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Regional Economic Impact Study for the McClellan Kerr Arkansas River Navigation System
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Heather Nachtmann, Ph.D.
Othman Boudhoum, M.S.
Furkan Oztanriseven, M.S., M.B.A.
University of Arkansas

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Maritime Transportation Research and Education Center
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University of Arkansas
4190 Bell Engineering Center
Fayetteville, AR 72701
479-575-6021

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Project Abstract

The McClellan-Kerr Arkansas River Navigation System (MKARNS), located in Oklahoma and Arkansas, contains 440 miles of waterway and is a crucial part of the United States' transportation system. The MKARNS strategically connects the heartland of the United States with the rest of the world via the Mississippi River and Port of New Orleans. We investigate the regional economic impacts of the MKARNS in order to inform waterway stakeholders of the system's value. Our study considers regional economic impacts from hydropower energy generation, USACE O&M expenditures, private sector investment expenditures, port activities, shippers' activities, transportation cost savings, and recreation benefits related to the MKARNS. Our findings show the MKARNS contributes total impacts of $8.5 billion in sales, $4.3 billion in GDP, and 55,872 jobs to the national economy. The findings of this study will inform future MKARNS investment decisions which can result in sustainable growth in the regional and national economy.

1. Introduction

1.1 Project Description

This report contains findings from the MBTC 4001 – Regional Economic Impact Study for the McClellan-Kerr Arkansas River Navigation System (MKARNS) project. The project was funded by the Arkansas State Highway and Transportation Department through the Mack-Blackwell Transportation Center and conducted for the Arkansas Waterways Commission and Maritime Transportation Research & Education Center (martrec.uark.edu) as a match project to U.S. Department of Transportation Grant Award Number DTRT13-G-UTC50. This research was completed in partnership with Dr. Dennis Robinson of the Institute for Economic Advancement at the University of Arkansas at Little Rock whose team recently completed a related project funded by the Oklahoma Department of Transportation (Robinson et al., 2014).

Our study initially focused on the Arkansas segment of the MKARNS and expanded to a combined look at the regional economic impacts of the entire MKARNS by combining our Arkansas impact findings with the Oklahoma impact findings obtained by Dr. Robinson's team and published in Final Report FHWA-OK-14-16 (Robinson et al., 2014). The regional economic impacts of the MKARNS are obtained by combining the individual impacts of seven major activities of the system: 1) hydropower energy generation, 2) U.S. Army Corps of Engineers (USACE) operations and maintenance (O&M) expenditures, 3) private sector investment expenditures, 4) port activities, 5) shippers' activities, 6) transportation cost savings, and 7) recreation benefits.

The MKARNS consists of 445 miles of navigable rivers and canals and connects the heartland of the United States with the rest of the world (Shoulberg, 2015). Thirteen of its eighteen locks are located in Arkansas, and its other five locks are located in Oklahoma. The locks on the MKARNS are generally 600-feet long and 110-feet wide, enabling a total of eight barges and one towboat to be locked at one time (Shoulberg, 2015). In 2013, approximately twelve million tons of goods are transported via the MKARNS (Oklahoma Department of Transportation (ODOT), 2014). These goods include sand, rock, fertilizer, wheat, raw steel, petroleum products, and petrochemical processing equipment (ODOT, 2014). Another important fact about the MKARNS is that it offers year-round, accessible inland waterway transportation (ODOT, 2014)

to five public ports and approximately fifty private port terminals (Arkansas Oklahoma Port Operators Association (AOPOA), 2010).

The five public ports along the MKARNS attract over ninety industries and employ approximately 6,000 employees (AOPOA, 2004). In the last 25 years, 54,000 direct jobs with $78 million annual payments generated over $1 billion indirect payroll in the MKARNS (AOPOA, 2004).

Water transportation is a cost efficient transportation mode; thus transporting on the MKARNS may generate substantial cost savings for shippers. The MKARNS has accommodated trade between forty-two countries and the Arkansas River Basin Region (AOPOA, 2004). Therefore, the MKARNS is important for both domestic and international trade. Three foreign trade zones are located along MKARNS at the cities of Little Rock, Muskogee, and Catoosa (AOPOA, 2004).

1.2 Research Approach

A multiregional social accounting matrix (MRSAM) model (Robinson et al., 2014) was employed to assess the economic impacts of the MKARNS. The most recent inland waterway commerce data from the U.S. Department of Commerce, U.S. Economic Census, and Waterborne Commerce Statistics Center were utilized (U.S. Department of Commerce, 2015; U.S. Census Bureau, 2015; Waterborne Commerce Statistics Center, 2011). Our research approach consists of four major tasks including:

- *Task 1: Literature review*
  Relevant literature on regional economic impact analysis and inland waterway transportation was identified and reviewed.
- *Task 2: Data collection*
  Recent and historical economic and ancillary benefit data related to the MKARNS were identified, mined, and organized.
- *Task 3: Economic impact analysis*
  Detailed analysis of the regional economic impacts of the MKARNS was conducted using the data collected in Task 2. A MRSAM model was performed on the Arkansas segment of the MKARNS and combined with the analogous Oklahoma results and

data from the Oklahoma Department of Transportation project (Robinson et al., 2014) resulting in a regional economic impact analysis of the entire MKARNS.

- *Task 4: Documentation and dissemination*
  Project results were documented in this technical report and presented at the 2015 American Society of Engineering Management International Annual Conference. A related journal article and public-friendly executive summary are in progress.

2. Background

2.1 Inland Waterways

Maritime transportation functions as the backbone of world trade. Approximately 80% of world trade by volume and approximately 70% by value are transported by sea (UNCTAD, 2014). Seaborne trade reached a total volume of 9.6 billion tons in 2013 accounting for a total of 500 billion ton-miles (UNCTAD, 2014). Economically developed countries' imports accounted for 38% of total imports transported by water, in comparison with 60% for developing countries and 2% for emerging economies. Developing countries accounted for the majority of exports using water transportation with 61% of total volume, and developed countries accounted for 33% (UNCTAD, 2014).

The inland waterway system of the U.S. is comprised of 25,000 miles of navigable rivers and canals. Twelve thousand miles of navigable waterways are used for navigation purposes, facilitated by 237 lock chambers (Center for Ports and Waterways, Texas Transportation Institute, 2007). The inland waterway system connects and moves freight to and from thirty-eight states as shown in Figure 1.

Each year, approximately 624 million tons of cargo is carried throughout the U.S. inland waterways, constituting 14% of all intercity freight. Use of these navigation channels helped to avoid 58 million truck trips which would have doubled the number of trucks on the road (Center for Ports and Waterways, Texas Transportation Institute, 2007). In 2010, the cargo transported on the U.S. inland waterways had a value of $70 billion. The economic output of the total U.S. maritime industry in 2010 is estimated to be over $100 billion. That same year, the U.S maritime industry supported 500,000 jobs and provided more than 33,000 jobs aboard its vessels and barges alone (American Waterways Operators, 2013).

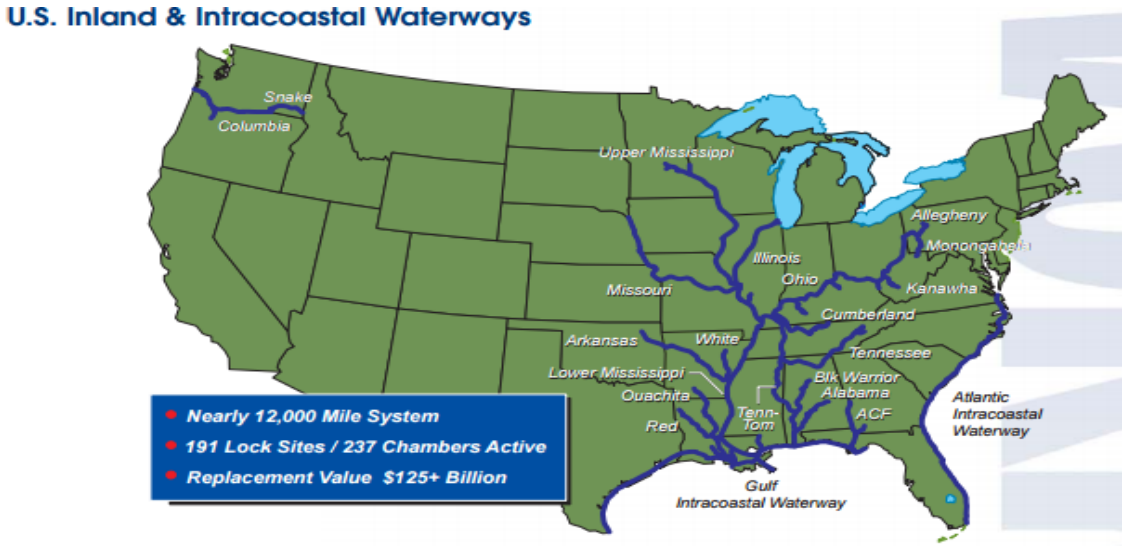

Figure 1: U.S. Inland and Intracoastal Waterways (USACE, 2000)

Waterway transportation is recognized as the least costly mode of transportation but also as the slowest mode and the mode with most limited connections as predetermined by the natural flow of waterways. Additional benefits of water transportation include:

- Using water transportation leads to an annual transportation savings of $7 billion in the United States (USACE, 2009).
- Transportation cost for barges is lower than for rail or trucks. The cost of one ton-mile (moving one ton of freight for a mile) is 0.72 cents with a barge, 2.24 cents with rail, and 26.62 cents with a large semi-truck (Guler, Johnson, & Cooper, 2012).
- Water transportation is more fuel efficient than other modes of transportation and decreases air emissions (USACE, 2009). One gallon of fuel can move one ton of freight 155 miles by truck, 436 miles by rail, and 576 miles by barge (Center for Ports and Waterways, Texas Transportation Institute, 2007).
- The cargo capacity for barges is higher than for rail or trucks. One barge can carry 1,500 tons, which is equivalent to the capacity of 15 railcars or 58 large semi-trucks, as shown in Figure 2.

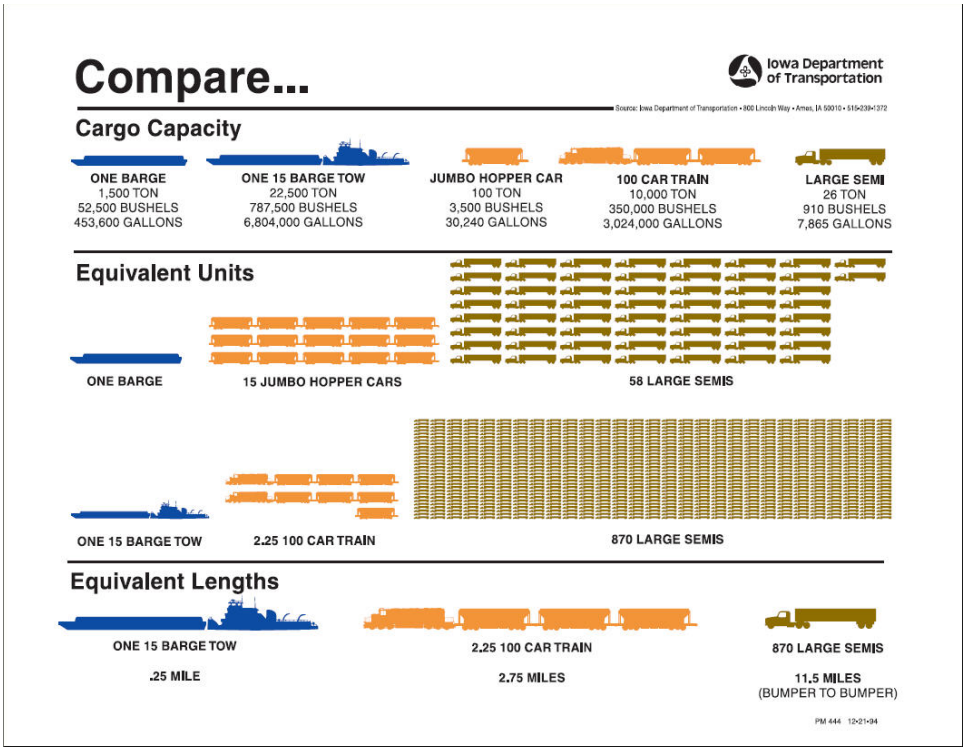

Figure 2: Comparison of Cargo Capacity (Iowa Department of Transportation, 2008)

- Shipping freight via inland waterways causes fewer fatalities than shipping via railroads or trucks. One fatality occurring on inland waterways is equivalent to 22.7 fatalities on railroads and as many as 155 fatalities on truck freight (Center for Ports and Waterways, Texas Transportation Institute, 2007). One injury occurring in inland waterways is equivalent to 125 injuries occurring on railroads and as many as 2,171 injuries occurring on truck freight (Center for Ports and Waterways, Texas Transportation Institute, 2007).

