposed Action are likely to cause little if any change to stage elevations. Simons, Li, and Associates (1984) postulated that dredging was the primary cause of bed degradation on the Kansas River from RM 9.6 to 22 and was likely a contributing cause of degradation at Topeka. One of their supporting arguments is that the worst degradation and channel widening occurred in dredged reaches and did not occur in non-dredged reaches. This statement was made based on their qualitative assessment. This assertion was tested for the recent decade by comparing the measured cross-sections from 1999 to 2009 and the location of authorized dredging reaches (USACE, 2010). A probability assessment was used to answer the question "Are cross-sections in authorized dredging reaches more likely to be degrading than nearby cross-sections not in dredging reaches?" For this analysis, authorized dredging reaches that were dredged during at least 1 year between 1999 and 2009 were considered dredged reaches. Table 7 indicates that a cross-section has the same probability of being degraded (71 percent) whether or not it is in a dredge reach. A similar analysis was done with dredged reach defined as an authorized dredging reaches that was dredged during at least three years from 1999 to 2009. Table 8 indicates that 78 percent of cross-sections in reaches dredged 3 or more years are degraded while only 64 percent of cross-sections that are not in reaches with at least 3 years of dredging are degraded. This suggests that the more heavily dredged reaches are slightly more likely to be degraded than are nearby lightly dredged or non-dredged reaches.

Table 7 Degradation Probability Matrix for Reaches Dredged at Least One Year

	Totals	48	34
Totals		Dredged	Not dredged
58	Degraded	34	24
24	Not degraded	14	10

Out of all degraded reaches	59%	are dredged
	41%	are not dredged
Out of all non degraded reaches	58%	are dredged
	42%	are not dredged
Out of all dredged reaches	71%	are degraded
	29%	are not degraded
Out of all non dredged reaches	71%	are degraded
	29%	are not degraded

Table 8 Degradation Probability Matrix for Reaches Dredged at Least Three Years

Totals		Dredged 3 years	Not Dredged 3 years
	Totals	37	45
58	Degraded	29	29
24	Not degraded	8	16

Out of all degraded reaches	50%	are in dredged reaches (3 or more years)
	50%	are not in dredged reaches (3 or more years)
Out of all non degraded reaches	33%	are in dredged reaches (3 or more years)
	67%	are not in dredged reaches (3 or more years)
Out of dredged reaches (3 or more years)	78%	are degraded
	22%	are not degraded
Out of non-dredged reaches (3 or more years)	64%	are degraded
	36%	are not degraded

Simons, Li, and Associates (1984) assertion that dredging was the primary cause of bed degradation on the Kansas River was tested with a second analysis, the quantification of the total volume of sediment lost or gained in each dredged reach (USACE, 2010). The change in volume of bed material was calculated as the change in cross-sectional area from one time period to another, multiplied by the stream length over which that cross-section applies (half the distance to the previous cross-section plus half the distance to the next cross-section, not extending past the limits of the dredged reach). Analyzed this way, 13 of 18 (72 percent) dredged reaches experienced an overall loss in volume from 1998 to 2009, while 5 of 18 (28 percent) experienced a gain. An analysis of the last 5 of those years, 2004 to 2009, shows that only 6 of 13 (46 percent) dredged reaches experienced degradation, while 7 of 13 (54 percent) experienced aggradation. This is further evidence that the overall degradational trend of the river has slowed or stopped.

Plotting the quantity of sediment dredged versus the change in volume of the bed (Figure 17) reveals negligible to non-existent correlation between dredging and degradation in the dredged reaches. This is true when the time period is broken into two time periods (1998 to 2003 and 2004 to 2009) or when the entire time period is analyzed together. If dredging were indeed the primary cause of degradation in the Kansas River from 1999 to 2009, a stronger correlation would be evident.

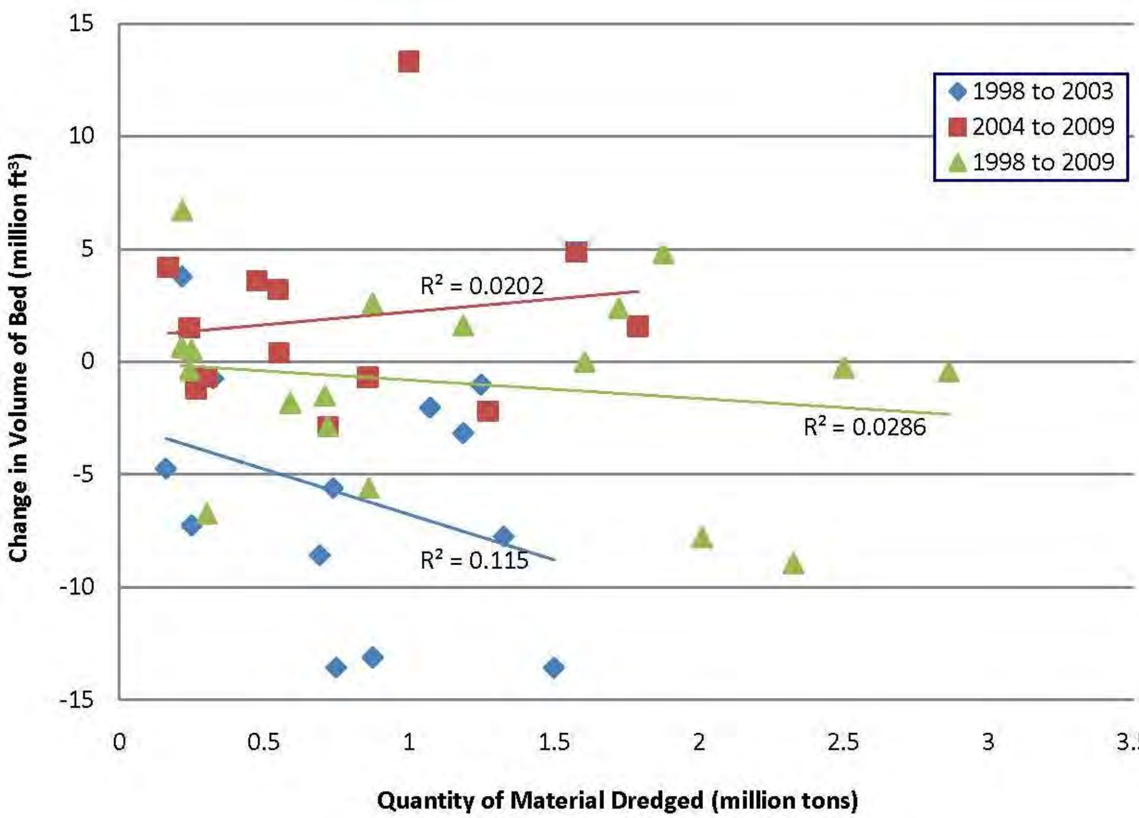

Figure 17 Correlation between Dredging and Volume of Material Lost to Bed Degradation

Figure 18 shows the correlation between dredging and the weight of sediment lost to bed degradation by converting the volume of sediment lost to a weight. This conversion does not change the relationship, but it illustrates that the dredged amount is much higher than the sediment lost from the dredging reaches. Sediment from upstream is replacing the dredged sediments.

In summary, from the above analysis of dredging volumes and river cross-sections taken semi-annually from 1998 to 2009, the USACE has concluded that:

- Dredging amounts are significantly less than they have been in the past.
- The rates and locations of dredging from 1999 to 2009 did not cause significant stage degradation at the DeSoto or Topeka gages.
- Cross-sections in dredged reaches (at least 1 year of dredging) are no more likely to have degraded than nearby cross-sections not in dredged reaches.

- Cross-sections in actively dredged reaches (3 or more years of dredging) are slightly more likely to have degraded than nearby cross-sections not in actively dredged reaches.
- Most of the authorized dredging reaches lost bed material volume from 1998 to 2004 but not from 2004 to 2009.
- The volume of bed material lost from the dredged reaches is not correlated to the quantity of dredged material.

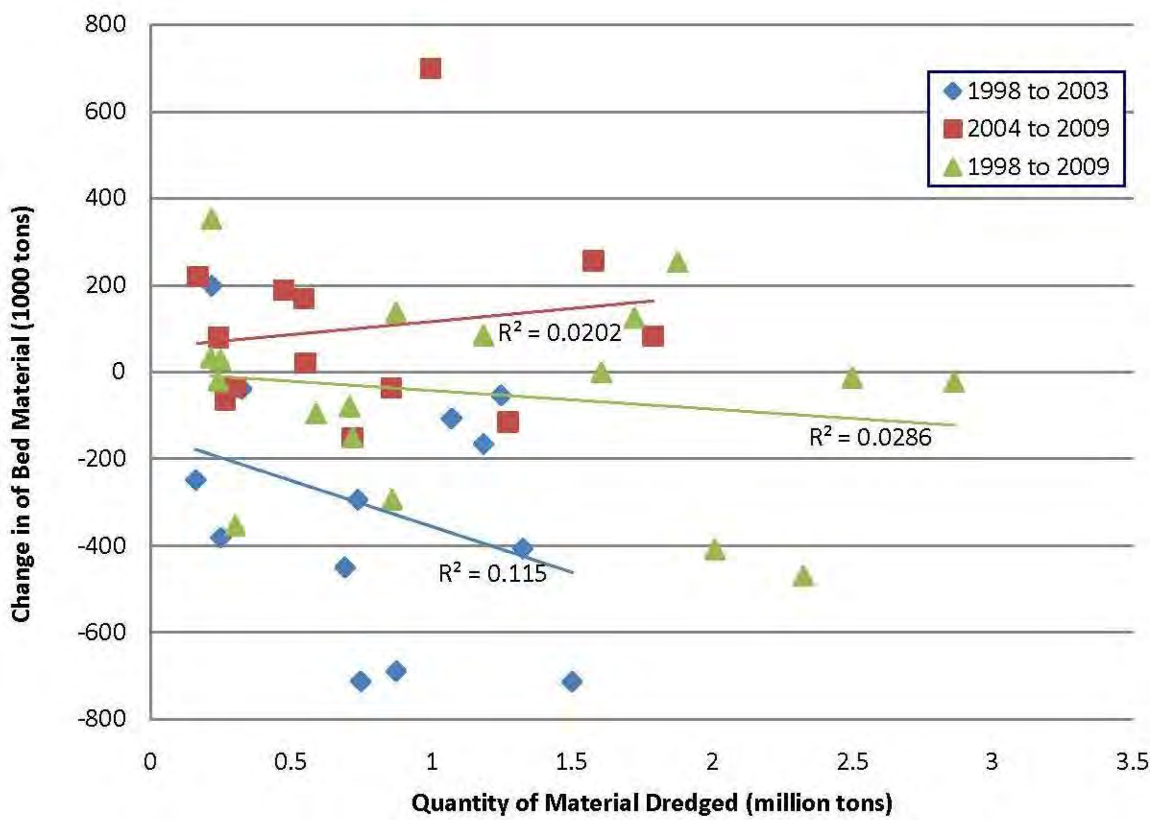

Figure 18 Correlation between Dredging and Weight of Sediment Lost to Bed Degradation

The extraction of higher quantities of materials per year by the Dredgers could accelerate the rate of riverbed degradation and could have a potential to significantly impact river geomorphology if uncontrolled riverbed degradation were allowed to occur. However, the 1,900,000 tons requested per year by the Dredgers is below the amount that the Regulatory Plan (by which the Proposed Action is administered) would limit. The existing Regulatory Plan limits the amount that could be authorized to 3,150,000 per year and stipulates that any 5-mile-long reach of river that degrades an average of 2 feet, below the 1992 baseline elevations established for that reach, would be closed to further dredging. The analysis of cross-sections taken in 2011 (USACE, 2012b) determined that none of the requested reaches were degraded more than 2 feet in 2011 and therefore dredging was allowed to continue at the requested rate. Six of the requested dredging reaches had previously been open to dredging and still had not degraded beyond the limits set in the Regulatory Plan (Table 4). Table 4 also shows that one of the requested dredging reaches (RM 89.7 to 91.0) had previously been degraded more than 2 feet but from 2011 to 2013 has aggraded and was less than 2 feet below the 1992 baseline (-1.42 feet). Based on the analysis above and the regulatory restrictions imposed on dredging activities by the Regulatory Plan, authorization of the eight requested dredging reaches that are currently degraded less than the limits in the Regulatory Plan is not anticipated to result in significant indirect impacts to the geomorphology of the Kansas River.

3.2.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. Selection of the No-Action Alternative would eliminate all impacts to the morphology of the Kansas River caused by dredging in the river. The elimination of dredging activities in the river could increase channel stability in some reaches of the river due to the elimination of fluctuations in riverbed elevations caused by dredging activities. However, the removal of dredging operations from the river would not eliminate impacts associated with reservoir operations, which contribute to riverbed degradation and bank erosion through trapping of sediments and reductions in suspended sediment concentrations released to downstream water bodies. Trapping of sediments in reservoirs and reductions in suspended sediment concentrations in reservoir releases significantly reduces sediment recharge in downstream areas, which ultimately contributes to riverbed degradation and channel instability in the Kansas River.

The No-Action Alternative would shift aggregate extraction to other sources in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative include Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

No direct impacts are likely to occur to the geomorphology of the Kansas or Missouri River, as a result of pit mining operations in the Kansas and Missouri River floodplains.

Indirect Impacts

The development of floodplain pit mines in close proximity to the riverbank on either the Kansas or Missouri River could indirectly result in a breach (blowout) of the floodplain area located between the pit mine and the river channel during overbank flood flows. A breach through the riverbank and into the mine pit would direct river flows through the mined area. Although these events are infrequent, a breach of the river channel embankment could create a permanent change in the channel's alignment and an altered floodplain condition. Indirect impacts to the geomorphology of the Kansas and Missouri Rivers is not anticipated to be more than minimal; however, if a breach to the riverbank would occur, impacts to river geomorphology could be significant.

Crushed Limestone from Quarry Operations

Direct Impacts

No direct impacts are likely to occur to the geomorphology of the Kansas or Missouri River as a result of quarry operations.

Indirect Impacts

No indirect impacts are likely to occur to the geomorphology of the Kansas or Missouri Rivers, as a result of quarry operations.

3.2.2.3 Reduced Limit Alternative

Direct Impacts

This alternative would reduce the allowable amount of sand and gravel that could be dredged annually from the river to about 53 percent of the amount that the Regulatory Plan would allow under the Proposed Action (1,670,000 tons versus 3,150,000 tons). Dredging operations cause a localized decrease in bed elevations at the dredge site and can have undesirable consequences to critical infrastructure such as bank stabilization structures, if set back buffers are not maintained between dredge operations and sensitive structures. Dredge holes appear to refill rapidly in the Kansas River after cessation of dredging. The 2010 Kansas City District Report noted that in a high sediment transport system such as the

Kansas River, the dredge hole will refill quickly if dredging is stopped. This statement is further supported by the findings of the 2009 report entitled, *Fish Community Response to Habitat Alteration: Impacts of Sand Dredging in the Kansas River* (2009 Fischer Report), that noted that the high mobility of sand allows for a quick recovery of degraded areas in a sand bed system. The 2009 Fischer Report documented that after dredging operations were halted at a dredge site located upstream of the town of Edwardsville, the dredge hole completely filled with sediment within a month. Although the Reduced Limit Alternative would reduce the allowable amount of sand and gravel that could be dredged annually from the river to about 53 percent of the amount that could be dredged under the Proposed Action, selection of the Reduced Limit Alternative would not be expected to substantially reduce localized impacts relative to selection of Proposed Action. Based on the dredge set back buffers and other regulatory restrictions imposed on dredging by the USACE, direct impacts to river geomorphology are not anticipated to be significant.

Indirect Impacts

Indirect impacts to the geomorphology of the Kansas River would be similar to those identified for the Proposed Action. This alternative would reduce the allowable amount of sand and gravel that could be dredged annually from the river to about 53 percent of the amount that the Regulatory Plan would allow under the Proposed Action (1,670,000 tons versus 3,150,000 tons). Although selection of the Reduced Limit Alternative could result in the extraction of less sand and gravel annually than the Proposed Action, it would not be likely to result in a reduction in the total number of dredging operations located along the river. It is possible that higher annual extraction limits associated with the Proposed Action could result in a rate of riverbed degradation exceeding the rate for the Reduced Limit Alternative; however, the limit for riverbed degradation, regardless of how rapidly it could occur, is 2 feet, per the Regulatory Plan. Therefore, selection of the Reduced Limit Alternative would not be likely to result in substantially reduced indirect impacts to river geomorphology relative to the Proposed Action. Indirect impacts to the geomorphology of the Kansas River are not anticipated to be significant.

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3.3 LAND USE

3.3.1 Affected Environment

The most extensive land cover within a 12-mile-wide corridor, extending 6 miles on each side of the Kansas River, is grassland with 45 percent of the coverage, followed by cropland at 28 percent. These are the two most widespread land covers in the floodplain alone, as well; however, their order of coverage is reversed. Cropland is predominant in the floodplain, covering 60 percent of the area, and grassland is a distant second with 14 percent. The rich, tillable soils of the Kansas River floodplain are highly valued and are extensively farmed. Cultivated land located outside of the Kansas River floodplain extends up the valleys of many of the larger tributaries such as the Big Blue River at Manhattan, Vermillion Creek north of Wamego, and the Wakarusa River south of Lawrence. Some large areas of upland cropland can be found in southern Leavenworth County and in eastern Douglas and western Johnson counties, where deeper soils developed on outcrops of shale and soft sandstones, which were covered in part by glacial drift. Cropland is scattered throughout the uplands from Shawnee County eastward. Westward from Shawnee County, the uplands become increasingly covered by grassland, the characteristic land cover of the Flint Hills (Brady et al., 1998). Table 9 shows the areal extent and percent coverage for 10 different land-cover categories in both the Kansas River corridor and the Kansas River floodplain.

Table 9 General Land Use Classifications - Kansas River Corridor and Floodplain (Brady et al., 1998)

General Class	Floodplain Area		12-Mile-Wide Corridor	
	Percent	Square Miles	Percent	Square Miles
Commercial/Industrial	4	14.1	3	47.9
Cropland	60	201.4	28	472.8
Grassland	14	48.6	45	774.3
Other	4	15.0	2	30.4
Residential	3	10.4	6	103.1
Urban-Grassland	1	4.8	2	39.4
Urban-Water	0	0.2	0	1.7
Urban-Woodland	0	0.5	1	11.2
Water	6	19.1	2	37.6
Woodland	7	24.1	11	185.6

Woodlands comprise 11 percent of the Kansas River corridor. Some of the larger tracts are in the east half of the corridor in the bluffs bordering the Kansas River and along some of the river's small tributaries. Woodlands generally have less coverage west of Topeka, and are confined to many small drainages and creek valleys branching off the Kansas River and its larger tributaries. In the Fort Riley area northeast of Junction City and north of the Kansas River, the larger tributary valleys are filled with woodlands; however, on privately owned land south of the river, tributary valleys are mostly cropland. In the floodplain, 7 percent of the land is woodland. Although few large woodland tracts can be found, a discontinuous riparian forest grows along the entire length of the Kansas River (Brady et al., 1998).

The next most widespread land cover in the Kansas River corridor is residential, which makes up 6 percent of the corridor. Most of this classification occurs in the larger cities, such as the Kansas City metropolitan area, Lawrence, Topeka, Manhattan, and Junction City. The percentage of land cover for residential areas in the floodplain is 3 percent. Much of this land is in larger cities; however, several small towns lie completely in the floodplain, such as Ogden, Belvue, Rossville, Silver Lake, Perry, and Linwood (Brady et al., 1998).

Residential land cover is exceeded by water in the floodplain and a classification known as "other." Water comprises 6 percent of the floodplain, but only 2 percent of the Kansas River corridor as a whole. The most prominent body of water in the floodplain is the Kansas River itself. Smaller areas of water include the tributaries and drainage ditches that empty into the river and the oxbow lakes and other cutoff river courses that hold water. Oxbows include lakes near Ogden, Eureka Lake southwest of Manhattan, Silver Lake at the town of Silver Lake, and Lake View Lake northwest of Lawrence. Additional bodies of water include sand pits, borrow pits, and sewage-disposal ponds (Brady et al., 1998).

The largest body of water in the Kansas River corridor is the lower end of Perry Reservoir, northwest of the town of Perry. A small part of Tuttle Creek Reservoir, north of Manhattan, is also in the Kansas River corridor as are the ponds located below both Tuttle Creek and Milford dams, the latter being just northwest of Junction City. Three large reservoirs associated with the Jeffrey Energy Center, in southeastern Pottawatomie County, also contribute to this 2 percent coverage, as well as larger streams, farm ponds, and watershed reservoirs that can be identified through use of mapping systems (Brady et al., 1998).

The classification "other" includes surfaces that are neither soil nor vegetation. These areas could be sand, concrete, or bare rock. Four percent of the floodplain is classified as "other," and most of it is bare sand in sand bars both in and along the Kansas River. Areas of un-vegetated sand near dredges, sand pits, and other excavations are also classified as "other." Stretches of major highways and their intersections and interchanges are also mapped as "other." Some large commercial/industrial facilities contain bare areas used for material and waste storage that fall into this category, such as the electrical generating stations along the river east of Topeka and on the north edge of Lawrence. Limestone quarries such as those found east of Topeka and east of Bonner Springs, and landfills such as those north of Lawrence and in Shawnee have large areas of exposed rock and are mapped as "other." Tuttle Creek Dam, Perry Dam, and parts of Milford and Clinton dams, as well as their outlet structures and emergency floodways, are all areas of riprap, concrete, or bedrock mapped as "other" (Brady et al., 1998).

Commercial/industrial areas comprise 4 percent of the floodplain and 3 percent of the Kansas River corridor. The largest concentration of commercial/industrial areas is in the lower Kansas River floodplain in Wyandotte County where major components include railroad yards in addition to manufacturing and warehousing facilities. Most commercial/industrial areas are in business districts in the larger cities. Large airports fall in this category and most are located in the floodplain, such as Marshall Field at Fort Riley, Manhattan Municipal Airport, and Fairfax Municipal Airport on the Missouri River floodplain in Kansas City. Parts of The University of Kansas in Lawrence, Kansas State University in Manhattan, and Washburn University in Topeka are mapped as commercial/industrial, as are many of the installations at Fort Riley near Junction City (Brady et al., 1998).

The remaining categories are urban in nature and include urban-grassland, urban-water, and urban-woodland. When combined these categories make up just 1 percent of the floodplain and 3 percent of the corridor area with urban-grassland being the dominant category. Parks, cemeteries, golf courses, athletic fields and campuses surrounding universities, hospitals, and other institutions all contribute to the urban-grassland category (Brady et al., 1998).

In summary, the combined categories commercial/industrial and residential, which includes most of the built-up areas, cover 7 percent of the floodplain and 9 percent of the Kansas River corridor as a whole. The combination of cropland and grassland, which represents most of the agricultural land, covers 74 percent of the floodplain and 73 percent of the Kansas River corridor. Water covers 6 percent of the floodplain and 2 percent of the corridor while woodlands cover 7 percent of the floodplain and 12 percent of the corridor. The largely barren areas classified as "other" cover 4 percent of the floodplain and 2 percent of the Kansas River corridor (Brady et al., 1998).

3.3.2 Environmental Consequences

Environmental consequences associated with impacts to land use are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.3.2.1 Proposed Action

Direct Impacts

No new facilities would be constructed under the Proposed Action, although one currently idle on-shore processing area previously utilized for Kansas River dredging could resume operations near Topeka (LBB, LLC). Existing construction sand and gravel facilities would generally process a smaller amount of material than previously permitted and would not affect the predominant adjacent land uses (croplands, grasslands, and woodlands). Therefore, no change in in land use or adverse impact to adjacent land use would occur in these segments under the proposed action.

Indirect Impacts

No new facilities would be constructed and Dredgers would use existing facilities that are in compliance with local land use designations. Under the Proposed Action existing construction sand and gravel facilities would continue to operate as they do now and the processing amounts would not exceed 3,150,000 tons. Therefore, no change in in land use or adverse impact to adjacent land use would occur in these segments under the proposed action.

3.3.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all Kansas River dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. The existing land-based processing plants would either become idle due to the closure of river dredging operations or would be converted to a secondary use such as raw material storage, or they could be sold for some other use. Any conversion of the property would impact the land use classification for the site, if utilized for a purpose other than sand and gravel operations. The direct, indirect and cumulative impact on land use for existing land-based processing plants, if the No-Action Alternative is selected, would most likely be minimal since the majority of the sites contain less than 15 acres and are primarily located in non-urbanized areas or industrialized areas that would allow the property to be converted to a secondary use.

The No-Action Alternative would require the Dredgers to seek other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations) all have a potential to impact Land Use.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

The No-Action Alternative could result in an increase in pit dredging operations in the Kansas and possibly the Missouri River floodplains. Opportunities to develop pit dredging sites for sand and gravel production are primarily limited to available lands outside urban and industrialized areas. Such areas are typically utilized for agricultural production, primarily as row crop and occasionally for pasture or hay lands. Direct impacts associated with pit dredging operations would primarily result from construction of new pit dredging sites, the expansion of existing dredge pits, acquisition of additional land for processing, storage and sale of aggregate materials and new access roads. Floodplains adjacent to these two major surface water systems typically contain a much higher proportion of wetlands as compared to other land resources across the landscape. Many of these wetlands are farmed under normal circumstances but conversion of those properties to mining would require review and permit authorization as required by the CWA.

Indirect Impacts

The No-Action Alternative could result in an increase in pit dredging operations in the Kansas and Missouri River floodplains. The following indirect impacts could occur as a result of selection of the No-Action Alternative:

- *Severed Farming Operations* - A severed farm is one in which the farmland is severed either laterally or diagonally by an action, thus dividing a contiguous parcel into two or more individual plots. Development of additional pit dredging operations, including access roads, could increase the number of severed and otherwise affected farm properties.
- *Landlocked Parcels* – A landlocked parcel is defined as that portion of the land that is isolated by an action, thereby rendering it inaccessible by public road, existing easement, or proposed access roads. Development of additional pit dredging operations, including access roads, could increase the number of landlocked parcels.
- *Adverse Travel* – Adverse travel is a measure of the additional miles traveled by a farmer to reach a severed or otherwise affected parcel of land created by an action. Development of additional pit dredging operations, including access roads, could result in adverse travel impacts due to the increase in severed and otherwise affected farm operations.
- *Farm Displacements* – The number of farm buildings that require demolition or removal due to the action including farm residences, barns, sheds, pens, bins, silos, windmills, or other structures associated with farm operations. Development of additional pit dredging operations, including access roads, could result in farm displacements.
- *Agricultural Income Loss* – Agricultural income loss is the loss of agricultural revenue resulting from an action. Development of additional pit dredging operations including access roads and other facilities on farmland could result in the long-term loss of production with corresponding losses to agricultural income. In addition, the revenues to the local economy resulting from the sale and costs of seed, chemicals, equipment and labor to farm these areas displaced by floodplain pit operations would be foregone.
- *County Property Tax Revenues* – The conversion of productive farmland to pit dredging operations in Kansas results in a decrease of the land parcel valuation which in turn decreases long-term property tax income for the particular county where the pit site is located. Although it can vary by county, most local and county governing bodies require a special use tax royalty for this type of land use, usually assessed by the ton of material produced. These tax royalties are utilized for increased county costs resulting from the pit operations upon county roads and other infrastructure and do not directly or completely mitigate property tax shortfalls resulting from the change in land use.

Other Indirect impacts could include the expansion of existing roads or development of new roads and other public infrastructure to support truck traffic to and from pit dredging operations. In addition, increases in dust and noise resulting from the operations could be viewed as negative by adjacent landowners. Increased traffic around the new or expanded pit sites could contribute to additional indirect impacts, including traffic safety.

Further study and discussion regarding the severity of indirect Impacts cannot be assessed at this time due to a lack of specificity relating to the total number and locations of potential future pit dredging operations that may be developed, if the No-Action Alternative is selected.

Crushed Limestone from Quarry Operations

Direct Impacts

Construction of limestone quarries and access roads typically involve large-scale earth moving operations, which can convert land use over a relatively large area. The total area displaced by quarries over time would most likely be substantially less than the area required for floodplain pit dredging operations, since crushed limestone is a less desirable material for use in concrete than sand and gravel extracted from the floodplain. If the No-Action Alternative is selected, development of quarries would most likely result in conversion of agricultural land to commercial/industrial use. Long-term impacts on land use are mitigated, to some extent, by state mining reclamation requirements, which are typically imposed on these activities. Direct impacts to land use could become significant over time, depending upon the total acreage impacted.

Indirect Impacts

Indirect impacts to land use would be similar to those for pit dredging operations in the Kansas and Missouri River floodplains. These impacts would include conversion of land use, displacement of farming operations and the expansion or development of roads and other public infrastructure to support truck traffic to and from quarry sites. Indirect impacts to land use are not anticipated to be more than minimal.

3.3.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts would be similar to those identified for the Proposed Action.

Indirect Impacts

Indirect impacts would be similar to those identified for the Proposed Action.

3.4 INFRASTRUCTURE

3.4.1 Affected Environment

3.4.1.1 Transportation

From the earliest arrival of man into the project area, the Kansas River and its valley have been avenues of transportation through eastern Kansas. European settlement brought navigation to the river in the 1800s; however, the flashy nature of the river and its shallow, braided course during low flows made navigation difficult. Today the Kansas River is classified as a navigable river, but no commercial navigation takes place on its waters. In 1865, the Union Pacific Railroad's Eastern Division began pushing westward into Kansas from Kansas City along a course that is still operated by the Union Pacific Railroad, following the north side of the Kansas River west to Junction City and beyond. The Atchison Topeka & Santa Fe Railroad, now part of the BNSF Railroad, began building track across Kansas in 1868. Its track follows the south bank of the Kansas River between Kansas City and Topeka, where it turns to the south and leaves the study area (Brady et al., 1998).

Interstate Highway 35 angles across the southeast end of the study area. Interstate Highway 70 (I-70) enters the study area near Junction City and is aligned close to the Kansas River in the Junction City, Topeka, Lawrence, and Kansas City areas. I-70 passes over the Kansas River in Lawrence and Kansas City. Interstate Highway 670 also passes over the Kansas River in Kansas City. Two north/south interstate highways cross the Kansas River in Johnson and Wyandotte Counties, Kansas (I-435 and Interstate Highway 635, respectively). Other federal highways within the study area include U.S. Highway 24, beginning north of Manhattan and closely following the north bank of the Kansas River eastward to Lawrence. U.S. Highway 24 travels east through Wyandotte County, joining I-70 just before passing over the Kansas River in Kansas City.

Numerous state routes parallel to or cross the Kansas River and its floodplain. Highway K-18 travels from Junction City east to just south of Wamego. Highway K-32 travels from east of Lawrence to Kansas City. Highway K-10 travels east from just west of Lawrence into Johnson County staying south of the Kansas River. Highway K-177 travels north to Manhattan where it ends at the Kansas River. Highway K-99 travels south to north and passes over the Kansas River at Wamego. Highway K-4 travels southwest to northeast and passes over the Kansas River in the Topeka area. Highway K-7 travels south to north through Olathe and passes over the Kansas River in Bonner Springs. An extensive system of county and township roads exists along the Kansas River, often following the orthogonal land-survey grid of 1-mile-square sections. Some of these roads are paved and many are gravel or dirt.

Thirty bridges carry highways and lesser roads across the Kansas River between Junction City and the confluence of the Kansas and Missouri Rivers in Kansas City, Kansas. Five railroad bridges cross the Kansas River in the first 2 miles of the river upstream of its mouth. Two additional railroad bridges cross the river in Topeka. Table 10 identifies bridge crossing locations along the Kansas River by RM as measured progressively upstream from the mouth of the Kansas River (Brady et al., 1998).

Table 10 Bridge Crossings on the Kansas River

Approximate RM Location	Bridge Name and Location
0.2	Railroad bridge downstream from Lewis and Clark Viaduct in Kansas City
0.3	Lewis and Clark Viaduct--I-70 in Kansas City
0.5	James Street bridge in Kansas City
0.8	Railroad bridge in Kansas City
1.1	Central Avenue bridge in Kansas City
1.4	Interstate Highway 670 bridge in Kansas City
1.5	Dual railroad bridge in Kansas City
2.0	Abandoned railroad bridge in Kansas City
2.1	Kansas Avenue bridge in Kansas City
2.4	Railroad bridge in Kansas City
3.3	7th Street—U.S. Highway 169 bridge in Kansas City
4.3	12th Street bridge in Kansas City
5.0	18th Street Expressway--US Highway 69 bridge in Kansas City
5.9	Kansas Avenue—Highway K-32 bridge in Kansas City
7.2	Interstate Highway 635 bridge in Kansas City
9.4	Turner Memorial—Highway K-32 bridge in Kansas City
15.3	I-435 bridge east of Edwardsville
20.3	Highway K-7 bridge at Bonner Springs
31.0	Wyandotte Street bridge at DeSoto
42.4	222nd Street bridge north of Eudora
51.8	Massachusetts Street bridge in Lawrence
53.0	I-70--Kansas Turnpike bridge in Lawrence
63.7	Lecompton Road bridge at Lecompton
79.7	Highway K-4 bridge east of Topeka
83.6	Sardou Avenue bridge in Topeka
83.7	Santa Fe Railroad bridge in Topeka

Table 10 Bridge Crossings on the Kansas River

Approximate RM Location	Bridge Name and Location
84.2	Kansas Avenue bridge in Topeka
84.5	Topeka Avenue bridge in Topeka
84.5	Railroad bridge in Topeka
87.8	US Highway 75 bridge in Topeka
101.1	County road between Willard and Rossville at Willard
106.0	Maple Hill Road between Saint Mary's and Maple Hill
115.4	Schideman Road southeast of Belvue
127.0	Highway K-99 bridge at Wamego
149.2	Highway K-177 bridge at Manhattan
163.6	Highway K-18 bridge south of Ogden
169.0	Marshall Field bridge at Fort Riley

Note: Railroad bridge crossings are monitored and maintained by the individual railway companies that operate the line. Highway, state, county and local bridge crossings are monitored and maintained by federal, state, county and local entities.

3.4.1.2 Pipelines

Several pipelines cross the study area. Natural gas pipelines are most numerous in the eastern part of the study area. Additional pipelines are of two types: those carrying refined products and those carrying liquid petroleum gases (Brady et al., 1998). The 1990 Kansas River EIS contains a list of pipelines that cross the Kansas River, which includes ownership and RM locations.

3.4.1.3 Bowersock Dam

Bowersock Dam is the oldest manmade structure on the Kansas River. It was constructed in 1872 near RM 52 in Lawrence and originally provided mechanical power for a milling company and other manufacturing plants. The dam is privately owned and currently generates electricity. The location of the dam benefits the operation of a Lawrence public water supply intake and the Lawrence Energy Center cooling water intake, which are upstream of the dam (KWO, 2009).

The City of Lawrence and BMPC signed an agreement in the early 1990s that formalized a long-standing working relationship. The City of Lawrence has spent approximately $25 million in recent years maintaining and upgrading the structure. One of the considerations was to stabilize the foundation of the dam from erosion, caused at least in part by downstream degradation (KWO, 2009). The downstream degradation is a localized impact to the footing of the dam created by decades of river flows over the dam. In 2009, as BMPC planned how to stabilize the foundation of the dam, they considered expanding its production capacity as well. This would require a major license from the Federal Energy Regulatory Commission (FERC) and the operation would relinquish its status as an exempted project. BMPC filed applications with FERC and the USACE in 2009 and eventually obtained the FERC License and DA Permit and construction began on May 16, 2011. By December 2011, they had excavated a 50-foot-deep hole down to bedrock for the foundation of the new hydroelectric power plant on the north bank of the Kansas River. The 2012 drought aided the construction of the new power plant. They also installed a new rubber bladder on top of the dam that can be inflated to increase the height of the dam, which will allow the mill pond upstream of the power plant to rise in elevation when water is needed for power production. The power plant began producing in November 2012.

3.4.1.4 Weirs and Water Supply Intake Structures

See Section 3.6 of this Report for discussions concerning potential impacts to these structures.

3.4.1.5 Well Fields (Vertical and Lateral)

See Chapter 3.6 of this Report for discussions concerning potential impacts to well fields.

3.4.2 Environmental Consequences

Environmental consequences associated with impacts to infrastructure are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.4.2.1 Proposed Action

Direct Impacts

Dredging operations on the Kansas River have a potential to result in direct impacts to infrastructure located in the river due to undermining of structures or inadvertent contact with structures during dredging activities. Potential impacts could occur to boat ramps, bridges, Bowersock Dam, pipelines, bank protection works, water supply weirs and jetties, and water intake structures. Construction of dredged material processing plants has a potential to impact infrastructure in the floodplain. Since permits issued by the USACE to authorize commercial dredging on the Kansas River contain Special Conditions that exclude dredging operations near critical structures; and since plant sites associated with existing dredging operations on the river are in place, direct impacts to infrastructure are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to infrastructure could include reduced stability (possible slumping or failure) of infrastructure such as boat ramps, bridges, Bowersock Dam, pipelines, bank protection works, water supply weirs and jetties, and water intake structures as a result of riverbed degradation, head-cutting, and changes to stage levels. Indirect impacts to infrastructure could also include truck traffic on public roads and bridges leading to and from pit mining plant sites. Since the primary compliance criteria in the USACE's Regulatory Plan limits riverbed degradation to an average of 2 feet below the 1992 baseline elevations for any 5-mile-long reach of river, indirect impacts to infrastructure in and immediately adjacent to the river are not anticipated to be significant. In addition, indirect impacts from truck traffic on public roads and bridges leading to and from processing plant sites are not anticipated to be more than minimal.

3.4.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. The No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative include Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

No direct impacts would occur to infrastructure located in the Kansas or Missouri Rivers. Pit mining operations could impact infrastructure located in the Kansas and Missouri River floodplains such as levees, pipelines and roads. It is assumed that federal, state and local approvals, where applicable, and landowner involvement would result in minimal direct impacts to infrastructure.

Indirect Impacts

Indirect impacts to infrastructure would primarily result from increased truck traffic on public roads and bridges leading to and from pit mining plant sites. Indirect impacts to infrastructure are not anticipated to be more than minimal.

Crushed Limestone from Quarry Operations

Direct Impacts

Direct impacts to infrastructure would be similar to those identified for pit dredging operations in the Kansas and Missouri River floodplains.

Indirect Impacts

Indirect impacts to Infrastructure would be similar to those identified for pit dredging operations in the Kansas and Missouri River floodplains.

3.4.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts to infrastructure would be similar to those identified for the Proposed Action. Direct impacts to infrastructure are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to infrastructure would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the extraction of less sand and gravel annually than the Proposed Action, it would not be likely to result in a reduction in the total number of dredging operations or plant sites located along the river. It is possible that higher annual extraction limits associated with the Proposed Action could result in a rate of bed degradation exceeding the rate for the Reduced Limit Alternative; however, the limit for bed degradation, regardless of how rapidly it could occur, is 2 feet. Therefore, selection of the Reduced Limit Alternative would not be likely to result in substantially reduced indirect impacts to infrastructure relative to the Proposed Action. Indirect impacts to infrastructure are not anticipated to be significant.

3.5 ECONOMICS AND DEMOGRAPHICS

This section addresses potential direct and indirect impacts to economic and demographic (socioeconomic) trends that could result from proposed commercial dredging activity on the Kansas River. As described in this section, commercial dredging activity can generate a range of socioeconomic impacts and benefits. The Proposed Action would provide employment and regional economic benefits and would not result in negative socioeconomic impacts. Accordingly, no avoidance, minimization, or mitigation measures are required or identified.

This section focuses on the socioeconomic resources likely to be affected by the Proposed Action or the alternatives (No Action Alternative and Reduced Limit Alternative). The No Action Alternative evaluates actions that may result as a response to suspending the proposed Kansas River dredging activities and include floodplain pit dredging in Kansas and Missouri River floodplains and crushed limestone from quarry operations.

The subsection below describes the regulatory setting related to socioeconomics and defines the regulatory triggers for evaluating existing economic and demographic conditions in the regional economy effected by commercial sand and gravel dredging in the Kansas River. Section 3.5.1 defines the affected environment for this economic and demographic analysis (including the existing demographic and social characteristics of the study area, an overview of the regional economy and local economic conditions and trends, and an overview of the sand and gravel industry, the existing sand and gravel dredging operations, and the markets they serve). Section 3.5.2 addresses potential direct and indirect impacts associated with the Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

Regulatory Setting

The regulatory setting for economic and demographic (socioeconomic) resources is limited to NEPA requirements for economic analysis and policies and regulations related to environmental justice. Section 1502.1 of the CEQ regulations for implementing NEPA states that a purpose of NEPA is to “inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment.” Section 1508.14 of the CEQ regulations define the human environment as one that “shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." In accordance with CEQ Section 1508.14, the analysis in this EIS considers the potential economic effects resulting from the physical effects of commercial dredging activity on the Kansas River and the commercial sand and gravel market.

The regulatory setting for environmental justice is triggered by Executive Order (EO) 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations) dated February 11, 1994 (59 FR 7629). EO 12898 requires each federal agency to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (59 FR 7629). The CEQ has oversite responsibility of compliance with EO 12898 and NEPA. Section 3.5.4.1 provides existing demographic and social characteristics of the study area, and Section 3.5.5 evaluates whether the Proposed Action or alternatives could result in a disproportionately high and adverse effect on minority or low-income populations within the study area.

3.5.1 Affected Environment

The focus of this EIS is on the commercial dredging of sand and gravel in the Kansas River between RM 0 and 170 beginning at the downstream end of the Kansas River at its confluence of the Missouri River and extending upstream to the end of the river, near the confluence of the Smokey Hill and Republican Rivers. The economic and demographic study area addressed in this analysis is defined as the primary market area[2] served by commercial sand and gravel production from the Kansas River. This analysis defines the "primary market area" as the area encompassing an approximately 30 mile-wide radius from each Dredger's land-based processing facility used for existing and proposed dredging activity on the Kansas River (Figure 19). The approximately 30 mile-wide radius was selected based on KAPA's estimate that Dredgers can remain competitive with a transportation haul distance of up to a 30 mile-wide radius from their plant. Producers do not generally haul sand more than 30 miles from the plant due to competing producer

1.

[2] The majority of customers are local manufacturers and contractors within the primary market area which includes counties in Kansas and Missouri.

companies located along the river. Thus, the primary market area is defined by the 30 mile-wide radius from plant facilities.

The primary market area includes counties with at least 25 percent of their land area within a 30 mile-wide radius of existing and proposed plant facilities on the Kansas River. Thus, counties that are crossed by the 30-mile radius but have less than 25 percent of their land area within the 30-mile radius are not included in the primary market area. This criterion is consistent with methods used by USACE to define the primary market area for commercial aggregate produced from the lower Missouri River (USACE, 2011). Table 11 identifies the 14 counties included in the primary market area. Accordingly, the study area for this economic and demographic analysis accounts for the primary market area which consists of a 14 county region and includes 11 counties in Kansas and extends into three counties in Missouri that account for market areas in the Kansas City Metropolitan Area.

Table 11 Primary Market Area for Sand and Gravel Production in the Kansas River

Primary Market Area[a]	**States and Counties**
	Kansas: Douglas, Franklin, Jackson, Jefferson, Johnson, Leavenworth, Miami, Osage, Shawnee, Wabaunsee, Wyandotte
	Missouri: Clay, Jackson, Platte

[a] The "Primary Market Area" represents the total of the 14 counties with at least 25 percent of their land area within a 30-mile radius of existing or proposed sand plants on the Kansas River.

Based on the proximity of the Kansas River to the major urban areas in Kansas and urban counties in Missouri, commercial sand and gravel production plays a substantial role in the state and regional economies. The economic analysis provided in this section accounts for direct and indirect effects associated with sand and gravel production from the Kansas River on the primary market area which accounts for the greater 14 county region (Figure 19). Therefore, analysis of the primary market area occurs at the regional level and analysis of economic impacts at the county level is provided where relevant data is available.

The regional market area considered in this economic review consists of the primary market area described as the study area in Section 3.5.3. This study area includes portions of the Kansas City Metropolitan Area on the downstream end of the Kansas River through Junction City, Kansas on the upstream end of the river, near the confluence of the Smokey Hill and Republican Rivers. Commercial sand and gravel production plays a vital role in the regional economy since most construction projects involve the addition of sand and gravel aggregates. The Kansas River is and historically has been the major source of sand and gravel in the 11 county market area of the Kansas River where nearly 41 percent of the state's population resides (Table 12).

This section first provides demographic and social characteristics to describe the population of the primary market area and throughout the states of Kansas and Missouri. Second, this section provides an overview of the regional economy and of the construction sand and gravel industry. Third, this section explains the differences in costs associated with Kansas River dredging operations and floodplain pit dredging operations. Lastly, this sections provides a brief overview of crushed limestone form quarry operations.

3.5.1.1 Demographic and Social Characteristics

This section provides population estimates and projections, social characteristics associated with race and ethnicity, and economic indicators of social well-being for the primary market area for commercial sand and gravel production on the Kansas River. This analysis of population data for the primary market area provides insight into the growth and potential future demand for commercial sand and gravel in the region as well as supporting analysis of environmental justice concerns in compliance with EO 12898 and NEPA.

Population

Data obtained from the University of Kansas, Institute for Policy and Social Research (IPSR) shows that the population of the primary market area was 2,166,805 at the time of the 2010 census. This is a 10 percent increase in the population of the primary market area since the time of the 2000 census (Table 12). In 2010, the population of primary market area counties in Kansas accounted for approximately 41 percent of the Kansas population and for approximately 54 percent of the entire primary market area.

Table 12 Population Estimates for the Study Area

Market Area	2000 Census Total Population	2010 Census Total Population	Population Change Over the Decade (Percent Change)
Kansas			
Douglas	99,962	110,826	11
Franklin	24,784	25,992	5
Jackson	12,657	13,462	6
Jefferson	18,426	19,126	4
Johnson	451,086	544,179	21
Leavenworth	68,691	76,227	11

Table 12 Population Estimates for the Study Area

Market Area	2000 Census Total Population	2010 Census Total Population	Population Change Over the Decade (Percent Change)
Miami	28,351	32,787	16
Osage	16,712	16,295	-2
Shawnee	169,871	177,934	5
Wabaunsee	6,885	7,053	2
Wyandotte	157,882	157,505	0
Total for Counties in Kansas	**1,055,307**	**1,181,386**	**12**
Missouri			
Clay	184,006	221,939	21
Jackson	654,880	674,158	3
Platte	73,781	89,322	21
Total for Counties in Missouri	**912,667**	**985,419**	**8**
Total Primary Market Area	**1,967,974**	**2,166,805**	**10**
State of Kansas	**2,688,418**	**2,853,118**	**6**
State of Missouri	**5,595,211**	**5,988,927**	**7**

Sources: University of Kansas, IPSR 2015a, 2015b, and the State of Missouri Office of Administration, Division of Budget and Planning 2015.

Table 13 summarizes historical, current estimates, and projected population trends through 2030 for the primary market area. The University of Kansas IPSR uses United States census data to provide projected population estimates. Table 13 shows that between 2000 and 2030, the population of the primary market area is projected to grow by approximately 31 percent. Kansas State's population estimates provide a reference for comparison between the primary market area and statewide population trends. The population of the State of Kansas is expected to increase by approximately 17 percent over the same period (Table 13).

Thus, the increase in the population of the primary market area (31 percent) between 2000 and 2030 is a substantial increase relevant to the statewide population growth of Kansas (17 percent) and Missouri (21 percent) over the same period (Table 13). Although the population of the primary market area would exceed the percentage increase of Kansas and Missouri over the same period from 2000 to 2030, it is difficult to determine how this increase would affect demand for construction sand and gravel as the construction sand and gravel market is generally driven by trends in the construction industry.

Table 13 Population Projections for the Study Area (2000-2030)

Market Area	2000 Census Total Population	2010 Census Total Population	2020 Projected Population	2030 Projected Population	Percent Change 2000 - 2030
Kansas					
Douglas	99,962	110,826	124,579	139,589	40
Franklin	24,784	25,992	27,222	28,071	13
Jackson	12,657	13,462	14,360	15,307	21
Jefferson	18,426	19,126	20,182	20,735	13
Johnson	451,086	544,179	645,145	752,881	67
Leavenworth	68,691	76,227	82,078	87,946	28
Miami	28,351	32,787	35,545	38,842	37
Osage	16,712	16,295	15,933	15,382	-8
Shawnee	169,871	177,934	186,148	190,211	12
Wabaunsee	6,885	7,053	7,139	7,230	5
Wyandotte	157,882	157,505	157,809	153,344	-3
Total for Counties in Kansas	**1,055,307**	**1,181,386**	**1,316,140**	**1,449,538**	**37**
Missouri					
Clay	184,006	221,939	261,469	300,021	63
Jackson	654,880	674,158	689,226	714,467	9
Platte	73,781	89,322	102,810	114,904	56
Total for Counties in Missouri	**912,667**	**985,419**	**1,053,505**	**1,129,392**	**24**
Total Primary Market Area	**1,967,974**	**2,166,805**	**2,369,645**	**2,578,930**	**31**
State of Kansas	**2,688,418**	**2,853,118**	**3,003,691**	**3,137,345**	**17**
State of Missouri	**5,595,211**	**5,988,927**	**6,389,850**	**6,746,762**	**21**

Sources: University of Kansas, IPSR 2015c, and the State of Missouri Office of Administration, Division of Budget and Planning 2015b.

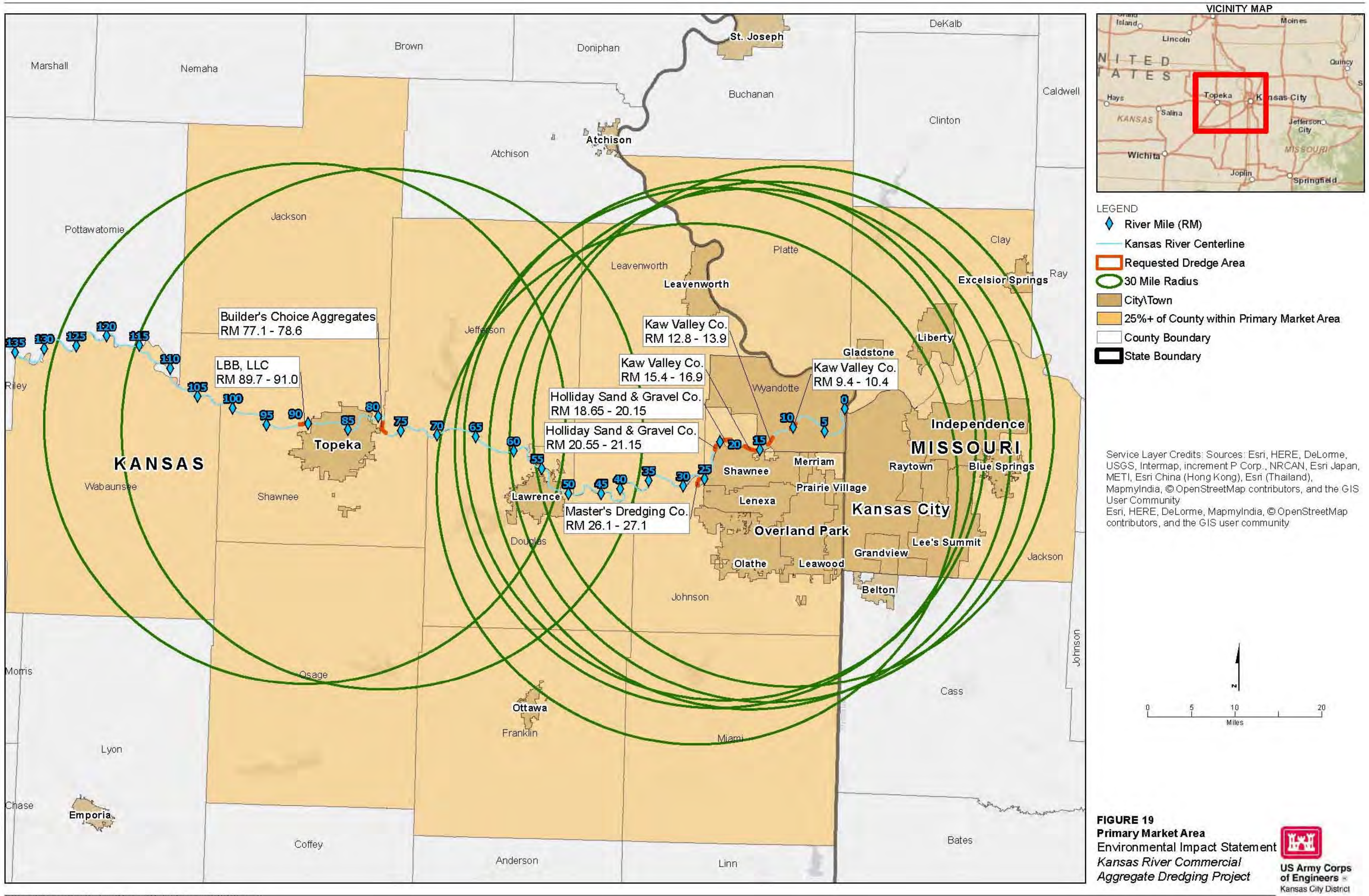

Figure 19 Primary Market Area

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Race and Ethnicity

To assess potential environmental justice related impacts associated with the Proposed Action, it is necessary to know the racial and ethnic composition of the primary market area for the Proposed Action. The race and ethnicity of the population within the primary market area is shown in Table 14. The majority of the population in the primary market area (approximately 90.3 percent) consists of the two largest racial groups, White (approximately 77 percent) and Black/African American (approximately 12.4 percent), respectively. The remaining approximately 9.7 percent of the primary market area population is represented by people identifying as some other race (approximately 3.7 percent), people identifying with more than one race (approximately 3.1 percent), Asian (approximately 2.9 percent), and people identifying as American Indian/Alaskan Native or Native Hawaiian / Pacific Islander (approximately 1 percent).

Approximately 8.6 percent of population in the primary market area identifies as Hispanic or Latino in ethnicity, which is slightly lower than in the statewide population of Kansas (approximately 10.5 percent), and much higher than the statewide population of Missouri (approximately 3.5 percent). As shown in Table 14, the population of the primary market area is generally more diverse than the statewide populations of Kansas and Missouri.

Table 14 Race and Ethnicity of the Study Area Population (2010)

Market Area	Race (Percentage of Total Population)							Ethnicity
	White	Black / African American	American Indian / Alaskan Native	Asian	Native Hawaiian / Pacific Islander	Other Race	Multi-Racial	Hispanic / Latino
Kansas								
Douglas	84.5	3.9	2.7	3.7	0.1	1.3	3.7	5.1
Franklin	93.7	1.3	0.8	0.4	0	1	2.8	3.6
Jackson	87.2	0.5	8	0.4	0	0.7	3.1	3.3
Jefferson	96.3	0.5	0.9	0.2	0	0.3	1.7	1.8
Johnson	86.0	4.3	0.4	4.2	0.1	2.5	2.5	7.2
Leavenworth	83.8	9.4	0.8	1.3	0.1	1.3	3.3	5.7
Miami	95.2	1.3	0.6	0.4	0	0.6	1.9	2.5
Osage	96.9	0.3	0.7	0.2	0	0.3	1.5	2
Shawnee	81.2	8.6	1.2	1.2	0.1	3.6	4.1	10.8
Wabaunsee	96.5	0.4	0.5	0.1	0	0.3	2.1	2.9
Wyandotte	54.6	25.2	0.8	2.5	0.1	12.9	3.7	26.4
Total for Counties in Kansas	**81.6**	**7.7**	**0.9**	**2.9**	**0.1**	**3.7**	**3.1**	**9.6**

Table 14 Race and Ethnicity of the Study Area Population (2010)

Market Area	Race (Percentage of Total Population)							Ethnicity
	White	Black / African American	American Indian / Alaskan Native	Asian	Native Hawaiian / Pacific Islander	Other Race	Multi-Racial	Hispanic / Latino
Missouri								
Clay	87.5	5.2	0.5	2.1	0.3	1.8	2.7	5.9
Jackson	66.9	23.9	0.5	1.6	0.2	3.8	3.1	8.4
Platte	87.2	5.9	0.5	2.3	0.3	1.3	2.5	5
Total for Counties in Missouri	**73.4**	**18.1**	**0.5**	**1.8**	**0.3**	**3.1**	**2.9**	**7.5**
Total Primary Market Area	**77.9**	**12.4**	**0.7**	**2.4**	**0.2**	**3.4**	**3.0**	**8.6**
State of Kansas	**83.8**	**5.9**	**1**	**2.4**	**0.1**	**3.9**	**3**	**10.5**
State of Missouri	**82.8**	**11.6**	**0.5**	**1.6**	**0.1**	**1.3**	**2.1**	**3.5**

Source: University of Kansas, Institute for Policy and Social Research 2015b, and the State of Missouri Office of Administration, Division of Budget and Planning 2015c.

Economic Indicators of Social Well-Being

This section provides three key economic indicators of social well-being for the primary market area which include unemployment, per-capita income, and poverty rates. Table 15 shows a summary of these three indicators for the 14 counties that make up the primary market area and for the states of Kansas and Missouri (Table 15).

Annual average unemployment patterns recorded in 2013 (Table 15) varied across the 14 counties that make up the primary market area. The highest unemployment rate was Wyandotte County, Kansas (8.1 percent), followed by Jackson County, Missouri (7.7 percent) and Osage and Franklin counties, Kansas (6.7 percent and 6.2 percent, respectively). Unemployment rates where lowest in Johnson and Douglas counties in Kansas (4.3 percent and 4.8 percent, respectively). The annual average statewide unemployment rates for Kansas and Missouri (5.3 percent and 6.7 percent, respectively) fell between the highest and lowest unemployment rates shown in the primary market area.

Per-capita personal income is a measure of the average income of an area and can be used to compare the relative wealth of local jurisdictions. Per-capita income varies across the 14 counties that make up the primary market area. Per-capita income levels were highest in

Johnson County, Kansas ($60,068) and Platte County, Missouri ($47,516), which are both located in the Kansas City Metropolitan Area. Per-capita income levels were lowest in Wyandotte County ($29,996) and Osage County ($35,744), which are both located in Kansas and are below the state of Kansas per-capita income of $44,891 (Table 15).

Poverty rates represent the percentage of an area's total population living at or below the poverty level as recorded by the U.S. Census Bureau. Table 15 shows the poverty rates recorded in 2013 of the 14 counties that make up the primary market area in relation to the statewide poverty levels for Kansas and Missouri. The highest poverty rate (25.6 percent) in the primary market area occurred in Wyandotte County, Kansas and the lowest poverty rate (6.1 percent) occurred in Johnson County, Kansas; both counties are located in the Kansas City Metropolitan Area. The poverty rates for the state of Kansas and Missouri are 13.9 percent and 15.9 percent, respectively.

Table 15 Economic Indicators of Social Well-Being in the Study Area

Market Area	Unemployment (2013 Annual Averages)		Per-Capita Income (2013)	Poverty Rate (2013)
	Labor Force	Unemployment Rate		
Kansas				
Douglas	63,574	4.8	36,911	16.6
Franklin	13,984	6.2	36,156	14.1
Jackson	7,290	5.1	39,712	10.4
Jefferson	10,195	5.8	36,809	10.1
Johnson	314,313	4.3	60,068	6.1
Leavenworth	34,620	6.0	37,484	11.2
Miami	16,795	5.6	44,796	9.4
Osage	8,285	6.7	35,744	12.7
Shawnee	92,106	5.8	41,598	16.8
Wabaunsee	3,771	5.1	43,544	9.4
Wyandotte	74,907	8.1	29,996	25.6
State of Kansas	**1,486,764**	**5.3**	**44,891**	**13.9**
Missouri				
Clay	126,538	6.1	40,339	10.9
Jackson	352,371	7.7	41,965	17.2
Platte	52,628	5.7	47,516	8.5
State of Missouri	**3,015,888**	**6.7**	**41,639**	**15.9**

Source: Bureau of Labor Statistics 2013, 2015, and Bureau of Economic Analysis 2014.

3.5.1.2 Overview of the Regional Economy

This section reviews employment and income measures to provide an economic overview of the primary market area in relation to the states of Kansas and Missouri. This analysis is based on a review of current employment and income measures collected from the U.S. Bureau of Economic Analysis. The information provided in Tables 16 and 17 is described at the industry level to present an understanding of which local industries in the primary market area represent significant sources of jobs and income. This analysis provides a characterization of the economic climate in Kansas and Missouri and across the 14 counties that make up the primary market area, while highlighting the role of commercial sand and gravel production in the regional economy.

Employment and Major Industries

This section describes the total employment and employment by industry for the primary market area in relationship to the states of Kansas and Missouri (Table 16). This information also provides context for the size, strength, and diversity of the regional economy in relation to statewide and local (county) economies. As shown in Table 16, the primary market area supported approximately 1.4 million jobs in 2013. During the same year, the state of Kansas supported approximately 1.9 million jobs and the state of Missouri supported approximately 3.6 million jobs.

The largest concentration of employment within the primary market area occurred in four counties located in the in Kansas City Metropolitan Area. Jackson County, Missouri had the largest concentration of jobs with 447,906, followed by Johnson County, Kansas with 430,308 jobs, Clay County, Missouri with 124,198 jobs, and Wyandotte County, Kansas with 101,247 jobs. Together, these counties accounted for 79 percent of the jobs in the primary market area. Although not in the Kansas City Metropolitan Area, Shawnee County also supported a large number of jobs in relation to other primary market area counties, with 118,039 jobs. Counties located in the state of Kansas accounted for 56 percent of the jobs in the primary market area.

Information on employment by industry (Table 16) shows the diversity of the economy in the primary market area. The largest economic sectors in the primary market area included All Other Services (which included real estate and leasing; professional, scientific, and technical services; management of companies and enterprises; administration and waste services; education services; health care and social assistance; arts, entertainment, and recreation; accommodation and food services; and other services except public administration), Government (federal, state, and local), Wholesale and Retail Trade, Manufacturing, and Construction. Although the Mining sector accounted for approximately less than 1 percent of the total employment in the primary market area, the Construction sector that relies on sand and gravel as an input for production supports 66,117 (approximately 5 percent) jobs in the primary market area. The construction trade also represented approximately 5 percent of the employment base in the state of Kansas.

