Missouri River Freight Corridor
Assessment and Development Plan

Evaluation of Market Nodes, River Management Strategies, Assessment of Infrastructure Needs and Concepts of Operations

(Technical Memo 4)

Prepared By

Hanson Professional Services, Inc.

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1.0 INTRODUCTION

Growth of waterborne freight volumes is the outcome of a combination of regional and global economic forces outside the control of any single link in the transportation chain. It is influenced by investment and operating decisions made at the individual port or terminal level – a location that serves a high economic growth region but is encumbered by poor infrastructure is unlikely to grow in line with its counterparts.

History has shown that the Missouri River can support waterborne commerce, but challenges exist that hinder its ability to do so. In order for freight to return to the River, ports and terminals must be capable of handling cargo – the necessary waterway infrastructure must be present. To this end, Task 4 “Evaluation of Market Nodes, River Management Strategies, and Assessment of Infrastructure Needs” examines the capacity, opportunities, and constraints of the Missouri River freight system.

The following evaluation of economics, market locations, infrastructure, environmental impacts, and other modal transportation logistics provides a foundation for the suggested strategies and Concepts of Operations aimed at increasing Missouri River freight. The preliminary Concepts of Operations were presented to the Project Coordination Team (PCT) and other stakeholders at the Research Findings Forum. Activities at and results from the Forum aided in refining these ideas into the final Concepts of Operations.

2.0 EVALUATION OF MARKETS & NODES

The Task 3 Report generated a macro market view of freight volume that had specific characteristics conducive to shifting from land transportation modes to a waterborne mode. The report utilized recognized freight data sources and a multi-layer criteria-driven approach to establish commodities and volumes conducive to barge shipment to/from a five-state Missouri River Barge (MRB) Region (Exhibit 2.1).

Exhibit 2.1

In order to identify the baseline freight for this study, the macro market view of freight volume from Task 3 was refined by identifying freight with sufficient volume, compatible origin/destination (O/D) pairs, and geographic proximity to be potentially captured by a Missouri River transportation alternative. Establishing this “qualified” market share does not initially attempt to determine if it will shift or if the physical infrastructure and transportation assets required to support the shift are present. These issues are discussed in the Concepts of Operations in Section 3 of this report. The refined market view does, however, establish whether adequate freight volumes exist that could potentially be penetrated by waterway business interests. Assuming reliability, cost, and transit time can meet shipper expectations, stakeholders can then engage in commercial efforts to create a freight shift to a waterborne transportation alternative.

2.1 Baseline Determination Methodology

The baseline data was established through a refinement process utilizing the 2007 Freight Analysis Framework (FAF3) data from the Task 3 output, as generally described above, and further refined to specifically target a Missouri River freight corridor. The target area required determination of freight flows into and out of the study area by applicable counties (see Exhibits 2.2 and 2.5), as well as those freight flows that were intra-regional. County selection was generally accomplished by identification of those counties having relative proximity to the Missouri River for facilitation of waterway modal shift, as is further described below.

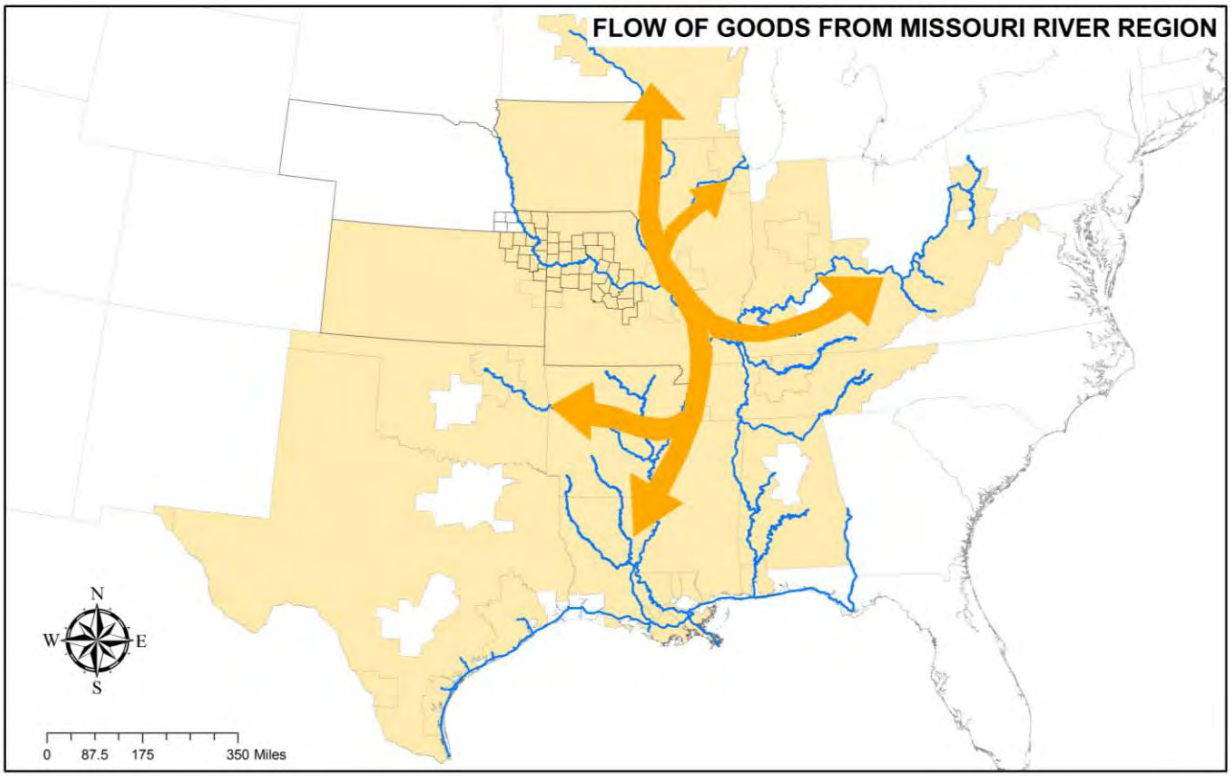

Exhibit 2.2

The Task 3 data output contained 2007 freight volumes moving between an applicable county origin/destination inside the Missouri River freight corridor and an applicable Metropolitan Statistical Area (MSA) origin/destination outside the freight corridor. The data was further refined to eliminate shipments (including intra-regional shipments) less than 5,000 tons annually, as well as those shipments to/from MSA's that were not connected by waterways with access to/from the Missouri River. The 5,000-ton annual threshold eliminated freight that was not of a market size sufficient to initiate a shift or significant increase of volume on the waterway.

The output also identified the current primary land transportation mode (truck or rail) in order to compare the challenges and service balance required to make the potential modal shift a reality. In some instances, FAF data exhibited modal assignment

ambiguities, because of the multi-modal approach to the database structure. In those instances, the primary modal routing was used. If the current transportation mode was not easily confirmed, the most conservative public benefit selection was assigned or the modes were allocated proportionally for the purpose of estimating and comparing the effects of a modal shift. The baseline output provides a foundation for a case of public benefit for increased support of marine highway concepts, specifically for the Missouri River, through modal comparison of environmental, safety, and public investment benefits.

Additionally, the database included international trade route designators which allow insight into world market freight movement patterns. This permitted consideration of external world market change, such as the Panama Canal expansion, which could create potential opportunities or impact world trade patterns.

The Task 3 output indicated a potential water transportation market size of 59 million metric tons, all within five primary commodity groups (Exhibit 2.3). As expected, the composition of the potential market is heavily weighted toward agricultural commodities – 75% of the 59 million tons of potential compatible freight in the five-state region. Existing rail transportation infrastructure, as well as many of the inventoried water terminal facilities, is designed to serve this commodity group. The remaining commodity groups are composed of a mixture of commodities with varied transportation, material handling, and facility requirements.

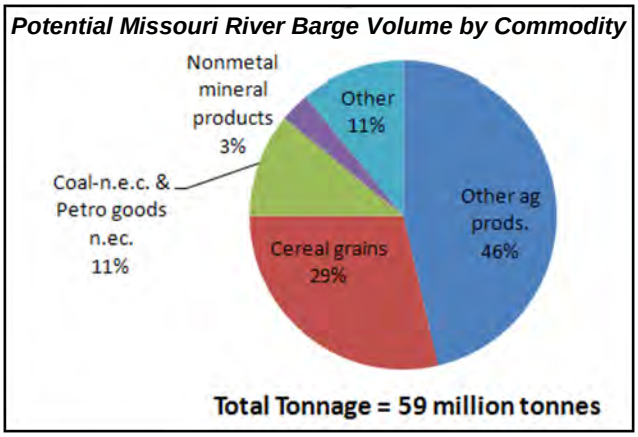

Exhibit 2.3

The potential 59-million-ton market represents shipments from the MRB Region and appropriate counties meeting criteria of shipment size, location, and other qualities conducive to potential economic freight advantage if moved by water. In analyzing commodity groups and volumes that could take advantage of the potential modal shift, several additional criteria must be considered, such as the following:

- Facility infrastructure
- Transportation system capacity
- Regional-centric nodes of origin/destination
- Material handling capabilities
- Domestic and international destinations
- Overall supply chain performance
- Possible paradigm shifts in world commerce

For the purpose of Task 4, the potential applicable market size for all commodity groups within the MRB Region should reflect, particularly in the case of agricultural products, a

production zone defined by the economics of transportation. Therefore, a two-county zone along both sides of the Missouri River (Exhibit 2.4) represents an estimate of the competitive truck range between river-located marine facilities and the market sources.

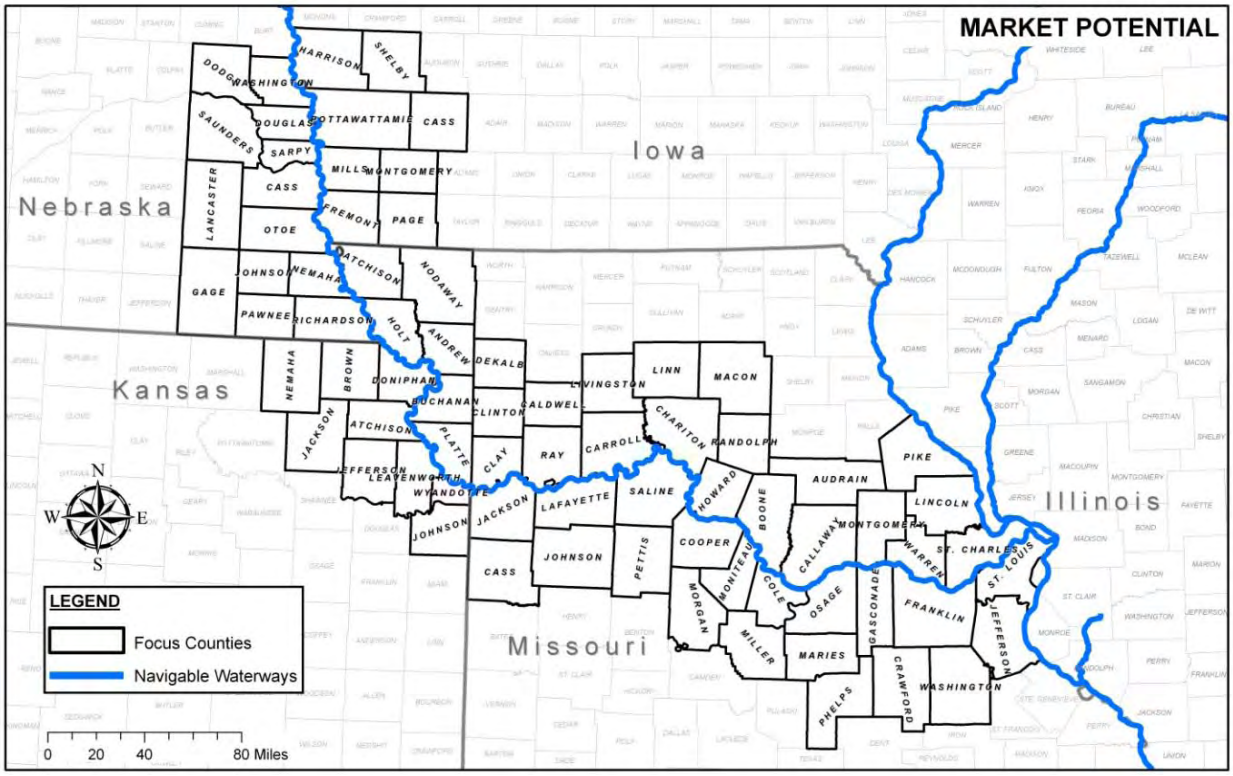

Exhibit 2.4

This refined market area more appropriately reflects the geographic area that could be feasibly penetrated from a competitive standpoint, versus the volume economy of scale market area defined by Task 3. As shown in Exhibit 2.4, the market area extends from Harrison/Washington Counties (near Blair, Nebraska) to those Missouri counties adjacent to the Mississippi River.

A third and final level of market area reduction was required to identify the baseline market information most pertinent to this project (focused primarily on the state of Missouri).. Although all opportunities are important to the overall success of the modal shift, resources and available information specifically targeted the Missouri River segment from the northwest Missouri state line to Warren/Montgomery Counties (near Hermann, Missouri). The counties east of Hermann (in the greater St. Louis region) are not included, as they would typically utilize a Mississippi River gateway. Therefore, all subsequent references herein to the "baseline market area" apply to the two-county zone either side of the Missouri River between these end points (Exhibit 2.5).