2.2 McClellan-Kerr Arkansas River Navigation System

The MKARNS is a 445 mile navigation system originating from the Tulsa Port of Catoosa. The MKARNS flows in the southeast direction through Arkansas to the Mississippi River as shown in Figure 3. Approximately 308 miles of the navigation system is located in Arkansas, while 137 miles is situated in Oklahoma (King, 2002). The MKARNS has a minimum depth of nine feet, and except for 75 miles of the 445 mile system, a twelve foot channel has been established. The MKARNS width ranges from 150 feet on the Verdigris River, 250 feet on the Arkansas River,

and 300 feet on the Arkansas Post Canal and the White River. The major cities in Arkansas that are located along the MKARNS are Fort Smith, Conway, Russellville, and Little Rock.

Figure 3: McClellan-Kerr Arkansas River Navigation System (USACE, 2015)

There are eighteen locks along the MKARNS with thirteen locks located in Arkansas and five locks located in Oklahoma. The locks are approximately 110 feet wide and 600 feet long. Five locks (Locks 12 and 13 in Arkansas, and Locks 14, 17, and 18 in Oklahoma) on the MKARNS were classified as low use according to 2010 usage (USACE, 2013). The traffic through the waterway varies from lock to lock as shown in Figure 4, which represents the tonnage up bound and down bound in thousand tons for each lock of the eighteen locks (Waterways Council, Inc., 2011a; Waterways Council, Inc., 2011b).

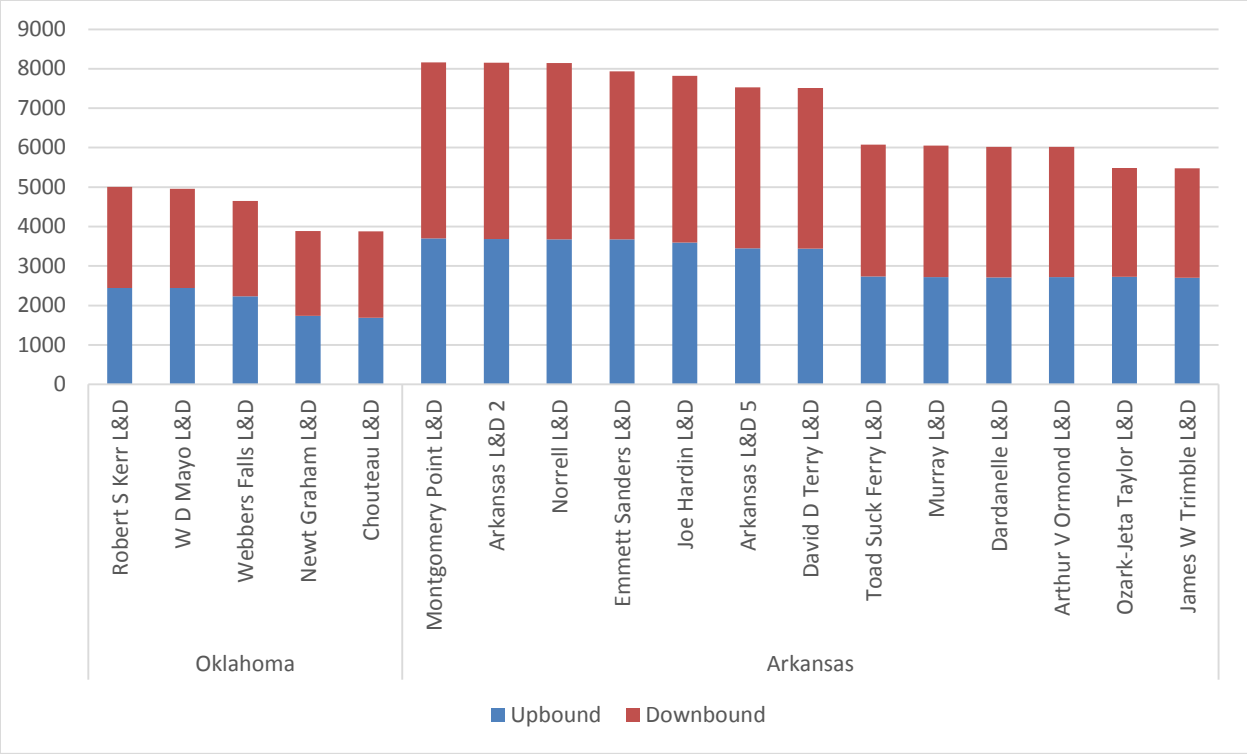

Figure 4: 2011 Flow Tonnages (in thousand tons) through MKARNS Locks

In 2013, the total tonnage throughout the entire MKARNS was approximately 12.1 million tons. On land, 120,781 railcars or 483,121 semi-trucks would be needed to transport an equivalent tonnage (USACE, 2014). In 2013, sand gravel and rock, chemical fertilizers, iron and steel, wheat, and petroleum products had the highest share of tonnage transported on the MKARNS as shown in Figure 5 (USACE, 2014).

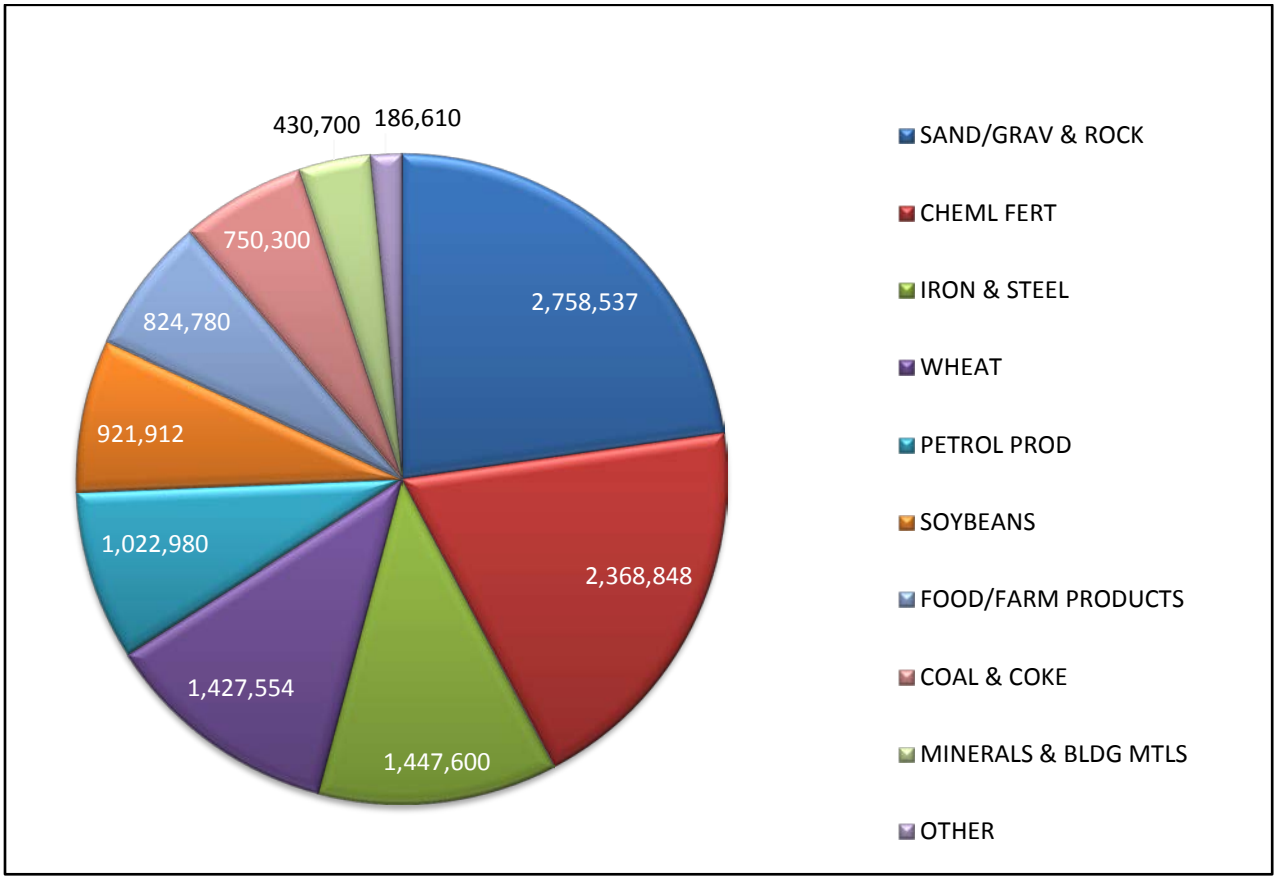

Figure 5: 2013 MKARNS Flow Tonnages by Commodity Type

The MKARNS allows for year round navigation, as shown in Figure 6. The maximum tonnage transported in January, July, and October with more than 1.1 million tons each month. The months of May, August, and December had the lowest traffic in 2013 with less than 900,000 monthly tons (USACE, 2014).

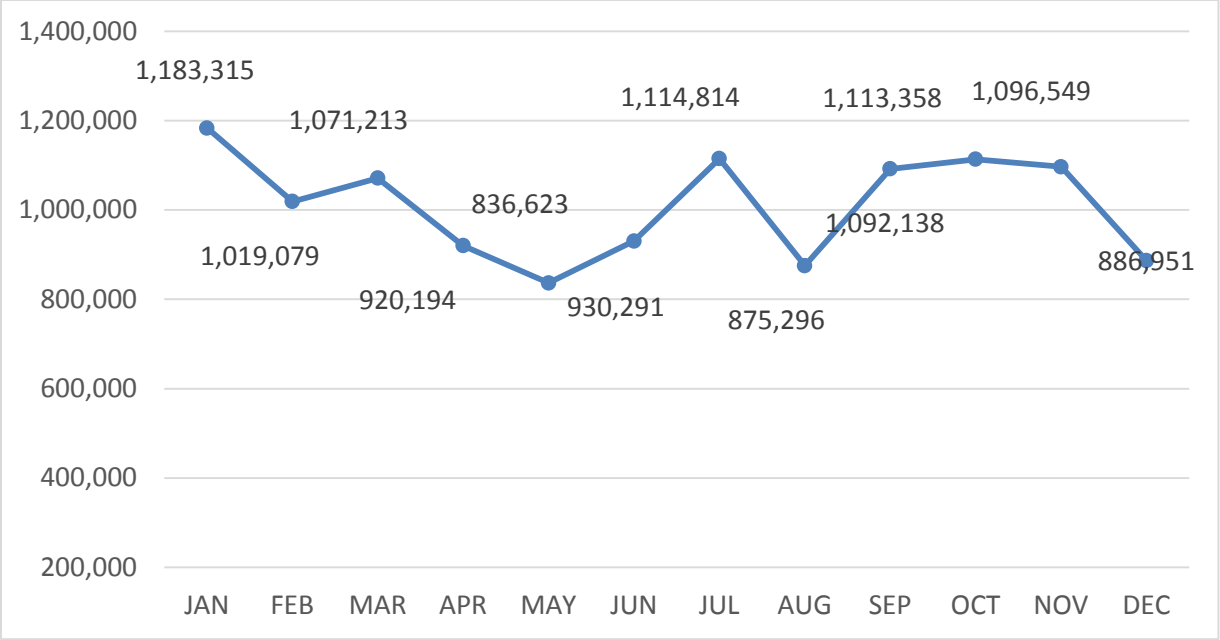

Figure 6: 2013 MKARNS Flow Tonnages by Month

The MKARNS exhibits a 420 foot drop in elevation from the Port of Catoosa to the Mississippi River as shown in Figure 7. This significant elevation change is managing by the eighteen MKARNS locks and dams which work together to maintain the navigation channel.