Earnings and Income

This section describes the total earnings by industry for the primary market area in relationship to the states of Kansas and Missouri (Table 17). This economic measurement includes earnings by industry (as opposed to total personal income) to account for the cumulative earnings (including benefits) of wage and salary workers to better capture statewide and regional estimates of economic activity across industry.

In 2013, the primary market area accounted for approximately $79.9 billion in total earnings across all industries. In the state of Kansas, earnings totaled approximately $93.1 billion. Similar to trends associated with employment by industry, the industries with the largest earnings in the primary market included All Other Sectors, Government, Wholesale and Retail Trade, Manufacturing, Finance and Insurance, and Construction (Table 17). Although the Mining sector accounted for approximately less than 1 percent of the total earnings in the primary market area, the Construction sector that relies on sand and gravel as an input for production supports $4.6 billion (approximately 6 percent) of the earnings in the primary market area. The construction industry also represented approximately 5.3 percent of earnings in the State of Kansas.

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Table 16 Total Employment and Employment by Industry in the Study Area (2013)

	Industry/Sector												
Market Area	**Farm / Agriculture**	**Natural Resources**	**Mining**	**Construction**	**Manufacturing**	**Wholesale and Retail Trade**	**Transportation and Warehousing**	**Utilities**	**Finance and Insurance**	**All Other Services[a]**	**Government**	**Not Disclosed**	**Total**
Kansas													
Douglas	941	95	451	2,683	3,657	6,770[b]	1,139	-[b]	1,641	29,507	15,775	1,230	63,889
Franklin	1,016	-[b]	249	706	924	1,873	1,946	-[b]	366	2,717[b]	2,130	1,541	13,468
Jackson	1,002	-[b]	-[b]	-[b]	282	1,115	187	-[b]	482	2,258[b]	2,036	1,681	9,043
Jefferson	1,024	-[b]	-[b]	699	262	455[b]	106	-[b]	195	1,130[b]	1,187	1,182	6,240
Johnson	627	264	2,384	17,613	21,024	64,545	12,196	1,830	41,978	234,905	32,942	-	430,308
Leavenworth	1,130	94	236	1,988	1,156	3,274[b]	617	-[b]	2,073	14,182	12,643	396	37,789
Miami	1,360	-[b]	146	740	578	1,360	-[b]	-[b]	375	3,673	2,229	373	10,834
Osage	975	-[b]	-[b]	220	125	639	101	-[b]	199	1,270	1,326	236	5,091
Shawnee	810	-[b]	500	5,684	6,605	14,718	-[b]	-[b]	8,442	53,180	23,519	4,581	118,039
Wabaunsee	604	-[b]	-[b]	215	195	212	48	-[b]	-[b]	-[b]	539	1,080	2,893
Wyandotte	169	-[b]	-[b]	5,129	10,716	9,047[b]	9,926	-[b]	1,639	40,522	18,164	5,935	101,247
Total for Counties in Kansas	**9,658**	**453**	**3,966**	**35,677**	**45,524**	**104,008**	**26,266**	**1,830**	**57,390**	**383,344**	**112,490**	**18,235**	**798,841**
Missouri													
Clay	648	191	340	6,135	9,843	19,612	5,782	219	4,690	61,043	15,695	-	124,198
Jackson	747	204	675	22,012	24,818	58,643	13,250	1,765	32,941	229,878	62,973	-	447,906
Platte	662	-[b]	-[b]	2,293	3,477	9,312	3,488	285	2,359	26,708	4,538	301	53,423
Total for Counties in Missouri	**2,057**	**395**	**1,015**	**30,440**	**38,138**	**87,567**	**22,520**	**2,269**	**39,990**	**317,629**	**83,206**	**301**	**625,527**
Total Primary Market Area	**11,715**	**848**	**4,981**	**66,117**	**83,662**	**191,575**	**48,786**	**4,099**	**97,380**	**700,973**	**195,696**	**18,536**	**1,424,368**
State of Kansas	**63,122**	**9,706**	**44,669**	**88,841**	**169,855**	**248,326**	**59,791**	**7,942**	**100,300**	**775,275**	**296,431**	**-**	**1,864,258**
State of Missouri	**100,932**	**13,195**	**9,907**	**182,408**	**266,213**	**501,494**	**121,712**	**12,423**	**191,839**	**1,704,038**	**475,712**	**-**	**3,579,873**

Notes:

[a] All Other Services include real estate and leasing; professional, scientific, and technical services; management of companies and enterprises; administration and waste services; education services; health care and social assistance; arts, entertainment, and recreation; accommodation and food services; and other services except public administration.

[b] Does not represent actual total due to missing estimates for counties avoiding disclosure of confidential information; included in market area and state totals.

Source: Bureau of Economic Analysis 2013a.

Table 17 Earnings by Industry in the Study Area (2013)

	Industry/Sector												
Market Area	**Farm / Agriculture ($)**	**Natural Resources ($)**	**Mining ($)**	**Construction ($)**	**Manufacturing ($)**	**Wholesale and Retail Trade ($)**	**Transportation and Warehousing ($)**	**Utilities ($)**	**Finance and Insurance ($)**	**All Other Services[a] ($)**	**Government ($)**	**Not Disclosed ($)**	**Total ($)**
Kansas													
Douglas	11,274	1,889	12,910	139,958	248,690	174,791[b]	51,128	-[b]	69,363	860,835	883,762	87,778	2,542,378
Franklin	21,123	-[b]	8,819	25,994	51,564	76,639	102,571	272	9,336	68,510	101,167	53,998	519,993
Jackson	20,202	-[b]	-[b]	-[b]	11,464	22,251	5,804	118	9,909	37,710	90,063	55,509	253,030
Jefferson	14,615	-[b]	-[b]	40,317	10,461	10,523[b]	3,525	-[b]	4,311	27,303[b]	48,614	41,172	200,841
Johnson	4,057	51,612	91,684	1,227,330	2,081,442	3,508,093	656,935	203,367	3,004,411	12,582,770	1,841,058	-	25,252,759
Leavenworth	1,280	1,886	2,559	90,289	69,521	71,410[b]	19,387	-[b]	64,210	404,380	1,246,235	23,383	1,994,540
Miami	2,162	-[b]	6,897	37,709	35,736	64,699	-[b]	-[b]	18,722	116,374	103,205	23,136	408,640
Osage	24,345	-[b]	-[b]	7,680	4,935	15,230	3,847	274	6,633	30,792[b]	49,641	4,242	147,619
Shawnee	19,056	-[b]	26,963	333,652	416,122	616,891	-[b]	-[b]	564,222	2,193,210	1,371,932	354,775	5,896,823
Wabaunsee	7,105	-[b]	-[b]	8,358	7,618	4,055	943	64	-[b]	-[b]	18,736	22,186	69,065
Wyandotte	4,533	-[b]	-[b]	306,646	956,884	295,458[b]	652,261	-[b]	68,984	1,804,765	1,067,391	411,902	5,568,824
Total for Counties in Kansas	**129,752**	**55,387**	**149,832**	**2,217,933**	**3,894,437**	**4,860,040**	**1,496,401**	**204,095**	**3,820,101**	**18,126,649**	**6,821,804**	**1,078,081**	**42,854,512**
Missouri													
Clay	20,374	4,210	5,033	479,875	918,671	897,209	353,107	24,408	174,983	2,683,933	968,490	-	6,530,293
Jackson	29,033	3,878	8,193	1,753,534	1,884,125	2,754,246	844,185	212,559	2,756,626	13,177,171	4,499,673	-	27,923,223
Platte	33,887	-[b]	-[b]	153,527	231,728	385,517	184,091	38,557	113,089	1,119,203	284,809	8,248	2,552,656
Total for Counties in Missouri	**83,294**	**8,088**	**13,226**	**2,386,936**	**3,034,524**	**4,036,972**	**1,381,383**	**275,524**	**3,044,698**	**16,980,307**	**5,752,972**	**8,248**	**37,006,172**
Total Primary Market Area	**213,046**	**63,475**	**163,058**	**4,604,869**	**6,928,961**	**8,897,012**	**2,877,784**	**479,619**	**6,864,799**	**35,106,956**	**12,574,776**	**1,086,329**	**79,860,684**
State of Kansas	**4,042,790**	**516,653**	**2,363,628**	**4,927,057**	**12,975,820**	**10,170,529**	**3,471,380**	**1,038,267**	**5,362,230**	**31,874,052**	**16,321,270**	**-**	**93,063,676**
State of Missouri	**3,070,959**	**378,865**	**485,301**	**10,229,290**	**18,664,062**	**20,860,926**	**6,522,355**	**1,476,207**	**11,415,820**	**76,140,621**	**28,689,658**	**-**	**177,934,064**

Notes:
[a] All Other Services include real estate and leasing; professional, scientific, and technical services; management of companies and enterprises; administration and waste services; education services; health care and social assistance; arts, entertainment, and recreation; accommodation and food services; and other services except public administration.
[b] Does not represent actual total due to missing estimates for counties avoiding disclosure of confidential information; included in market area and state totals.

Source: Bureau of Economic Analysis 2013b.

3.5.1.3 Overview of the Construction Sand and Gravel Industry

The Kansas River's bed material consists primarily of sand and has little silt or clay compared to most rivers. The ease of accessibility and the relatively clean nature of the sand and gravel within the river allow the Producers to utilize nearly all of the dredged material for commercial sale. As a result, dredges in the Kansas River produce some of the highest-quality, least-expensive sand in the United States. Due to the low unit value of the sand and gravel, the economic viability of each sand and gravel source is determined by the quantity of material available for extraction, operating costs, and transportation costs. Of those elements, transportation costs can account for 50 percent or more of the price paid by consumers. As a result, the further a sand and gravel source is located from area markets, the greater the chance that the operations would not be economically feasible. Consequently, the transportation position of a sand and gravel source must be the primary factor in making the cost judgment among alternative resources.

It is difficult to determine the amount of sand and gravel that will be needed to meet future market needs; however, the historical record for sand and gravel production from the Kansas River provides a general trend for market demand. The volume of sand and gravel dredged from the Kansas River can fluctuate year to year based on economic conditions, trends in the construction industry, permitted extraction limits, limitations due to riverbed degradation, and the availability of sand and gravel from alternative sources. Table 18 below identifies the annual sand and gravel production from the Kansas River between 1991 and 2014.

Over the period between 1991 and 1999, commercial dredging on the Kansas River averaged 2,790,000 tons per year with a low of 2,450,000 tons in 1998 and a high of 2,990,000 tons in 1991. Over the period between 2000 and 2014, commercial dredging on the Kansas River averaged approximately 1,393,096 tons per year with a low of 768,798 tons in 2014 and a high of 2,046,058 tons in 2001. The lower average annual production rate since 1999 may be attributed to: 1) a reduction in the number of Kansas River dredging operations (closure of degraded river reaches by the USACE); 2) a reduction in market demand for roadway/highway programs and commercial/residential development; and 3) the availability and competition from other aggregate sources such as Missouri River dredging and floodplain pit mines.

Table 18 Total Annual Sand and Gravel Production from the Kansas River

Year	Extracted (Tons)	Permitted (Tons)	Percent of Permitted Extraction
1991**	2,995,262	4,776,500	62.71
1992**	2,855,898	4,317,700	66.14
1993**	2,916,094	3,858,800	75.57
1994**	2,697,728	3,400,000	79.34
1995**	2,948,019	3,400,000	86.71
1996**	2,988,000	3,400,000	87.88
1997 *	2,777,860	3,400,000	81.70
1998 *	2,455,930	3,400,000	72.23
1999**	2,490,472	3,400,000	73.25
2000**	1,847,536	3,400,000	54.34
2001**	2,046,058	3,400,000	60.18
2002**	1,615,920	3,400,000	47.53
2003**	1,847,155	3,400,000	54.33
2004**	1,667,449	3,400,000	49.04
2005**	1,349,510	3,400,000	39.69
2006**	1,721,524	2,700,000	67.51
2007**	1,323,163	2,200,000	60.14
2008**	1,118,093	2,200,000	50.82
2009**	1,228,509	2,200,000	55.84
2010**	940,061	2,200,000	42.73
2011**	994,387	2,200,000	45.20
2012**	1,244,027	2,200,000	56.55
2013**	1,184,255	2,200,000	53.82
2014**	768,798	2,200,000	34.94
2015**	509,145	2,200,000	23.14

* Extracted tonnage provided by the Kansas Department of Revenue – Planning and Research Records

** Extracted tonnage provided by the USACE, Kansas City District

3.5.1.4 Kansas River Dredging Costs

The following economic review is based on the techniques and information from "*Kansas River Dredging Operations: Baseline Study and Comparison of Alternatives*" (Booker Associates, 1986) and from "*An Analysis of Sand Mining Alternatives along the Kansas River Basin*" (Blechinger, 1997). The data in these two reports about the production of sand and gravel in the Kansas River serve as the baseline for production and transportation costs associated with the dredging industry. These figures will be compared against the costs identified for floodplain pit dredging and dredging associated with other sources such as the Missouri River.

All costs previously calculated by Mr. Blechinger in 1997 reflected the use of the Implicit Price Deflator (IPD) index, which was based on the Gross Domestic Product, to assess the amount of inflation that had occurred since the original presentation of costs by Booker Associates in 1986. The economic review presented below applies the IPD index to adjust for the effect of inflation from 1996 to 2013. The IPD index is prepared by the United States Department of Commerce, Bureau of Economic Analysis. Table 19 indicates the inflation (IPD) indexes from 1996 to 2013.

Table 19 Gross Domestic Product Inflation Indexes (1996 – 2012)

Year	Index Rate
1996	83.166
1997	84.630
1998	85.581
1999	86.840
2000	88.720
2001	90.725
2002	92.191
2003	94.131
2004	96.782
2005	100.000
2006	103.234
2007	106.230
2008	108.589
2009	109.529
2010	110.977
2011	113.353
2012	115.387
2013	116.456*

* The 2013 Gross Domestic Product Index is based on the current Implicit Price Deflator calculation completed for the fiscal year through June 2013. (Department of Commerce, Bureau of Economic Analysis, 2013).

The calculated inflation rate for the period 1996 to 2013 is 40.02 percent. That is the inflation rate used for the economic information presented in this section. Production costs previously computed by Booker Associates and subsequently by Blechinger will be multiplied by the calculated inflation rate (1.4002) to reflect 2013 prices.

Production and Operation Costs

For the purpose of this review, the production costs associated with commercial dredging in the Kansas River for sand and gravel production includes:

- Land
- Buildings
- Equipment
- Repair and Maintenance
- Labor
- Taxes
- Miscellaneous costs (insurance, utilities, exploration fees, legal fees, monitoring fees)
- Contingency fund

A detailed description of each of these elements is provided in both the Booker Associates study (1986) and the Blechinger report (1997). Table presents an economic overview of a river-based operation with varying levels of production.

Table 20 Summary of 2013 Kansas River Dredging Operation Costs

2013 Costs	Production 400,000 tons*	Production 300,000 tons	Production 250,000 tons	Production 200,000 tons	Production 150,000 tons
Dredge	$1,915,474	$958,086	$958,086	$958,086	$958,086
Plant	$1,053,896	$526,947	$526,947	$526,947	$526,947
Conveyor	$383,235	$383,235	$383,235	$383,235	$383,235
Loader	$574,852	$287,426	$287,426	$287,426	$287,426
Scale	$57,485	$57,485	$57,485	$57,485	$57,485
Misc.	$191,617	$191,617	$191,617	$191,617	$191,617
Land	$76,647	$57,485	$47,904	$38,323	$28,743
Office	$125,190	$93,893	$78,243	$62,595	$46,946
Cont. Fund	$18,779	$14,084	$11,737	$9,390	$7,042
Annual Cost	$32,378	$24,284	$20,236	$16,189	$12,142
Maintenance.	$166,068	$124,552	$103,793	$83,034	$62,275
Labor	$919,763	$689,822	$574,852	$459,881	$344,911
Taxes	$11,582	$8,687	$7,239	$5,791	$4,343
Misc.	$383,235	$287,426	$239,522	$191,617	$143,335
Total	$1,849,490	$1,326,483	$1,138,803	$951,120	$763,063
Cost/Ton	$4.62	$4.42	$4.55	$4.75	$5.09

* The production of 400,000 tons of sand and gravel per year is calculated based on two loaders, two dredges, and two plants.

The economic values presented in Table 20 reflect 2013 costs associated with the operation of a Kansas River sand plant site based on the calculated assumptions prepared by Booker Associates and further analyzed by Mr. Blechinger. According to information provided by the KAPA, the cost per ton of sand and gravel produced from the Kansas River averages $4.50 per ton west of Topeka and $7.00 per ton east of Lawrence. The variation between the adjusted calculations presented in Table 20 and the cost per ton identified by the dredging companies is related to increased land costs and taxes, fuel and electricity for operations, bi-annual monitoring requirements, and increased labor rates. The land footprint for a river sand operation is approximately 10 to 12 acres for plant, scale, and stockpiles.

In addition, the selling price and the gross profit margin are not presented as part of Table 20 due to variations in individual dredging company management and operations. Key factors that affect the selling price and the profitability of each company include:

- Market competition and average selling price,

- Number of employees reflected in the overall labor cost,
- Land costs, and
- Financed or owned equipment rates.

The Dredging companies within KAPA provided information that indicates gross profits for most companies range between 5 and 15 percent. They also noted that the market rate for the sale of sand averages $9 per ton in the lower river (Lawrence and Kansas City metropolitan areas) and averages $5 per ton in the upper river (Topeka and Manhattan areas).

Existing commercial sand and gravel operations on the Kansas River directly support approximately 75 to 95 jobs in the mining industry depending on the time of the season. The types of direct job opportunities associated with these operations include dredge operators, barge captains, plant operators, equipment operators, heavy machinery operators (drying operations), mechanics, machinery service technicians, safety personnel, management, sales and administrative staff. The total amount of labor income associated with these direct jobs is estimated to be approximately $4.5 million annually (Moses, 2015, personal communication).

Transportation Costs

The average cost to deliver a load of sand and gravel in 2015 is $0.20/ ton-mile or $5 per mile for an average 25 ton load (Moses, 2015, personal communication). Charges vary according to distance, roads traveled, destination area, volume of the order, jobsite conditions, and fuel prices. The highest transportation charges are associated with city driving due to the cost of driving in a congested area compared to typical highway driving. To transport a load of sand from one side of Johnson County to the other side may double the cost of the sand. In addition, long hauls monopolize trucks that could be used to make two or three short hauls. Most producers do not generally haul sand more than 50 miles in a north or south direction. Haul distances in an east or west direction are typically 30 miles or less to account for overlaps in local markets among competing producer companies located along the river. As described in Section 3.5.3, KAPA estimates that most producers can remain competitive with a haul distance up to a 30-mile radius from their plant, which is consistent with the defined primary market area for this analysis (Figure 19). At $0.20/ton-mile an average 25 ton load is $150 for a 30-mile haul, which adds $6 per ton to the cost of sand and gravel nearly doubling the cost of sand (Moses, 2015, personal communication).

Exceptions may occur where a destination may not have local material sources, where there are backhauling opportunities, when the material is being requested during the “off-season”, or when the end user is willing to pay the increased transportation costs.

State of Kansas Royalty Revenues

Under current statutes, the State of Kansas receives a royalty of $0.15 per ton from sand and gravel dredging operations located on navigable streams in the state. The amount of sand and gravel dredged from the Kansas River during 2012, as reported by the Kansas Department of Revenue, was 934,807 tons. Based on the $0.15 per ton royalty, the income received by the state was $140,221 for the year 2012 (Kansas Department of Revenue, 2012). Based on the same royalty, the income received by the state would be approximately $76,372 for the year 2015 with 509,145 tons of sand and gravel dredged.

3.5.1.5 Floodplain Pit Dredging Costs

A typical floodplain pit dredging site is cleared of overburden and then excavated until a suitable pit has been exposed that can support a floating dredge. Dredging pits are located in the alluvial deposits of the Missouri River and Kansas River floodplains. For a dredging pit site to be economically feasible, sand deposits must generally have a minimum thickness of 25 feet, with an average overburden depth of 12 feet. The minimum acreage required to support a pit mining operation for an approximately 12-year production period, at an average of 300,000 tons per year, would equate to 61 acres (Booker Associates, 1986). According to KAPA, overburden on a typical site should not exceed 20 feet in thickness but can vary depending upon the depth of marketable materials. Once the land has been cleared of the overburden that overlay the sand deposits, floodplain pit dredging operations are similar to the operations described for Kansas River dredging. The following economic review is based on the techniques and information provided by the Booker Associates study (1986) and in the Blechinger report (1997).

Production and Operation Costs

For the purpose of this review, the production and operational costs associated with commercial pit dredging operations include the same topics addressed for Kansas River dredging, plus the following considerations:

- Increased land area

- Removal of overburden
- Exploration, zoning and permitting

Table 21 presents an economic overview of a floodplain pit dredging operation with varying levels of production.

For a floodplain pit dredging operation that is capable of producing 190,000 tons per year, the production cost per ton basis would increase an estimated 11 percent compared to Kansas River dredging operations shown in Table 20. However, KAPA has noted that the need to provide reclamation activities after the site has been depleted of marketable materials has not been included in the analysis presented in Table 21. The cost to reclaim a dredged pit can vary widely depending on the location of the site, its proximity to developed areas, and the requirements established by the local zoning authority and the state agencies that regulate mining activities. According to KAPA, the cost to complete reclamation activities could be as much as $0.25 per ton of sand and gravel harvested. The addition of $0.25 per ton to the production costs identified in Table 21 would increase the overall production cost by an estimated 14 percent compared to Kansas River dredging operations shown in Table 20. In addition, the extraction of sand and gravel from the floodplain can result in production inefficiencies not typically encountered when dredging in the Kansas River. These inefficiencies are related to geologic variations such as mud seams and clay seams that are encountered during pit mining operations.

Table 21 Summary of 2013 Floodplain Pit Operation Costs

2013 Costs	Production 400,000 tons*	Production 300,000 tons	Production 250,000 tons	Production 200,000 tons	Production 150,000 tons
Dredge	$958,086	$958,086	$958,086	$958,086	$958,086
Plant	$526,947	$526,947	$526,947	$526,947	$526,947
Conveyor	$383,235	$383,235	$383,235	$383,235	$383,235
Loader	$574,852	$287,426	$287,426	$287,426	$287,426
Scale	$57,485	$57,485	$57,485	$57,485	$57,485
Misc. Equip.	$191,617	$191,617	$191,617	$191,617	$191,617
Land	$322,009	$256,236	$222,521	$189,359	$156,196
Office	$125,190	$93,893	$78,243	$62,595	$46,946
Cont. Fund	$18,779	$14,084	$11,737	$9,390	$7,042
Exploration	$7000	$7000	$7000	$7000	$7000
Eng./Permits	$57,600.	$57,600	$57,600	$57,600	$57,600
Annual Cost	$81,723	$66,048	$58,083	$50,204	$42,786
Maintenance	$153,280	$114,960	$95,800	$76,640	$57,480

Table 21 Summary of 2013 Floodplain Pit Operation Costs

2013 Costs	Production 400,000 tons*	Production 300,000 tons	Production 250,000 tons	Production 200,000 tons	Production 150,000 tons
Overburden	$122,600	$91,950	$76,625	$61,300	$45,975
Labor	$919,763	$689,822	$574,852	$459,881	$344,911
Taxes	$23,478	$18,382	$15,790	$13,228	$10,665
Misc.	$406,000	$304,500	$253,750	$203,000	$152,250
Total	$1,907,717	$1,467,679	$1,259,509	$1,051,424	$844,801
Cost/Ton	$4.77	$4.89	$5.04	$5.26	$5.63

* The production of 400,000 tons per year is calculated based on two loaders.

Blechinger (1997) documented that keys to a successful and profitable floodplain pit dredging operation include:

- The selection of sites with low ratios of overburden depth compared to the depth of usable sand deposits,
- Operation of the dredge pit in conjunction with a ready-mix concrete operation to reduce trucking costs,
- Acquisition of land at or below market value (more common in western areas of the Kansas River floodplain), and
- Finding land within counties where there is less opposition to sandpit operations in order to reduce planning, engineering and legal fees.

Based on available boring logs, the majority of the counties with a larger percentage of land with good overburden ratios are located west of Topeka, Kansas (Blechinger, 1997). Based on existing commercial dredging operations, these western counties seem to favor floodplain pit dredging versus Kansas River dredging. There are currently no Kansas River dredging operations located west of the Topeka Metropolitan Area.

Transportation Costs

The method of haul, average trip length and the cost per ton mile affects the delivered price of sand and gravel from pit mining operations. Based on the information prepared by Booker Associates (1986) and Mr. Blechinger (1997), transportation costs for sand and gravel would remain the same as the rate for material dredged from the Kansas River. The average cost to transport a load of sand and gravel in 2015 was $0.20 per ton mile. Again, at $0.20/ ton-mile an average 25 ton load is $150 for a 30-mile haul, which adds $6 per ton to the cost of sand and gravel (Moses, 2015, personal communication). Charges vary according to distance, roads traveled, destination area, volume of the order, jobsite conditions, and fuel prices. Although the initial locations of floodplain dredge pits may be within acceptable haul distances to area markets, similar to those for existing Kansas River dredging sites, long-term use of dredge pits would require replacement sites to become further removed from the primary market area in order to find suitable materials and accessible properties.

3.5.1.6 Crushed Limestone from Quarry Operations

The use of crushed limestone (also referred to herein as manufactured sand and gravel) for concrete and other similar construction purposes is relatively limited based on the abundance of other better suited materials, such as quartz sand and gravel mined from rivers and adjacent floodplains. Manufactured sand and gravel is more friable and is not generally conducive to finishing applications due to the angular nature of the material. However, coarse limestone aggregate is a highly desirable product for asphalt production due to its angular shape. It is assumed that manufactured sand and gravel could provide some additional resources to the region; however, it is unlikely that the use of these materials, as a substitute for river or floodplain sand and gravel, would be widely accepted. Due to the limited range of use as a replacement material for river or floodplain mined sand and gravel, only a brief summary of production and operation, and transportation cost estimates for crushed limestone are provided herein. The operation and management of crushed limestone quarries are not anticipated to change within the region and would be expected to continue to serve as a supplemental resource for specific project applications such as asphalt production. With respect to manufactured sand, the market is limited. Manufactured sand does not finish or pump well in concrete; and therefore its use is limited to lower vertical concrete and asphalt paving.

Production and Operation Costs

For the purpose of this review, the production and operational costs associated with crushed limestone from quarry operations include the same topics addressed for Kansas River dredging and floodplain pit dredging. Several key components of cost that would differ for crushed limestone from quarry operations than from Kansas River dredging and floodplain pit dredging include but would not be limited to land, labor, equipment, and permitting.

Crushed limestone from quarry operations would require considerably more land than the proposed Kansas River dredging operations. The amount of land required for operation depends on the thickness and the quality of the ledge used for quarry. Quarry operations on a thicker ledge would typically require a lesser amount of land than a thinner ledge, which would require more land for quarry operations. Ledges sizes are highly variable depending on the quality of the ledge. Ledges are typically mined out a quarter of a section at a time. Most completed operations in eastern Kansas used one-half to three-fourths of a ledge section.

A typical Kansas River sand plant requires approximately five to six employees per shift. Whereas crushed limestone from quarry operations would require five to six employees per shift plus the crusher operator and the grinder operator. Additional employees would be needed for stripping, blasting and hauling to the crusher, but the costs of these activities may be shared by other products manufactured (Moses, 2015, personal communication). Equipment costs for crushed limestone from quarry operations would be higher than equipment costs associated with Kansas River dredging. Crushed limestone from quarry operations require a crusher (some operations require a secondary crusher) and a grinder to reduce limestone to a particle small enough to be considered a fine aggregate. These additional equipment costs associated with crushed limestone from quarry operations would be approximately $800,000 to $1 million.

Permitting costs associated with crushed limestone from quarry operations can be substantial when added to the overall cost of the land for the quarry reserve. Blasting, noise abatement, dust abatement, truck traffic and zoning concerns pose additional issues generally associated with quarry operations.

Transportation Costs

Transportation costs associated with crushed limestone from quarry operations do not vary from transportation costs associated with Kansas River dredging or floodplain pit dredging. As described in Section 3.5.4.4, the average cost to deliver a load of sand and gravel in 2015 is $0.20/ ton-mile or $5 per mile for an average 25 ton load (Moses, 2015, personal communication). Charges vary according to distance, roads traveled, destination area, volume of the order, jobsite conditions, and fuel prices. There are currently no manufactured sand producers in either northeast Kansas or northwest Missouri. However, manufactured sand and gravel substitutes would need to be trucked in from approximately

70 miles outside of the primary market area which would require an additional $14 per ton to the cost of sand and gravel and would more than double the transportation costs associated with Kansas River dredging and floodplain pit dredging (Moses, 2015, personal communication).

3.5.2 Environmental Consequences

This section evaluates potential direct and indirect economic-related effects associated with changes in construction sand and gravel production from the Kansas River as defined by the Proposed Action and alternatives considered in the primary market area defined in Section 3.5.3. Economic impacts are considered by the NEPA as impacts on the human environment and are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

In addition, this section provides analysis on potential environmental justice impacts associated with the Proposed Action and alternatives based on production levels anticipated to meet existing demand in the primary market area. The analysis focuses on whether minority and low-income communities in the study area would be disproportionately affected from an economic standpoint because of the proposed dredging activity from the Kansas River.

3.5.2.1 Proposed Action

Direct Impacts

According to Booker Associates (1997) and Mr. Blechinger (1997), Kansas River dredging is the most cost effective method for sand and gravel production within primary market area. The continued use of Kansas River sand and gravel would allow the cost of sand and gravel to remain low in both local markets and within the primary market area. From a regional perspective, the net economic impacts of the Proposed Action would be positive.

As described in Section 3.5.4.4, existing commercial sand and gravel operations on the Kansas River directly support approximately 75 to 95 jobs in the primary market area depending on the time of the season. The total amount of labor income associated with these direct jobs is estimated to be approximately $4.5 million annually (Moses, 2015, personal communication).

In addition, due to the high silica content found in Kansas River sand, the Dredgers also supply local area fiberglass fabricators including Owens Corning and the CertainTeed Corporation in the Kansas City area and the Johns Manville plant in McPherson, Kansas.

The potential economic benefits attributed to reductions in sand and gravel costs associated with Kansas River dredging operations could be realized by the general population including minority and low-income populations. Therefore, adverse economic effects are unlikely to disproportionality impact minority or low-income populations and no adverse environmental justice impacts are anticipated.

Indirect Impacts

Continued dredging could generate indirect economic impacts due to degradation of the riverbed. Localized or regional degradation could indirectly impact infrastructure within the river and create financial and engineering burdens on local communities and private interests. However, since the primary compliance criteria in the USACE's Regulatory Plan limits riverbed degradation to an average of 2 feet below the 1992 baseline elevations for any 5-mile-long reach of river, indirect impacts to infrastructure in and immediately adjacent to the river are not anticipated to be significant.

Existing commercial sand and gravel operations on the Kansas River indirectly support a variety of construction and transportation jobs in the primary market area depending on the time of the season. These indirect jobs include trucking operations, independent truck drivers, ready mix concrete operations, concrete finishers, asphalt finishers, sales people, and services support personnel (Moses, 2015, personal communication).

Potential economic benefits attributed to reductions in sand and gravel costs could be realized by the general population including minority and low-income populations. Therefore, adverse economic effects are unlikely to indirectly impact minority or low-income populations and no adverse environmental justice impacts are anticipated.

3.5.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. The Dredgers would be required to cease river dredging operations and possibly to close their land-based plant sites once their stock piled materials have been sold. Plant closure costs would be incurred by the individual dredging companies. In addition, selection of the

No-Action Alternative would indirectly impact the Dredgers due to 1) layoffs for current employees; 2) costs for development planning for alternative business solutions (i.e., floodplain mining); and 3) salvage and sale of idle equipment.

The No-Action Alternative would shift the market demand for sand and gravel to be met by other sources. The three primary alternative sources of sand and gravel identified for the No-Action Alternative are Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations. If the Dredgers are unable to establish operations to obtain sand and gravel from these other sources, those Dredgers would be out of the sand and gravel industry and might not continue to be financially viable companies. If these companies fail or have to downsize, workers may become unemployed if they cannot find employment with other companies who are able to expand or establish operations seeking these other sources of sand and gravel. The three primary alternative sources of sand and gravel also have a potential to directly impact the general economy.

The removal of dredging operations from the Kansas River could aid in long term channel stability, decreasing the potential for infrastructure damage with a corresponding decrease in the costs associated with maintaining the infrastructure. However, since the primary compliance criteria in the USACE's Regulatory Plan limits riverbed degradation to an average of 2 feet below the 1992 baseline elevations for any 5-mile-long reach of river, damage to river infrastructure and associated maintenance costs are not anticipated to be significant.

Under the No Action Alternative reductions in sand and gravel production, reductions in truck transportation, and related increases in the cost of sand and gravel in the primary market area could result in indirect adverse economic impacts. Direct impacts would be concentrated on people working in the construction sand and gravel industry in the primary market area. To the extent that employees in these industries are minority or low-income populations, environmental justice impacts could occur. However, at the regional scale, anticipated adverse economic impacts would affect the general population of the primary market area and are not anticipated to fall disproportionally on minority or low-income populations. Therefore, no adverse environmental justice impacts are anticipated.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

Selection of the No Action alternative, denial of the requested Kansas River dredging permits, would increase the demand of sand and gravel from the Missouri and Kansas River floodplains, and other alternative sources. Increased demand would require the development of new floodplain pit dredging operations to accommodate the sand and gravel needs. Developing dredge pits within the floodplain results in direct impacts to agricultural production. In order to accommodate the current Kansas River production level of 1,500,000 tons of sand and gravel per year, the average market demand since 2000, it is estimated that 25 to 34 acres of land would need to be converted to pit dredging operations each year (Blechinger, 1997; Booker Associates, 1986). The majority of the land converted to pit dredging operations would be agricultural properties. The negative direct economic impact would include the value of annual production and expenditures on seed, chemical inputs, equipment, and labor. Conversely, new plant sites would either be constructed by moving existing equipment from non-operational facilities or through the purchase of new equipment. These new pit dredging operations would add jobs for workers who construct and operate the plants and would have a positive direct economic impact associated with the value of the produced sand and gravel and expenditures on land, equipment, technical services, and general labor. However, developing these new pit dredging operations would also create capital costs for those businesses establishing the new operations. These costs will be carried over to the consumer. According to Booker Associates (1986) and Blechinger (1997), sand and gravel produced from floodplain pit dredging will cost at least 16 percent ($0.72/ton) more than sand and gravel from the Kansas River, plus any additional cost of transporting the sand ($0.20 per ton mile) if the pit is farther from the primary market area. This cost increase for sand and gravel would affect both the initial user as well as the end user of the mixed product (concrete and asphalt).

Under current statutes, the State of Kansas receives a royalty of $0.15 per ton from sand and gravel dredging operations located on navigable streams in the state. The average Kansas River production level since 2000 was 1,500,000 tons of sand and gravel per year. Based on the $0.15 per ton royalty, the state will lose $225,000 in revenue each year if the sand and gravel previously dredged from the Kansas River is obtained by floodplain pit dredging.

At a regional level within the primary market area, these direct impact effects would be minor, would be distributed across the population generally, and are not expected to disproportionately impact low-income populations. Therefore, no adverse environmental justice impacts are anticipated.

Indirect Impacts

The construction of additional roadways, bridges and utilities could be required for new floodplain pit dredging sites. Infrastructure improvements may encourage other development, which could continue to increase regional tax bases and stimulate economic growth. While new roadways and other infrastructure may be constructed, existing infrastructure within the floodplain could degrade and require repair due to increased traffic demands. These infrastructure expenses would place a financial burden on local governments.

The construction of new pit dredging operations would also indirectly affect the end user. Due to the high capital investment required to establish a dredge pit site, the investment cost would be passed on to the entities (industries, individuals, local governments, state governments, etc.) that use the products. The increase in cost to the end user for dredge pit mine site development could reduce the total number of projects that would be completed in any given year due to the end users budget restrictions.

At a regional level within the primary market area, these indirect impacts effects would be minor, would be distributed across the population generally, and are not expected to disproportionately impact low-income populations. Therefore, no adverse environmental justice impacts are anticipated.

Crushed Limestone from Quarry Operations

Direct Impacts

As described in Section 3.5.4.5, selection of the No Action alternative, denial of the requested Kansas River dredging permits, would increase the demand of sand and gravel from alternative sources such as crushed limestone from quarry operations. Increased demand would require the development of new quarry operations to accommodate the sand and gravel needs.

Direct impacts to the economy (increased product cost) associated with the use of crushed limestone from quarry operations would be anticipated and would primarily result from increased costs associated land, equipment, labor and with transportation of the product to the primary market area. Crushed limestone has been demonstrated to be a suitable product for asphalt production and for concrete work that can utilize larger more angular shaped materials. Although crushed sand from quarry operations can be used for ready mix concrete, absorption issues can lead to variances in slump, which would require the addition of water to improve workability. The addition of extra water can ultimately impact the integrity of the concrete as well as its finished quality. Therefore, it is unlikely that crushed limestone would provide significantly greater resources to the primary market area as a substitute for sand and small gravel used in finished concrete or ready mix.

However, additional land costs would result from the amount of land required for new quarry operations would depend on the size and quality of the quarry ledge. New quarry sites would require the purchase of new equipment. These new quarry operations could add jobs for workers who construct and operate the plants and would have a positive direct economic impact associated with the value of the produced sand and gravel and expenditures on land, equipment, technical services, and general labor. However, developing these new quarry operations would also create capital costs for those businesses establishing the new operations. These costs will be carried over to the consumer. These negative and positive benefits may equal out and result in no net economic loss.

There are currently no manufactured sand producers in either NE Kansas or NW Missouri. However, manufactured sand and gravel substitutes would need to be trucked in from approximately 70 miles outside of the primary market area which would require an additional $14 per ton to the cost of sand and gravel and would more than double the transportation costs associated with Kansas River dredging and floodplain pit dredging (Moses, 2015, personal communication). Charges would vary according to distance, roads traveled, destination area, volume of the order, jobsite conditions, and fuel prices. Therefore, although the anticipated increase in the use of crushed limestone from quarry operations would be limited, direct economic impacts (cost increases) to regional users of the material would likely occur.

At a regional level within the primary market area, these anticipated direct impacts would be minor, would be distributed across the population generally, and are not expected to disproportionately impact low-income populations. Therefore, no adverse environmental justice impacts are anticipated.

Indirect Impacts

An increase in the use of crushed limestone as a replacement for sand and gravel from the Kansas River could require many of the industry specifications to be amended to allow for the variation in material strength and coarseness. The adoption of new industry specifications would require a significant investment of time to review new products, test materials, and develop guidance for use of alternative materials. Other indirect impacts would be similar to those described in the floodplain pit dredging discussion above. Indirect impacts could include the construction of additional roadways, bridges and utilities, or increased maintenance of existing infrastructure within the floodplain that may degrade due to increased traffic demands. These infrastructure expenses would place a financial burden on local governments.

The construction of new plant sites would also indirectly affect the end user. The increase in cost to the end user associated with development of new quarries and associated increases in transportation costs could reduce the total number of projects that would be completed in any given year due to industry or government budget restrictions. Furthermore, KAPA anticipates that an increase in quarry operations necessary to meet the demand of the primary market area would generate approximately 320,000 more miles of truck hauling annually which would increase diesel fuel consumption and associated greenhouse gas emissions (Moses, 2015, personal communication). Blasting, noise abatement, dust abatement, truck traffic and increased permitting costs pose additional indirect impacts that would result from new quarry operations.

At a regional level within the primary market area, these indirect impact effects would be minor, would be distributed across the population generally, and are not expected to disproportionately impact low-income populations. Therefore, no adverse environmental justice impacts are anticipated.

3.5.2.3 Reduced Limit Alternative

Direct Impacts

Based on Booker Associates (1986) and Mr. Blechinger (1997), Kansas River dredging is the most cost effective method of sand and gravel production within the primary market area. The continued use of Kansas River sand and gravel would allow the cost of materials to remain low in both local markets and within the primary market area. However, the reduction in total annual extraction associated with this alternative would require any increase in regional demand beyond the allowable extraction limit to be supplemented by alternative material sources. Those alternative sources come with an increased cost for production and a sale price that would directly impact the end user.

At a regional level within the primary market area, these anticipated direct impacts would be minor, would be distributed across the population generally, and are not expected to disproportionately impact low-income populations. Therefore, no adverse environmental justice impacts are anticipated.

Indirect Impacts

Indirect economic impacts would be similar to those identified for the Proposed Action. However, this alternative would reduce the allowable amount of material that could be extracted annually from the river under the Proposed Action. The lower annual rate of extraction would most likely reduce the potential rate of bed degradation and could affect how rapidly, or if, 2 feet of degradation could occur in some reaches. However, the Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet below the 1992 baseline elevations established for that reach, will be closed to further dredging. Therefore, based on the regulatory restrictions imposed on Kansas River dredging by the USACE, the indirect impact on the economy due to riverbed degradation, channel bank instability, and infrastructure loss is not anticipated to be substantially lower for the Reduced Limit Alternative than for the Proposed Action.

At a regional level within the primary market area, these indirect impact effects would be minor, would be distributed across the population generally, and are not expected to disproportionately impact low-income populations. Therefore, no adverse environmental justice impacts are anticipated.

3.6 WATER RESOURCES

3.6.1 Affected Environment

Water resources include both surface and groundwater (water supply) with water quality being the primary concern for environmental impacts. Water supply and water quality are discussed collectively as water resources.

3.6.1.1 Water Supply

The Kansas River valley is a primary source of drinking water for approximately 800,000 people in northeast Kansas (USGS, 2011). Groundwater is the primary source for water use in the basin, accounting for more than 53 percent of the total supply. There are five federal reservoirs in the Kansas-Lower Republican basin. Four of these, Milford, Tuttle Creek, Perry and Clinton are operated by the USACE for multiple purposes. Milford, Tuttle Creek, Perry and Clinton are used for public water supply programs that serve numerous cities and rural water districts in the basin, primarily in the rapidly growing urbanized communities within the Kansas River corridor (KWO, 2009). The fifth, Lovewell Reservoir, is operated by the USBR, and is used primarily for irrigation.

Groundwater is available, to varying extent, throughout the Kansas-Lower Republican basin and is mainly located in three aquifers, which include the Dakota Aquifer, Glacial Drift Aquifer and Alluvial Aquifer. The alluvial aquifer occupies the valleys of the Kansas, Republican and Blue Rivers, and some tributaries. The major cause of Kansas groundwater elevation declines is intense use of groundwater resources. Approximately 84 percent of the groundwater pumped each year is used for irrigation purposes. In some areas, decades of irrigation pumping has lowered groundwater levels more than 200 feet, although most areas are considerably less. The combination of intense pumping and several years of below-normal precipitation can accelerate the downward trend in water table elevations. This is a typical response since below-normal precipitation can be expected to result in decreased groundwater recharge. More importantly, below-normal precipitation generally results in increased groundwater pumping (Sophocleous, 1989).

Most of the approximately 190 public water suppliers in the basin use groundwater as a source of supply. Local municipalities and water districts utilize well fields located in the floodplain as well as surface water intakes located in the Kansas River to obtain raw water for treatment and distribution. There are currently ten active water supply systems that utilize the Kansas River or the associated alluvial aquifer (Kansas Department of Agriculture - Division of Water Resources, 2006). These systems include:

- WaterOne: WaterOne has a surface water supply intake located along the right descending bank of the Kansas River at RM 15. The water intake on the river is aided by a weir (coffer dam) constructed across the river to divert water to the intake unit. WaterOne also has 21 water supply wells located in the floodplain of the Kansas River between RMs 13 and 14. WaterOne serves over 400,000 people, primarily within Johnson County, KS.
- City of Bonner Springs: The City of Bonner Springs has five water supply wells located between RMs 19.4 and 20.15. The wells draw water from the Kansas River alluvial aquifer. Additional water demands are met by the City through agreements with the Kansas City (Kansas) Board of Public Utilities. The City of Bonner Springs provides service to approximately 7,500 residents.
- City of Olathe: The Kansas River is the sole source of raw water supply for the city of Olathe. The City operates eight vertical water wells and four radial collector wells located in the floodplain of the Kansas River between RMs 25.7 and 31.7. A fifth radial collector well has been planned by the City but has not yet been constructed. Based on demand modeling, the radial collector field is anticipated to go into service by 2017. The City of Olathe serves approximately 127,000 residents.
- City of Eudora: The Kansas River is the sole source of raw water supply for the city of Eudora. The City has four water supply wells located in the Kansas River floodplain that draw water from the alluvial aquifer. The wells are located between RMs 44 and 45. The City serves approximately 6,200 residents.
- City of Lawrence: The City of Lawrence has a surface water supply intake located on the right descending bank of the Kansas River immediately upstream of Bowersock Dam near RM 52. The backwater created by the dam maintains relatively constant stage levels, which provides a reliable water supply to the intake structure. The City also operates six water supply wells, which are located in the alluvial aquifer along the riverbanks. Clinton Reservoir is an additional source of water supply for the City. The City serves approximately 89,000 residents.

- City of Lecompton: The Kansas River is the sole source of raw water supply for the city of Lecompton. The City has two water supply wells located in the Kansas River floodplain that draw water from the alluvial aquifer. The wells are located northwest of the City between RMs 63 and 64.
- City of Topeka: The city of Topeka uses the Kansas River as its sole source of raw water supply for the community as well as for the sale of water to surrounding rural water districts, which serve customers located in Shawnee, Jackson, Wabaunsee, Osage, Douglas and Jefferson Counties. The City has two water supply intakes located on the right descending bank of the Kansas River near RM 87.0. The intakes are aided by a weir (coffer dam) constructed across the river to divert water to the intake units. The estimated total number of people served by Topeka is approximately 175,000, plus commercial, industrial and public agencies.
- City of St. Marys: The City of St. Marys has three water supply wells located in the Kansas River alluvial aquifer. The City serves approximately 2,800 residents.
- City of Wamego: The City of Wamego has four water supply wells located within the Kansas River alluvial aquifer. The City also maintains a fifth well located outside the Kansas River valley, which serves as a secondary water supply source. The City of Wamego serves approximately 2,000 residents in the city and a small number of homes outside the city limit.
- City of Manhattan: The City of Manhattan has water supply wells located near the confluence of the Kansas River and the Big Blue River, on the east side of the city. The wells draw water from the Kansas River alluvial aquiver. The City of Manhattan serves approximately 54,000 residents.

The majority of the water collection wells utilized by the municipal water departments discussed above are located within the alluvial aquifer in the floodplain adjacent to the Kansas River. A secondary well system (radial collector wells) is primarily used by the city of Olathe. Radial collector wells consist of horizontal screens that are placed in the alluvial aquifer directly beneath the river channel. Radial collector wells typically have the horizontal screens installed approximately 20 to 25 feet below the river bed. The advantage of these wells is that they are capable of producing five to ten times the volume of water produced by vertical wells.

Both of the well types discussed above (vertical and radial collector) are considered riverbank infiltration wells, which obtain the bulk of their water by inducing infiltration of water through the sand and gravel in the riverbed or the floodplain aquifer. Utilization of infiltration through the riverbed aides in the removal of particulates and organic compounds from surface waters as the water progresses through the riverbed and into the underlying sand layer.

The Kansas River and wells in the river valley are also used as a source of cooling water for three power plants operated by Westar Energy. These plants include the 1875 MW Jeffery Energy Center, the 242 MW Tecumseh Energy Center, and the 600 MW Lawrence Energy Center. In addition to the municipal users and energy centers mentioned above, other water rights users are located along the Kansas River that rely on raw water supplies from the river or the adjacent alluvial aquifer for such uses as agricultural irrigation and small quantities of potable water. The Sunflower Army Ammunition Plant was historically an important water rights entity on the river due to the National Security priority given to the Plant. The Sunflower Plant's raw water intake and an associated jetty located at RM 32.9 are no longer in use. The Sunflower Plant has been deactivated and the Government property has been sold and transferred into private ownership.

3.6.1.2 Water Quality

Water-quality issues in the lower Kansas River basin are dominated by non-point sources for contamination from agricultural land. Water-quality issues include: 1) large sediment discharges into streams and sediment deposition in reservoirs caused by intensive cultivation of row crops and subsequent erosion; 2) pesticides washed into streams and reservoirs that could affect aquatic life and impair raw public water supplies, including both surface and groundwater sources; 3) bacterial contamination to surface water and groundwater caused by runoff from pastureland and feedlot operations, and municipal wastewater discharges; and 4) nutrient enrichment in reservoirs (USGS, 1987). Water-quality issues in the lower Kansas River basin are primarily related to land-use practices with agricultural being the dominant factor; however, industrial and residential land uses also impact water quality in the Kansas River and the adjacent alluvial aquifer.

Modern agricultural practices include intensive cultivation, and the application of pesticides and fertilizers to the land. Runoff from agricultural land contributes sediment, pesticides, and other organic compounds and nutrients to river systems, reservoirs, and groundwater sources. Reservoir management can affect channel geometry and, therefore, erosion and sediment transport, which in turn have an effect on the transport of contaminants that are attached to sediment. Sediment further serves as a vehicle for the transport of phosphorus, ammonia, organic nitrogen, organic carbon, and sparingly soluble pesticides. The transport of these constituents associated with sediment discharge is viewed by state and federal agencies as an important water-quality issue in the basin (USGS, 1987).

The Kansas Department of Health and Environment (KDHE) is responsible for monitoring and reporting water-quality impaired waters in accordance with the requirements of the 1972 amendments to the Federal CWA. As an example of KDHE's annul reporting, in 1998 Kansas had 1,108 water bodies identified as water-quality impaired on the section 303(d) list. Of those water bodies, 136 sites were located in the Kansas River basin. Most impairment in the Kansas River basin was caused by excessive levels of nutrients, bacteria, and sediment (KDHE, 1998). Similarly, the 2004 section 303(d) list also included impairments related to nutrients, bacteria, and sediment for those impaired waters within the Kansas River basin (KDHE, 2004a). Nutrient enrichment has been identified as one of the leading causes of impairment for rivers and streams in Kansas (KDHE, 2002).

In July 1999, the USGS and KDHE, with assistance from the USEPA, began a cooperative effort to describe water quality in the lower Kansas River basin. The study found that the mean streamflow rate for the Kansas River at DeSoto (station 06892350, which is the most downstream monitoring location on the Kansas River) for the period October 1, 1999 through September 30, 2003 was approximately 6,500 cfs. That number is slightly less than the historic mean of approximately 7,400 cfs, based on data collected from 1918 to 2003 (Putnam & Schneider, 2004). Of the total flow at DeSoto during the 5-year period addressed in the USGS and KDHE study (1999–2003), the largest contribution to stream flow (29 percent) came from the Big Blue River as discharge from Tuttle Creek Reservoir. The next largest flow contribution (18 percent) came from the Smoky Hill River. The Delaware River downstream from Perry Reservoir contributed 10 percent, the Republican River downstream from Milford Reservoir contributed eight percent, and the Wakarusa River downstream from Clinton Reservoir contributed 4 percent of the stream flow at DeSoto. The remaining 31 percent came from combined miscellaneous sources including Vermillion, Mill, Soldier, and Stranger Creeks; direct rainfall and runoff; and groundwater contributions.

Reservoirs typically change stream flow regimes by reducing the magnitude of peak flows and increasing the magnitude of low flows (Williams & Wolman, 1984). The transport of constituents (nutrients, bacteria, or sediments) through reservoir controlled river systems is affected by the interaction between the inflowing water and the chemical processes occurring within the reservoir (Thornton, Kimmel, & Payne, 1990). Reservoirs serve as repositories, or sinks, for contaminants such as nutrients, pesticides, and sediment-associated contaminants (USEPA, 1984; Humenick, Smolen, & Dressing, 1987). Although most of the sediment entering reservoirs is permanently trapped and deposited on the bottom, chemicals such as soluble herbicides remain in the water column and are stored temporarily until flushed from the reservoir, which results in smaller peak concentrations that can persist for much longer periods (Stamer, Battaglin, & Goolsby, 1998).

Although urban development represents a very small fraction of the total basin land use, major urban and industrial areas are located along the river at Manhattan, Topeka, Lawrence, and Kansas City, Kansas. All of these cities, in addition to many smaller communities, use water from the Kansas River or the adjacent alluvial aquifer for municipal water supply. Potential point sources of contamination in the Kansas River basin upstream from DeSoto include 30 municipal and industrial wastewater discharges, 22 of which are downstream from Manhattan and have a combined design outflow of 90 MGD (139 cfs), and eight large confined animal livestock operations (poultry, swine, and beef). Potential nonpoint sources of contamination include agricultural and urban runoff and seepage from onsite waste systems (septic systems). Both point and nonpoint sources can contribute nutrients, bacteria, sediment, and other constituents to the river that either become suspended in the water column or bind themselves to the sediment material carried by the river.

3.6.1.3 Water-Quality Standards

The CWA of 1972 established the foundation for all states to develop water-quality protection programs (USEPA, 2013a). Water-quality standards, which include designated uses, water-quality criteria, and anti-degradation requirements, are established by states and approved by the USEPA. Water-quality criteria are developed to protect the designated uses and can be either numeric or narrative.

The CWA requires that states establish total maximum daily loads (TMDLs) to meet water-quality criteria and to protect designated beneficial uses for each water body (KDHE, 2004b). A TMDL is the maximum quantity of a contaminant that a water body can receive and meet water-quality criteria. Because of its importance for municipal water supply, recreation, and aquatic-life support, the Kansas River basin was selected as the state's first priority among 12 major river basins for the development and implementation of TMDLs (KDHE, 2004c). Section 303(d) of the CWA requires states to identify all water bodies where state water quality standards are not being met. The most recent 303(d) list for the State of Kansas was published in 2012, and can be found on the KDHE website: http://www.kdheks.gov/tmdl/2012/303d_List_Long.pdf.

Any activity requiring a DA permit under Section 404 of the CWA for the discharge of dredged or fill material into waters of the United States should be reviewed by the state for issuance of a Section 401 water quality certification. However, as explained in Chapter 1, Section 1.2, return water discharged from onshore processing plants of commercial sand and gravel dredging operations is considered a point source discharge subject to regulation under authority of Section 402 of the CWA, not under Section 401. The USEPA has delegated to the KDHE the authority and responsibility to regulate water quality under both Sections 401 and 402 but the KDHE has historically chosen to not regulate the discharge from onshore processing plants associated with Kansas River dredging operations.

No federal legislation regarding groundwater quality has been enacted that is as comprehensive as the CWA; however, federal legislation of significance related to groundwater includes the Resource Conservation and Recovery Act of 1976, the associated Comprehensive Environmental Response, Compensation and Liability Act of 1980; and the Superfund Amendments and Reauthorization Act of 1986. Each of these Acts addresses solid and hazardous wastes, and storage tanks and their influence or impact to groundwater. In addition, the Safe Drinking Water Act was amended in 1996, focusing on the need for source water assessments of public water systems that treat raw water. Sources of raw water may be either surface water or groundwater. These assessments are used to identify potential sources of water contaminants in drinking water. Finally, the USEPA published the Groundwater Rule on November 8, 2006. The purpose of the Groundwater Rule is to provide increased protection against microbial pathogens, specifically bacterial and viral pathogens, in public water systems that use groundwater. The Groundwater Rule establishes a risk-targeted approach to identify public water systems that are susceptible to contamination. Systems determined to be at risk for microbial contamination must take corrective action to protect consumers from harmful bacteria and viruses.

3.6.1.4 Previous Studies

The Kansas River, because of its historical, ecological and economic value, has been the subject of a number of studies for a variety of purposes. Studies have evaluated water-quality conditions and trends, flooding characteristics, geomorphology, effects of dredging, and the effects of urbanization (Jordan and Stamer, 1995; Pope, 1995; Helgesen, 1996; Rasmussen, Ziegler, and Rasmussen, 2005). Water-quality studies have investigated dissolved solids, major ions, nutrients, metals and trace elements, radioactivity, pesticides, bacteria, biological indicators including macroinvertebrates and fish, and sediment. One of the most comprehensive ongoing water-quality studies began in 1986 as part of the USGS National Water-Quality Assessment Program, which resulted in a series of reports.

A summary of significant findings from previous water-quality studies is provided below:

- Commercial dredging had little effect on water-quality constituents and plankton composition; however, the effects on benthic invertebrates and fish populations, caused by habitat transformation, were significant (Cross and DeNoyelles, 1982).
- Prior to 1990, commercial dredging activities on the Kansas River had been a major factor affecting riverbed degradation, bank erosion, channel widening, natural resource losses, and damages to non-dredging interests in and along the downstream part of the river (USACE, 1990a). Due to these prevailing conditions, in 1990 and 1991 the USACE implemented restrictions for commercial sand and gravel operations on the Kansas River to limit the effects of dredging to an acceptable level that would aid in sustaining the resources of the Kansas River (USACE, 1990b).
- Large sediment yields (soil inputs) from surface runoff occur due to erodible soils, row-crop production, and excessive precipitation (Jordon and Stamer, 1995).
- The most severe dissolved oxygen deficiencies (concentrations less than 5.0 milligrams per liter [mg/L]) were caused by wastewater-treatment discharges into tributaries that contribute to the Kansas River (Pope, 1995).
- Concentrations of dissolved solids commonly exceeded 500 mg/L, primarily due to inflow of water from the Smoky Hill River. The Smoky Hill River contributed large

concentrations of sodium and chloride ions to the Kansas River as a result of groundwater discharge from the underlying aquifer (Jordan and Stamer, 1995; Helgesen, 1996). However, although still exceeding concentrations of 500 mg/L and based on real-time water quality measurements taken by the USGS station at De Soto, Kansas, dissolved solids concentrations, on average, have been decreasing since 2013: 773 mg/L in 2013, 741 mg/L in 2014, 664 mg/L in 2015, and 402 mg/L year-to-date in August 2016 (USGS, 2016).

- Nonpoint source contributions to the Kansas River have accounted for more than 97 percent of the bacteria load in the Kansas River. One of the bacterial contributions includes *Escherichia coli.* Escherichia coli concentrations can be reliably estimated from historical fecal coliform bacteria. Further, turbidity within a water source can act as a reliable surrogate for *Escherichia coli* bacteria (Rasmussen, Ziegler, and Rasmussen, 2005).

3.6.2 Environmental Consequences

Environmental consequences associated with impacts to water resources are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.6.2.1 Proposed Action

Direct Impacts

WATER SUPPLY

Direct impacts to water supplies could occur as a result of damage to intake facilities due to inadvertent contact with dredging equipment. Direct impacts could also occur to horizontal collector wells in the riverbed due to inadvertent contact with a dredge suction-line boom. However, because the USACE's Regulatory Plan contains restrictions excluding dredging within 500 feet of any water intake structure or an associated weir or diversion jetty, direct impacts to water supplies are not anticipated to be more than minimal.

WATER QUALITY

Direct impacts to water quality could occur as a result of processing plant dredge return water discharges back to the river and from the suspension of riverbed materials into the water column due to agitation of the riverbed by the dredge suction-head. The USACE's permit Special Conditions require that each processing plant route dredge return water through a siltation basin to remove suspended solids prior to reintroduction of the water to the river. River bed materials disturbed by the dredge suction-head could become suspended in the surrounding water column and be transported to downstream areas. However, the entrainment of dredged material by the suction-head is highly efficient and only a small fraction of the disturbed bed materials is likely to escape entrainment. A study completed by scientists at the University of Kansas, Division of Biological Sciences entitled, "*Report on the Impacts of Commercial Dredging on the Fishery of the Lower Kansas River,*" concluded that increased suspended solids from dredge operations are not detectable at points 200 meters (approximately 650 feet) downstream of the operating dredge (Cross and DeNoyelles, 1982). Similarly, the USACE study completed in 1990 as part of the Riverside Levee project determined that suspended solid concentrations below dredging operations on the Missouri River near the confluence of the Kansas and Missouri Rivers would return to background concentrations within approximately 1,300 feet (USACE, 1990c).

Direct impacts to water quality could also result from the temporary re-suspension of contaminants located in pore water (water contained in the spaces between sediment particles). The Kansas River is primarily a sand bed system with limited silts or fine clays; therefore, pore water is located within the spaces between the sand particles that make up the majority of the riverbed. The USACE, (1990c), determined that dredging in sand bed sediments would not release significant levels of contaminants. The USACE also determined that in those areas near dredging activities where contaminant levels could increase, the mixing effect within the river would quickly reduce any elevated concentrations to background levels (USACE, 1990c). Therefore, direct impacts to water quality would be localized (near dredging activities) and are not anticipated to be more than minimal.

Indirect Impacts

WATER SUPPLY

Indirect impacts to water supplies could include changes in alluvial aquifer water levels or Kansas River stage levels resulting from bed degradation. Lower bed elevations could have a potential to destabilize some water intake structures through slumping or sliding of the structure as a result of riverbank failure. Lower bed elevations also have a potential to lower stage levels, which could influence the ability of intake structures to collect water during low flows and could reduce pumping efficiency by reducing the hydraulic head for surface and groundwater intake structures. Sediment deposition downstream of dredging activities could alter the composition of the bed (a shift to finer materials) near well fields. These areas of deposition would most likely be scoured during high-flow events, but could have a temporary impact on the porosity and hydraulic conductivity of the bed. A reduction in the hydraulic conductivity through the riverbed could affect the efficiency of the alluvial aquifer to supply water to collector wells. Based on the primary compliance criteria contained in the USACE's Regulatory Plan, which limits riverbed degradation to an average of 2 feet below the 1992 baseline elevations for any 5-mile-long reach of river and excludes dredging near sensitive infrastructure, indirect impacts to water supplies are not anticipated to be more than minimal.