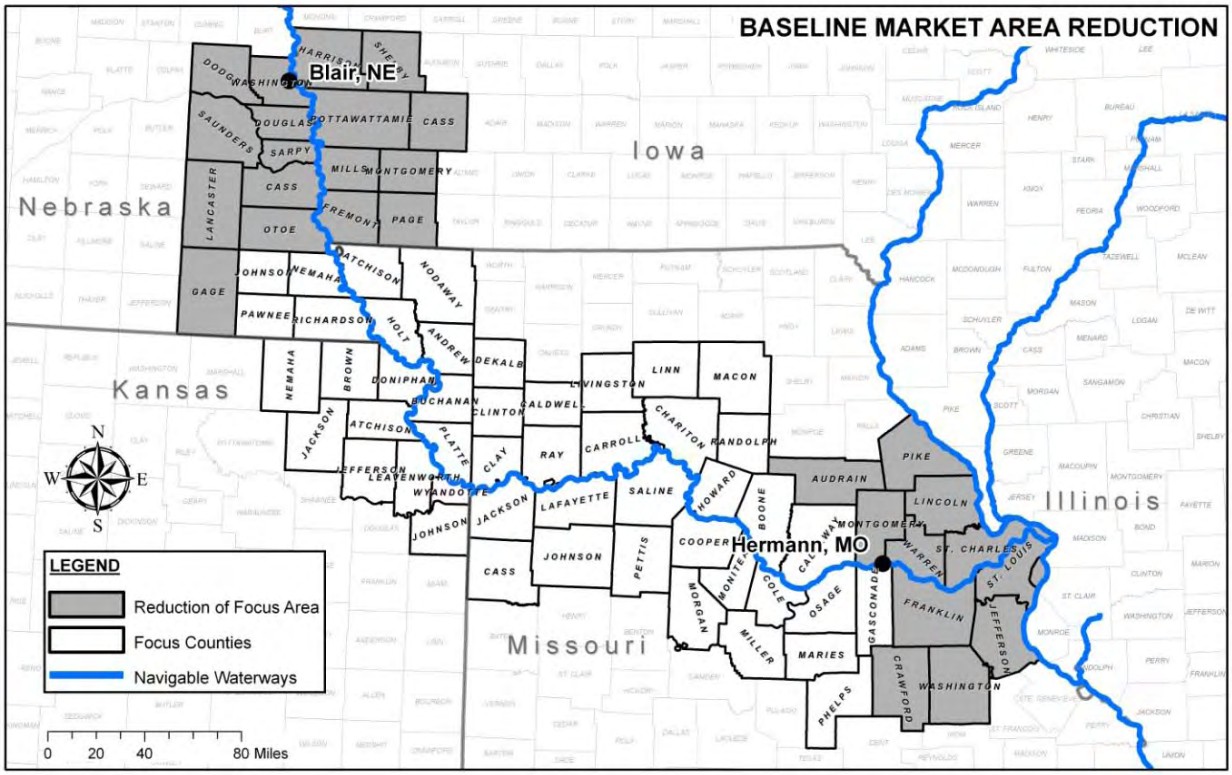

Exhibit 2.5

2.2 Traditional Markets

Traditional markets are those that have played a significant role in Missouri River freight history. These markets are generally supported by an established, although currently underutilized, infrastructure and transportation network. Therefore, given competitive economics and proven River reliability, these commodities have significant potential to return to the River.

2.2.1 Agricultural Dry Bulk

Cereal Grains

Cereal grains are comprised of a number of distinct commodities, primarily consisting of wheat, corn (maize), sorghum, and oats. Task 3 output derived a total potential market size of approximately 17 million tons of cereal grains that meet the criteria of shipment size, MRB Region location, and other qualities conducive to potential waterborne transportation. The cereal grains commodity group is heavily weighted toward world market exports.

Other Agricultural Products

Other agricultural products are comprised of a number of distinct commodities, including soybeans, other oilseeds, and miscellaneous grain farming. Task 3 output derived a total market size of 27.1 million tons that meet the criteria of shipment size and MRB Region location conducive to potential waterborne transportation. As with cereal grains, this commodity group is heavily weighted toward world market exports.

Market Potential

The production of agricultural dry bulk represents a significant portion of potential Missouri River freight. Combining the cereal grains and other agricultural products groups yields a market picture conducive to commodity planting changes, facility flexibility, and assignments based on owners' decision making, economics, transportation conveyance compatibility, and available services.

The potential market area for agricultural dry bulk is defined by the facility infrastructure serving the market identified during Task 2 and a competitive range associated with the economics of trucking between facilities and the farm. Whenever possible, the data and comments associated with market areas outside of the baseline market area were considered; however, the primary focus is the commercial areas with direct state of Missouri interest. Therefore, the project focus necessitated the reduction of the applicable market size, as previously described in Section 2.1.

The combined Task 3 tonnage for agricultural dry bulk moving in the region totals approximately 44.1 million tons. The refined Task 4 total market, adjusted for transportation options in the Missouri River competitive county area from Blair to

Hermann is 16 million tons. Further data analysis within the baseline market area suggests the total volume moving in the region, and with a potential to shift to barge transportation, is approximately 11.9 million tons. Assuming broad-based strategies are implemented (see Section 3.1.2), the following volumes are projected to potentially shift to the Missouri River over a five-year period:

- Year 1 Potential Shift: 373,000 tons
- Year 3 Potential Shift: 158,000 tons
- Year 5 Potential Shift: 84,000 tons
- Cumulative Potential Shift: 615,000 tons annually

System Capacity

In order to evaluate the potential agricultural dry bulk market shift to a waterborne transportation option, it is necessary to identify production volumes, facility capacity, and facility capability to service the market. Because bulk agricultural commodities have similar handling characteristics and data sources, a broad facility capacity review was appropriate. The review included geographic clusters conducive to crop flexibility. Regional facility market clusters are characterized as those counties served by bulk facilities located in or around significant county production centers (Exhibit 2.6). As indicated, the bulk facility clusters are identified as: Central Missouri Region, Kansas City Region, and Northwest Missouri Region. Specific dry bulk elevator locations are shown in Exhibit 2.7, and the current operational status of those facilities is shown in Exhibit 2.8.

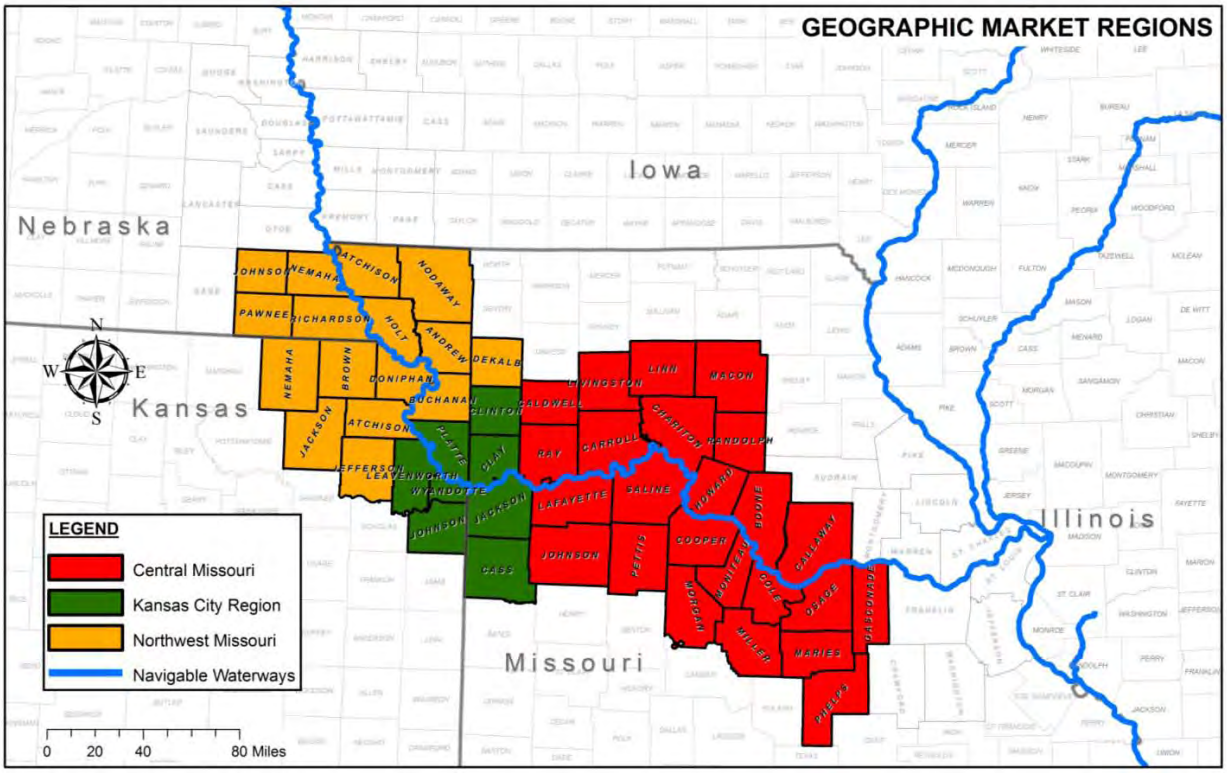

Exhibit 2.6

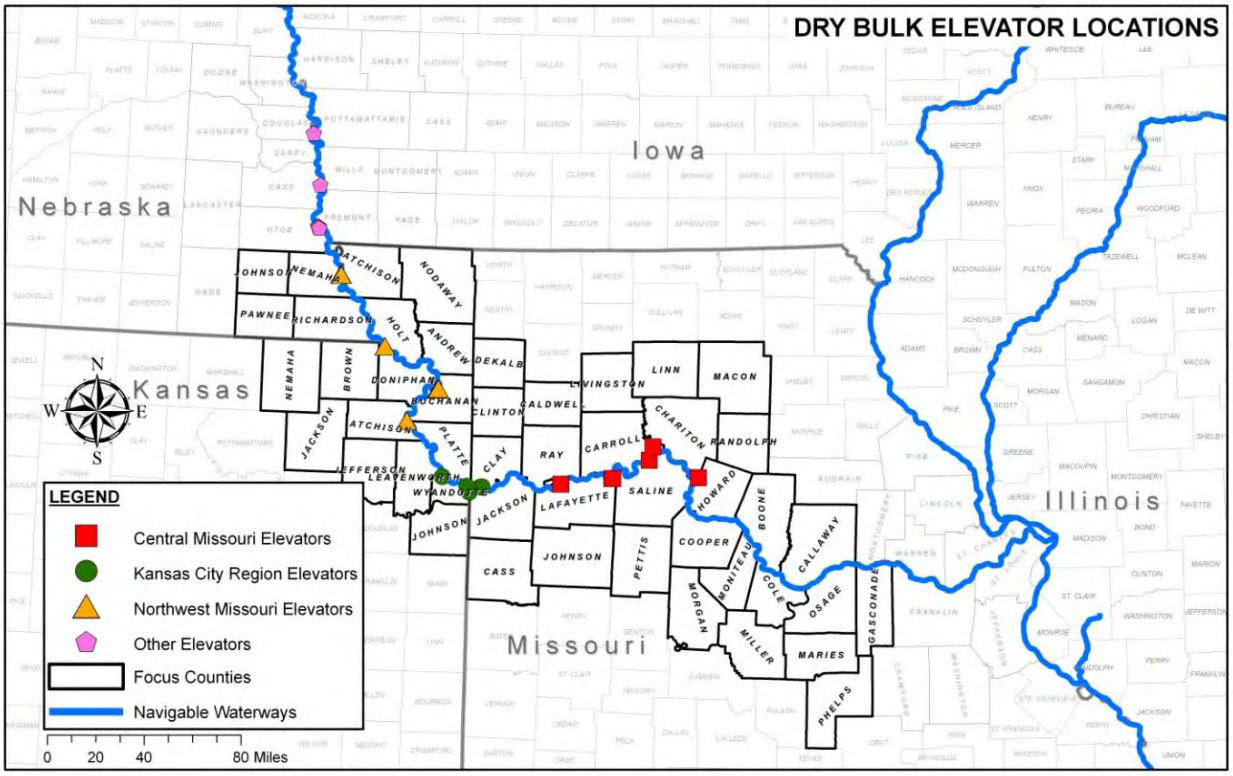

Exhibit 2.7

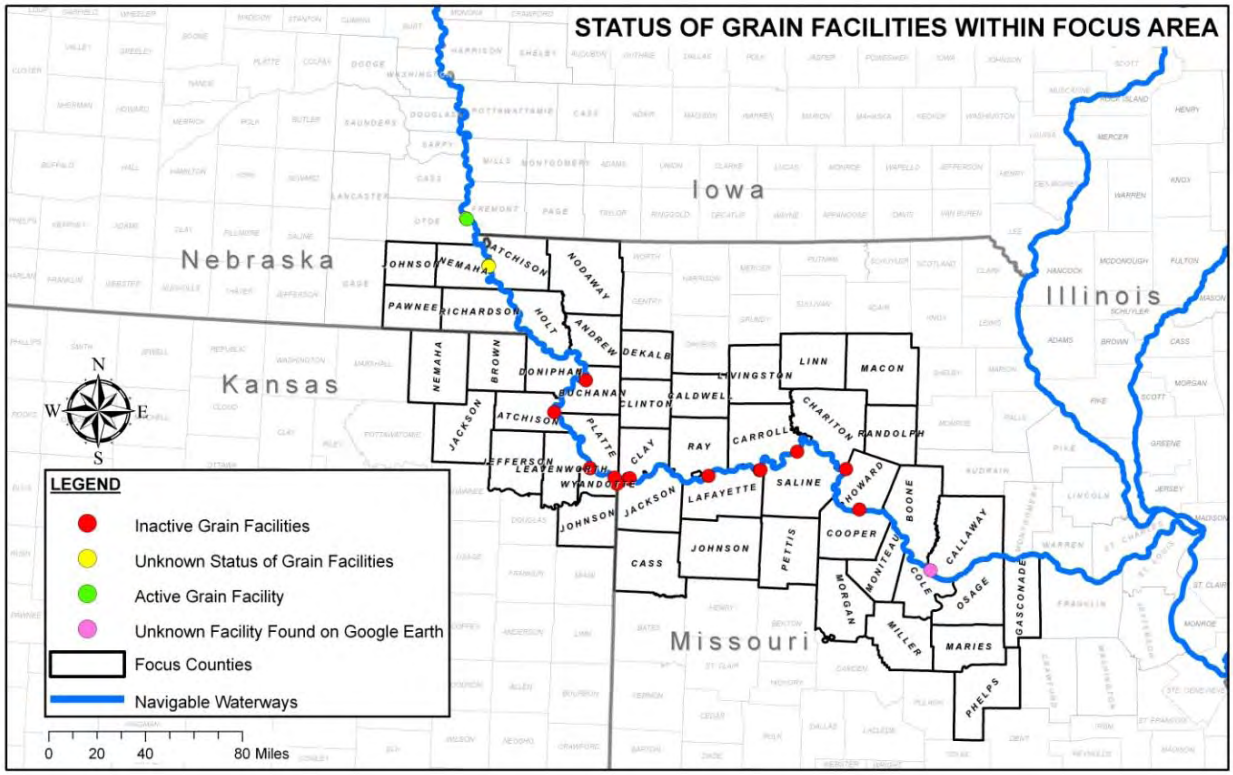

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Exhibit 2.8

During Task 4, a follow up stakeholder survey was conducted regarding freight movement on the Missouri River. The purpose of this survey was to identify and address technical variables/issues that will affect the development, consensus building, and future implementation of the Missouri River Concepts of Operations (Section 3). The survey recipients were specifically targeted due to their current or historical Missouri River operations and/or facilities.

As is reported in Appendix C, the survey results indicated the targeted turnover of bulk grain facilities is typically around 4.5 times capacity. So, if one assumes this is a minimal average turnover, the total agricultural dry bulk terminal throughput is on the order of 5.5 million tons. This does not imply all facilities are utilized at this time, but it does attempt to indicate potential capacity on a regional basis. Capacity for the facilities identified in Exhibit 2.7 is summarized in Table 2.1. Cereal grains (primarily corn) account for about 70% of agricultural dry bulk production within the baseline market area, and soybeans account for most of the remaining 30%.