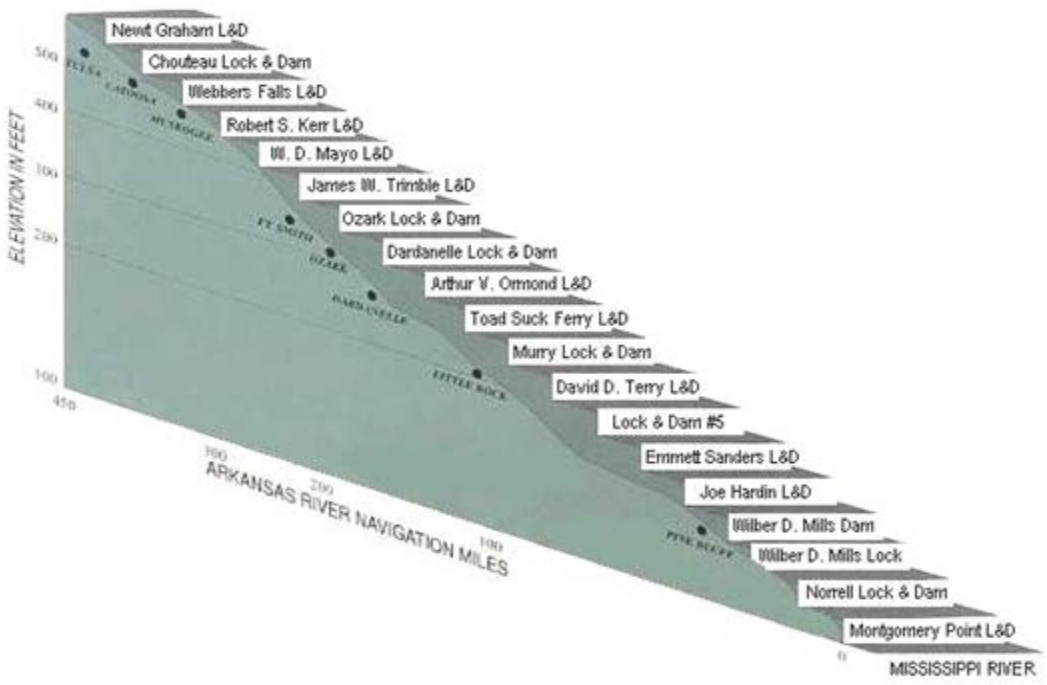

Figure 7: MKARNS Lock Lift (AOPOA, 2005)

Along the MKARNS, there are eight hydropower plants, six located in Arkansas and two located in Oklahoma. An additional six hydropower plants are installed in the reservoirs associated with the MKARNS. In the Arkansas segment of the MKARNS, the USACE originally constructed two hydroelectric facilities as part of the MKARNS. These hydroelectric plants are the Ozark-Jetta Taylor powerhouse and the Dardanelle. Due to increasing energy costs, four additional hydroelectric facilities were constructed at existing locks and dams on the MKARNS post-initial construction. Three of the new facilities were sponsored by the Arkansas Electric Cooperative Corporation (Ellis, Whillock, and Dam 2); while the Murray facility was developed by the city of North Little Rock. In the Oklahoma segment of the MKARNS, two hydropower plants were installed in Robert S. Kerr and Webber Falls reservoirs, which are operated by the USACE (Reynolds, 2013). Four of the plants located in MKARNS reservoirs are also operated by the USACE (Keystone, Fort Gibson, Tenkiller Ferry, and Eufala). The Kaw hydroelectric plant is run by Oklahoma Municipal Power Authority, and the Pensacola Dam is operated by the Grand River Dam Authority. Table 1 represents the installed capacity (in kilowatts) of each MKARNS hydropower facilities.

Table 1: MKARNS Hydropower Facilities (U.S. Army Corps of Engineers, 2005)

MKARNS Facilities	Installed Hydropower Capacity (KWs)
Arkansas L&D 2	108,000
Murray L&D	39,000
Dardanelle L&D	148,000
Arthur V Ormond L&D	32,400
Ozark-Jeta Taylor L&D	100,000
James W Trimble L&D	32,400
Robert S Kerr L&D	110,000
Webbers Falls L&D	60,000
Keystone	70,000
Pensacola Dam	96,000
Fort Gibson	45,000
Tenkiller Ferry	39,100
Eufaula	90,000
Kaw	25,600

The inland waterways provide many recreational opportunities including fishing, boating, and hiking. The USACE is considered the largest federal provider of outdoor recreation. USACE projects attract approximately 370 million visits with approximately 10% of the U.S. population visiting a USACE project at least once a year. These recreational projects generate $18 billion annually and sustain approximately 350,000 jobs. The USACE aims to provide "quality outdoor public recreation experiences to serve the needs of present and future generations and contribute to the quality of American life, while managing and conserving natural resources consistent with ecosystem management principles" (USACE, 2010).

Lakes and parks have an immense role in the tourism-based economy in Arkansas. According to USACE (2011), the Little Rock Corps of Engineers district is ranked in the top five USACE districts based on projects visitation. In 2011, 3,547 recreational vessels locked through the thirteen locks across the Arkansas segment of the MKARNS, while 1,134 recreational vessels locked through the five Oklahoma locks. A total of 5.4 million people, 1.2 million in Oklahoma and 4.2 million in Arkansas, visited USACE-operated projects such as campgrounds, parks, boat ramps, reservoirs, hiking, and picnicking areas (ODOT, 2012).

From Little Rock to the Mississippi River, the Arkansas River has twenty three recreation areas. The Arkansas River is known for outdoor activities such as water sports, fishing and boating.

Many USACE-operated campgrounds charge fees to its users. In general, the locks and dams on the Arkansas River offer access to some of the best fishing locations in the United States. The Arkansas Game and Fish Commission organizes many fishing tournaments such as the Arkansas Big Bass Classic and BASSMASTERS (Arkansas, 2015). The USACE (2013) also states that the "money spent by visitors to USACE lakes on trip expenses adds to the local and national economies by supporting jobs and generating income."

2.3 Economic Impact Studies

Nachtmann (2001) utilized an input-output framework to calculate the direct, indirect, and induced economic impacts of the Arkansas inland waterway navigation including economic value, earnings, and employment. Hamilton et al. (2001) created a computer based kit to analyze the economic significance of inland waterway ports and terminals located in rural areas (Hamilton, 2001). Nachtmann (2007) conducted an economic impact study for the Port of Cincinnati-Tristate indicating $338 million in economic value, $160 million in employee earnings, and 4,055 jobs. Martin Associates (2012) conducted an economic impact study of Indiana ports. Their findings suggest that 51,577 jobs, more than $2.8 billion personal income, more than $6.3 billion total value of economic activity, and more than $271 million state and local taxes were generated by Indiana ports in 2011 (Martin Associates, 2012). In an economic study of the ports of Louisiana, the total economic impacts were found to be approximately 73,000 jobs, $3.9 billion personal earnings, and $289 million and $228 million taxes generated by the state and local governments respectively (Richardson & Heidelberg, 2012). MacKenzie et al. (2011) investigated the economic impact of suddenly closing an inland port due to disruptions through a simulation and multi-regional input-output method that quantified the disruption impacts on the Port of Catoosa. In summary, multiple studies have focused on economic impacts of water transportation and indicate significant impacts on the national economy.

3. Methodology

Our aim is to evaluate the regional economic impacts of the Arkansas segment of the MKARNS and combined these results with the Oklahoma segment of the MKARNS economic impact results found by Robinson et al. (2014) to obtain the regional economic impacts of the entire MKARNS. It is important to note that the total impacts of the entire system is not simply the sum of the Arkansas segment impacts and Oklahoma segment impacts due to overlap in

commodities that flow between the two segments. We define six separate impact study regions including Arkansas, Oklahoma, Kansas, Missouri, Texas, and the rest of the United States. To conduct a comparable regional economic impact analysis as Robinson et al. (2014), we utilize a multiregional social accounting matrix model (MRSAM) (Pyatt & Round, 1985) which is based on a multiregional variable input-output framework. This accounting framework explains the interdependencies between different industries in a study region and is designed to improve the traditional input-output model by considering income distributions, production and resource endowments, and economic and demographic flow between study regions. This framework captures all transactions between industries, institutional sectors, and economic agents (Pyatt and Round, 1985).

The foundation of the MRSAM model is based on balancing inputs and outputs of all industries as shown in Equation 1 (Miller and Blair, 2009).

- r = number of regions
- n = number of industrial sectors
- X = $rn*1$ production vector
- T = $rn*rn$ matrix of multiregional trading patterns
- A = $rn*rn$ MRSAM technical coefficients
- Y = $rn*1$ final demand purchases vector

$$X = TAX + Y \tag{1}$$

When we solve Equation 1 for industry output change (ΔX) in terms of final demand change (ΔY), we obtain Equation 2.

$$\Delta X = (I - TA)^{-1}\Delta Y \tag{2}$$

- $(I - TA)^{-1}$ = Leontief multiregional inverse matrix

The Leontief multiregional inverse matrix enables measurement of the total economic impact which consists of direct, indirect, and induced impacts.

The MRSAM model we implemented (Robinson et al., 2014) assumes that: (1) a single output is produced for each industry in each study region, (2) regardless of cost and price changes, the regional IO coefficients stay constant, (3) input costs or output prices do not impact the input mixes or employment, income, and trade structures, and (4) trade coefficients remain the same regardless of the cost and price changes. The structure of multiregional multipliers is presented in Table 2, where the columns indicate the impacting regions, and the rows illustrate the impacted regions.

Table 2: Structure of Multiregional Multipliers

Impacted Regions	Region A	Region B	Region C
Region A	Region A's Economic Impact on Region A	Region B's Economic Impact on Region A	Region C's Economic Impact on Region A
Region B	Region A's Economic Impact on Region B	Region B's Economic Impact on Region B	Region C's Economic Impact on Region B
Region C	Region A's Economic Impact on Region C	Region B's Economic Impact on Region C	Region C's Economic Impact on Region C
Region A	Region A's Impact on Region A's Employee Compensation	Region B's Impact on Region A's Employee Compensation	Region C's Impact on Region A's Employee Compensation
Region B	Region A's Impact on Region B's Proprietors' Income	Region B's Impact on Region B's Proprietors' Income	Region C's Impact on Region B's Proprietors' Income
Region C	Region A's Impact on Region C's Household Income	Region B's Impact on Region C's Household Income	Region C's Impact on Region C's Household Income

4. Economic Impact Results

Our study initially focused on the Arkansas segment of the MKARNS and expanded to a combined look at the regional economic impacts of the entire MKARNS by combining our Arkansas impact findings with the Oklahoma impact findings (Robinson et al., 2014). The regional economic impacts of the MKARNS are obtained by combining the individual impacts of seven major activities of the system:

1. Hydropower Energy Generation (Section 4.1)
2. USACE O&M Expenditures (Section 4.2)
3. Private Sector Investment Expenditures (Section 4.3)
4. Port Activities (Section 4.4)

5. Shippers' Activities (Section 4.5)
6. Transportation Cost Savings (Section 4.6)
7. Recreation Benefits (Section 4.7)

4.1 Economic Impacts from Hydropower Energy Generation

To measure the economic impacts from hydropower energy generation, we first identified the MKARNS hydropower facilities (Southwestern Power Administration, 2012). These facilities are Dam 2, Murray, Whillock, Ellis, Dardanelle, and Ozark in Arkansas and Robert S. Kerr and Webber Falls in Oklahoma. Next, we obtain the estimated annual energy production and installed capacity values by the hydroelectric power facilities in the study region (Southwestern Power Administration, 2012). To measure economic impacts, the following alternative energy generation sources were considered: conventional combined cycle, advanced combined cycle, advanced CC with CCS, conventional combustion turbine, and advanced combustion turbine (Robinson et al., 2014). Since the other sources had significantly higher costs, we selected the advanced combined cycle power plant as our alternative energy source in this study (Robinson et al., 2014).