WATER QUALITY

Water quality impacts are expected to be low due to the limited zone of influence downstream of a dredging operation and due to the fact that sand bed systems do not bind contaminants in the same manner as do silt or clay based systems. Contaminants within a sand bed system are primarily suspended in the water column (not bound to the substrate). Therefore, dredging in a sand bed system does not have as much potential to release large amounts of contaminants into the water column as does dredging in a silt or clay based system. Because of this, indirect impacts to water quality are not anticipated to be more than minimal.

3.6.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. This action in and of itself will not have any impact on water supply or quality. However, the No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative include Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations. The potential impacts of these alternative sources of sand and gravel on water supply and quality are discussed below.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

WATER SUPPLY

No direct impacts to water supplies are anticipated. A recent hydrogeologic study regarding the proposed Penny's Concrete and Sand LLC floodplain pit dredging site in Douglas County, Kansas (Conestoga-Rovers & Associates, 2013) concluded that operation of the proposed pit is not anticipated to have any appreciable or unacceptable effect on the City of Eudora's municipal water supply wells, private water supply wells, or the Kansas River. Although this study is site specific, floodplain pit mining sites are not generally expected to influence water supplies; however, individual sites can vary including the hydrogeologic conditions associated with any particular location along the floodplain.

WATER QUALITY

Water exposed during floodplain pit dredging is essentially groundwater that becomes exposed to the surface during land-disturbing activities, removal of overburden, and dredging. The water contained in the lagoon formed by these operations is therefore connected to the alluvial aquifer. Any runoff of contaminated material, such as fuel, lubricants, or other chemicals, could contaminate groundwater resources. Due to the porosity of floodplain soils, groundwater would flow laterally through dredge pits. Therefore, if contamination occurred in a dredge pit, it could potentially impact water quality in adjacent well fields. Significant potential sources of contamination appear limited and would most likely be related to spills of fuels and lubricants into the dredge pit as a consequence of dredging operations. Reclamation activities would also have a potential to contaminate groundwater supplies. However, it is assumed that reclamation requirements and oversight would strictly control potential groundwater contamination associated with reclamation activities. Direct impacts to water quality are not anticipated to be more than minimal.

Indirect Impacts

WATER SUPPLY

No indirect impacts to groundwater supply are anticipated to occur as a result of spills of materials such as oils or fuels due to the anticipated small quantities of these easily absorbed and/or evaporated contaminants combined with available filtering techniques.

WATER QUALITY

Indirect impacts to groundwater quality could occur as a result of spills of contaminants, such as fuels and lubricants, onto plant site soils. Due to the porosity of floodplain soils, spills onto land surfaces could result in leaching of contaminants into the ground over time, which could contaminate groundwater quality at adjacent well fields. In addition, spills of contaminated materials on the plant site could be carried into surface waters by stormwater runoff, which could contaminate water quality in adjacent tributaries and the Kansas River. Due to controls implemented at pit mining sites, as part of the Spill Prevention Control and Countermeasure Plan developed as part of the site's Operation and Maintenance Plan, indirect impacts to surface water and groundwater quality are not anticipated to be more than minimal.

Crushed Limestone from Quarry Operations

Direct Impacts

WATER SUPPLY

No direct impacts to water supplies are anticipated.

WATER QUALITY

No direct impacts to water quality are anticipated.

Indirect Impacts

WATER SUPPLY

No indirect impacts to water supplies are anticipated.

WATER QUALITY

Indirect impacts to water quality could occur as a result of land surface contamination at quarry operations. Limestone quarries are typically located in bedrock that has limited permeability; therefore, the potential for contaminants to leach through the rock and into groundwater is low. However, spills of contaminated materials on the plant site could be carried into surface waters by stormwater runoff, which could contaminate water quality in adjacent tributaries and the Kansas River. Significant potential sources of contamination are limited and would most likely be related to fuel and lubricant spills associated with equipment operation. Indirect impacts to water quality are not anticipated to be more than minimal.

3.6.2.3 Reduced Limit Alternative

Direct Impacts

WATER SUPPLY

Direct impacts to water supplies would be similar to those identified for the Proposed Action.

WATER QUALITY

Direct impacts to water quality would be similar to those identified for the Proposed Action.

Indirect Impacts

WATER SUPPLY

Indirect impacts to water supplies would be similar to those identified for the Proposed Action. However, this alternative would reduce the allowable amount of material that could be extracted annually from the river to nearly half of the amount requested under the Proposed Action (1,670,000 tons versus 3,150,000 tons). The lower annual rate of extraction would be likely to reduce the potential rate of riverbed degradation and could affect how rapidly, or if, 2 feet of degradation could occur in some reaches. The Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet, below the 1992 baseline elevations established for that reach, will be closed to further dredging. Therefore, based on the regulatory restrictions imposed on dredging activities by the USACE, selection of The Reduced Limit Alternative would not be likely to result in substantially reduced impacts to water supply relative to the Proposed Action. Indirect impacts to water supplies are not anticipated to be more than minimal.

WATER QUALITY

Indirect impacts to water quality would be similar to those identified for the Proposed Action.

3.7 RECREATION

This section first describes and then evaluates potential effects on recreational resources related to the Proposed Action and alternatives (No Action Alternative and Reduced Limit Alternative). Dredging along the Kansas River is a historical and ongoing activity. Therefore, recreational impacts would only occur if the Proposed Action or alternatives would result in a change in the availability or quality of recreational opportunities along the Kansas River.

This section provides an overview of the affected environment with a focus on existing recreational resources which include recreational boating access to the Kansas River; access to federal, state, or locally recognized parks and trails adjacent to the Kansas River; and access to hunting and fishing areas along the Kansas River. Analysis provided in this section also evaluates the potential direct and indirect impacts to recreational resources that could result from sand and gravel dredging activities along the length of the Kansas River (RMs 0 to 170). For example, direct impacts could include impacts of dredging facilities on boaters based on the location of dredges in the river, and indirect impacts could include impacts of dredging on park and trail resources adjacent to the river. The study area and assessment methods used in this analysis are defined below.

Study Area and Assessment Methods

This section describes the methods used to determine potential impacts to recreational resources associated with the Proposed Action and alternatives. The Kansas River is 170 miles long, beginning at the confluence of the Republican and Smokey Hill Rivers near Junction City, Kansas, and ending at its confluence with the Missouri River in Kansas City, Kansas. The recreational resources study area used for this analysis encompasses lands within a 0.25-mile buffer area (referred to herein as the study area) along the length of the Kansas River from RM 0 to 170. The study area extends 0.25 mile inland from the banks of the Kansas River. The study area was used to identify and evaluate potential direct and indirect impacts to existing and planned recreational uses on the Kansas River. The study area is shown on Figure 20.

Aerial photography, the Kansas Department of Wildlife, Parks and Tourism (KDWPT) Web site, and other relevant Web sites and databases from jurisdictions crossed by the Proposed Action were used to identify recreational resources within the study area. The USACE has been unable to identify official surveys or studies documenting boat ramp use or recreational boater trips on the Kansas River. Friends of the Kaw provided USACE with estimates of recreational boater use on the Kansas River based on their documentation of monthly paddle trip logs and sign-in sheets for the paddle events that they host (Buehler, 2015, personal communication).

For this analysis, recreational resources encompass federal, state, and local recreation areas such as wildlife refuges, scenic and historic byways, federal and state forest lands, parks, landmarks, campgrounds, hiking trails, golf courses, hunting, fishing and boating facilities, and other significant public and special interest areas.

Recreational resources listed above that are not located in the study area, which include federal and state forest lands, federal parks, and wildlife refuges are not discussed further in this section. Recreational resources that are located within the study area are described as existing resources such as boating access locations to the Kansas River, access to federal, state or locally recognized parks and trails adjacent to the Kansas River, and access to hunting and fishing areas along the Kansas River.

3.7.1 Affected Environment

The 11 counties located along the Kansas River contain approximately 41 percent of the state population (Table 12). The river, its floodplain, and adjacent lands provide a major statewide corridor for travel and commerce. The river is not only an important resource for industry and agriculture but also provides recreational opportunities to individuals both within and outside of the State of Kansas. Recreation opportunities in and along the Kansas River include hunting, fishing, hiking, canoeing, and other outdoor activities that draw people to the river. Figure 20 shows the recreational resources in the study area in relation to the location of the requested dredge areas associated with the Proposed Action.

A study completed by the Heritage Conservation and Recreation Service (abolished and absorbed by the National Park Service in 1981) indicated that the lower Kansas River (downstream of Lawrence) could be classified as a "*recreational river*" under the Wild and Scenic Rivers Act, based on the conditions that existed at the time of the study. To date, no congressional action has occurred regarding this classification.

The Kansas River was designated on July 14, 2012 as a National Waters Trail by the National Park Service's Rivers, Trails, and Conservation Assistance Program (referred to as the Kansas River Trail). The National Water Trails System is a distinctive national network of exemplary water trails. Designation of a river as a National Waters Trial provides assistance in obtaining technical resources and funding for planning and implementing water trail projects. The designation of a river as a National Waters Trail does not result in a requirement for agency coordination or permitting to authorize activities that may affect the river. The Kansas River Trail is a joint project of the National Park Service and the KDWPT. According to the KDWPT, the river "offers outstanding scenic, recreational, historic and cultural opportunities, appropriate for novice boaters and families. The river also provides areas for picnicking, wildlife viewing, fishing, and relaxing" (National Water Trail System, 2014).

3.7.1.1 Recreational Boating and Boat Access

The 1990 Kansas River Dredging EIS identified five boat launching ramps along the river. Since that time, an additional 16 boat ramps have been built, and two additional boat access ramps are also identified in this analysis (7th Street Trafficway Access and Wilder Park Canoe Access at approximately RM 4 and 15.5, respectively), creating a total of 23 boat access ramps to the Kansas River (KDWPT, 2015a). Existing boat access and proposed/former boat access locations are identified and shown on the maps to Figure 20.

Boating is considered recreating on the Kansas River Trail. Accordingly, recreationists using the Kansas River Trail are included in the analysis of direct impacts to recreational boating based on the presence of dredges and barges within the river.

Table 22 Kansas River Boat Access Locations

RM	Map Number in Figure 20	Access Name
0	1	Kaw Point Boat Access
4	1	7th Street Trafficway Boat Access
9	1	Turner Bridge Boat Access
15	1, 2	WaterOne Coffer Dam Boat Access (Blocked off since 2010)
15.5	2	Wilder Park Canoe Access
16	2	Edwardsville Boat Access
26	2	Cedar Creek Boat Access
31	2	DeSoto Boat Access
42	3	Eudora (Wakarusa River) Boat Access

Table 22 Kansas River Boat Access Locations

RM	Map Number in Figure 20	Access Name
47	3	Mud Creek Boat Access
51	4	Lawrence 8th Street Boat Access
54	4	Lawrence Riverfront Park Boat Access
64	4	Rising Sun (Perry-Lecompton) Boat Access
77	5	Topeka – Seward Boat Access
87	6	Topeka – Weir Boat Access
90	6	Topeka – Kaw River State Park Boat Access
119	8	Belvue Boat Access
128	9	Wamego Boat Access
137	9	St. George Boat Access
147	10	Manhattan Linear Park (Blue River) Boat Access
149	10	Manhattan - Fairmont Park Boat Access
163.5	11	Ogden Boat Access
173	11	Junction City Boat Access

Source: KDWPT, 2015a

Five of the 23 boat access locations listed in Table 22 are located directly adjacent to a historically requested dredge area associated with the Proposed Action. As shown on Figure 20, these five boat access locations include: Turner Bridge Boat Access (located adjacent to the dredge area requested by Kaw Valley Companies, Inc., between RM 9.4 and 10.4); Edwardsville Boat Access (located adjacent to the dredge area requested by Kaw Valley Companies, Inc., between RM 15.4 and 16.9); Cedar Creek Boat Access (located adjacent to the dredge area requested by Master's Dredging between RM 26.1 and 27.1); Topeka – Seward Boat Access (located adjacent to the dredge area requested by Builder's Choice Aggregates between RM 77.1 and 78.6); and, Topeka – Kaw River State Park Boat Access (located adjacent to the dredge area requested by LBB, LLC., between RM 89.7 and 91.0.

Recreational Boater Activity on the Kansas River

As described above under Section 3.7, the USACE has not been able to identify official surveys or studies documenting boat ramp use or recreational boater trips on the Kansas River. However, to the extent that documentation of Kansas River recreational boater use is currently available, Friends of the Kaw provided estimates of current recreational boater use based on their own documentation of monthly paddle trip logs and sign-in sheets for the paddle events that they host on the river (Buehler, 2015, personal communication).

Table 23 shows the trip schedule, section of the river floated, and number of recreational boater participants on the Kansas River between 2014 and 2015 (Buehler, 2015, personal communication). The number of participants on Kansas River paddle trips led by Friends of the Kaw increased from 234 participants in 2014 to 636 participants in 2015 (Table 23). The participants reported for each event may however represent several of the same members of the organization participating in multiple events throughout the year. Although Table 23, does not provide a complete representation of all individual recreational boater use within the study area, it provides a snap shot of recreational boating activity between 2014 and 2015. The sections of the river floated, as shown in Table 23, also provides a snapshot of boat access ramp use on the Kansas River in 2014 and 2015. The boat access ramps shown in Table 23 that are within the reach or adjacent to a requested dredge area associated with the Proposed Action include the Turning Bridge Boat Access, Edwardsville Boat Access, Cedar Creek Boat Access, and the Topeka boat access locations.

Friends of the Kaw documented participation in a total of seven recreational canoe and kayak paddle events on the Kansas River during 2015. These events included the Kawlloween Race, the Gritty, the Kawnivore, the Great Kaw Adventure Race, two fishing trips and a fishing tournament that spanned the length of the Kansas River. Approximately 545 recreationists (in addition to the participants shown in Table 23) attended these events in 2015 (Buehler, 2015, personal communication). Friends of the Kaw noted that recreational events on the River are becoming more popular and have increased in occurrence over the last several years.

Table 23 Friends of the Kaw Trip Schedule and Number of Participants (2014 and 2015)

Date	Section of the River	Number of Participants
2014		
June 8, 2014	DeSoto to Cedar Creek	45
June 25, 2014	Lower River	15
July 8, 2014	DeSoto to Cedar Creek	18
July 12, 2014	Manhattan to St. George	35
August 9, 2014	Eudora (Wakarusa River) to DeSoto	21
August 9, 2014	Topeka to Rising Sun (Perry-Lecompton)	35
September 25, 2014	Eudora (Wakarusa River) to DeSoto	13
October 5, 2014	DeSoto to Cedar Creek	33
October 8, 2014	Lower River	19
Total		**234**
2015		
April 28, 2015	DeSoto to Cedar Creek	17

Table 23 Friends of the Kaw Trip Schedule and Number of Participants (2014 and 2015)

Date	Section of the River	Number of Participants
July 26, 2015	DeSoto to Cedar Creek	8
August 1, 2015	Manhattan to St. George	101
August 2, 2015	Lawrence to Eudora (Wakarusa River)	26
August 9, 2015	Rising Sun (Perry-Lecompton) to Lawrence	34
September 5, 2015	Eudora (Wakarusa River) to DeSoto	23
September 12, 2015	Eudora (Wakarusa River) to DeSoto	12
September 13, 2015	Cedar Creek to Edwardsville	13
September 20, 2015	Rising Sun (Perry-Lecompton) to Lawrence	21
September 26, 2015	Eudora (Wakarusa River) to DeSoto	36
September 27, 2015	Turner Bridge to Kaw Point	24
September 29, 2015	Manhattan to St. George	50
October 4, 2015	Edwardsville to Turner Bridge	12
October 10, 2015	Wamego to Belvue	37
October 11, 2015	DeSoto to Cedar Creek	25
October 17, 2015	Rising Sun (Perry-Lecompton) to Lawrence	24
October 18, 2015	DeSoto to Cedar Creek	58
Total		**636**

Source: Buehler, 2015, personal communication

To ensure the safety of recreational boaters on the Kansas River, mitigation measures are identified to reduce or avoid potential impacts to the safety of recreational boaters in relation to the proposed sand and gravel dredging in the requested dredge areas of the Kansas River (see Section 5.2.4).

Proposed Boat Access Areas

Three boat access ramps are in the preliminary planning stages of development and are proposed within the study area on the Kansas River but are not developed at this time (KDWPT, 2015a). These potential boat access locations include the City of Shawnee Access at approximately RM 22, the Willard Bridge Access at approximately RM 102, and the Maple Hill Bridge Access at approximately RM 107. These potential boat access locations are shown on Figure 20. None of these proposed boat access ramps are within the reach of a requested dredge area associated with the Proposed Action.

Potential Hazards to Recreational Boaters

Identified hazards to recreational boaters on the Kansas River include but are not limited to the WaterOne Coffer Dam, the Bowersock Dam, the Low Head Dam at Tecumseh Power Plant, and Old Railroad Bridges 1 and 2 located at approximately RM 85 in Topeka, Kansas

(KDWPT, 2015b). These boating hazards are shown on Figure 20. KDWPT advises recreational boaters and paddlers to take special safety precautions when boating near these recreational hazard areas to observe water levels and reservoir releases prior to boating. These recreational hazard areas are not located within the reach or directly adjacent to the requested dredge areas associated with the Proposed Action.

3.7.1.2 Parks, Trails, and Other Recreational Resources

Recreational opportunities identified within the 0.25-mile recreation resources study area include 1 state park, 19 local parks, 1 historic site, 5 trails and associated trail systems, 2 golf courses, 1 community recreational facility for soccer, and 1 state wildlife area. These recreational resources are shown on Figure 20 and listed in Table 24 according to the name of the recreational resource, the approximate RM where located, and type of recreational resource. To remain consistent with Figure 20, Table 24 identifies the recreational resources beginning at RM 0 and moving west to RM 170.

Three of the 30 recreational resources listed in Table 24 and shown on Figure 20 are located within the study area and directly adjacent to a historically requested dredge area associated with the Proposed Action. Gary L. Haller National Recreation Trail and Miller Creek Streamway Park are located within the study area south of the dredge area requested by Kaw Valley Companies, Inc., between RM 15.4 and 16.9. Kaw River State Park is located within the study area south of the dredge area requested by LBB, LLC, between RM 89.7 and 91.0.

Table 24 Recreational Resources within 0.25 Mile of the Kansas River between River Mile 0 and 170

Approximate Location (RM)	Map Number in Figure 20	Recreational Resource	Type of Recreational Resource
0	1	Kaw Point Riverfront Park	Local Park
0	1	Lewis & Clark Historic Park at Kaw Point	Local Park
1	1	St. John's Park	Local Park
12	1	Grinter Place Museum	Historic Site
16	2	Gary L. Haller National Recreation Trail	Trails
16	2	Mill Creek Streamway Park	Local Park
30	2	Miller Memorial Park	Local Park
30	2	Burning Tree Golf Course	Golf Course
31	2	Riverfest Park	Local Park
49	3	Lawrence River Trails	Trails

Table 24 Recreational Resources within 0.25 Mile of the Kansas River between River Mile 0 and 170

Approximate Location (RM)	Map Number in Figure 20	Recreational Resource	Type of Recreational Resource
52	4	Walnut Park	Local Park
52	4	Robinson Park	Local Park
52	4	Constant Park	Local Park
52	4	Buford M. Watson Jr. Park	Local Park
53	4	Burcham Park	Local Park
56	4	Riverfront Park	Local Park
84	6	Santa Fe Park	Local Park
85	6	Veterans Park	Local Park
85	6	W. Giles Park	Local Park
85	6	Ward-Meade Park	Local Park
87	6	Auburndale Park	Local Park
88	6	Sunflower Soccer Association	Community Recreation Facility
90	6	MacLennan Park Trails & Ponds at Cedar Creek	Trails
90	6	Kaw River State Park	State Park
91	6	Kansas River Wildlife Area	State Wildlife Area
148	10	Manhattan River Trail	Trails
148	10	Manhattan Linear Park Trail	Trails
149	10	Fairmont Park	Local Park
158	10	Stagg Hill Golf Course	Golf Course
173	11	Mullins Park	Local Park

In addition to the sites addressed above, I-435 is the only scenic or historic byway that crosses the Kansas River within the study area. The portion of I-435 that crosses the Kansas River from north to south (at approximately RM 15) is referred to as the Kansas Frontier Military Byway (KDWPT, 2012). The byway crosses the Kansas River near the WaterOne Coffer Dam. The state of Kansas lists this historic byway as a point of access to military sites of historic value. However, none of the military sites of interest or scenic places along the Kansas Frontier Military Byway are located within the study area (KDWPT, 2015c).

3.7.1.3 Hunting and Fishing

KDWPT's website provides public land locations suitable for fall and spring hunting (KDWPT, 2015d). KDWPT's website also provides a fishing atlas where recreational anglers can identify the locations of KDWPT Fishing Impoundments & Stream Habitats

(FISH) properties that are open to public fishing access from March 1 through October 31 (KDWPT, 2015e). Based on a desk top analysis of the Google Earth files provided on these websites, there are no recognized fall and spring hunting sites, or FISH properties located within the study area.

The Kansas River Wildlife Area (located south and inland of the Kansas River along SW Murray Hill Road adjacent to the city limits of Topeka, Kansas) is the only listed public wildlife area where hunting is permitted in the study area (KDWPT, 2015d). Hunting in this location is managed through a special hunts program and is limited to shotgun and archery only (KDWPT, 2015d).

Information regarding access and use of specific fishing locations along the Kansas River is limited. BMPC, located at approximately RM 52.4, provides an annual Recreation Report to the FERC to maintain its FERC license for operation of the Bowersock Hydroelectric Project (Bowersock Dam) on the Kansas River. In their 2014 Recreation Report, BMPC stated that they had 2,900 annual daytime visits to the fishing deck located on the Bowersock Dam, and 300 annual nighttime visits to the fishing deck with a peak weekend average of 350 visits and a peak night time average of 25 visits to the fishing deck (Hill-Nelson, 2015, personal communication). However, the Bowersock Dam is not located near a requested dredge area and would not be impacted by dredge activities associated with the Proposed Action.

3.7.2 Environmental Consequences

Environmental consequences associated with impacts to recreation are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.7.2.1 Proposed Action

Direct Impacts

Direct impacts to recreational boaters in and along the river would include diminished recreation experiences due to noise and visual impacts and safety concerns related to boat passage around working dredges. Although noise and visual impacts are a concern for recreationists, these impacts are generally localized due to the sinuous nature of the river channel and screening by riparian vegetation. Noise and visual impacts would be limited to the period of time when recreational boaters are passing an active dredge area and would dissipate as boaters move past the requested dredge areas associated with the Proposed

Action. Furthermore, Section 3.13.2.1, shows that the incremental impacts to noise levels associated with the Proposed Action are not anticipated to be significant and concerns raised by individual receptors such as boaters could be evaluated on a case-by-case basis by federal, state, county and/or local agencies involved in permitting and agency approvals for individual dredging operations.

Recreational access to these boat access locations and passage into the river would not change under the Proposed Action. However, safety issues relating to the possibility of watercraft colliding with a dredge or its mooring cables is a serious concern. As described in Section 3.7.1.2, five of the 23 boat access locations listed in Table 22 are located directly adjacent to a requested dredge area associated with the Proposed Action. As shown on Figure 20, these five boat access locations include: Turner Bridge Boat Access, Edwardsville Boat Access, Cedar Creek Boat Access, Topeka – Seward Boat Access, and Topeka – Kaw River State Park Boat Access.

Recreational boaters entering the Kansas River at one of these five boat access locations would be more likely to encounter one of the five requested dredge operations described above due to the proximity of the dredge area to the boat access site (Figure 20). Therefore, potential conflicts between the requested dredge activities and recreational boating would be more likely to occur near these five boat access locations. All current USACE permits contain a Special Condition that requires Dredgers to coordinate with the U.S. Coast Guard to ensure safety standards for commercial operations on the Kansas River are met. The current USACE permits also contain a Special Condition that requires dredge operators to allow safe passage past dredge equipment for all boats, rafts, and other water craft. New permits would contain similar or more stringent special conditions to ensure safety. To further ensure the safety of recreational boaters on the Kansas River, mitigation measures have been identified to reduce or avoid potential impacts to the safety of recreational boaters in relation to the requested dredge areas of the Kansas River (see Section 5.2.4).

Specifically, Section 5.2.4 contains a recommendation that a new Section should be included in the Regulatory Plan to address safety issues. Four requirements have been proposed to limit the potential for dangerous conflicts between watercraft and dredges (see Section 5.2.4), the mitigation recommendations described below, and Appendix A for a

Revised Regulatory Plan). Assuming implementation of the recommended safety requirements, direct impacts to recreation are not anticipated to be significant.

Indirect Impacts

Indirect impacts associated with the Proposed Action could include impacts of dredging on park and trail resources adjacent to the river and could include increased bed degradation near public boat access locations. Indirect impacts to recreationists along parks and trails upland of the riverbanks could include diminished recreation experiences due to noise and visual impacts. Recreational access to these parks and trails would not change under the Proposed Action.

Three of the 30 recreational resources listed in Table 24 and shown on Figure 20 are located within the study area and adjacent to a requested dredge area associated with the Proposed Action. Gary L. Haller National Recreation Trail and Miller Creek Streamway Park are located within the study area south of the dredge area requested by Kaw Valley Companies, Inc., between RM 15.4 and 16.9. Kaw River State Park is located within the study area south of the dredge area requested by LBB, LLC, between RM 89.7 and 91.0.

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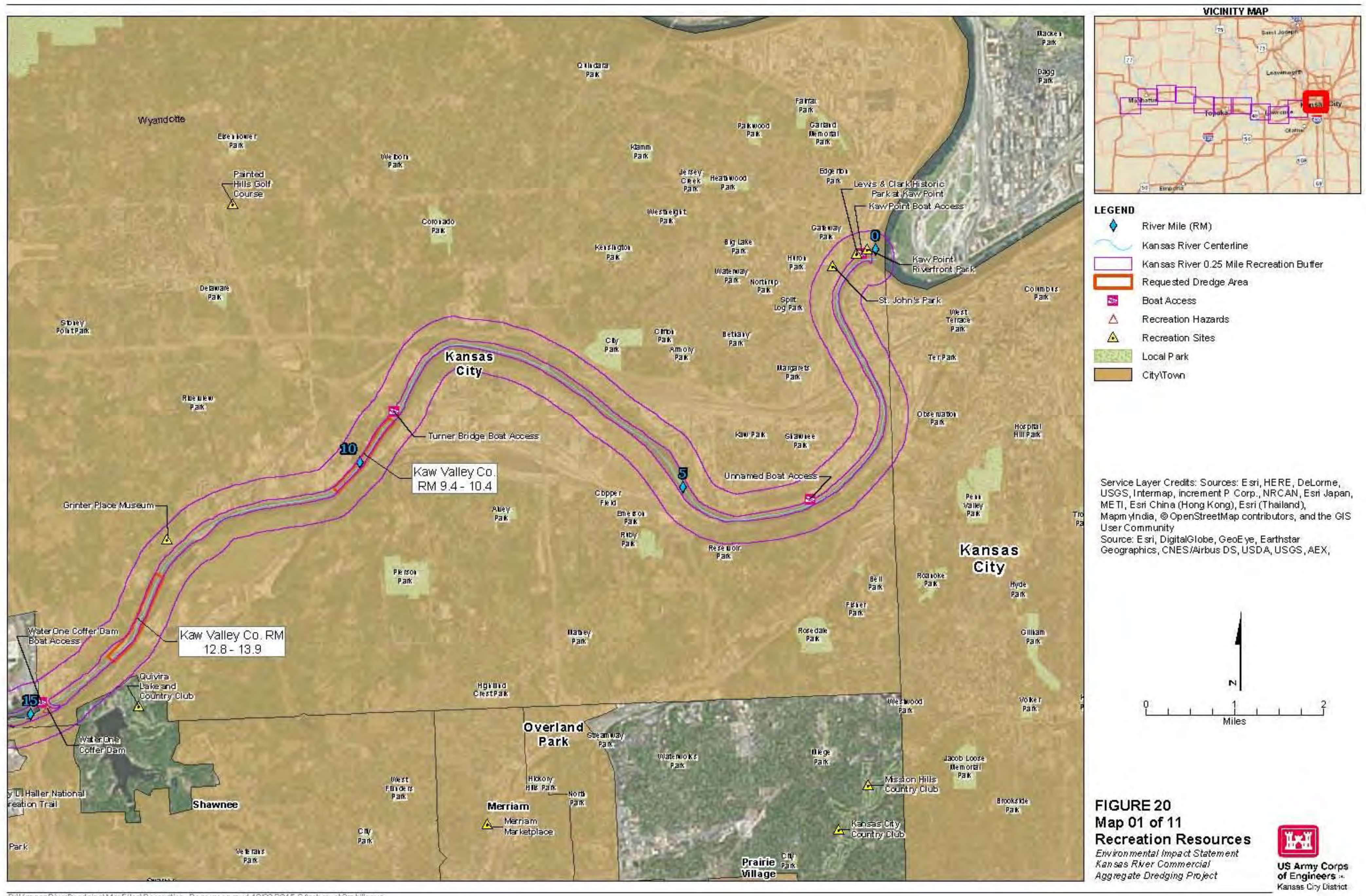

Figure 20 Recreation Resources (Map 1 of 11)

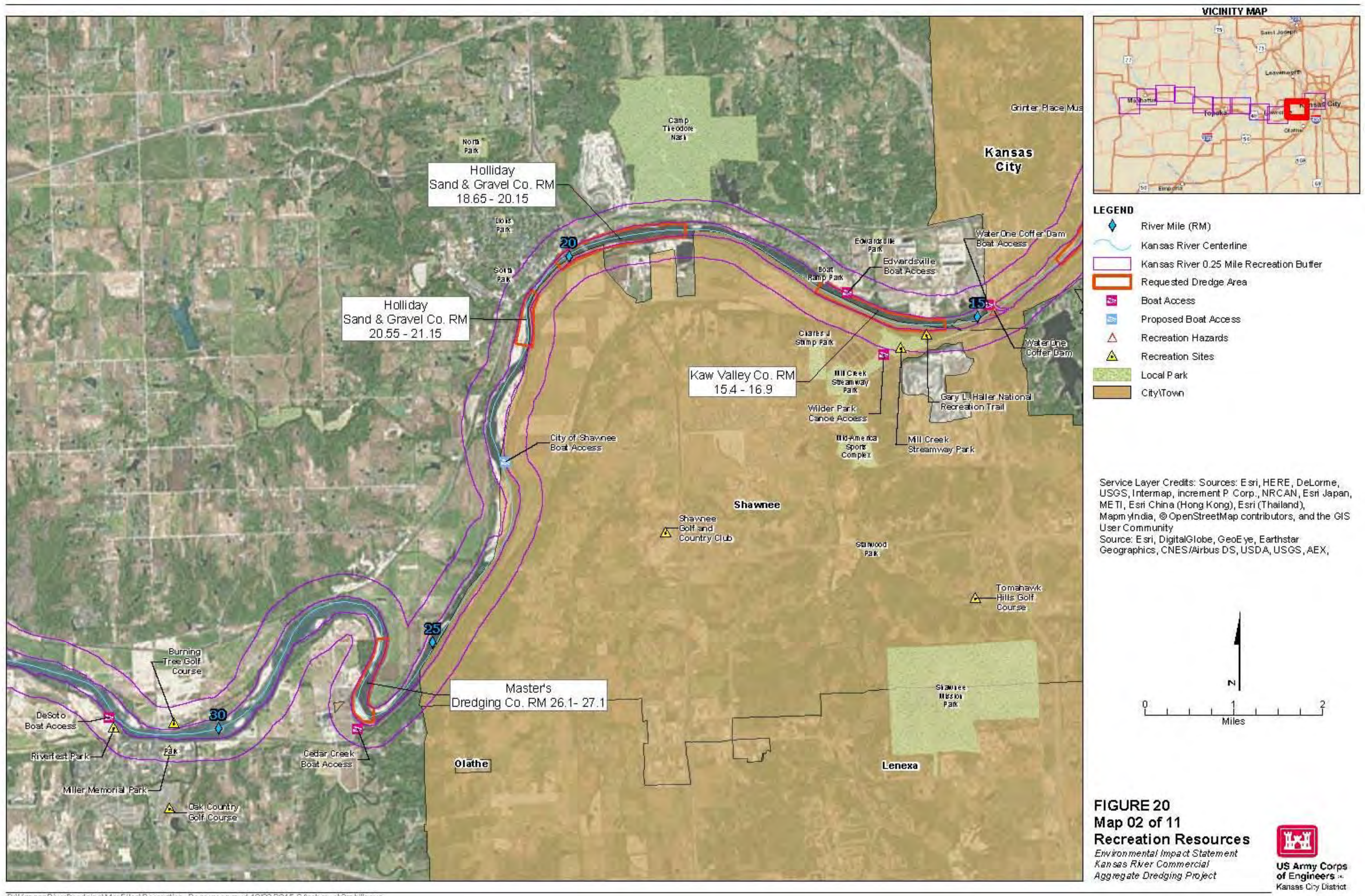

Figure 20 **Recreation Resources (Map 2 of 11)**

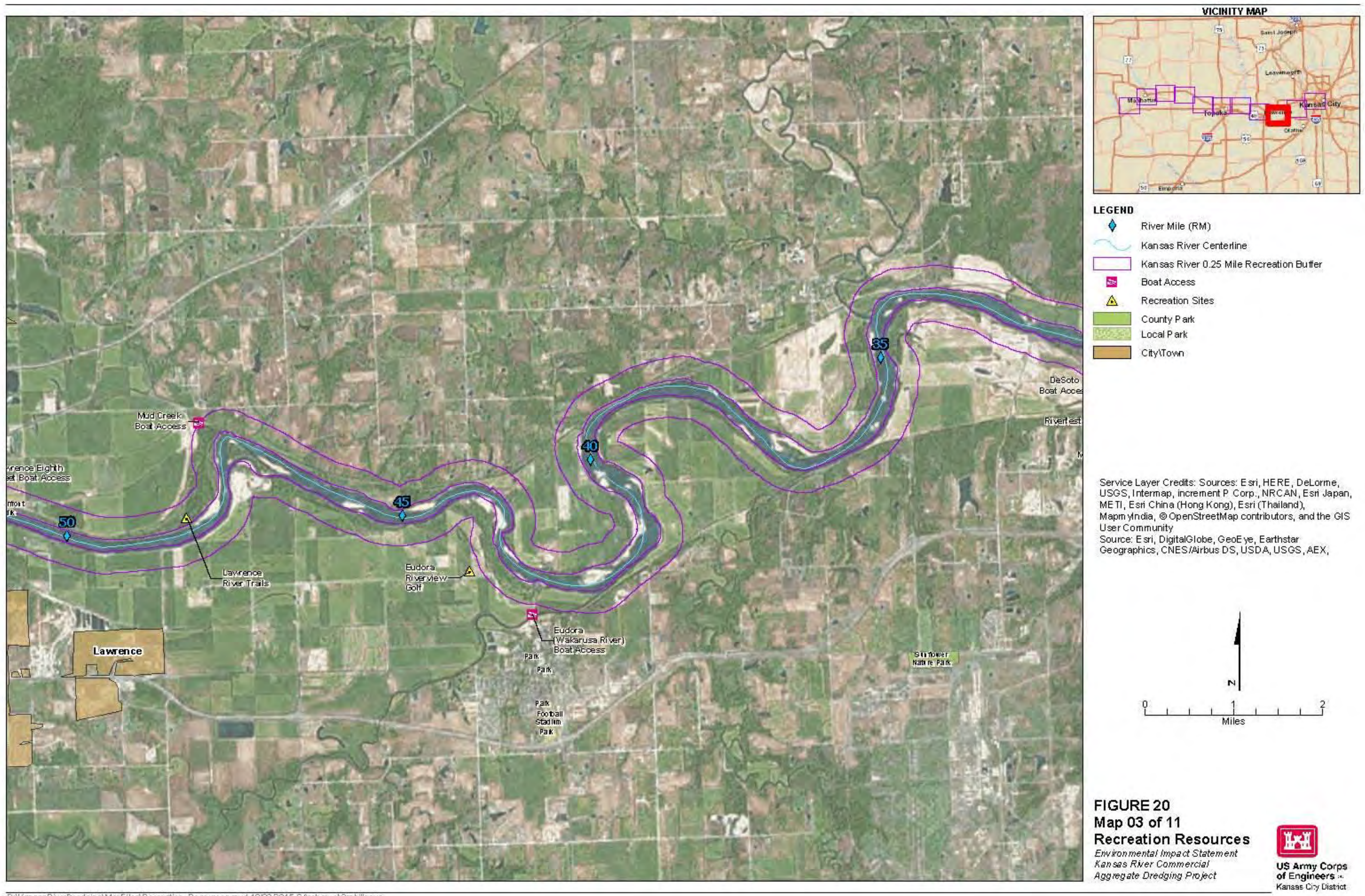

Figure 20 Recreation Resources (Map 3 of 11)

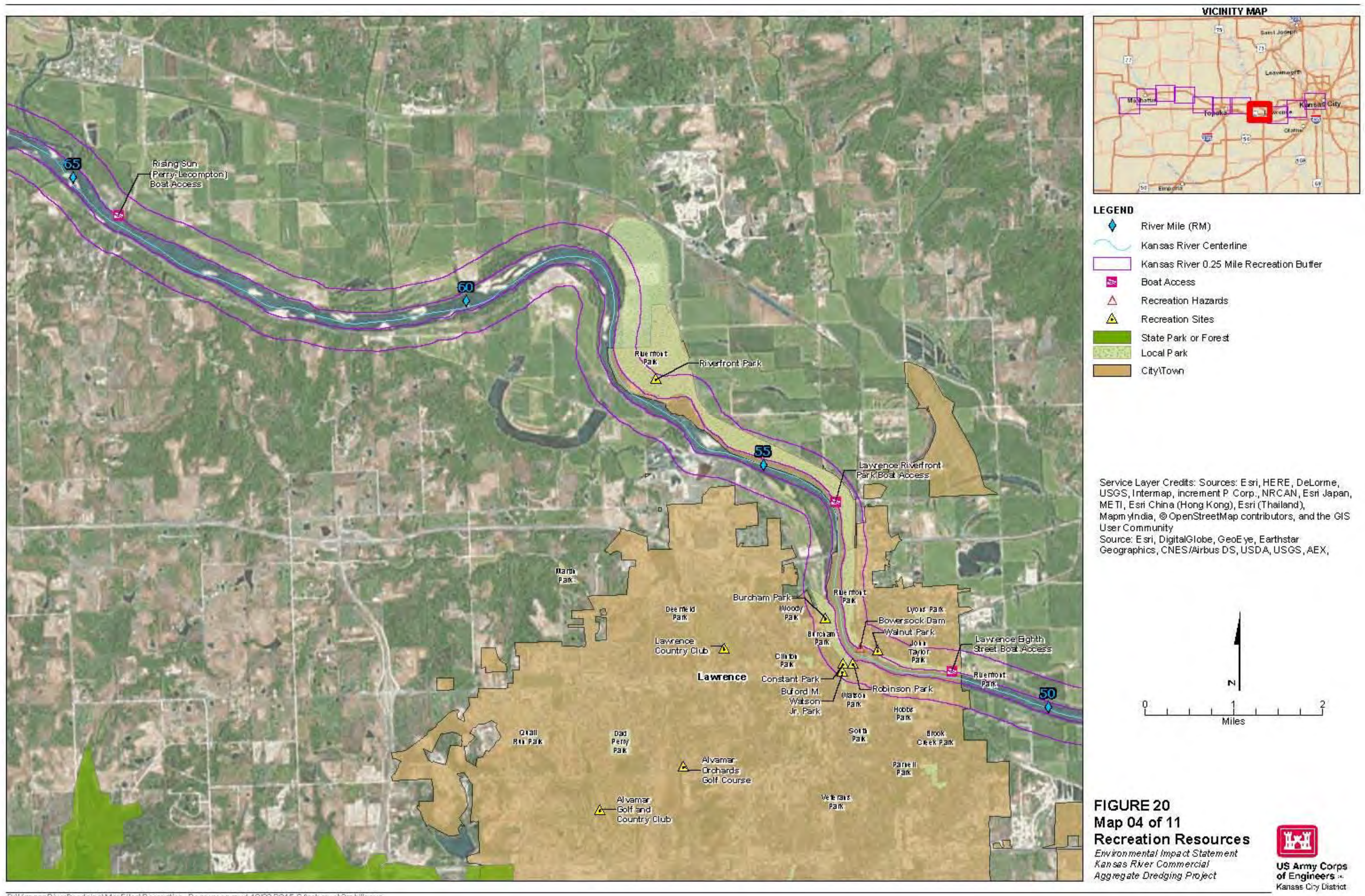

Figure 20 **Recreation Resources (Map 4 of 11)**

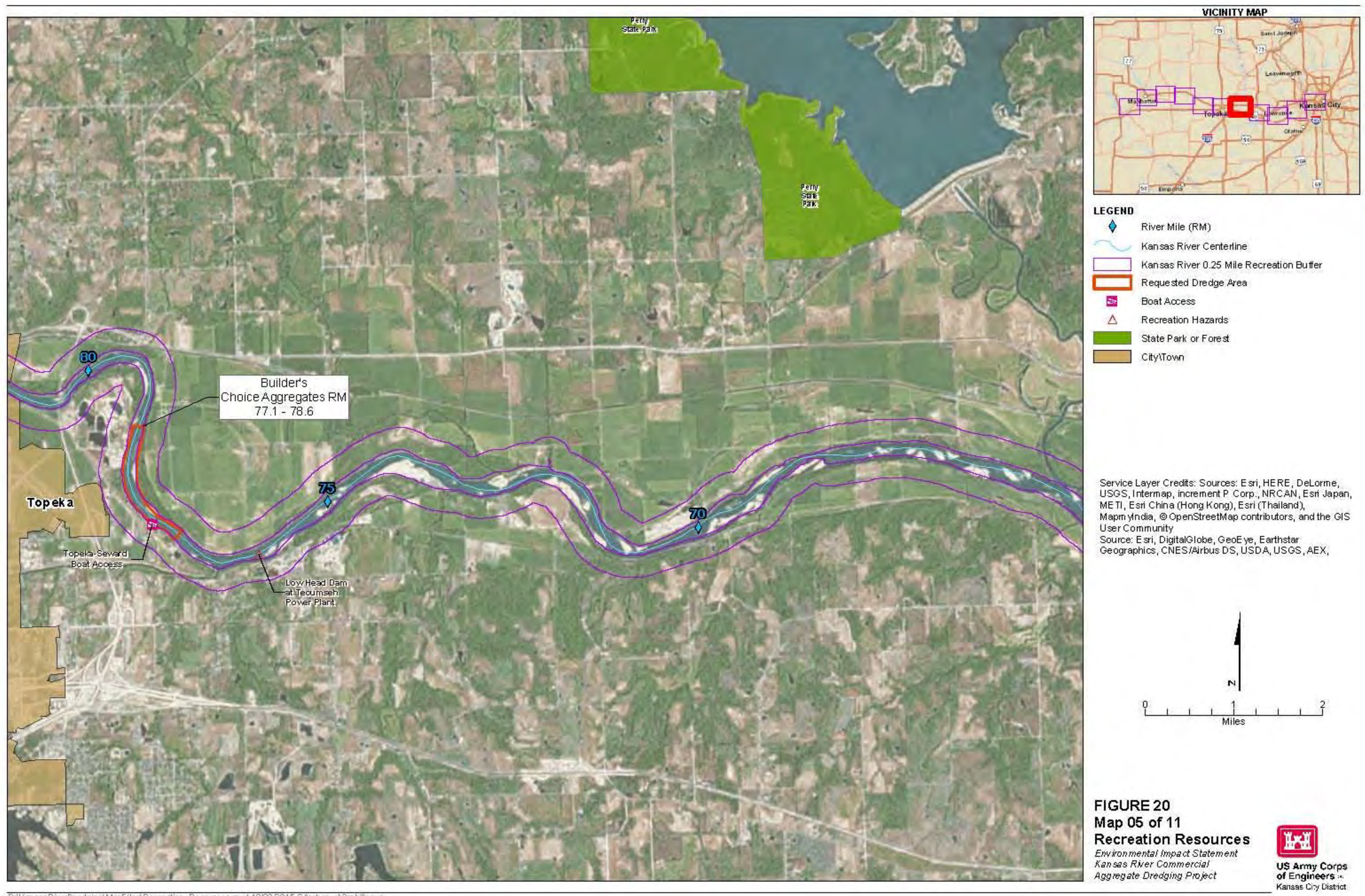

Figure 20 **Recreation Resources (Map 5 of 11)**

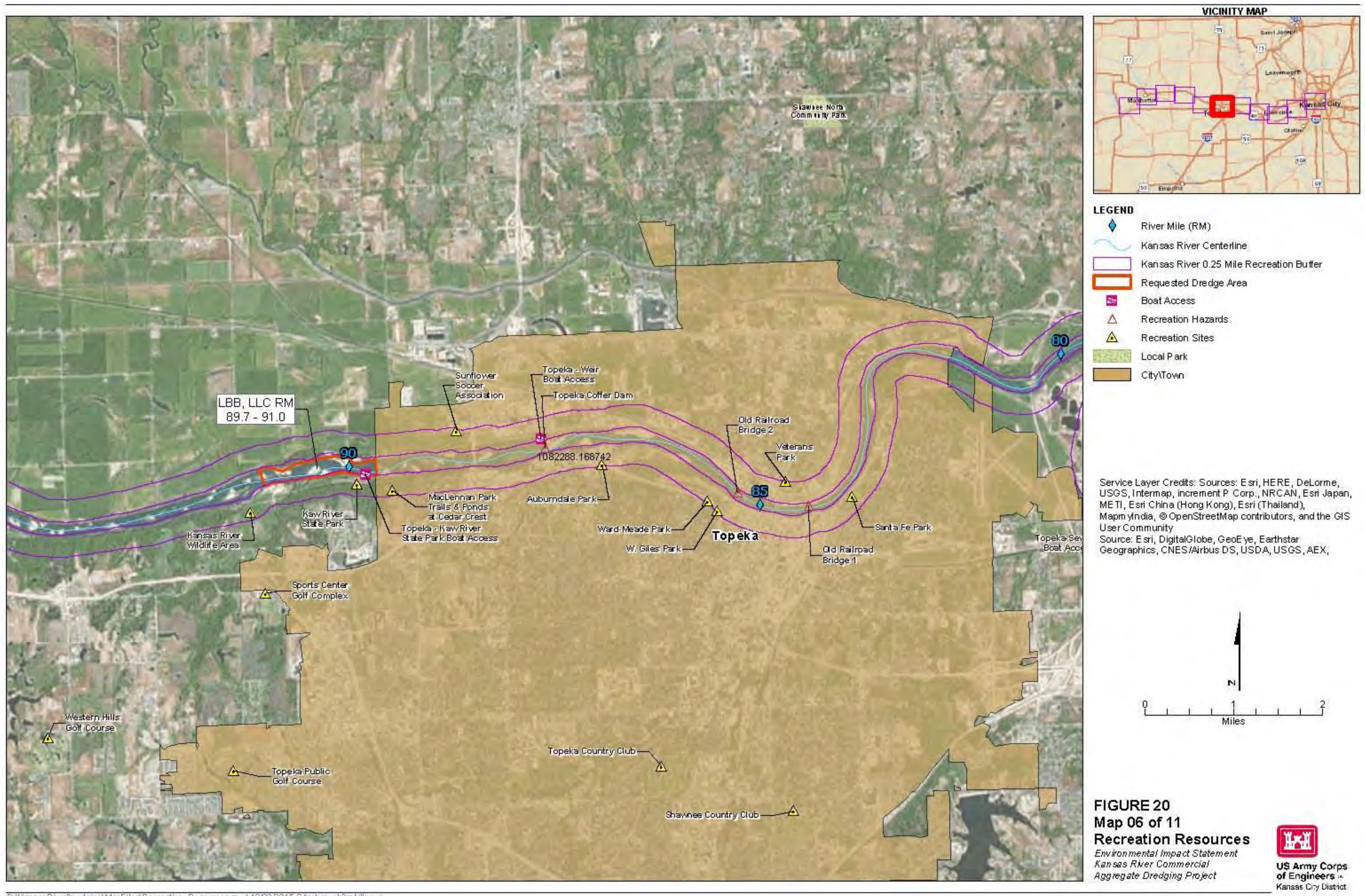

Figure 20 **Recreation Resources (Map 6 of 11)**

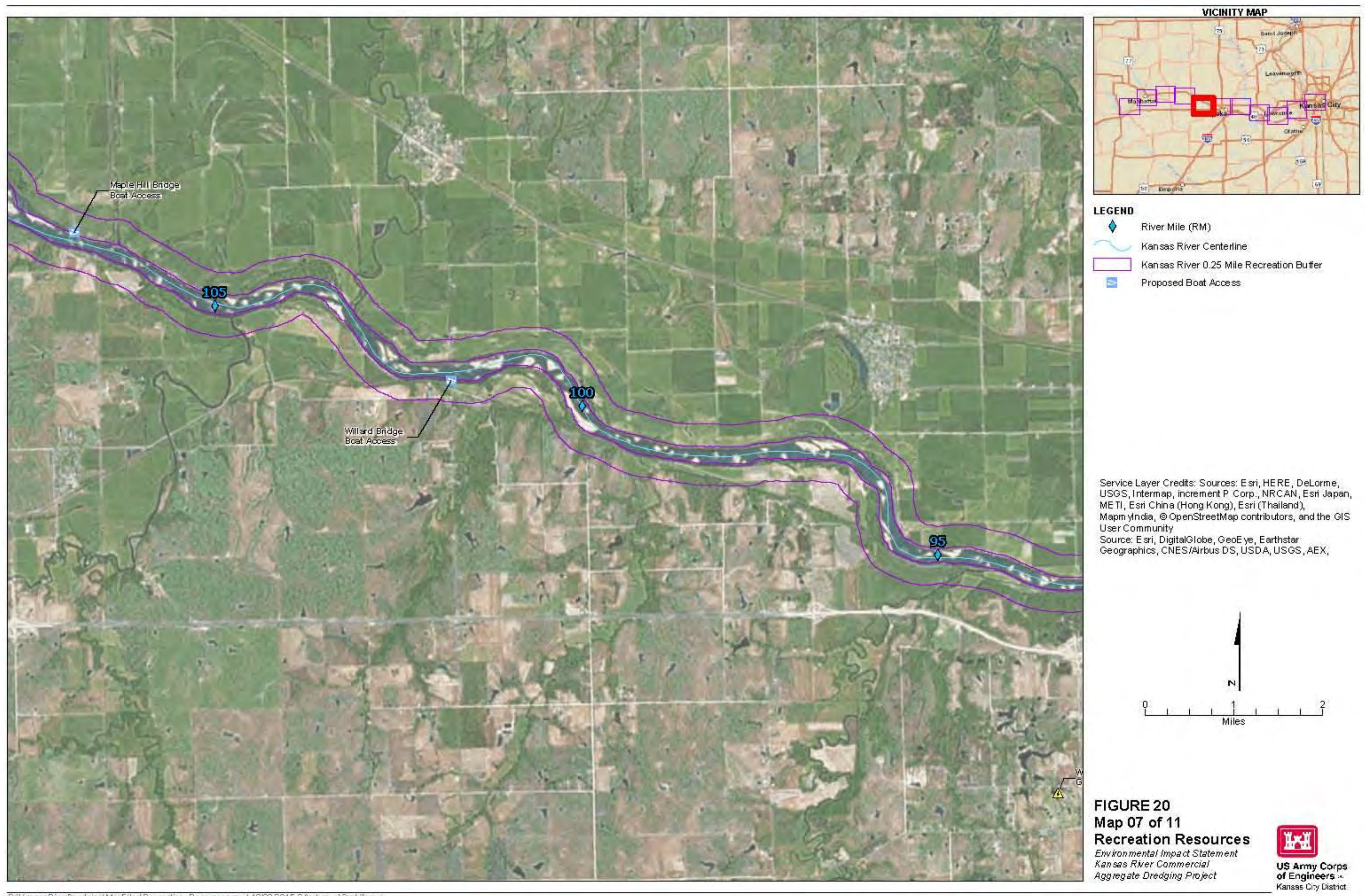

Figure 20 Recreation Resources (Map 7 of 11)

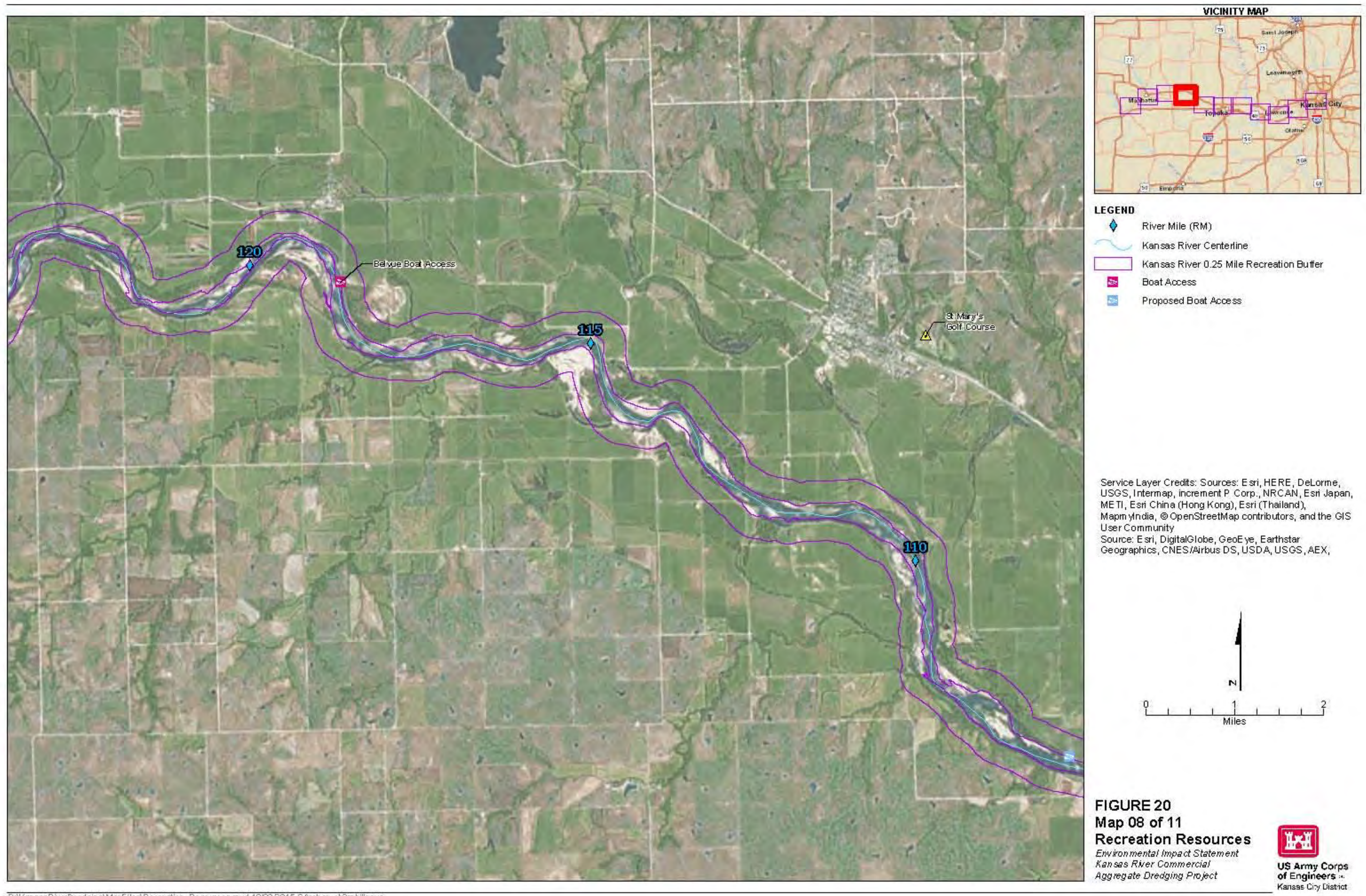

Figure 20 **Recreation Resources (Map 8 of 11)**

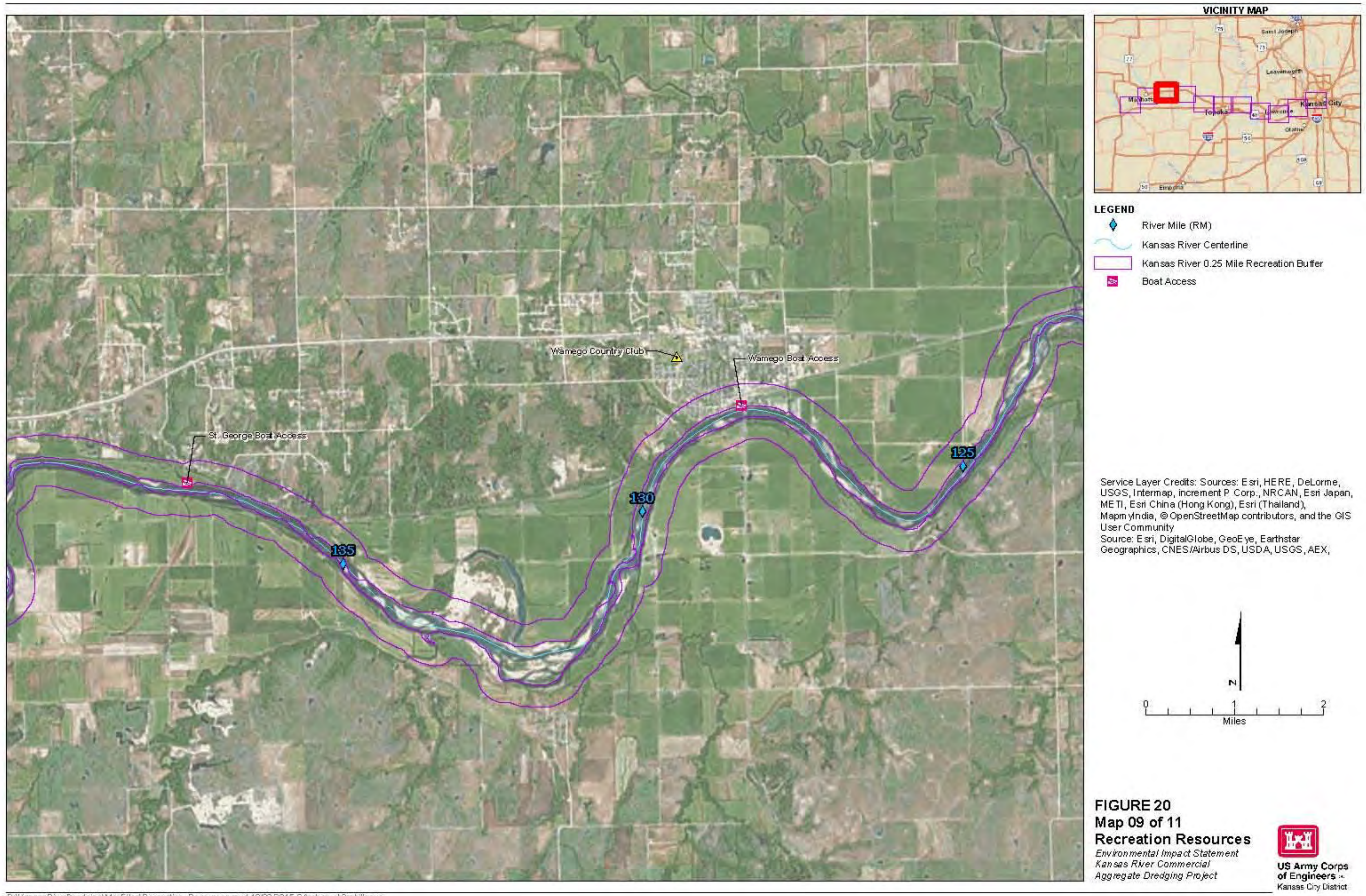

Figure 20 **Recreation Resources (Map 9 of 11)**

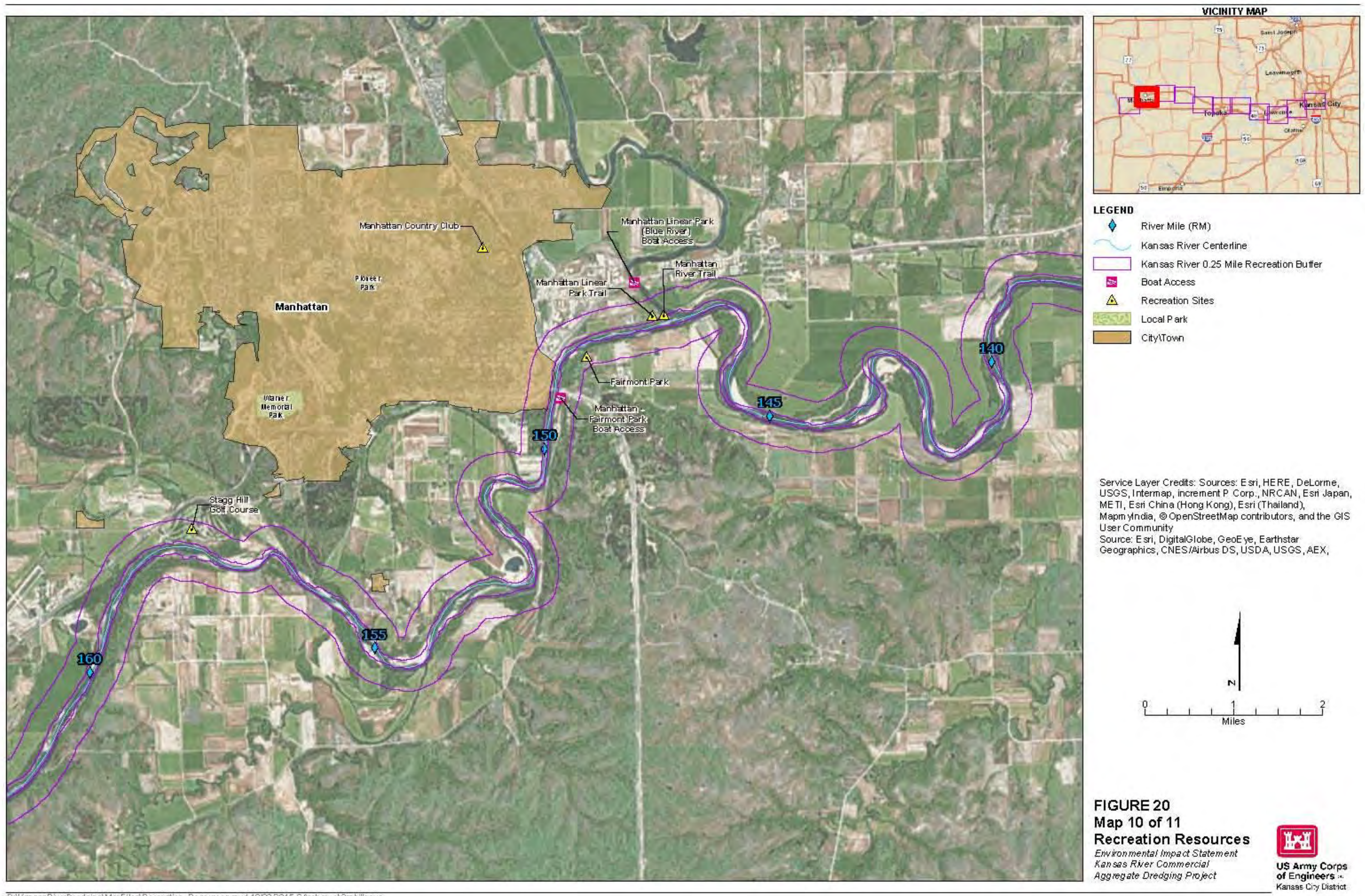

Figure 20 Recreation Resources (Map 10 of 11)

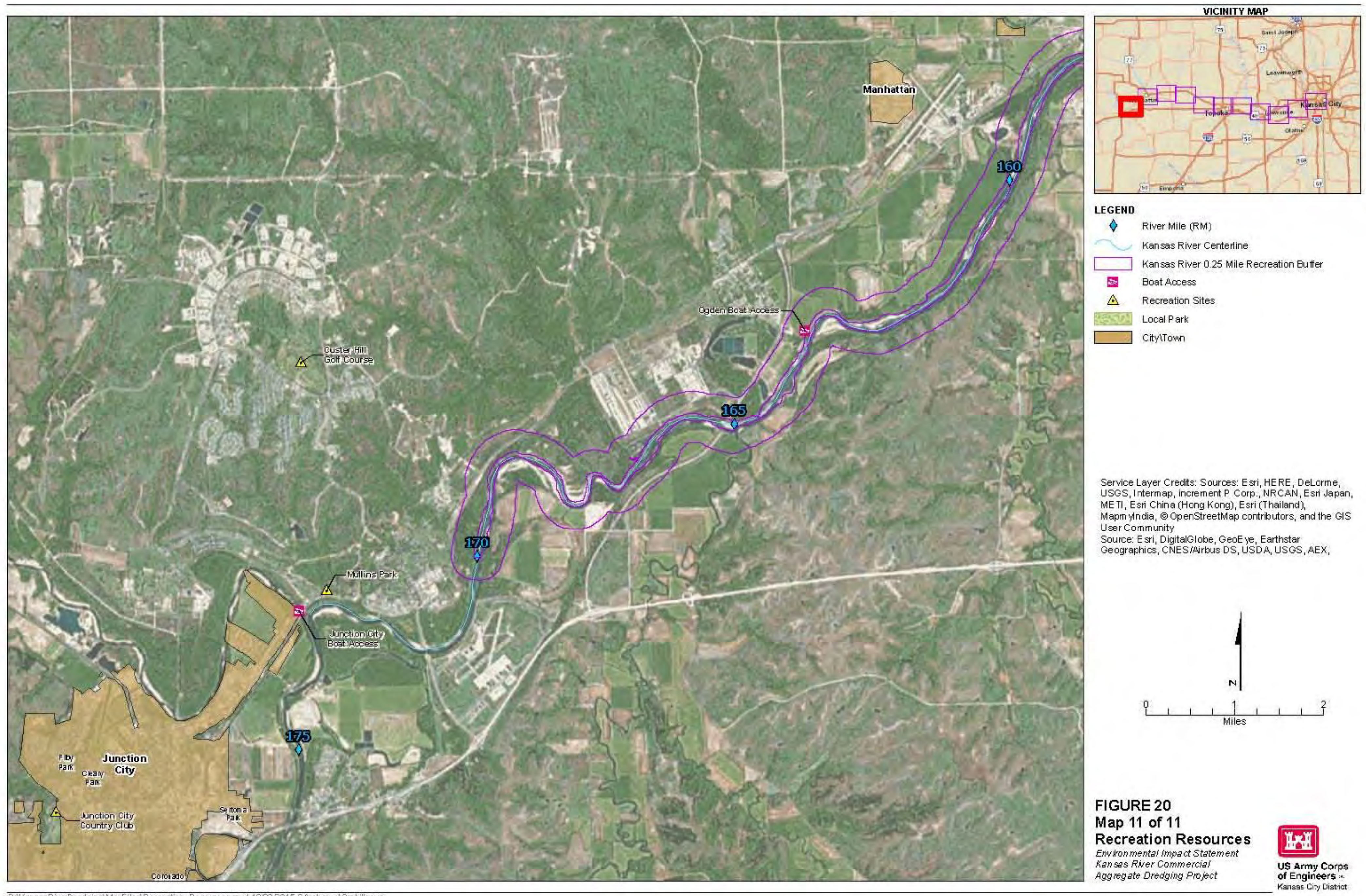

Figure 20 **Recreation Resources (Map 11 of 11)**

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Noise and visual impacts are a concern for recreationists, however these impacts are generally localized due to the sinuous nature of the river channel and screening by riparian vegetation. As described in Section 3.13.2.1, direct impacts to noise levels associated with the Proposed Action are not anticipated to be more than minimal and concerns raised by individual receptors such as boaters could be evaluated on a case-by-case basis by federal, state, county, and/or local agencies involved in permitting and agency approvals for individual dredging operations. Therefore, the incremental impacts to noise levels associated with the Proposed Action are not anticipated to be significant.