The data shown in Table 2.1 suggests excess capacity in the Kansas City Region. However, a shortfall in the Central and Northwest Missouri Regions may exist to fully serve the regional production when evaluated against the full market potential. Recognizing that all of the available market production is not likely to shift to a waterborne mode and the receipt of grains will not absolutely match the market area projected, sensitivity analysis and scenario building must occur to identify facility capacity needs.

Table 2.1 – Dry Bulk Elevator Capacity Summary

Region	Facility	Location (Mi./Bank)	Approx. Capacity (MBu)	Approx. Capacity (tons)	Approx. Regional Capacity (tons)	4.5x Estimated Throughput (tons)	4.5x Regional Throughput (tons)
Central MO	MFA Agri Services - Glasgow	226.4 L	1.50	44,000	239,653	198,000	1,078,440
	AgriServices of Brunswick	256.2 L	3.00	88,000		396,000	
	Central Missouri Agriculture	262.8 R	0.74	21,707		97,680	
	Bartlett & Co. - Waverly	293.2 R	1.38	40,480		182,160	
	Central Missouri Ag. - Waverly	293.4 R	1.10	32,267		145,200	
	MFA Agri Services - Lexington	318.2 R	0.45	13,200		59,400	
KC Region	Bartlett Grain - KC	361.1 L	3.82	112,053	792,587	504,240	3,566,640
	Cargill Inc. - Chouteau	361.6 L	0.90	26,400		118,800	
	Bartlett & Co. - KC/Wyandotte	367.6 R	10.0	293,333		1,320,000	
	Bartlett Grain - Fairfax	373.0 R	10.0	293,333		1,320,000	
	ADM/Growmark - Wolcott	386.6 R	2.30	67,467		303,600	
NW MO	Bartlett Grain - Atchison	421.0 R	0.95	27,867	202,107	125,400	909,480
	Bartlett & Co. - St. Joseph	446.6 L	3.94	115,573		520,080	
	White Cloud Grain Co.	488.0 R	0.80	23,467		105,600	
	Searcy Grain - Brownville	535.2 R	0.36	10,560		47,520	
	Bunge Corp. - Brownville	535.4 R	0.84	24,640		110,880	
				TOTAL CAPACITY:	**1,234,347**	---	**5,554,560**

In order to compare regional elevator capacity to regional agricultural dry bulk production, county production trends for the baseline market area were determined using US Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) data. Analysis indicated a total of over 5.3 million tons of agricultural dry bulk was produced in the three regions combined, representing a significant Missouri River potential freight market. Based on this data, the combined production is regionally distributed as follows: the Central Missouri Region produced 53% of the agricultural bulk, followed by the Northwest Missouri Region at 35%, and the Kansas City Region at 11%. Therefore, the total dry bulk production (5.3 million tons) could roughly coincide with the total throughput capacity estimate (5.5 million tons) of waterside dry bulk elevators within the baseline market area.

The agricultural dry bulk market is shipped to both foreign and domestic destinations. It also includes those grains that originate elsewhere and are shipped into the region. However, agricultural dry bulk leaving the region is the predominant volume in terms of market size. In fact, dry bulk received from origins outside the region totals about 276,600 tons – less than 1% of the 44.1 million tons moving through the MRB Region.

System Constraints

Although total commodity production volume appears to nearly match capacity on a throughput basis, the system does appear to have some constraints. The constraints exist in the realities of the competitive economic range of riverside infrastructure and the crop type/yield variance that could be encountered. The geographic throughput capacity

imbalances do not necessarily imply under-utilization of specific facilities, but may imply other transportation infrastructure (particularly rail) have developed greater efficiency than waterborne alternatives. This efficiency may draw on a much larger economic reach than defined in this study; however, the information is valuable for identification of needs and future actions.

The material handling system of almost every waterside facility requires investment at levels that were previously estimated in Task 2. Storage capacity and loading/unloading rates varied from marginal to acceptable. The location of facilities with equipment rated as marginal may not be appropriate when considering the investment required to make them serviceable. An economic analysis on the individual facility level will be required to determine which facilities warrant material handling system investment and which do not, and this analysis is beyond the scope of this study.

Market Nodes

Agricultural dry bulk markets were analyzed in the context of how they move today, how they had moved traditionally, the varied dynamics of world trade, and influences to shipping economics that may occur at coastal port interfaces. O/D pairs were identified that had specific relevance to the contextual goals of the project, particularly those O/D pairs with proximity to core market origins/destinations (farms or intermediate distribution facilities) within the study area, physical facilities to transfer the product at the origin/destination, and primary modal continuity between origin and destination.

As previously discussed, the majority of agricultural dry bulk shipments in the MRB Region are exports, with origins in market regions previously identified (Exhibit 2.6). Approximately 54% of the baseline market area agricultural dry bulk tonnage was identified as exports to foreign destinations, with the remainder exported out of the baseline market area to other domestic destinations. Exports to foreign markets were bound for eight general trade destinations:

- Canada
- Mexico
- Other Americas
- Europe
- Africa
- South & Central Asia
- East Asia
- Southeast Asia

2.2.2 Non-Agricultural Commodity Markets

<u>Non-Metallic Mineral Products</u>

Non-metallic mineral products are composed of a broad-based set of primary minerals and mined materials that are commonly used in the manufacturing of items typical of building materials, fertilizers, ceramic tile, concrete, and glass. The classification consists of three commodity groups of relevance to Missouri River freight: clay, cement, and various salt materials. The Task 3 output suggests a total non-metallic mineral products potential market size of about 1.8 million tons within the MRB Region.

Clay – The clay portion of the non-metallic mineral products commodity group is primarily used in the production of various tile products. Production of clay is somewhat localized compared to other broad-based shipping markets along the Missouri River. Few clay terminals are located along the River, and shipment of clay by water is currently conducted along a single route.

Cement – The cement portion of the non-metallic mineral products commodity group is closely tied with demand for concrete and ready mix operations aligned with various commercial and infrastructure projects. Distribution centers (Exhibit 2.9) serve large geographic areas and are generally located in or near population centers requiring infrastructure construction and experiencing commercial growth. Along the Missouri River baseline market area, two population centers have waterside cement distribution facilities (near the Jefferson City and Kansas City MSA's).

Salt – Considering the small quantity of salt that has recently shipped on the Missouri River, it has proven impossible to identify this market in detail (the material may have been used in downstream packaging or minor blending, but this has not been verified).

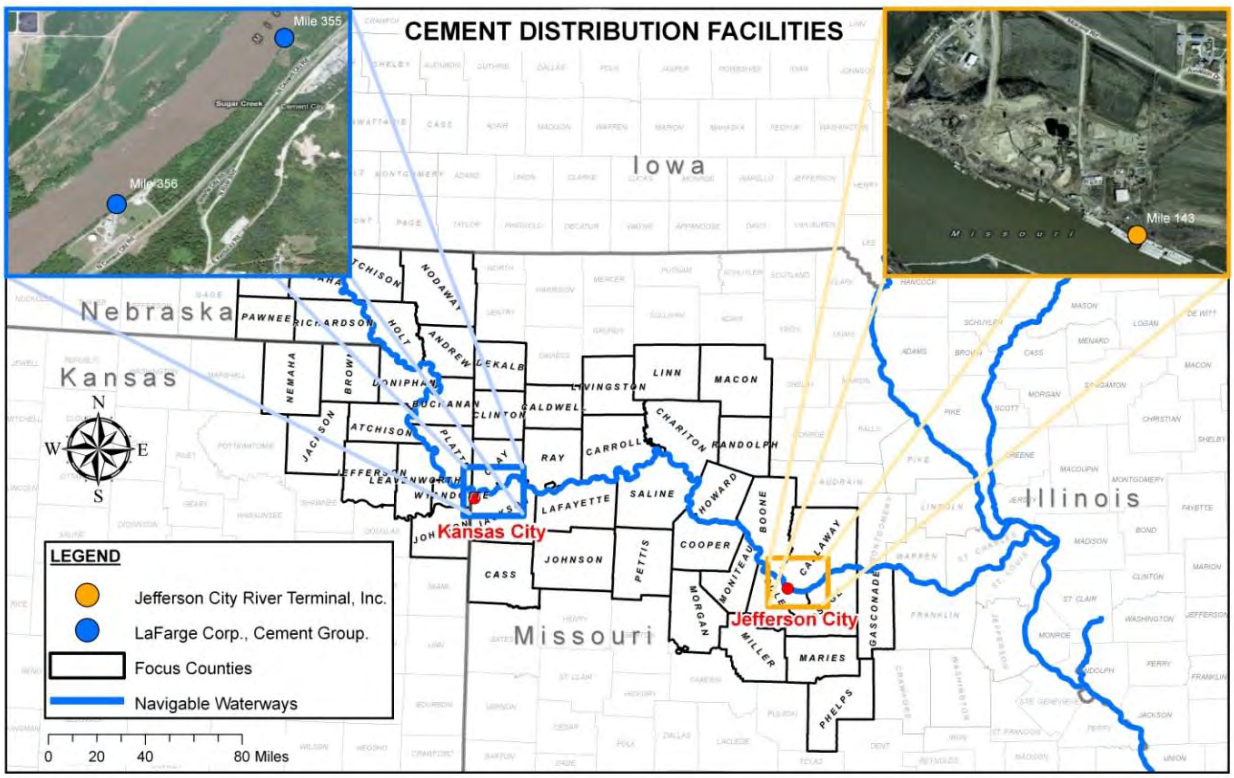


Exhibit 2.9

Market Potential

The non-metallic mineral products market potential is estimated to be approximately 190,000 tons, resulting from market growth, shiftable freight, and new opportunities. The

clay and cement volumes are expected to be well within the market grasp of the region within a short period of time when implemented as outlined in each product section, but the salt market will require additional market development.

Clay - As reported by the US Army Corps of Engineers (USACE) for the 2009 base market year, 16,677 tons of clay was shipped on the Missouri River, and the initial market potential is estimated to be about 20,000 tons. The demand for the product generally correlates to consumer demand in the housing market and discretionary spending, which were both down in 2009. The demand for clay from the baseline market area would likely parallel the forecast in Gross Domestic Product (GDP). According to the Congressional Budget Office's *Budget and Economic Outlook: Fiscal Years 2011 to 2021*, the economy will have a slow recovery with reduction of unemployment not reaching 5.3% until 2016. GDP will grow at a forecast pace of 3.4% from 2013-2016, but soften to 2.4% annually through 2021. It is likely that demand for clay will be impacted more by these national trends and less by local growth.

Cement – As reported by the USACE for the 2009 base market year, 57,358 tons of cement was shipped on the Missouri River, and the initial market potential is estimated to be about 120,000 tons. The Kansas City distribution center identified in Task 2 has the capability to receive cement by water, but presently does so primarily by rail. Facility management has reported interest in receipt by water and indicated an initial demand of 50,000 tons could be handled. Based on stakeholder comments related to the historical cement tonnage moved on the Missouri River, it is likely that tonnage could increase once reliability is shown and appropriate barge transportation equipment is identified. As the economy recovers and investment in infrastructure and commercial/residential construction picks up, the long-term market potential for cement is promising.

Salt – As reported by the USACE for the 2009 base market year, only 2,283 tons of salt was shipped on the Missouri River, and the initial market potential is estimated to be about 50,000 tons. Stakeholder surveys indicate a potential demand for salt shipments from southern Louisiana to the Kansas City Region. However, road salt in the area has not historically come from the southern Louisiana region directly by water. Waterside storage and distribution services would have to be developed over time, unless salt storage capability can be quickly integrated at an existing dry bulk terminal in the Kansas City Region.

Market Nodes

Clay – The clay market O/D pair consists of the Central Missouri Region and Oklahoma via the McClellan-Kerr Waterway (Exhibit 2.10). The modest volumes and customer service requirements result in what is likely a niche opportunity.

Cement – The cement market has several potential points of origin in and along the Mississippi/Illinois River systems from Chicago to New Orleans. The destinations generally consist of the major MSA's of Jefferson City and Kansas City that serve as local distribution centers, as shown in Exhibit 2.11.

Salt – Major salt market suppliers have mines in southern Louisiana that are located on islands or areas that can only be serviced by barge. Road salt received by barge is already routinely handled in the St. Louis area. The seasonal stockpile of the material fits well with the major population center destinations identified (Exhibit 2.12).