4.1.1 MKARNS Hydropower Energy Generation Impacts

To measure the economic impacts associated with hydropower energy generation, we considered the capital, fixed O&M, and variable O&M costs between the investment alternatives (U.S. Energy Information Administration, 2013). Based on the efficiencies of alternative energy generation facilities, we calculated the plant size needed to replace the established hydropower energy generation facilities. Next, we annualized the capital, fixed O&M, and variable operations and maintenance costs for the energy generation decision alternatives and adjusted these values for the study year based on the time value of money (Marriott, 2007). Consumer price index is used for this adjustment. Finally, the calculated direct economic impacts associated with hydropower and advanced combined cycle energy generation alternatives are multiplied by the MKARNS MRSAM multipliers to calculate total (direct, indirect, and induced) economic impacts.

To measure the net MKARNS hydropower energy generation impacts (as shown in Table 6), the MKARNS advanced combined cycle O&M expenditure impacts (as shown in Table 5) are

subtracted from the summation of the MKARNS hydropower operating O&M expenditure impacts (as shown in Table 3) and the MKARNS advanced combined cycle foregone income impacts (as shown in Table 4).

Table 3: MKARNS Hydropower O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 1.7 M	14	$ 0.5 M	$ 0.1 M	$ 0.3 M	$ 0.1 M	$ 0.9 M	$ 0.5 M
Power Plant	$ 5.4 M	7	$ 0.6 M	$ 0.0 M	$ 1.4 M	$ 0.6 M	$ 2.6 M	$ 0.7 M
Oklahoma	$ 0.9 M	7	$ 0.2 M	$ 0.0 M	$ 0.2 M	$ 0.0 M	$ 0.5 M	$ 0.3 M
Power Plant	$ 2.4 M	3	$ 0.3 M	$ 0.0 M	$ 0.5 M	$ 0.2 M	$ 1.1 M	$ 0.3 M
Kansas	$ 0.1 M	0	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M
Missouri	$ 0.3 M	2	$ 0.1 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.1 M	$ 0.1 M
Texas	$ 0.7 M	4	$ 0.2 M	$ 0.0 M	$ 0.2 M	$ 0.0 M	$ 0.4 M	$ 0.2 M
Rest of US	$ 2.6 M	14	$ 0.7 M	$ 0.1 M	$ 0.5 M	$ 0.1 M	$ 1.4 M	$ 0.8 M
US Total	$ 14.0 M	51	$ 2.6 M	$ 0.4 M	$ 3.1 M	$ 1.1 M	$ 7.1 M	$ 2.9 M

Table 4: MKARNS Advanced Combined Cycle Foregone Income Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 130.0 M	980	$ 34.7 M	$ 5.4 M	$ 23.8 M	$ 6.7 M	$ 70.7 M	$ 40.2 M
Oklahoma	$ 71.4 M	469	$ 17.6 M	$ 3.5 M	$ 13.8 M	$ 3.3 M	$ 38.1 M	$ 21.0 M
Kansas	$ 5.4 M	34	$ 1.3 M	$ 0.2 M	$ 0.9 M	$ 0.2 M	$ 2.6 M	$ 1.6 M
Missouri	$ 30.6 M	177	$ 8.0 M	$ 1.4 M	$ 6.3 M	$ 1.1 M	$ 16.8 M	$ 9.4 M
Texas	$ 55.2 M	303	$ 13.2 M	$ 2.9 M	$ 11.1 M	$ 2.5 M	$ 29.6 M	$ 16.0 M
Rest of US	$ 180.0 M	1,018	$ 48.7 M	$ 8.6 M	$ 33.1 M	$ 7.1 M	$ 97.5 M	$ 57.3 M
US Total	$ 472.5 M	2,979	$ 123.5 M	$ 22.0 M	$ 89.0 M	$ 21.0 M	$ 255.3 M	$ 145.4 M

Table 5: MKARNS Advanced Combined Cycle O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 1.2 M	10	$ 0.3 M	$ 0.1 M	$ 0.2 M	$ 0.1 M	$ 0.7 M	$ 0.4 M
Power Plant	$ 4.9 M	7	$ 0.6 M	$ 0.0 M	$ 1.2 M	$ 0.5 M	$ 2.4 M	$ 0.7 M
Oklahoma	$ 0.8 M	5	$ 0.2 M	$ 0.0 M	$ 0.2 M	$ 0.0 M	$ 0.4 M	$ 0.2 M
Power Plant	$ 2.1 M	3	$ 0.3 M	$ 0.0 M	$ 0.5 M	$ 0.2 M	$ 1.0 M	$ 0.3 M
Kansas	$ 0.1 M	0	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M
Missouri	$ 0.2 M	1	$ 0.1 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.1 M	$ 0.1 M
Texas	$ 1.3 M	6	$ 0.3 M	$ 0.1 M	$ 0.3 M	$ 0.1 M	$ 0.7 M	$ 0.3 M
Rest of US	$ 2.2 M	12	$ 0.6 M	$ 0.1 M	$ 0.4 M	$ 0.1 M	$ 1.2 M	$ 0.7 M
US Total	$ 12.7 M	44	$ 2.4 M	$ 0.3 M	$ 2.8 M	$ 1.0 M	$ 6.5 M	$ 2.7 M

Table 6: MKARNS Net Hydropower Energy Generation Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 130.9 M	984	$ 34.9 M	$ 5.5 M	$ 24.0 M	$ 6.8 M	$ 71.1 M	$ 40.3 M
Oklahoma	$ 71.8 M	470	$ 17.6 M	$ 3.5 M	$ 13.9 M	$ 3.3 M	$ 38.3 M	$ 21.1 M
Kansas	$ 5.4 M	34	$ 1.3 M	$ 0.2 M	$ 0.9 M	$ 0.2 M	$ 2.6 M	$ 1.6 M
Missouri	$ 30.7 M	177	$ 8.0 M	$ 1.4 M	$ 6.3 M	$ 1.2 M	$ 16.8 M	$ 9.4 M
Texas	$ 54.6 M	301	$ 13.0 M	$ 2.8 M	$ 10.9 M	$ 2.5 M	$ 29.3 M	$ 15.9 M
Rest of US	$ 180.3 M	1,020	$ 48.8 M	$ 8.6 M	$ 33.3 M	$ 7.1 M	$ 97.7 M	$ 57.4 M
US Total	$ 473.7 M	2,986	$ 123.7 M	$ 22.0 M	$ 89.2 M	$ 21.0 M	$ 255.9 M	$ 145.7 M

If the MKARNS is no longer operable, we will need to replace existing hydropower plants with alternative natural gas plant(s). The impact to the nation will be as follows:

- Sales will decrease by $474 million
- 2,986 full time and part time jobs will be lost
- Business taxes will decrease by $21 million
- National GDP will decrease by $256 million.

The impacts on Arkansas alone are:

- Sales will decrease by $131 million
- 984 full time and part time jobs will be lost
- Business taxes will decrease by $7 million
- Arkansas GDP will decrease by $71 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $72 million
- 470 full time and part time jobs will be lost
- Business taxes will decrease by $3 million
- Oklahoma GDP will decrease by $38 million.

4.1.2 MKARNS Arkansas Segment Hydropower Impacts

In this section, we conducted a similar analysis to measure the economic impacts of hydropower energy generation facilities from the Arkansas segment of the MKARNS (Table 10). The results are illustrated in Tables 7-10.

Table 7: MKARNS Arkansas Segment Hydropower Operating O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 1.7 M	13	$ 0.5 M	$ 0.1 M	$ 0.3 M	$ 0.1 M	$ 0.9 M	$ 0.5 M
Power Plant	$ 5.4 M	7	$ 0.6 M	$ 0.0 M	$ 1.4 M	$ 0.6 M	$ 2.9 M	$ 0.7 M
Oklahoma	$ 0.1 M	1	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.1 M	$ 0.0 M
Kansas	$ 0.0 M	0	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M
Missouri	$ 0.2 M	1	$ 0.1 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.1 M	$ 0.1 M
Texas	$ 0.4 M	2	$ 0.1 M	$ 0.0 M	$ 0.1 M	$ 0.0 M	$ 0.2 M	$ 0.1 M
Rest of US	$ 1.9 M	11	$ 0.5 M	$ 0.1 M	$ 0.4 M	$ 0.1 M	$ 1.1 M	$ 0.6 M
US Total	$ 9.7 M	36	$ 1.8 M	$ 0.2 M	$ 2.2 M	$ 0.8 M	$ 5.3 M	$ 2.0 M

Table 8: MKARNS Arkansas Segment Advanced Combined Cycle Foregone Income Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 128.0 M	969	$ 34.3 M	$ 5.4 M	$ 23.6 M	$ 6.7 M	$ 69.9 M	$ 39.6 M
Oklahoma	$ 8.2 M	49	$ 1.9 M	$ 0.4 M	$ 1.5 M	$ 0.4 M	$ 4.1 M	$ 2.3 M
Kansas	$ 2.5 M	15	$ 0.6 M	$ 0.1 M	$ 0.4 M	$ 0.1 M	$ 1.2 M	$ 0.7 M
Missouri	$ 26.8 M	153	$ 7.0 M	$ 1.2 M	$ 5.7 M	$ 1.0 M	$ 14.9 M	$ 8.2 M
Texas	$ 33.7 M	188	$ 8.0 M	$ 1.8 M	$ 6.5 M	$ 1.6 M	$ 17.9 M	$ 9.8 M
Rest of US	$ 135.0 M	768	$ 36.6 M	$ 6.5 M	$ 25.0 M	$ 5.4 M	$ 73.4 M	$ 43.0 M
US Total	$ 334.1 M	2,141	$ 88.4 M	$ 15.3 M	$ 62.6 M	$ 15.1 M	$ 181.3 M	$ 103.7 M

Table 9: MKARNS Arkansas Segment Advanced Combined Cycle O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 1.2 M	9	$ 0.3 M	$ 0.0 M	$ 0.2 M	$ 0.1 M	$ 0.6 M	$ 0.4 M
Power Plant	$ 4.9 M	7	$ 0.6 M	$ 0.0 M	$ 1.2 M	$ 0.5 M	$ 2.4 M	$ 0.7 M
Oklahoma	$ 0.1 M	1	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.1 M	$ 0.0 M
Kansas	$ 0.0 M	0	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M
Missouri	$ 0.2 M	1	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.1 M	$ 0.0 M
Texas	$ 0.9 M	4	$ 0.2 M	$ 0.0 M	$ 0.2 M	$ 0.1 M	$ 0.5 M	$ 0.2 M
Rest of US	$ 1.7 M	9	$ 0.4 M	$ 0.1 M	$ 0.3 M	$ 0.1 M	$ 0.9 M	$ 0.5 M
US Total	$ 9.0 M	32	$ 1.7 M	$ 0.2 M	$ 2.0 M	$ 0.7 M	$ 4.6 M	$ 1.9 M

Table 10: MKARNS Arkansas Segment Net Hydropower Energy Generation Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 128.9 M	973	$ 34.4 M	$ 5.4 M	$ 23.8 M	$ 6.7 M	$ 70.6 M	$ 39.8 M
Oklahoma	$ 8.2 M	49	$ 1.9 M	$ 0.4 M	$ 1.5 M	$ 0.4 M	$ 4.1 M	$ 2.3 M
Kansas	$ 2.5 M	15	$ 0.6 M	$ 0.1 M	$ 0.4 M	$ 0.1 M	$ 1.2 M	$ 0.7 M
Missouri	$ 26.8 M	153	$ 7.0 M	$ 1.2 M	$ 5.7 M	$ 1.0 M	$ 14.9 M	$ 8.2 M
Texas	$ 33.2 M	186	$ 8.0 M	$ 1.7 M	$ 6.4 M	$ 1.6 M	$ 17.6 M	$ 9.7 M
Rest of US	$ 135.2 M	769	$ 36.6 M	$ 6.5 M	$ 25.1 M	$ 5.4 M	$ 73.5 M	$ 43.1 M
US Total	$ 334.9 M	2,146	$ 88.5 M	$ 15.3 M	$ 62.7 M	$ 15.1 M	$ 181.9 M	$ 103.8 M

If the MKARNS is no longer operable in Arkansas, we will need to replace existing hydropower plants with alternative natural gas plant(s). The impact to the nation will be as follows:

- Sales will decrease by $335 million
- 2,146 full time and part time jobs will be lost
- Business taxes will decrease by $15 million
- National GDP will decrease by $182 million.