Indirect impacts to recreation could include increased bed degradation near public boat access locations, which could lead to the undermining of the ramp and negatively impact boat access. The Proposed Action includes requests for permit authorization from the USACE to dredge a maximum of 3,150,000 tons of material annually from the Kansas River. The quantity of sand and gravel extracted over the last 14 years has ranged between 1,000,000 and 2,000,000 tons, with an average near 1,400,000 tons per year. According to the USACE (2010), the recent rates of dredging have not caused stage degradation at the DeSoto gage. The USACE (2010) also noted slower or minimal stage degradation at Topeka when compared with previous decades. The USACE (2010) further noted that no significant stage degradation has occurred at either the DeSoto or Topeka gage stations since 1999. Based on the USACE findings, it is assumed that the rate of bed degradation since 1999 has not adversely impacted the structural integrity of boat ramps. If uncontrolled bed degradation was allowed to occur, then extracting the maximum 3,150,000 tons of material per year allowed by the Regulatory Plan for the Proposed Action would likely accelerate the rate of bed degradation and would have a potential to adversely impact boat ramps. However, since the magnitude of bed degradation is strictly limited to a 2-foot decline in any 5-mile reach through the Regulatory Plan, it is not likely that impacts would be more than minimal.

3.7.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. This action in and of itself will not have any negative impact on recreation. However, the No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations) all have a potential to impact recreation.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

Direct impacts to recreation in and along the Kansas and Missouri Rivers could include diminished recreation experiences due to noise and visual impacts related to pit dredging operations, including truck traffic. Pit dredging operations would be located on private land and would not be expected to interfere with access to public lands used for recreation. Direct impacts to recreation are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to recreation could include potential increases in truck traffic on roads leading to river access routes. This issue cannot be evaluated, at this time, since the number and location of potential additional dredge pit sites and truck routes is unknown. Depleted dredge pits could be restored as wetlands or lakes that provide recreational opportunities.

Crushed Limestone from Quarry Operations

Direct Impacts

Direct impacts to recreation would be similar to those identified for floodplain pit mining operations.

Indirect Impacts

Indirect impacts to recreation would be similar to those identified for floodplain pit mining operations.

3.7.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts to recreation would be similar to those identified for the Proposed Action.

Indirect Impacts

Indirect impacts to recreation would be similar to those identified for the Proposed Action. This alternative would reduce the allowable amount of material that could be extracted annually from the river to nearly half of the amount requested under the Proposed Action.

The quantity of material extracted over the last 14 years has ranged between 1,000,000 and 2,000,000 tons, with an average near 1,400,000 tons per year, which is similar to the rate of the Reduced Limit Alternative.

According to a USACE study (2010), the recent rates of extraction by dredging operations have not caused stage degradation at the DeSoto gage. The Report also noted slower or minimal stage degradation at Topeka when compared with previous decades. The Report further noted that no significant stage degradation has occurred at either the DeSoto or Topeka gage stations since 1999. Consequently, boat ramps are not likely to have been adversely affected by the level of dredging that has occurred since 1999.

The reduced annual rate of extraction for the Reduced Limit Alternative relative to the Proposed Action (1,670,000 tons versus 3,150,000 tons) would reduce the potential rate of riverbed degradation and potential impacts to boat ramps, if uncontrolled riverbed degradation would be allowed to occur. However, the Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet (for any reason), below the 1992 baseline elevations established for that reach, will be closed to further dredging. Therefore selection of the Reduced Limit Alternative would not be likely to result in substantially reduced impacts to boat ramps relative to the Proposed Action. Indirect impacts to recreation are not anticipated to be more than minimal.

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3.8 WETLANDS

3.8.1 Affected Environment

Based on the USFWS 1993 estimates, Kansas lost 405,600 acres (48 percent) of its wetlands between the 1780s and 1980s. The vast majority of these wetlands were shallow and often ephemeral wetlands, which were drained between the mid-1950s and mid-1970s. Most losses in Kansas have been associated with the draining and conversion of wetlands to agriculture land.

Most wetlands in Kansas occur on private lands due to the relatively small amount of public land in the state. Wetlands remaining along the Kansas River occur both in the floodplain and the river. Floodplain wetlands include farmed wetlands, scrub-shrub wetlands, palustrine emergent wetlands and forested wetlands. Floodplain wetlands are supported by overland runoff, overbank flooding and occasionally by high water tables. In-stream wetlands primarily occur on islands within the Kansas River.

The USACE is responsible for regulating the discharge of dredged or fill material in waters of the U.S., including wetlands, under authority of Section 404 of the CWA. Wetlands are defined as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Under Section 404, the USACE may authorize the discharge of dredged or fill material in wetlands only if it is found to be necessary and the least environmentally damaging practicable alternative after considering the avoidance, minimization, and appropriate compensatory mitigation.

3.8.2 Environmental Consequences

Environmental consequences associated with impacts to wetlands are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.8.2.1 Proposed Action

Direct Impacts

Dredging in the Kansas River could impact wetlands in the floodplain as a result of construction or expansion of processing plant sites. Dredging operations have very little potential to impact wetlands within the river channel since dredging activities primarily occur in areas where flow velocities are relatively high and water depths are sufficient to preclude the growth of wetland vegetation. The permits also exclude dredging in areas where wetlands are likely to occur. All of the processing plant sites associated with existing dredging areas on the river are in place and are not likely to be relocated in the near future. Therefore, most of the potential impacts to wetlands, associated with existing land-based operations, have occurred and are not anticipated to measurably increase over time. Direct impacts to wetlands are not anticipated to be more than minimal.

Indirect Impacts

Uncontrolled dredging in the Kansas River could cause riverbed degradation, which could lower water surface elevations (stage levels) in the river. Decreasing river stage levels are likely to lower groundwater elevations and the frequency and duration of surface water in the floodplain, which results in decreased wetland acreage and changes in wetland types. The Proposed Action would allow a maximum of 3,150,000 tons of sand and gravel be dredged annually under the Regulatory Plan. The quantity of sand and gravel dredged over the last 14 years has ranged between approximately 1,000,000 and 2,000,000 tons, with an average near 1,500,000 tons per year. According to the 2010 Kansas City District Report, the recent dredging rates have not caused stage degradation at the DeSoto gage. The Report also noted slower or minimal stage degradation at Topeka when compared with previous decades. The Report further noted that no significant stage degradation has occurred at either the DeSoto or Topeka gage stations since 1999. Consequently, wetlands are not likely to have been adversely affected by the rate of dredging that has occurred since 1999. Dredging the maximum 3,150,000 tons of sand and gravel per year as allowed by the Regulatory plan under the Proposed Action would likely accelerate the rate of bed degradation and would have a potential to adversely impact wetlands in the floodplain, if uncontrolled bed degradation would be allowed to occur. However, since the magnitude of bed degradation is strictly limited through the USACE's Regulatory Plan, it is not likely that impacts would be more than minimal. The Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet, below the 1992 baseline elevations established for that reach, will be closed to further dredging. The Regulatory Plan's 2-foot limit on bed degradation would limit the potential for dredging to impact wetlands in the floodplain. Based on the regulatory restrictions imposed on dredging by the USACE, indirect impacts to wetlands are not anticipated to be more than minimal.

3.8.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. This action in and of itself will not have any impact on wetlands. However, the No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations) all have a potential to directly impact Wetlands.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

The No-Action Alternative would most likely result in an increase in pit dredging operations in the Kansas and possibly the Missouri River floodplains. Opportunities to develop floodplain pit dredging sites for sand and gravel production are primarily limited to available lands outside urban and industrialized areas. Such areas are typically dedicated to agriculture use, primarily as pasture or crop lands, some of which may be wetlands. The Missouri River floodplain supports an abundance of wetlands due to soil types and other factors. However, the Kansas River floodplain contains better drained soils than the Missouri River floodplain and does not support the number of wetland areas found in the Missouri River floodplain. The construction of additional pit dredging sites in the Missouri and Kansas River floodplains would most likely result in impacts to wetlands. Because any new dredge pits in wetland areas would likely require a permit under Section 404 of the CWA which would address avoidance, minimization, and appropriate compensatory mitigation for the wetlands impacted, the direct impacts to wetlands are not anticipated to more than minimal.

Indirect Impacts

Indirect impacts to wetlands would primarily be limited to the expansion or development of roads and other public infrastructure to support truck traffic to and from pit dredging sites. Indirect impacts to wetlands are not anticipated to be more than minimal.

Crushed Limestone from Quarry Operations

Direct Impacts

Construction of limestone quarries and access roads has a potential to directly impact wetlands. However, since limestone quarries are typically located in the bluffs along the edge of the Kansas and Missouri River floodplains the potential to impact wetlands would be substantially lower than for floodplain pit dredging operations. Direct impacts would likely be limited to wetlands associated with impoundments (primarily within small ponds built on tributary systems), low gradient swales and hill-slope seep wetlands associated with shallow bedrock. Direct impacts to wetlands are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to wetlands would primarily be limited to the expansion or development of roads and other public infrastructure to support truck traffic to and from the quarries. Indirect impacts to wetlands are not anticipated to be more than minimal.

3.8.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts to wetlands would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the annual dredging of less sand and gravel than the Proposed Action, it would not be likely to result in a reduction in the total number of processing plant sites located along the river. Therefore, selection of the Reduced Limit Alternative would not be likely to result in substantially reduced direct impacts to wetlands. Direct impacts to wetlands are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to wetlands would be similar to those identified for the Proposed Action. This alternative would reduce the allowable amount of sand and gravel that could be dredged annually from the river to about 53 percent of the maximum amount that the Regulatory Plan would allow under the Proposed Action (1,670,000 tons versus 3,150,000 tons). The quantity of sand and gravel dredged over the last 14 years has ranged between approximately 1,000,000 and 2,000,000 tons, with an average near 1,500,000 tons per year, which is similar to the rate of the Reduced Limit Alternative. According to an evaluation completed in 2010 (USACE, 2010), the recent rates of extraction by dredging operations had not caused stage degradation at the DeSoto gage and slower or minimal stage degradation at Topeka when compared with previous decades. The USACE (2010) further noted that no significant stage degradation has occurred at either the DeSoto or Topeka gage stations since 1999. Consequently, wetlands are not likely to have been adversely affected by the level of dredging that has occurred since 1999. The reduced annual rate of dredging in the Reduced Limit Alternative relative to the Proposed Action (1,670,000 tons versus 3,150,000 tons) would reduce the potential rate of bed degradation and potential impacts to wetlands located in the floodplain, if uncontrolled bed degradation would be allowed to occur. However, the USACE’s Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet, below the 1992 baseline elevations established for that reach, will be closed to further dredging. Therefore selection of the Reduced Limit Alternative would not be likely to result in substantially reduced impacts to wetlands in the Kansas River floodplain relative to the Proposed Action. Indirect impacts to wetlands are not anticipated to be more than minimal.

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3.9 FLOODPLAINS

3.9.1 Affected Environment

The Kansas River floodplain and the floodplains of its tributaries are important resources that convey large stormwater events and provide high-quality wildlife habitat, fertile agricultural land, and a source for mineral deposits such as sand and gravel. The floodplain of the Kansas River is defined as a riverine floodplain, which is comprised of the floodway and the flood fringe. The floodway encompasses the channel and a portion of the adjacent floodplain area necessary to convey floodwaters. The flood fringe is land located outside the floodway that is at or below the base flood elevation and stores but does not effectively convey floodwaters. Lands located in the flood fringe will be inundated during a 1 percent flood event (flood events defined as having a probability of occurrence once every 100 years) but, due to physical characteristics of the floodplain, do not effectively convey floodwaters. The base flood elevation and the floodway and flood fringe are determined through hydraulic modeling.

Floodplain management, for flood control purposes, is regulated by the FEMA and is implemented by local agencies. The State of Kansas passed Kansas Statutes Annotated (K.S.A.) 12-766, Floodplain Zoning, giving cities and counties zoning authority to help control flooding related issues, and statute K.S.A. 24-126, Kansas Administrative Regulations (K.A.R.) 5-43, and K.A.R. 5-44 to administer proposed activities within the floodplain. The Division of Water Resources is designated as the state coordinating agency to work with local agencies on the National Flood Insurance Program.

The FEMA floodplain maps (Digital Flood Insurance Rate Maps) delineate the floodway and the 100-year (1 percent chance event) and 500-year flood levels for floodplains across the country. These maps are used by FEMA to define areas eligible for participation in the National Flood Insurance Program (NFIP). In order to participate in the NFIP, local entities are required to implement floodplain management regulations, which allow local floodplain property owners to become eligible to purchase federal flood insurance. A large portion of the Kansas River valley is mapped as a floodway and contains 100-year and 500-year floodplain areas identified on FEMA floodplain maps. Floodplain management regulations in effect at any given location are developed by the local entity responsible for floodplain management.

Generally accepted uses of FEMA designated floodplains include recreational areas, habitat development and conservation areas, agricultural uses, and non-habitable accessory structures. Activities that typically require floodplain development permits include:

- New construction,
- Additions to existing structures,
- Temporary buildings and accessory structures,
- Storage of materials,
- Roads and bridges, and
- Fill, grading, excavation, and mining operations.

3.9.1.1 Designated Floodplain Areas

There are more than 75 FEMA designated floodplains within the 10 county area located along the Kansas River. Floodplains are designated for the Kansas River and the following major tributaries that convey runoff to the Kansas River:

- Big Blue River
- Wakarusa River
- Delaware River
- Mill Creek
- Stranger Creek
- Captain Creek
- Buck Creek
- Muddy Creek
- Soldier Creek
- Indian Creek
- Cross Creek
- Vermillion Creek

3.9.1.2 Floodplain Resources

In 1986, Burns & McDonnell prepared a report entitled, "*Kansas River Floodplain Sand and Gravel Investigations*" to aid the USACE in its preparation of the 1990 Kansas River Commercial Dredging EIS. The report concluded that potential sources of suitable aggregate materials are available in the Kansas River floodplain between Lawrence and Kansas City, Kansas to support commercial sand and gravel pit mining operations. Sand and gravel deposits in the Kansas River floodplain were determined to be influenced by glacial activity that deposited eroded materials during the Pleistocene Epoch. The Kansas River valley floodplain is underlain by Pennsylvanian Age bedrock primarily consisting of limestone and shale. Alluvial deposits are laid over the bedrock and consist of fine silts and clays in the upper layer, fine sands in the intermediate layers, and course sand in the lower layers (Burns & McDonnell, 1986). The suitability of a particular area within the floodplain for use as a commercial sand and gravel pit dredging site is dependent upon the amount of overburden that must be removed and the availability of sufficient quantities of fine and coarse sands. Coarse gradations of sand are used in concrete and asphalt, while finer gradations are used for masonry sands or are blended with coarser sands for use in concrete and asphalt.

According to the Blechinger (1997), sand deposits in the floodplain consist of glacial till, terrace deposits, and alluvium. The report noted that the majority of the glacial deposits are located in the floodplain north of the river, with a limited amount of glacial deposits located south of the river. Glacial deposits can be heavily laden with clays, making separation of suitable materials from undesirable materials difficult. Conversely, the lower depth of the alluvial deposits is almost entirely sand, which is overlaid with silt and topsoil (referred to as overburden). Alluvial deposits are located within the Kansas River floodplain and along many of its tributaries. Based on a review of available boring logs, Blechinger (1997) determined that the majority of counties with a larger percentage of floodplain land containing good overburden ratios (overburden vs. depth of sand deposits) were located west of Topeka, Kansas.

3.9.2 Environmental Consequences

Environmental consequences associated with impacts to floodplains are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.9.2.1 Proposed Action

Direct Impacts

All of the processing plants associated with existing dredging on the river are in place and are not likely to be relocated in the near future. Therefore, most of the impacts to the floodplain, associated with existing land-based operations, have occurred and are not anticipated to measurably increase over time. Therefore, direct impacts to the floodplain are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to floodplain resources are primarily associated with the potential contribution of dredging to bed degradation. Bed degradation could cause stage elevations to decrease during periods of low flows. Reduced stage elevations could allow an increase in the amount of vegetation established on the riverbanks and on sand bars, especially during periods of prolonged low flows. Vegetation on the riverbanks traps sediment, which accretes land within the channel and reduces the channel cross-section area available to convey high flows. Reduced channel capacity results in an increase in stage elevations at high flows, which, in turn, increases the frequency of overbank flooding. The Regulatory Plan contains conditions that limit degradation to an average of 2 feet, below the 1992 baseline elevations, for any 5-mile-long reach of river. Therefore, indirect impacts to the floodplain are not anticipated to be more than minimal.

The processing plants constructed to serve the Kansas River dredging operations could indirectly impact the sand, gravel, and other aggregate resources located within the floodplain. As with the processing plants on the Missouri River, the Kansas River processing plants would be zoned for their specific industrial use, requiring the local zoning authority to rezone the property for an alternative or secondary use. In addition, heavy equipment operation combined with large stock piles and the plant site infrastructure will alter the property's condition. However, given the limited area for the land-based operations, typically 5 to 15 acres, minimal impact is expected to floodplain resources when compared to the total resources available across the floodplain area.

3.9.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers.

This action in and of itself will not have any impact on the floodplain. However, the No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

Direct impacts to the Kansas and Missouri River floodplains would include potential impacts to floodplain resources and flood elevations. Floodplain pit dredging operations would directly impact floodplain resources located at each pit dredging site. Those resources consist of surface areas such as vegetative communities and cropland, and the subsurface materials such as sand, gravel, silt, clay, and rock. In order to accommodate the current Kansas River production level of 1,500,000 tons of sand and gravel per year, the average market demand since 2000, it is estimated that 25 to 34 acres of land would need to be converted to pit dredging operations each year (Blechinger, 1997; Booker Associates, 1986). The surface silt and clay material would be removed as overburden at each site, and the sand and gravel would be extracted for sale to regional markets.

In order to develop a floodplain pit mining site, the floodplain administrator (city or county) would require the development entity to comply with Section 60.3(d)(3) of the NFIP. An analysis would be required to assess the change in hydraulics of the floodway resulting from construction of structures and placement of fill material. Any construction activity that would decrease the capacity of the floodplain or the floodway must be compensated by increasing the floodway cross-section area equal to the loss in order to ensure no increase in pre-project base flood elevations. All projects requiring a Floodplain Fill Permit must be supported with an engineering evaluation that demonstrates that "No Rise" in flood elevation will occur from the proposed activities. Impacts to flood elevations are not anticipated to be more than minimal due to the regulatory requirements imposed by local floodplain administrators. Direct impacts to Kansas and Missouri River floodplains are not anticipated to be significant.

Indirect Impacts

Pit dredging in the Kansas and Missouri River floodplains could minimally increase the flood storage capacity of the floodplain, which could decrease flood elevations. However, the development of floodplain pit mines in close to the riverbank on either the Kansas or Missouri River could indirectly result in a breach (blowout) of the floodplain area located between the pit mine and the river channel during overbank flood flows. A breach through the riverbank and into the mine pit would direct river flows through the mined area. Although a breach through the riverbank could create a permanent change in the channel's alignment and an altered floodplain condition, these events are infrequent. Indirect impacts to the Kansas and Missouri River floodplains are not anticipated to be significant.

Floodplain mineral resources are not renewable; therefore, the removal of sand and gravel would indirectly impact the amount of floodplain resources available in the future. In order to accommodate the current Kansas River production level of 1,500,000 tons of sand and gravel per year, the average market demand since 2000, it is estimated that 25 to 34 acres of land would need to be converted to pit dredging operations each year (Blechinger, 1997; Booker Associates, 1986). Given the difficulty of property acquisition combined with past local and regional opposition, the utilization of a non-renewable resource may indirectly increase the distance sand and gravel producers must locate their facilities from the local market to open and operate a floodplain pit site.

Crushed Limestone from Quarry Operations

Direct Impacts

Quarry operations generally harvest limestone bedrock layers in the uplands adjacent to the floodplain, in areas where sand and gravel resources are not generally found in harvestable quantities. Limestone quarry operations would have little direct impact on floodplain mineral resources, which primarily consist of sand and gravel.

Limestone quarry operations are typically located along the fringe of the floodplain where limestone rock layers are more readily available in the bluffs. For those quarry operations that may be located within the floodplain, the floodplain administrator (city or county) would require the development entity to comply the requirements of Section 60.3(d)(3) of the NFIP, as discussed, above, in the floodplain pit dredging alternative. All projects requiring a Floodplain Fill Permit must be supported with an engineering evaluation that demonstrates that "No Rise" in pre-project base flood elevations would occur from the proposed activities. Direct impacts to the Kansas and Missouri River floodplains are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to the Kansas and Missouri River floodplains related to the development or expansion of crushed limestone quarry operations are not anticipated to be more than minimal. Indirect impacts could include the construction or maintenance of roads and utilities across the floodplain. These activities could require the placement of fill to elevate the roadway above the floodplain elevation for public safety. In addition, the excavation of floodplain soils to bury utilities, or the placement of road base would disturb the floodplain resources. In most circumstances the area of disturbance would be limited to the right-of-way and easement area for the associated roadway or utility.

3.9.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts to the floodplain would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the dredging of less sand and gravel annually than the Proposed Action, it would not be likely to result in a reduction in the total number of processing plants located along the river. Therefore, selection of the Reduced Limit Alternative would not be likely to result in substantially reduced direct impacts to the floodplain. Direct impacts to the floodplain are not expected to be more than minimal.

Indirect Impacts

Indirect impacts to the floodplain would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the dredging of less sand and gravel annually than the Proposed Action, it would not be likely to result in a reduction in the total number of processing plants located along the river. It is possible that higher annual dredging limits associated with the Proposed Action could result in the bed degrading faster than under the Reduced Limit Alternative; however, the limit for bed degradation, regardless of how rapidly it could occur, is 2 feet. Therefore, selection of the Reduced Limit Alternative would not be likely to result in substantially reduced impacts to the floodplain relative to the Proposed Action. Indirect impacts are not anticipated to be more than minimal.

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3.10 TERRESTRIAL AND AQUATIC RESOURCES

3.10.1 Affected Environment

The following section addresses terrestrial and aquatic resources. Both terrestrial and aquatic resources were thoroughly discussed in a 1982 Burns & McDonnell report entitled, "*Cumulative Impacts of Commercial Dredging on the Kansas River,*" which was prepared to assist the USACE in the preparation of the Kansas River Dredging EIS (USACE, 1990a). Additional report findings, primarily from fish studies, are summarized in this Section, where applicable.

3.10.1.1 Terrestrial Resources

Terrestrial Habitat

The project area is located in the Central Irregular Plains Ecoregion and more specifically within the Osage Cuestas sub-region of Kansas. The ecoregion is mostly comprised of tallgrass prairie in the west and transitions to a combination of tallgrass prairie and oak hickory woodland in the east. Upland forests were dominated by shagbark hickory, bitternut hickory, red oak, white oak, and black oak, with Ohio buckeye, American bladdernut, and pawpaw found as common understory trees. Historic land cover in the area includes mosaic cropland, woodlands and grasslands.

The primary terrestrial habitat types located adjacent to the Kansas River include urban parkland, urban residential and commercial properties, broken riparian floodplain corridors, and cultivated floodplain fields. The vegetative community within the urban parkland primarily consists of mowed grasses and oak, maple, hickory, sycamore, cottonwood and other native trees. Vegetative cover associated with urban dwellings and commercial structures consists of a similar mix of grasses and trees. Vegetative communities in the riparian corridors typically consist of bur oak, elms, sycamore, box-elder, silver maple, cottonwood, willows, green ash, and hackberry trees with a herbaceous understory typically consisting of several species of grape, buckbrush, redbud, elderberry, Virginia creeper, and Virginia wild-rye. Invasive species within riparian areas include brome, fescue, Japanese honeysuckle, and garlic mustard.

Terrestrial Wildlife

Common Species

Species assemblages are a group of closely related species that co-occur within a particular habitat. Table 25 includes a list of common terrestrial wildlife species found along the floodplain of the Kansas and Missouri Rivers. Note that this table is not intended to be an exhaustive list of wildlife species, but its purpose is to highlight the most common species potentially present in the floodplain of the Kansas and Missouri Rivers.

Mammalian wildlife species with a high potential to be present along the Kansas River corridor at any given time include deer, fox (grey and red), coyotes, bobcats, weasels, opossums, rabbits, squirrels, raccoons, gophers, small rodents (mice, shrews, and voles) and bats. Birds likely to be present within the corridor include geese, turkey, owls, hawks, grouse, quail, doves, hummingbirds, woodpeckers, swallows, blue jays, cardinals, robins, neo-tropical migrants, starlings, sparrows, blackbirds, crows, and others. Lawns and vegetated urban areas associated with dwellings and commercial properties attract a variety of small mammals such as mice, shrews, voles, rabbits and squirrels. Urban properties also attract song birds, blue jays, cardinals, robins, black birds, sparrows, crows, and occasionally hawks and owls.

Special-Status Species

Special status species addressed here includes those species protected under the Kansas Nongame and Endangered Species Conservation Act. Species protected under the Federal Endangered Species Act (ESA) are discussed in Section 3.12 (Federally Listed Species). Any time project is proposed that will impact a state special status species' preferred habitats within its probable range, the project sponsor must contact the Ecological Services Section, KDWPT, 512 SE 25th Ave., Pratt, Kansas 67124-8174. Department personnel can then advise the project sponsor on permit requirements.

Based on the review of habitat requirements of special-status species, most terrestrial special-status species would not be directly affected by in-channel dredging. Special-status wildlife species present in the habitats located along the Kansas River could be impacted by dredging in the same manner as other species that use the same wetland habitats. As such, special-status wildlife species potentially in the floodplains of the Kansas and Missouri Rivers have been included with the common wildlife species listed in Table 25. Bald eagles and migratory birds may be present in riparian and forested wetland habitats along the floodplains of the Kansas and Missouri Rivers.

Table 26 contains a description of the use of terrestrial habitats by special-status species in the Project Area.

Table 25 Common Terrestrial Wildlife Species in the Project Area

Wildlife Assemblage	Common Species	Common Habitat Type
Waterfowl, wading, water, and shore birds	Great blue heron (*Ardea herodias*), green heron (*Butorides virescens*), Canada goose (*Branta Canadensis),* wood duck (*Aix sponsa*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), American wigeon (*Anas americana*)	Wetlands
	Killdeer (*Charadrius vociferous*)	Grasslands
Songbirds	House sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), house wren (*Troglodytes aedon*), barn swallow (*Hirundo rustica*), blue jay (Cyanocitta cristata), eastern bluebird (*Sialia sialis*), American robin (*Turdus migratorius*), Dickcissel (*Spiza americana*), eastern meadowlark (*Sturnella magna*)	Farms/towns, grasslands
	Song sparrow (*Melospiza melodia*), gray catbird (*Dumetella carolinensis*), northern mockingbird (*Mimus polyglottos*), brown thrasher (*Toxostoma rufum*)	Shrubs/brush
	Red-bellied woodpecker (*Melanerpes carolinus*), purple martin (*Progne subis*), downy woodpecker (*Picoides pubescens*), American crow (Corvus brachyrhynchos), Carolina chickadee (*Poecile carolinensis*), black-capped chickadee (*Poecile atricapillus*), tufted titmouse (*Baeolophus bicolor*), white-breasted nuthatch (*Sitta carolinensis*), blue-gray gnatcatcher (*Polioptila caerulea*), northern cardinal (*Cardinalis cardinalis*), indigo bunting (*Passerina cyanea*), eastern towhee (*Pipilo erythrophthalmus*)	Forest
	Red-winged blackbird (Agelaius phoeniceus)	Wetlands
Raptors	Bald eagle (*Haliaeetus leucocephalus),* northern harrier or marsh hawk (*Circus cyaneus),* red-shouldered hawk (*Buteo lineatus)*	Wetlands, shores of reservoirs, streams, rivers
	Red-tailed hawk (*Buteo jamaicensis),* northern rough-legged hawk (*Buteo lagopus),* black vulture (*Coragyps atratus),* turkey vulture (*Carthartes aura),* American kestrel (*Falco sparverius)*	Forest, farmland
	Broad-winged hawk (*Buteo platypterus),* Swainson's hawk (*Buteo swainsonii)*	Migrates through the Project area
Upland game birds	Greater prairie chicken (*Tympanuchus cupido*), mourning dove (*Zenaida macroura*)	Prairie
	Wild turkey (*Meleagris gallopavo*)	Forest

Table 25 Common Terrestrial Wildlife Species in the Project Area

Wildlife Assemblage	Common Species	Common Habitat Type
	Northern bobwhite (*Colinus virginianus*)	Shrub/brush
	Rock dove (*Columba livia*)	Towns/yards
Amphibians	Plains spadefoot (*Spea bombifrons*), Great Plains toad (*Bufo cognatus*), Fowler's toad (*Bufo fowleri*), Woodhouse's toad (*Bufo woodhousii*), Blanchard's cricket frog (*Acris crepitans blanchardi*), western chorus frog (*Pseudacris triseriata*), northern crayfish frog (*Rana areolata circulosa*), eastern American toad (*Bufo americanus americanus*), plains leopard frog (*Rana blairi*)	Floodplain
	Gray treefrog (*Hyla chrysoscelis and Hyla versicolor*), northern spring peeper (*Pseudicris crucifer crucifer*), Great Plains narrow-mouthed toad (*Gastrophryne olivacea*), eastern narrow-mouthed toad (*Gastrophryne carolinensis*), green frog *(Rana clamitans melanota*) ,pckerel frog (*Rana palustris*)	Forest, grasslands, wooded hills, marshes
	Bullfrog (*Rana catesbeiana*), southern leopard frog (*Rana sphenocephala*)	Permanent aquatic habitats
Reptiles	Western painted turtle (*Chrysemys picta bellii*), red-eared slider (*Trachemys scripta elegans*), common (northern) map turtle (*Graptemys geographica*), false map turtle (*Graptemys pseudogeographica pseudogeographica)* ,Ouachita map turtle (*Graptemys ouachitensis ouachitensis*)	Rivers, sloughs, oxbow lakes, ponds, drainage ditches (semi-aquatic)
	Graham's crayfish snake (*Regina grahamii),* western ribbon snake (*Thamnophis proximus proximus)*	Edges of streams, marshes, sloughs, ponds, wooded areas near water
	Ornate box turtle (*Terrapene ornata ornata*), southern coal skink (*Eumeces anthracinus pluvialis*), racerunner (*Cnemidophorus sexlineatus*), western slender grass lizard (*Ophisaurus attenuatus attenuatus*), eastern yellow-bellied racer (*Coluber constrictor flaviventris*), black rat snake (*Elaphe obsoleta*) ,eastern hog nosed snake (*Heterodon platirhinos*), prairie kingnose (*Lampropeltis calligaster calligaster*), speckled kingsnake *(Lampropeltis getula holbrooki*), red milk snake (*Lampropeltis triangulum syspila*), bullsnake (*Pituophis catenifer sayi)*	Pastures, open woods, glades, and prairies
	Three-toed box turtle (*Terrapene Carolina triungulis*), northern fence lizard (*Sceloporus undulates hyacinthinus*), ground skink (*Scincella lateralis*), five-lined skink (*Eumeces faciatus*), broadhead skink (*Eumeces laticeps*), western worm snake (*Carphophis vermis*), prairie ring-necked snake (*Diadophis punctatus arnyl*), Great Plains rat snake (*Elaphe guttata*), Midland brown snake *(Storeria dekayi wrightorum),* northern red-bellied Snake (*Storeria occipitomaculata occipitomaculata),* Osage copperhead (*Agkistrodon contortrix phaeogaster*), western ribbon snake (*Thamnophis proximus proximus),* Osage copperhead (*Agkistrodon contortrix phaeogaster*), timber rattlesnake (*Crotalus horridus)*	Forest, woodlands

Table 25 Common Terrestrial Wildlife Species in the Project Area

Wildlife Assemblage	Common Species	Common Habitat Type
Mammals	Raccoon (*Procyon lotor*), eastern gray squirrel (*Sciurus niger*)	Hardwood forests
	River otter(*Lutra canadensis*), mink (*Mustela vison*), opossum (*Didelphis viginiana*), long-tailed weasel (*Mustela frenata*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), swamp rabbit (*Sylviagus aquaticus*)	Along rivers, streams, lakes; wooded areas along streams
	Striped skunk (*Mephitis mephitis*) ,red fox (*Vulped fulva),* white-tailed deer (*Odocoileus virginianus*), gray fox (Urucyon *cineoargentus*), coyote (*Canis latrans*), eastern cottontail Rabbit (*Sylvilagus aquaticus*)	Forest borders, brushy fields near water
	White-tailed jackrabbit (*Lepus californicus*), badger (*Taxidea taxus*), spotted skunk (Civet) (*Spilogale interrupta*)	Prairie

BALD EAGLE

As of August 9, 2007, the bald eagle is no longer protected under the federal Endangered Species Act (ESA), and Section 7 consultation with the USFWS is no longer necessary. However, the bald eagle remains protected under the Bald and Golden Eagle Protection Act. Bald eagles are large, opportunistic birds of prey that feed largely on fish and waterfowl (Peterson 1986). Eagles tend to use rivers, lakes, and reservoirs where large trees provide perch sites for roosting and for locating prey. This species prefers trees greater than 11 inches (27.9 centimeters) diameter at breast height that are located within 100–600 feet (30.5–182.9 m) of water bodies. Nesting activity is most often initiated between January 1 and March 1, and the most critical time for incubation and rearing of young is between March 1 and May 15. During winter, they gather near large open water areas, usually occupying river habitats between November 15 and March 1. At night, wintering bald eagles may congregate at communal roosts and may travel as much as 12 miles (19.3 kilometers) from feeding areas to a roost site. Bald eagles are common migrants and winter residents throughout Kansas and Missouri and since the 1990s the number of bald eagle nests in these states have increased. Bald eagles and their nests have been observed along the Kansas River including both active and inactive nests.

MIGRATORY BIRDS

The Migratory Bird Treaty Act of 1918, as amended, is regulated by the USFWS. The Act was proposed as a means to put an end to the commercial trade in birds and their feathers that, by the early years of the 20th century, had wreaked havoc on the population of many native bird species. The Migratory Bird Treaty Act makes it illegal to pursue, hunt, take, capture, or kill or attempt to take, capture, or kill any migratory bird or "any part, nest, or egg of any such bird by any means or in any manner," except as allowed by permit. While the ESA defines the term "take" to include "to harm and harass," including habitat modification, "take" under the Act is not as broadly defined and thus includes only direct killing of protected birds.

Several species of migratory birds and their habitats can be found along the Kansas River floodplain. Typical bird species are identified in Table 25. Throughout the United States, 836 bird species are protected under the Migratory Bird Treaty Act (USFWS 2010); several of these species are located along the Kansas River for at least part of the year. Migratory birds use a variety of habitats, but several important bird areas (IBAs) have been identified within and near the Kansas River floodplain (National Audubon Society 2010). Most identified IBAs consist of wetlands, prairies, marshlands, and forested areas that are managed by various federal, state, and private partners.

Table 26 State Listed Terrestrial Wildlife Species in the Project Area

Common Name *Scientific Name*	Federal Status	KS Status	MO Status	General Habitat	Potential Impacts
Mammals					
Eastern spotted skunk *Spiglogale putorius*		T	E	It seems to prefer forest edges and upland prairie grasslands, especially where rock outcrops and shrub clumps are present. In western counties, it relies heavily on riparian corridors where woody shrubs and woodland edges are present. Woody fencerows, odd areas, and abandoned farm buildings are also important habitat for spotted skunks.	Its occurrence has been documented in Douglas, Leavenworth, Pottawatomie, Riley, and Wyandotte Counties. No critical habitat is currently designated within the Kansas River corridor. Floodplain pit dredging and construction of new processing plants for river dredging operations could potentially impact the eastern spotted skunk.
Birds					
Least tern *Sterna antillarum*	E	E	E	Barren areas near water such as saline flats in salt marshes, sand bars in river beds, and shores of large impoundments.	Least terns are summer residents of Kansas. Nesting birds have been recorded in six central and western Kansas counties, Jeffery Energy Center, and along the Kansas River. The following counties associated with the Project contain critical habitat for piping plover: Douglas, Geary, Jefferson, Johnson, Leavenworth, Pottawatomie, Riley, Shawnee, Wabaunsee, and Wyandotte. Kansas River dredging and floodplain pit dredging are not anticipated to adversely affect the least tern.
Piping plover *Charadrius melodus*	T	T		Sparsely vegetated shallow wetlands and open beaches and sandbars adjacent to or within streams and impoundments.	Piping plovers are rare migrants through Kansas. Nesting has been recorded on sand bars along the Kansas River. The following counties contain critical habitat for piping plover: Douglas, Geary, Jefferson, Johnson, Leavenworth, Pottawatomie, Riley, Shawnee, Wabaunsee, and Wyandotte. Kansas River dredging and floodplain pit dredging are not anticipated to adversely affect the piping plover.
Snowy plover *Charadrius alexandrinus*		T		Open salt flats, beaches and bars of rivers, and wetlands.	Historically found across Kansas. The snowy plover is a regular but uncommon migrant and summer resident in Kansas. Nesting occurs in scattered locations in central and southwestern Kansas where open salt flats or sandy areas near water occur. Its occurrence has been documented in Douglas, Geary, Jefferson, Pottawatomie, Riley, and Shawnee Counties; however, no designated critical habitat has been identified in these counties. Kansas River dredging and floodplain pit dredging are not anticipated to adversely affect the snowy plover.
Whooping crane *Grus americana*	E	E		Preferred resting areas are wetlands in level to moderately rolling terrain away from human activity where low, sparse vegetation permits ease of movement and an open view.	Regular spring and fall transients through Kansas. Douglas, Geary, Jefferson, Riley, and Shawnee are the only counties in the Project area with recorded historic occurrences; however, no designated critical habitat has been identified in these counties. Kansas River dredging and floodplain pit dredging are not anticipated to adversely affect the whooping crane.
Invertebrates					
American burying beetle *Nicrophorus americanus*	E	E	E	Frequently found in upland grasslands or near the edge of grassland/forest. Sandy/clay loam soils and food (carrion) availability are also important. The species appears to prefer loose soil in which carrion can be easily buried.	Since 1996, populations were found in four southeast counties in Kansas. Douglas, Pottawatomie, Riley, and Shawnee were the only counties in the Project area with recorded historic occurrences; however, no designated critical habitat has been identified in these counties. Grasslands and forests occupy approximately 21 percent of the Kansas River floodplain while cropland occupies 60 percent. Therefore, floodplain pit dredging is not anticipated to adversely affect the American burying beetle.

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3.10.1.2 Aquatic Resources

For purposes of this report, aquatic resources in the Kansas River are described as being either phytoplankton (minute plant life), zooplankton (minute animal life), benthic organisms (bottom dwelling species), or fish.

Plankton

Phytoplankton and zooplankton are very small plants and animals that float passively or swim weakly. Phytoplankton is the primary producer in most aquatic ecosystems and represents the first link in the aquatic food chain. Few studies of Kansas River plankton communities have been conducted and much of the available data is relatively old. Powers (1969) listed 225 species of phytoplankton for the Kansas River system, including all of its tributaries. A University of Kansas fishery study (Cross & DeNoyelles, 1982), which is the most comprehensive study of its type ever conducted for the lower Kansas River, resulted in the collection of 33 species of phytoplankton. In general, the plankton community in the Kansas River is highly variable and is influenced greatly by seasonal climatic changes and discharges from the reservoirs located along tributaries that convey water within the lower Kansas River basin.

No studies have been identified that address the zooplankton community in the Kansas River (Burns & McDonnell, 1982). Large rivers are not generally suitable to support a large number of zooplankton species or high population densities. Zooplankton requires slow or still water to feed and reproduce; therefore, zooplankton species composition and densities in the Kansas River are expected to be low.

Benthic Organisms

Benthic organisms live on or in the bottom of aquatic ecosystems. Of five studies reviewed that address benthic organisms, four were conducted in the Kansas City area and one was conducted in the Lawrence area. The greatest number of species collected (65) were recorded by Cross and DeNoyelles (1982). The species collected for all of the studies reviewed suggest a somewhat polluted environment in the lower river, although this condition appears to be improving (Burns & McDonnell, 1982). A major limiting factor for benthic organisms in the Kansas River is the pronounced shifting of the sandy substrate found throughout the river. The continuous shifting of the bed limits the ability of benthic organisms to colonize on or in the substrate.

Fish and Mollusks

A large number of fish species have been found in the Kansas River. Many of the species found in the river are typical of large, turbid rivers and include rough, game and forage species in the sunfish, minnow, sucker, catfish, gar, bass, perch, and drum families. The presence and abundance of various fish species at any location in the river is generally determined by their preference for specific habitat types such as pools, riffles or tributaries. Table 27 lists the state listed aquatic species in the Project Area and describes their general habitat and potential impacts.

The Kansas River is characterized by a constantly shifting sandy substrate, and by a lack of fish habitat diversity. Both are limiting factors for fish populations. Additional information on fish populations in the Kansas River can be found in Cross and DeNoyelles (1982), Burns & McDonnell (1982), and Fischer et al. (2012).

Table 27 State Listed Aquatic Wildlife Species in the Project Area

Common Name *Scientific Name*	Federal Status	KS Status	MO Status	General Habitat	Potential Impacts
Fish					
Blackside darter *Percina maculata*		T		This species inhabits cool, clear, medium-sized streams where it occupies shallow pools having moderate current and bottoms of clean gravel. Spawns in gravel pools greater than 1 foot deep.	None. Found only in Mill Creek in Wabaunsee County 22 miles upstream from the Kansas River.
Flathead chub *Platygobio gracilis*		T	E	The Flathead chub occurs from the Rio Grande to the Arctic Circle in small creeks and the largest rivers that have turbid fluctuating water levels and unstable sand bottoms. As with several other plains fishes, the chub relies on flood flows to successfully spawn.	None. Only documentation in Kansas since 1995 has been in the upper reaches of the Arkansas River and in the South Fork Nemaha River. Kansas designated critical habitat includes all reaches of the main stem of the Kansas River from the point it enters Douglas County at River Mile 71.3 to its confluence with the main stem Missouri River and all reaches of the main stem Missouri River congruent with the Kansas-Missouri border.
Hornyhead chub *Nocomis biguttatus*		T		The hornyhead chub formerly occurred in small to medium sized, moderate to low gradient, clear gravelly streams throughout most of the Kansas River and Marais des Cygnes River basins. It prefers pools and slow to moderate runs and is often associated with aquatic plants. Requires gravel areas free of silt for spawning. Spawns from late April through early July.	None. Habitat requirements not supported in the Kansas River.
Pallid sturgeon *Scaphirhynchus albus*	E	E	E	Main channel of large excessively turbid rivers, frequenting areas of swift currents over sand substrate.	In Kansas, pallid sturgeons are restricted to the main stem of the Missouri River. Although pallid sturgeons have occurred in the Kansas River at Lawrence (below Bowersock Dam) during flood flows, the river does not seem to provide permanent suitable habitat.
Plains minnow *Hybognathus placitus*		T		This species needs sufficient water flow and flow rates with high and low extremes in order to complete its life cycle. The plains minnow is partly herbivorous. It feeds in schools near the bottom where sediments accumulate on sandy substrates. High flows during the summer trigger spawning and the semi-buoyant eggs hatch as they are carried downstream where flow is more reliable.	The Missouri and Kansas Rivers are Kansas designated critical habitat. The plains minnow could potentially be impacted by Kansas and Missouri River dredging.

Table 27 State Listed Aquatic Wildlife Species in the Project Area

Common Name *Scientific Name*	Federal Status	KS Status	MO Status	General Habitat	Potential Impacts
Shoal chub *Macrhybopsis hyostoma*		T		Inhabits shallow riffles of large low-gradient streams of shifting sand.	Species is currently found in the Republican and lower Kansas rivers. However, it is now considered rare in the Kansas River where it was once abundant. Kansas River dredging could potentially impact the shoal chub, as the Kansas designated critical habitat is the main stem of the Kansas River from its start at the confluence of the Republican and Smoky Hill Rivers in Geary County to its confluence with the Missouri River in Wyandotte County, but it is not likely due to its rare presence in the Kansas River.
Shovelnose sturgeon *Scaphirhynchus platorynchus*	T			Inhabits main channel of large rivers with swift currents and firm substrate. Can be found in deep scours or along sand and gravel bars during certain times of the year.	Species occurs in the Missouri River. Take prohibitions only apply to activities associated with commercial fishing.
Sicklefin chub *Macrhybopsis meeki*		E		Sicklefin chubs require continuously and heavily turbid waters of large rivers where it frequents areas of strong current flowing over sand or gravel substrate.	Range historically restricted to the Missouri River and lower reach of the Kansas River. The USFWS removed this species from the federal candidate list in 2001. The Kansas River does not provide suitable permanent habitat for the sicklefin chub.
Silver chub *Macrhybopsis storeriana*		E		The silver chub is a fish of large sandy rivers. It lives on or near the bottom where it finds food by sight or taste. It is found in deep water during the summer months.	Kansas designated critical habitat includes the Missouri River bordering Kansas and the Kansas River from the confluence of Republican and Smoky Hill rivers (Ft. Riley) to the Missouri River. No documented occurrences in the Kansas River since 1980. Kansas and Missouri River dredging could potentially impact the silver chub but it is not likely.

Table 27 State Listed Aquatic Wildlife Species in the Project Area

Common Name *Scientific Name*	Federal Status	KS Status	MO Status	General Habitat	Potential Impacts
Sturgeon chub *Macrhybopsis gelida*		T		Sturgeon chubs prefer large turbid sandy rivers over substrate of small gravel and coarse sand. They like areas swept by currents especially at heads of islands or exposed sandbars.	Range historically restricted to the Missouri River and lower reach of the Kansas River. The USFWS removed this species from the federal candidate list in 2001. Kansas River dredging could potentially impact the sturgeon chub, as the Kansas designated critical habitat is the main stem of the Kansas River from its start at the confluence of the Republican and Smoky Hill Rivers in Geary County to its confluence with the Missouri River in Wyandotte County, but it is not likely.
Topeka shiner *Notropis topeka*	E	T	E	Near the headwaters of small prairie streams with high water quality and cool temperatures. These streams generally exhibit intermittent flow during the summer, however pools are maintained by springs or groundwater percolation. The substrates of these streams are most often clean gravel, however bedrock and clay hardpan overlain by a thin silt layer are not uncommon. Topeka shiners most often occur in pool and run areas.	The Kansas and Missouri Rivers are not suitable Topeka shiner habitat. The Topeka shiner is known to occur in Mission Creek main stem in Shawnee County from where it crosses State Highway 4 (more than eight miles from the Kansas River) upstream into Wabaunsee County, in Mill Creek and its tributaries in Wabaunsee County from where it crosses I-70 (more than 22 miles from the Kansas River) upstream to where it crosses State Highway 99, and in Deep Creek main stem in Riley County from where it crosses the Riley/Wabaunsee County line (1.5 miles from the Kansas River) upstream to I-70. Two feet of bed degradation on the Kansas River is not likely to cause headcutting up to these reaches of these streams. Kansas River dredging is not anticipated to adversely affect the Topeka shiner.
Western silvery minnow *Hybognathus argyritis*		T		This species historically occurred in the Missouri River and the creeks and backwaters of its floodplain, and was common in the lower Kansas River. It prefers relatively deep water where flow is sluggish and bottoms are silted, but it does occur in strong currents of the mainstream.	None. Habitat requirements are not supported in the Kansas River.

Table 27 State Listed Aquatic Wildlife Species in the Project Area

Common Name *Scientific Name*	Federal Status	KS Status	MO Status	General Habitat	Potential Impacts
Invertebrates					
Flat floater mussel *Anodonta suborbiculata*		E		In Kansas, the flat floater mussel seems to prefer shallow areas of relatively permanent oxbow lakes having organically rich mud bottoms. This preferred habitat is subject to water level changes due to fluctuations in runoff water and flood flows that recharge oxbow lakes. Flat floaters appear, however, to be able to repopulate suitable areas when favorable habitat conditions return.	None. The current probable range of the flat floater in Kansas is restricted to the lower reaches of the Neosho and Marais des Cygnes Rivers.
Mucket mussel *Actinonaias ligamentina*		E		The species is generally found in large creeks and small to medium rivers with gravel, gravel-sand and gravel-silt substrates with moderate to swift currents.	None. Historically, the mucket was never widespread in Kansas, occurring along the Marais des Cygnes River from Osage County to the Missouri State line. The species is currently known from only two locales along the Marais des Cygnes River in Franklin and Miami counties.

3.10.2 Environmental Consequences

Environmental consequences associated with impacts to terrestrial and aquatic resources are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.10.2.1 Proposed Action

Direct Impacts

TERRESTRIAL RESOURCES

All of the processing plants associated with existing dredging activities on the river are in place and are not likely to be relocated in the near future. Most of the impacts to terrestrial resources associated with existing land-based operations have occurred and are not anticipated to measurably increase over time. These impacts may entail the expansion of pits, temporary storage and material stockpile areas and equipment and maintenance areas into agricultural areas surrounding the plant sites. Minor modifications to the size, shape or extent of an existing processing plant site could, however, occur due to operational needs of a dredging company but direct impacts to terrestrial resources are not anticipated to be more than minimal.

AQUATIC RESOURCES

Direct impacts to aquatic resources would primarily be related to disturbance of the bed as a result of dredging operations. Disturbance of the bed would not be expected to have a measurable impact on plankton populations but could impact fish and benthic organisms due to short-term and long-term impacts to shallow water depths, and the shape and composition of the bed. Harvey (1986) and Rempel and Church (2009) concluded that dredging had no significant effects on macroinvertebrates. Harvey (1986) concluded that the influence of dredging on benthic organisms was highly localized and that fish and invertebrates were influenced more by natural abiotic variations than by dredging. Fischer et al. (2012) concluded, "*Our study found little direct effect of sand dredging on the fish community of a Great Plains sand bed river.*"

All of the processing plants associated with existing dredging activities on the river are in place and are not likely to be relocated in the near future. Therefore, most of the impacts to aquatic resources such as wetlands associated with existing land-based operations, have occurred and are not anticipated to measurably increase over time. Expanding processing plants in streams and wetlands would likely require a Department of the Army permit under Section 404 of the CWA which would address avoidance, minimization, and appropriate compensatory mitigation for the aquatic resources impacted. The USACE would require the avoidance of higher quality aquatic habitat and compensatory mitigation for unavoidably impacted aquatic habitat. Impacted aquatic habitat would probably be replaced at least at a one-to-one ratio by the creation or restoration of similar aquatic habitat in either a mitigation bank or on-site. Direct impacts to aquatic resources are not anticipated to be more than minimal.

Indirect Impacts

TERRESTRIAL RESOURCES

Indirect impacts to terrestrial resources could result from plant expansion or development of roads and other public infrastructure to support increased dredging and additional truck traffic to and from processing plants. Potential indirect impacts include habitat fragmentation and changes to the vigor and composition of terrestrial plant life related to bed degradation and an associated reduction in ground water elevations. Habitat fragmentation resulting from the loss of terrestrial habitats may isolate wildlife communities and impact reproductive opportunities for some species. Indirect impacts to terrestrial resources are not anticipated to be significant however due to the small footprint of the existing plant sites in relation to the total amount of these resources available within the floodplain

AQUATIC RESOURCES

Indirect impacts to aquatic resources would primarily be related to bed degradation and changes in the composition of bed materials. Bed degradation would not be expected to have a measurable impact on plankton populations but could impact fish and benthic organisms due to long-term impacts to shallow water depths in some areas of the river, especially shoreline and backwater areas. Bed degradation could cause a loss of riverbank stability, which could cause sloughing of riverbank materials into shallow water areas along the shoreline. Bed degradation would not be expected to significantly impact sandbars since a gradual decline in bed elevations would typically result in a corresponding decline in water surface elevations. However, bed degradation in backwater areas (Missouri River backwater, WaterOne weir, Bowersock Dam, and the Topeka municipal water supply weir) could have an exaggerated impact on shallow water areas since degradation in these areas would result in a corresponding increase in water depths. Riverbed degradation could also lower water table elevations in the floodplain, which could affect wetland communities (see Chapter 3, Section 3.9 for a discussion of potential impacts to wetlands). The long-term removal of sand and gravel from the river could result in a shift in the composition of the riverbed to finer particle sizes. Changes to the composition of the river's substrate could, in turn, affect benthic organisms and fish populations. Based on the USACE's Regulatory Plan, which stipulates that any 5-mile-long reach of river that degrades an average of 2 feet below the 1992 baseline elevations established for that reach will be closed to further dredging, indirect impacts to aquatic resources are not however anticipated be more than minimal. This conclusion is based upon overall extraction limits by river reach, the maintenance of similar bed elevations over time and the natural recruitment of new aggregate materials into and through the reaches where dredging occurs.

3.10.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. This action would eliminate all impacts from dredging on aquatic resources in the Kansas River. However, the No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations) all have a potential to impact Terrestrial and Aquatic resources.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

TERRESTRIAL RESOURCES

The No-Action Alternative would most likely result in an increase in pit dredging operations in the Kansas and possibly the Missouri River floodplains. Opportunities to develop floodplain pit dredging sites for sand and gravel production are primarily limited to available lands outside urban and industrialized areas. Much of these areas are pasture, crops lands, and forest land which all provide terrestrial habitat to some degree. Direct impacts associated with pit dredging operations would primarily result from construction of new pit dredging sites, expansion of existing dredge pits, and access roads for processing, storage, and sale of aggregate materials. Construction or expansion of processing plants could result in short-term and long-term losses of terrestrial habitat, altered composition of vegetation, altered habitat functions, and impacts to wildlife from habitat fragmentation and loss. In order to accommodate the current Kansas River production level of 1,500,000 tons of sand and gravel per year, the average market demand since 2000, it is estimated that 25 to 34 acres of land would need to be converted to pit dredging operations each year (Blechinger, 1997; Booker Associates, 1986). Direct impacts to terrestrial resources are not anticipated to be significant due to the scarcity of available and suitable floodplain sites for performing this type of operation within the existing market areas. Local zoning and permit considerations regarding land use, noise and roadway restrictions further limit this alternative.

AQUATIC RESOURCES

Constructing or expanding floodplain pit dredging sites could directly impact aquatic resources such as streams and wetlands by mechanized clearing of the vegetation or top soil, filling with base material or concrete for buildings or roads, dredging through the wetland or stream, or discharging processing water and waste material into the wetland or stream. These actions could decrease aquatic habitat quantity or quality. For example, discharging process water and waste material directly into a wetland or stream could result in habitat degradation through filling of interstitial spaces in stream substrates and decreased depths of pools that are habitat for larger fish species. Constructing or expanding a dredge pit in streams and wetlands would likely require a Department of the Army permit under Section 404 of the CWA which would address avoidance, minimization, and appropriate compensatory mitigation for the aquatic habitat impacted. The USACE would require the avoidance of higher quality aquatic habitat and compensatory mitigation for unavoidably impacted aquatic habitat. Impacted aquatic habitat would probably be replaced at least at a one-to-one ratio by the creation or restoration of similar aquatic habitat in either a mitigation bank or on-site as part of the site reclamation. For these reasons, direct impacts to aquatic resources are not anticipated to be significant.

Indirect Impacts

TERRESTRIAL RESOURCES

Indirect impacts to terrestrial resources could result from the expansion or development of roads and other public infrastructure to support additional truck traffic to and from pit dredging sites. Indirect impacts could include losses of terrestrial areas, altered composition of vegetation, altered habitat functions, and impacts to wildlife from habitat fragmentation and loss habitat fragmentation. Habitat fragmentation resulting from the loss of terrestrial habitat may isolate wildlife communities, which could impact reproductive opportunities for some species. The long-term impact could become significant over time; however, these issues cannot be fully evaluated at this time since the number and location of potential additional pit dredging sites is unknown.

AQUATIC RESOURCES

Constructing or expanding a floodplain pit dredging site or associated public roads or infrastructure could result in destruction of stream or wetland habitat and introduction of contaminants and sediment via storm water runoff. These changes in water quality could result in decreased aquatic habitat quality or quantity. For example, the increased introduction of sediment in water bodies from site runoff could result in habitat degradation through filling of interstitial spaces in stream substrates and decreased depths of pools that are habitat for larger fish species. Additional aquatic habitat alteration from floodplain open-pit mining would occur if the excavation pit was captured by the active stream channel during flooding, which would cause an abrupt relocation of the channel and extensive channel instability. Captured pits that are large relative to the stream channel create lake-like environments that can locally change aquatic habitat type and conditions and the associated biological community. Constructing or expanding a floodplain pit dredging site or associate public roads or infrastructure in streams and wetlands would likely require a Department of the Army permit under Section 404 of the CWA which may require avoidance, minimization, and appropriate compensatory mitigation for the aquatic resources impacted.