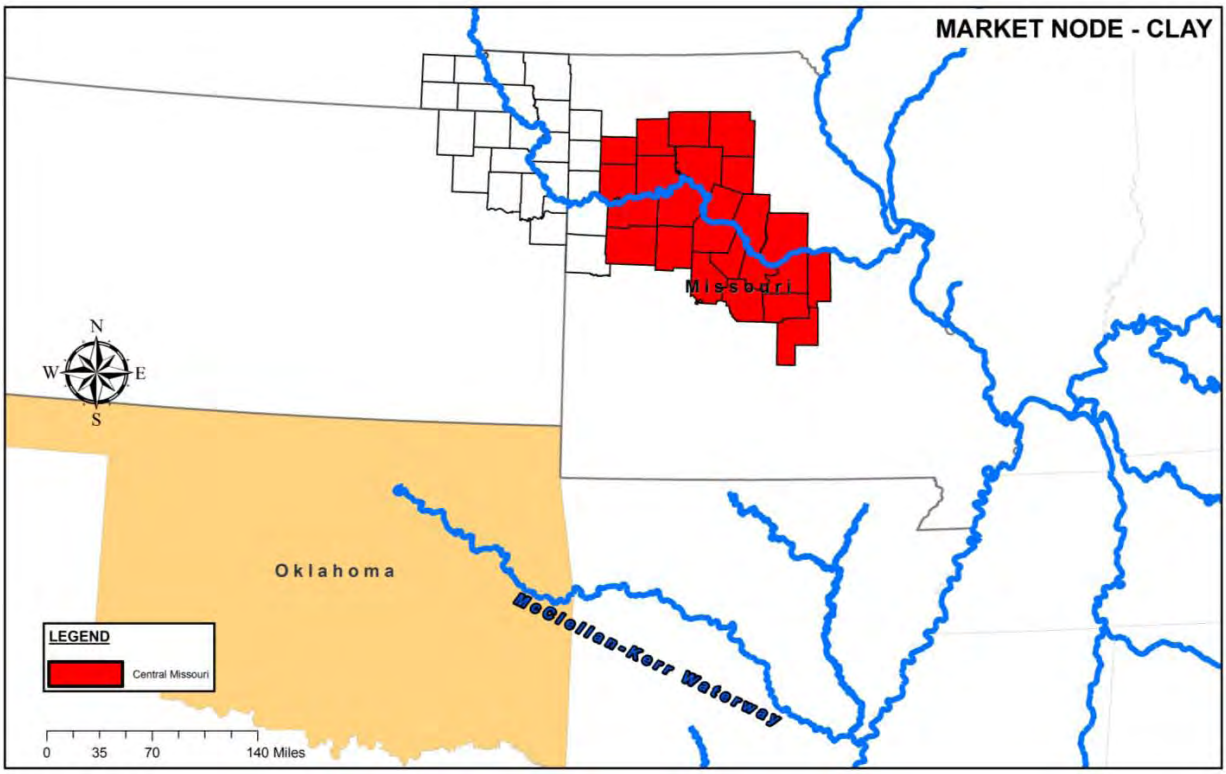
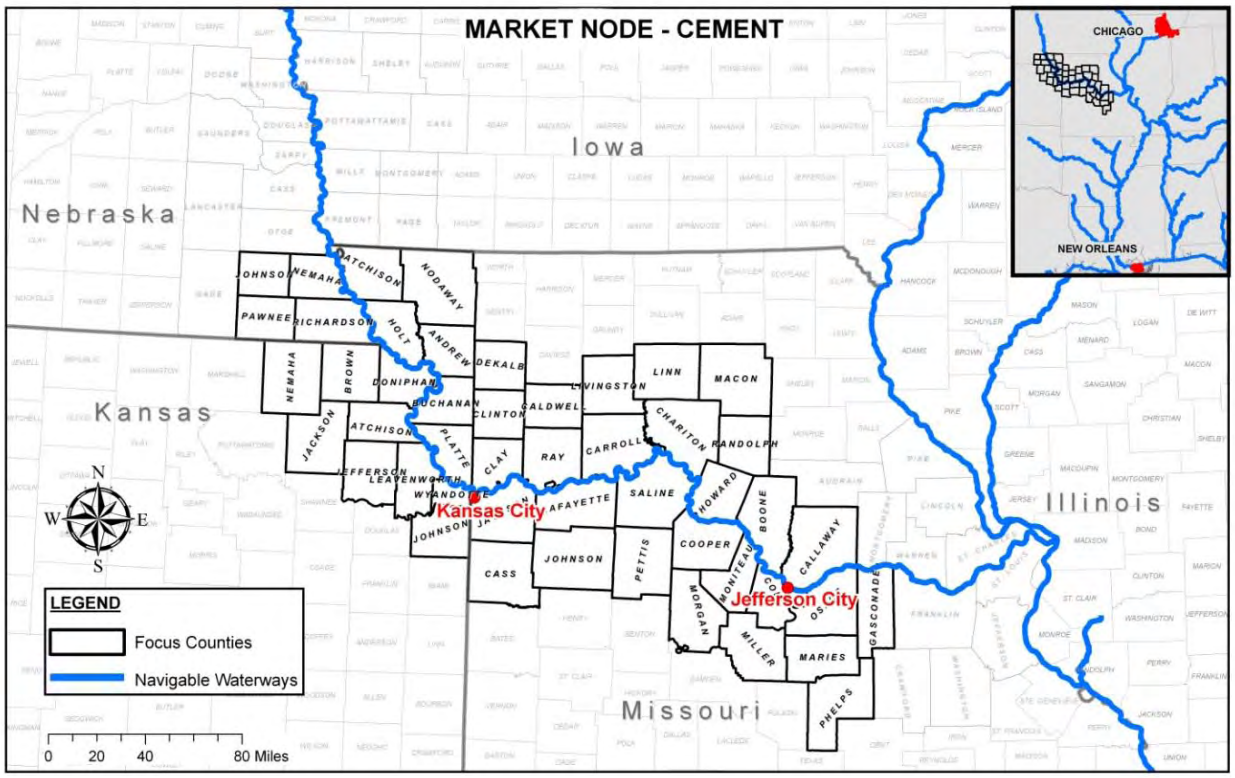


Exhibit 2.10



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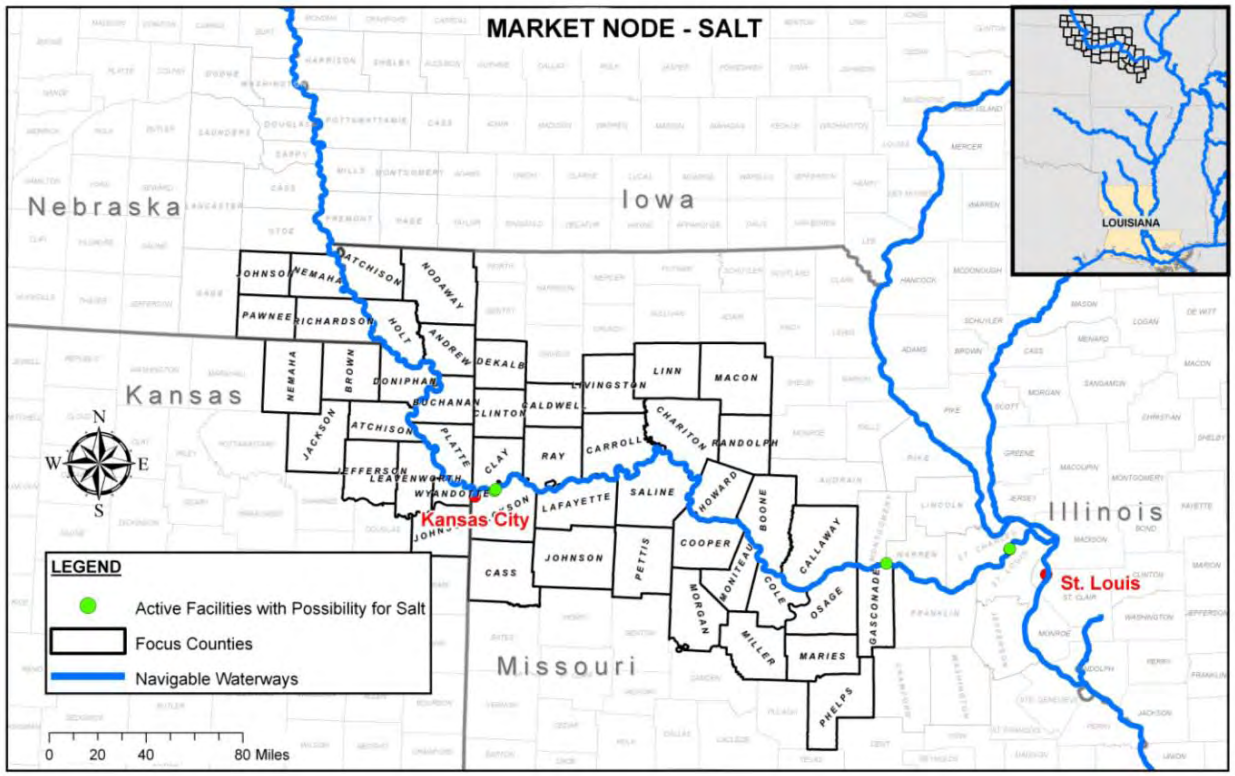


Exhibit 2.12

Fertilizer

Fertilizer is a prominent market group in the MRB Region and complements certain aspects of the much larger agricultural dry bulk market. Complementary movements involve the demand for fertilizer shipments moving into the region, counter the agricultural product demand for transportation service out of the region. Important to recognize is the economic benefit of potentially moving freight by barge in two directions (fertilizer inbound and agricultural dry bulk outbound), avoiding an empty backhaul and assuming product integrity can be maintained through barge cleaning services.

Market Potential

The Task 3 Report did not separately report a fertilizer market size and potential for the MRB Region, yet recognized it as an important component to the overall freight market. Fertilizer is currently moving on the Missouri River, and the potential to secure additional tonnage is significantly enhanced by that fact. As reported by the USACE for the 2009 base market year, 23,724 tons of fertilizer was shipped on the Missouri River. The total fertilizer market potential, based on estimated competitive market reach and geographic range, is approximately 2.0 million tons. The projected shiftable market tonnage for the baseline market area is approximately 1.6 million tons. Implementation of the strategies presented in Section 3.1.2 could result in an initial fertilizer market penetration and potential market shift on the order of 93,000 tons.

System Capacity

The Task 2 inventory identified a total of six fertilizer storage facilities within the baseline market area. Of those facilities, only one was determined to be active, and estimates indicate the facility has fertilizer storage capacity of about 45,000 tons and throughput capacity of about 225,000 tons (Table 2.2). On a regional basis, only the Central Missouri Region currently maintains fertilizer storage capacity.

Table 2.2 – Active Dry Fertilizer Facility Capacity Summary

Region	Facility	Location (Mi./Bank)	Approx. Capacity (tons)	Approx. Regional Capacity (tons)	5x Estimated Throughput (tons)	5x Regional Throughput (tons)
Central MO	AgriServices of Brunswick	256.2 L	45,000	45,000	225,000	225,000
KC Region	---	---	0	0	0	0
NW MO	---	---	0	0	0	0
			TOTAL CAPACITY:	**45,000**	---	**225,000**

The Task 2 inventory identified five inactive fertilizer storage facilities: one in the Central Missouri Region, one in the Kansas City Region, and three in the Northwest Missouri Region (Exhibit 2.13). Due to its unique properties, facilities are specifically designed to handle fertilizer. The life expectancy of fertilizer storage facilities is relatively short

compared to those used for the storage of agricultural dry bulk, and many facilities that were active a decade ago may no longer be serviceable.

System Constraints

The system has several potential constraints that may impact the feasibility of shifting additional fertilizer tonnage from truck and rail to a waterborne transportation option. The greatest constraint appears to be the availability of waterside facility capacity in areas of demand. The Central Missouri Region may be relatively balanced in terms of the capacity and demand, but the Kansas City and Northwest Missouri Regions are currently underserved in terms of fertilizer storage capacity and service capabilities.

Liquid fertilizer was not distinguishable from dry fertilizer in the data. The liquid market on the Missouri River was previously serviced by an operator that had multiple tank terminals located in proximity to riverside demand. As reported through survey comments and interviews, tanks were leased to third party entities on a throughput basis. This operator is apparently no longer in business, and the Task 2 inventory indicates the facilities are in a state of significant disrepair. Limited liquid fertilizer storage capacity exists along the River, but receipts are currently by rail or truck and significant market demand for a waterborne alternative has not been identified.

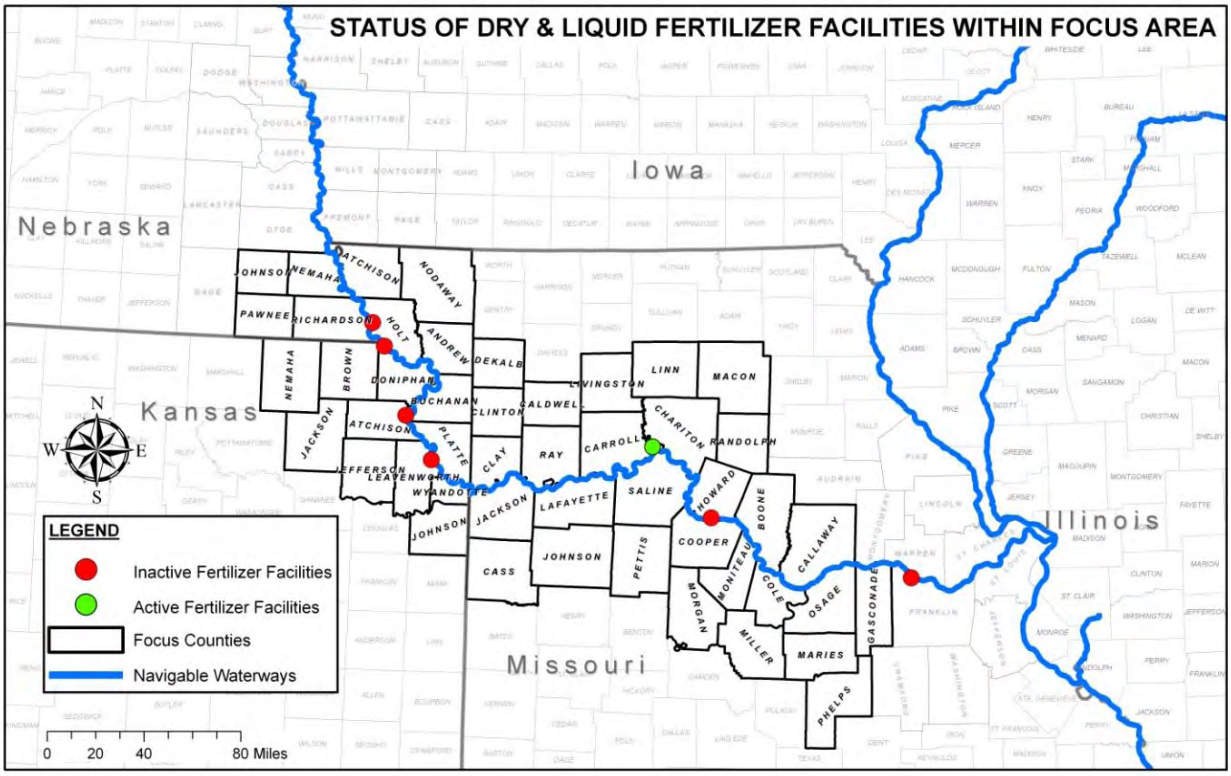


Exhibit 2.13

Market Nodes

Regional fertilizer markets generally correspond with regional agricultural dry bulk market locations – fertilizer demand aligns with agricultural dry bulk production yields. However, the economic reach of fertilizer facilities appears to be almost twice that found for the agricultural dry bulk market. Tonnage moved by truck was higher than rail, which may imply more localized, small quantity destinations and fewer large operations that could potentially benefit from the economies of scale provided by a waterborne option.

A review of O/D nodes indicated potential opportunities to create a shift to waterborne transportation from truck and rail on a few challenging segments. These segments include routes between the baseline market area and the following MSA's:

- Minneapolis
- Chicago
- St. Louis (IL)
- Tulsa
- Houston
- Arkansas

Within the baseline market area, the market volume is identified to be about 641,000 tons on those segments.

Petroleum Products

As reported by the USACE, 119,856 tons of petroleum products ("Asphalt, Tar, & Pitch") moved by water on the Missouri River in 2009. Asphalt has special terminal and transportation requirements. Of primary concern is the need to keep the product hot to accommodate handling between conveyance and landside tanks. Few terminals on the Missouri River currently appear to be capable of handling the product (Exhibit 2.14), and only one facility (a Kansas City terminal) appears to be actively utilizing barge capabilities for petroleum products. Of additional concern is the risk mitigation imposed on asphalt carriers and terminals associated with pollution, regulatory compliance, and insurance related to the transportation of petroleum products (especially those classed as grade #6 oil or below).