The impacts on Arkansas alone are:

- Sales will decrease by $129 million
- 973 full time and part time jobs will be lost
- Business taxes will decrease by $7 million
- Arkansas GDP will decrease by $71 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $8 million
- 49 full time and part time jobs will be lost
- Business taxes will decrease by $400 thousand
- Oklahoma GDP will decrease by $4 million.

4.1.3 MKARNS Oklahoma Segment Hydropower Impacts

In this section, we conducted a similar analysis to measure the economic impacts of hydropower energy generation facilities in the MKARNS Oklahoma segment. The results are illustrated in Tables 11-14.

Table 11: MKARNS Oklahoma Segment Hydropower Operating O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$0.0 M	0	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M
Oklahoma	$0.8 M	6	$0.2 M	$0.0 M	$0.2 M	$0.0 M	$0.5 M	$0.3 M
Power Plant	$2.4 M	2	$0.3 M	$0.0 M	$0.5 M	$0.2 M	$1.1 M	$0.3 M
Kansas	$0.0 M	0	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M
Missouri	$0.1 M	0	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M
Texas	$0.3 M	2	$0.1 M	$0.0 M	$0.1 M	$0.0 M	$0.2 M	$0.1 M
Rest of US	$0.6 M	4	$0.2 M	$0.0 M	$0.1 M	$0.0 M	$0.3 M	$0.2 M
Total US	$4.2 M	14	$0.8 M	$0.1 M	$0.9 M	$0.3 M	$2.1 M	$0.9 M

Table 12: MKARNS Oklahoma Segment Advanced Combined Cycle Foregone Income Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$1.8 M	12	$0.4 M	$0.1 M	$0.2 M	$0.1 M	$0.8 M	$0.5 M
Oklahoma	$64.5 M	482	$16.9 M	$3.0 M	$13.1 M	$3.4 M	$36.6 M	$20.0 M
Kansas	$2.8 M	19	$0.7 M	$0.1 M	$0.4 M	$0.1 M	$1.3 M	$0.8 M
Missouri	$4.3 M	27	$1.2 M	$0.2 M	$0.7 M	$0.2 M	$2.2 M	$1.3 M
Texas	$20.2 M	114	$4.8 M	$1.1 M	$4.1 M	$0.9 M	$11.0 M	$5.9 M
Rest of US	$40.8 M	231	$10.9 M	$2.1 M	$6.9 M	$1.6 M	$21.5 M	$13.0 M
US Total	$134.3 M	885	$34.9 M	$6.6 M	$25.5 M	$6.3 M	$73.3 M	$41.5 M

Table 13: MKARNS Oklahoma Segment Advanced Combined Cycle O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$0.0 M	0	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M
Oklahoma	$0.7 M	5	$0.2 M	$0.0 M	$0.1 M	$0.0 M	$0.4 M	$0.2 M
Power Plant	$2.1 M	2	$0.3 M	$0.0 M	$0.5 M	$0.2 M	$1.0 M	$0.3 M
Kansas	$0.0 M	0	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M
Missouri	$0.0 M	0	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M	$0.0 M
Texas	$0.4 M	2	$0.1 M	$0.0 M	$0.1 M	$0.0 M	$0.2 M	$0.1 M
Rest of US	$0.5 M	3	$0.1 M	$0.0 M	$0.1 M	$0.0 M	$0.3 M	$0.2 M
Total US	$3.8 M	12	$0.7 M	$0.1 M	$0.8 M	$0.3 M	$1.9 M	$0.8 M

Table 14: MKARNS Oklahoma Segment Net Hydropower Energy Generation Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$1.8 M	12	$0.4 M	$0.1 M	$0.2 M	$0.1 M	$0.8 M	$0.5 M
Oklahoma	$65.0 M	484	$17.0 M	$3.1 M	$13.2 M	$3.5 M	$36.8 M	$20.3 M
Kansas	$2.8 M	19	$0.7 M	$0.1 M	$0.4 M	$0.1 M	$1.3 M	$0.8 M
Missouri	$4.3 M	28	$1.2 M	$0.2 M	$0.7 M	$0.2 M	$2.2 M	$1.3 M
Texas	$20.0 M	113	$4.7 M	$1.1 M	$4.1 M	$0.9 M	$10.9 M	$5.9 M
Rest of US	$40.9 M	232	$10.9 M	$2.2 M	$6.9 M	$1.6 M	$21.6 M	$13.1 M
US Total	$134.8 M	887	$35.0 M	$6.7 M	$25.5 M	$6.3 M	$73.6 M	$42.0 M

If the MKARNS is no longer operable in Oklahoma, we will need to replace existing hydropower plants with alternative natural gas plant(s). The impact to the nation will be as follows:

- Sales will decrease by $135 million
- 887 full time and part time jobs will be lost
- Business taxes will decrease by $6 million

- National GDP will decrease by $74 million.

The impacts on Arkansas alone are:

- Sales will decrease by $2 million
- 12 full time and part time jobs will be lost
- Business taxes will decrease by $100 thousand
- Arkansas GDP will decrease by $800 thousand.

The impacts on Oklahoma alone are:

- Sales will decrease by $65 million
- 484 full time and part time jobs will be lost
- Business taxes will decrease by $4 million
- Oklahoma GDP will decrease by $37 million.

4.2 Economic Impacts from USACE O&M Expenditures

To measure the direct impacts of USACE O&M, we calculated the MKARNS Arkansas segment USACE O&M expenditures as $18 million by subtracting the MKARNS Oklahoma expenditures of $10.4 million (Robinson et al., 2014) from the $28.4 million of total MKARNS expenditures (USACE, 2012). Tulsa USACE District expenditures (Robinson et al., 2014) are utilized to calculate the breakdown of the MKARNS expenditures and the MKARNS Arkansas segment expenditures. The calculated direct impacts are multiplied with the MRSAM multipliers, and the total economic impacts associated with USACE O&M expenditures.

4.2.1 MKARNS USACE O&M Expenditure Impacts

In this section, we present the economic impact results from USACE O&M expenditures for the entire MKARNS (as shown in Table 15).

Table 15: MKARNS USACE O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$27.6 M	243	$8.9 M	$1.9 M	$3.6 M	$1.2 M	$15.6 M	$10.8 M
Oklahoma	$18.4 M	143	$5.7 M	$1.1 M	$2.7 M	$0.8 M	$10.3 M	$6.8 M
Kansas	$1.1 M	6	$0.3 M	$0.0 M	$0.1 M	$0.0 M	$0.5 M	$0.3 M
Missouri	$3.5 M	22	$0.9 M	$0.2 M	$0.6 M	$0.1 M	$1.8 M	$1.1 M
Texas	$12.6 M	74	$3.2 M	$0.8 M	$2.3 M	$0.6 M	$6.8 M	$4.0 M
Rest of US	$30.4 M	175	$8.2 M	$1.5 M	$5.3 M	$1.2 M	$16.2 M	$9.7 M
US Total	$93.6 M	663	$27.2 M	$5.6 M	$14.6 M	$3.9 M	$51.3 M	$32.7 M

The loss of MKARNS USACE O&M expenditures will have the following impacts nationwide:

- Sales will decrease by $94 million
- 663 full time and part time jobs will be lost
- Business taxes will decrease by $4 million
- National GDP will decrease by $51 million.

The impacts on Arkansas alone are:

- Sales will decrease by $28 million
- 243 full time and part time jobs will be lost
- Business taxes will decrease by $1 million
- Arkansas GDP will decrease by $16 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $18 million
- 143 full time and part time jobs will be lost
- Business taxes will decrease by $800 thousand
- Oklahoma GDP will decrease by $10 million.

4.2.2 MKARNS Arkansas Segment USACE O&M Expenditure Impacts

We also conducted an economic impact analysis to measure the economic impacts of the MKARNS USACE O&M expenditures in Arkansas alone (as shown in Table 16).

Table 16: MKARNS Arkansas Segment USACE O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$27.0 M	240	$8.8 M	$1.9 M	$3.5 M	$1.2 M	$15.4 M	$10.7 M
Oklahoma	$1.8 M	12	$0.4 M	$0.1 M	$0.3 M	$0.1 M	$0.9 M	$0.5 M
Kansas	$0.5 M	3	$0.1 M	$0.0 M	$0.1 M	$0.0 M	$0.2 M	$0.1 M
Missouri	$2.7 M	17	$0.7 M	$0.1 M	$0.4 M	$0.1 M	$1.4 M	$0.8 M
Texas	$6.6 M	40	$1.7 M	$0.4 M	$1.2 M	$0.3 M	$3.6 M	$2.1 M
Rest of US	$21.2 M	123	$5.8 M	$1.1 M	$3.7 M	$0.8 M	$11.4 M	$6.8 M
Total US	$59.9 M	434	$17.5 M	$3.6 M	$9.2 M	$2.6 M	$32.9 M	$21.1 M

The loss of MKARNS USACE O&M expenditures in Arkansas alone will have the following impacts nationwide:

- Sales will decrease by $60 million
- 434 full time and part time jobs will be lost
- Business taxes will decrease by $3 million
- National GDP will decrease by $33 million.

The impacts on Arkansas alone are:

- Sales will decrease by $27 million
- 240 full time and part time jobs will be lost
- Business taxes will decrease by $1 million
- Arkansas GDP will decrease by $15 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $2 million
- 12 full time and part time jobs will be lost
- Business taxes will decrease by $100 thousand
- Oklahoma GDP will decrease by $900 thousand.

4.2.3 MKARNS Oklahoma Segment USACE O&M Expenditure Impacts

Here we present the economic impact results from MKARNS USACE O&M expenditures in Oklahoma alone (as shown in Table 17).

Table 17: MKARNS Oklahoma Segment USACE O&M Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor income
Arkansas	$0.6 M	4	$0.1 M	$0.0 M	$0.1 M	$0.0 M	$0.3 M	$0.2 M
Oklahoma	$16.6 M	131	$5.2 M	$1.0 M	$2.4 M	$0.7 M	$9.4 M	$6.3 M
Kansas	$0.6 M	4	$0.1 M	$0.0 M	$0.1 M	$0.0 M	$0.3 M	$0.2 M
Missouri	$0.8 M	5	$0.2 M	$0.0 M	$0.1 M	$0.0 M	$0.4 M	$0.3 M
Texas	$5.9 M	34	$1.5 M	$0.4 M	$1.1 M	$0.3 M	$3.2 M	$1.9 M
Rest of US	$9.2 M	51	$2.5 M	$0.4 M	$1.6 M	$0.3 M	$4.8 M	$2.9 M
Total US	$33.7 M	229	$9.7 M	$2.0 M	$5.3 M	$1.4 M	$18.3 M	$11.6 M

The loss of MKARNS USACE O&M expenditures in Oklahoma alone will have the following impacts nationwide:

- Sales will decrease by $34 million
- 229 full time and part time jobs will be lost
- Business taxes will decrease by $1 million
- National GDP will decrease by $18 million.

The impacts on Arkansas alone are:

- Sales will decrease by $600 thousand
- 4 full time and part time jobs will be lost
- No impact on business taxes
- Arkansas GDP will decrease by $300 thousand.

The impacts on Oklahoma alone are:

- Sales will decrease by $17 million
- 131 full time and part time jobs will be lost
- Business taxes will decrease by $700 thousand
- Oklahoma GDP will decrease by $9 million.

4.3 Private Sector Investment Expenditures Economic Impacts

We obtain total private capital expenditure data for the MKARNS in Arkansas (Executive Director of Arkansas Waterways Commission, 2015) and the MKARNS in Oklahoma (Robinson et al., 2014). The total MKARNS private sector capital expenditure is $8 million since 1971 with $3 million in Arkansas and $5 million in Oklahoma. We annualized these investments by utilizing a 3.375% discount rate (Robinson et al., 2014) and assumed that the annual investment contribution will continue yearly in the future. Next, we utilized the water transportation capital

expenditures by commodity to calculate the breakdown of these investments by commodity (Robinson et al., 2014). We multiplied the total private sector investment values with the water transportation capital expenditures by commodity values to calculate the direct impacts. Finally, we multiplied these direct impact values with the MRSAM multipliers to obtain the total economic impacts.

4.3.1 MKARNS Private Sector Investment Expenditure Impacts

In this section, we present economic impact results of private sector investment expenditures in the entire MKARNS (as shown in Table 18).