Crushed Limestone from Quarry Operations

Direct Impacts

Direct impacts to terrestrial and aquatic resource would be similar to those shown for floodplain pit dredging operations. However, the total area displaced by quarries over time would most likely be less than the area required for dredge pits, since crushed limestone is a less desirable material for use in concrete than sand and gravel extracted from dredge pits. Direct impacts to terrestrial and aquatic resources could become significant over time depending upon the total acreage of land converted to quarry operations.

Indirect Impacts

Indirect impacts to terrestrial and aquatic resources would be similar to those identified for pit dredging operations in the Kansas and Missouri River floodplains.

3.10.2.3 Reduced Limit Alternative

Direct Impacts

TERRESTRIAL RESOURCES

Direct impacts to terrestrial resources would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the dredging of less sand and gravel annually than the Proposed Action, it would not be likely to result in a reduction in the total number of processing plants on the floodplain. Therefore, selection of the Reduced Limit Alternative would not be likely to result in significantly reduced impacts to terrestrial resources relative to the Proposed Action. For this reason, direct impacts to terrestrial resources are not anticipated to be significant.

AQUATIC RESOURCES

Direct impacts to aquatic resources would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the dredging of less sand and gravel annually than the Proposed Action, it would not be likely to reduce the total number of dredging operations on the river. It is possible that higher annual dredging limits associated with the Proposed Action could result in a rate of bed degradation exceeding the rate for the Reduced Limit Alternative. However, the USACE's Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet below the 1992 baseline elevations established for that reach will be closed to further dredging. Therefore, selection of the Reduced Limit Alternative is not likely to result in reduced indirect impacts to aquatic resources relative to the Proposed Action.

Indirect Impacts

TERRESTRIAL RESOURCES

Indirect impacts to terrestrial resources would be similar to those identified for the Proposed Action.

AQUATIC RESOURCES

Although selection of the Reduced Limit Alternative could result in the dredging of less sand and gravel annually than the Proposed Action, it would not be likely to reduce the total number of dredging operations on the river. It is possible that higher annual dredging limits associated with the Proposed Action could result in an increased rate of bed degradation exceeding that for the Reduced Limit Alternative. However, due to the bed degradation limit of the Regulatory Plan, a reach would be closed to further dredging under either action. Selection of the Reduced Limit Alternative is not likely to result in measurable reduced impacts to aquatic resources relative to the Proposed Action.

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3.11 FEDERALLY LISTED SPECIES

3.11.1 Affected Environment

The following section discusses the occurrence and status of animal and plant species that are listed as threatened or endangered under the ESA of 1973 (50 CFR Section 402.02), and describes the habitat necessary to support those species. The term ‘‘endangered species’’ means any species that is in danger of extinction throughout all or a significant portion of its range. The term ‘‘threatened species’’ means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. “Candidate species” are plants and animals for which the USFWS has sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

State-listed species of conservation concern, federal candidate and delisted species, migratory birds, and other sensitive species are addressed in Section 1.1 (Terrestrial and Aquatic Resources). Information presented relating to species occurrence and life history is based on available literature, correspondence and communications with federal and state agencies, websites, and a thorough review of state natural heritage programs.

The ESA is the primary federal law protecting threatened and endangered species. The ESA and its subsequent amendments provide for the protection and conservation of federally listed species and the habitats upon which they depend. Under Section 7 of the ESA, federal agencies (such as the USACE) are required to consult with the USFWS to ensure that any federal undertaking would not likely jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat. “Critical habitat” refers to specific geographic areas that contain features essential for the conservation of a threatened or endangered species, and that may require special management and protection.

The Action Area for purposes of this report is the Kansas River and its floodplain, beginning at the confluence of the Smoky Hill and Republican Rivers near Junction City and ending at its confluence with the Missouri River at Kansas City.

3.11.1.1 Consultation with the US Fish and Wildlife Service

In response to the USACE's request for comments during the agency's last permit evaluation in 2006, the USFWS requested an analysis of impacts to four listed species, which included the interior least tern (federally listed as endangered), the piping plover (federally listed as threatened), the pallid sturgeon (federally listed as endangered), and the bald eagle (no longer listed but covered under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act). On March 20, 2006 the USACE initiated informal consultation with the USFWS under Section 7 of the ESA during which it determined that the proposed dredging was not likely to adversely affect the four listed species. In a letter dated April 13, 2006 the USFWS concurred with the USACE's determination.

The USFWS responded to the USACE's November 9, 2011 public notice describing the Dredgers current Kansas River dredging permit applications by providing a comment letter dated December 9, 2011. The USFWS comment letter informed the USACE that a Kansas State University study was ongoing that, when completed, might provide new information concerning the impact of dredging on fish communities in the Kansas River. The USFWS requested that the information provided in the Kansas State University study and other new information be included in the current review of potential dredging-related impacts to federally listed species. The USFWS requested that the USACE’s previous EA, for the proposed activities, consider any new and updated information on potential impacts to the interior least tern, piping plover, pallid sturgeon and bald eagle. During the 2015 public scoping period of the EIS, the USFWS furnished written comments regarding the federally listed species within the project area. The species included the previously mentioned species and also included one additional listing for the northern long-eared bat (*Myotis septentrionalis*).

3.11.1.2 Federally Listed Species

The Kansas Biological Survey Natural Heritage Inventory and the KDWPT Web site were reviewed to determine the potential for occurrence of listed plant and animal species in the Action Area. Table 28 provides a list of the federal listed species identified in the Action Area. Table 28 also includes a brief description of habitat, their likelihood of occurrence in the Action Area, and a preliminary determination of effects.

A total of 11 federally listed species that may potentially occur in the Action Area were identified by USACE. Four of these species were carried forward for further analysis and include the interior least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), pallid sturgeon (*Scaphirhynchus albus*) and the northern long-eared bat (*Myotis septentrionalis*).

During the public scoping period in 2015, the USFWS commented that they identified four terrestrial and three aquatic species as occurring in the project area. The terrestrial species protected under the ESA included the interior least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), northern long-eared bat (*Myotis septentrionalis*) and Mead's milkweed (*Asclepias meedii*). Aquatic species identified by USFWS included the pallid sturgeon (*Scaphirhynchus albus*), shovelnose sturgeon (*Scaphirhynchus platorynchus*) and Sturgeon Chub (*Scaphirhynchus platorhynchus).* Of the 3 aquatic species identified, only the pallid sturgeon is currently protected under the ESA as it relates to the federal action.

A detailed description of the remaining endangered species carried forward for more review is provided below including an assessment of potential impacts related to each of the alternatives considered.

Interior Least Tern

The interior population of the least tern (*Sterna antillarum*) was listed as endangered on June 27, 1985 (50 Federal Register [FR] 21,784-21,792) (USFWS, 1990). The USFWS has the authority to designate areas of critical habitat for federally listed endangered species, but has not done so for the interior least tern in Kansas.

The interior least tern is a migratory species recognized as having distinct interior and coastal populations. The interior population occurs along major rivers in the interior United States, including the Missouri and Mississippi Rivers and their major tributaries. The coastal populations breeding areas include the Pacific Coast south of the San Francisco Bay, the Gulf Coast, and the Atlantic Coast up to central Maine. The interior least tern winters in coastal areas of Central and South America.

The interior least tern is the smallest North American tern and is a colonial nester (Thompson, et al., 1997). Shallow nests, or scrapes, are built in sand or fine substrate gravel with sparse vegetation. A 2005 breeding bird distribution survey (Lott, 2006) found that, although interior least tern populations occurred over much of the species historical range, populations were limited to locations with suitable nesting habitat along rivers and lake shorelines. Colonies were also identified in sand pits, industrial sites, alkali flats, and on rooftops (Lott, 2006). The 2005 breeding bird distribution survey identified 17,591 interior least terns (Lott, 2006).

The interior least tern is primarily piscivorous (fish-eating) but may occasionally consume aquatic invertebrates (Thompson, et al., 1997). Least terns feed in shallow waters of rivers and reservoirs by hovering over and diving into the water to catch fish (USFWS, 1990).

The USFWS published a recovery plan for the interior population of least terns in 1990 (USFWS, 1990). The recovery plan identified threats to the species, which included the physical and functional loss of breeding habitat due to river management actions. Loss of habitat results from channelization, dredging, and impoundment of rivers, which eliminates nesting habitat. Nesting habitat is also functionally affected by managed water levels, which have the potential to inundate occupied or potential nesting habitat.

In 1996, the interior least tern was discovered nesting on several recently scoured sand bars in the Kansas River, in Wabaunsee County, between the cities of Manhattan and Wamego. This was the first documented account of least terns nesting on the Kansas River (Busby et al., 1997). In the same year USFWS documented a total of seven breeding pairs. In the following year, five breeding pairs of least terns were documented on the river. It is suspected that recent occurrences of least terns can be attributed to scour events following the 1993 flood, which removed riparian vegetation and created new sandbars (Busby et al., 1997).

From 1998 to 2005, 99 pairs of interior least terns nested on the Kansas River, with an average of 12 nesting pairs each year. These birds successfully fledged 47 juveniles (USACE, 2005).

Piping Plover

The piping plover (*Charadrius melodus*) was federally listed on December 11, 1985 (50 FR, 50726–50734) (USFWS, 1988). The U.S. Fish and Wildlife Service has the authority to designate areas of critical habitat for federally listed endangered species, but has not done so for piping plover in Kansas.

Table 28 Federally Listed Species

Common Name	Federal Status	General Habitat	Potential Impacts
American burying beetle *Nicrophorus americanus*	Endangered	Frequently found in upland grasslands or near the edge of grassland/forest. Sandy/clay loam soils and food (carrion) availability are also important. The species appears to prefer loose soil in which carrion can be easily buried.	Since 1996, populations were found in four southeast counties in Kansas. Douglas, Pottawatomie, Riley, and Shawnee were the only counties in the Project area with recorded historic occurrences; however, no designated critical habitat has been identified in these counties. Grasslands and forests occupy approximately 21 percent of the Kansas River floodplain while cropland occupies 60 percent. Therefore, floodplain pit dredging is not anticipated to adversely affect the American burying beetle. Not carried forward for further discussion in the Environmental Consequences of this Section 3.11.
Least tern *Sterna antillarum*	Endangered	Barren areas near water such as saline flats in salt marshes, sand bars in river beds, and shores of large impoundments.	Least terns are summer residents of Kansas. Nesting birds have been recorded in six central and western Kansas counties, Jeffery Energy Center, and along the Kansas River. The following counties associated with the Project contain critical habitat for piping plover: Douglas, Geary, Jefferson, Johnson, Leavenworth, Pottawatomie, Riley, Shawnee, Wabaunsee, and Wyandotte. Kansas River dredging and floodplain pit dredging are not anticipated to adversely affect the least tern. Carried forward for further discussion in the Environmental Consequences of this Section 3.11.
Mead's Milkweed *Asclepias meadii*	Threatened	Mesic to dry tallgrass and upland prairies with sandstone or chert bedrock, prairie hay meadows, railroad right-out-way prairie remnants, virgin mesic silt loam prairies, and in igneous glades.	Remnant virgin prairies are very rare on the Kansas and Missouri River floodplains because most of the floodplain has been cultivated. Floodplain pit dredging is not anticipated to adversely affect the Mead's Milkweed. Not carried forward for further discussion in the Environmental Consequences of this Section 3.11.

Table 28 Federally Listed Species

Common Name	Federal Status	General Habitat	Potential Impacts
Northern long-eared bat *Myotis septentrionalis*	Threatened	The bats may roost singly or in colonies in hibernacula (primarily caves and mines) and underneath bark, in cavities, or in crevices of both live and dead trees. The bats have also been found, rarely, roosting in structures like barns and sheds.	River dredging is not anticipated to adversely impact the Northern long-eared bat because the species is terrestrial in nature and the dredging operations would not impact suitable habitat. Carried forward for further discussion in the Environmental Consequences of this Section 3.11.
Pallid sturgeon *Scaphirhynchus albus*	Endangered	Main channel of large excessively turbid rivers, frequenting areas of swift currents over sand substrate.	In Kansas, pallid sturgeons are restricted to the main stem of the Missouri River. Although pallid sturgeons have occurred in the Kansas River at Lawrence (below Bowersock Dam) during flood flows, the river does not seem to provide permanent suitable habitat. Carried forward for further discussion in the Environmental Consequences of this Section 3.11.
Piping plover *Charadrius melodus*	Threatened	Sparsely vegetated shallow wetlands and open beaches and sandbars adjacent to or within streams and impoundments.	Piping plovers are rare migrants through Kansas. Nesting has been recorded on sand bars along the Kansas River. The following counties contain critical habitat for piping plover: Douglas, Geary, Jefferson, Johnson, Leavenworth, Pottawatomie, Riley, Shawnee, Wabaunsee, and Wyandotte. Kansas River dredging and floodplain pit dredging are not anticipated to adversely affect the piping plover. Carried forward for further discussion in the Environmental Consequences of this Section 3.11.
Shovelnose sturgeon *Scaphirhynchus platorynchus*	Threatened	Inhabits main channel of large rivers with swift currents and firm substrate. Can be found in deep scours or along sand and gravel bars during certain times of the year.	Species occurs in the Missouri River. Take prohibitions only apply to activities associated with commercial fishing. Not carried forward for further discussion in the Environmental Consequences of this Section 3.11.

Table 28 Federally Listed Species

Common Name	Federal Status	General Habitat	Potential Impacts
Sprague's pipit *Anthus spragueii*	Candidate	A ground nester that breeds and winters on open grasslands.	Species occurs in native prairie habitat and breeds in the north-central United States in Minnesota, Montana, North Dakota, and South Dakota, as well as south-central Canada. Wintering occurs in Arizona, Texas, Oklahoma, Arkansas, Mississippi, Louisiana, and New Mexico. The Kansas River corridor is not suitable habitat for the Sprague's pipit. Not carried forward for further discussion in the Environmental Consequences of this Section 3.11.
Topeka shiner *Notropis topeka*	Endangered	Near the headwaters of small prairie streams with high water quality and cool temperatures. These streams generally exhibit intermittent flow during the summer, however pools are maintained by springs or groundwater percolation. The substrates of these streams are most often clean gravel, however bedrock and clay hardpan overlain by a thin silt layer are not uncommon. Topeka shiners most often occur in pool and run areas.	The Kansas and Missouri Rivers are not suitable Topeka shiner habitat. The Topeka shiner is known to occur in Mission Creek main stem in Shawnee County from where it crosses State Highway 4 (more than eight miles from the Kansas River) upstream into Wabaunsee County, in Mill Creek and its tributaries in Wabaunsee County from where it crosses Interstate Highway 70 (more than 22 miles from the Kansas River) upstream to where it crosses State Highway 99, and in Deep Creek main stem in Riley County from where it crosses the Riley/Wabaunsee County line (1.5 miles from the Kansas River) upstream to Interstate Highway 70. Two feet of bed degradation on the Kansas River is not likely to cause headcutting up to these reaches of these streams. Kansas River dredging is not anticipated to adversely affect the Topeka shiner. Not carried forward for further discussion in the Environmental Consequences of this Section 3.11.
Western Prairie Fringed Orchid *Platanthera praeclara*	Threatened	Grows on mesic to wet sections of native upland and bottomland prairies. The biggest threat to populations is the invasion of prairies by woody species and the possibility of prairies being plowed.	Remnant virgin prairies are very rare on the Kansas and Missouri River floodplains because most of the floodplain has been cultivated. Floodplain pit dredging is not anticipated to adversely affect the Western Prairie Fringed Orchid. Not carried forward for further discussion in the Environmental Consequences of this Section 3.11.

Table 28 Federally Listed Species

Common Name	Federal Status	General Habitat	Potential Impacts
Whooping crane *Grus americana*	Endangered	Preferred resting areas are wetlands in level to moderately rolling terrain away from human activity where low, sparse vegetation permits ease of movement and an open view.	Regular spring and fall transients through Kansas. Douglas, Geary, Jefferson, Riley, and Shawnee are the only counties in the Project area with recorded historic occurrences; however, no designated critical habitat has been identified in these counties. Kansas River dredging and floodplain pit dredging are not anticipated to adversely affect the whooping crane. Not carried forward for further discussion in the Environmental Consequences of this Section 3.11.

The piping plover is a migratory species recognized as having distinct interior and coastal populations. The interior populations include the Great Lake–Big Rivers population and those that occur in the Great Plains region. This Great Plains population breeds along major rivers in the interior United States, including the Missouri and Mississippi Rivers and their major tributaries. The coastal populations nest on sandy substrate on barrier islands, beaches, and estuaries on the Atlantic Coast from North Carolina to Maine. The piping plover winters on the Atlantic and Gulf Coasts from North Carolina to Texas, Mexico, Central America, and the Caribbean.

The piping plover is a small (6-7 inches long) whitish plover the color of dry sand. It has a narrow black band above the forehead which reaches from eye to eye, a complete or incomplete dark ring around the neck, and yellow legs. In summer, the bill is yellow with a dark tip. In winter the bill and legs are dark.

Historical breeding habitat primarily consisted of unvegetated sand bars within major river systems, alkali wetlands, and reservoir and lake shorelines with suitable nesting substrate (USFWS, 1988). Piping plovers feed on freshwater and marine benthic invertebrates and terrestrial invertebrates (Elliot-Smith & Haig, 2007) found in shallow water near the shoreline or on beaches (USFWS, 1988). They require sparsely vegetated shallow wetlands and open beaches for foraging near sparsely vegetated islands or sandbars adjacent to or within streams and impoundments that are suitable nesting habitat. Piping plover nests consist of shallow scrapes on sand bars, beaches, or shorelines. Nesting has been recorded on sand bars along the Kansas River. Piping plovers may occasionally occur throughout the state, where suitable habitat is found.

The USFWS published a recovery plan for the Great Lakes and Great Plains piping plover (USFWS, 1988). The Great Plains region, as defined for the recovery plan, did not include rivers in Kansas. The recovery plan identified threats to this species as the physical and functional loss of breeding habitat due to recreational activities and river management actions. Recreational effects to habitat include vehicular and pedestrian traffic in suitable nesting sites. Channelization, dredging, and impoundment of rivers can also eliminate sand bar nesting habitat.

Two breeding pairs of piping plover were documented on the Kansas River in 1996 by researchers (Busby et al., 1997). These were the first documented piping plover nest sites ever recorded in Kansas (Boyd & Olsen, 2006) (USACE, 2006). Since 1998, 21 pairs of piping plovers nested on the Kansas River with an average of two to three pairs nesting on the river annually. Since 2000 (when more intensive piping plover monitoring was initiated on the Kansas River), 23 piping plover nests were observed including reestablishment of nests by several pairs that lost their initial nests (USACE, 2006).

The USFWS's 1998 recovery plan goal was to establish 465 piping plover breeding pairs throughout their range. The number of breeding pairs has increased steadily since 1998, until it surpassed the recovery plan goal in 2005. The number of breeding pairs has fluctuated below the recovery plan goal since 2005, but has been approximately three times the baseline number of breeding pairs identified in the recovery plan (USFWS, 2009a) (USFWS, 2009b).

Pallid Sturgeon

The pallid sturgeon *(Scaphirhyncus albus)* was listed as endangered on September 6, 1990 (55 FR 36641). The U.S. Fish and Wildlife Service has the authority to designate areas of critical habitat for federally listed endangered species, but has not done so for the pallid sturgeon.

The pallid sturgeon may reach a length of 60 inches. However, no Kansas specimens have been recorded that were longer than 30 inches. The belly is entirely naked of scales and the barbels across the snout are unequal in length with the outer pair being longer. The pallid sturgeon prefers the main channel of large excessively turbid rivers and frequent areas with swift currents over a firm sand substrate.

The pallid sturgeon is morphologically adapted to life in swift waters on the bottom of large, turbid, free-flowing rivers (Kallemeyn, 1983 and Gilbraith et al., 1988). This species evolved in the diverse environments of the Missouri and Mississippi Rivers where the floodplain, backwaters, chutes, sloughs, islands, sand bars, and main channel provided numerous microhabitats (USFWS, 1993). Historically, these habitats were subject to constant change. Since the 1950s, construction of dams on the upper Missouri River has resulted in dramatic long-term changes to the character of the river (Busby et al., 1997). The construction of dams in the Kansas River basin has also changed the character of the Kansas River.

According to the USFWS (2003), the pallid sturgeon has been captured in tributary mouths, over sandbars, along main channel borders, and in deep holes. Tagged wild pallid sturgeon have been found to move short distances up some tributaries, which suggests that pallid sturgeon use tributaries opportunistically for feeding when conditions allow (DeLonay, et al., 2009). In addition, small pallid sturgeon have been captured in off-channel shallow-water habitat areas (USFWS, 2003).

Pallid sturgeon primarily use main channel, secondary channel, and channel border habitats throughout their range. The most recent information suggests that the species spend the majority of their time at or near the river bottom where relative depths exceed 75 percent of the maximum channel cross section as expressed as a percent. (USFWS 2014 Recovery Plan). Juvenile and adult pallid sturgeon are rarely observed in habitats lacking flowing water, such as backwaters or sloughs. DeLonay and Little (2002) reported that sturgeon were often found in locations of turbulence where currents vary by as much as 1.5 meters per second (m/s). They also found that sharp changes in bottom relief and the position of the channel thalweg appear to have greater influence over sturgeon location than depth, substrate, or velocity. In Missouri River sampling efforts of newly released pallid sturgeon hatchery larvae, the concentration increased as sampled from the inside bend towards the outside bend across the river channel with the highest concentration found near the bottom in the high-velocity thalweg of the channel (Braaten et al. 2010).

Population monitoring for the species in the lower Kansas River is accomplished by the Missouri Department of Conservation (MDC). Data regarding pallid collection and surveys for the Kansas River are found in Annual Reports “Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segment 11”. These reports are prepared in association with the Missouri River Recovery Program. The study area for Segment 11 described in the report is restricted to the Kansas River from Lawrence, Kansas to the confluence with the Missouri River. The study area is divided into twenty two separate bends in the river at locations between the mouth at RM 0 and Bowersock Dam at RM 52.1. Since sampling in this area began in 2006, a total of 17 individuals have been captured within the 52 mile sampling reach and all were restricted to areas below the Johnson County WaterOne weir at approximate RM 14.7. The capture of a pallid sturgeon in 2007 during sampling represented the first capture of a pallid sturgeon in the Kansas River since 1952 when five were caught just downstream of Bowersock Dam at Lawrence, Kansas. Only one wild pallid sturgeon has been captured since the beginning of sampling by the MDC and that occurred during surveys conducted in 2011.

The primary range and habitat of the pallid sturgeon consists of the Missouri River and portions of the Mississippi River including some of its tributaries downstream of the Mississippi River confluence with the Missouri River (USFWS, 1993). Within the State of Kansas, pallid sturgeon are mainly restricted to the main stem of the Missouri River. The MDC also captured 983 adult shovelnose sturgeon from the Kansas River, both below and above the WaterOne weir. All but 5 of 23 of those young-of-year sturgeon sampled were found above the WaterOne weir. Some of these sturgeon were too small to determine species by external characteristics alone but were most likely shovelnose sturgeon due to the high number of shovelnose compared to pallid sturgeon in the river (Whiteman, Winders, Niswonger and Travnichek, 2012). It is questionable if the Kansas River provides permanent suitable pallid sturgeon habitat (KDWPT, 2011b).

In 1993, the USFWS released the Pallid Sturgeon Recovery Plan (USFWS, 1993). The short-term recovery objective was to prevent species extinction by establishing three captive broodstock populations in separate hatcheries. The long-term objectives were to downlist and, eventually, delist the species through protection, habitat restoration, and propagation activities by 2040 (USFWS, 1993). The Pallid Sturgeon Recovery Plan identified six Recovery Priority Management Areas for implementation of recovery tasks based on the most recent pallid sturgeon records of occurrence and the potential of these areas to contribute to the recovery of the species. Recovery-Priority Management Area 4 is generally the Missouri River below Gavins Point Dam to its confluence with the Mississippi River and specifically the areas 20 miles upstream and downstream of the confluences of the Platte, Kansas, and Osage Rivers.

The USFWS Revised Recovery Plan for Pallid Sturgeon published in 2014, states that the status of the species is currently stable but that the pallid sturgeon continues to be affected by a range of threats. These threats were identified as habitat alteration, water quality, entrainment (Including suction-based dredging operation), climate change, overutilization, disease or predation, inadequacy of existing regulatory mechanisms, effects of new energy development, hybridization with shovelnose sturgeon and invasive species.

SHOVELNOSE STURGEON

The shovelnose sturgeon *(Scaphirhynchus platorhynchus)* was listed as a threatened species due to a close similarity with the pallid sturgeon. Pallid sturgeon have been known to hybridize with shovelnose sturgeon in the wild, and viable offspring have been produced in laboratory settings. The protection of this species under the take provisions of the endangered species act only applies however to commercial fishing operations that could incidentally harvest either of the two species during this activity. No further discussion of the shovelnose sturgeon is warranted for the proposed action.

Northern long-eared bat

The northern long-eared bat (*Myotis septentrionalis*) was listed as threatened species in Kansas on May 4, 2015. No critical habitat has been designated for this species. It is a medium-sized bat with a body length between 3 to 3.7 inches and a wingspan of up to 10 inches. Color can vary between medium to dark brown on the back and are normally a pale-brown on the underside. This bat is distinguished by its long ears, particularly as compared to other bats within the genus, *Myotis*. They emerge at dusk and fly through the understory of forested areas feeding on moths, flies and other insects which they can catch either while in flight using echolocation or by snatching resting insects from vegetation. The northern long-eared bat is found across much of the eastern and north central United States and all Canadian provinces from the Atlantic coast west to the southern Northwest Territories and eastern British Columbia (USFWS, 2015).

Northern long-eared bats begin breeding in late summer or early fall when males begin swarming near hibernacula (primarily caves). After copulation, females store sperm during hibernation until spring, when they emerge from their hibernacula, ovulate, and the stored sperm fertilizes an egg. This strategy is called delayed fertilization. After fertilization, pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup. The bats may roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees (USFWS, 2015). Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices. It has also been found, rarely, roosting in structures like barns and sheds   Adult northern long-eared bats can live up to 19 years (USFWS, 2015).

The most immediate threat to this species is the disease, white-nose syndrome. If this disease had not emerged, it is unlikely the northern long-eared bat would be experiencing such a dramatic population decline. Symptoms were first observed in New York in 2006 and the disease has spread rapidly throughout the northern long-eared bat's most common historical range. A recent estimated number of northern long-eared bats obtained from hibernacula counts show a population decline of up to 99 percent in the Northeast portion of the country. Although there is uncertainty about the rate that white-nose syndrome disease will spread, it is expected to stretch throughout the species' range (USFWS, 2015).

On February 15, 2016, a final rule, 4(d) rule, became effective regarding the environmental assessment and biological opinion for the species (81 FR 1900). In the 4(d) rule, two conservation measures involving tree removal activities were adopted for protection of the species. Conservation measure 1 establishes a 0.25 mile buffer around known and occupied sites for protection of the species from disturbance. Conservation measure 2 restricts activities involving the removal of known and occupied maternity roost trees or trees within 150 foot radius of such sites from the period of June 1 through July 31st of each year.

3.11.2 Environmental Consequences

Environmental consequences associated with impacts to federally listed threatened and endangered species are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

Due to similarities in habitat requirements, habitat usage and research studies, the interior least tern and piping plover are discussed together, where appropriate.

3.11.2.1 Proposed Action

Direct Impacts

INTERIOR LEAST TERN AND PIPING PLOVER

Direct impacts to the interior least tern and piping plover could occur as a result of disturbance to active nests or the removal of active nesting habitat and foraging areas located on sandbars within the Kansas River channel. Federal regulatory requirements under Section 404 of the CWA and Section 7 of the ESA would ensure that any proposed processing plants involving the discharge of dredged or fill material into wetlands or other waters of the U.S. located in the Kansas River floodplain would be required to avoid and minimize impacts. Special Conditions for current USACE permits for Kansas River dredging state "If at any time a pair of least terns or plovers nest within three RMs of a dredge site, additional consultation with the USFWS will be required." If this same condition or similar restrictive condition is incorporated into future permit authorizations, direct impacts to the interior least tern and piping plover are not anticipated.

PALLID STURGEON

Potential direct impacts to the pallid sturgeon include entrainment (incidental trapping of fish in the dredge suction field), physical disturbance of spawning habitat, disturbance of pallid sturgeon by dredge noise, disturbance of pallid sturgeon by sediment plumes from dredging or the discharge of process water from the processing plants, and the effects of dredging on pallid sturgeon foraging.

The Kansas River between Lawrence and its confluence with the Missouri River (52 RMs) is identified as Segment 11 in the USFWS Pallid Sturgeon Recovery Plan for the Missouri and Mississippi Rivers. The plan includes monitoring of pallid sturgeon populations and population trends in individual river segments in the recovery area.

During the 2014 Survey, 1 hatchery-stocked pallid sturgeon was collected, for an overall total of 17 hatchery-stocked pallid sturgeons that have been collected in the Kansas River since 2006. These fish represent the first recorded pallid sturgeons collected in the Kansas River since 1952 (McDaniel et al., 2015).

The USFWS has stocked over 1.4 million pallid sturgeon into the recovery area during its recovery efforts. No fish have been stocked into the Kansas River. The 17 individuals collected since 2007, were all from hatchery-stock and appear to be incidental migrants to the lower 15-mile segment of the Kansas River. There is no indication that pallid sturgeon occur above the WaterOne weir. The WaterOne weir, Bowersock Dam and the Topeka weir create barriers to fish movement into upstream areas during normal river stages. However, it is possible that fish could pass these barriers during flood stages. Shovel nose sturgeon occur in the Kansas River both below and above the WaterOne weir (Winders, Niswonger, & Whiteman, 2010). Man-made reservoirs and flood control operations in the Kansas River basin have reduced turbidity levels in the river that may be necessary to provide suitable habitat for breeding populations of pallid sturgeon.

The USACE (2011c) concluded that based on the best available information reported in the literature and the specific factors on the lower Missouri River, the potential for entrainment of pallid sturgeon due to dredging and towboat propellers and related mortality would be extremely low and improbable and thus judged to be minor and discountable. These conclusions are supported by studies where sturgeon entrainment was found to be low, as well as by other studies that found no entrainment of pallid sturgeon. The volume of water being processed while dredging is underway represents a very small fraction of the total amount of water in the channel making the likelihood of dredging entrainment of the species improbably low for the proposed action. The Kansas River dredges use pipelines rather than barges and towboats to transport the dredged sand and gravel to shore. The absence of towboats with propellers combined with the scarcity of pallid sturgeon in the Kansas River would suggest that that the potential for entrainment of pallid sturgeon from dredging in the Kansas River would be even less probable and thus minor and discountable.

Based on the understanding of pallid sturgeon spawning habitats at the time, the USACE (2011c) concluded that commercial dredging is very unlikely to result in direct disturbance of known and suspected pallid sturgeon spawning habitats. We know of no subsequent studies that suggest that Kansas River dredging would adversely affect potential pallid sturgeon spawning habitat in the Kansas River.

Based on the existing information, the USACE (2011c) concluded that there was no basis for concluding that noise from Missouri River commercial sand and gravel dredging would adversely affect pallid sturgeon. We know of no subsequent studies that suggest that noise from Kansas River dredging would adversely affect pallid sturgeon.

The USACE (2011c) concluded that increased elevated suspended sediment from Missouri River dredging would have little effect on pallid sturgeon, a species adapted to high levels of turbidity; and plumes downstream of dredging activities may result in a slight temporary beneficial increase in cover habitat to pallid sturgeon that are located downstream of dredging activities. USACE knows of no subsequent studies that suggest that turbidity or sediment plumes from Kansas River dredging or processing plants would adversely affect pallid sturgeon.

The USACE (2011c) concluded that the effects of dredging on pallid sturgeon foraging would likely be limited and temporary, given that the proportion of the total foraging area of the river bottom dredged would be low, and the probability that alteration of the bottom substrates may produce equally productive fish and invertebrate habitats and greater substrate diversity. We know of no subsequent studies that suggest that Kansas River dredging would adversely affect pallid sturgeon foraging.

Direct impacts to the pallid sturgeon are not anticipated. Therefore, Kansas River dredging is not anticipated to adversely affect this species.

NORTHERN LONG-EARED BAT

No direct impacts to the Northern long-eared bat are expected to occur as a result of the proposed action because the species is terrestrial in nature and the dredging operations would not impact suitable habitat.

Indirect Impacts

INTERIOR LEAST TERN AND PIPING PLOVER

Indirect impacts to the interior least tern and piping plover are primarily related to the potential loss of habitat due to bed degradation and the expansion or construction of public roads and other supporting infrastructure in the floodplain. Bed degradation could reduce sandbar stability and abundance in the river channel, and could increase failure of unstable riverbanks, which could, in turn, impact shallow water habitat in some areas of the river.

The Regulatory Plan would allow no more than 3,150,000 tons of sand and gravel to be dredged annually from the Kansas River under the Proposed Action. The quantity of sand and gravel dredged from the river over the last 14 years has ranged between approximately 1,000,000 and 2,000,000 tons, with an average near 1,500,000 tons per year. According to the USACE (2010), the recent dredging rates have not caused stage degradation at the DeSoto gage. The USACE (2010) also noted slower or minimal stage degradation at Topeka when compared with previous decades. The USACE (2010) further noted that no significant stage degradation has occurred at either the DeSoto or Topeka gage stations since 1999. Consequently, tern and plover habitat is not likely to have been adversely affected by the rate of dredging that has occurred since 1999. Dredging the 3,150,000 tons of sand and gravel per year under the Proposed Action would likely accelerate the rate of bed degradation and would have a potential to adversely impact tern and plover habitat, if uncontrolled bed degradation were allowed to occur. However, since the magnitude of bed degradation would be strictly limited through the USACE's Regulatory Plan, it is anticipated that impacts would not be more than minimal. The Regulatory Plan stipulates that any 5-

mile-long reach of river that degrades an average of 2 feet, below the 1992 baseline elevations established for that reach, will be closed to further dredging. The Regulatory Plan's 2-foot limit on bed degradation would limit the potential for dredging to impact tern and plover habitat.

Federal regulatory requirements under Section 404 of the CWA and Section 7 of the ESA would ensure that any proposed activities involving the discharge of dredged or fill material into wetlands or other waters of the U.S. located in the Kansas River floodplain would be required to avoid and minimize impacts. Therefore, expansion or construction of public roads and other infrastructure supporting Kansas River dredging are not expected to significantly impact habitat (primarily wetlands) in the Kansas River floodplain. Indirect impacts of Kansas River dredging to the interior least tern and piping plover are not anticipated to be more than minimal.

PALLID STURGEON

Indirect impacts to the pallid sturgeon could occur as a result of habitat modification primarily due to bed degradation. The Regulatory Plan would allow no more than 3,150,000 tons of sand and gravel to be dredged annually from the Kansas River under the Proposed Action. The quantity of sand and gravel dredged over the last 14 years has ranged between approximately 1,000,000 and 2,000,000 tons, with an average near 1,500,000 tons per year. According to the USACE (2010), the recent dredging rates have not caused stage degradation at the DeSoto gage. The USACE (2010) also noted slower or minimal stage degradation at Topeka when compared with previous decades. The USACE (2010) further noted that no significant stage degradation has occurred at either the DeSoto or Topeka gage stations since 1999. Consequently, pallid sturgeon habitat is not likely to have been adversely affected by the rate of dredging that has occurred since 1999. Dredging the 3,150,000 tons of sand and gravel per year under the Proposed Action would likely accelerate the rate of bed degradation and would have a potential to adversely impact pallid sturgeon habitat, if uncontrolled bed degradation were allowed to occur. However, since the magnitude of bed degradation would be strictly limited through the USACE's Regulatory Plan, it is not likely that impacts would be more than minimal. The Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet, below the 1992 baseline elevations established for that reach, will be closed to further dredging. The

Regulatory Plan's 2-foot limit on bed degradation would limit the potential for dredging to impact pallid sturgeon habitat.

As part of their Pallid Sturgeon Population Assessment Program, MDC have captured a total of 17 hatchery-stocked pallid sturgeon in the Kansas River since 2006 (McDaniel et al., 2015). The USFWS has stocked over 1.4 million pallid sturgeon into the recovery area during its recovery efforts. However, no pallid sturgeon have been stocked into the Kansas River thus far. The 17 pallid sturgeon collected in the Kansas River since 2006, were all from hatchery-stock and appear to be incidental migrants to the lower 15-mile segment of the river. This area was dredged throughout the recovery efforts in accordance with the USACE's Regulatory Plan which limits riverbed degradation to an average of 2 feet below the 1992 baseline elevations for any 5-mile-long reach of river. Indirect impacts to the pallid sturgeon associated with bed degradation are not anticipated to be more than minimal. It is not anticipated that Kansas River dredging will adversely affect this species.

NORTHERN LONG-EARED BAT

Indirect impacts to the bat could occur as a result of habitat removal. The construction of land-based processing plant sites and associated access roads could indirectly impact roosting trees as a result of site clearing activities. However, no new land-based processing plant sites are anticipated due to the small number of dredging companies historically operating on the Kansas River, the limits on extraction tonnage, and the number and location of open reaches in relation to market location. Therefore, no indirect impacts to the species are anticipated and Kansas River dredging is not anticipated to adversely affect this species.

3.11.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. Selection of the No-Action Alternative would eliminate all potential impacts to threatened and endangered species from dredging the Kansas River.

The No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations) all have a potential to impact threatened and endangered species.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

INTERIOR LEAST TERN AND PIPING PLOVER

The Biological Assessment for Commercial Sand and Gravel Dredging on the Missouri River (USACE, 2011c) concluded that commercial dredging on the lower Missouri River is not likely to adversely affect interior least tern or piping plover due to the lack of suitable nesting habitat, the rare occurrence and lack of breeding interior least terns, and the absence of critical habitat along the Missouri River bordering Kansas and Missouri. Therefore, pit dredging in the Missouri River floodplain is not anticipated to have any direct impact on the interior least tern or piping plover.

Direct impacts to terns and plovers are not likely to occur from pit dredging in the Kansas River floodplain. These species generally build their nests in sand or other fine substrate with sparse vegetation along rivers and lake shores. Potential nesting habitat is very limited in the floodplain but wetlands on the floodplain may be used by the species for foraging. Federal regulatory requirements under Section 404 of the CWA and Section 7 of the ESA would ensure that any proposed activities involving the discharge of dredged or fill material into wetlands or other waters of the U.S. located in the Kansas River floodplain would be required to avoid and minimize impacts.

In 1994, a population of least terns was observed nesting near the Kansas River on fly-ash spoil piles at the Jeffrey Energy Center in northeastern Kansas (USACE, 2006). This observation would indicate that floodplain pit dredging activities have a potential to create nesting habitat for terns and plovers on sand covered areas created at dredge pits. Piping plovers have been found to use dredge pits created during floodplain dredging along the Platte River, in Nebraska, for nesting (Sidle & Kirsch, 1993). Typically, these manmade sand flats are utilized in those portions of the species historical range where natural sand bars are limited. In areas where natural sand bars are limited, the increase in dredge pits may alter the piping plover distribution (Sidle & Kirsch, 1993). The Nebraska Game and Parks Department (NGPD, 2013) reported a low success rate of interior least terns using dredge pits due to frequent human disturbance and predation. It is assumed that piping plovers using dredge pits would experience similar pressures. Due to increased disturbance at these sites, reproductive success is reduced compared to sand bars in rivers. The use of dredge pits as an alternative source of materials would provide additional nesting habitat, although the habitat associated with dredge pits would be of relatively low quality. Consultation with the USFWS and the use of Best Management Practices during site selection and operation of facilities would reduce potential adverse impacts to terns and plovers. Pit dredging on the Kansas River floodplain is not anticipated to have more than minimal direct impacts to the interior least tern or piping plover.

PALLID STURGEON

Pit dredging in the floodplains of the Kansas and Missouri Rivers would have no direct impact on the pallid sturgeon.

NORTHERN LONG-EARED BAT

Direct impacts to the Northern long-eared bat could occur as a result of this action. These impacts would occur as a result of tree clearing and site preparation for new or expanded sand and gravel processing facilities within the floodplain of the Kansas River. Activities that cut or destroy known maternity roost trees or remove trees within established buffer areas could directly impact this species but no direct impacts to this species are anticipated from pit dredging if restrictive tree clearing dates recommended by the USFWS are adhered to during construction.

Indirect Impacts

INTERIOR LEAST TERN AND PIPING PLOVER

The Biological Assessment for Commercial Sand and Gravel Dredging on the Missouri River (USACE, 2011c) concluded that commercial dredging on the lower Missouri River is not likely to adversely affect interior least tern or piping plover due to the lack of suitable nesting habitat, the rare occurrence and lack of breeding interior least terns, and the absence of critical habitat along the Missouri River bordering Kansas and Missouri. Therefore, pit dredging in the Missouri River floodplain is not anticipated to have any indirect impact on the interior least tern or piping plover.

Potential indirect impacts of pit dredging in the Kansas River floodplain to the interior least tern and piping plover are primarily related to the potential loss of wetland foraging habitat associated with expansion or construction of public roads and other supporting infrastructure in the floodplain. Pit dredging operations would not contribute to bed degradation and potential secondary impacts to nesting habitat and foraging habitat in the Kansas River. Federal regulatory requirements under Section 404 of the CWA and Section 7 of the ESA would ensure that any proposed activities involving the discharge of dredged or fill material into wetlands or other waters of the U.S. located in the Kansas River floodplain would be required to avoid and minimize impacts. Therefore, expansion or construction of public roads and other infrastructure supporting pit dredging are not expected to significantly impact habitat (primarily wetlands) in the Kansas River floodplain. Pit dredging on the Kansas River floodplain is not anticipated to have more than minimal indirect impacts to the interior least tern or piping plover.

PALLID STURGEON

Uncontrolled storm water runoff from floodplain dredge pits and supporting roads and infrastructure could result in the introduction of contaminants to adjacent water bodies. Any proposed dredge pits or construction of supporting infrastructure that would result in the discharge of dredged or fill material in wetlands or other waters of the U.S. located in the floodplains of the Kansas and Missouri Rivers would require a permit under Section 404 of the CWA. The Section 404(b)(1) guidelines and Section 7 of the ESA would require measures necessary to avoid and minimize potential impacts. Therefore, indirect impacts to the pallid sturgeon are not anticipated from pit dredging in the floodplains of the Kansas and Missouri Rivers.

NORTHERN LONG-EARED BAT

Indirect impacts to the northern long-eared bat could result from audible and visual disturbances associated with dredge and plant site operations. Indirect impacts to the northern long-eared bat are not anticipated to be more than minimal

Crushed Limestone from Quarry Operations

Direct Impacts

Direct impacts to the interior least tern, piping plover, pallid sturgeon and northern long-eared bat are similar to those identified for pit dredging operations in the Kansas and Missouri River floodplains except that quarries are in upland sites that are less likely to have aquatic resources suitable for pallid sturgeon or tern and plover nesting or foraging habitat.

Indirect Impacts

Indirect impacts to the interior least tern, piping plover, pallid sturgeon and northern long-eared bat are similar to those identified for pit dredging operations in the Kansas and Missouri River floodplains except that quarries are in upland sites that are less likely to have aquatic resources suitable for pallid sturgeon or tern and plover nesting or foraging habitat.

3.11.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts to the interior least turn, piping plover, pallid sturgeon and northern long-eared bat would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the dredging of less sand and gravel annually than the Proposed Action, it would not be likely to result in a reduction in the total number of dredging operations on the river. Direct impacts to the interior least tern, piping plover, pallid sturgeon and northern long-eared bat are not anticipated. Therefore, Kansas River dredging is not anticipated to adversely affect these species.

Indirect Impacts

Indirect impacts to the interior least turn, piping plover, pallid sturgeon and northern long-eared bat would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the dredging of less material annually than the Proposed Action, it would not be likely to result in a reduction in the total number of dredging operations on the river. In addition, the Regulatory Plan contains conditions that limit degradation to an average of 2 feet, below the 1992 baseline elevations, for any 5-mile-long reach of river. It is possible that higher annual dredging limits associated with Proposed Action could result in a rate of bed degradation exceeding the rate for the Reduced Limit Alternative; however, the limit for bed degradation, regardless of how rapidly it could occur, is 2 feet. Therefore, selection of the Reduced Limit Alternative would not be likely to result in significantly reduced impacts to the interior least turn, piping plover, pallid sturgeon or northern long-eared bat relative to the Proposed Action. Indirect impacts to the interior least tern, piping plover, pallid sturgeon and northern long-eared bat are not anticipated.

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3.12 CULTURAL RESOURCES

3.12.1 Affected Environment

3.12.1.1 Introduction

"Cultural resources" are defined as the broad pattern of events, real properties, and cultural life ways or practices that have significance to humans. Buildings and places where events have occurred, archeological sites containing information about human activities, traditional places or activities that hold special significance, and folkways that are practiced as either cultural or life sustaining are all part of the broad category features of groups of people. Cultural resources typically found in or near the Kansas River include Native American habitation and burial sites, historic trails, settlements, farmsteads, bridges, and dams.

3.12.1.2 Regulatory Setting

Projects involving federal land, funds, review, or permitting are subject to compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 (16 USC 470). Section 106 requires federal agencies such as the USACE to take into account the effects of their undertakings on historic properties. An "historic property" is any district, archeological site, structure, sacred site, or object that is included on or eligible for inclusion in the National Register of Historic Places. As the lead federal agency with jurisdiction over the permitting of commercial dredging along the Kansas River, the USACE is responsible for ensuring compliance with Section 106 of the NHPA and other pertinent cultural resource laws and regulations. Section 106 also requires that the USACE consult with State Historic Preservation Offices (SHPOs), federally recognized Native American tribes, local governments, and other interested parties regarding the proposed undertaking. In addition, the Advisory Council on Historic Preservation would be consulted for projects adversely impacting historic properties.

Part of the USACE's responsibility under the NHPA is to determine areas that may be affected by the undertaking, or the Area of Potential Effect (APE). Project-related activities with the potential to directly affect historic properties include excavation and removal of sand and gravel from the main channel of the Kansas River. Potential indirect effects that may result from increased river bed degradation related to dredging include erosion, induced instability, head-cutting, and related channel effects from dredging activities. Areas affected by erosion induced by head-cutting could include banks of the Kansas River and localized areas of tributaries. Because of the above known and potential impacts, the APE for this Project was determined to include the main channel of the Kansas River from its start at the confluence of the Republican and Smoky Hill Rivers in Geary County to its confluence with the Missouri River in Wyandotte County, Kansas and extending from the top of bank to approximately 50 feet below the river bottom (i.e., the greatest potential depth of dredging activities). The APE also includes perennial tributaries joining the Kansas River for a distance of 0.25 mile upstream or to the first upstream control point. A "control point" includes any natural streambed feature or human-made structure that provides grade control and controls or impedes the upstream progress of a head-cut. Because degradation of the tributaries is not likely to extend more than 20 feet beyond the current banks of the Kansas River and its tributaries, the APE extends 20 feet landward of each bank.

Processing plants owned and operated by the Dredgers are not included in the APE as they were previously permitted by the USACE, if authorization was required. It is reasonably foreseeable that some alternatives may result in extraction of sand or gravel from new upland mining sources. These upland mining sources are not included in the APE for this Project because actions related to the upland mining sources would not be subject to any of the USACE permits that would be issued under this Project. Construction and operation of proposed sand plants and alternate mining sources were considered in the indirect impacts analysis.

3.12.1.3 Background Research

Two preliminary cultural resource studies were utilized to provide supporting materials for the 1990 Kansas River Commercial Dredging EIS. A study completed by Thomas A. Witty Jr. entitled, *"Preliminary Archaeological Literature Search – Eastern Portion of the Kansas River and Tributaries,"* provided background data for the EIS to assess potential dredging-related impacts to archaeological resources (Witty, 1979). An additional study completed by Gail White entitled, "*Preliminary Assessment – Historic Sites and Historic Architecture, Kansas River and Tributaries",* also provided background information for the EIS to assess potential dredging-related impacts to historical resources (White, 1979). A summary of the findings for each report is provided below. Additional site specific cultural resource studies have been completed for various purposes within the Kansas River valley since completion of the 1990 Kansas River Commercial Dredging EIS. However, no new cultural resource studies have been initiated since completion of the EIS to specifically address dredging activities on the river.

Archaeological Resources

The archaeological study conducted by Thomas A. Witty, Jr., in the Kansas River valley identified 126 sites (Witty, 1979). The locations of the sites indicate a fairly even historic cultural distribution along the river. The known sites represent the Archaic period (6000 before Christ to 1 a*nno Domini* [A.D.], 20 percent of the sites), Early Ceramic period (A.D. 1 to 1000 A.D., 49 percent of the sites), Middle Ceramic period (A.D. 1000 to 1500 A.D., 20 percent of the sites), Late Ceramic period (1500 A.D. to 1800 A.D., less than 1 percent of the sites), and the Historic period (1800 A.D. to 1865 A.D., 11 percent of the sites).

Historic and Architecture Sites

A preliminary identification and assessment of known historic and architectural resources located within a 0.5 mile corridor on either side of the Kansas River and its major tributaries (Wakarusa, Delaware, Big Blue, Smoky Hill, Saline and Solomon Rivers; and Vermillion and Soldier Creeks) was completed. A total of 29 urban zones, 244 buildings, 98 bridges, 11 dams, three historic markers and 34 cemeteries of known or potential historical significance were identified within the study area. Two districts, and 26 structures and sites included in the National Register of Historic Places are located within the study area (White, 1979).

3.12.2 Environmental Consequences

Environmental consequences associated with impacts to cultural resources are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

The Kansas SHPO provided a review of potential cultural resource impacts for the Proposed Actions described in the USACE Public Notice dated, November 9, 2011. The Kansas SHPO stated that it has no objection to issuance of the requested permits (Kansas SHPO, 2011).

3.12.2.1 Proposed Action

Direct Impacts

Dredging in the river has very little potential to impact cultural resources. The Kansas River is a known source of Pleistocene mammalian artifacts; however, those materials are not generally found in situ since they are eroded from the bed and banks and are then transported downstream by river flows. Since these materials are typically isolated, remnant artifacts found out of context, their scientific value is limited. In addition, fossils are not protected under Section 106 of the NHPA of 1966 (Public Law 89-665; 16 U.S.C. 470 *et seq*). Dredging is confined to the middle of the channel and excluded near the banks and islands where cultural resources may be found in situ. Direct impacts to cultural resources are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts of Kansas River dredging to cultural resources could result from tributary head cutting and scouring of the river bed near bridge abutments associated with bed degradation. These processes may (1) destroy or damage all or part of a historic property; or (2) expose archaeological resources, thereby, making an entire site or part of a site vulnerable to human disturbance such as looting or vandalism. The Regulatory Plan would allow no more than 3,150,000 tons of sand and gravel to be dredged annually from the Kansas River under the Proposed Action. The quantity of sand and gravel dredged from the river over the last 14 years has ranged between approximately 1,000,000 and 2,000,000 tons, with an average near 1,500,000 tons per year. According to the USACE (2010), the recent dredging rates have not caused stage degradation at the DeSoto gage. The USACE (2010) also noted slower or minimal stage degradation at Topeka when compared with previous decades. The USACE (2010) further noted that no significant stage degradation has occurred at either the DeSoto or Topeka gage stations since 1999. Dredging the 3,150,000 tons of sand and gravel per year under the Proposed Action would likely accelerate the rate of bed degradation and would have a potential to adversely impact cultural resources on the banks of the Kansas River and its tributaries, if uncontrolled bed degradation were allowed to occur. However, since the magnitude of bed degradation would be strictly limited through the USACE's Regulatory Plan, it is not likely that impacts would be more than minimal. The Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet, below the 1992 baseline elevations established for that reach, will be closed to further dredging. The Regulatory Plan's 2-foot limit on bed degradation would limit the potential for dredging to impact cultural resources.

Indirect impacts to cultural resources could also result from the expansion or development of roads and other public infrastructure to support truck traffic to and from processing plant sites. Expansion or construction of roads and supporting infrastructure that would result in the discharge of dredged or fill material into waters of the U.S. would require a Section 404 permit and evaluation of potential impacts to cultural resources under Section 106. Indirect impacts to cultural resources are not anticipated to be more than minimal.

3.12.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. Selection of the No-Action Alternative would eliminate all impacts to cultural resources from dredging the Kansas River.

The No-Action Alternative would rely on other sources of sand and gravel in order to meet the market demand. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River Floodplains, and crushed limestone from quarry operations) all have a potential to impact cultural resources.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

Construction of dredge pit sites and access roads (typically a minimum of 60 acres for a dredge pit and plant site) involve large-scale earth moving operations, which have a potential to directly impact known and as yet undiscovered cultural resources. Dredge pits have a typical life span between 10 and 15 years, depending on dredge pit size. Therefore, new dredge pits would be continually developed as old dredge pits expire and are taken out of production. Dredge pits are subject to state mining reclamation requirements, which would trigger a site review by the Kansas SHPO. Expansion or construction of dredge pits and supporting infrastructure that would result in the discharge of dredged or fill material into waters of the U.S. would require a Section 404 permit and evaluation of potential impacts to cultural resources under Section 106. Direct impacts to cultural resources associated with pit dredging are not anticipated to be significant due to previous disturbances to potential cultural resources from farming, other similar human activities, historic river channel migration and extensive modification of the floodplain by previous work.

Indirect Impacts

Indirect impacts to cultural resources would primarily be limited to expansion or construction of roads and other public infrastructure to support truck traffic to and from dredge pit plant sites. Expansion or construction of roads and supporting infrastructure that would result in the discharge of dredged or fill material into waters of the U.S. would require a Section 404 permit and evaluation of potential impacts to cultural resources under Section 106. Indirect impacts to cultural resources are not anticipated to be significant due to previous disturbances from farming and other similar activities, historic river channel migration and extensive modification of the floodplain by previous work.

Crushed Limestone from Quarry Operations

Direct Impacts

Direct impacts to cultural resources associated with quarries are similar to those identified for pit dredging operations in the Kansas and Missouri River floodplains. There is however a higher potential for direct effects primarily to unknown cultural sites as the disturbance of these upland areas may not require federal review or protection. The potential for less disturbed sites is also likely greater in these locations than other considered mining options in the river or its' floodplain that have been extensively modified by previous actions and river erosion associated with channel migration. In a general sense, higher elevation floodplain terraces lend themselves to closer archeological investigation based upon landscape position and consideration towards primary human food, shelter and protection needs. Direct impacts to cultural resources are not however anticipated to be significant due to State or other government review and permitting programs (Surface mining permits, land zoning and construction permits) for new quarry sites. This anticipated review would prevent disturbance to sites of historic or cultural significance and is unlikely that unknown sites would contain resources eligible for inclusion in the historic register. No comments or concerns related to potential impacts of this nature were received during the public scoping period.

Indirect Impacts

Indirect impacts to cultural resources associated with quarries are similar to those identified for pit dredging operations in the Kansas and Missouri River floodplains. Indirect impacts to cultural resources are not anticipated to be significant based upon the very limited nature of excavation and disturbance to buried sites caused by ancillary roads and operational areas associated with these pit operations. If existing eligible historic sites were however located in the vicinity of a quarry, there could be impacts, including visual, aesthetic, physical (blasting) and noise-related resulting from operation of the quarry. No comments or concerns related to potential impacts of this nature were received during the public scoping period.

3.12.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the dredging of less sand and gravel annually than Proposed Action, it would not be likely to result in a reduction in the total number of dredging operations on the river. Direct impacts to cultural resources are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts would be similar to those identified for the Proposed Action. Although selection of the Reduced Limit Alternative could result in the dredging of less material annually than Proposed Action, it would not be likely to result in a reduction in the total number of dredging operations on the river. In addition, the Regulatory Plan contains conditions that limit degradation to an average of 2 feet, below the 1992 baseline elevations, for any 5-mile-long reach of river. It is possible that higher annual dredging limits associated with Proposed Action could result in a rate of bed degradation exceeding the rate for the Reduced Limit Alternative; however, the limit for bed degradation, regardless of how rapidly it could occur, is 2 feet. Therefore, selection of the Reduced Limit Alternative would not be likely to result in significantly reduced impacts to cultural resources relative to the Proposed Action. Indirect impacts to cultural resources are not anticipated to be more than minimal.

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3.13 NOISE

3.13.1 Affected Environment

Noise is commonly defined as unwanted sound (mechanical energy transmitted by pressure waves through a medium such as air) that annoys or disturbs people and may cause adverse psychological or physiological effects on human health. Because noise is an environmental issue that can interfere with human activities, evaluation of noise is necessary when considering the environmental impacts associated with a proposed project.

Sound pressure level using the decibel (dB) scale is most commonly used to characterize the loudness of sound. Because the human ear is not equally sensitive to all sound frequencies, noise measurements are weighted more heavily for frequencies to which humans are sensitive in a process called A-weighting (dBA). Table 29 summarizes typical A-weighted sound levels for common noise sources.

Because sound levels often vary over time, the equivalent sound level (L_{eq}) is used to represent the average sound energy over a given period of time. Noise impacts from a temporary mobile noise source such as a dredge operation are typically evaluated against a 1-hour L_{eq} noise standard. Noise impacts from a permanent stationary facility such as a sand plant are typically evaluated against a 24-hour weighted average such as the day-night level (L_{dn}). The L_{dn} is the energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m. to account for increased sensitivity to noise during those hours.

In general, human sound perception is such that a change in sound level of 1 dB cannot typically be perceived by the human ear, a change of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling or halving the sound level. A doubling of sound energy results in a 3 dB increase in sound level. An example of this is a roadway where the volume of traffic doubles. Although this is a substantial increase in traffic volume, the increase in noise would be only 3 dB (i.e., just noticeable).

When evaluating noise from equipment operations, the noise level produced by the equipment is typically characterized in terms of a measured sound level at a specific distance, typically 50 feet. This “source” information can be determined from measurements or from standard reference data. With the source sound level, the sound level at various distances—including the sound level at specific receiver locations—can be predicted. The rate at which sound attenuates over distance depends on several factors, described below.

Table 29 Typical A-Weighted Sound Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	—110—	Rock band
Jet flyover at 1,000 feet		
	—100—	
Gas lawnmower at 3 feet		
	—90—	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	—80—	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawnmower at 100 feet	—70—	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	—60—	
		Large business office
Quiet urban daytime	—50—	Dishwasher in next room
Quiet urban nighttime	—40—	Theater, large conference room (background)
Quiet suburban nighttime		
	—30—	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	—20—	
		Broadcast/recording studio

Notes:
dBA = A-weighted decibel
mph = miles per hour
Source: Caltrans, 1998

For a point source such as a stationary compressor or construction equipment, sound attenuates based on distance at a rate of 6 dB per doubling of distance. For example, if a point sound source produces a sound level of 85 dBA at 50 feet, the sound level at 100 feet would be 79 dBA and the sound level at 200 feet would be 73 dBA. For a line source such as free-flowing traffic on a freeway, sound attenuates at a rate of 3 dB per doubling of distance (Caltrans, 1998).

Atmospheric conditions such as wind, temperature gradients, and humidity can change how sound propagates over distance and can affect the level of sound received at a given location. The degree to which the ground surface absorbs acoustical energy also affects sound propagation. Sound that travels over an acoustically absorptive surface such as grass attenuates at a greater rate than sound that travels over a hard surface such as pavement or water. The increased attenuation is typically in the range of 1–2 dB per doubling of distance. This increases the attenuation rate for point sources to 7–8 dB per doubling of distance and the attenuation rate for line sources to 4–6 dB per doubling of distance. Barriers such as buildings and topography that block the line of sight between a source and receiver also increase the attenuation of sound over distance. Typically, a barrier that blocks the line of sight between a noise source and a receiver will reduce sound by at least 5 dB.

3.13.2 Environmental Consequences

Environmental consequences associated with impacts to noise are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

On February 20, 2013, a series of sound level meter readings were taken for the Schaake Sand Pit at 1752 North 1500 Road, in Lawrence, KS (near Kansas River mile 47.0). The readings were taken to measure sound levels for dredge operations and to assess the potential noise impact to nearby residences. Sound levels were measured at 92 dBA at the cab of the dredge and 65 dBA at sensitive noise receptors including two nearby residences. The study concluded that there were no noise level increases to sensitive noise receptors. The nearest receptor was approximately 3,000 feet from the dredge. Background noise levels without the dredging operation were also 65 dBA (Kansas Safety Consultants, 2013).

3.13.2.1 Proposed Action

Direct Impacts

The primary sources for noise from the Proposed Action include dredging operations; operation of plant processing and loading equipment such as conveyors, cranes, front loaders and other equipment; and traffic of heavy trucks. Noise impacts associated with the Proposed Action primarily affect rural and industrial/commercial areas. Noise increases would primarily be limited to the dredge site and processing plant site. Based upon the typical rural or industrial/commercial surroundings for the proposed activity, dredging-related noise level impacts are not expected to be more than minimal. However, it is possible that a few individual receptors could experience an undesirable increase in noise levels related to dredging operations. If concerns are raised by individual receptors, evaluation of the issue through zoning, land use and other regulatory authorities granted to state, county and/or local municipality or agency is available. Direct impacts to noise levels are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to noise levels would primarily be associated with the expansion or development of roads and other public infrastructure to support truck traffic to and from processing plants. Due to the remote location of the majority of considered dredge and processing sites, the low density of population near these areas and/or similar noise levels resulting from farming or adjacent commercial and industrial operations, noise from activities indirectly related to dredging are not expected to rise to a level requiring mitigation or further evaluation. Indirect impacts to noise levels from the Proposed Action are not anticipated to be more than minimal.

3.13.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. Selection of the No-Action Alternative would eliminate all noise impacts from dredging on the Kansas River.