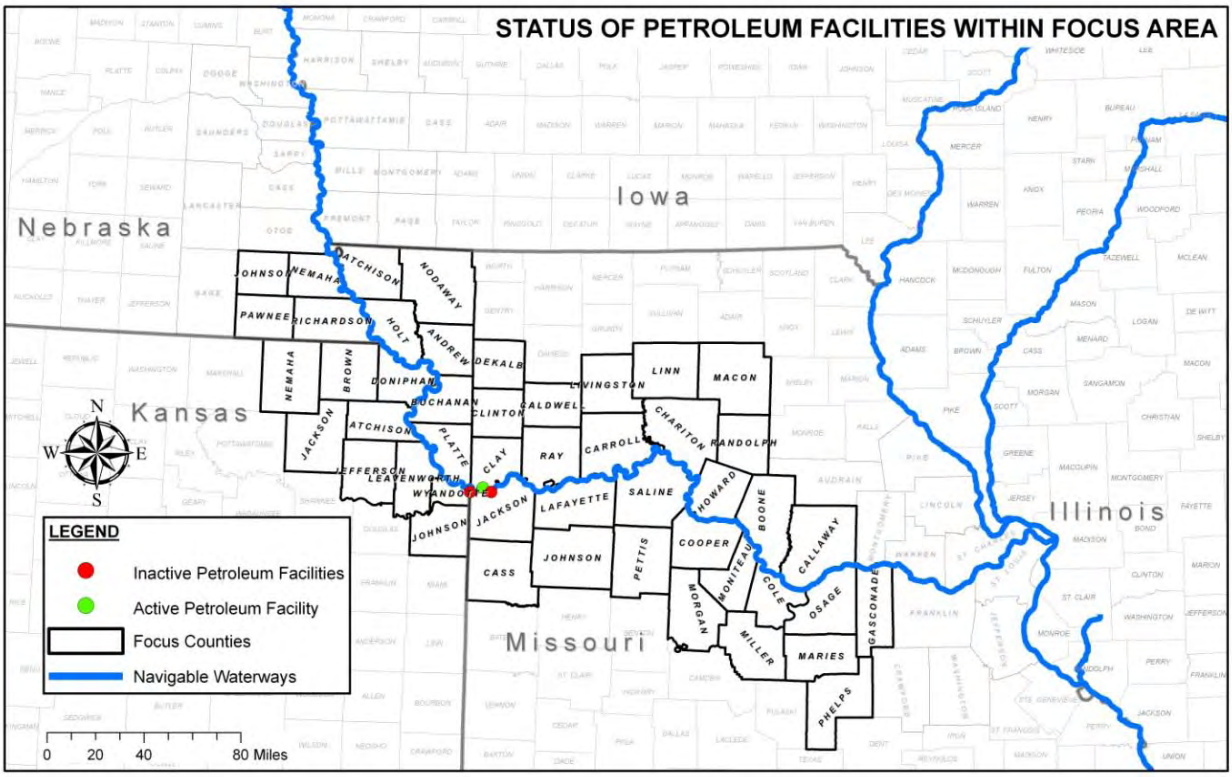


Exhibit 2.14

Market Potential

When evaluating the market potential for additional petroleum products (particularly asphalt) to shift to waterborne transportation options, further discussion regarding the unique supply chain issues related to this product is warranted. Many grades of asphalt are produced, depending on the intended application. Asphalt products with unique characteristics and volumes are produced from specific crude oils and refineries. For example, asphalt used in roofing materials, or other related commercial uses, is very different than asphalt used for road material and typically ships in smaller quantities. Therefore, the creation of a supply chain tends to develop long-lasting relationships between suppliers and distributors, with the match of supply and demand changing infrequently. This may explain the longevity of the supply chain to the existing Kansas City facility, even when Missouri River navigation has been challenged.

Survey responses indicate an initial waterborne market demand for approximately 138,000 tons of petroleum product shipments, which appears to roughly balance existing waterborne capacity and demand. Assuming Missouri River transportation continues to show sustained reliability, it is possible for future supply chain interest to shift to waterside refineries. Considering this possibility, additional regional petroleum product storage capacity would have to be developed, which would require a significant strategic capital commitment by a potential terminal operator. Thus, petroleum products are not envisioned as a strategic market for future growth opportunities.

Market Nodes

Petroleum product markets are presently considered intra-regional, with nodes in the St. Louis MSA and in the Kansas City Region. Task 4 market research did not provide any information on petroleum product origins/destinations or volume, except the volume currently moving on the Missouri River. This suggests that any additional tonnage in the region may be smaller than the shipment size threshold established for the identification of waterborne freight. More than likely, any additional demand for petroleum products is currently moved by rail or pipeline and could be sourced from many locations across the country, including inland refining locations. With increased demand, appropriate facilities, and river reliability, additional market nodes may develop.

Animal Feeds

The animal feeds freight classification generally consists of various agricultural materials, byproducts, and other nutrients that are processed into blended feed material for livestock, aquaculture, and other animals. With regards to material handling and storage requirements, animal feeds generally have similar characteristics to agricultural dry bulk. Examples of plant products used in animal feeds include:

- Forage material such as hay, alfalfa meal, and alfalfa pellets
- Grains such as corn, sorghum, and wheat
- Meals such as soybeans and canola
- Processed grains such as DDGS and corn gluten

Alfalfa Pellets –Similar to alfalfa hay, alfalfa pellets are a high-protein forage source primarily used as a cattle and equine feed ingredient. Regional alfalfa production is high, but it is concentrated in counties outside the baseline market area. In fact, most potentially shiftable alfalfa pellet production is located in Nebraska and Iowa. The product generally ships in bulk form, but it is susceptible to breakage while being handled or transported in pellet form.

Other Animal Feeds – Other animal feeds identified in the market area, especially DDGS (discussed in Section 2.3), are treated as emerging markets, as they have not traditionally been transported on the Missouri River, but may represent significant waterborne transportation potential.

Market Potential

Data from the USACE Waterborne Commerce Statistics Center[1] indicated 31,570 tons of “Animal Feed, Prep” was transported on the Missouri River in 2009. As reported, this commodity originated between Omaha, Nebraska, and Sioux City, Iowa, likely from a facility near Blair, Nebraska. Because this product shipped on the Missouri River in 2009, it indicates that barge service can be competitive, facility capacity can support

[1] http://www.ndc.iwr.usace.army.mil/wcsc/wcsc.htm

growth in animal feed commodities, and represents a core market opportunity for future freight growth, but it is not included in the shiftable baseline market area.

It is possible that shiftable tonnage could increase, but regional alfalfa competes with other states, namely Wisconsin, which has the highest domestic alfalfa hay production. Further, regional alfalfa production figures for 2010 and forecasts for 2011 indicate the cost has increased significantly (by approximately 50%) from 2009, which may impact its future regional competitiveness with other states.

Gravel & Crushed Stone

The gravel and crushed stone material moved by barge on the Missouri River for the 2009 base market year, as reported by the USACE, totals 116,920 tons. This tonnage was composed of “waterway improvement material” and represents material used for shoreline stabilization, channel maintenance, dike repairs, and general navigation system maintenance along the Missouri River corridor.

Market Potential

The 2009 volume reported by the USACE was distributed to two market regions: 28,621 tons was utilized in the region upriver of Kansas City, and the balance of 88,299 tons was utilized downriver from Kansas City. This material is generally brought in by barge and delivered directly to the construction site. Future gravel and crushed stone freight volumes are directly tied to available budgets and annual expenditures for USACE maintenance projects on the Missouri River.

Natural Sands

The natural sands market almost exclusively consists of sand and gravel dredged from the Missouri River. Therefore, this commodity has been a significant annual contributor to the total volume of freight moved on the River. However, this commodity is unique compared to most other commodities previously discussed, due to the fact that it does not typically move into or out of the system – it’s intra-regional. The material is dredged from specific areas within the system, as permitted by the USACE, and then barged to in-system waterside facilities for discharge and subsequent use for various purposes, primarily construction related.

In recent years, the industry has been required to prepare an environmental impact statement (EIS) in order to address National Environmental Policy Act (NEPA) requirements for USACE dredging permits. A final Missouri River Commercial Dredging EIS was recently completed, and according to an USACE news release dated April 1, 2011, permits were issued to six companies for dredging in 2011.

Market Potential

USACE data indicates sand and gravel dredging in the Missouri River peaked in 2002 at almost 9 million tons per year. However, since that time, annual dredging volumes have consistently decreased to 4.6 million tons in 2009, as reported by the USACE. The recently completed EIS recommends an "Environmentally Preferred Alternative" with extraction limits for each Missouri River segment, limiting total dredged volumes to almost 5.9 million tons annually from 2011 through 2015. Table 2.3 summarizes dredging activity by segment for the recent past, as well as proposed future dredging activities. The dredging segments are illustrated in Exhibit 2.15.

Table 2.3 – Missouri River Dredging Summary

Segment	Mile Mark	Annual Avg. 2004-2008 (tons/yr)	Max. Intensity 2004-2008 (tons/mi/yr)	To Be Allowed 2011-2015 (tons/yr)
St. Charles	0 - 130	1,706,895	245,672	1,710,000
Jeffereson City	130 - 250	1,633,852	272,049	1,630,000
Waverly	250 - 357	815,505	155,825	1,140,000
Kansas City	357 - 391	2,520,107	304,694	540,000
St. Joseph	391 - 498	326,928	92,836	860,000
TOTAL:	---	7,003,287	---	5,880,000

SOURCE: USACE, Missouri River Commercial Dredging EIS, Final EIS

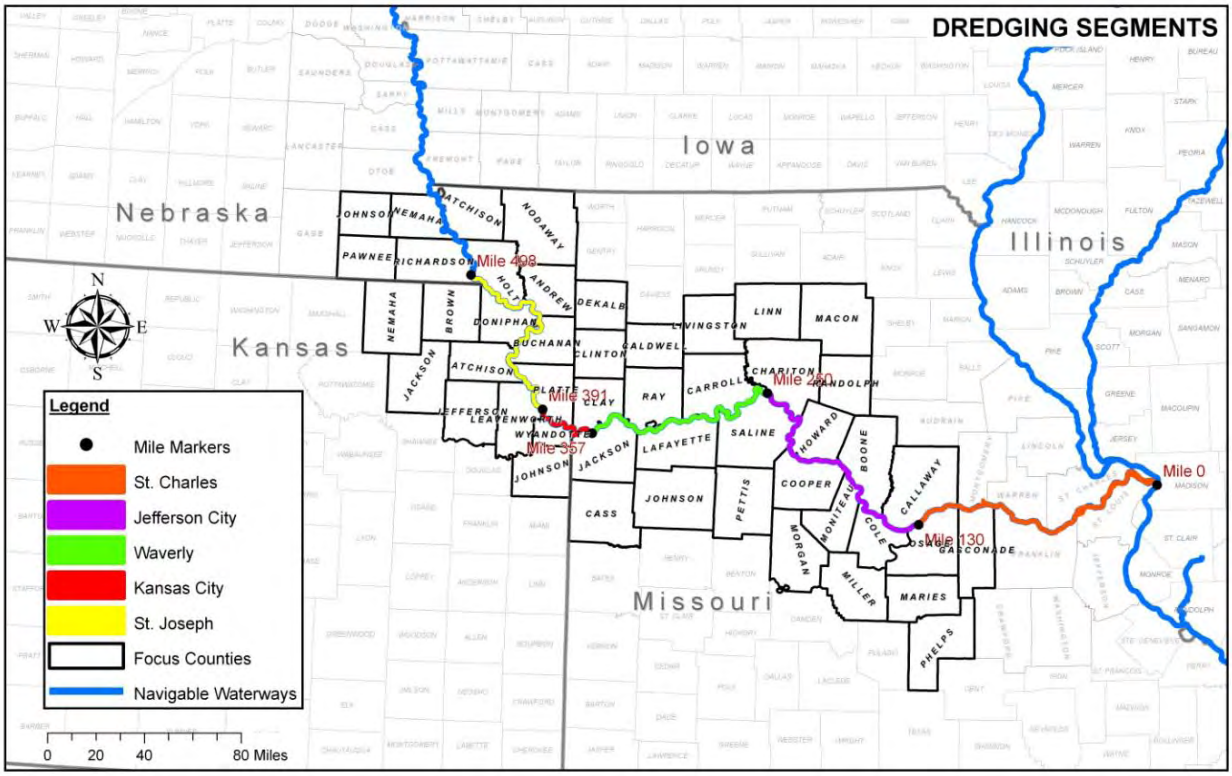


Exhibit 2.15

System Capacity

Based on information obtained from the aforementioned EIS, the natural sands storage capacity within the baseline market area is on the order of 2.6 million tons (Table 2.4). Note, this storage capacity estimate is almost half the total volume that will be permitted annually from 2011 to 2015. The greatest storage capacity is concentrated in the Kansas City region, as would be expected based on historic Missouri River dredging trends. However, due to these trends, dredging in the general Kansas City area will be significantly limited by future USACE permits.

The total storage capacity reported in Table 2.4 represents static storage at waterside distribution facilities shown in Exhibit 2.16. Assuming a modest average turnover rate of 2.5 times static capacity per year, substantial distribution capability is available to meet the permitted market as needed over a wide geographic distribution.

System Constraints

As discussed above, the natural sands market on the Missouri River is limited by USACE dredging permits. Further, change in commodity trends are not anticipated from the standpoint of natural sands continuing to move almost exclusively on an intra-regional basis. Facility capacity does not appear to be a constraint, based on historical performance and the data presented herein.