Table 18: MKARNS Private Sector Investment Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$100.3 M	884	$29.3 M	$5.0 M	$13.5 M	$6.9 M	$54.8 M	$34.4 M
Oklahoma	$117.9 M	762	$30.7 M	$4.7 M	$13.4 M	$4.5 M	$53.3 M	$35.4 M
Kansas	$54.5 M	200	$11.3 M	$1.0 M	$3.6 M	$1.0 M	$16.9 M	$12.3 M
Missouri	$44.2 M	224	$11.0 M	$1.6 M	$5.4 M	$1.4 M	$19.4 M	$12.6 M
Texas	$122.5 M	586	$29.8 M	$5.4 M	$18.2 M	$4.7 M	$58.1 M	$35.2 M
Rest of US	$590.3 M	2,868	$155.3 M	$22.2 M	$87.0 M	$19.8 M	$284.2 M	$177.5 M
US Total	$1,029.7 M	5,524	$267.5 M	$39.9 M	$141.2 M	$38.1 M	$486.7 M	$307.4 M

The loss of MKARNS private sector investment expenditures will have the following impacts nationwide:

- Sales will decrease by $1,029 million
- 5,524 full time and part time jobs will be lost
- Business taxes will decrease by $38 million
- National GDP will decrease by $487 million.

The impacts on Arkansas alone are:

- Sales will decrease by $100 million
- 884 full time and part time jobs will be lost
- Business taxes will decrease by $7 million
- Arkansas GDP will decrease by $55 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $118 million

- 762 full time and part time jobs will be lost
- Business taxes will decrease by $5 million
- Oklahoma GDP will decrease by $53 million.

4.3.2 MKARNS Arkansas Segment Private Sector Investment Expenditure Impacts

We conducted an economic impact analysis to measure the economic impacts of the MKARNS private sector investment expenditures in Arkansas alone. The results are presented in Table 19.

Table 19: MKARNS Arkansas Segment Private Sector Investment Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$91.1 M	837	$27.3 M	$4.8 M	$12.5 M	$6.6 M	$51.2 M	$32.1 M
Oklahoma	$6.9 M	43	$1.7 M	$0.3 M	$1.0 M	$0.3 M	$3.3 M	$2.0 M
Kansas	$36.5 M	117	$7.3 M	$0.5 M	$1.8 M	$0.5 M	$10.1 M	$7.7 M
Missouri	$16.5 M	102	$4.5 M	$0.8 M	$2.5 M	$0.7 M	$8.4 M	$5.2 M
Texas	$34.5 M	185	$8.6 M	$1.7 M	$5.5 M	$1.5 M	$17.3 M	$10.2 M
Rest of US	$210.5 M	1,109	$57.4 M	$8.4 M	$32.4 M	$7.6 M	$105.8 M	$65.8 M
US Total	$395.9 M	2,394	$106.6 M	$16.5 M	$55.8 M	$17.3 M	$196.2 M	$123.1 M

The loss of MKARNS segment private sector investment expenditures in Arkansas alone will have the following impacts nationwide:

- Sales will decrease by $396 million
- 2,394 full time and part time jobs will be lost
- Business taxes will decrease by $17 million
- National GDP will decrease by $196 million.

The impacts on Arkansas alone are:

- Sales will decrease by $91 million
- 837 full time and part time jobs will be lost
- Business taxes will decrease by $7 million
- Arkansas GDP will decrease by $51 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $7 million
- 43 full time and part time jobs will be lost
- Business taxes will decrease by $300 thousand

- Oklahoma GDP will decrease by $3 million.

4.3.3 MKARNS Oklahoma Segment Private Sector Investment Expenditure Impacts

The economic impacts of the MKARNS private sector investment expenditures in Oklahoma alone are presented in Table 20.

Table 20: MKARNS Oklahoma Segment Private Sector Investment Expenditure Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$9.6 M	49	$2.2 M	$0.3 M	$1.1 M	$0.2 M	$3.7 M	$2.4 M
Oklahoma	$129.2 M	818	$33.6 M	$4.4 M	$18.9 M	$4.8 M	$61.6 M	$37.9 M
Kansas	$17.4 M	80	$3.9 M	$0.5 M	$1.8 M	$0.4 M	$6.6 M	$4.4 M
Missouri	$25.4 M	112	$6.0 M	$0.8 M	$2.6 M	$0.6 M	$10.0 M	$6.8 M
Texas	$91.0 M	416	$21.8 M	$3.7 M	$13.8 M	$3.3 M	$42.6 M	$25.5 M
Rest of US	$356.7 M	1,630	$91.1 M	$13.7 M	$50.7 M	$11.3 M	$166.9 M	$104.9 M
US Total	$629.5 M	3,105	$158.5 M	$23.4 M	$88.9 M	$20.7 M	$291.5 M	$181.9 M

The loss of MKARNS segment private sector investment expenditures in Oklahoma alone will have the following impacts nationwide:

- Sales will decrease by $630 million
- 3,105 full time and part time jobs will be lost
- Business taxes will decrease by $21 million
- National GDP will decrease by $292 million.

The impacts on Arkansas alone are:

- Sales will decrease by $10 million
- 49 full time and part time jobs will be lost
- Business taxes will decrease by $200 thousand
- Arkansas GDP will decrease by $4 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $129 million
- 818 full time and part time jobs will be lost
- Business taxes will decrease by $5 million
- Oklahoma GDP will decrease by $62 million.

4.4 Economic Impacts from Port Activities

First, we obtained port expenditures data (USACE, 2011) which were multiplied by the commodity flow values between the study regions (Waterborne Commerce Statistics Center, 2011). However, since Arkansas has more than one navigable river system, we also utilized data from the USACE (USACE, 2014) to estimate the commodity flow strictly from/to the MKARNS in Arkansas. We classified the commodities as either liquid bulk or dry bulk and other (USACE, 2011). Next, we multiplied the discounted and annualized port activity costs by type of cargo per ton data (Robinson et al., 2014) with the calculated commodity flow data to measure the direct economic impacts associated with the port activities. Finally, we utilized the MRSAM multipliers to calculate the economic impacts.

4.4.1 MKARNS Port Activities Impacts

In this section, we present economic impact results of port activities on the entire MKARNS (as shown in Table 21).

Table 21: MKARNS Port Activities Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$503.6 M	3,494	$135.9 M	$20.2 M	$56.7 M	$12.0 M	$224.8 M	$76.9 M
Oklahoma	$585.1 M	3,744	$142.6 M	$55.1 M	$78.2 M	$15.9 M	$291.8 M	$133.3 M
Kansas	$25.7 M	156	$6.2 M	$1.2 M	$4.0 M	$0.8 M	$12.1 M	$5.1 M
Missouri	$126.1 M	776	$31.9 M	$7.1 M	$17.4 M	$3.7 M	$60.1 M	$24.5 M
Texas	$281.7 M	1,689	$71.5 M	$15.7 M	$50.4 M	$10.8 M	$148.5 M	$66.2 M
Rest of US	$1,381.5 M	8,211	$379.2 M	$74.6 M	$219.7 M	$46.7 M	$720.1 M	$294.3 M
US Total	$2,903.7 M	18,070	$767.3 M	$173.8 M	$426.4 M	$89.9 M	$1,457.4 M	$600.3 M

The loss of port activities expenditures from the entire MKARNS will have the following impacts nationwide:

- Sales will decrease by $2,904 million
- 18,070 full time and part time jobs will be lost
- Business taxes will decrease by $90 million
- National GDP will decrease by $1,457 million.

The impacts on Arkansas alone are:

- Sales will decrease by $504 million

- 3,494 full time and part time jobs will be lost
- Business taxes will decrease by $12 million
- Arkansas GDP will decrease by $225 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $585 million
- 3,744 full time and part time jobs will be lost
- Business taxes will decrease by $16 million
- Oklahoma GDP will decrease by $292 million.

4.4.2 MKARNS Arkansas Segment Port Activities Impacts

We also analyzed the economic impacts of the MKARNS port activities in Arkansas alone as shown in Table 22.

Table 22: MKARNS Arkansas Segment Port Activities Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$490.6 M	3,415	$133.1 M	$19.8 M	$54.7 M	$11.6 M	$219.1 M	$152.9 M
Oklahoma	$21.0 M	124	$4.8 M	$1.3 M	$3.6 M	$0.8 M	$10.5 M	$6.1 M
Kansas	$10.0 M	59	$2.4 M	$0.4 M	$1.6 M	$0.3 M	$4.8 M	$2.8 M
Missouri	$92.4 M	569	$23.3 M	$5.4 M	$12.6 M	$2.6 M	$43.9 M	$28.6 M
Texas	$175.3 M	1,112	$46.3 M	$10.1 M	$29.3 M	$6.3 M	$92.0 M	$56.4 M
Rest of US	$713.8 M	4,300	$199.2 M	$37.9 M	$115.3 M	$24.5 M	$376.8 M	$237.0 M
US Total	$1,503.1 M	9,580	$409.0 M	$74.8 M	$217.0 M	$46.1 M	$747.0 M	$483.8 M

The loss of port activities expenditures from the MKARNS in Arkansas alone will have the following impacts nationwide:

- Sales will decrease by $1,503 million
- 9,580 full time and part time jobs will be lost
- Business taxes will decrease by $46 million
- National GDP will decrease by $747 million.

The impacts on Arkansas alone are:

- Sales will decrease by $491 million
- 3,415 full time and part time jobs will be lost
- Business taxes will decrease by $12 million

- Arkansas GDP will decrease by $219 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $21 million
- 124 full time and part time jobs will be lost
- Business taxes will decrease by $0.8 million
- Oklahoma GDP will decrease by $11 million.

4.4.3 MKARNS Oklahoma Segment Port Activities Impacts

In Table 23, we present results from our economic impact analysis of the MKARNS port activities in Oklahoma alone.

Table 23: MKARNS Oklahoma Segment Port Activities Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$40.4 M	267	$10.2 M	$1.5 M	$5.1 M	$1.1 M	$17.9 M	$17.9 M
Oklahoma	$577.2 M	3,702	$140.9 M	$54.9 M	$76.5 M	$15.4 M	$287.8 M	$287.8 M
Kansas	$16.3 M	101	$3.9 M	$0.8 M	$2.5 M	$0.5 M	$7.7 M	$7.7 M
Missouri	$16.8 M	226	$9.4 M	$1.8 M	$5.3 M	$1.1 M	$17.7 M	$17.7 M
Texas	$113.4 M	617	$27.0 M	$6.0 M	$22.5 M	$4.8 M	$60.2 M	$60.2 M
Rest of US	$693.1 M	4,057	$186.9 M	$38.0 M	$108.7 M	$23.1 M	$356.7 M	$356.7 M
US Total	$1,477.1 M	8,969	$378.3 M	$103.1 M	$220.5 M	$46.1 M	$747.9 M	$747.9 M

The loss of port activities expenditures from the MKARNS in Oklahoma alone will have the following impacts nationwide:

- Sales will decrease by $1,477 million
- 8,969 full time and part time jobs will be lost
- Business taxes will decrease by $46 million
- National GDP will decrease by $748 million.

The impacts on Arkansas alone are:

- Sales will decrease by $40 million
- 267 full time and part time jobs will be lost
- Business taxes will decrease by $1 million
- Arkansas GDP will decrease by $18 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $577 million

- 3,702 full time and part time jobs will be lost
- Business taxes will decrease by $15 million
- Oklahoma GDP will decrease by $288 million.

4.5 Economic Impacts from Shippers' Activities

We utilized the cargo handling cost data for each commodity (USACE, 2011) and multiplied these costs with their commodity flows data using the origin data to attribute these costs. Next, we multiplied the calculated direct impacts with the MRSAM multipliers.

4.5.1 MKARNS Shippers' Activities Impacts

In this section, we present economic impact results from the shippers' activities along the entire MKARNS (as shown in Table 24).