The No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations) all have a potential to directly impact Noise levels.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

The primary sources for noise from floodplain pit dredging include dredging operations; operation of plant processing and loading equipment such as conveyors, cranes, front loaders and other equipment; and traffic of heavy trucks. An increase in floodplain pit dredging, resulting from the No-Action Alternative, has a potential to affect noise levels primarily in un-urbanized areas such as lands currently zoned agricultural. Noise increases would primarily be limited to the dredge pit and processing plant site and adjacent properties. Noise increases associated with truck traffic would primarily be limited to roads that are dedicated to hauling materials from the materials processing site. Noise generated by potential new and expanded floodplain pit dredging operations would vary depending on site location and the land uses and density of adjacent property. It is not possible at this time to identify where new or expanded floodplain pit dredging sites would be located but the location would depend upon several constraints such as aggregate qualities, quantities, overburden quantity, local zoning, the distances to existing and suitable roads and distance to available market locations. Noise impacts to sensitive noise receptors such as schools, parklands and residences would likely be reviewed and approved through local planning and zoning programs and regulatory authority. Direct impacts to noise levels are not anticipated to be significant.

Indirect Impacts

Indirect impacts to noise levels would primarily result from the expansion and development of roads to support truck traffic to and from processing plant sites. Based upon the locations where existing pit mines are located and given the low density of populations in floodplain areas because of flooding concerns, indirect impacts to noise levels are not anticipated to be significant.

Crushed Limestone from Quarry Operations

Direct Impacts

Although the primary sources for noise from crushed limestone quarry operations would differ slightly from floodplain pit dredging operations, these operations would result in similar impacts to noise levels. One difference between pit mining and quarry operations would be the potential for explosive blasting operations which could generate short-term disproportionate noise levels in the vicinity of the quarry. Noise generated by the potential expansion or development of limestone quarry operations would vary depending on site location and the distance and density of noise receptors. It is not possible at this time to specifically identify where quarry sites would be expanded or developed but the dependent variables and parameters relied upon for the analysis of noise levels associated with floodplain pit mining would be similar for this alternative. Noise impacts to sensitive noise receptors such as schools, parklands and residences would also be reviewed and subject county and/or local agencies involved in permitting for planning, zoning and land-use ordinances. Therefore, an increase in limestone quarry operations, as a result of selection of the No-Action Alternative, is not anticipated to have a significant impact on local or regional noise levels.

Indirect Impacts

Indirect impacts to noise levels would primarily result from explosive blasting and the expansion and development of roads to support truck traffic to and from quarry sites. Based upon the locations where existing quarries are located and given the low density of populations in these areas, the difficulty in developing new quarry sites due to land-use and zoning restrictions, indirect impacts to noise levels are not anticipated to be significant.

3.13.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts would be similar to those identified for the Proposed Action.

Indirect Impacts

Indirect impacts would be similar to those identified for the Proposed Action.

3.14 AIR QUALITY

3.14.1 Affected Environment

3.14.1.1 Introduction

This section provides the context necessary to understand air quality and climate change effects in the Project area resulting from the Proposed Action and alternatives. Operation of dredges and materials-handling equipment powered by internal combustion engines emits pollutants as exhaust, which affects local and regional air quality. These emissions can cause deterioration of ambient air quality and expose sensitive populations to increased health risks, including cancer and respiratory diseases.

3.14.1.2 Regulatory Setting

This section describes the regulatory framework for the Project area and the standards that will be used to determine whether implementation of the Proposed Action or alternatives would result in potential adverse effects to air quality.

Federal

National Ambient Air Quality Standards

The Clean Air Act (CAA), enacted in 1963 and last amended in 1990, requires the USEPA to set National Ambient Air Quality Standards (NAAQS) (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of NAAQS: ***Primary standards*** provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The USEPA has set NAAQS for six principal pollutants, which are called "criteria" pollutants. The six principle pollutants are identified in Table 30. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air ($\mu g/m^3$).

The KDHE Bureau of Air, in cooperation with three local agencies, operates the Kansas Ambient Air Monitoring Network to provide air quality data from 25 sites around the state.

The air monitoring data is analyzed to determine compliance with the NAAQS and to evaluate air quality trends. Currently the Kansas Ambient Air Monitoring Network measures five of the six criteria air pollutants. Monitoring for lead was phased out during 1998, due in large part to the significant drop in measured values caused by the elimination of lead compounds as an additive in gasoline. The USEPA calculates the Air Quality Index for the remaining five major air pollutants regulated by the CAA: ground-level ozone, particulate matter (PM), carbon monoxide, sulfur dioxide, and nitrogen oxides (NOx). Regional attainment with the NAAQS is based on local monitoring data. If monitored pollutant concentrations meet federal standards over a designated period, the area is classified as being in attainment for that pollutant. If monitored pollutant concentrations violate the standards, the area is considered a nonattainment area for that pollutant. Regions previously designated as nonattainment areas that have since obtained attainment are designated as maintenance areas. For the ozone standards, nonattainment and maintenance areas are further categorized into groups according to the increasing severity of the exceedance (for example, marginal, moderate, serious, severe, and extreme). Likewise, for the carbon monoxide standard, areas are grouped into moderate or serious nonattainment or maintenance areas, depending on the severity of the exceedance. If data are insufficient to determine whether a pollutant is violating the standard, the area is designated as unclassified. All counties within the study area are currently in attainment for NAAQS.

Table 30 National Air Quality Standards (October 2015)

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 μg/m³ (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [80 FR 65291, Oct 26, 2015]		primary and secondary	8-hour	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 μg/m³	annual mean, averaged over 3 years
		secondary	Annual	15 μg/m³	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 μg/m³	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 μg/m³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed October 26, 2015. In 1997, USEPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour sulfur dioxide standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

Federal Conformity Requirements

The federal CAA requires that the federal government not engage, support, or provide financial assistance for licensing or permitting, or approve any activity not conforming to the appropriate State Implementation Plan (SIP). The rule applies to federal projects in areas designated as nonattainment areas and ensures that they will not interfere with strategies implemented to attain the NAAQS for any of the six criteria pollutants and in some areas designated as maintenance areas. Project-level conformance with the SIP is demonstrated through a general conformity analysis. Because all counties within the study area are currently in attainment for NAAQS, a general conformity analysis is not required.

State

The KDHE is responsible for maintaining NAAQS in Kansas. The KDHE construction permits ensure that emissions from new or modified equipment comply with the New Source Performance Standards (40 CFR Parts 60, 61, and 62), and the National Standards for Hazardous Air Pollutants. Operating permits are based on a facility's potential to emit. These permits satisfy the requirements of the federal CAA Title V program and closely parallel the requirements of 40 CFR Part 70.

Table 31 summarizes rules and regulations that may apply to the Proposed Action or other alternatives considered. Failure to comply with any applicable state regulation would be a violation subject to enforcement action.

Table 31 KDHE Rules and Regulations Restricting Emissions

State	Rule	Description
Kansas	28-19-20	Limits the amount of PM from any processing machine, equipment, or other device.
	28-19-21	Regulates unique chemical or physical compounds that require emissions rates lower than those in Rule 28-19-20.
	28-19-31	Restricts PM emissions from sources used for indirect heating.
	28-19-57	Establishes emissions restrictions for times designated as an air pollution alert period and an air pollution warning period.
	28-19-650	Establishes emissions opacity limits for sources not covered by other regulations.

USEPA Approved Kansas Regulations 40 CFR 52.870I

Local

One local agency in Missouri and one local agency in Kansas have jurisdiction over potential emission sources at the county level in the Project area. The Kansas City Air Quality (Kansas City) is the official regulatory agency in the Kansas City Metropolitan Area. Likewise, the Wyandotte County Department of Air Quality (Wyandotte County) has local jurisdiction over potential emission sources in Wyandotte County. Both of these local agencies enforce state rules and require construction and operating permits for facilities exceeding applicable thresholds. Permits issued at the local level function as state permits.

In addition to enforcing state regulations, Kansas City has established air quality codes to address the unique air pollution problems in that respective region. Chapter 2 of Title 10 of the Missouri Code of State Regulations outline air quality standards specific to the Kansas City Metropolitan Area that may apply to the No-Action Alternative as a result of changing emissions levels. The rule restricts the idling time of heavy-duty vehicles in the Kansas City area so that no owner/operator of a heavy-duty diesel vehicle covered may idle the vehicle for more than 5 minutes in any 60-minute period, except for those operators exempted from the rule as noted in Section C. The rule applies throughout Clay, Platte, and Jackson Counties, Missouri.

3.14.2 Environmental Consequences

Environmental consequences associated with impacts to air quality are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative. All counties within the study area are currently in attainment for NAAQS.

3.14.2.1 Proposed Action

Direct Impacts

Direct impacts to air quality primarily relate to operation of loaders and other mechanical equipment to construct new processing plants; operation of dredges to extract sand and gravel from the Kansas River; operation of loaders and other mechanical equipment at processing plants to process, handle, and store sand and gravel; and operation of trucks to transport processed materials to area markets. All these activities use equipment powered by internal combustion engines which emit pollutants as exhaust. Air pollutants of concern associated with sand and gravel operations include carbon monoxide, NO_X, ozone, and PM.

The Proposed Action includes requests for authorization from the USACE to dredge 1,900,000 tons of sand and gravel annually from the Kansas River. This amount is well below the limit of 3,150,000 tons, which represents a potential maximum quantity that could be extracted under the Regulatory Plan due to restrictions concerning the rate of sand and gravel extraction from specified reaches of the Kansas River and by any one dredge. The quantity of sand and gravel actually removed from the river by dredging since 1999 has ranged between approximately 1,000,000 and 2,500,000 tons, with an average of 1,405,000 tons per year.

Over the 17 years from 1984 to 2000, annual extraction averaged approximately 2,849,000 tons. Extraction totals for the period of 1984 through 1987 all exceeded 3,150,000 tons annually and for the period of 1988 through 1993 were only slightly less than that amount. Annually dredging the 3,150,000 tons of the Proposed Action theoretically allowed by the Regulatory Plan would be expected to annually produce pollution similar to dredging related activities during the 17 year period from 1984 to 2000. Each county within the State of Kansas is given one of the following four classifications related to air quality: 1) exceeding NAAQS; 2) meeting the standards; 3) not meeting the standards; or 4) cannot be classified because of insufficient data. All the counties within the Project Area are classified as meeting all NAAQS (USEPA, 2013b). The amount of pollutants produced by all the activities associated with the various levels of dredging performed over the period of 1984 through 2012 (29 years) has not caused any of the affected counties to not meet the NAAQS. Therefore, direct impacts to air quality from the Proposed Action are not anticipated to be significant.

Indirect Impacts

Indirect impacts to air quality would primarily be associated with the expansion or development of roads to support truck traffic to and from processing sites and possible construction at processing sites located adjacent to the river. There would be emissions generated by construction activities including fugitive dust from site grading activity, gravel roads and exhaust emissions from construction equipment and trucks hauling materials from processing sites. These emissions, with the exception of haul trucks would be temporary and would cease when construction activities are complete. Emissions and dust resulting from truck traffic would vary by the location and size of the processing site, road type and condition, weather, market demand, season of the year and other variables such as the time of day and day of the week. The pollutants resulting from truck travel to and from processing sites would be similar to other types of farming and vehicle traffic on roadways within the affected counties. As stated previously, none of the affected counties have failed to meet the NAAQS during the past 29 year period. Indirect impacts to air quality from the Proposed Action are not anticipated to be significant.

3.14.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers.

Selection of the No-Action Alternative would eliminate all air pollutants from activities related to dredging the Kansas River.

The No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations) are all likely to produce similar levels of air pollutant and have similar impacts on air quality.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

Direct impacts to air quality from floodplain pit dredging primarily relate to operation of loaders and other mechanical equipment to construct new processing plants; remove over burden material; and extract, process, handle, store and transport sand and gravel to area markets. All these activities use equipment powered by internal combustion engines which emit pollutants as exhaust. Air pollutants of concern associated with sand and gravel operations include carbon monoxide, NO_X, ozone, and PM.

There would be emissions generated by construction activities including fugitive dust from site grading, and criteria pollutant exhaust emissions from construction equipment associated with construction of new processing plants. Emissions generated by construction of each processing plant would be similar to those of the Waldron processing plant presented in Table 4.14-1 of the Missouri River Commercial Dredging EIS (USACE, 2011a). These emissions would be temporary and would cease when construction is complete. Construction of any one new processing plant would not exceed the federal *de minimis* thresholds.

Because none of the counties are classified as nonattainment areas with regard to the NAAQS, a conformity analysis is not required for emissions from dredging, processing, handling, and delivery processes occurring associated with floodplain pit dredging in the Project Area. Emissions from floodplain pit dredging operations would be proportionate to dredging the same amount of sand and gravel from the Kansas River and are not anticipated to exceed the federal *de minimis* thresholds.

Indirect Impacts

Indirect impacts to air quality would primarily be associated with the expansion or development of roads to support truck traffic to and from pit sites and construction occurring at processing sites. There would be emissions generated by construction activities including fugitive dust from site grading activity, gravel roads and exhaust emissions from construction equipment and trucks hauling materials from processing sites. These emissions, with the exception of haul trucks would be temporary and would cease when construction activities are complete. Emissions and dust resulting from truck traffic would vary by the location and size of the processing site, road type and condition, weather, market demand, season of the year and other variables such as the time of day and day of the week. The pollutants resulting from truck travel to and from processing sites would be similar to other types of farming and vehicle traffic on roadways within the affected counties. As stated previously, none of the affected counties have failed to meet the NAAQS during the past 29 year period. Indirect impacts to air quality are not anticipated to be significant.

Crushed Limestone from Quarry Operations

Direct Impacts

Direct impacts to air quality from limestone quarry operations primarily relate to operation of loaders and other mechanical equipment to construct new processing plants; excavate limestone; and manufacture, handle, store and transport sand and rock to area markets. All these activities use equipment powered by internal combustion engines which emit pollutants as exhaust. Air pollutants of concern associated with limestone quarry operations include carbon monoxide, NO_X, ozone, and PM.

Air pollution from limestone quarry operations would be similar in quantity and composition to air pollution from Kansas River dredging and floodplain pit dredging since they use essentially the same equipment. However, limestone quarries would generally be located in the uplands outside the Kansas River floodplains so the emissions would occur outside the floodplain and farther away from the major urban areas on the floodplain. Air pollution from delivery of sand and gravel to the market areas could be greater because of longer transport distance. Because none of the counties in the Project Area are classified as nonattainment areas with regard to the NAAQS, a conformity analysis is not required for emissions from limestone quarries in the Project Area. Emissions from limestone quarry operations are not anticipated to exceed the federal *de minimis* thresholds.

Indirect Impacts

Indirect impacts to air quality would primarily be associated with the expansion or development of roads to support truck traffic to and from quarry sites and construction activities. There would be emissions generated by construction work including fugitive dust from site grading activity, roads and exhaust emissions from construction equipment and trucks hauling materials from processing sites. These emissions, with the exception of haul trucks would be temporary and would cease when construction activities are complete. Emissions and dust resulting from truck traffic would vary by the location and size of the processing site, road type and condition, weather, market demand, season of the year and other variables such as the time of day and day of the week. The pollutants resulting from truck travel to and from processing sites would be similar to other types of farming and vehicle traffic on roadways within the affected counties. None of the affected counties have failed to meet the NAAQS during the past 29 year period and quarry activities similar in nature to this alternative are present in all of these counties. Indirect impacts to air quality are not anticipated to be significant.

3.14.2.3 Reduced Limit Alternative

Direct Impacts

Direct impacts to air quality for The Reduced Limit Alternative primarily relate to operation of loaders and other mechanical equipment to construct new processing plants; operation of dredges to extract sand and gravel from the Kansas River; operation of loaders and other mechanical equipment at processing plants to process, handle, and store sand and gravel; and operation of trucks to transport processed materials to area markets. All these activities use equipment powered by internal combustion engines which emit pollutants as exhaust. Air pollutants of concern associated with sand and gravel operations include carbon monoxide, NO_X, ozone, and PM.

The Reduced Limit Alternative would authorize the Dredgers to dredge 1,670,000 tons of sand and gravel annually from the Kansas River. This amount is well below the limit of 3,150,000 tons, which represents a potential maximum quantity that could be extracted under the Regulatory Plan due to restrictions concerning the rate of sand and gravel extraction from specified reaches of the Kansas River and by any one dredge. The quantity of sand and gravel actually removed from the river by dredging since 1999 has ranged between approximately 1,000,000 and 2,500,000 tons, with an average of 1,405,000 tons per year.

Over the 17 years from 1984 to 2000, annual extraction averaged approximately 2,849,000 tons. Extraction totals for the period of 1984 through 1987 all exceeded 3,150,000 tons annually and for the period of 1988 through 1993 were only slightly less than that amount. Each county within the State of Kansas is given one of the following four classifications related to air quality: 1) exceeding NAAQS; 2) meeting the standards; 3) not meeting the standards; or 4) cannot be classified because of insufficient data. All the counties within the Project Area are classified as meeting all NAAQS (USEPA, 2013b). The amount of pollutants produced by all the activities associated with the various levels of dredging performed over the period of 1984 through 2012 (29 years) has not caused any of the affected counties to not meet the NAAQS. Emissions related to the extraction of less material are anticipated to be equal to or less than past extraction activity. Therefore, direct impacts to air quality from the Proposed Action are not anticipated to be significant.

Indirect Impacts

Indirect impacts to air quality under this alternative would be similar to or less than the proposed action. Impacts would primarily be associated with the expansion or development of roads to support truck traffic to and from processing sites and possible construction at processing sites located adjacent to the river. There would be emissions generated by construction activities including fugitive dust from site grading activity, gravel roads and exhaust emissions from construction equipment and trucks hauling materials from processing sites. These emissions, with the exception of haul trucks would be temporary and would cease when construction activities are complete. Emissions and dust resulting from truck traffic would vary by the location and size of the processing site, road type and condition, weather, market demand, season of the year and other variables such as the time of day and day of the week. The pollutants resulting from truck travel to and from processing sites would be similar to other types of farming and vehicle traffic on roadways within the affected counties. As stated previously, none of the affected counties have failed to meet the NAAQS during the past 29 year period. Indirect impacts to air quality from the Proposed Action are not anticipated to be significant.

3.15 CLIMATE CHANGE

3.15.1 Affected Environment

3.15.1.1 Introduction

The study area has a continental climate that is characterized by cold winters, warm-to-hot summers, moderate winds, abundant sunshine, low-to-moderate humidity, and a pronounced peak in rainfall late in spring and during the first half of summer. The area is in the region of prevailing westerlies, where transient low-pressure disturbances and intrusions of cold polar air are common. Both of these influences contribute to the changeable weather pattern that is characteristic of Kansas and other Midwestern states.

The Gulf of Mexico is the principal source of moisture for precipitation in Kansas. Because the flow of moist air from the Gulf is more frequent over the eastern part of the study area than over the western part, the average annual precipitation in the study area decreases approximately 1 inch per 17 miles from east to west across the state (Soil Conservation Service, 1975).

Approximately 75 percent of the annual precipitation within the study area occurs between April and September. The average annual precipitation (central to eastern Kansas) varies from 32 to 36 inches. Summer thunderstorms producing rainfall in excess of 5 inches have been recorded in nearly every part of Kansas, but more frequently in the eastern part. Some of the thunderstorms are violent and produce heavy rainfall, large hailstones, and tornadoes. Damage from these storms, however, is generally local in extent and occurs in a variable and spotted pattern.

Winter precipitation usually results from the passage of well-developed low-pressure systems and active fronts and may occur as either rain or snow or a mixture of both. Precipitation amounts in winter are, in general, considerably less than for other seasons of the year. Snowfall in the study area is light in most years. In the eastern area of detailed investigations (Leavenworth, Wyandotte, Johnson and Douglas Counties), snowfalls average about 20 inches per year. At the western boundary of the study area at Manhattan, snowfalls average around 18.4 inches per year. Generally, February is the month of highest snowfall and snow generally remains on the ground for only a few days.

The annual range in temperature in the study area is fairly wide. Heat can be intense in the summer and arctic air occasionally surges into the area in winter. Severe winter weather is normally experienced in December, January, and February, with January having the lowest mean daily temperature. Temperatures of 10 to 25 degrees Fahrenheit below zero have been recorded in November through April. July and August are ordinarily the hottest summer months. Temperatures of over 100 degrees Fahrenheit have been recorded from April through November. Prevailing surface wind direction and mean speed normally follow a seasonal pattern. During the winter, winds from the north and west prevail over the Kansas River basin. During the rest of the year, winds generally are from the south or southwest. Mean velocities are usually highest in March and April and average 11 to 19 miles per hour.

3.15.1.2 Background

The cause of global climate change is generally accepted to be the increased production of greenhouse gases (GHG) resulting from, among other things, human activities worldwide. The climate change regulatory setting, both nationally and statewide, is complex and evolving and focused on regulating GHG emissions. The following discussion, concerning GHG emissions, has been reproduced from the Missouri River Commercial Dredging EIS (USACE, 2011a). The information presented identifies key legislation, executive orders, and seminal court cases relevant to the assessment of project-related GHG emissions. The Proposed Action and the alternatives carried forward for detailed study are not currently subject to GHG regulations. However, the CEQ has published Draft Guidance for the consideration of climate change impacts in NEPA analyses (Sutley, 2010). The Draft Guidance suggests that the impacts of projects directly emitting GHGs in excess of 25,000 tons of carbon dioxide equivalent (CO_2e) be annually considered in a qualitative and quantitative manner. However, the guidance stresses that, given the nature of GHGs and their persistence in the atmosphere, climate change impacts should be considered on a cumulative level.

Federal Action

In 2002, President George W. Bush set a national policy goal of reducing the GHG emission intensity (tons of GHG emissions per million dollars of gross domestic product) by 18 percent by 2012. No binding reductions were associated with the goal. Rather, the USEPA administers a variety of voluntary programs and partnerships with emitters of GHG in which the USEPA collaborates with industries producing and using synthetic gases to reduce emissions of these particularly potent GHGs.

On September 30, 2009, the USEPA proposed a new rule that would establish significance thresholds for six GHGs. The rule would define when CAA permits under the New Source Review and Title V operating permit programs would be required for new and existing facilities. The proposed threshold is 25,000 tons of CO_2e per year. Facilities exceeding this threshold would be required to obtain a permit that would demonstrate they are using Best Management Practices. The USEPA estimates that 14,000 large sources would need to obtain permits, the majority of which would be municipal solid waste landfills (USEPA, 2009).

USEPA Finding of Endangerment

On December 7, 2009, the USEPA Administrator found that current and projected concentrations of GHGs threaten the public health and welfare of current and future generations. Additionally, the Administrator found that combined emissions of carbon dioxide, methane, nitrous oxide, and fluorinated compounds from motor vehicles contribute to atmospheric concentrations and thus to the threat of climate change.

USEPA Proposed Rule – Mandatory Greenhouse Gas Reporting

On January 1, 2010, the USEPA implemented a rule that requires mandatory reporting of emissions of GHGs from large sources in the United States. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions are required to report annual emissions to the USEPA.

3.15.2 Environmental Consequences

Environmental consequences associated with impacts to climate change are discussed below. Direct and indirect impacts are presented for Proposed Action, No-Action Alternative, and the Reduced Limit Alternative.

3.15.2.1 Proposed Action

Direct Impacts

Direct impacts to climate change primarily relate to GHG emissions from operation of loaders and other mechanical equipment to construct new processing plants; operation of dredges to extract sand and gravel from the Kansas River; operation of loaders and other mechanical equipment at processing plants to process, handle, and store sand and gravel; and operation of trucks to transport processed materials to area markets. All these activities use equipment powered by internal combustion engines which produce GHG emissions as engine exhaust.

The equipment required for Kansas River dredging is similar to the equipment currently used in the Missouri River dredging, except that dredged material is not transported via barges and towboats on the Kansas River. Emissions from Missouri River commercial dredging activities were quantified based on information summarized in Appendix D of the Missouri River Commercial Dredging EIS (USACE, 2011a). According to the Missouri River Commercial Dredging EIS (USACE, 2011a), approximately 0.0062 metric tons of CO_2e are emitted per ton of sand and gravel dredged from the Missouri River. Dredging the full 3,150,000 tons allowed by the Proposed Action would produce about 24,180 metric tons of CO_2e per year from the dredging and processing operations. GHG emissions generated by construction of each processing plant would be similar to those of the Waldron processing plant determined in the Missouri River Commercial Dredging EIS (USACE, 2011a).

Assuming that other fleet characteristics (for example, engine type, year, and horsepower) are similar to those on the Missouri River, GHG emissions generated by Kansas River dredging likely would be less per ton than emissions generated by Missouri River dredging because no towboats are used on the Kansas River. However, if sand and gravel extracted from the Kansas River must be hauled farther than sand and gravel dredged from the Missouri, total GHG emissions generated by Kansas River dredging may be equal to or could possibly be greater dependent upon the amount of hauling and difference in hauling distances. Based on the overall information above, direct impacts to climate change from the Proposed Action are not anticipated to be more than minimal because the action does not directly emit GHGs in excess of 25,000 tons of CO_2e).

Indirect Impacts

Indirect impacts to climate change would primarily be associated with the expansion or development of roads and other public infrastructure to support truck traffic to and from processing plants. All these activities use equipment powered by internal combustion engines which produce GHG emissions as engine exhaust. These GHG emissions cannot be estimated, would be temporary and would cease when construction activities are complete. Based on the information describing the direct impacts, the assumption that indirect impacts would be less than direct impacts and the threshold for GHG concern and reporting, indirect impacts to climate change from the Proposed Action are not anticipated to be more than minimal.

3.15.2.2 No-Action Alternative

The No-Action Alternative would result in the cessation of all dredging following denial of the current permit requests and expiration of the existing permits currently held by the Dredgers. Selection of the No-Action Alternative would eliminate 9,300 tons of CO_2e per year currently produced by the average level of extraction from Kansas River dredging (1,500,000 tons of sand and gravel per year).

The No-Action Alternative would shift aggregate extraction to other sources of sand and gravel in order to meet the market demand for sand and gravel. The three primary alternative sources of sand and gravel identified for the No-Action Alternative (Missouri River dredging, pit dredging in the Kansas and Missouri River floodplains, and crushed limestone from quarry operations) will all produce GHGs and have some level of impact on climate change.

Pit Dredging in the Kansas and Missouri River Floodplains

Direct Impacts

Direct impacts to climate change from floodplain pit dredging primarily relate to operation of loaders and other mechanical equipment to construct new processing plants; remove over burden material; and extract, process, handle, store and transport sand and gravel to area markets. All these activities use equipment powered by internal combustion engines which produce GHG emissions as engine exhaust.

The equipment required for operation of land-based processing sites for floodplain pit dredging is similar to the equipment currently used at similar plants for Kansas and Missouri

River dredging. Emissions from Missouri River commercial dredging activities were quantified based on information summarized in Appendix D of the Missouri River Commercial Dredging EIS (USACE, 2011a). According to the Missouri River Commercial Dredging EIS (USACE, 2011a), approximately 0.0062 metric tons of CO_2e are emitted per ton of sand and gravel dredged from the Missouri River. If the No-Action Alternative were selected, about 1,500,000 tons of sand and gravel previously provided by Kansas River dredging would currently need to be replaced. If floodplain pit dredging fully replaced that 1,500,000 tons, it would emit about 9,300 metric tons of CO_2e per year. Emissions generated by construction of any new processing plant would be similar to those of the Waldron processing plant presented in Table 4.14-1 of the Missouri River Commercial Dredging EIS, or about 8,430 metric tons per processing plant (USACE, 2011a).

Floodplain pit dredging operations typically do not involve the use of towboats. As shown in Appendix D of the Missouri River Commercial Dredging EIS (USACE, 2011a), towboats are a more polluting transport on a pound-per-pound basis than haul trucks. Consequently, shifting production to land-based sources may likely produce less GHG emissions than does Missouri River dredging. Based on the overall information above, direct impacts to climate change from pit dredging sites are anticipated to be less than Missouri River dredging and approximately the same as Kansas River dredging. Based on the information describing the threshold for GHG concern and reporting, direct impacts to climate change from pit mining are not anticipated to be more than minimal.

Indirect Impacts

Indirect impacts to climate change would primarily be associated with the expansion or development of roads and other public infrastructure to support truck traffic to and from processing plants. All these activities use equipment powered by internal combustion engines which produce GHG emissions as engine exhaust. These GHG emissions cannot be estimated, would be temporary and would cease when construction activities are complete. Based on the information describing the direct impacts, the assumption that indirect impacts would be less than direct impacts and the threshold for GHG concern and reporting, indirect impacts to climate change from pit mining are not anticipated to be more than minimal.

Crushed Limestone from Quarry Operations

Direct Impacts
Direct impacts to climate change from limestone quarry operations would be similar to those for pit dredging. Based on the information previously described for pit mining, direct impacts to climate change from quarry sites are not anticipated to be more than minimal.

Indirect Impacts
Indirect impacts to climate change from limestone quarry operations would be similar to those for pit dredging. Based on the information previously described for that alternative, indirect impacts to climate change from quarry sites are not anticipated to be more than minimal.

3.15.2.3 Reduced Limit Alternative

Direct Impacts
Direct impacts to climate change from the Reduced Limit Alternative would be similar to, although less than those for the Proposed Action. However, because the Reduced Limit Alternative would produce far fewer (53 percent) emissions than the proposed action which does not exceed the levels for concern and individual regulation as specified by USEPA, direct impacts to climate change from the Reduced Limit Alternative are not anticipated to be more than minimal.

Indirect Impacts
Indirect impacts to climate change would primarily be associated with the expansion or development of roads and other public infrastructure to support truck traffic to and from processing plants. All these activities use equipment powered by internal combustion engines which produce GHG emissions as engine exhaust. These GHG emissions cannot be estimated, would be temporary and would cease when construction activities are complete. Based on the information describing the direct impacts, the assumption that indirect impacts would be less than direct impacts and the threshold for GHG concern and reporting, indirect impacts to climate change from pit mining are not anticipated to be more than minimal.

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CHAPTER 4

Cumulative Impacts

4.1 INTRODUCTION

Cumulative impacts are the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7). For each environmental factor, Chapter 3 presents information about past and present environmental conditions—including future trends, where appropriate followed by environmental and socioeconomic consequences of implementing the Proposed Action and alternatives described in Chapter 2. The assessment of cumulative impacts in this Chapter addresses the cumulative impacts of all commercial dredging added to the impacts of other past, present, and reasonably foreseeable future actions.

The cumulative impact analysis chapter is intended to provide a broader, more expansive assessment of potential impacts associated with implementing the Proposed Action and alternatives considering the wide array of other activities, new and ongoing projects, and programs in the Project area and vicinity. In this way, the potential interactions between commercial dredging of sand and gravel and reasonably foreseeable projects and programs can be explored, and any significant adverse or beneficial cumulative impacts can be identified and considered.

The USACE recognizes that there are many activities affecting the Kansas River. The analysis below assesses the best available information related to how those activities affect the environmental resources. The conclusion that the USACE has reached that the Proposed Action does not result in the potential for significant cumulative impacts is based on assessment of the best available information about other activities on the Kansas River and on the analysis of data from 20 years of river monitoring associated with commercial dredging. The USACE has determined that the impact of dredging on many environmental factors is related to the extent that the river bed degrades. The Regulatory Plan has limited the amount of bed degradation that can occur before dredging is suspended and therefore has minimized the effect of dredging on the related environmental factors. The cumulative impacts of the Proposed Action and other past, present, and reasonably foreseeable activities affecting the Kansas River are not significant.

4.2 PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

The Kansas River ecosystem was historically a highly dynamic, highly variable river system but it experienced a marked ecological transformation during the 20th century. At the beginning of the century, the Kansas River was notorious for large floods, for a sinuous and meandering river channel that moved freely across its floodplain, and for massive sediment transport. The river was characterized by log jams, snags, whirlpools, chutes, bars, cut-off channels, and secondary channels around bars. The main channel typically had a deeper thalweg (the deepest part of the river) that contained the faster-moving flow and a shallower section(s) on one or both sides of the channel.

4.2.1 Channel Modification

Beginning in 1857 the Kansas River Navigation Company operated steamboats on the river from Kansas City to Lawrence and Topeka, and sometimes as far west as Fort Riley. Riverboat traffic continued through the territorial period and into the early years of statehood, falling off rapidly in the early 1860s due to the difficulty of navigating the river during low flows, increasing competition from railroads, and Kansas legislation. The river is currently designated as a Navigable Water under both state and federal law; however, modern commercial navigation on the river is primarily confined to dredging (Kansas Cyclopedia, 1912). Although it is a federally designated Navigable Water, the Kansas River was never a federally designated navigation or bank stabilization project and was not channelized river-wide like the Missouri River was by the Bank Stabilization and Navigation Project (BSNP). The Kansas River banks have been stabilized by riprap, weirs, or dikes in a relatively small portion of its length generally where specific structures have been threatened. According to the Friends of the Kaw's Kansas River Inventory (Friends of the Kaw, 2013), there are 11 locations of bank stabilization of some kind. Additionally, several manmade structures or channel modifications relating to water supply continue to directly affect the Kansas River ecosystem by acting as grade control and as biological barriers for aquatic species in the river. These activities include the Bowersock Dam at Lawrence, WaterOne weir downstream of the I-435 Bridge, the low head weir for the Westar Energy-Tecumseh Energy Center just downstream of Topeka, the city of Topeka water intake weir, and the Jeffery Energy Center weir and water intake. The Missouri River BSNP also affects the Kansas River through the changed stage-discharge relation of the Missouri and Kansas Rivers.

4.2.2 Reservoir Construction and Operation

Eighteen reservoirs have been built in the Kansas River watershed since 1949. Many of the reservoirs were built in response to the 1951 Kansas River flood which was so severe that it destroyed large parts of Topeka and other riverside communities along the river. Most of the reservoirs are primarily operated for flood control purposes and control about 80 percent of the total drainage area. These reservoirs have modified the natural water discharge pattern, decreasing the frequency of both very high and very low flows, while increasing the frequency of more moderate discharge events. This has changed the quantity and type of sediment that the river moves and where the sediment comes from since the reservoirs also trap much of the sediment eroded up stream. Many of these reservoirs have lost a significant part of their storage capacity due to sedimentation. The state of Kansas is currently planning a pilot study project to dredge accumulated sediment from and restore the water storage capacity of John Redmond Reservoir in hopes of finding a viable solution for the other reservoirs.

4.2.3 Flood Control Levees

The Kansas River flood of 1951 also led to the construction of flood control levees in Kansas City, Lawrence, Topeka, and Manhattan. These levees constrain the river, change the natural flood cycles, and affect the geomorphology and ecology of the river.

4.2.4 Municipal Water Supply

The Kansas River is the primary source of drinking water for approximately 800,000 people in towns and cities along the river including the Kansas City Metropolitan Area, Lawrence, Topeka, Manhattan, and Fort Riley. The growing consumption of river and ground water has impacted both the morphology and ecology of the Kansas River ecosystem.

4.2.5 Irrigation

Beginning in the 1890s, farmers began to use windmill powered pumps to tap underground aquifers to irrigate farmland in Kansas. However, windmill irrigation proved to be unsatisfactory on a large scale in western Kansas where water was often more than 100 feet below the surface. The introduction of the internal combustion engine in the early 1900s provided the power needed to tap this water supply and irrigation expanded to 95,000 acres of irrigated Kansas cropland in 1920. After World War II, Kansas farmers tapped into the vast Ogallala, Dakota, Glacial Drift, and Alluvial Aquifers and continued to expand their use of irrigation. Advances in technology made it easier and more economical to reach and distribute the ground water. Today, approximately 84 percent of the groundwater pumped each year in Kansas is used for irrigation. As groundwater levels have dropped more than 200 feet in some areas, concerns about depletion of the Aquifer have led to the widespread use of high efficiency drop down sprinkler heads (Kansas Historical Society, 2013). The physical effect of the expansion of irrigation in the Kansas River watershed is that river flows in most of the western tributaries to the Kansas River are lower than they were in the severe droughts of the 1920s and 1950s (Annett, 2009). Prolonged low river levels can be devastating to aquatic species in the river.

4.2.6 Agriculture

Expansion of agriculture in the Kansas River watershed has also affected the Kansas River by increasing rates of erosion. Even with the use of no-till farming practices, surface erosion is much greater than it is for native prairie. The eroded sediment is higher in fine organic and mineral particles; nitrogen, phosphorus and potassium fertilizer; pesticides; and herbicides (Annett, 2009). The developing bio-fuel industry has driven up the price of various crops and encouraged farmers to put uncultivated land into production. This has led to the elimination of many forested or grassland stream buffers, reduced stormwater filtration, and increased stream bank erosion throughout the watershed.

4.2.7 Urbanization and Development

The Kansas River is approximately 170 miles long and borders ten of the 105 counties in Kansas. These ten counties account for more than 40 percent of the state's population, with six of the state's 10 largest cities located along the river's banks. The Kansas City Metropolitan Area is a transportation hub with an international airport, river port, intersecting interstate highways, and several intermodal transportation facilities. The Kansas River valley serves a major transportation corridor from Kansas City westward across the state. Transportation networks include the Union Pacific Railroad along the north side of the river between Kansas City and Junction City, the BNSF Railroad along the south side of the river between Kansas City and Topeka, I-70, U.S. Highway 24, Highway K-18, Highway K-32, and Highway K-10. The excellent transportation networks have led to urbanization and industrialization along the Kansas River floodplain which has increased the demand for sand and gravel for use in construction materials; water for public, industrial and commercial uses; and recreational opportunities such as fishing, canoeing and kayaking. It has also increased the amount of pollutants discharged into the river directly from point sources as well as indirectly from stormwater runoff. These human activities have all affected the Kansas River.

4.3 CUMULATIVE IMPACT ASSESSMENT

4.3.1 Geology and Geomorphology

River geomorphology is the primary environmental factor affected by dredging. River geomorphology is also affected by other actions, projects, and programs as they influence sediment dynamics (i.e., sediment budget, composition, and transport) and sediment management in the Kansas River. These factors subsequently influence channel form and geometry, and the location and abundance of habitat features in the river as well as river bed degradation and aggradation. Projects and activities that similarly affect sediment dynamics and bed degradation include bank stabilization, reservoir construction and operation, levee construction and maintenance, and water consumption and control structures.

Channel modifications including Bowersock Dam, the WaterOne weir, the Westar Energy-Tecumseh Energy Center weir, the weir for the Topeka municipal water supply intake, and the weir for the Jeffery Energy Center water intake all function as grade control and prevent bed degradation below the structures from migrating up river. Coarser sediment is also captured above the structures. The river channel in parts of Kansas City, Lawrence, Topeka, and Manhattan, Kansas have also been hardened and narrowed with levees and other flood-control works. Sections of the river bounded by levees generally have steeper banks, little riparian vegetation, and experience deeper faster flows during flood events rather than wider and slower flows across the floodplain (Annett, 2009). The deeper and faster flows will erode and transport more sediment. Even without flood control levees, the 1951 Kansas River flood dramatically altered the river system resulting in a straighter channel with a larger cross-sectional area than before the flood.

The 18 reservoirs constructed in the Kansas River watershed since 1949 have modified the natural pattern of water discharges and sediment movement of through the system. The reservoirs absorb and retain much of the pulse of water from large precipitation events and release it more evenly over a longer period of time. This prevents the extremely high and low flow events and lowers the volume of sediment previously moved during flood events. The reservoirs also trap much of the course grained sediment and increase the percentage of fine-grained materials in the bed load. The relatively clean water released from the reservoirs can cause bed and bank erosion downstream as the discharge water seeks to satisfy its sediment-carrying capacity. The effects of bed and bank erosion associated with sediment starved release water is primarily confined to the tributaries located immediately downstream of the reservoirs and not the Kansas River (Brady, et al., 1998; Simons, Li, and Associates, 1984; and USGS, 1967).

Many farmers in western Kansas, Nebraska, and eastern Colorado have transitioned from growing less productive dry-land wheat and milo to more productive and profitable corn, soybeans, and alfalfa hay that depends on irrigation. With the growing bio-fuels industry raising the sale price and demand for various crops, Northeastern Kansas farmers are increasingly installing center-pivot irrigation systems to ensure high crop production even during dry years. The growing consumption of water from both surface and ground water in the Kansas River watershed is modifying the patterns of water and sediment movement through the system. While streams in the Flint Hills region of southeastern Kansas still demonstrate the expected stream flow patterns that mirror precipitation, stream flow in the Republican, Smoky Hills, Solomon, and Saline Rivers have become disproportionately low during drought periods because irrigation is depleting the groundwater that would normally enter the streams and supplement flows. Lower flows into the reservoirs on these rivers means lower water discharges and less sediment delivered to the Kansas River. A lower bed load during low flow periods reduces the amount of material that could be sustainably dredged.

The demand for increased agricultural production is also motivating farmers to put marginal uncultivated land into production. Rather than re-enrolling highly erodible or flood prone land in various federal conservation programs, farmers may find it more profitable to clear and farm these forested or grassland areas that often buffer the adjacent rivers and streams. This will often result in increased surface erosion and riverbank failure. The increased sedimentation may negatively impact the tributaries but could actually increase the sediment supplied to the Kansas River and result in some aggradation.

From the discussion above, it is clear that dredging is only one of several ongoing activities that affect the geomorphology of the Kansas River. However, the Regulatory Plan recognizes and addresses cumulative impacts because it prohibits dredging in any 5-mile reach that is degraded more than 2 feet below the 1992 baseline regardless of the cause. This takes into account the effects of both the permitted action and all other activities or conditions that contribute to bed degradation. The Regulatory Plan would also apply to the Reduced Limit Alternative so the cumulative effect of the two dredging alternatives would be essentially the same. Under the No-Action Alternative, the incremental effect of dredging on river geomorphology would be eliminated but the other activities affecting geomorphology would remain the same. Section 3.2.1.5 of this Draft EIS reviews the: 1) the survey data collected since implementation of the Regulatory Plan in 1991; 2) the bed elevation trending analysis prepared as part of this Report; and 3) the 2010 USACE report on the hydrologic and geomorphic changes in the Kansas River, and shows that the Regulatory Plan has worked as intended. Based on the regulatory restrictions imposed on dredging activities by the USACE, the incremental impacts to the geomorphology of the Kansas River associated with either the Proposed Action or Reduced Limit Alternative, when added to other activities that may impact the morphology of the Kansas River, are not anticipated to be significant.

The No-Action Alternative would most likely result in an increase in pit dredging operations in the Kansas and possibly the Missouri River floodplains or in crushing limestone from quarry operations. Neither alternative would involve work within the Kansas River so impacts resulting from those operations would have no effect upon the Kansas River.

4.3.2 Land Use

As the Kansas River basin was settled in the 1800s, the river valley provided access to fertile land, ample wildlife and water, and timber useful for building. Towns were born and grew, industries developed, railroads and highways were built, but they were limited by the relative position of land on the floodplain and the likelihood of flooding. Farmers could tolerate occasional flooding but avoided cultivating extremely flood prone lowlands. Construction of the flood control reservoirs and levees in the Kansas River basin reduced the likelihood of flooding and spurred the conversion of grasslands and forests to cultivated agriculture. The reservoirs also provided steady water supplies and recreational opportunities which promoted growth of Kansas City, Lawrence, Topeka, and Manhattan from small frontier towns to large cities and urban areas. Construction of more flood control levees and reservoirs is not expected in the reasonably foreseeable future but these urban areas can be expected to continue to grow and experience urban sprawl. There will be growing pressure to convert farmland, grassland, and forest into residential, commercial, and industrial areas.

In 1998, commercial and industrial activities occupied about four percent (14.1 square miles) of the land on the Kansas River floodplain (Brady, et al., 1998). Each processing plant occupies 5 to 15 acres so the Proposed Action would cumulatively occupy no more than 240 acres, or about 0.1 percent of the floodplain. Since the majority of the permits requested under the Proposed Action and Reduced Limit Alternative involve existing operations, impacts to land use associated with the development of new processing plant sites are not anticipated to be more than minimal. The incremental impacts associated with either the Proposed Action or Reduced Limit Alternative, when added to the cumulative impacts from other activities that may impact land use, are not anticipated to be significant.

The No-Action Alternative would most likely result in an increase in pit dredging operations in the Kansas and possibly the Missouri River floodplains or in crushing limestone from quarry operations. Pit dredging operation has previously been studied and a 61-acre development parcel, which provides approximately 47.5 acres for mining and 13.5 acres for operational facilities (Booker Associates, 1986) was determined to be the minimal economically viable project site size. Although the referenced study is a bit dated, no known advances or efficiencies in technology or management of these sites to reduce the footprint of the pit operations or increase production cost are known. In order to accommodate the current Kansas River production level of 1,500,000 tons of sand and gravel per year, the average market demand since 2000, it is estimated that 25 to 34 acres of land would need to be converted to pit dredging operations each year (Blechinger, 1997; Booker Associates, 1986) assuming no other alternative sources of sand and gravel are utilized. As new dredge pits open, the need for improved infrastructure including roads and utilities could create opportunity for additional industrial development adjacent to the pit sites. Dredge pits have a typical life span between 10 and 15 years, depending on dredge pit size, and new dredge pits would be continually developed as old dredge pits expire and are taken out of production. Therefore, floodplain pit dredging operations have a potential to consume approximately 1,580 acres (about 0.7 percent of the Kansas River floodplain) of undeveloped land over a –0-year period. Quarries would impact similar amount of land uplands outside the floodplain. The incremental impacts associated with the No-Action Alternative, when added to the cumulative impacts from other activities that may impact land use, are more than either the Proposed Action or Reduced Limit Alternative but are still not anticipated to be significant.

4.3.3 Infrastructure

Infrastructure such as Bowersock Dam, bridges, pipelines, water supply weirs, water intake structures, levees, and boat ramps are negatively affected by riverbed degradation, head-cutting, and changes to river stage levels. The impacts to infrastructure are generally related to the degree of bed degradation which is affected by bank stabilization, reservoir construction and operation, floods, levee construction and maintenance, agriculture, water consumption, and control structures in addition to dredging as discussed in Section 4.3.1.

From the discussion in Section 4.3.1, it is clear that dredging is only one of several ongoing activities that affect infrastructure through degradation of the Kansas River. However, the Regulatory Plan recognizes and addresses cumulative impacts to infrastructure because it prohibits dredging in any 5-mile reach that is degraded more than 2 feet below the 1992 baseline regardless of the cause. This takes into account the effects of both dredging and all other activities or conditions that contribute to bed degradation and associated potential effects on infrastructure. The Regulatory Plan would also apply to the Reduced Limit Alternative so the cumulative effect of the two dredging alternatives would be essentially the same. Under the No-Action Alternative, the incremental effect of dredging on bed degradation and associated effects on infrastructure would be eliminated but the other activities affecting infrastructure would remain the same. The incremental impacts to infrastructure associated with either the Proposed Action, Reduced Limit Alternative, or No-Action Alternative when added to the cumulative impacts from other activities that may impact infrastructure, are not anticipated to be significant.

4.3.4 Economics and Demographics

The analysis of economic impacts is an important component of a cumulative impact analysis because the economic well-being of local communities depends not only on the economic impact of individual activities such as river dredging but is influenced by a wide range of activities and macroeconomic trends.

Data on total employment and employment by industry provide insights into the size, strength, and diversity of a local economy. Section 3.5.1 includes economic information about the primary market area, which encompasses a 30-mile radius around the requested dredge areas associated with the Proposed Action. In 2013, the primary market area had an employment base of approximately 1.4 million jobs (Table 15). Based on the information on employment by industry, the economy in the primary market area is diverse. The largest economic sectors in the primary market area were Other Services, Wholesale and Retail Trade, and Government (federal and state/local); the Natural Resources and Mining sector accounted for a relatively small proportion (less than 1 percent) of total employment in the primary market area. The Construction sector that relies on sand and gravel as a production input supported approximately 66,117 jobs and represented approximately 5 percent of the employment base in the primary market area.

The measure of earnings by industry is more relevant than total personal income in evaluating the potential impacts of changes in commercial dredging on the local economy because it focuses on the wages and salaries of employees and the business income of proprietors. In addition, it excludes factors such as transfer payments that are unlikely to be affected by changes in commercial dredging. Total earnings of all industries in the primary market area was $79.09 billion in 2013 (Table 16). Following patterns similar to employment, the level of earnings was highest in the Other Services sector. Other sectors that provided a relatively high proportion of employment earnings include Government, Wholesale and Retail Trade, and Manufacturing. The Natural Resources and Mining sector generated approximately $226.5 million, which is less than one percent of the total earnings of all industries in the primary market area. The Construction sector that relies on sand and gravel as a production input earned $4.6 billion which represents approximately 6 percent of the total earnings of all industries in the primary market area.

Both the Proposed Action and Reduced Limit Alternative would meet current market demands for sand and gravel. However, the No-Action Alternative would likely result in increased production from existing alternate sources of sand in the short term to satisfy existing demand, in addition to an increase in the delivered cost of sand and gravel to consumers based on higher transportation costs. In response to reduced supplies from the Kansas River, it is also likely that new sand and gravel operations would be developed in the Kansas and Missouri River floodplains over the long term to meet future demand more cost efficiently. The long-term cumulative impacts associated with new floodplain operations would be an increase in the regional cost of sand and gravel relative to the use of existing alternate sources in the region if the new floodplain sources are located farther away from the markets. Because the Natural Resources and Mining and Constructions sectors make up only approximately 5 percent of the total employment and approximately 6 percent of the total industry earnings of the primary market area, the incremental impacts associated with either the Proposed Action, Reduced Limit Alternative, or No-Action Alternative when added to the cumulative impacts from other activities that may impact the regional economy, are not anticipated to be significant.

Furthermore, the continued use of Kansas River sand and gravel would allow the cost of sand and gravel to remain low in both local markets and within the primary market area. From a regional perspective, the net economic impacts of the Proposed Action would be positive and no adverse environmental justice impacts are anticipated.

4.3.5 Water Resources

The source of much of the water consumed in the region along the Kansas River is either the Kansas River or the alluvial aquifer in the Kansas River floodplain. The supply and quality of that water are cumulatively affected by river geomorphology, water control structures, reservoir management, agriculture, industrialization, urbanization, land use, and recreation in addition to dredging.

4.3.5.1 Water Supply

Bed degradation in a reach of the river generally lowers the surface water profile in that reach of the river and the ground water table in the adjacent alluvial aquifer. A lower water surface profile can impair or disable water intake structures in the river. A lower ground water table can impair or disable vertical or radial collector wells. Bed degradation is cumulatively affected by bank stabilization, reservoir construction and operation, floods, levee construction and maintenance, agriculture, water consumption, and control structures in addition to dredging as discussed in Section 4.3.1.

The urban areas along the Kansas River corridor have experienced tremendous growth over the last several decades and continue to grow today. If the trend continues into the future, the demand for water supply can be expected to increase. Additionally, agriculture in the Kansas River basin has increasingly turned to irrigation. Irrigation consumes approximately 85 percent of the water used in the state. Future demand for water supply from federal reservoirs is projected to increase. Increasing demands coupled with decreasing supplies will eventually result in water supply shortages during severe drought conditions. Preliminary studies indicate that if a multi-year, severe drought occurred in the foreseeable future, water supply shortages could occur because of diminished storage (Kansas State University, 2008). Because water is a limited natural resource, increasing water consumption is a feedback loop in that it negatively impacts the ability to obtain that resource.

Many reservoirs have been built in Kansas which historically did not have many natural lakes. Soils in the region are very erodible. The soils in Kansas are generally deep, rich silts, clays, and loams. As these materials naturally eroded, they historically moved into valleys and stream channels and eventually down to the Mississippi delta. Today these materials move into the reservoirs and collect behind the dams. Sediment can fill a reservoir in 100 to 200 years, the projected life expectance of most reservoirs. Human activities such as urbanization, agriculture, and alteration of riparian and wetland habitats have changed flow regimes, increasing the concentrations and rates at which sediment enters streams and rivers and decreasing the life expectancy of reservoirs even more (Kansas State University, 2008).

Sedimentation and the resulting loss of water storage capacity in flood-control reservoirs located in the Kansas River basin, in Kansas, has become an increasing issue of concern for the state. The KWO has determined that based on a comparison of pre-impoundment and 2009 reservoir surveys, approximately 289,059 acre-feet of sediment has accumulated in Clinton, Kanapolis, Milford, Perry, and Tuttle Creek Reservoirs since they were constructed (KWO, 2009). This represents a 29 percent loss in water storage capacity in these five USACE operated reservoirs in the Kansas River basin. This phenomenon is also occurring in other reservoirs throughout Kansas and the KWO is so concerned that they have initiated a request with the USACE to dredge John Redmond Reservoir in the Marais des Cygnes basin. They are completing the request for permission to alter a USACE project and preparing an EIS. They plan to issue $25 million in bonds to fund a 5-year project at the reservoir that would include $13.2 million for dredging, $4.5 million for land acquisition to dispose of the sediment, and $7.3 million for stream bank stabilization. The project could become a model of how to restore the capacity of the reservoirs in the Kansas River basin.

It is clear that dredging is only one of several ongoing activities that affect water supply through degradation of the Kansas River bed. However, the Regulatory Plan recognizes and addresses cumulative impacts to water supply because it prohibits dredging in any 5-mile reach that is degraded more than 2 feet below the 1992 baseline regardless of the cause. This takes into account the effects of both the permitted action and all other activities or conditions that contribute to bed degradation and associated potential effects on water supply. The Regulatory Plan would also apply to the Reduced Limit Alternative so the cumulative effect of the two dredging alternatives would be essentially the same. Under the No-Action Alternative, the incremental effect of dredging on bed degradation and associated effects on water supply would be eliminated but the other activities affecting water supply would remain the same. The severity of the incremental impacts associated with the Proposed Action, Reduced Limit Alternative, or No-Action Alternative when added to the cumulative impacts from other activities that may impact water supply, are not anticipated to be significant.

4.3.5.2 Water Quality

Commercial dredging of sand and gravel would disturb and suspend large amounts of river bottom sediments each year in the Kansas River. The potential exists for cumulative impacts on water quality to accompany this activity even though the site-specific incremental impacts of dredging on water quality generally are considered to be minor (see Section 0). Nutrients are of particular importance when considering cumulative impacts because nutrients are pervasive in aquatic environments and strongly influence trophic status, dissolved oxygen dynamics, and primary production. Other present or reasonably foreseeable future actions or trends that could affect the potential for cumulative impacts on water quality include agriculture, urbanization, and industrialization. These activities introduce large quantities of sediment into the Kansas River that may affect trends in watershed loadings of nutrients in the Missouri River basin. In addition, nutrient loading from the Mississippi River, into which the Kansas River empties via the Missouri River, has been implicated as one of the primary causes of hypoxia in the Gulf of Mexico (Sutula, Bianchi, & McKee, 2004).

Hypoxia is primarily a problem for estuaries and coastal waters; the dissolved oxygen concentrations in hypoxic waters are less than 2–3 parts per million (ppm). Hypoxia can be caused by a variety of factors, including excess nutrients (primarily nitrogen and phosphorus) and water body stratification due to saline or temperature gradients. Excess nutrients, often referred to as "eutrophication," promote algal growth. As dead algae decompose, oxygen is consumed in the process, resulting in low levels of oxygen in the water.

Nitrogen from the Mississippi River basin, into which the Kansas River basin empties via the Missouri River, has been implicated as one of the primary causes of hypoxia in the Gulf (Sutula, Bianchi, and McKee 2004). New information concerning the role of phosphorous in the hypoxic zone in the Gulf has recently emerged (USEPA, 2007). Phosphorus is now believed to be an important limiting constituent during spring and summer in lower salinity, near-shore coastal waters (USEPA 2007). Both nitrogen and phosphorous contribute to the excessive phytoplankton production and the associated hypoxia in the Gulf. Because of the role of these nutrients in hypoxia, the USEPA scientific advisory board has called for reductions in both nitrogen and phosphorous (USEPA 2007).

The USGS annually predicts the extent of the Gulf hypoxic zone based on upstream hydrologic and nutrient data. The greatest nutrient runoff from the Mississippi River basin has been found to occur from land uses in the upper Mississippi and Ohio-Tennessee River sub-basins (USEPA 2007). The net nutrient flux contributed by the Missouri River is modeled through data obtained from the Hermann, Missouri sampling station (USGS, 2007). Typically, the Missouri River basin contributes approximately 20 percent of the total phosphorous and approximately 15 percent of the total nitrogen loads to the Gulf via the Mississippi River (Soballe, 2009). About 73 percent of the Missouri River basin's total phosphorus and 70 percent of the basin's total nitrogen entered the river below Omaha, Nebraska (USEPA, 2007).

The USGS completed a comparative analysis between the baseline period of 1980 – 1996; 5-year moving averages thereafter indicate a decrease in the average annual streamflow and fluxes of nitrogen to the Gulf (Battaglin et al, 2010). However, the analysis found an increase in the flux of total phosphorus between the baseline period and subsequent 5-year periods. Study results attributed the decreases in annual nutrient fluxes that have occurred between the 1980–1996 baseline period and more recent years to natural causes (climate and streamflow) and not management actions or other human-controlled activities in the Mississippi-Atchafalaya River basin.

In the absence of data specific for the Kansas River basin, data from the Missouri River basin (as measured at Hermann, Missouri) can be informative when considering that approximately 73 and 70 percent of the basin's total phosphorus and nitrogen respectively enter the river below Omaha, Nebraska. This sub-basin includes the Platte, Kansas, Grand, and Osage Rivers. The inputs of water (streamflow), total nitrogen, and total phosphorus from the Missouri River basin, (as measured at Hermann, Missouri) as a percentage of the Gulf totals have decreased (Battaglin et al., 2010). Total nitrogen flux from the Missouri River basin (as a percentage of the Gulf total) averaged 15 percent for 1980–2006; 16 percent for the 1980–1996 baseline period; and 12, 13, and 11 percent for the 2000–2004, 2001–2005, and 2002–2006 5-year periods, respectively. Total phosphorous flux from the Missouri River basin (as a percentage of the Gulf total) averaged 21 percent for 1980–2006; 21 percent for the 1980–1996 baseline period; and 19, 20, and 16 percent for the 2000–2004, 2001–2005, and 2002–2006 5-year periods, respectively.

Actions that introduce nutrients to receiving waters include migration of fertilizer from agricultural fields, golf courses, and lawns; erosion of soil containing nutrients; disposal of animal manure; atmospheric deposition of nitrogen; sewage treatment plant discharges; and other industrial discharges (USEPA, 2007). Land-disturbing activities can be a significant source of sediment phosphorous, especially when eroded sediments are rich in nutrients from past agricultural practices (USEPA, 2007). Water quality monitoring has shown that nutrient and sediment levels and bacteria densities were substantially larger during periods of increased stream flow, indicating important contributions from non-point sources in the basin (Rasmussen et al., 2005). Any past, current, or future projects introducing nutrients via these mechanisms would cumulatively contribute to nutrient loading in the Kansas River. It is important to recognize that commercial dredging excavates bed material, processes it, and discharges the process water back into the river after it passes through a settling basin. Commercial dredging does not introduce any new sediment or nutrients to the Kansas

River. Floodplain dredge pits or upland quarries could however introduce new sediment and nutrients to the Kansas River.

Given the variable trends in nutrient flux in the Kansas River and the very small incremental contribution of sand and gravel dredging, pit dredging, or limestone quarries to cumulative nutrient loading in the Kansas River, the incremental impacts associated with either the Proposed Action, Reduced Limit Alternative, or No-Action Alternative when added to the cumulative impacts from other activities that may impact the water quality, are not anticipated to be significant.

4.3.6 Recreation

Under Kansas state law, the Kansas River is one of only three rivers in the state open to navigation by the public; the others are the Missouri and Arkansas Rivers. With approximately 40 percent of the population of Kansas residing in 10 counties along the Kansas River, the river is an important recreational resource. Recreation is affected by changes in river geomorphology, reservoir construction and operation; land use; levee construction; river control structures; water consumption by municipalities, industries, and agriculture; and urbanization in addition to dredging.

Changes to the river geomorphology including river bed degradation and lower water surface profiles can negatively affect recreational access to the Kansas River by damaging or disabling public boat ramps. The impacts to recreational boat ramps are generally proportional to the degree of bed degradation which is affected by bank stabilization, reservoir construction and operation, floods, levee construction and maintenance, agriculture, water consumption, and control structures in addition to dredging as discussed in Section 4.3.1. On the other hand, the reservoirs in the Kansas River basin have positively affected recreation by increasing the periods of moderate river flow that favor recreational navigation.

The Bowersock Dam at Lawrence, WaterOne weir downstream of the I-435 Bridge, the low head weir for the Westar Energy-Tecumseh Energy Center just downstream of Topeka, the city of Topeka water intake weir, and the Jeffery Energy Center weir present physical barriers or safety hazards to recreational users, particularly boaters on the river. Boaters may only navigate between weirs or must portage over land around each weir. There have been several deaths over the years when boats have gone over a weir and become trapped in what is known as a keeper hydraulic, a water flow that recirculates object that get caught in it (Jones, 2011). Friends of the Kaw is working to provide better warning of and portage around these weirs or to convert them into low grade rapids to alleviate the dangers.

Property ownership, land use, urbanization, and industrialization have a substantial impact on recreation access to the Kansas River. Although the river is public property up to the ordinary high water mark, much of the river is surrounded by private property restricting public access. Except where the adjacent land is federal, state, or city property, recreation is confined to the river, sand bars, islands, and banks below the ordinary high water mark. This often requires recreationists to access the river by boats. Friends of the Kaw, cities, and the KDWPT are working to improve access by building more public boat ramps or acquiring land along the river for public use.

Additional safety requirements are also recommended for inclusion in the Regulatory Plan to prevent collisions between recreational boaters and dredges or their discharge pipes or mooring cables. The Regulatory Plan would apply to both the Proposed Action and the Reduced Limit Alternative so the cumulative effect of the two dredging alternatives would be essentially the same. Based on these regulatory restrictions that would be imposed on dredging activities by the USACE, incremental impacts to recreation on the Kansas River associated with either the Proposed Action or the Reduced Limit Alternative, when added to other activities that may cumulatively impact recreation on the Kansas River, are not anticipated to be significant.