Table 2.4 – Sand/Gravel Facility Capacity Summary

Company	Plant Name	Location		Approx. Facility Storage Capacity (tons)	Approx. Company Storage Capacity (tons)
		County	Mi. Mark		
Capital Sand Company, Inc.	Washington	Franklin	65.4	150,000	653,000
	Jefferson City	Cole	143.5	202,000	
	Rocheport	Boone	186.3	68,000	
	Boonville	Cooper	196.6	50,000	
	Glasgow	Chariton	226.2	38,000	
	Carrollton	Carroll	287.0	10,000	
	Lexington	Lafayette	317.2	135,000	
E.N. Rau Contractor Company	Washington	Franklin	69.0	100,000	100,000
Hermann Sand & Gravel, Inc.	Hermann	Gasconade	96.9	150,000	300,000
	Jefferson City	Cole	146.6	150,000	
Holliday Sand & Gravel Company, LLC	Randolph	Clay	359.9	100,000	400,000
	Riverside	Platte	371.8	200,000	
	St. Joseph	Buchanan	447.7	100,000	
J.T.R., Inc.	St. Charles	St. Charles	16.7	60,000	100,000
	Riverview	St. Louis	31.2	40,000	
Limited Leasing	Ft. Belle	St. Louis	8.2	50,000	330,000
	Chesterfield	St. Louis	28.0	190,000	
	Bridgeton	St. Louis	44.0	90,000	
Master's Dredging Company, Inc.	Waldron	Platte	389.0	750,000	750,000
				TOTAL:	**2,633,000**

SOURCE: USACE, Missouri River Commercial Dredging EIS, Final EIS

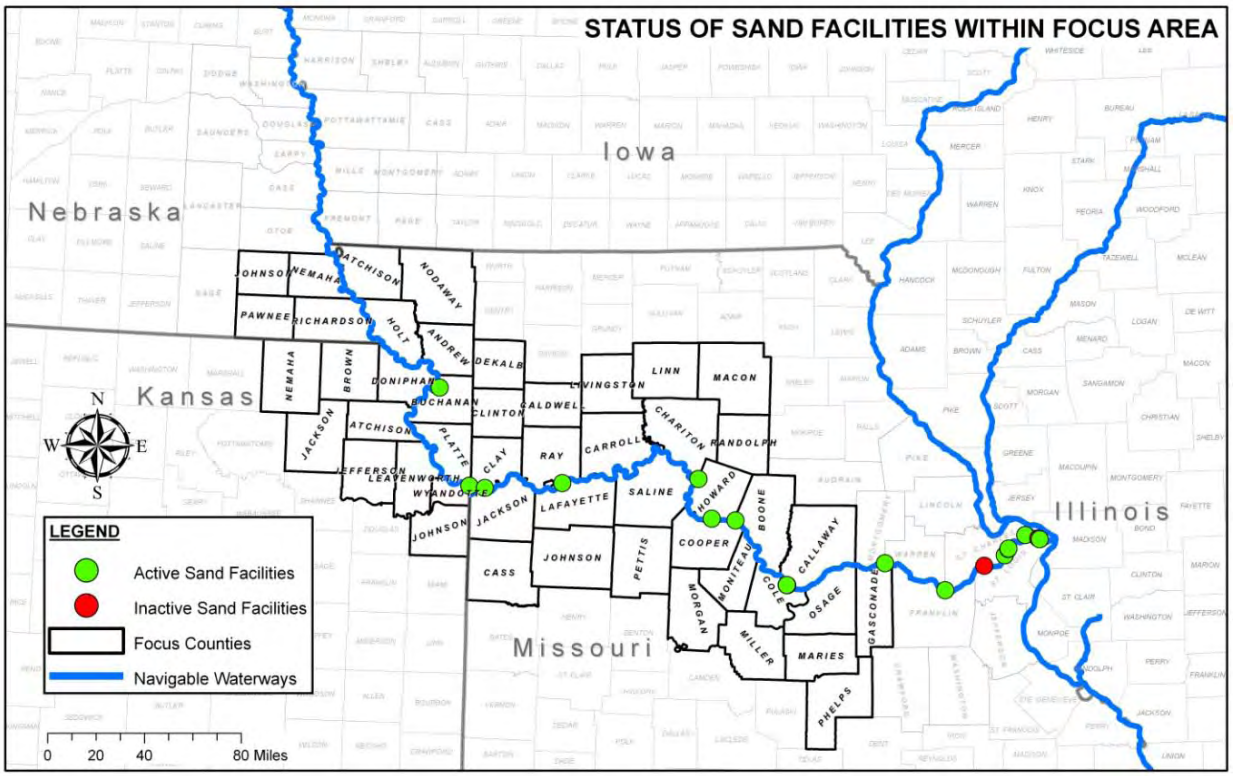


Exhibit 2.16

2.3 Emerging Markets

Emerging markets represent an important part of the overall Missouri River freight development opportunity. Emerging markets are defined as freight opportunities that represent new commodity markets within the baseline market area. As compared to traditional markets, emerging market commodities generally differ in form and material handling requirements. Therefore, the emerging market will not be able to capitalize on much of the existing infrastructure and will be more challenging to develop in terms of Missouri River freight movements. However, the emerging markets represent current opportunities with significant potential freight volumes, increased public safety, improved air quality, and economies of scale that may result in reduced costs to consumers through the shift to waterborne transportation.

<u>Waste/Scrap</u>

The waste/scrap commodity market is primarily composed of scrap steel, but it also includes other recyclables such as waste paper, wood fiber, and non-ferrous materials. Auto shredders are a major source of scrap steel – the number of US auto shredders has increased significantly in the past ten years, and facility capacity has nearly doubled during that time. Several shredders are located within the MRB Region, including facilities in St. Louis, Kansas City, St. Joseph, Omaha, and Sioux City. However, the Task 2 inventory indicated only one waterside scrap facility within the baseline market area, and that facility appears to be inactive (Exhibit 2.17).

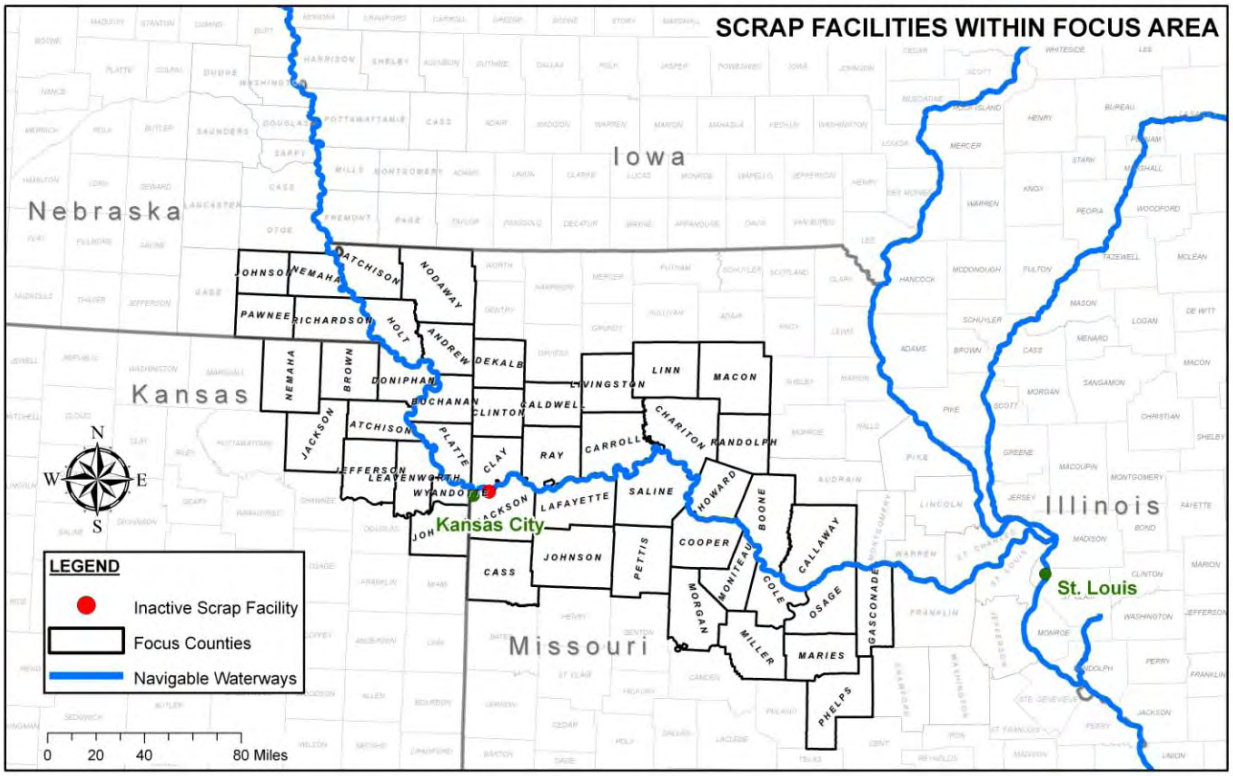


Exhibit 2.17

In recent years, approximately 25% of the annual US scrap market tonnage was exported, with a record high of nearly 25 million tons exported in 2009 and about 22 million tons projected in 2010. Primary export destinations include China, Turkey, South Korea, and Taiwan. Scrap was most commonly shipped in bulk, with some shipments by container.

Market Potential

Task 3 output indicates an intra-regional scrap/waste market size of almost 671,000 tons that shipped by truck from the Kansas City area to the St. Louis area in 2009 (Table 2.5). Unfortunately, the data does not differentiate between steel scrap and other recyclables; however, it is likely that steel recyclables represented the majority of this tonnage. Note, non-steel waste/scrap is not generally conducive to shipping by barge.

Conservatively assuming 50% of the intra-regional waste/scrap tonnage shown in Table 2.5 was composed of steel, the market potential for a shift to waterborne transportation is significant at about 335,000 tons. Estimates indicate an initial market penetration on the order of 30% of the presumed steel waste/scrap market, or approximately 100,000 tons potentially shifting to a waterborne freight alternative on the Missouri River.

Table 2.5 – 2009 Intra-Regional Waste/Scrap Summary

Origin	Destination	Mode	2009 Total (tons x1000)
Kansas City CSA (MO)	St. Louis CSA (IL)	Truck	13.89
Kansas City CSA (KS)	St. Louis CSA (IL)	Truck	0.01
Kansas City CSA (MO)	St. Louis CSA (MO)	Truck	650.72
Kansas City CSA (KS)	St. Louis CSA (MO)	Truck	6.35
		TOTAL:	**670.97**

2009 Waste/Scrap Domestic Commodity Movements SCTG 41 (ferrous scrap code 41120)

Coal (Bituminous Coal and Lignite Surface Mining)

As a power generation feedstock, coal was transported by barge on the Missouri River many years ago. The state had 56 coal-fired power generation stations at 24 locations in 2005. Most coal-fired facilities in Missouri receive coal by rail, but some facilities located adjacent to the Mississippi River receive coal by barge.

Missouri coal mines produced 394,000 tons of coal in 2006 (0.03% of the U.S. total), making Missouri the second-smallest coal-producing state in the country. According to the American Coal Foundation, Missouri uses 34 million tons of coal annually for 83% of its power generation needs, ranking it 10th nationally in state coal consumption.[2]

A regional review of power providers was undertaken, as well as conducting phone interviews regarding operations of coal-fired facilities in close proximity to the Missouri River. Four (4) facilities were identified as exhibiting potential for coal shipments by barge on the Missouri River (Exhibit 2.18):

- Marshall Municipal Steam Plant
- University of Missouri-Columbia Power Plant
- Columbia Municipal Power Plant
- Chamois Power Plant

[2] http://www.sourcewatch.org

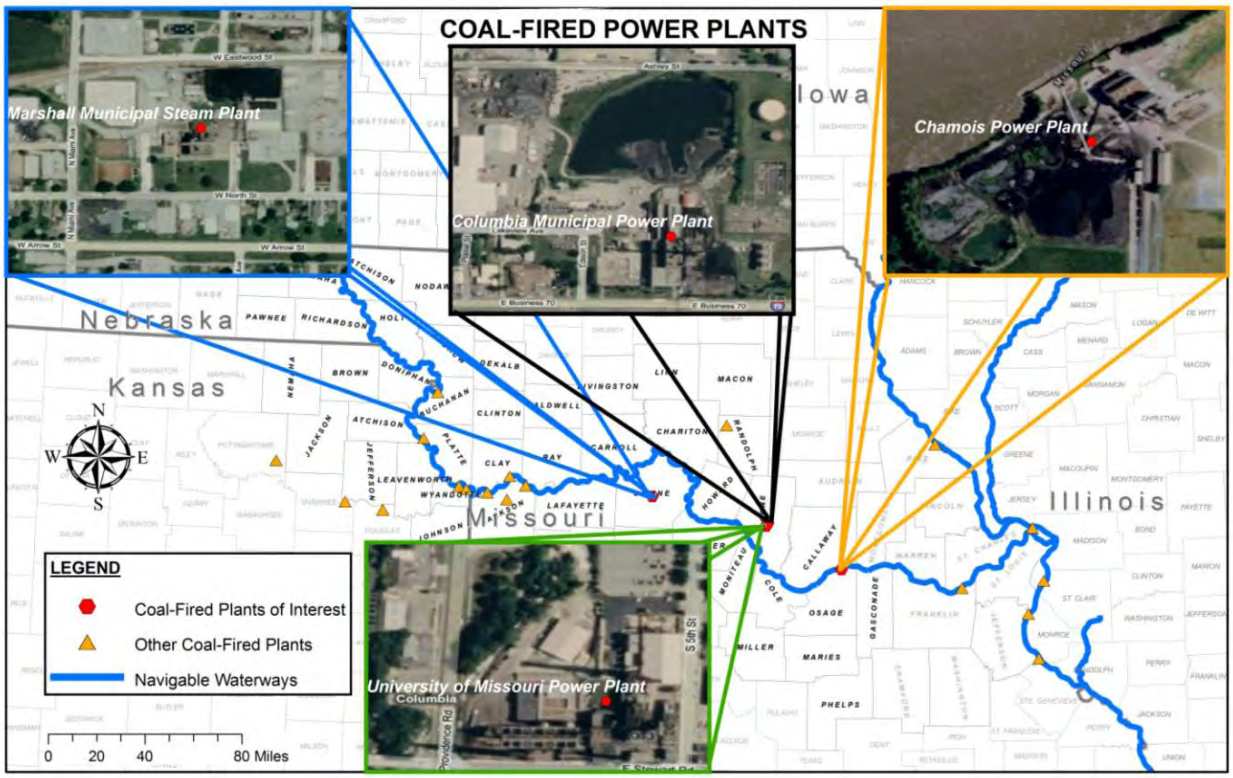


Exhibit 2.18

Market Potential

Three (3) of the identified facilities indicated that they receive some or all of their required coal from sources outside the region. These shipments originated in eastern states that reportedly have available barge access. Based on this information, a barge transportation opportunity may develop with coal volumes projected to be on the order of 200,000 to 250,000 tons annually. Developing this commodity market may create a niche transportation and terminal opportunity in three Missouri River locations: Jefferson City, the Brunswick/Miami area, and Chamois.

Survey responses indicated the Chamois plant did receive coal by barge at one time, but as noted in the Task 2 inventory, the material handling equipment has fallen into disrepair. A review of the Task 3 output suggests coal shipments originate from two locations in Illinois, and the volume trucked from these two locations is approximately 236,900 tons annually. The coal sources, as reported by plant managers, have barge loading capability for product that is currently trucked. Coal is also transported from Pennsylvania to Nebraska, but additional investigation may be required to determine the targeted destination. If waterside loading capability exists at the Pennsylvania origin, a 64,000-ton long-haul market opportunity may exist from there to destinations in Northwest Missouri or further north to Nebraska.