Table 24: MKARNS Shippers' Activities Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$325.4 M	1,543	$64.8 M	$4.8 M	$44.7 M	$8.0 M	$122.4 M	$69.7 M
Oklahoma	$398.1 M	1,461	$18.0 M	$31.8 M	$14.5 M	$3.3 M	$67.6 M	$49.8 M
Kansas	$7.5 M	42	$1.8 M	$0.3 M	$1.0 M	$0.2 M	$3.3 M	$2.1 M
Missouri	$17.7 M	107	$4.6 M	$0.8 M	$2.9 M	$0.6 M	$8.9 M	$5.4 M
Texas	$203.6 M	1,224	$54.5 M	$9.3 M	$34.0 M	$7.2 M	$105.1 M	$63.8 M
Rest of US	$822.3 M	4,699	$234.9 M	$36.1 M	$137.5 M	$28.9 M	$437.4 M	$271.0 M
US Total	$1,774.6 M	9,077	$378.5 M	$83.1 M	$234.6 M	$48.4 M	$744.7 M	$461.7 M

The loss of shippers' activities expenditures from the entire MKARNS will have the following impacts nationwide:

- Sales will decrease by $1,775 million
- 9,077 full time and part time jobs will be lost
- Business taxes will decrease by $48 million
- National GDP will decrease by $745 million.

The impacts on Arkansas alone are:

- Sales will decrease by $325 million
- 1,543 full time and part time jobs will be lost
- Business taxes will decrease by $8 million

- Arkansas GDP will decrease by $122 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $398 million
- 1,461 full time and part time jobs will be lost
- Business taxes will decrease by $3 million
- Oklahoma GDP will decrease by $68 million.

4.5.2 MKARNS Arkansas Segment Shippers' Activities Impacts

In Table 25, we present economic impact results of the MKARNS shippers' activities in Arkansas alone.

Table 25: MKARNS Arkansas Segment Shippers' Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$326.0 M	1,546	$64.8 M	$4.8 M	$44.7 M	$8.0 M	$122.3 M	$69.6 M
Oklahoma	$5.2 M	33	$1.2 M	$0.3 M	$0.9 M	$0.2 M	$2.6 M	$1.5 M
Kansas	$2.7 M	14	$0.6 M	$0.1 M	$0.4 M	$0.1 M	$1.2 M	$0.7 M
Missouri	$10.6 M	65	$2.7 M	$0.5 M	$1.8 M	$0.4 M	$5.4 M	$3.2 M
Texas	$71.8 M	429	$19.0 M	$3.3 M	$12.2 M	$2.6 M	$37.1 M	$22.3 M
Rest of US	$328.0 M	1,893	$93.7 M	$14.6 M	$55.6 M	$11.7 M	$175.7 M	$108.4 M
US Total	$744.3 M	3,980	$182.2 M	$23.6 M	$115.6 M	$23.1 M	$344.4 M	$205.8 M

The loss of port activities expenditures from the MKARNS in Arkansas alone will have the following impacts nationwide:

- Sales will decrease by $744 million
- 3,980 full time and part time jobs will be lost
- Business taxes will decrease by $23 million
- National GDP will decrease by $344 million.

The impacts on Arkansas alone are:

- Sales will decrease by $326 million
- 1,546 full time and part time jobs will be lost
- Business taxes will decrease by $8 million
- Arkansas GDP will decrease by $122 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $5 million

- 33 full time and part time jobs will be lost
- Business taxes will decrease by $200 thousand
- Oklahoma GDP will decrease by $3 million.

4.5.3 MKARNS Oklahoma Segment Shippers' Activities Impacts

The economic impact results of the MKARNS shippers' activities in Oklahoma alone are presented in Table 26.

Table 26: MKARNS Oklahoma Segment Shippers' Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$5.7 M	37	$1.4 M	$0.2 M	$0.8 M	$0.2 M	$2.5 M	$1.6 M
Oklahoma	$387.3 M	1,437	$17.9 M	$32.4 M	$16.1 M	$3.3 M	$69.6 M	$50.3 M
Kansas	$4.9 M	29	$1.2 M	$0.2 M	$0.7 M	$0.1 M	$2.2 M	$1.4 M
Missouri	$7.4 M	44	$1.9 M	$0.3 M	$1.1 M	$0.3 M	$3.6 M	$2.2 M
Texas	$129.1 M	777	$34.7 M	$6.1 M	$21.2 M	$4.5 M	$66.6 M	$40.8 M
Rest of US	$483.9 M	2,749	$138.1 M	$22.0 M	$79.3 M	$16.9 M	$256.3 M	$160.1 M
US Total	$1,018.3 M	5,073	$195.2 M	$61.3 M	$119.2 M	$25.2 M	$400.9 M	$256.5 M

The loss of port activities expenditures from the MKARNS in Oklahoma alone will have the following impacts nationwide:

- Sales will decrease by $1,018 million
- 5,073 full time and part time jobs will be lost
- Business taxes will decrease by $25 million
- National GDP will decrease by $401 million.

The impacts on Arkansas alone are:

- Sales will decrease by $6 million
- 37 full time and part time jobs will be lost
- Business taxes will decrease by $200 thousand
- Arkansas GDP will decrease by $3 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $387 million
- 1,437 full time and part time jobs will be lost
- Business taxes will decrease by $3 million
- Oklahoma GDP will decrease by $70 million.

4.6 Economic Impacts from Transportation Cost Savings

To compute the economic impacts from transportation cost savings, we first obtained commodity flow data between the individual study regions by commodity (Waterborne Commerce Statistics Center, 2011) and the annualized net present value of MKARNS water transportation savings data (Robinson et al., 2014). Next, we calculated the savings/commodity value ratios for every arc between the study regions. Last, we multiplied the savings/commodity value ratios with the MRSAM multipliers (Robinson et al., 2014) to measure the total economic impacts associated with the transportation benefits economic impacts.

4.6.1 MKARNS Transportation Cost Savings Impacts

We present the economic impact results of transportation cost savings resulting from moving to a higher cost, alternative mode of transportation for cargo shipped on the entire MKARNS (as shown in Table 27).

Table 27: MKARNS Transportation Cost Savings Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 24.5 M	137	$ 4.5 M	$ 1.0 M	$ 3.3 M	$ 0.6 M	$ 9.4 M	$ 5.5 M
Oklahoma	$ 14.0 M	66	$ 2.8 M	$ 0.6 M	$ 2.7 M	$ 0.6 M	$ 6.8 M	$ 3.4 M
Kansas	$ 1.9 M	7	$ 0.3 M	$ 0.1 M	$ 0.3 M	$ 0.0 M	$ 0.7 M	$ 0.4 M
Missouri	$ 8.9 M	44	$ 1.9 M	$ 0.4 M	$ 1.7 M	$ 0.4 M	$ 4.4 M	$ 2.3 M
Texas	$ 45.0 M	181	$ 9.8 M	$ 2.4 M	$ 8.1 M	$ 1.6 M	$ 22.0 M	$ 12.2 M
Rest of US	$1,234.8 M	5,564	$ 316.5 M	$ 58.1 M	$ 252.3 M	$ 52.5 M	$ 679.4 M	$374.6 M
US Total Impact	$1,615.4 M	6,000	$ 335.9 M	$ 62.6 M	$ 268.5 M	$ 55.7 M	$ 722.7 M	$398.5 M

Losing navigation along the entire MKARNS will lead to higher costs associated with using an alternative mode of transportation and will have the following impacts nationwide:

- Sales will decrease by $1,615 million
- 6,000 full time and part time jobs will be lost
- Business taxes will decrease by $56 million
- National GDP will decrease by $723 million.

The impacts on Arkansas alone are:

- Sales will decrease by $25 million
- 137 full time and part time jobs will be lost
- Business taxes will decrease by $600 thousand

- Arkansas GDP will decrease by $9 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $14 million
- 66 full time and part time jobs will be lost
- Business taxes will decrease by $600 thousand
- Oklahoma GDP will decrease by $7 million.

4.6.2 MKARNS Arkansas Segment Transportation Cost Savings Impacts

Table 28 contains economic impact results from MKARNS transportation cost savings in Arkansas alone.

Table 28: MKARNS Arkansas Segment Transportation Cost Savings Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 22.3 M	127	$ 4.1 M	$ 0.9 M	$ 3.0 M	$ 0.5 M	$ 8.5 M	$ 5.0 M
Oklahoma	$ 2.4 M	11	$ 0.5 M	$ 0.1 M	$ 0.4 M	$ 0.1 M	$ 1.0 M	$ 0.6 M
Kansas	$ 1.0 M	4	$ 0.2 M	$ 0.0 M	$ 0.1 M	$ 0.0 M	$ 0.4 M	$ 0.2 M
Missouri	$ 6.3 M	32	$ 1.3 M	$ 0.3 M	$ 1.2 M	$ 0.2 M	$ 3.1 M	$ 1.6 M
Texas	$ 25.5 M	101	$ 5.4 M	$ 1.3 M	$ 4.5 M	$ 0.9 M	$ 12.0 M	$ 6.7 M
Rest of US	$ 773.6 M	3,459	$ 194.5 M	$ 36.0 M	$ 158.7 M	$ 33.1 M	$ 422.4 M	$230.5 M
US Total Impact	$ 968.2 M	3,732	$ 206.1 M	$ 38.6 M	$ 167.8 M	$ 34.9 M	$ 447.4 M	$244.7 M
Transport Savings	$ 137.2 M	-	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 137.2 M	$ 0.0 M
US Total Impact	$1,105.5 M	3,732	$ 206.1 M	$ 38.6 M	$ 167.8 M	$ 34.9 M	$ 584.6 M	$244.7 M

Losing water transportation along the MKARNS in Arkansas alone will lead to higher transportation costs associated with alternative mode(s) of transportation and will have the following impacts nationwide:

- Sales will decrease by $1,105 million
- 3,732 full time and part time jobs will be lost
- Business taxes will decrease by $35 million
- National GDP will decrease by $585 million.

The impacts on Arkansas alone are:

- Sales will decrease by $22 million
- 127 full time and part time jobs will be lost
- Business taxes will decrease by $500 thousand
- Arkansas GDP will decrease by $9 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $2 million
- 11 full time and part time jobs will be lost
- Business taxes will decrease by $100 thousand
- Oklahoma GDP will decrease by $1 million.

4.6.3 MKARNS Oklahoma Segment Transportation Cost Savings Impacts

Here we present the economic impacts from MKARNS transportation cost savings in Oklahoma alone (as shown in Table 28).

Table 28: MKARNS Oklahoma Segment Transportation Cost Savings Impacts

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$ 3.8 M	19	$ 0.7 M	$ 0.2 M	$ 0.5 M	$ 0.1 M	$ 1.5 M	$ 0.9 M
Oklahoma	$ 9.9 M	49	$ 2.0 M	$ 0.5 M	$ 2.0 M	$ 0.5 M	$ 4.9 M	$ 2.4 M
Kansas	$ 0.9 M	3	$ 0.2 M	$ 0.0 M	$ 0.1 M	$ 0.0 M	$ 0.3 M	$ 0.2 M
Missouri	$ 2.9 M	14	$ 0.6 M	$ 0.1 M	$ 0.6 M	$ 0.1 M	$ 1.4 M	$ 0.8 M
Texas	$ 20.3 M	84	$ 4.6 M	$ 1.1 M	$ 3.8 M	$ 0.8 M	$ 10.3 M	$ 5.8 M
Rest of US	$ 483.6 M	2,205	$ 127.1 M	$ 23.1 M	$ 98.7 M	$ 20.3 M	$ 269.2 M	$150.2 M
US Total Impact	$ 521.3 M	2,374	$ 135.2 M	$ 25.0 M	$ 105.6 M	$ 21.8 M	$ 287.7 M	$160.2 M
Transport Savings	$ 156.1 M	-	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 0.0 M	$ 156.1 M	$ 0.0 M
US Total Impact	$ 677.4 M	2,374	$ 135.2 M	$ 25.0 M	$ 105.6 M	$ 21.8 M	$ 443.8 M	$160.2 M

Losing water transportation along the MKARNS in Oklahoma alone will lead to higher transportation costs associated with alternative mode(s) of transportation and will have the following impacts nationwide:

- Sales will decrease by $677 million
- 2,374 full time and part time jobs will be lost
- Business taxes will decrease by $22 million
- National GDP will decrease by $444 million.

The impacts on Arkansas alone are:

- Sales will decrease by $4 million
- 19 full time and part time jobs will be lost
- Business taxes will decrease by $100 thousand
- Arkansas GDP will decrease by $2 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $10 million

- 49 full time and part time jobs will be lost
- Business taxes will decrease by $500 thousand
- Oklahoma GDP will decrease by $5 million.