The No-Action Alternative would most likely result in an increase in pit dredging operations in the Kansas and possibly the Missouri River floodplains or in crushing limestone from quarry operations. Neither pit dredging nor quarries would involve work directly on the Kansas River so would affect river access only when adjoining the river. Because the dredge pits would be a small portion of land adjoining the river, the incremental impacts associated with the No-Action Alternative, when added to the cumulative impacts from other activities that may impact recreation, are not anticipated to be significant.

4.3.7 Wetlands

As discussed in Section 3.8.1, Kansas had lost more than 400,000 acres of wetlands by the 1980s. Most of these losses were due to the draining and conversion of wetlands to agriculture land but urbanization, industrialization also played a role. The construction of the flood control reservoirs and levees also contributed to wetland loss by reducing the extent and frequency of flooding on the historic Kansas River floodplain and making it safer for cultivation or development. Federal legislation in the 1970s and 1980s sought to slow the loss of wetlands. Section 404 of the CWA of 1972 prohibited the deposition of fill material in wetlands. The 1985 Food Security Act included a provision prohibiting the payment of subsidies to farmers who have converted wetlands to farmland. Both of these federal programs continue to slow the deliberate conversion of wetlands.

Bed degradation and changes to river stage levels can also reduce the frequency of overbank flooding, lower the water table of the alluvial aquifer, and thus eliminate or modify the wetland hydrology. Bed degradation continues to be affected by various activities as discussed in Section 4.3.1. From the discussion in Section 4.3.1, it is clear that dredging is only one of several ongoing activities that affect wetlands through degradation of the Kansas River. However, the Regulatory Plan recognizes and addresses cumulative impacts to wetlands because it prohibits dredging in any 5-mile reach that is degraded more than 2 feet below the 1992 baseline regardless of the cause. This takes into account the effects of both the permitted action and all other activities or conditions that contribute to bed degradation and associated potential effects on wetlands. The Regulatory Plan would also apply to the Reduced Limit Alternative so the cumulative effect of the two dredging alternatives would be essentially the same. Under the No-Action Alternative, the incremental effect of dredging on bed degradation and associated effects on wetland would be eliminated and any impacts of new dredge pits or quarries on wetlands would be mitigated through the Section 404 permitting process. The incremental impacts to wetlands associated with the Proposed Action, Reduced Limit Alternative, or No-Action Alternative when added to the cumulative impacts from other activities that may impact wetlands, are not anticipated to be significant.

4.3.8 Floodplains

Historically the Kansas River was a very dynamic river with a wide and active floodplain. Floodplains helped absorb and slow the rate of runoff and reduce the severity of flooding farther downstream. When floods escaped the riverbanks and spread across the floodplain, water velocity slowed and sediment settled out and built up the floodplain. Over millennia, this process developed deep deposits of fertile soils alternating with coarser mineral deposits such as sand and gravel. The floodplain provided high-quality and productive mixture of aquatic, wetland, and terrestrial wildlife habitat. These same rich soils, mineral deposits, timber, wildlife and water encouraged their development as farmland, communities, and industries. The inherent flood prone nature of the Kansas River floodplain increasingly conflicted with its development until the Kansas River flood of 1951 precipitated the construction of various flood control reservoirs on tributaries to the Kansas River and improved flood control levees in urban areas along the Kansas River. Urbanization and flood control continue to be the biggest threat to floodplain functions.

Cumulative impacts to the floodplain could increase with the addition of three new processing plants. All of the processing plants associated with existing dredging activities on the river are in place and are not likely to be relocated in the near future. Therefore, most of the impacts to floodplain resources and floodplain flood elevations, associated with the Proposed Action, have occurred and are not anticipated to measurably increase over time. Additionally, the potential floodplain area that might be occupied by all the existing and proposed processing plants of the Proposed Action and Reduced Limit Alternative is no more than 240 acres, or about 0.1 percent of the floodplain. Therefore, the incremental impacts associated with either the Proposed Action or Reduced Limit Alternative, when added to the cumulative impacts from other activities that may impact floodplains, are not anticipated to be significant.

Cumulative impacts to the Kansas and Missouri River floodplains related to the expansion or development of dredge pits would vary depending on site locations and other variables. There are 20 floodplain pit dredging operations that are currently or have historically been located within the Kansas and Missouri River floodplains within 100 miles of the Kansas City metropolitan area. It is not possible, at this time, to identify where potential new or expansion of existing floodplain pit mining sites would be located or what affect they would have when added to other activities within the Kansas or Missouri River floodplains. However, it is estimated that 25 to 34 acres of land would need to be converted to pit dredging operations each year in order to accommodate the current Kansas River production level of 1,500,000 tons of sand and gravel per year, the average market demand since 2000 (Blechinger, 1997; Booker Associates, 1986). The cumulative impact of pit dredging to floodplain resources over time, and other activities that may affect floodplain resources, could become significant over time as more and more of those resources have been exploited and fewer remain. The cumulative impact of pit dredging to flood elevations over time, and other activities that may affect flood elevations, are likely to be offsetting with minimal net effect.

Cumulative impacts to the Kansas and Missouri River floodplains related to the development or expansion of limestone quarry operations would vary depending on site locations and other variables. It is not possible, at this time, to identify precisely where limestone quarries would be developed or expanded but generally they are located in the bluffs or uplands outside the floodplain. The cumulative impact of limestone quarry operations to floodplain resources and floodplain flood elevations, and other activities that may affect floodplains, are not anticipated to be more than minimal.

4.3.9 Terrestrial and Aquatic Resources

Terrestrial and aquatic wildlife are affected by reservoir construction and operation, land use, levee construction, agriculture, urbanization, water consumption, and agriculture in addition to dredging.

4.3.9.1 Terrestrial Resources

Terrestrial habitat and species have been greatly affected by change in land use as discussed in Section 4.3.2. The conversion of floodplain forests and grasslands to agriculture has created a mosaic of crop fields, hedge rows, wooded drainage corridors, hay fields and abandoned farmland dominated by that plant species that thrive on disturbed areas. Plant species that are not adapted to disturbance or become established long after disturbed areas are colonized by early succession species have struggled. This mosaic of diverse habitat has favored many common generalist wildlife species such as deer, turkey, coyote, raccoons, opossum, squirrels, and rabbits. Other wildlife species that favor large tracts of mature native forest or grassland have not tolerated the changes brought on by agriculture. Urbanization has had a similar effect of simplifying and fragmenting the floodplain ecosystem and favoring generalists. Agriculture has also affected terrestrial resources in numerous ways through the introduction of chemical pesticides, herbicides, and fertilizers.

The Proposed Action and Reduced Limit Alternative could impact terrestrial resources by the addition of new processing plant sites or the expansion of existing facilities. The processing plant sites associated with existing dredging on the river are already in place and are not likely to be relocated in the near future. Therefore, most of the impacts to terrestrial resources, associated with existing land-based processing operations have occurred and are not anticipated to significantly increase over time. The incremental effect of the

Proposed Action or Reduced Limit Alternative on terrestrial resources when added to the cumulative impacts of the numerous other non-dredge related activities affecting terrestrial resources are not anticipated to be significant.

In order to be economically viable, a pit dredging site was previously determined to be a minimum of 61 acres in size, which provides approximately 47.5 acres for mining and 13.5 acres for operational facilities (Booker Associates, 1986). In order to accommodate the currently authorized maximum limit of Kansas River production level of 2,200,000 tons of sand and gravel per year, it is estimated that 25 to 34 acres of land would need to be converted to pit dredging operations each year (Blechinger, 1997; Booker Associates, 1986). The authorized limit of extraction should however be compared to recent actual extraction tonnage that averaged only 1,405,651 tons or 51 percent of the actual authorized limit for the period of 1999 through 2015. Dredge pits have a typical life span between 10 and 15 years, depending on dredge pit size, and new dredge pits would be continually developed as old dredge pits expire and are taken out of production. Using the maximum rate of extraction authorized, floodplain pit dredging operations have a potential to consume 1580 acres of undeveloped land over a 20 year period. This land represents 0.7 percent of the Kansas River floodplain and will be only one component of a mosaic of terrestrial resources including cropland, grassland, and woodlands. Dredge pits or quarries potentially would impact less than 1 percent of the Kansas River floodplain over the next 20 years. The states of Kansas and Missouri regulate floodplain pit dredging under their mining and reclamation acts and require each pit dredging operation to be licensed, to file a reclamation plan, submit a reclamation bond, and reclaim pit dredging sites upon completion of dredging operations. The incremental impacts to terrestrial resources associated with the No-Action Alternative, when added to the cumulative impacts from other activities that may impact terrestrial resources, are more than either the Proposed Action or Reduced Limit Alternative but are still not anticipated to be significant based upon the size of the floodplain and adjacent uplands when compared to areas (acreages) possibly disturbed by new or expanded pits or quarries.

4.3.9.2 Aquatic Resources

Aquatic habitat and species have been greatly affected by construction of the flood control reservoirs on the tributaries to the Kansas River and water weirs on the Kansas River. These structures have reduced the frequency of extremely high and low flows and act as biological barriers to aquatic organisms. These periods of high and low flows have been a normal part of the Kansas River ecosystem for thousands of years. Drought benefited the Kansas River by reducing populations of non-native, harmful plants and animals in it and its prairie tributaries. Droughts can also concentrate prey in small pools, where they provide an easy meal to predatory fish and birds. Severe and prolonged periods of low flow can stress fish and other aquatic organisms and cause population crashes and even extinctions from parts of the river system. This was not a big problem before the dams were constructed because the aquatic organisms could generally return when higher flows resumed (Annett, 2009). The expansion of irrigated agriculture in the Kansas River basin has changed flow patterns in the Kansas River and many of its tributaries. Flows no longer are proportional to precipitation in the basin but are now disproportionately low during drought periods because of increased surface and groundwater consumption for irrigation.

Floods were an important part of the native Kansas River ecosystem as were droughts. The flood control lakes have reduced flooding by capturing runoff events. Flooding has also been worsened by urbanization as the amount of pavement and other impermeably surfaces in the watershed has increased, vegetation has decreased, and the rate and speed of storm water runoff has increased. Floods are disastrous to people, but floods benefit the native river ecosystem by washing in food like insects, moving back trees that may constrain the channel, create new sand bar habitat, open up spawning areas, and trigger reproduction in fish (Annett, 2009). When a river tops its banks and floods across the floodplain, the fish can move out into slower shallow water and search for food. If the flooding occurs during spawning season, we often see increased reproduction and recruitment of fish in the flooded areas. Bed degradation has caused the banks to become incised and, along with the flood control levees, prevents fish from moving out of the faster currents during high water events. If they can't reach slow water refuges during floods, fish can become stressed, reproduction reduced, and populations can decline (Annett, 2009). Agriculture, industrialization, and urbanization have also negatively impacted aquatic resources by impairing water quality as discussed in Section 4.3.5.2.

Numerous fish studies have been completed for the Kansas River since completion of the 1990 Kansas River Dredging EIS. The conclusions of all of the studies reviewed are consistent in that they indicate that dredging has little direct effect on fish communities and that species adapted to shallow, turbid river conditions have declined since the 1950s while those with less specialized habitat needs have become more prevalent. Paukert et al.

(2008) further supported this and indicated that dredging in the Kansas River may have created altered habitats that are more suited to tolerant lentic fishes like centrarchids (sunfish), but declines in native fish assemblages in the Kansas River had occurred prior to dredging. Haslouer et al. (2005) indicated that the majority of the declines in large river fishes were most dramatic since the 1950s as a result of water diversion, tributary impoundment, and other anthropogenic effects. Lake like effects have been created in several areas of the river by three large structures, which include the WaterOne weir, Bowersock Dam and the Topeka weir. The Missouri River backwater area in the lower Kansas River also exhibits deeper, slower moving water. Fischer et al. (2012) concluded:

> *"Our results show that dredging in Great Plains rivers can increase depths, but alterations to fish community structure was not evident, probably because many of these fishes are adapted to a range of habitat conditions and are highly mobile."*

The No-Action Alternative would most likely result in an increase in pit dredging operations in the Kansas and possibly the Missouri River floodplains or in crushing limestone from quarry operations. Direct impacts to aquatic resources resulting from new or expanded processing areas for Kansas River dredging operations, dredge pits or upland quarries would be mitigated through the Section 404 permitting process and are thus not considered to result in cumulative impacts because aquatic resource mitigation efforts are focused upon a watershed approach whereby ecological lifts are performed in the same locality as the impacts associated with the permit. Based on the findings discussed above, the incremental impacts to aquatic resources resulting from the Proposed Action, Reduced Limit Alternative, No-Action Alternative, Floodplain pit or quarry Alternatives when added to the cumulative impacts of other ongoing activities that may affect aquatic resources, are not anticipated to be significant.

4.3.10 Federally Listed Species

4.3.10.1 Interior Least Tern and Piping Plover

Historically the interior population of least tern was restricted to the Rio Grande, Red, Arkansas, Missouri, and Mississippi Rivers and some of their tributaries from Texas northward to the upper reaches of the Missouri River in North Dakota and Montana (Thompson, et al., 1997). The piping plover historically nested on open beaches along the Atlantic coast as well as sandbars along rivers and lake shores from the Platte River in

Nebraska, northward into Canada and several locations around the Great Lakes (Haig, 1992). These species generally build their nests in sand or other fine substrate with sparse vegetation along rivers and lake shores. The USFWS published a recovery plan for the Great Lakes and Great Plains piping plover in 1988 (USFWS, 1988) and one for the interior population of least terns in 1990 (USFWS, 1990). The Great Plains region, as defined for the recovery plans, did not include rivers in Kansas. The recovery plans identified threats to these species as the physical and functional loss of breeding habitat due to recreational activities and river management actions. Recreational effects to habitat include vehicular and pedestrian traffic in suitable nesting sites. Channelization, dredging, and impoundment of rivers can also eliminate sand bar nesting habitat (USFWS, 1988).

In 1994, a population of least terns was observed nesting near the Kansas River on fly-ash spoil piles at Jeffrey Energy Center in northeastern Kansas (USACE, 2006). The first documented nesting of least terns and piping plovers on the Kansas River was in 1996 and 1997 (Busby, et al., 1997). This was the first nesting of piping plover ever recorded in Kansas and the first time the least tern was known to nest along the Kansas River. Their occurrence was believed to be due to available suitable nesting habitat resulting from record floods on the Kansas River in 1993 and 1995 (the floods resulted in many newly scoured sandbars on the Kansas River), and because other habitats were unavailable during nest initiation due to prolonged flooding on the Missouri, Platte, and lower Mississippi Rivers (USFWS, 2000).

In 2000, the USFWS issued a Biological Opinion regarding the USACE's operation of the Missouri and Kansas Rivers and their reservoir systems. The Biological Opinion found that the USACE's operations jeopardized the least tern and piping plover and required the USACE to collect and evaluate various data about the least tern and piping plover and determine whether the Kansas River provides a source or sink for the species (USACE, 2006).

After completing the required studies, the USACE concluded that piping plovers and least terns nesting on the Kansas River produced only 0.2 percent of the Missouri River basin's (basin) piping plover fledglings and 1.4 percent of the basin's least tern fledglings, from 2000 to 2005. This low level of productivity on the Kansas River contributed little to the overall basin population recovery of the species (USACE, 2006). Also, the larger islands and sand bars created by the record flood of 1993 and used as nesting habitat by the piping plover and least terns along the Kansas River have been revegetated by trees and shrubs. The smaller islands and sandbars became lower as they were increasingly over-topped by high blow events. This deterioration of nesting habitat will likely make nesting success on the Kansas River more difficult in the future (USACE, 2006). Since 1998, during the nesting season for the terns and plovers, reservoir operations upstream of the potential nesting sites have been modified from what is specified in the Water Control Manual to minimize impacts to listed species. In general, the modified reservoir operations have involved reduced target stages on the Kansas River to avoid flooding existing nests. The USACE concluded that only 0.2 to 0.3 percent of the basin wide number of fledglings from 1998 to 2005 benefitted from their operations modified to protect the nests versus the normal operations dictated by the Water Control Manual.

Kansas River dredging and related activities could potentially disturb terns and plover or result in the loss of nesting and foraging habitat located within the river channel or on the floodplain. Special Conditions for current USACE permits for Kansas River dredging require additional consultation with the USFWS any time a pair of least terns or plovers nest within three RMs of a dredge site. Federal regulatory requirements under Section 404 of the CWA and Section 7 of the ESA would minimize the potential impacts of associated activities on the floodplain.

The Regulatory Plan would allow no more than 3,150,000 tons of sand and gravel to be dredged annually from the Kansas River under the Proposed Action. The quantity of sand and gravel dredged over the last 14 years has ranged between approximately 1,000,000 and 2,000,000 tons, with an average near 1,500,000 tons per year. According to the USACE (2010), tern and plover habitat is not likely to have been adversely affected by the rate of dredging that has occurred since 1999. Dredging the 3,150,000 tons of sand and gravel per year under the Proposed Action would likely accelerate the rate of bed degradation and would have a potential to adversely impact tern and plover habitat, if uncontrolled bed degradation were allowed to occur. However, the Regulatory Plan stipulates that any 5-mile-long reach of river that degrades an average of 2 feet, below the 1992 baseline elevations established for that reach, will be closed to further dredging. The Regulatory Plan’s 2-foot limit on bed degradation would limit the potential for dredging to impact tern and plover habitat.

Recreational activities, including vehicular and pedestrian traffic in suitable nesting sites, were identified as threats to the interior least tern and piping plover (USFWS, 1990 and USFWS, 1988). The Kansas River is one of only three state owned and publically accessible rivers in the state of Kansas. The 10 counties located along the Kansas River contain 40 percent of the regional population (Brady, et al., 1998). The river provides recreational opportunities including hunting, fishing, hiking, canoeing, and other outdoor activities that draw people to the river with 21 boat ramps providing access throughout the river. On July 14, 2012, the Kansas River was designated as a National Water Trail by the National Park Service's Rivers, Trails, and Conservation Assistance Program. Various groups including KDWPT and The Friends of the Kaw are working to increase recreational use of the Kansas River. The impacts to the interior least tern and piping plover from recreational use of the Kansas River are likely to increase.

The incremental impacts to the interior least terns and piping plover associated with the Proposed Action, Reduced Limit Alternative, or No-Action Alternative, when added to the cumulative impact of other reasonably foreseeable activities that may impact the interior least terns and piping plover, are not anticipated to be significant.

4.3.10.2 Pallid Sturgeon

The pallid sturgeon is morphologically adapted to life in swift waters on the bottom of large, turbid, free-flowing rivers (Kallemeyn, 1983 and Gilbraith et al., 1988). This species evolved in the diverse environments of the Missouri and Mississippi Rivers where the floodplain, backwaters, chutes, sloughs, islands, sand bars, and main channel provided numerous microhabitats (USFWS, 1993). Historically, these habitats were constantly changing. Since the 1930s, construction of dams on the upper Missouri River and channelization of the lower Missouri River have resulted in dramatic long-term changes to the character of the lower Missouri River. The construction of dams in the Kansas River basin has also changed the character of the Kansas River. As a result of these modifications, much of the dynamic nature of the Missouri and Kansas Rivers has been eliminated. For the portion of the lower Missouri River between the Platte River, in Nebraska and its confluence with the Mississippi River, the USFWS stated that larval and juvenile pallid sturgeon abundance is limited by the quantity of shallow-water habitat that provides rearing and refugia habitat for this life stage (USFWS, 2003). Accordingly, restoration of shallow-water habitat is one of the key objectives of the USFWS Pallid Sturgeon Recovery Plan. Considerable management efforts and funds have been and continue to be directed toward restoration of shallow-water habitat in the Missouri River. Shallow-water habitat is being created by a variety of mechanisms, including excavation of side channel chutes, dike notching, bank notching, and construction of chevrons (Jacobson, Blevins, and Bitner, 2009).

The Kansas River between Lawrence and its confluence with the Missouri River (52 RMs) is identified as Segment 11 in the USFWS Pallid Sturgeon Recovery Plan for the Missouri and Mississippi Rivers. As part of their Pallid Sturgeon Population Assessment Program, MDC captured a total of 12 hatchery-stocked pallid sturgeon in the Kansas River since 2007 (Winders, Niswonger, & Whiteman, 2010). These were the first recorded pallid sturgeon found in the Kansas River since 1952. MDC continues to annually assess the pallid sturgeon population in the Kansas River, but the USACE has no shallow-water habitat improvement projects planned in the Kansas River.

The USFWS has stocked over 1.4 million pallid sturgeon into the recovery area during its recovery efforts. No fish have been stocked into the Kansas River. The 12 individuals collected since 2007, were all from hatchery-stock and appear to be incidental migrants to the lower 15-mile segment of the Kansas River. There is no indication that pallid sturgeon occur above the WaterOne weir. The WaterOne weir, Bowersock Dam and the Topeka weir create barriers to fish movement into upstream areas during normal river stages. However, it is possible that fish could pass these barriers during flood stages. Shovel nose sturgeon occur in the Kansas River both below and above the WaterOne weir (Winders, Niswonger, & Whiteman, 2010). Man-made reservoirs and flood control operations in the Kansas River basin have reduced turbidity levels in the river that may be necessary to provide suitable habitat for breeding populations of pallid sturgeon.

The Regulatory Plan would allow no more than 3,150,000 tons of sand and gravel to be dredged annually from the Kansas River under the Proposed Action. The quantity of sand and gravel dredged over the last 14 years has ranged between approximately 1,000,000 and 2,000,000 tons, with an average near 1,500,000 tons per year. According to the USACE (2010), pallid sturgeon habitat is not likely to have been adversely affected by the rate of dredging that has occurred since 1999. Dredging the 3,150,000 tons of sand and gravel per year under the Proposed Action would likely accelerate the rate of bed degradation and would have a potential to adversely impact pallid sturgeon habitat, if uncontrolled bed degradation were allowed to occur. However, since the magnitude of bed degradation would be strictly limited through the USACE's Regulatory Plan, it is not likely that impacts to pallid sturgeon habitat would be more than minimal.

The incremental impacts to the pallid sturgeon associated with the Proposed Action, Reduced Limit Alternative, or No-Action Alternative, when added to the cumulative impacts of other reasonably foreseeable activities that may impact pallid sturgeon, are not anticipated to be significant.

4.3.10.3 Bald Eagle

In the mid-1900s, bald eagle populations were severely affected by a variety of factors including exposure to the pesticide dichlorodiphenyltricholoroethane (DDT). Because the eagles were higher level predators, the fairly low and non-lethal level of DDT in their prey was biomagnified in the eagle population. DDT interfered with the eagle's metabolism, making the bird either sterile or lay eggs with thin and brittle egg shells unable to withstand the weight of a brooding adult. The reproductive success and population of bald eagles in the United States plummeted from 300,000 to 500,000 in the 1700s to only 412 nesting pairs in the 48 contiguous states by the 1950s. Population reductions were also the result of several other factors such as the widespread loss of suitable habitat, legal and illegal shooting, power-line electrocution, air craft collision in flight, oil, lead and mercury poisoning, or by human and predator intrusion at nest sites.

The bald eagle was first protected in the United States by the 1918 Migratory Bird Treaty Act then in 1940 by the Bald Eagle Protection Act which prohibited commercial trapping and killing of the birds. The species was declared and endangered species in 1967 and DDT was banned from use in the United States in 1972. In the state of Kansas, the number of bald eagle nests has steadily increased from a single nest in 1989 to 33 nests in 2009. At the same time, the number of fledged eagle chicks has risen from only two in 1989 to 65 in 2009. In 1997, the first successful bald eagle nest was seen on the Kansas River. From 1997 to 2010, the Kansas River has had 12 nesting territories which have produced 122 fledged eaglets (Friends of the Kaw, 2014). In addition to the resident breeding pairs of bald eagles in Kansas, up to 3,000 migratory eagles winter in the state when the water bodies in their summer range are frozen over.

The Bald and Golden Eagle Protection Act prohibit the "take" of an eagle. The definition of "take" includes disturbing bald eagles such that a nesting attempt is not successful. The

USFWS advises people to avoid approaching an active nest any closer than 100 yards until and unless the eagles exhibit an acceptance of such behavior. You are too close if you cause an adult to flush from the nest. Recreation, agriculture, transportation, and urbanization all have the potential to disturb and "take" bald eagles along the Kansas River. Several of the nests on the Kansas River are located near boat ramps, dredging operations, and even in developed areas. In fact, a pair nested in Lawrence, Kansas across from the 8th Street boat ramp from 2007 to 2008 then built a new nest nearby in 2009. This suggests that the bald eagles in the area are accustomed to and not particularly disturbed by the human activities, including dredging, that normally occur near those locations. The incremental impacts to the bald eagle associated with the Proposed Action, the Reduced Limit Alternative, or No-Action Alternative, when added to the cumulative impacts of other reasonably foreseeable activities that may impact the bald eagle, are not anticipated to be significant.

4.3.10.4 Northern long-eared bat

The northern long-eared bat (*Myotis septentrionalis*) was listed as threatened species in Kansas May 4, 2015. No critical habitat has been designated for this species. It is a medium-sized bat with a body length between 3 to 3.7 inches and a wingspan of up to 10 inches. Color can vary between medium to dark brown on the back and are normally a pale-brown on the underside. This bat is distinguished by its long ears, particularly as compared to other bats within the genus, *Myotis*. They emerge at dusk and fly through the understory of forested areas feeding on moths, flies and other insects which they can catch either while in flight using echolocation or by snatching resting insects from vegetation. The northern long-eared bat is found across much of the eastern and north central United States and all Canadian provinces from the Atlantic coast west to the southern Northwest Territories and eastern British Columbia.

Northern long-eared bats begin breeding in late summer or early fall when males begin swarming near hibernacula (primarily caves). Pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup. The bats may roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees.

The most immediate threat to this species is the disease, white-nose syndrome. Symptoms were first observed in New York in 2006 and the disease has spread rapidly throughout the northern long-eared bat's most common historical range

On February 15, 2016, a final rule, 4(d) rule, became effective regarding the environmental assessment and biological opinion for the species. In the 4(d) rule, two conservation measures involving tree removal activities were adopted for protection of the species. Conservation measure 1 establishes a 0.25 mile buffer around known and occupied sites for protection of the species from disturbance. Conservation measure 2 restricts activities involving the removal of known and occupied maternity roost trees or trees within 150 foot radius of such sites from the period of June 1 through July 31 of each year.

The incremental impacts to the northern long-eared bat associated with the Proposed Action, Reduced Limit Alternative, or No-Action Alternative, when added to the cumulative impacts of other reasonably foreseeable activities that may impact this species, are not anticipated to be significant. These impacts would occur as a result of tree clearing and site preparation for new or expanded land-based sand and gravel processing facilities within the floodplain of the Kansas River; however, no new land-based sand and gravel processing facilities are anticipated due to the small number of dredging companies historically operating on the Kansas River, the limits on extraction tonnage, and the number and location of open reaches in relation to market location. Activities that cut or destroy known maternity roost trees or remove trees within established buffer areas for maternity roost trees could however impact the species.

4.3.11 Cultural Resources

Cultural resources along the Kansas River include pre-historic Native American habitation and burial sites and historic trails, settlements, farmsteads, bridges, and dams. Federally funded or authorized projects are required to comply with Section 106 of the NHPA of 1966 as discussed in Section 3.12.1.2. However, projects without a federal interest do not have the same requirement and may inadvertently or intentionally damage or destroy cultural resources. Land disturbance and construction for residential, commercial, industrial, or agricultural development can affect cultural resources. Various bridges along the Kansas River were constructed more than fifty years ago and could be considered historical structures. As they near the end of their functional lifespan, state and local transportation departments struggle with the decision of whether to replace the bridges or repair and restore the bridges while maintaining their historical integrity. While cultural resources are unimportant to many people, they are highly prized and sought after by both amateur and professional collectors of historic artifact. Many people are not aware that disturbing cultural resources on federal, state, or local government property may be illegal.

Cultural resources in or near the Kansas River or its tributaries can also be affected by changes in river geomorphology. Bed degradation or lateral channel migration can damage cultural resources or expose and make them vulnerable to vandals or collectors. From the discussion cumulative effects on river geomorphology in Section 4.3.1, it is clear that dredging is only one of several ongoing activities that could affect cultural resources through degradation of the Kansas River. However, the Regulatory Plan recognizes and addresses cumulative impacts to geomorphology and cultural resources because it prohibits dredging in any 5-mile reach that is degraded more than 2 feet below the 1992 baseline regardless of the cause. This takes into account the effects of both the permitted action and all other activities or conditions that contribute to bed degradation and associated potential effects on cultural resources. The Regulatory Plan would also apply to the Reduced Limit Alternative so the cumulative effect of the two dredging alternatives would be essentially the same. Under the No-Action Alternative, the incremental effect of dredging on bed degradation and associated effects on infrastructure would be eliminated but the other activities affecting infrastructure would remain the same. Therefore, incremental impacts to cultural resources associated with the Proposed Action or the Reduced Limit Alternative, when added to the cumulative impacts of other reasonably foreseeable activities that may impact cultural resources, are not anticipated to be significant.

Floodplain pit dredging and quarry operations have a potential to consume approximately 1,580 acres of undeveloped land over a 20 year period. Dredge pits and quarries are subject to state mining reclamation requirements and also require a site review by the Kansas SHPO. Expansion or construction of dredge pits, quarries, and supporting infrastructure that would result in the discharge of dredged or fill material into waters of the U.S. would require a Section 404 permit and evaluation of potential impacts to cultural resources under Section 106. Therefore, incremental impacts to cultural resources from pit dredging or quarries in the Kansas and Missouri River floodplains, when added to other cumulative activities that may impact cultural resources, are not anticipated to be significant.

4.3.12 Noise

Noise levels along the Kansas River corridor vary widely and are affected by their land use and the type of human activities that are found nearby. Motorized equipment like airplanes, trucks, trains, automobiles, tractors, boats, and lawnmowers are common outdoor sources of noise as is manufacturing and industrial equipment such as dredges and sand processing plants. Airports, busy highways, industrial, commercial, and busy urban areas are some of the noisiest areas while quiet suburbs and nighttime rural areas are the quietest. Rural areas during the day, however, can be fairly noisy due to nearby highways, trains, trucks, and farm equipment. I-70 is one of the busiest and noisiest roads in Kansas and runs parallel and not far from the Kansas River for much of the distance from Kansas City to Junction City. As a whole, truck traffic on Kansas' highways is expected to grow by 102 percent and general vehicle traffic by 52 percent over the next 20 years. I-70 is one of the highways expected to experience the greatest increase (KDOT, 2014). This increased traffic will increase noise levels near the roadway substantially. The Union Pacific Railroad follows the north side of the Kansas River from Kansas City west to Junction City and the BNSF Railroad follows the south side of the Kansas River from Kansas City west to Topeka. Both of these railways carry several trains each day. The ten counties along the Kansas River contain account for more than 40 percent of the state's population, with six of the state's ten largest cities located along the river's banks. As these cities continue to grow noise levels from development associated with this expansion will increase as well.

The Proposed Action, Reduced Limit Alternative, and pit dredging and quarries under the No-Action Alternative would involve the use of similar construction and processing equipment having similar impacts upon noise levels. The relatively small incremental impact upon noise levels associated with the Proposed Action, Reduced Limit Alternative, or No-Action Alternative, when added to and compared with the cumulative impacts of other reasonably foreseeable activities described above that will also likely increase noise levels, are not anticipated to result in a significant increase to total noise levels.

4.3.13 Air Quality

Air quality is affected not only by emissions from equipment used in the proposed and alternative actions but also by numerous other industrial, commercial, agricultural, and social activities in the area. There are four categories of air pollution sources; Point Sources, Area Sources, On-road Mobile Sources, and Non-road Mobile Sources. Point sources are large, stationary sources such as natural gas compressor stations, power plants, and grain processing or storage facilities. Areas sources are individually smaller but more numerous and produce a significant amount of emissions as a whole. Examples include motor vehicle refueling, residential fuel combustion, and household solvents and paints. On-road Mobile sources include cars, trucks, buses, and motorcycles. Non-road Mobile Sources generally are not driven on highways and include lawnmowers, locomotives, tractors, boats, and ATVs. Industries in Kansas contribute only about 12 percent of the total air pollutant emissions in the state. Area sources account for about 55 percent of the air pollutant emissions in Kansas (KDOT, 2014).

USEPA has determined the major sources in Kansas for six common air pollutants; carbon monoxide, lead, nitrogen oxides, volatile organic compounds, PM, and sulfur dioxide each air pollutant in 2008 (USEPA, 2014). On-road Mobile sources account for about 69 percent of all carbon monoxide emissions in Kansas. Aircraft accounted for about 80 percent of all lead emissions in Kansas. The two largest sources of nitrogen dioxide emissions in Kansas were On-road Mobile sources at about 24 percent and electric generation at about 20 percent. Kansas On-road Mobile sources were the largest source of volatile organic compound emissions about 28 percent. There are two sizes of PM measured. Unpaved road dust was the largest source of both PM 2.5 and PM 10 at about 39 and 60 percent respectively. Coal fired power plants accounted for an overwhelming 93 percent of the sulfur dioxide produced by fuel combustion in Kansas. Nationwide, fuel combustion produced 85 percent of the sulfur dioxide emissions.

The Kansas River has been dredged for decades using essentially the same type of equipment. Annual air emissions produced by the dredging operations have fluctuated in proportion to annual production. During this time all the counties within the Project Area were classified as meeting all NAAQS (USEPA, 2013b). The amount of pollutants produced by all the activities associated with the level of dredging experienced over these years as well as other activities that may impact air quality has not caused any of the counties to not meet the NAAQS. The Proposed Action, Reduced Limit Alternative, and No-Action Alternative would all use essentially the same equipment and produce about the same level of emissions. The incremental impacts to air quality associated with the Proposed Action, Reduced Limit Alternative, or No-Action Alternative, when added to the cumulative impacts of other reasonably foreseeable activities that may impact air quality, are not anticipated to be significant.

4.3.14 Climate Change

The cause of global climate change is generally accepted to be the increased production of GHGs resulting from, among other things, human activities worldwide. Unlike criteria pollutant impacts, which are local and regional, climate change impacts occur at a global level. In addition, the relatively long lifespan and persistence of GHGs require that climate change be considered a cumulative and global impact. It is unlikely that any increase in global temperature or sea level could be attributed to the emissions resulting from a single project. Rather, it is more appropriate to conclude that the GHG emissions associated with the Proposed Action and alternatives would combine with emissions across the United States and the globe to cumulatively contribute to global climate change.

Estimated GHG emissions generated by the Proposed Action and alternatives are presented in Table 32. These emissions are minuscule in comparison to current and projected global GHG emissions. Attributing any observed climate change to GHG emissions produced by the various alternatives would be speculative; in addition, no scientific or regulatory consensus exists regarding when project-related GHG emissions would be considered a significant impact in the context of NEPA

To put the Proposed Action and alternatives in perspective, total estimated GHG emissions were compared to the most recent global and national GHG inventories.[3] Emissions generated by construction of new facilities were amortized assuming a 5-year project lifetime and were included in the emissions totals. Based on the estimates presented in Table 32, the incremental impacts to climate change associated with the Proposed Action, Reduced Limit Alternative, or No-Action Alternative, when added to the cumulative impacts of other reasonably foreseeable activities that may impact climate change, are not anticipated to be significant.

1.

[3] A "GHG inventory" is a quantification of all GHG emissions and sinks within a selected physical and/or economic boundary. GHG inventories can be performed on a large scale (e.g., for global and national entities) or on a small scale (e.g., for a particular building or person).

Table 32 Annual Project-Level Greenhouse Gas Emissions in U.S. and Global Contexts

Emissions Type	CO_2e (metric tons)
2011 USEPA national GHG emissions inventory	6,702,000,000
2004 IPCC global GHG emissions inventory	49,000,000,000

Alternative	GHG Emissions (metric tons CO_2e)	Percentage of 2011 National Emissions (%)	Percentage of 2004 Global Emissions (%)
Proposed Action GHG emissions[a]	29,238	0.00044	0.000060
No Action Alternative GHG emissions	-9,300	0.00014	0.000019
Missouri River Dredging GHG emissions[b]	8,219	0.00012	0.000017
Floodplain Pit Dredging GHG emissions[b]	9,300	0.00014	0.000019
Limestone Quarry GHG emissions[b]	9,300	0.00014	0.000019
The Reduced Limit Alternative GHG emissions[a]	15,412	0.00023	0.000031

Notes:

CO_2e = Carbon dioxide equivalent
GHG = Greenhouse gases
IPCC = International Panel on Climate Change
USEPA = U.S. Environmental Protection Agency

[a] Construction emissions have been amortized over a 5-year period.

[b] Alternate source emissions were approximated by dividing the total emissions produced by dredging in the LOMR under the Proposed Action and each alternative by the number of permitted tons. This value was multiplied by the expected volume of sand and gravel to be extracted from alternate sources. See footnotes 4 and 5 in Section 4-14.

Sources: IPCC, 2007; USEPA, 2013

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CHAPTER 5

Mitigation and the Regulatory Plan

5.1 BACKGROUND

Mitigation measures are actions taken to avoid, minimize, rectify, reduce, or compensate for resource losses (USACE regulatory program guidance, 33 CFR 320.4(r)). Mitigation measures developed for current commercial dredging operations on the Kansas River are applied through:

- The 1990 Regulatory Plan for Commercial Dredging Activities on the Kansas River, which contains mitigation criteria applied uniformly (not on a case-by-case basis) to all permitted commercial dredging operations on the river, including the recommended modifications to the Regulatory Plan (Appendix A);
- Special conditions developed on a case-by-case basis for each individual permitted dredging area; and
- Applicable state and other federal agency requirements.

The Regulatory Plan was developed to aid the USACE in its administration of proposed and permitted commercial dredging on the river. The Regulatory Plan contains various restrictions to limit the magnitude of dredging-related impacts on the morphology and ecology of the river; on manmade structures located in and along the river; and on other public and private interests such as adjacent land, water supplies and recreation. The Regulatory Plan is subdivided into two main parts entitled, "Dredging Restrictions" and "Monitoring Program." The Dredging Restrictions consists of criteria developed to limit dredging-related impacts to an acceptable level. The Monitoring Program utilizes cross-section and other data collected from the river to monitor dredging-related impacts to ensure that the established maximum acceptable level of impacts is not exceeded.

At all times since the implementation of the 1990 Regulatory Plan, a dredging reach has been regulated based on the most degraded of any 5-mile reach that intersects the dredging area. Since that time, no regulatory action has suspended dredging in only a portion of an authorized dredging area while allowing dredging in the other part. A reach has either been cleared for dredging or closed completely. The most degraded 5-mile reach need not completely envelop the dredging area, just intersecting any part of the authorized dredging area is sufficient for closure. The exact methodology for computing degradation over 5-mile-long reaches was not specified in the Regulatory Plan and like many engineering methodologies, has changed over time. The current methodology reduces subjectivity and increases efficiency when compared to previous methods. In 2011 for example, the reaches that exhibited more than 2 feet of degradation were re-analyzed using the older methods. Using the different methodologies did not change the status of any dredging reach with respect to the 2 foot degradation threshold (USACE, 2012a).

The computation of the average reduction in riverbed elevations in 5-mile-long reaches includes two steps. First, the change in bed elevation at individual cross-sections is computed. Second, an average is taken of bed change values over 5-mile-long reaches. A survey conducted in 1992 established baseline average bed elevations for each cross-section. Different methodologies yield equivalent results except at cross-sections with mid-channel features that rise above the baseline water surface elevation. At those cross-sections differences can be large, however, there are so few cross-sections containing these features that the overall effect on 5-mile reaches is minor (USACE, 2012a).

The USACE has developed recommendations for modifications to the Regulatory Plan intended to correct deficiencies and remove mitigation requirements that do not add value to the Regulatory Plan. The recommended modifications are based on data and observations collected since the Regulatory Plan's implementation in 1991. The recommendations for modifications to the Regulatory Plan are include for consideration as Appendix A of this Draft EIS.

The following resources have been reviewed to determine if the recommended modifications are appropriate:

- Survey data collected since implementation of the Regulatory Plan in 1991;

- General observations relating to river dynamics, primarily the magnitude of morphological changes in the river since reissuance of commercial dredging permits in 1991; and
- Literature sources made available since completion of the USACE's Commercial Dredging EIS in 1990.

5.2 MITIGATION

5.2.1 Geomorphology

Permits issued by the USACE, for either the Proposed Action or Reduced Limit Alternative, would be subject to the restrictions provided in the Regulatory Plan and additional Special Conditions developed to limit potential dredging-related impacts on the geomorphology of the river to an acceptable level.

5.2.2 Land Use

The Kansas Sand and Gravel Act (K.S.A. 70a-102) provides for the taxable compensation of sand and gravel at a rate of $0.15 per ton removed from rivers and islands belonging to the state. While not in and of itself a mitigation measure, the act (K.S.A. 70a-105) establishes a sand royalty fund in which $0.0375 per ton sold shall be returned as described in the K.S.A. 82a-309, below (*Distribution of proceeds from sale of sand products taken from river beds owned by state*).

> *(1) If the sand products are taken from the bed of the river at a location which is within the boundaries of a drainage district, the board of directors of the district from which the sand products were taken shall be entitled to receive 2/3 of the amount returned and the remaining 1/3 shall be divided among the remaining drainage districts in the county, to be used for bank stabilization, soil conservation, or maintenance and operation of flood control systems, in proportion to the frontage on such river.*
>
> *(2) If the sand products are taken from the bed of the river at a location which is not within the boundaries of a drainage district, the proceeds attributable to such sand products shall be returned to the counties which have adopted this act and have notified, prior to July 1 following the*

adoption of this act, the director of taxation of such adoption, and through which such river flows, in proportion to the mileage of the riverbank in such county. Moneys paid to a county pursuant to this paragraph shall be disbursed or used as follows:

(A) If there are one or more drainage districts organized under the laws of this state which are located in such county along a river that is the property of the state of Kansas and which operate and maintain river flood control improvements in or along such river, the county shall disburse such moneys to each such drainage district, to be used for bank stabilization, soil conservation, or maintenance and operation of flood control systems, in proportion to each district's frontage on such a river.

(B) If there is no drainage district organized under the laws of this state which is located in such county along a river that is the property of the State of Kansas, the county may use the moneys for construction, operation and maintenance of public improvements located along, in or over such a river or for the preservation of land and development and maintenance of public areas along such river or tributaries adjacent to such river.

The Kansas Department of Agriculture – Division of Conservation is responsible for administering the Surface-Mining Land Conservation and Reclamation Act (Kansas Statutes Annotated (K.S.A.), 49-601-624). The Act requires that producers who mine industrial materials or minerals of commercial value such as sand, gravel, limestone, clay, gypsum, shale, sandstone, silt, caliche, volcanic ash or salt be licensed to operate a mine, register their mining sites, file a reclamation plan for each site, submit a reclamation bond, and reclaim mining sites upon completion of mining operations. The Kansas Administrative Regulations (K.A.R.), 11-8-8 establishes the reclamation bond amount at $400.00 per acre for sand and gravel operations and $600.00 per acre for all other minerals. Some counties require a reclamation bond greater than the amount established by the K.A.R. to satisfy their conditional use order. The program requires an Annual Report and Site Registration Renewal each year, indicating the number of acres affected and tons of material produced. When all reclamation requirements are met, the Reclamation Bond can be released.

5.2.3 Water Resources

WATER SUPPLY

Permits issued by the USACE, for either the Proposed Action or Reduced Limit Alternative, would be subject to the Regulatory Plan which contains restrictions that limit the magnitude of riverbed degradation and exclude dredging near manmade structures including water intake structures, weirs and diversion jetties. Additional Special Conditions could be incorporated into the USACE's permits, on a case-by-case basis, to address potential site specific dredging-related impacts to water supply structures. No specific mitigation measures have been proposed for this alternative.

WATER QUALITY

Permits issued by the USACE, for either the Proposed Action or Reduced Limit Alternative, would be subject to the USACE's permits require each processing plant to route dredge return water through a siltation basin to remove suspended solids prior to discharging the water back into the river. The Regulatory Plan and permit restrictions related to dredging in the vicinity of public water supply intakes address water quality issues. The dredging of sand and aggregate materials is less likely to impact water quality than other types of dredging in silt or clay bottom environments due to the nature of the material and the resulting temporary suspension of fines within the water column. Flowing water in the river also acts to mitigate the effect of particle suspension and turbidity through dispersal over a greater area and quantity of water.

A Spill Prevention Control and Countermeasure Plan would be developed as part of the Operation and Maintenance Plan for each floodplain pit dredging site as required under the National Pollutant Discharge Elimination System (NPDES) permit process. These plans are intended to provide oversight of operational activities including response measures to spills and releases of chemicals of concern.

5.2.4 Recreation

Current USACE permits contain Special Conditions that require Dredgers to coordinate with the United States Coast Guard (USCG) to ensure safety standards are met for dredge operations. The USACE permits also contain a Special Condition that requires dredge operators to allow safe passage past dredge equipment for all boats, rafts, and other water craft. The following safety requirements are recommended for inclusion in the Regulatory

Plan (Appendix A) and would apply to either the Proposed Action or the Reduced Limit Alternative:

- Dredge operators must remain vigilant for approaching watercraft and other activities on the river and must provide safe passage through the dredging area during operations and while the dredge is unattended.
- All cables above the surface of the water must be clearly marked and visible to approaching vessels. Side cables across the main navigation channel must be left slack and at least 10 feet below the water surface or on the riverbed when the dredge is unattended.
- USCG-approved buoys (Danger buoys) must be placed no less than 200 feet and no more than 500 feet of the upstream and downstream extent of the dredging operation areas to warn on-coming vessel operators that obstruction(s) to navigation exist.
- USCG-approved blinking or steady white lights must be placed and operational on the channel-ward upstream and downstream extent of the dredge vessel and the midpoint of the discharge pipeline from sunset to sunrise.
- All vessels used in dredging operations must be operated and maintained in accordance with the USCG Inland Navigation Rules (33 USC 2020-2030) and as may be prescribed by the State of Kansas Boating Statutes and Regulations.

5.2.5 Wetlands

Permits issued by the USACE, for either the Proposed Action or Reduced Limit Alternative, would be subject to the restrictions contained in the Regulatory Plan. All proposed new processing plants that directly impact wetlands would require authorization under Section 404 of the CWA, which would consider avoidance, minimization, and appropriate compensatory mitigation to address wetland impacts.

Any new pit mines or quarries in wetland areas would likely require a permit under Section 404 of the CWA which would address avoidance, minimization, and appropriate compensatory mitigation for the wetlands impacted. The state also requires a mine reclamation plan that could include plans to restore wetlands on the mined site. No specific mitigation measures are proposed for this alternative.

5.2.6 Floodplains

Impacts to flood elevations within the floodplain could require compensatory increases to the cross-sectional area of any FEMA designated floodway to limit flood elevations to pre-development conditions. However, no specific mitigation measures have been proposed for this alternative because they would be determined by the appropriate local floodplain management agencies.

5.2.7 Terrestrial and Aquatic Resources

The Kansas Surface-Mining Land Conservation and Reclamation Act (K.S.A. 49-601-624) and Missouri Land Reclamation Act (RSMo 444.770, 444.772 and 444.778, 10 CSR 40-10.050(14)) require that mining operations including floodplain pit dredging operations be licensed to operate, register their mining sites, file a reclamation plan for each site, submit a reclamation bond, and reclaim mining sites upon completion of mining operations. It is assumed that the agency responsible for administering the reclamation plan, (Kansas Department of Agriculture – Division of Conservation or MDNR), would require that the sites be reclaimed to replace terrestrial or aquatic habitat lost as a result of project operations. Any new pit dredging operations impacting wetlands and streams would also likely require a permit under Section 404 of the CWA which would address avoidance, minimization, and appropriate compensatory mitigation for the aquatic resources impacted. The USACE would require the avoidance of higher quality aquatic resources and compensatory mitigation for aquatic resources unavoidably impacted by dredging. Impacted aquatic resources would probably be replaced at least at a one-to-one ratio by the creation or restoration of the wetlands in either a wetland mitigation bank or on-site as part of the site reclamation. No additional mitigation measures are proposed for this specific alternative.

5.2.8 Federally Listed Species

Permits issued by the USACE, for either the Proposed Action or Reduced Limit Alternative, would be subject to the primary compliance criteria in the USACE's Regulatory Plan, which limits bed degradation to an average of 2 feet below the 1992 baseline elevations for any 5-mile-long reach of river, would limit potential impacts to pallid sturgeon, least tern, and piping plover habitat associated with bed degradation. The permits would also contain a Special Condition that states “If at any time a pair of least terns or piping plovers nest within three RMs of a dredge site, additional consultation with the USFWS will be required.”

Federal regulatory requirements under Section 404 of the CWA and Section 7 of the ESA would ensure that any dredge pits or quarries involving the discharge of dredged or fill material into wetlands or other waters of the U.S. located in the Kansas River floodplain would be required to avoid and minimize potential impacts to pallid sturgeon, least terns, and piping plovers or their habitat.

5.2.9 Cultural Resources

Permits issued by the USACE, for either the Proposed Action or Reduced Limit Alternative, would incorporate a General Condition that requires the Dredgers to immediately notify the USACE if any previously unknown historic or archeological remains are discovered while accomplishing the authorized activity. Other requirements (Special Conditions) may be imposed by the USACE, on a case-by-case basis, to address potential cultural resource issues.

Federal regulatory requirements under Section 404 of the CWA and Section 106 of the NHPA would ensure that any dredge pits or quarries involving the discharge of dredged or fill material into wetlands or other waters of the U.S. located in the Kansas River floodplain would be required to avoid and minimize potential impacts to cultural resources.

5.2.10 Noise

No mitigation measures are proposed.

5.2.11 Air Quality

The equipment used in the Proposed Action and other considered actions would be required to meet any USEPA air emission standards for that equipment. No additional mitigation measures are proposed.

5.2.12 Climate Change

No mitigation measures are proposed.

5.3 RECOMMENDED MODIFICATIONS TO CURRENT REGULATORY PLAN

This section lists and evaluates each proposed recommendation and determines if it should be implemented or not. Each proposed recommendation identifies the Section, page, and paragraph of the Regulatory Plan and the recommended modification. Following the proposed recommended modification is the USACE's analysis and decision regarding that recommendation. Please refer to Appendix A of this EIS for a revised Regulatory Plan that includes the changes described below.

5.3.1 Proposed Modifications

5.3.1.1 Dredging Restrictions (Sections I – IX)

Section I, Page A – 3, 2nd Paragraph

USACE recommends revision of the following statement:

> "*If riverbed elevations in a 5-mile-long reach of river approach 2 feet of degradation, dredging activities which adversely affect bed elevations in that reach will be altered or terminated before unacceptable impacts occur. Further, if the average reduction of riverbed elevations in a 5-mile-long reach of river attains 2 feet (regardless of the cause), dredging activities which adversely affect bed elevations in that reach will be terminated.*"

This restriction provides for alteration or termination of dredging in a reach based on an assumption that dredging in that reach will adversely affect bed elevations in upstream/downstream reaches that are approaching or have reached 2 feet of bed degradation. Due to the uncertainty behind such an action, it is recommended that the criteria for reach closure be simplified to conform to the Regulatory Plan's intent to limit bed degradation to an average of 2 feet through any 5-mile-long reach of river.

Section I, Page A – 3, Footnote

USACE recommends revision of the following footnote:

> "*The average reduction in riverbed elevations through a 5-mile-long reach of river will be computed by the Kansas City District using data collected through the Monitoring Program. Any 5-mile-long reach of river is subject to riverbed elevation averaging. A 5-mile-long reach can begin at any location on the river and will extend 5 miles upstream or downstream of that location.*"

The current methodology used to calculate the average reduction in bed elevations through a 5-mile-long reach of river includes 5-mile-long reaches that contain water control structures that span the river and create a large differential between upstream and downstream bed elevations (e.g., WaterOne weir, Bowersock Dam, and the city of Topeka water intake weir). These structures create a backwater area that slows river velocities that increases the deposition of bed materials on the upstream side of the structure. Each of these structures effectively acts as grade control, which significantly reduces the impact of upstream dredging on downstream reaches and eliminates the impact of downstream dredging on upstream reaches. Due to the impact of these structures on channel characteristics, it is recommended that the criteria for calculating the average reduction in bed elevations through a 5-mile-long reach of river be amended.

Section I, Page A – 3, 3rd Paragraph

USACE recommends revision of the following statement:

> "*Due to the implementation of a monitoring program, it is estimated that most producers would have 2 - 3 years notice prior to closure of a dredged-out reach[5] of river. However, if an unforeseen event such as a flood causes excessive lowering of the riverbed which requires the unexpected closure of a reach of river, the affected producers will normally be allowed to continue dredging in that reach for one year in order to allow sufficient time for the relocation of their dredging operations.*"

Clarification is recommended to remove any ambiguity in these statements regarding the USACE's role concerning notification of anticipated future reach closures, and the criteria defining unforeseen events that require the unexpected closure of a reach.

Section I, Page A – 3, 3rd Paragraph

In addition to the revision above to the 3rd paragraph on page A-3, USACE recommends revision of the following:

> "*A reach of river which has been dredged-out and closed to dredging will not be reopened until its riverbed elevations increase to an average elevation exceeding the established minimum for that reach, and until sufficient materials have accumulated to support renewed dredging activities for a reasonable period of time.*"

Clarification is recommended to provide clearer guidance and less subjectivity for the decision to reopen a 5-mile-long reach of river that has been closed to dredging due to excessive degradation. The accumulation of 6 inches of bed material through a 5-mile-long reach of river (assuming a typical dredge area width of 450 feet, after subtracting required offset distances from adjacent riverbanks) equates to approximately 350,000 tons of material (based on a conversion ratio of 1.6 tons/cubic yard of wet sand). Therefore, the available amount of material exceeds the maximum annual dredging amount allowed for any dredging operation on the river. Based on the observed long-term response to dredging on the river, the average annual amount of sand replenishment within dredged reaches is near 100 percent. Although long-term monitoring shows that some reaches have degraded since initiation of monitoring activities in 1991, the average annual rate of degradation within those reaches is generally less than 1 inch.

USACE Decision

The USACE revised the four statements identified above to clearly define the acceptable degradation level, clarify how degradation will be measured and analyzed, and clarify when a degraded area will be closed and re-opened to dredging. In addition, the USACE recommends adding a paragraph at the end of Section I to clarify the actions taken by the USACE to implement reach closures. The proposed modification concerning permit suspension would allow the USACE to close and/or reopen reaches through notification by letter, rather than through termination/reauthorization of permits. Please refer to Appendix A for revised Section I text of the Regulatory Plan. The following paragraphs will replace the third paragraph and footnote on page A–3 and the first paragraph on page A-4.

Section II, Pages A – 4 and A – 18, Parts A and B and Figure A - 6

USACE recommends removal of references to the "*Atchison, Topeka, and Santa Fe Railway Company Bridge*" from Parts A and B and from Figure A – 6 because the bridge has been physically removed.

USACE Decision

The USACE revised Section II per the recommendations above; refer to Appendix A for revised Section II text of the Regulatory Plan.

Section VII, Pages A – 7 and A – 16, Part B.2. and Figure A - 3

The USACE recommends removal of Part B.2. and Figure A – 3. The Sunflower Army Ammunition Plant has been permanently closed, and the former Plant's water intake structure and diversion jetty have been abandoned. The intake is perched at low flows and the diversion jetty retains very little integrity due to severe damage suffered during high river flows. The property was transferred to Sunflower Redevelopment LLC, in 2005 (a nonfederal entity). The protective buffer implemented for the Sunflower Army Ammunition Plant water intake facility was designed to reduce channel degradation in the vicinity of the Plant in order to limit a drop in stage levels at the intake. The Plant no longer plays a role in national emergency mobilization and cannot be reactivated to meet such needs.

USACE Decision

There is no longer sufficient reason to maintain this provision. Part B.2. and Figure A – 3 will be removed from the Regulatory Plan; refer to Appendix A for these revisions.

However, dredging will continue to be excluded within 500 feet of the water intake structure and diversion jetty of the former Sunflower Army Ammunition Plant under Part B which excludes dredging within 500 feet of any water intake structure or associated weir or diversion jetty.

Section IX, Page A – 13, Part A.1.

USACE recommends revisions to Part A.1. to require appropriately sized siltation basins for all dredged return water prior to its reintroduction to the river and require submittal of as-built drawings and management plans for these siltation basins.

USACE Decision

The USACE has made revisions to Part A.1. (Appendix A).

Section X (Proposed New Section), Page A - 13

USACE recommends adding a new section with the following safety requirements:

- Dredge operators must remain vigilant for approaching watercraft and other activities on the river and must provide safe passage through the dredging area during operations and while the dredge is unattended.

- All cables above the surface of the water must be clearly marked and visible to approaching vessels. Side cables across the main navigation channel must be left slack and at least 10 feet below the water surface or on the riverbed when the dredge is unattended.
- USCG-approved buoys (Danger buoys) must be placed no less than 200 feet and no more than 500 feet of the upstream and downstream extent of the dredging operation areas to warn on-coming vessel operators that obstruction(s) to navigation exist.
- USCG-approved blinking or steady white lights must be placed and operational on the channel-ward upstream and downstream extent of the dredge vessel and the midpoint of the discharge pipeline from sunset to sunrise.
- All vessels used in dredging operations must be operated and maintained in accordance with the USCG Inland Navigation Rules (33 USC 2020-2030) and as may be prescribed by the State of Kansas Boating Statutes and Regulations.

USACE Decision

The USACE added Section X to the Regulatory Plan (Appendix A).

5.3.1.2 Monitoring Program (Sections I – V)

Section IV, Page A – 23, Part B

The collection of water surface profiles has been problematic (difficult to achieve and sporadic). Since the collection of such data does not add significant value to monitoring efforts, it is recommended that this data collection requirement be considered for removal.

USACE Decision

The USACE has removed this requirement (Appendix A).

Section IV, Page A – 23, Part C

The submittal of dredged material quantities to the USACE semiannually does not appear to add value to monitoring efforts. Since the frequency of data submittals has not exceeded one per year since 1992, it is recommended that this requirement be modified to reduce such submissions to 1 annually.

USACE Decision

Due to this requirement not adding value and adding an administrative burden, the USACE has revised Part C (new Part B; Appendix A).

Section V, Page A - 23

Aerial photography resources, that meet the requirements provided in Section V, are readily available at no cost through multiple sources on the Internet. Since alternative sources are available to meet the requirements stipulated in Section V, it is recommended that this data collection requirement be removed.

USACE Decision

The USACE has removed the requirement in Section V (Appendix A).

5.3.2 Proposed Changes Considered But Not Carried Forward

5.3.2.1 Dredging Restrictions (Sections I – IX)

Section VII, Pages A – 7, Part B.1.

USACE recommended revisions to Part B.1. because the WaterOne weir, located at RM 15.0, has been improved from a piled stone structure to a cofferdam filled with sand and capped with poured concrete. The cofferdam has been driven to bedrock and has little potential to be impacted by downstream dredging, which is limited to 2 feet of bed degradation below the 1992 baseline elevations for the reach. USACE recommended the reexamination and possible modification to reduce the 2,500-foot dredging limit implemented below the weir.

USACE Decision

The USACE has considered this recommendation and determined that there is insufficient reason to modify this provision of the Regulatory Plan.

CHAPTER 6

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CHAPTER 7

Public and Agency Comments

7.1 PUBLIC COORDINATION

7.1.1 NEPA Scoping Process

Following publication in the FR of the Notice of Intent (NOI) to prepare an EIS, the USACE initiated the public and agency scoping process. The scoping process provided opportunity for the general public, non-governmental organizations (NGOs), government agencies, and other stakeholders to learn about the Proposed Action and to comment on the issues that should be evaluated in the environmental analysis, as well as alternatives to the Proposed Action that should be considered during preparation of the EIS. Comments provided during the completed scoping period focused the impact analysis and aided in the selection of a reasonable range of alternatives.

Opportunity for stakeholder input occurred over a two month period. Public scoping was opened on July 17, 2015, and closed on September 15, 2015.

7.1.1.1 Stakeholder Notification

Public awareness of the USACE intent to prepare an EIS and to obtain stakeholder input to the scoping process was created by:

- Publication of a “Notice of Intent to Prepare an Environmental Impact Statement for Commercial Dredging of Construction Aggregate From the Kansas River in the State of Kansas” on July 15, 2015, in Volume 80, Number 135 of the FR (80 FR 41489). This NOI announced the USACE’s intent to prepare an EIS and listed the date, time, and location of the public scoping meeting to be held in the Project area, as well as contact information for the USACE representative for preparation of the EIS.

- Posting on July 17, 2015, on the USACE Kansas City website of a “Notice of Public Scoping for Kansas River Dredging Notice of Intent to Prepare an Environmental Impact

Statement." This notice announced the USACE intent to prepare an EIS, listed the date, time and location of the public scoping meeting to be held in the Project area, contact information for the USACE representative for preparation of the EIS, and included drawings depicting the proposed dredging areas within the Kansas River. Notification of this posting was distributed by email to various local, state, and federal government agencies; Indian tribes; NGOs; and other individuals and organizations who had previously requested to be notified of USACE public notices.

- Distribution of a press release to the Lawrence Journal-World on July 29, 2015, announcing the public scoping meeting and listing the date, time and location of the public scoping meeting and contact information for the USACE representative for preparation of the EIS.
- Distribution, by letter dated July 8, 2015, of an invitation to federal and state agencies to attend the agency and public scoping meetings on August 4, 2015. Agencies receiving the letter included the USEPA, USFWS, USGS, KDHE, KDWPT, Kansas Geological Survey, and KSHS.

7.1.1.2 Scoping Meetings

The USACE hosted two meetings to obtain agency and public input into the EIS scoping process.

The USACE hosted an Agency Coordination Meeting at the USACE Kansas City District office in Kansas City, Missouri on August 4, 2015. This meeting was attended by the USACE, third-party EIS contractor staff, and agency personnel from the USEPA, USFWS, USGS, KDWPT, and Kansas Geological Survey. Representatives from the KDHE and KSHS declined to attend the meeting. At the Agency Coordination Meeting held on August 4, 2015, USACE representatives gave a presentation that described the Proposed Action, potential environmental impacts, the EIS development process, opportunities for comment throughout the process, and a timeline for preparation of the EIS. The USACE asked agency representatives to summarize the interest of their agency in the process of authorizing continued dredging and the environmental issues and alternatives that should be evaluated in the EIS.