Liquid Fertilizer

Liquid fertilizer is an important commodity to the overall region and, like dry fertilizers, varies in type depending on the requirements of the crop and conditions. No liquid fertilizer is currently reported to be moving in the baseline market area by waterborne transportation, but it once was received by barge at a number of locations (Exhibit 2.19). Most of those locations were reviewed during the Task 2 inventory and were reported to be under single ownership, but the current ownership status of those sites is unknown.

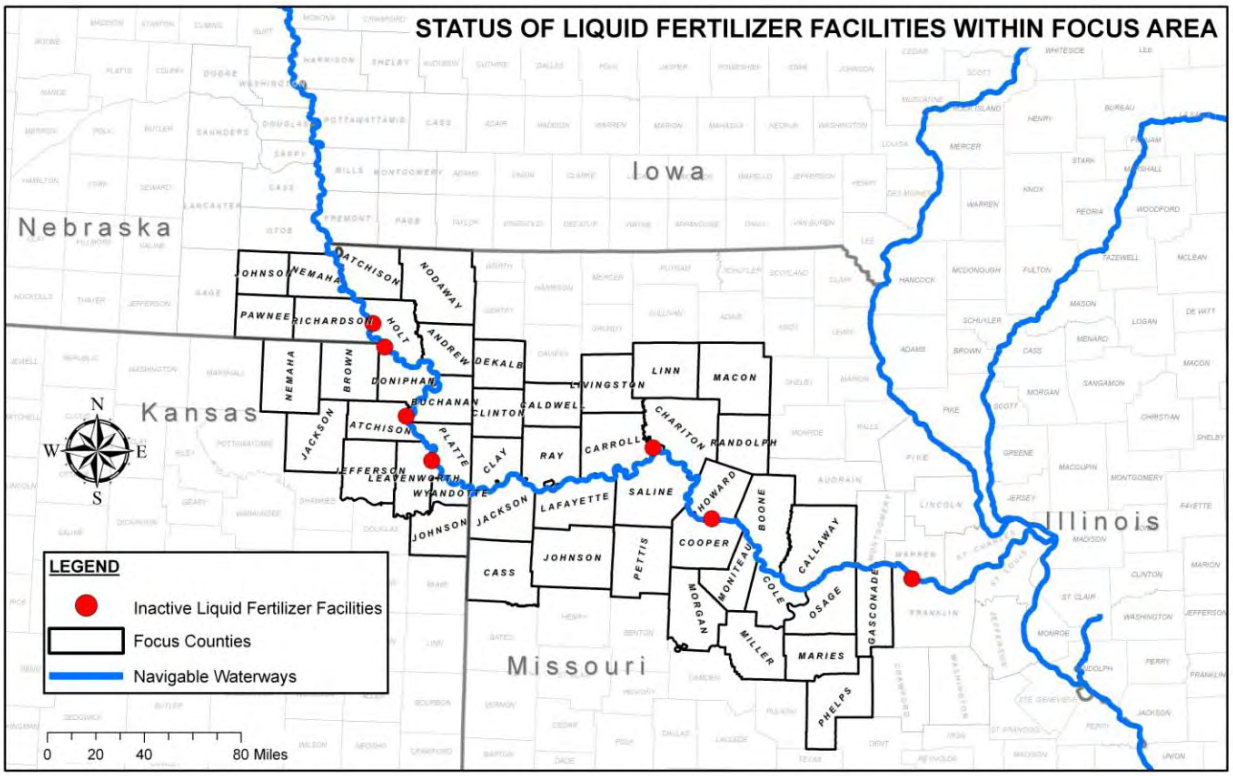


Exhibit 2.19

Market Potential

The Task 3 output did not identify an existing liquid fertilizer market in the baseline market area, although it is assumed that a market likely exists, based on survey responses. USACE data suggests a former baseline market area liquid fertilizer storage capacity on the order of 130,000 tons. Assuming sufficient facility capacity is developed or redeveloped, potential demand may approach 150,000 tons annually on a throughput basis, with initial waterborne transportation market penetration estimated at about 50,000 tons annually.

Ethanol

Ethanol production facilities are generally concentrated near the Corn Belt areas of the Midwest, as shown in Exhibit 2.20. In 2004, ethanol was transported by roughly one-third each rail, truck, and barge. As the industry has evolved, the long distances from production facilities to primarily coastal demand centers make truck transportation of ethanol non-feasible from an economic perspective. By 2005, two-thirds of all ethanol produced was transported by rail and only 10% by barge, due largely in part to the relatively limited river access of many ethanol plants.

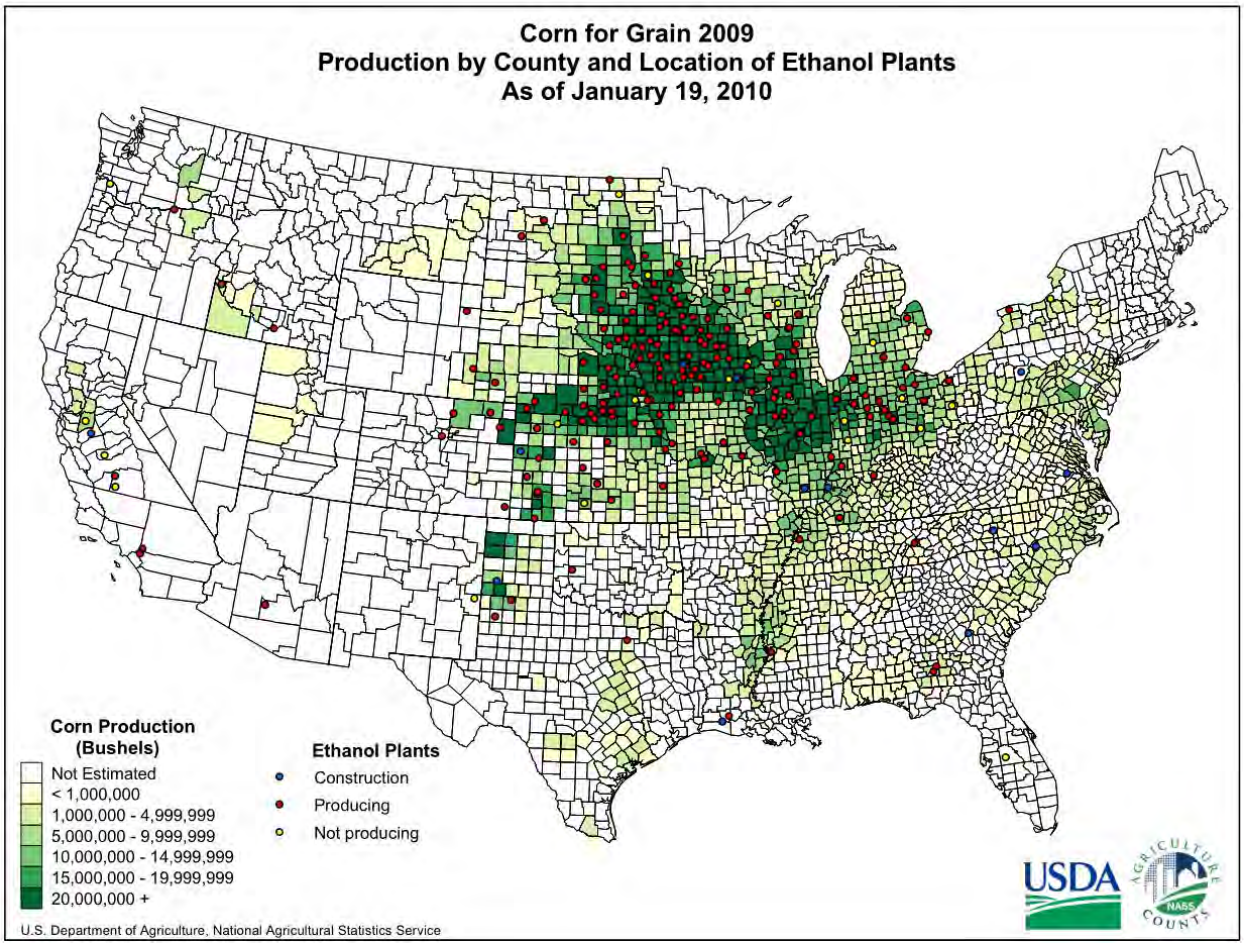


Exhibit 2.20

Market Potential

An evaluation of ethanol plants within the market area and in relatively close proximity to the Missouri River was conducted and is summarized in Table 2.6. The summary of ethanol producers and annual volumes suggests regional production is likely sufficient to support a waterborne transportation option on the Missouri River. An alternative to truck and rail increases competitive transportation options, and it may increase competitive destination alternatives as well.

Table 2.6 – Ethanol Production Facilities Summary

Facility	Location	Annual Production		
		Gallons	Barrels	Tons
Mid-Missouri Energy	Malta Bend, MO	40,000,000	952,381	131,690
Show Me Ethanol	Carrollton, MO	55,000,000	1,309,524	181,074
LifeLine Foods	St. Joseph, MO	50,000,000	1,190,476	164,613
MGP Ingredients	Atchison, KS	2,000,000	47,619	6,585
Golden Triangle Energy	Craig, MO	20,000,000	476,190	65,845
Green Plains Renewables	Shenandoah, IA	65,000,000	1,547,619	213,996
	TOTAL:	**232,000,000**	**5,523,810**	**763,802**

SOURCE: Ethanol Pruducer Magazine

Considering the accessibility of primary ethanol destination terminals along inland waterways (Chicago, New Orleans, and Houston, for example), the use of barge transportation may be economically and logistically feasible. The approximate 232 million gallons of ethanol production identified in Table 2.6 is equivalent to 5.5 million barrels, or about 764,000 tons annually. The initial market penetration is estimated at about 63,100 tons per year. In order to serve this potential barge transportation market, reliability of Missouri River navigation will be a necessity.

See the USDA Ethanol Transportation Backgrounder[3], September 2007, for charts and notes to support the discussion above.

Dried Distillers Grains

Distillers grains are a byproduct of the distillation process and are commonly used in animal feeds. Traditionally originating from breweries, distillers grains are more recently being produced as a byproduct of the ethanol production process. Wet distillers grains (WDG) have a limited shelf life of only four to five days, their moisture content is about 70%, and they are not generally considered compatible with barge transportation. However, dried distillers grains with solubles (DDGS) have a nearly indefinite shelf life and only contain about 10% moisture. As a commodity, DDGS is typically transported by similar means as other agricultural dry bulk products.

Market Potential

As previously shown in Table 2.6, six ethanol plants are located in relatively close proximity to the Missouri River within the market area. Combined and at full capacity, these facilities can produce about 232 million gallons of ethanol per year, which based on anecdotal production information, corresponds to about 790,000 tons of DDGS. Initial DDGS market penetration is conservatively estimated at about 50,000 tons annually.

[3] http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5063605&acct=atpub

Given the overall ethanol production capacity within the MRB Region, DDGS appears to represent a potentially significant Missouri River freight opportunity. Overall system opportunity could well exceed the estimated market opportunity. The DDGS market potential is further enhanced by industry projections indicating strong export growth, highlighting the importance of connections to the Lower Mississippi River and Gulf of Mexico ports.

Container-on-Barge

The Task 3 output did not strongly suggest Container-on-Barge (COB) was a viable commodity group that could easily shift from current modal preferences to a waterborne option. The primary reasoning: a high percentage of retail consumer products are shipped via COB, and modeling is ultra-sensitive to inventory carrying cost and, therefore, transit time.

Recognition that COB has its place as a means to transport goods is important. However, COB in itself cannot serve all truck or compatible freight types equally or efficiently. COB requires consideration of door-to-door conceptual delivery service and generally is not successful if viewed only as a port-to-port freight opportunity. Single port origin or destination, however, does simplify the business model and is one reason why international freight connections appear to have greater COB success than domestic containerized freight.

The identification of a freight opportunity does not necessarily drive the decision to use COB as the preferred mode of choice. Containers are primarily ocean carrier controlled equipment and, as such, are an asset that will be managed to maximize profitable use. Therefore, profitable equipment control dictates that containers are assigned to carry a load between any two points, dependent on transportation time and price. Significant communication is required between shippers and ocean carriers, or through intermediaries, to determine if and how COB equipment will be provided for inland barge movements.

Market Potential

A closer look at future COB markets may yield insight into potential supply chain and carrier equipment control strategies for a few commodity groups. Examples of potential commodity groups that may lend themselves to containerized shipment from the Missouri River region include DDGS, Identity Preserved (IP) grains, and those movements that can match imported containers received through Gulf of Mexico trade gateways.

Ocean carrier equipment decisions are beyond the scope of this project; however, the initial decision must rely upon market viability to ship via container. Answers to the following questions provide insight into market viability:

- Assuming acceptable equipment can be made available, what market(s) are available for container shipment?
- What issues need to be considered in market development?
- What are the infrastructure and water service needs that have to be addressed for success?

The opportunity to secure a COB market for the Missouri River is not immediate and will not likely be tapped on a regular basis until sometime beyond a five year horizon. However, spot opportunities for shipments of large tonnage may be available, as well as empty container repositioning for ocean carriers.

Over-Dimensional/Over-Weight

Over-Dimensional/Over-Weight (OD/OW) is an emerging market for the Missouri River. Project shipments have been and are expected to continue to be a source of spot opportunity for specialized carriers. Although some terminal operators have reportedly promoted their market locations for targeted OD/OW commodities, success has been limited or elusive to date.

The Task 3 output identified spot movements of large equipment, such as stamping presses, power generation equipment, large diameter tanks, and process units. However, the Task 3 data did not recognize the OD/OW movements that are an ongoing challenge for state highway departments. The increasing OD/OW movements by truck corresponds to increasing conflicts between trucks and the driving public, not to mention the disproportionate wear on highway infrastructure.

Additionally, the development of alternative energy, particularly in the form of wind farms, appears to have gained momentum for the foreseeable future. Task 3 ranked the top 10 project cargoes by unit value, and wind energy components ranked second. Wind energy construction components are almost entirely in the OD/OW classification.

Highway OD/OW

The U.S. Department of Transportation (USDOT) Maritime Administration (MARAD) Marine Highway Program identifies waterway corridors that have the potential to serve as an alternative to the Interstate Highway System. In Missouri, two waterway corridors are designated: M-70, which generally parallels I-70 in an east/west orientation, and M-55, which generally parallels I-55 in a north/south orientation. Both marine corridors intersect in the St. Louis area, as shown in Exhibit 2.21.