4.7 Economic Impacts from Recreation Benefits

First, recreation visitation data from the Arkansas and Oklahoma segments were obtained (USACE, 2013). The number of day and overnight visitors were estimated (Robinson et al., 2014). Next, the associated recreation expenditures were calculated for both day and overnight visitors to estimate the direct economic impacts. Finally, the MRSAM multipliers were used to calculate total economic impacts as shown in Table 29

Table 29: Economic Impacts of The MKARNS Recreation Expenditures

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$528.2 M	11,429	$194.1 M	$6.2 M	$39.2 M	$28.5 M	$267.9 M	$200.3 M
Oklahoma	$105.6 M	2,123	$19.9 M	$8.1 M	$12.4 M	$3.1 M	$43.5 M	$27.9 M
US Total Impact	$633.8 M	13,552	$214.0 M	$14.3 M	$51.6 M	$31.6 M	$311.4 M	$228.3 M

Loss of the recreation activities from the entire MKARNS will result in the following impacts nationwide:

- Sales will be reduced by $634 million
- 13,552 full time and part time jobs will be lost
- Business taxes will decrease by $32 million
- Arkansas GDP will decrease by $311 million.

The recreation activities alongside the MKARNS generate the following impacts in Arkansas:

- Sales will be reduced by $528 million
- 11,429 full time and part time jobs will be lost
- Business taxes will decrease by $29 million
- Arkansas GDP will decrease by $268 million.

The recreation activities alongside the MKARNS generate the following impacts in Oklahoma:

- Sales will be reduced by $106 million
- 2,123 full time and part time jobs will be lost
- Business taxes will decrease by $3 million

- Oklahoma GDP will decrease by $44 million.

4.8 Total Economic Impacts

The total MKARNS economic impacts are calculated as the sum of the following activities' impacts:

1. Hydropower Energy Generation (Section 4.1)
2. The USACE O&M Expenditures (Section 4.2)
3. Private Sector Investment Expenditures (Section 4.3)
4. Port Activities (Section 4.4)
5. Shippers' Activities (Section 4.5)
6. Transportation Cost Savings (Section 4.6)
7. Recreation Benefits (Section 4.7)

4.8.1 MKARNS Total Economic Impacts

Here we present our MKARNS economic analysis results by study region and by type of economic impact in Tables 30 and 31 respectively. Table 30 contains the summation of the total nationwide results presented in Sections 4.1 through 4.7.

Table 30: MKARNS Total Economic Impacts by Type of Economic Impact

Economic Impact	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value-Added	Labor Income
Hydropower Energy Generation	$474 M	2,986	$124 M	$22 M	$89 M	$21 M	$256 M	$146 M
USACE O&M Expenditures	$94 M	663	$27 M	$6 M	$15 M	$4 M	$51 M	$33 M
Private Sector Investment	$1,030 M	5,524	$267 M	$40 M	$141 M	$38 M	$487 M	$307 M
Port Activities	$2,904 M	18,070	$767 M	$174 M	$426 M	$90 M	$1,457 M	$941 M
Shippers' Activities	$1,775 M	9,077	$379 M	$83 M	$235 M	$48 M	$745 M	$462 M
Transportation Cost Savings	$1,615 M	6,000	$336 M	$63 M	$268 M	$56 M	$1,009 M	$398 M
Recreation Benefits	$634 M	13,552	$214 M	$14 M	$52 M	$32 M	$311 M	$228 M
US Total Impact	$8,525 M	55,872	$2,114 M	$401 M	$1,226 M	$289 M	$4,316 M	$2,515 M

You can see in Table 30 that Port Activities ($2,904 million), Shippers' Activities ($1,775 million), and Transportation Cost Savings ($1,615 million) are the largest contributors to MKARNS impacts on Sales. Port Activities (18,070 jobs) and Shippers' Activities (9,077 jobs)

also heavily contributes to MKARNS' Employment impacts along with Recreation Benefits (13,552 jobs). Port Activities ($90 million), Transportation Cost Savings ($56 million), and Shippers' Activities ($48 million) are primary drivers of the Business Tax impacts nationwide. In terms of GDP, the largest contributors are Port Activities ($1,457 million), Transportation Cost Savings ($1,009 million), and Shippers' Activities ($745 million).

Table 31 contains the total economic impacts by impacted region for the MKARNS as a whole.

Table 31: MKARNS Total Economic Impacts by Region

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$1,640 M	18,715	$472 M	$45 M	$185 M	$64 M	$766 M	$517 M
Oklahoma	$1,311 M	8,769	$237 M	$105 M	$138 M	$32 M	$512 M	$342 M
Kansas	$96 M	445	$21 M	$3 M	$10 M	$2 M	$36 M	$24 M
Missouri	$231 M	1,351	$58 M	$11 M	$34 M	$7 M	$111 M	$70 M
Texas	$720 M	4,054	$182 M	$37 M	$124 M	$27 M	$370 M	$218 M
Rest of US	$4,240 M	22,537	$1,143 M	$201 M	$735 M	$156 M	$2,235 M	$1,344 M
US Total Impact	$8,525 M	55,872	$2,114 M	$401 M	$1,226 M	$289 M	$4,316 M	$2,515 M

The loss of operating the entire MKARNS will have the following impacts nationwide:

- Sales will decrease by $8,525 million
- 55,872 full time and part time jobs will be lost
- Business taxes will decrease by $289 million
- National GDP will decrease by $4,316 million.

The impacts on Arkansas alone are:

- Sales will decrease by $1,640 million
- 18,715 full time and part time jobs will be lost
- Business taxes will decrease by $64 million
- Arkansas GDP will decrease by $766 million.

The impacts on Oklahoma alone are:

- Sales will decrease by $1,311 million
- 8,769 full time and part time jobs will be lost
- Business taxes will decrease by $32 million
- Arkansas GDP will decrease by $512 million.

4.8.2 MKARNS Arkansas Segment Total Economic Impacts

In this section, we present our MKARNS economic impacts results for Arkansas alone by type of economic impact (see Table 32) and by study region (see Table 33). The results in Table 32 are the summation of the economic impact results presented in Sections 4.1 through 4.7.

Table 32: MKARNS Arkansas Segment Total Economic Impacts by Type of Economic Impact

Economic Impact	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Hydropower Energy Generation	$335 M	22,041	$88 M	$15 M	$63 M	$15 M	$182 M	$104 M
USACE O&M Expenditures	$60 M	18,566	$17 M	$4 M	$9 M	$3 M	$33 M	$21 M
Private Sector Investment	$396 M	272	$107 M	$16 M	$56 M	$17 M	$196 M	$123 M
Port Activities	$1,503 M	213	$409 M	$75 M	$217 M	$46 M	$747 M	$484 M
Shippers' Activities	$744 M	938	$182 M	$24 M	$116 M	$23 M	$344 M	$206 M
Transportation Cost Savings	$1,105 M	2,053	$206 M	$39 M	$168 M	$35 M	$585 M	$245 M
Recreation Benefits	$528 M	11,654	$194 M	$6 M	$39 M	$28 M	$268 M	$200 M
US Total Impact	$4,672 M	33,695	$1,204 M	$179 M	$667 M	$168 M	$2,355 M	$1,383 M

Table 33: MKARNS Arkansas Segment Total Economic Impacts by Region

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$1,614 M	18,566	$467 M	$44 M	$181 M	$63 M	$755 M	$510 M
Oklahoma	$45 M	272	$10 M	$2 M	$8 M	$2 M	$22 M	$13 M
Kansas	$53 M	213	$11 M	$1 M	$4 M	$1 M	$18 M	$12 M
Missouri	$155 M	938	$39 M	$8 M	$24 M	$5 M	$77 M	$48 M
Texas	$347 M	2,053	$89 M	$19 M	$59 M	$13 M	$180 M	$107 M
Rest of US	$2,182 M	11,654	$587 M	$104 M	$391 M	$83 M	$1,166 M	$692 M
US Total Impact	$4,535 M	33,695	$1,204 M	$179 M	$667 M	$168 M	$2,355 M	$1,383 M

4.8.3 MKARNS Oklahoma Segment Total Economic Impacts

In this section, we present our MKARNS economic impacts results for Oklahoma alone by type of economic impact (see Table 34) and by study region (see Table 35). The results in Table 34 are the summation of the economic impact results presented in Sections 4.1 through 4.7.

Table 34: MKARNS Oklahoma Segment Total Economic Impacts by Type of Economic Impact

Economic Impact	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Hydropower Energy Generation	$135 M	887	$35 M	$7 M	$25 M	$6 M	$74 M	$42 M
USACE O&M Expenditures	$34 M	229	$10 M	$2 M	$5 M	$1 M	$18 M	$12 M
Private Sector Investment	$629 M	3,105	$159 M	$25 M	$87 M	$21 M	$291 M	$184 M
Port Activities	$1,477 M	8,969	$378 M	$103 M	$220 M	$46 M	$748 M	$481 M
Shippers' Activities	$1,018 M	5,073	$195 M	$62 M	$118 M	$25 M	$401 M	$257 M
Transportation Cost Savings	$677 M	2,374	$135 M	$25 M	$106 M	$22 M	$444 M	$160 M
Recreation Benefits	$106 M	2,123	$20 M	$8 M	$12 M	$3 M	$43 M	$28 M
US Total Impact	$4,077 M	22,761	$932 M	$233 M	$575 M	$125 M	$2020 M	$1,164 M

Table 35: MKARNS Arkansas Segment Total Economic Impacts by Region

Region	Sales	Employment	Employee Compensation	Proprietors' Income	Other Property Type Income	Indirect Business Tax	Value Added	Labor Income
Arkansas	$62 M	387	$15 M	$2 M	$8 M	$2 M	$27 M	$17 M
Oklahoma	$1,291 M	8,744	$236 M	$110 M	$136 M	$31 M	$514 M	$346 M
Kansas	$43 M	235	$10 M	$2 M	$6 M	$1 M	$18 M	$12 M
Missouri	$78 M	429	$19 M	$3 M	$10 M	$2 M	$35 M	$23 M
Texas	$380 M	2,042	$94 M	$18 M	$67 M	$15 M	$194 M	$113 M
Rest of US	$2,067 M	10,925	$557 M	$97 M	$348 M	$74 M	$1,075 M	$654 M
US Total Impact	$4,077 M	22,761	$932 M	$233 M	$575 M	$125 M	$2,020 M	$1,164 M

5. Summary

In this project, we implemented a multiregional social accounting matrix (MRSAM) framework to estimate the economic impacts of the MKARNS activities on the study regions of Arkansas, Oklahoma, Kansas, Missouri, Texas, and the Rest of the United States. We investigated the regional economic impacts of the MKARNS to inform waterway stakeholders of the value of the system and the loss of economic activities if the MKARNS does not continue to be operational. Our study considers economic impacts from 1) Hydropower Energy Generation, 2) USACE O&M Expenditures, 3) Private Sector Investment Expenditures, 4) Port Activities, 5) Shippers' Activities, 6) Transportation Cost Savings, and 7) Recreation Benefits.

Our findings indicate that the total economic impacts of the MKARNS nationwide are $8.5 billion in sales, $4.3 billion in GDP, and $2.5 billion in labor income. In addition, 55,872 jobs are created due to the activities related to the MKARNS. Port Activities are the largest component of the total economic impacts of the MKARNS followed by Shippers' Activities and

Transportation Cost Savings. The economic impacts associated with the Arkansas segment of the MKARNS on the Arkansas study region are $1.6 billion in sales, $766 million in GDP, $517 million in labor income, and 18,715 jobs. We also studied the economic impacts of the MKARNS Arkansas and Oklahoma segments nationwide and find that the MKARNS Arkansas segment has slightly greater economic impacts than the MKARNS Oklahoma segment in Sales impacts ($4.7 billion and $4.1 billion respectively) and GDP impacts ($2.4 billion and $2 billion respectively). There is a larger difference in terms of the number of jobs impacts by the MKARNS Arkansas segment versus the MKARNS Oklahoma segment nationwide (33,695 jobs and 22,761 jobs respectively).

This study demonstrates that the MKARNS contributes significant economic impacts in Arkansas and Oklahoma as well as nationwide. Our findings indicate that investing in the MKARNS will help the sustainable economic growth not only in the local region but across the entire United States.

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