One scoping meeting for public participation was held at the Lawrence Public Library in Lawrence, Kansas, which is within the Project area. The meeting occurred on August 4, 2015 from 4 p.m. to 7 p.m. and was attended by 38 attendees. During the meeting, the USACE representatives and third-party EIS contractor staff displayed a series of posters that described the Proposed Action, potential environmental impacts, the EIS development process, opportunities for public involvement and comment throughout the process, and a timeline for preparation of the EIS. The USACE representatives and the third-party EIS contractor were available to provide information and to answer questions. Comment forms were provided, and meeting attendees were encouraged to use the forms to submit specific detailed comments.

7.1.1.3 Scoping Comments Received

Members of the public and interested agencies had the opportunity to submit comments via standard mail, telephone, fax, or email at any time during the scoping period from July 15, 2015 to September 15, 2015. At the close of the comment period, 32 letters or emails had been received from governmental agencies, environmental organizations, and interested citizens for a total of 182 individual comments. Table 33 provides a summary of the comments received.

Table 33 Summary of Written Comments Received During the Scoping Period

Topic	Number of Comments	Comment Summaries
Alternatives	17	Five comments expressed an opinion in favor of open-pit mining and requested analysis addressing the feasibility of open-pit mining away from the Kansas River.
		Two comments expressed an opinion in favor of the No Action alternative.
		Eight comments suggested items to include in the alternatives analysis, such as a review of varied levels of aggregate mining from the river and for specific river reaches, use of sediments deposited in large reservoirs constructed on tributaries of the Kansas River, off-channel sand mining and locations to obtain substitute materials, and potential impacts from land based processing and transportation.
		Two comments suggested that the range of alternatives analysis include current available data.
Climate Change	1	One comment suggested that analysis of climate change events, such as increased droughts and flooding events, be included in the EIS.
Cumulative Impacts	3	Three comments made suggestions for factors to include in the cumulative effects analysis. Suggestions included issues related to watershed tributaries, aquatic environments, and sediment movement on the formation of sandbars, islands and other shallow water habitat in the Kansas River.
Economic Impacts	8	Two comments suggested that the State of Kansas increase the rate of royalties for dredging operations.
		Six comments suggested factors to include in the economic analysis. Suggestions included issues related to land valuation, economic analysis at a regional scale, market demand for sand and gravel, the relationship between transportation distances and total product costs, and the

Table 33 Summary of Written Comments Received During the Scoping Period

Topic	Number of Comments	Comment Summaries
		relationship between dredge operations and recreational and business opportunities on the Kansas River.
General Comments	22	Twenty-one comments were general and are either generally captured by comments specific to other issue areas addressed in the EIS or do not relate to specific issues to address in the EIS.
		One comment expressed concern that potential impacts could extend beyond the dredging sites and should be examined at a broad landscape scale rather than focusing specifically on each dredging site.
Hydrology	2	Two comments address river hydrology and bank stabilization.
Infrastructure Impacts	9	Five comments expressed concerns for well infrastructure and well field production capacity in relationship to the location of dredge reaches.
		Four comments expressed concerns for potential effects to infrastructure such as road bridges, pipelines, and boat ramps.
Mitigation	4	Four comments expressed a need for mitigation measures to be put in place.
Monitoring	14	Fourteen comments expressed a need for a monitoring plan to be put in place and suggested what that monitoring should entail such as measures for monitoring bed and bank degradation along the Kansas River
Noise Impacts	3	Three comments expressed concerns related to sound emission from dredge equipment operation.
Public Water Supply	5	Three comments expressed concerns that the Proposed Action not be located within one mile of a public water supply intake and apply the same considerations for horizontal collector wells.
		Two comments noted that the Kansas River is an important source of groundwater and drinking water for municipalities and water districts.
Purpose and Need	1	One comment suggested that the EIS include a purpose and need section that addresses a range of alternatives that would satisfy the project purpose.
Recreation	8	Eight comments expressed concern that the Proposed Action would negatively impact the recreational value of the river.
Safety	3	Three comments expressed concern that dredge operations associated with the Proposed Action could pose safety issues for boaters, canoers, and kayakers.
Sediment Transport / Sediment Budget	10	Five comments express concerns for channel morphology dynamics associated with dredging such as sediment transport and bed and bank erosion.
		Five comments expressed a need to develop a sediment budget that would account for sediment transport, erosion, and deposition in the Kansas River.
Species / Habitat Impacts	24	Ten comments express concern for aquatic and riparian habitat loss that could occur along the Kansas River as a result of the Proposed Action.
		Eight comments expressed concern for impacts of the Proposed Action on designated critical habitat and species protected by the Endangered Species Act such as pallid sturgeon, and piping plover.
		Two comments suggested that EIS analysis consider impacts to migratory biota and nesting habitat.
		One comment made suggests for measures to avoid and minimize impacts to listed fish species.
		One comment suggested that potential impacts to the quantity and quality of aquatic habitat be evaluated over the short and long term.
		One comment notes that impacts to aquatic species associated with noise related to dredging may not have been analyzed.

Table 33 Summary of Written Comments Received During the Scoping Period

Topic	Number of Comments	Comment Summaries
		One comment suggests that potential impacts to passage of aquatic organisms be analyzed in the EIS.
Water Quality / Quantity	26	Thirteen comments express concern that dredge operations could reintroduce contaminated sediments into the Kansas River that would affect the quality of public drinking water.
		Ten comments generally suggest that the Proposed Action would result in impacts to water quality.
		Two comments express concerns that the Proposed Action has the potential to impact water tables of surrounding wells.
		One comment requests that dredge operations be restricted based on flow readings obtained from the Kansas River.
Waterbody Bank / Bed integrity	22	Twenty comments express concern that the Proposed Action would increase stream bed degradation associated with bed and bank erosion.
		Two comments expressed concern that impacts to existing infrastructure due to geomorphic changes in the river are exacerbated by dredging.
Total Written Comments	182	

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Revised Regulatory Plan for Commercial Dredging Activities on the Kansas River

Appendix A

Table of Contents

List of Figures

Introduction

This Regulatory Plan has been developed to aid the Kansas City District, Corps of Engineers in its administration of permit applications for commercial dredging activities on the Kansas River. The Plan is intended to limit the magnitude of dredging-related impacts to the morphology and ecology of the river; to manmade structures located in and along the river; and to other public and private interests such as adjacent land, water supplies and recreation. Adverse impacts include: (a) riverbed degradation[1]; (b) bank erosion; (c) channel widening; (d) lowering of-water surface elevations in the river channel; (e) lowering of water table elevations adjacent to the river; (f) a reduction in the structural integrity of bridges, pipelines, jetties, dams, weirs and other manmade structures; and (g) a loss of environmental values resulting from (a) through (e).

The adverse impacts that result from commercial dredging activities are being controlled by establishing a <u>maximum acceptable level of impacts</u>[2] and by providing the restrictions necessary to keep impacts at or below the acceptable level. The maximum level of impacts established for purposes of this Plan is a level which will have only <u>minor effects</u>[3] on the morphology and ecology of the river and on public and private interests located in and along the river.

This Plan is subdivided into 2 main parts, entitled <u>Dredging Restrictions</u> and <u>Monitoring Program</u>. The Dredging Restrictions consists of criteria developed to limit dredging-related impacts to an acceptable level. The Monitoring Program will utilize data collected from the river to evaluate the impacts associated with restricted dredging in order to ensure that the established maximum acceptable level of impacts will not be exceeded. Data collected through the Monitoring Program will be used to quantify the actual rate of riverbed degradation, bank erosion, channel widening, and other parameters affecting the morphology and ecology of the river, and to evaluate related adverse impacts occurring to public and private interests located in and along the river. The data will ultimately be used to adjust the Dredging Restrictions, as needed over time, to assure that the established maximum acceptable level of impacts will not be exceeded, and/or to adjust the Restrictions if monitoring efforts reveal that certain constraints can be lessened or eliminated without exceeding the established acceptable level of impacts.

Every effort has been made to develop this Plan through the application of scientific principles. Due to the limitations inherent in predicting future changes in river morphology, some of the elements in the Plan are based upon professional judgment and experience. Development of the Plan has relied on information presented in economic, social, environmental and engineering studies prepared to address this activity; on information provided to the District by various involved parties; and on the information and experience acquired by the District over a decade of analyzing Kansas River dredging.

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[1] The term <u>riverbed degradation</u> refers to lowering of riverbed elevations.

[2] The term <u>maximum acceptable level of impacts</u> is defined for purposes of this Plan as the maximum level of impacts determined by the Kansas City District to be compatible with the overall public interest involved.

[3] The term <u>minor effects</u>, as used in this plan, is described as those effects which are not expected to have a significant impact on nondredging concerns such as adjacent landowners and various entities responsible for structures located in and along the river, nor would those effects be expected to unduly impact environmental resources.

Formulation of this Plan has been based on the following objectives: (a) limit the adverse impacts associated with commercial dredging activities to an acceptable level; (b) minimize the economic hardships which may occur to the producers, related construction concerns and consumers; and (c) provide a plan which will treat all producers equitably. Due to the complex nature of the issues relating to commercial dredging activities on the Kansas River, it has not been possible to develop a plan that will entirely satisfy the interests of all of the involved parties. This Plan satisfies the overall public interest involved and represents a compromise between the extremes of the alternatives available to the Kansas City District.

Dredging Restrictions

This section of the Regulatory Plan contains restrictions that have been developed to limit the adverse impacts associated with commercial dredging activities on the Kansas River. The restrictions are intended to limit those impacts to a level which will have only minor effects on the morphology and ecology of the river and on public and private interests located in and along the river. Implementation of the Dredging Restrictions in conjunction with the Monitoring Program is intended to ensure that the established maximum acceptable level of impacts will not be exceeded.

I. Restrictions Concerning Riverbed Degradation

The magnitude of dredging-induced riverbed degradation is a key factor influencing the degree of instability of the river channel. Degradation of the riverbed results in secondary impacts such as bank erosion, channel widening, lowering of water surface elevations in the river channel, lowering of water table elevations adjacent to the river, alteration of aquatic and terrestrial habitat, and a reduction in the structural integrity of manmade structures. Since secondary impacts increase as riverbed degradation increases, the degree of dredging-induced river channel instability can be limited by controlling the amount of dredging-related degradation.

Based on all available information, the Kansas City District has determined that most reaches of the Kansas River cannot sustain more than 2 feet of riverbed degradation below the riverbed elevations from the 1992 baseline riverbed elevation survey before secondary impacts exceed acceptable levels. Therefore, the maximum allowable reduction in the riverbed elevations is 2 feet for all reaches of the river. As part of the Monitoring Program, an independent engineering firm will survey various established cross-sections of the riverbed every other year. The Kansas City District will compare the survey data against the baseline survey data collected in 1992, to identify the average reduction in bed elevations through a 5-mile-long reach of river. Any 5-mile-long reach of river is subject to bed elevation averaging. The average bed elevation for a 5-mile long reach will be rounded to the nearest hundredth of a foot using standard rounding procedures. A 5-mile-long reach can begin at any location on the river and will extend 5 miles upstream of that location with the following exceptions: no 5-mile-long reach of river will extend through the WaterOne weir (river mile 15.0), Bowersock Dam (river mile 51.8), or the city of Topeka water intake weir (river mile 87.0).

Within several months of receiving new survey data at the frequency intervals outlined in Section IV, the Kansas City District will provide a report of the survey analysis to the producers that:

- Quantifies the amount of bed degradation in every 5-mile-long reach in the surveyed portions of the river;
- Identifies those 5-mile-long reaches that in the current survey have degraded 1.5 feet or more below the 1992 baseline in the current survey and may be immediately closed to dredging if the next survey shows the reach has degraded 2 feet or more below the 1992 baseline elevation for the reach;
- Identifies those 5-mile-long reaches that in the previous survey had degraded 1.5 feet or more below the 1992 baseline elevation for the reach, that in the current survey have degraded 2 feet or more below the 1992 baseline elevation for the reach, and will immediately be closed to dredging; and
- Identifies those 5-mile-long reaches that in the previous survey had not degraded 1.5 feet or more below the 1992 baseline, that in the current survey have degraded 2 feet or more below

the 1992 baseline because of an unforeseen event such as a flood or a prolonged period of low reservoir releases, and will be closed to dredging in 1 year.

A 5-mile-long reach of river that has degraded 2 feet or more below the 1992 baseline elevation for the reach and has been closed to dredging will not be reopened until its bed elevation increases to an average elevation exceeding the established minimum for that reach. If a previously closed 5-mile-long reach of river has aggraded, such that the average bed elevation for the reach is less than 2 feet but more than 1.5 feet below the 1992 baseline elevation for the reach, it will be reopened with annual extraction of each individual dredging area within the reach limited to 50 percent of the amount that would normally be allowed for each individual dredging area. If the reach has aggraded, such that the average bed elevation for the reach is 1.5 feet or less below the 1992 baseline elevation for the reach, it will be reopened to its full annual allotment of sand and gravel.

Closing a reach that has degraded excessively shall be implemented through suspension or modification (not termination) of the permit in accordance with 33 CFR 325.7. Suspension of dredging in dredging areas partially located in a degraded 5-mile-long reach shall be limited to only that portion of the dredging area located within the degraded reach. Reopening a previously closed reach that has recovered sufficiently shall be implemented through reinstatement or modification of the existing permit in accordance with 33 CFR 325.7, not by issuing a new permit.

II. Restrictions Concerning the Rate of Sand and Gravel Extraction from Specified Reaches of the River

The rate[4] of sand and gravel extraction from a reach of river is an important factor affecting the river channel's stability. The magnitude of instability induced into the river channel by dredging activities increases as the rate of extraction increases (channel stability decreases as the length of time utilized to reach a given level of degradation decreases).

Therefore, greater channel stability can be obtained by limiting the rate of extraction within a reach of river to provide a reasonable period of time for the channel to adjust to declining bed elevations.

The following restrictions are being implemented to limit the rate of sand and gravel extraction from specified reaches of the river:

A. The Confluence of the Kansas and Missouri Rivers to Bonner Springs (River Miles 0 - 21.2 (Approx.)).

A maximum of 1 million tons of sand and gravel can be extracted from this approximately 21.2-mile-long reach of river annually. Refer to Section VII .B.1.c. for an additional restriction concerning extraction rates within this reach.

B. Bonner Springs to River Mile 48.0 (River Miles 21.2 (Approx.) - 48.0).

No total annual extraction limit has been established for this approximately 26.8-mile-long reach of river. However, the maximum amount of sand and gravel that can be extracted annually from any 15-mile-long section of river within this reach is 750,000 tons. A 15-mile-long section of river can begin or end at any location within this reach.

C. River Mile 48.0 to Bowersock Dam at Lawrence (River Miles 48.0 - 51.8 (Approx.)).

A maximum of 150,000 tons of sand and gravel can be extracted from this approximately 3.8-mile-long reach of river annually.

[4] The term rate is defined for purposes of this report as tons/time.

D. Bowersock Dam at Lawrence to the Confluence of the Kansas, Smoky Hill and Republican Rivers Near Junction City (Approx. River Miles 51.8 - 170.4).

No total annual extraction limit has been established for this approximately 118.6-mile-long reach of river. However, the maximum amount of sand and gravel that can be extracted annually from any 15-mile-long section of river within this reach is 750,000 tons. A 15-mile-long section of river can begin or end at any location within this reach.

NOTE: The 750,000 ton extraction limit, per 15-mile-long section of river, referenced in parts B. and D. of this section does not apply to part A. of this section.

III. Restrictions Concerning the Rate of Sand and Gravel Extraction by an Individual Dredge

The rate of sand and gravel extraction by an individual dredge is an important factor affecting local[5] river channel stability. The diameter and depth of the dredge hole as well as local degradation beyond the dredge hole increase as extraction rates increase. Local degradation and secondary impacts, such as bank erosion and channel widening, can be limited and greater local channel stability can be obtained by limiting the extraction rate of an individual dredge. Therefore, the maximum annual extraction rate by a single dredge regardless of its location on the river will be limited to 300,000 tons of material. The actual allowable extraction rate for a single dredging operation may be less than 300,000 tons of material and will depend upon the reach of river being dredged and the number of dredges operating within that reach.

IV. Restrictions Concerning the Length of Individual Permitted Dredging Operations

The maximum length of any reach of river authorized for dredging under the terms of a single permit is 1.5 miles. This restriction is intended to allow the producers fair access to the river by preventing any producer from using the permitting process to create an unfair advantage over other producers by securing a permit for an excessively long reach of the river. This restriction applies to any new dredging operation permitted after implementation of this Regulatory Plan. It does not apply to a dredging operation permitted prior to implementation of the Plan, unless subsequent to implementation of the Plan that dredging operation is altered (such as the relocation of dredging boundaries) to an extent that those changes require the issuance of a new permit document .

V. Restrictions Concerning the Distance between Adjacent Permitted Dredging Boundaries

A minimum distance of 2,000 feet is required between the permitted reaches of adjacent dredging operations. This restriction will limit dredging-induced local channel instability, by maintaining at least a 2,000-foot-long undredged reach of river between adjacent dredges. This restriction applies to any new dredging operation permitted after implementation of this Regulatory Plan. It does not apply to a dredging operation permitted prior to implementation of the plan, unless subsequent to

[5] The term local refers to the area directly impacted by a working dredge. This area could be relatively small, extending only a few hundred feet from the dredge, or it could be quite large, extending many hundreds of feet upstream and/or downstream of the dredge.

implementation of the plan that dredging operation is altered (such as the relocation of dredging boundaries) to an extent that those changes require the issuance of a new permit document.

VI. Restrictions Concerning the Number of Dredges Authorized Under the Terms of an Individual Permit Document

The maximum number of dredges authorized to operate within a single permitted reach of river is 1. This restriction will limit dredging-induced local channel instability, by limiting the number of dredges within each permitted reach of river.

VII. Restrictions Concerning Manmade Structures

A. Bowersock Dam

This hydroelectric dam is located near river mile 51.8. It was constructed in 1872 and was enlarged in 1926. The exact construction details of the dam are unknown. The structure is believed to be relatively unstable, since the elevation of the riverbed downstream of the dam is considered to be marginally adequate to prevent sliding failure of the structure. The dam acts as a riverbed control structure, and if it should fail, it could induce severe riverbed degradation, bank erosion and channel widening for many miles upstream.

Due to the apparent unstable condition of Bowersock Dam and its importance as a riverbed control and hydroelectric generating facility, the following restrictions are being imposed on the reaches of river located immediately upstream and downstream of the dam:

1. Dredging activities upstream of Bowersock Dam will not be allowed within approximately 750 feet of the dam. The actual distance will be controlled by part C. of this section, since two bridges are located immediately upstream of the structure.
2. Dredging activities downstream of the dam will not be allowed within 2,250 feet of the structure.
3. The maximum volume of material that can be extracted annually between river mile 48.0 and Bowersock Dam is 150,000 tons.

Due to the uncertainties involved in evaluating the stability of Bowersock Dam, it is not possible to determine how many feet the downstream riverbed elevation can be lowered before the dam will fail. Therefore, the reach of river located immediately downstream of the dam will be closely monitored, and if dredging activities on the river appear to be jeopardizing the integrity of the structure, additional restrictions will be imposed.

Refer to Figure A-1 on page A-17 for additional clarification on the restrictions imposed on the reaches of river located immediately upstream and downstream of the dam.

B. Water Intake Structures and Associated Weirs and Jetties

No dredging will be allowed within 500 feet of any water intake structure or an associated weir or diversion jetty. This restriction will limit the potential for dredging-induced local channel instability to adversely impact the operation of such structures. This restriction does not apply to irrigation intakes.

The following additional restrictions are being imposed to protect the Water District No. 1[6] weir; the Sunflower Army ammunition Plant water intake structure and diversion jetty; and the city of Topeka's water intake structures, diversion jetties and weir:

1. Water District No. 1 Weir.

This weir is an important riverbed control located near river mile 15.0. The weir was initially constructed in the mid-1960s in response to continually lowering water surface elevations in that reach of river. If riverbed elevations downstream of the weir drop several more feet, the structure may fail. Failure of the weir could induce severe riverbed degradation, bank erosion and channel widening upstream of the structure and could impact water supplies for Water District No. 1 of Johnson County.

Due to the importance of the weir to Water District No. 1 for its water supply and due to the structure's importance as a riverbed control, the following restrictions are being placed on the reaches of river located immediately upstream and downstream of the weir:

a. Dredging activities upstream of the weir will not be allowed within 500 feet of the structure.

b. Dredging activities downstream of the weir will not be allowed within 2,500 feet of the structure.

c. The maximum volume of material that can be extracted annually between river mile 12.4 (the upstream end of a natural rock deposit) and the Water District No. 1 weir is 300,000 tons.

Refer to Figure A-2 on page A-18 for additional clarification on the restrictions imposed on the reaches of river located immediately upstream and downstream of the weir.

2. City of Topeka Water Intake Structures, Diversion Jetties and Weir.

The city of Topeka has 2 water intake structures, 2 diversion jetties and a weir located between river miles 86.9 and 87.2. These structures provide the city with its entire water supply. Low flow water surface elevations at the intakes are marginally adequate to meet the city's needs; therefore, any lowering of water surface elevations at the intakes could have a detrimental impact on the city's ability to withdraw water from the river. The diversion jetties divert flows from the left riverbank to the right bank where the intake structures are located. The weir functions like a dam, raising water levels upstream of the structure and increasing water surface elevations at the intakes. Loss of one of the diversion jetties or the weir or diminished function of the structures could severely impact the city's ability to meet its water supply needs.

Due to the importance of the city of Topeka's diversion jetties and weir to meet the city's water needs, the following restrictions are being imposed:

a. No dredging will be allowed between the most upstream jetty and the weir.

b. Dredging activities upstream of the diversion jetties and weir will not be allowed within 1,000 feet of the most upstream diversion jetty.

c. Dredging activities downstream of the diversion jetties and weir will not be allowed within 2,000 feet of the weir.

Refer to Figure A-4 on page A-20 for additional clarification on the restrictions imposed on the reaches of river located immediately upstream and downstream of the diversion jetties and weir.

[6] Water District No. 1 refers to Water District No. 1 of Johnson County.

C. Bridges

No dredging will be allowed within 500 feet of any bridge crossing the Kansas River. This restriction will limit the potential for dredging-induced local channel instability to adversely impact the structural integrity of bridges.

D. Pipelines

Pipelines buried in the riverbed have a high potential to be adversely impacted by dredging activities. If degradation of the riverbed exposes a pipeline, damage could occur through sagging, buoyancy or displacement of the line downstream due to an accumulation of debris. The following restrictions will limit the potential for dredging-induced localized degradation to expose buried pipelines:

1. No dredging will be allowed within 200 feet of any pipeline that is buried 10 feet or more below the riverbed's surface.
2. No dredging will be allowed within 500 feet of any pipeline that is buried less than 10 feet below the riverbed's surface.

Additional restrictions may be required for any pipeline located on or above the riverbed. Such restrictions would be developed on a case-by-case basis.

Each applicant is responsible for determining the locations and elevations of any pipelines crossing the river within a proposed permit's boundaries and within the reaches of river extending 500 feet upstream and downstream of those boundaries. This information or a negative response, if no pipelines exist, must be provided to the Kansas City District before a proposed permit can be issued.

E. Bank Stabilization Structures

No dredging will be allowed within 200 feet of any bank stabilization structure. When multiple structures (jetties, hardpoints, etc.) are utilized as components of a single project, no dredging will be allowed within 200 feet of the most upstream and downstream structures or landward of a line drawn parallel to the riverbank and located 200 feet riverward of the riverward edge of each structure . These restrictions will limit the potential for dredging-induced local channel instability to adversely impact bank stabilization efforts.

Refer to Figure A-5 on page A-21 for additional clarification on restrictions concerning multiple bank stabilization structures.

F. Levees

No dredging will be allowed within 150 feet of the riverward toe of any functional levee located along the river. This restriction will limit the potential for dredging-induced localized channel instability to adversely impact the structural integrity of levees.

G. Boat Ramps

Dredging operations are prohibited within 300 feet of any public boat ramp.

H. Other Structures

Restrictions regarding other manmade structures not identified in this section will be determined on a case-by-case basis.

VIII. Restrictions Concerning Natural Formations

A. Natural Rock Deposits in the River Channel

Natural rock deposits located on or in the riverbed may act as riverbed controls and/or may increase aquatic habitat diversity. The importance of a rock deposit is dependent upon its areal extent, its thickness and other relevant factors. Since the physical characteristics of rock deposits vary widely from one to another, and since the value of a deposit is based on its physical characteristics, it is not possible to develop restrictions which will consider all possible contingencies. Therefore, restrictions concerning natural rock deposits will be developed on a case-by-case basis (except for 1. and 2. below).

Restrictions concerning two important natural rock deposits are as follows:

1. Natural Rock Deposit between River Miles 12.2 and 12.4.

This natural rock deposit is an important riverbed control, and in addition, it provides valuable habitat diversity for fish and other aquatic organisms. The exact length, width and thickness of the deposit is unknown. The rock deposit functions as a riverbed control, retarding upstream bed degradation in the approximately 2 1/2-mile-long reach of river located between the deposit and the Water District No. 1 weir. If the rock deposit is displaced by dredging activities, it could induce severe riverbed degradation, bank erosion and channel widening in the reach of river between the deposit and the weir, which could ultimately result in failure of the weir.

Due to the importance of the rock deposit as a riverbed control and as valuable habitat for fish and other aquatic organisms, the following restrictions are being imposed:

a. Dredging activities will not be allowed within the reach of river containing the rock deposit (river miles 12.2 - 12.4).

b. Dredging activities upstream of the rock deposit will not be allowed within 500 feet of the deposit.

c. Dredging activities downstream of the rock deposit will not be allowed within 2,500 feet of the deposit.

Refer to Figure A-2 on page A-18 for additional clarification on these restrictions

2. Natural Rock Deposit between River Miles 21.8 and 22.8

This approximately 1-mile-long natural rock deposit is an important riverbed control. It also provides valuable habitat diversity for fish and other aquatic organisms, and during low river stages, it becomes a foraging area for wading and shore birds. The deposit extends from the right riverbank to within 200 - 300 feet of the left riverbank. The heavily dredged

21.8-mile-long reach of river located downstream of the rock deposit has significantly lower riverbed elevations than the undredged reach of river located upstream of the deposit. If the rock deposit is displaced by dredging activities, headcutting would proceed upstream from the heavily dredged downstream area and could induce severe riverbed degradation, bank erosion and channel widening in the reach of river located upstream of the deposit.

Due to the importance of the rock deposit as a riverbed control, as valuable habitat for fish and other aquatic organisms and as a foraging area for birds, the following restrictions are being imposed:

a. Dredging activities will not be allowed within the reach of river containing the rock deposit (river miles 21.8 - 22.8.

b. Dredging activities upstream of the rock deposit will not be allowed within 500 feet of the deposit.

c. Dredging activities downstream of the rock deposit will not be allowed in the reach of river located between the deposit and a point 500 feet downstream of river mile 21.2).

Refer to Figure A-6 on page A-22 for additional clarification on these restrictions.

B. Riverbanks

Dredges operating close to riverbanks have a high potential to adversely impact the stability of those banks, especially when dredging occurs near the outside of sharp river bends. Bank erosion induced by such dredging can result in the loss of land, damages to manmade structures, and adverse impacts to environmental resources. Therefore, the following restrictions are being imposed to limit the potential for dredging-induced local bed degradation to adversely impact riverbank stability:

1. No dredging will be allowed within 300 feet of the ordinary high water mark elevation[7] of any riverbank on the outside of a river bend located in a reach of river which has experienced a significant degree of lateral migration in recent years .

   Those river reaches are identified as:

   River miles 40.5 - 42.0

   River miles 47.5 - 48.0

2. No dredging will be allowed within 200 feet of the ordinary high water mark elevation of any riverbank on the outside of a sharp river bend which has a radius of curvature of 4,000 feet or less (provided that this restriction is not precluded by 1. above).

   Those bends are identified as:

   River Miles

   26 .0 - 27.0

   27.3 - 29.0

   34.0 - 35.5

   35.5 - 37.0

   39.2 - 40.0

   40.5 - 42.0

   43.2 - 44.5

   44.5 - 45.3

   46.7 - 47.3

   47.3 - 48.3

   55.0 - 56.5

   57.0 - 58.6

   78.0 - 79.3

   79.5 - 80.2

   114.3 - 114.8

[7] Ordinary High Water Mark - Refer to part E. of this section for a definition of this term.

114.9 - 115.3

117.4 - 119.0

120.0 - 120.3

124.0 - 125.0

130.7 - 131.3

131.5 - 132.2

132.2 - 133.6

133.7 - 134.1

139.0 - 139.5

140.6 - 141.2

141.7 - 142.2

142.5 - 143.6

143.6 - 144.4

146.2 - 147.3

150.1 - 150.5

150.6 - 151.3

151.9 - 152.6

153.5 - 154.7

164.9 - 165.3

166.0 - 167.0

168.0 - 169.3

3. Restrictions concerning areas of the river experiencing severe bank erosion and not identified in 1. and 2. above will be considered on a case-by-case basis.
4. No dredging will be allowed within 100 feet of the ordinary high water mark elevation of any riverbank not identified in 1. and 2. above unless special authorization is granted.

NOTE: The Kansas City District can provide ordinary high water mark elevations for any location on the river.

C. Islands

Islands[8] provide valuable ecological diversity by creating variability in water depths and current velocities. These factors are especially important to the river's fishery, since they are requirements for a diverse fish population. Islands also provide a refuge for birds and other wildlife.

Due to the infrequency of islands in the river and due to the importance of islands for the creation of a diverse fishery and to provide a refuge for birds and other wildlife, the following restrictions are being imposed:

[8] Islands - Refer to part E. of this section for a definition of this term.

1. No dredging will be allowed within 100 feet of the ordinary high water mark elevation of any island. This restriction applies to all islands, including those islands that form within a permitted reach of river after initiation of dredging operations in that reach.
2. No clearing of vegetation will be allowed from any island in the river to facilitate commercial dredging activities.

Natural processes influence the size, shape and abundance of islands over time. Several islands have formed in the river during recent years and more may be forming. Therefore, no attempt has been made to provide a comprehensive list of islands for this Plan. Kansas City District personnel will conduct field investigations to determine the presence or absence of an island, when such determinations are necessary.

Refer to Figure A-7 on page A-23 for additional clarification on the identification of an island.

D. Tributary Mouths

A reduction in the Kansas River's bed elevations can induce riverbed degradation in its tributaries. Lowering of bed elevations in the tributaries can result in additional adverse impacts such as bank erosion, channel widening, alteration of aquatic and terrestrial habitat, and a reduction in the structural integrity of manmade structures located in and along those tributaries. The following restriction is being imposed to limit the potential for dredging-induced localized riverbed degradation to adversely impact the Kansas River's tributaries:

No dredging will be allowed within 100 feet of a tributary mouth. The undredged zone will extend 100 feet riverward (into the Kansas River) of a straight line drawn across the tributary mouth and connected to the ordinary high water mark elevations on the Kansas River's banks on each side of the tributary.

Refer to Figure A-8 on page A-24 for additional clarification on this restriction.

E. Definition of Terms

The following definitions are provided to clarify potentially confusing terms found in this section:

1. The term ordinary high water mark is defined for purposes of this Regulatory Plan as the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of the soil; destruction of terrestrial vegetation; presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas.
2. The term island is defined for purposes of this Regulatory Plan as a land form that rises from within the river channel and which meets all of the following criteria: (a) it is permanent and not shifting from location to location within the river channel (unlike a sand bar); (b) it rises to an elevation such that it has a distinct ordinary high water mark line, or its surface elevation is greater than the ordinary high water mark elevation on the adjacent riverbank; and (c) it is a discrete land form such that an unbroken contour line can be extended 360 degrees around its perimeter at or above the elevation of the ordinary high water mark on an adjacent riverbank.

NOTE: For purposes of this Regulatory Plan, the definition of an island does not require the presence of vegetation. In addition, islands may not be surrounded by water during low river stages.

IX. Restrictions Concerning Water Quality

A. Dredged Return Water

Water separated from the dredged slurry and returned to the river could affect water quality parameters. Dredged return water may contain inordinately high levels of silt and/or toxic substances liberated from the dredged material during processing. In addition, the return water may pick up a high concentration of suspended solids and/or toxic substances from the plant site if it is discharged directly onto the ground and allowed to run-off into the river. Therefore, the following restrictions are being imposed to limit the potential for dredged return water to adversely impact the river's water quality:

1. Return water discharged from onshore processing plants for commercial sand and gravel dredging operations is considered a point source discharge subject to regulation under authority of Section 402 of the Clean Water Act. USACE regulates the proposed dredging only under Section 10 and not under Section 404 of the Clean Water Act. The design of sediment basins and management of discharges must comply with the requirements of Section 402 of the Clean Water Act as administered by KDHE and EPA:

   > *"All dredged return water and process water must be passed through an appropriately sized and maintained siltation basin prior to being discharged into any waters of the U.S. Design of sediment basins and management of discharges must comply with the requirements of Section 402 of the Clean Water Act as administered by KDHE and EPA."*

2. Dredged return water must be conveyed from the processing facility to the river by sluiceway or by piping.

B. Dredged Silt and Miscellaneous Debris

Silt collected in siltation basins and miscellaneous debris dredged from the river, such as wood, metal, paper and plastic cannot be returned to the water body. These waste materials must be disposed at a location and in a manner that will prevent their reintroduction to the river. This restriction will prevent dredged waste materials from adversely impacting water quality parameters in the river.

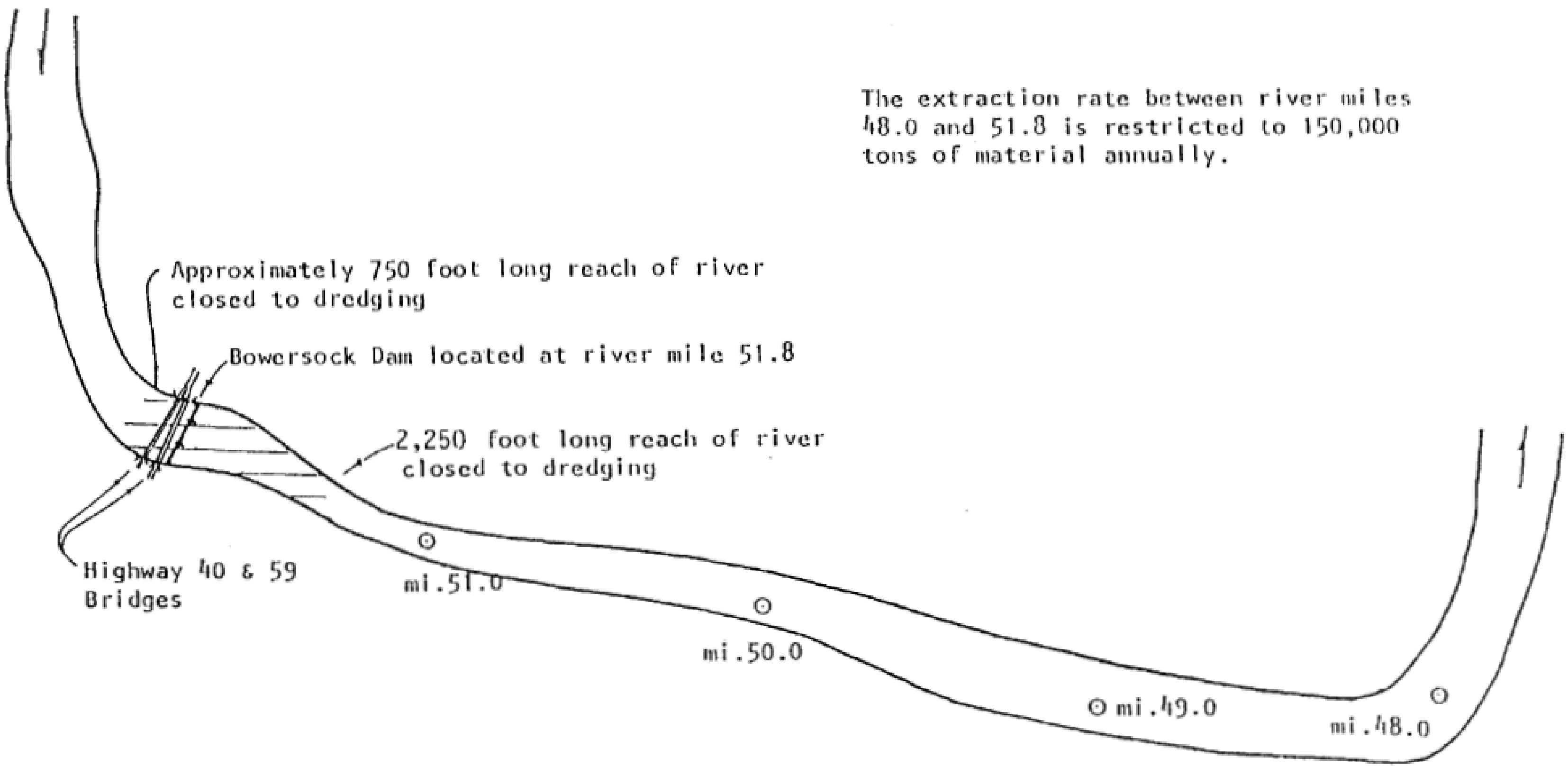
X. Safety

Safety issues relating to the possibility of watercraft colliding with a dredge or its mooring cables are a serious concern. Therefore the following restrictions are being imposed to limit the potential for dangerous conflicts between watercraft and dredging operations:

- Dredge operators must remain vigilant for approaching watercraft and other activities on the river and must provide safe passage through the dredging area during operations and while the dredge is unattended.
- All cables above the surface of the water must be clearly marked and visible to approaching vessels. Side cables across the main navigation channel must be left slack and at least 10 feet below the water surface or on the riverbed when the dredge is unattended.
- USCG approved buoys (Danger buoy) must be placed no less than 200 feet and not more than 500 feet of the upstream and downstream extent of the dredging operations area to warn on-coming vessel operators that obstruction(s) to navigation exist.
- USCG approved blinking or steady white lights must be placed and operational on the channel-ward upstream and downstream extent of the dredge vessel and the midpoint of the discharge pipeline from sunset to sunrise.

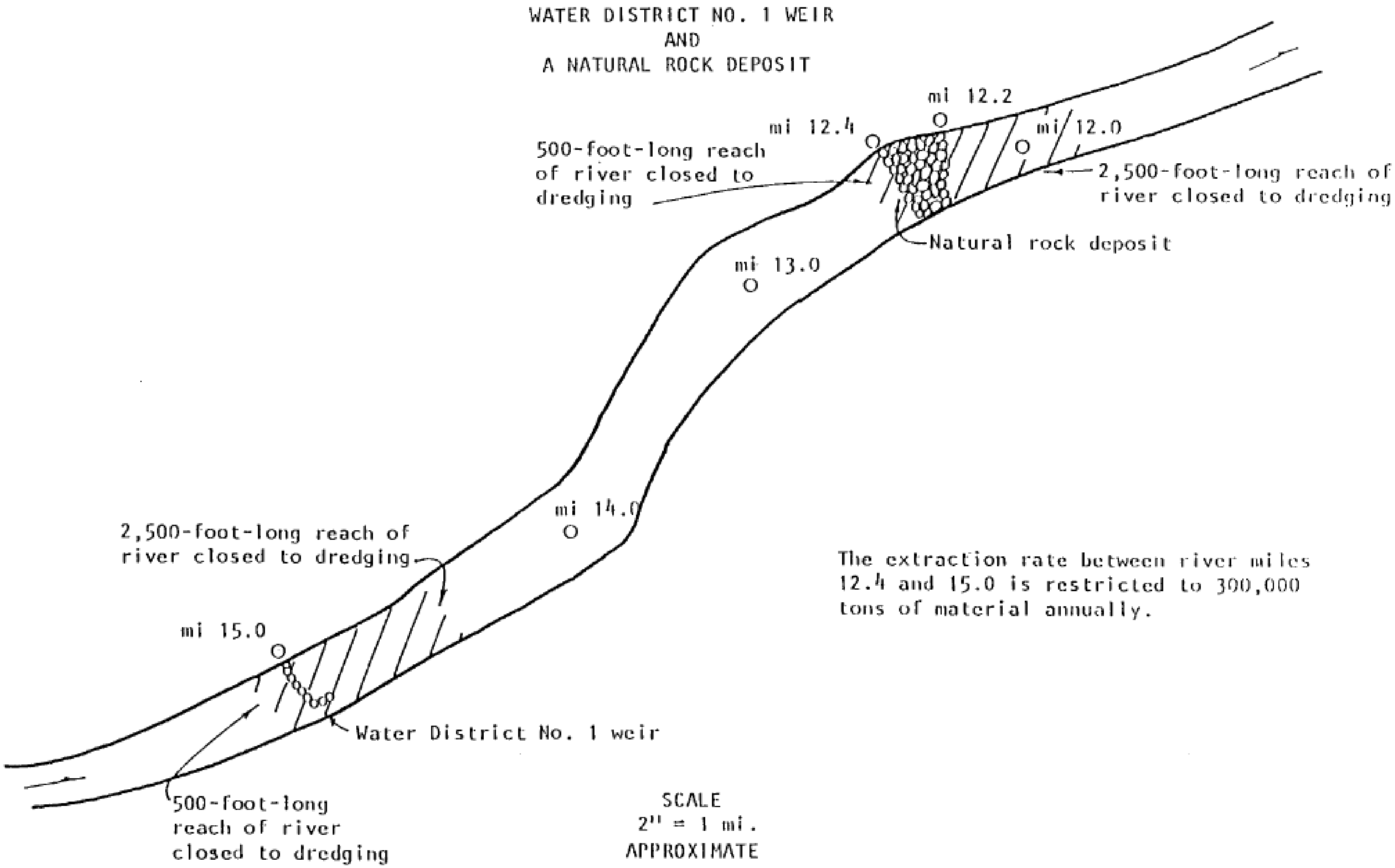
- All vessels used in dredging operations must be operated and maintained in accordance with the USCG Inland Navigation Rules (33 USC 2020-2030) and as may be prescribed by the State of Kansas Boating Statutes and Regulations.

BOWERSOCK DAM



SCALE
2" = 1 mi.
APPROXIMATE

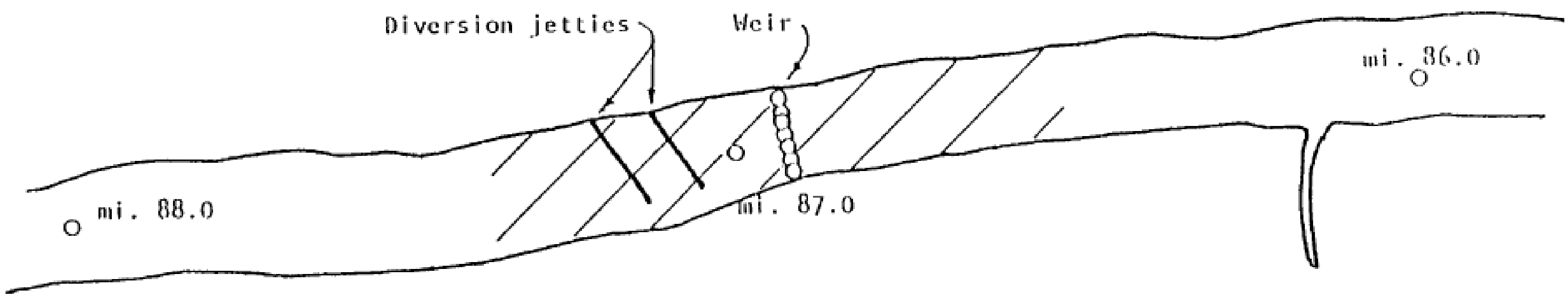
FIGURE A-1



WATER DISTRICT NO. 1 WEIR
AND
A NATURAL ROCK DEPOSIT
mi 12.2
mi 12.4
mi 12.0
500-foot-long reach of river closed to dredging
2,500-foot-long reach of river closed to dredging
Natural rock deposit
mi 13.0
mi 14.0
2,500-foot-long reach of river closed to dredging
The extraction rate between river miles 12.4 and 15.0 is restricted to 300,000 tons of material annually.
mi 15.0
Water District No. 1 weir
500-foot-long reach of river closed to dredging
SCALE
2" = 1 mi.
APPROXIMATE

FIGURE A-2

CITY OF TOPEKA
DIVERSION JETTIES & WEIR

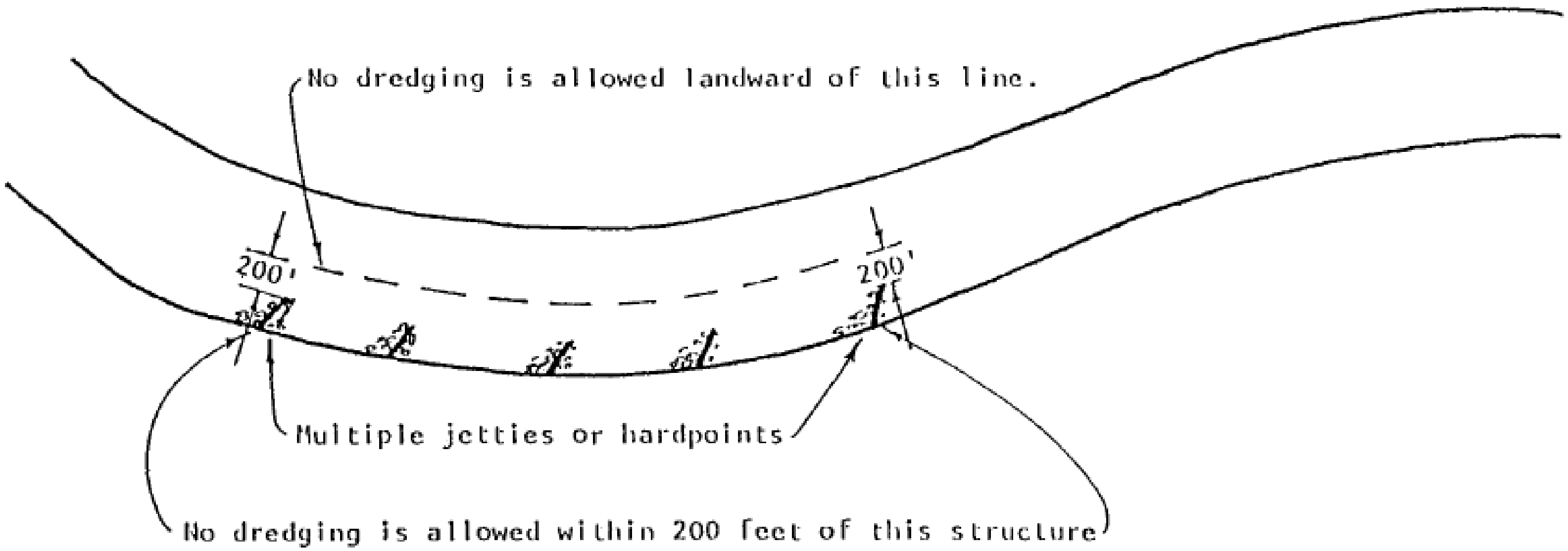


River miles 86.5 (approximately) to 87.4 (approximately) are closed to dredging.

SCALE
4" = 1 mi.
APPROXIMATE

FIGURE A-4

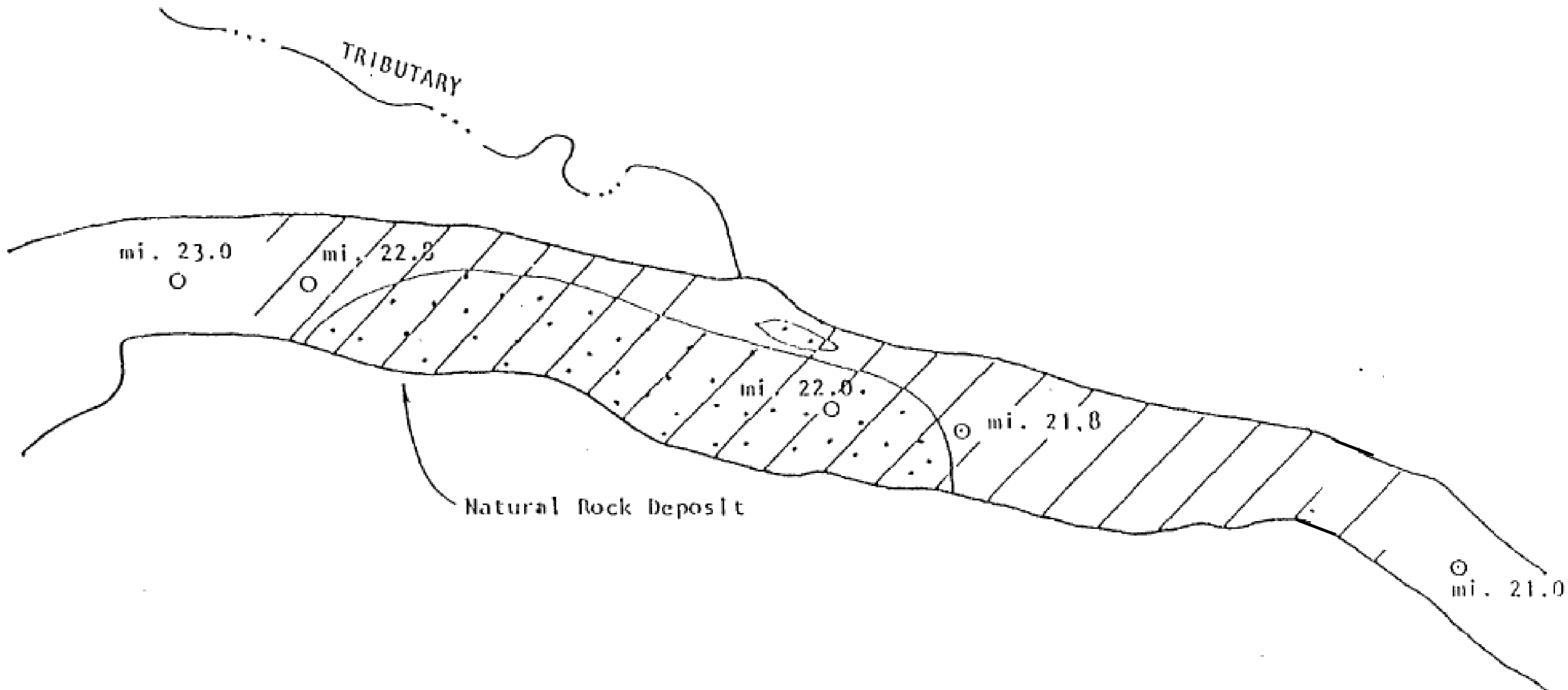
MULTIPLE BANK STABILIZATION STRUCTURES



TYPICAL PLAN VIEW

FIGURE A-5

NATURAL ROCK DEPOSIT

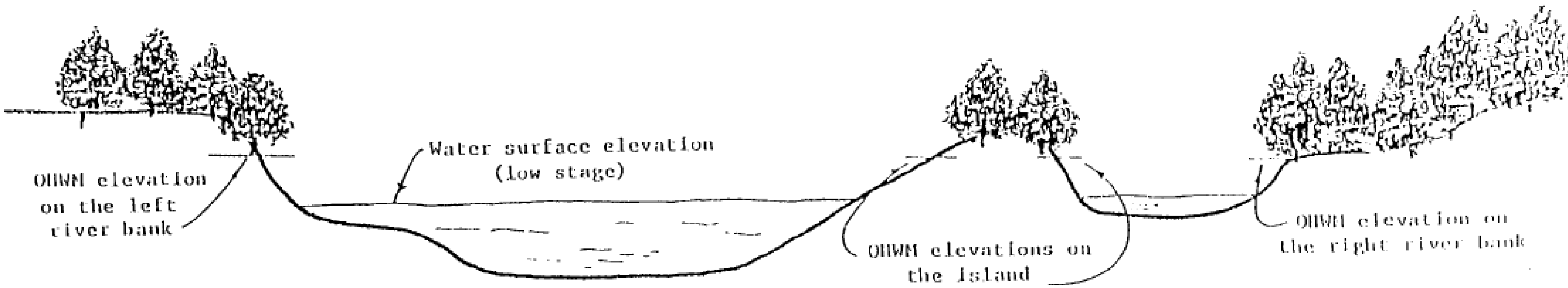


River miles 21.1 (approximately) to 22.9 (approximately) are closed to dredging.

SCALE
4" = 1 mi.
APPROXIMATE

FIGURE A-6

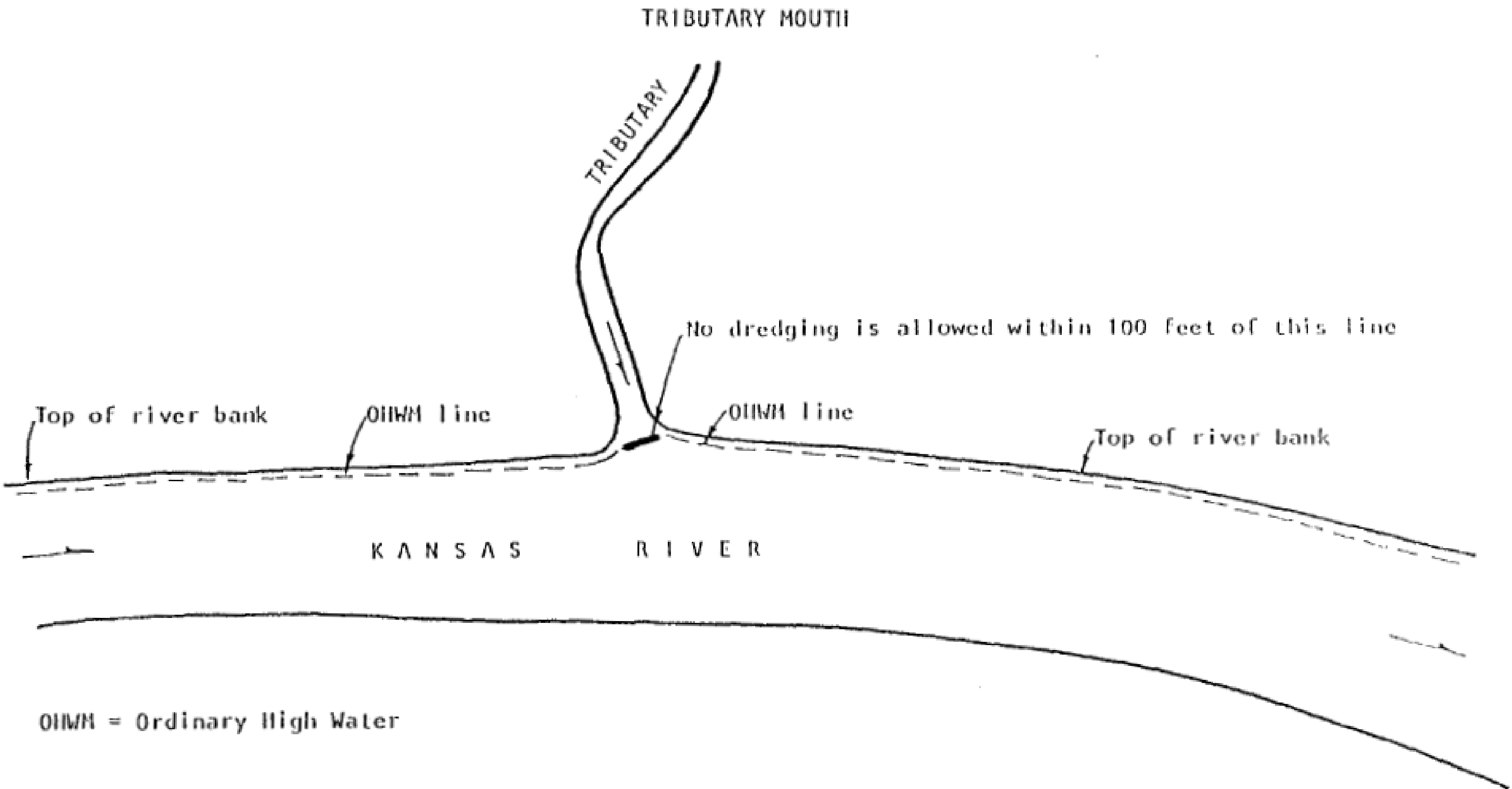
IDENTIFICATION OF AN ISLAND



OHWM = Ordinary High Water Mark

TYPICAL CROSS SECTION

FIGURE A-7



TYPICAL PLAN VIEW

FIGURE A-8

Monitoring Program

This section of the Regulatory Plan contains the criteria that have been developed to monitor the impacts of permitted dredging activities on the Kansas River. Data required to monitor dredging-related impacts must be collected by the sand and gravel producers on a routine basis and will be utilized by the Kansas City District to measure riverbed degradation and other parameters affecting the river channel's morphology. Implementation of the Monitoring Program in conjunction with the Dredging Restrictions will ensure that the established maximum acceptable level of impacts will not be exceeded.

I. General Information

Reliable monitoring of dredging-related impacts is dependent upon the collection and utilization of various types of information. Certain data pertinent to monitoring efforts is currently available to the Kansas City District; other information which is not available to the Kansas City District must be provided to the District by the sand and gravel producers. Monumented control sites must be established at various locations along the river in order to provide some of the required information. Establishment and maintenance of the control sites is the responsibility of the producers. Information to be provided by the producers includes channel cross-section surveys, water surface elevations, aerial photography, and production figures. Field data required by the District must be accompanied by field notes containing pertinent raw data in a standard engineering format with appropriate dates, times and locations of data collections. Certain information may be requested in a preprocessed form, such as channel cross-section survey data plotted for each survey range line. In addition, requested information may be required in digital form on diskette in a format acceptable to the Kansas City District.

When a dredged reach of river is abandoned, the producers may be required to continue control site maintenance and data collections, within the abandoned reach, for a reasonable period of time. Such a requirement would depend upon the location of the abandoned reach, the impact of dredging activities on the reach and other factors pertaining to the river channel's stability within the reach. Termination of control site maintenance and data collection is at the discretion of the Kansas City District.

Contractors employed by the producers and the procedures and equipment utilized by those contractors to establish control sites and to furnish data, aerial photography and any other required information, must be approved by the Kansas City District. This document is not intended to provide all of the details concerning data collection and submittal requirements. The producers or the contractors employed by the producers must contact the Kansas City District prior to the initiation of data collection efforts in order to assure that all data collection and submittal requirements are met. A thorough quality and error check of all required data must be performed prior to submittal to the Kansas City District.

The Monitoring Program is subject to modification by the Kansas City District at any time to ensure that the established maximum acceptable level of impacts is not being exceeded. Therefore, the sand and gravel producers are responsible for providing any additional information requested by the District to meet essential monitoring needs.

II. Control Sites

At least one monumented control site must be established on each riverbank at the control site locations identified in Section III. A., B., and C. to provide channel cross-section survey ranges. The control sites will also be used to collect water surface elevations and to establish ground controls for aerial photography. Control sites will be established with x, y and z coordinates using approved surveying methodology.

III. Survey Ranges

Monumented survey ranges must be established at the following locations:

A. Lower River (River Miles 0 - 51.8 [Bowersock Dam])

Monumented survey ranges will be located at approximately 1.5 mile intervals (any deviation must be approved by the Kansas City District) beginning at Turner Bridge near river mile 9.3 and ending within 1,000 feet of Bowersock Dam. In addition, a maximum of 5 monumented survey ranges will be located at 1,000 to 1,500-foot intervals through and/or adjacent to each permitted reach between Turner Bridge and Bowersock Dam. The actual number and location of ranges required in association with a permitted reach will be determined on a case-by-case basis and will depend on the length of the permitted reach and other pertinent factors. Existing monumented ranges, established by the Kansas City District, must be utilized when the locations of existing ranges coincide with required range locations. The use of existing ranges for the collection of required data will ensure continuity between historical and future data collections.

B. Topeka Area (Approximately River Miles 72 – 96)

Monumented survey ranges will be located at approximately 1.5 mile intervals (any deviation must be approved by the Kansas City District) beginning at least 5 miles below the most downstream permitted reach and ending at least 5 miles above the most upstream permitted reach. One range must be located within 500 feet of the downstream side of the Topeka water supply weir, which is located near river mile 86.9. In addition, a maximum of 5 monumented survey ranges will be located at 1,000 to 1,500-foot intervals through and/or adjacent to each permitted reach. The actual number and location of ranges required in association with a permitted reach will be determined on a case-by-case basis and will depend on the length of the permitted reach and other pertinent factors. Existing monumented ranges, established by the Kansas City District, must be utilized when the locations of existing ranges coincide with required range locations. The use of existing ranges for the collection of required data will ensure continuity between historical and future data collections.

C. Isolated Dredging Operations

Isolated dredging operations are permitted dredging operations that are not located within the monitored areas described in Section III. A. and B. Generally, 5 monumented survey ranges will be established to monitor each isolated dredging operation. However, the actual number of required ranges could be greater than 5 and will depend upon conditions present in the reach of river being dredged. Therefore, the number of ranges required to monitor an isolated dredge and the locations of those ranges will be developed on a case-by-case basis.

IV. Data Collection

A. Channel Cross-Section Surveys

A set of channel cross-section survey data consisting of at least 1 channel cross-section survey recorded along each monumented range line referenced in Section III. (Survey Ranges) must be collected as soon as possible after implementation of the Regulatory Plan, in order to provide base line data. A second set of channel cross-section data must be collected 4 years after implementation of the Regulatory Plan; and beginning 4 years after implementation of the Plan, sets of channel cross-section data must be collected at 2 year intervals (4, 6, 8, 10, 12 ...). Channel cross-section surveys must be conducted during discharges of 10,000 cfs or less. Each set of channel cross-section data must be provided to the Kansas City District as soon as possible after the data has been collected.

B. Sand and Gravel Production

Each year the total number of tons of material dredged from each permitted reach of the river between January 1 and December 31 must be provided to the USACE within 30 days of the end of the year.