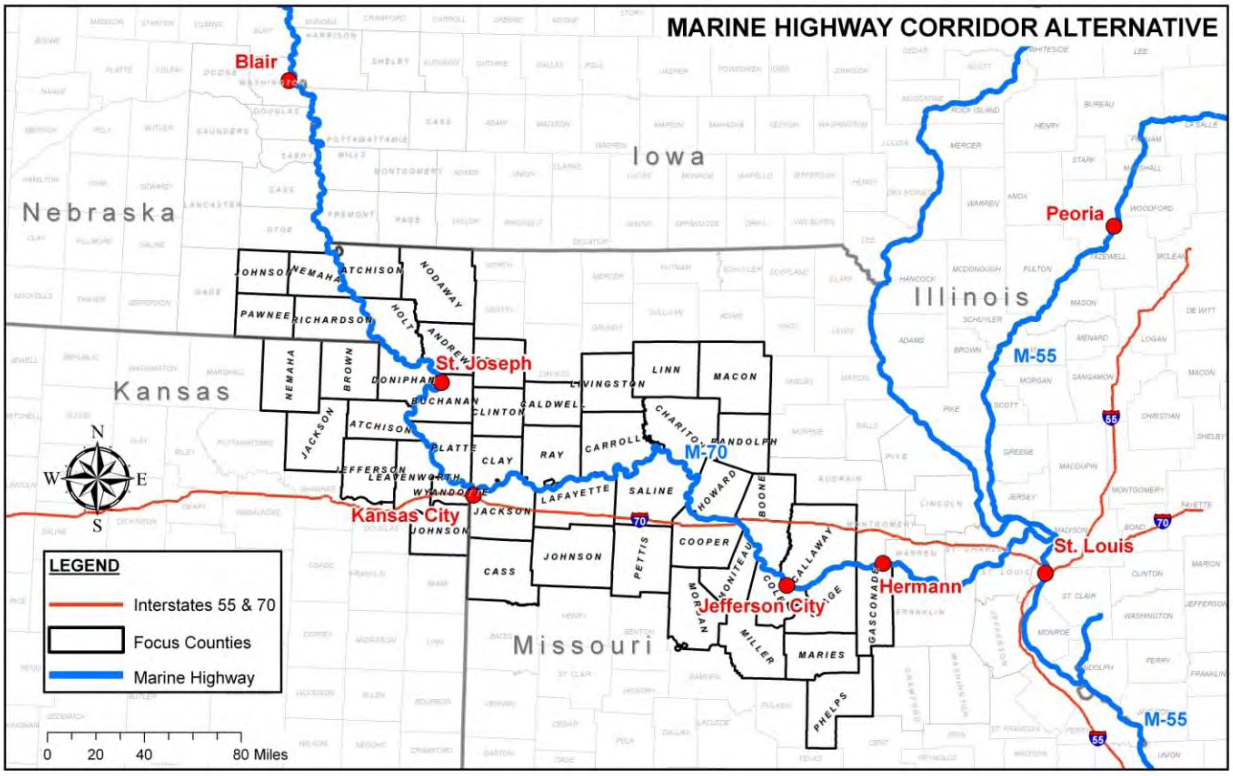


Exhibit 2.21

Market Potential

The Task 3 freight analysis utilized FAF3 data, which is based on historical reported freight movements and sorted by specific commodity groupings. Recognizing a potential future shift of OD/OW commodities may include many movements not captured in the Task 3 output, a broader data set was sought. OD/OW freight is differentiated by the necessity to acquire permits for transport on highways. Permits are issued by individual state DOT's to those trucking firms that will conduct the transport, so permitting for long-distance movements is more complex. In order to control or reduce highway wear, permits are required for loads of excessive length, width, and/or height, and loads of significant weight that exceeds gross and/or axle limits.

A data set of MoDOT issued OD/OW permits was obtained in an attempt to acquire additional market data. The data set included all permits issued during the 12-month period from 12/21/2009 to 12/21/2010, which consisted of 127,000 line items. The permit data set contained O/D pairs, freight classification, and mileage between O/D pairs. Sortable route determination could not be derived from most movements.

In order to estimate a potential applicable highway OD/OW market, sort criteria was developed for the MoDOT data set to eliminate commodities that were not conducive to waterborne transportation. Additionally, sort criteria identified movements that were too short to maximize waterborne transportation benefits, as well as O/D pairs that were not generally parallel to the Missouri River. Resulting permit data was culled to identify O/D

pairs that represent potential marine highway cargo activity centers. In analyzing the market for highway OD/OW, the resulting permit data identified applicable freight movements in the St. Louis, Kansas City, and St. Joseph corridor (Table 2.7).

Table 2.7 – M-70 Annual Applicable Moves

Origin	Destination	Movements
St. Louis	Kansas City	1,341
Kansas City	St. Louis	2,783
St. Louis	St. Joseph	417
St. Joseph	St. Louis	714

Table 2.7 data underestimates the total potential market from these regions, since all "unique" local O/D pairs could not be efficiently sorted from the MoDOT data set. The selected points identified freight movements through the state from O/D pairs entering and exiting state lines. However, the data does indicate a potential market which could substantially benefit the I-70 and M-70 corridor by reducing truck traffic and increasing barge freight movements, respectively. Further market analysis is recommended for this specialized market to expand it from spot shipments to a more general highway option.

Wind Energy OD/OW

The wind energy industry in the US is continuing to grow at a rapid pace. Currently, the most common equipment being installed is the 1.5 megawatt (MW) turbine. The blade associated with this turbine is typically in the 100 to 125-foot range in length and weighs on the order of 7.5 tons. Despite their large size and the coordination and permits required, wind turbine components are primarily transported on highways from ports and/or manufacturing facilities to wind farms, but some O/D pairs can be rail served. Wind turbine energy output is continuing to increase, now approaching 2.5 to 4 MW. The blade associated with this turbine is typically in the 125 to 160-foot range and weighs on the order of 10 tons. The nacelle associated with these larger turbines weighs approximately 80 to 90 tons. The larger wind turbines will only make the feasibility of transporting their components via highways more difficult in the future.

The central portion of the country, from Texas north through the Dakotas, represents the best conditions in the continental US for wind energy generation, as shown in Exhibit 2.22. As indicated, there is significant wind energy generation potential in Kansas, Nebraska, Iowa, and South Dakota, which are all areas potentially served by freight transportation on the Missouri River.

Although several wind turbine manufacturing facilities have opened in the US in recent years, domestic production does not meet current demands. Thus, many wind turbines are imported and transported to wind farms from coastal ports, including those along the Gulf of Mexico. Rather than trucking the turbines from southern ports, it may be feasible to barge them the majority of the way to their final destination by utilizing the Mississippi and Missouri Rivers.

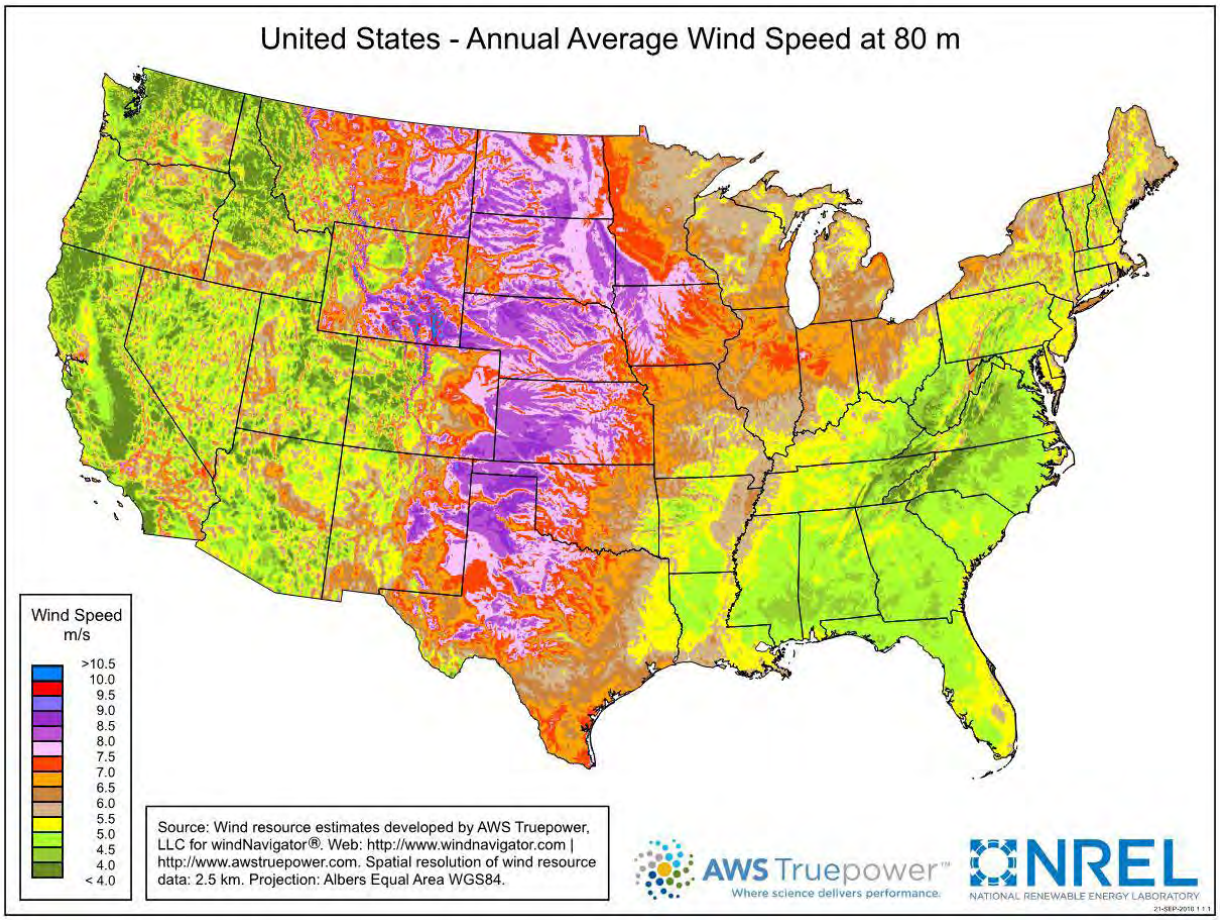


Exhibit 2.22

Oil & Gas Equipment

Oil and gas exploration in the north-central portion of the US has expanded greatly in the past decade. Primarily within Canada and the states of Montana and North Dakota, the area known as the Bakkan Formation was originally estimated in 1995 by the US Geological Survey (USGS) to contain around 150 million barrels of oil. That estimate was subsequently updated in 2008 to between 3 and 4.3 billion barrels of technically recoverable oil. As of 2007, around 105 million barrels of oil had been recovered from the Bakkan.

Potential may exist for the Missouri River to play a role in the oil and gas industry exploration in this area. Currently, the vast majority of oil drilling and refining infrastructure is located in and around the Gulf of Mexico. As drilling expands in the Bakkan Formation, additional drilling equipment will be needed. Thus, the Mississippi and Missouri Rivers may play a role in moving essential oil and gas exploration equipment to this region.

Similarly, recovered oil and gas will need to reach the existing refining infrastructure located in the Gulf of Mexico region. However, the Missouri River will likely play a very

limited role in transporting recovered oil to the Gulf region, due to the construction of the Keystone Pipeline project. The Keystone Pipeline is a 36-inch diameter pipeline currently connecting the Canadian portion of the Bakkan Formation to facilities in Cushing, Oklahoma. The pipe will ultimately traverse to existing refining infrastructure in the Port Arthur, Texas area.

2.4 Market Penetration & Stakeholder Actions

A variety of markets have been identified above that meet criteria conducive to a modal shift to waterborne transportation. In order to estimate the freight volumes that may shift, a balance between terminal capacity/availability and barge capacity must be established. The projected barge capacity, as a proportion of the market size, indicates the percentage of the market that has the potential to shift to the Missouri River. Market penetration is provided in the Concepts of Operations (Section 3), but in summary, the potential for traditional market penetration is approximately 817,000 tons, while the emerging markets represent an opportunity for an estimated 517,000 tons of freight.

The Task 4 analysis centered on markets that represent actual freight movements and met specific criteria that could empower stakeholders to facilitate a shift from truck and rail to barge on the Missouri River. The empowerment of stakeholders originates from understanding an enormous amount of information: Task output, strategy discussion, available resources, operational limitations, facility needs, waterway advantages and limitations, communication, historical challenges, and image building. Most important to recognize is that all stakeholders can benefit by remaining unified in goal and purpose.

A guide to focusing on goal and purpose is the Concepts of Operations. The Concepts of Operations are the stakeholders' "road map" for success and represent a condensed version of the history, issues, challenges, navigation public benefit potential, and an interlocking set of actions to move in the direction of system reliability. If the reality and perception of navigation reliability can be sustainable, market penetration can well exceed the projections indicated. The Concepts of Operations direct stakeholders to those needs that must be addressed in order to tap available markets, provide a vehicle for additional economic development, and jumpstart the rebirth of the Missouri River's historical place in commerce.

3.0 CONCEPTS OF OPERATIONS

The preceding traditional and emerging market analyses presented commodity and market node trends intended to provide valuable insight into future potential freight movements and modal shifts – the remainder of this document builds on those insights. The reality of inadequate water flow and the perception of future risk both contributed to the downfall of waterborne freight volumes on the Missouri River and the business activity that supported it over the past decade. However, freight volumes in recent years have been on the rise, and the most recent data indicates a continued increase for the foreseeable future.

The following sections discuss Missouri River freight history, federal operations of the River, environmental factors associated with the River, and ultimately suggest Concepts of Operations for developing freight markets and opportunities.

3.0.1 Freight History

Information was obtained from the USACE to characterize freight traffic on the Missouri River over the past 50 years (Exhibit 3.1). From 1960 through 2009, waterborne commerce has changed significantly, both in tonnage and composition. During the early years, tonnage was primarily composed of waterway materials for construction, sand and gravel from dredging operations, and farm products. During the past decade, tonnage has been almost exclusively composed of sand and gravel from Missouri River commercial dredging operations.

Overall, those movements that the USACE recognizes as freight volumes (not including dredge material) have fluctuated over the years for a variety of reasons, most recently decreasing due to the significant drought from roughly 2000 to 2007. Exhibit 3.1 shows the total Missouri River navigation tonnage by general commodity groups, as well as milestone events that affected operations, competition, or otherwise likely impacted total tonnage.

Description of Milestone Events

- Droughts – The data for the drought events and their duration was taken from a chart in the *Missouri River Mainstem Reservoir System – Summary of Actual 2009 Regulation, Missouri River Basin,*[4] published in September 2010 by the USACE, Northwestern Division, Missouri River Basin Water Management Division, Omaha, Nebraska. The drought events are obviously the type of milestone that has negatively impacted navigation in recent years. Most notably, the drought from 2000 to 2007 eliminated most commercial tonnage on the River. During that time and continuing into the present, environmental challenges and other competing water uses represent a significant challenge to the public perception of River navigation value.

[4] http://www.nwd-mr.usace.army.mil/rcc/reports/pdfs/rcc2009summary.pdf

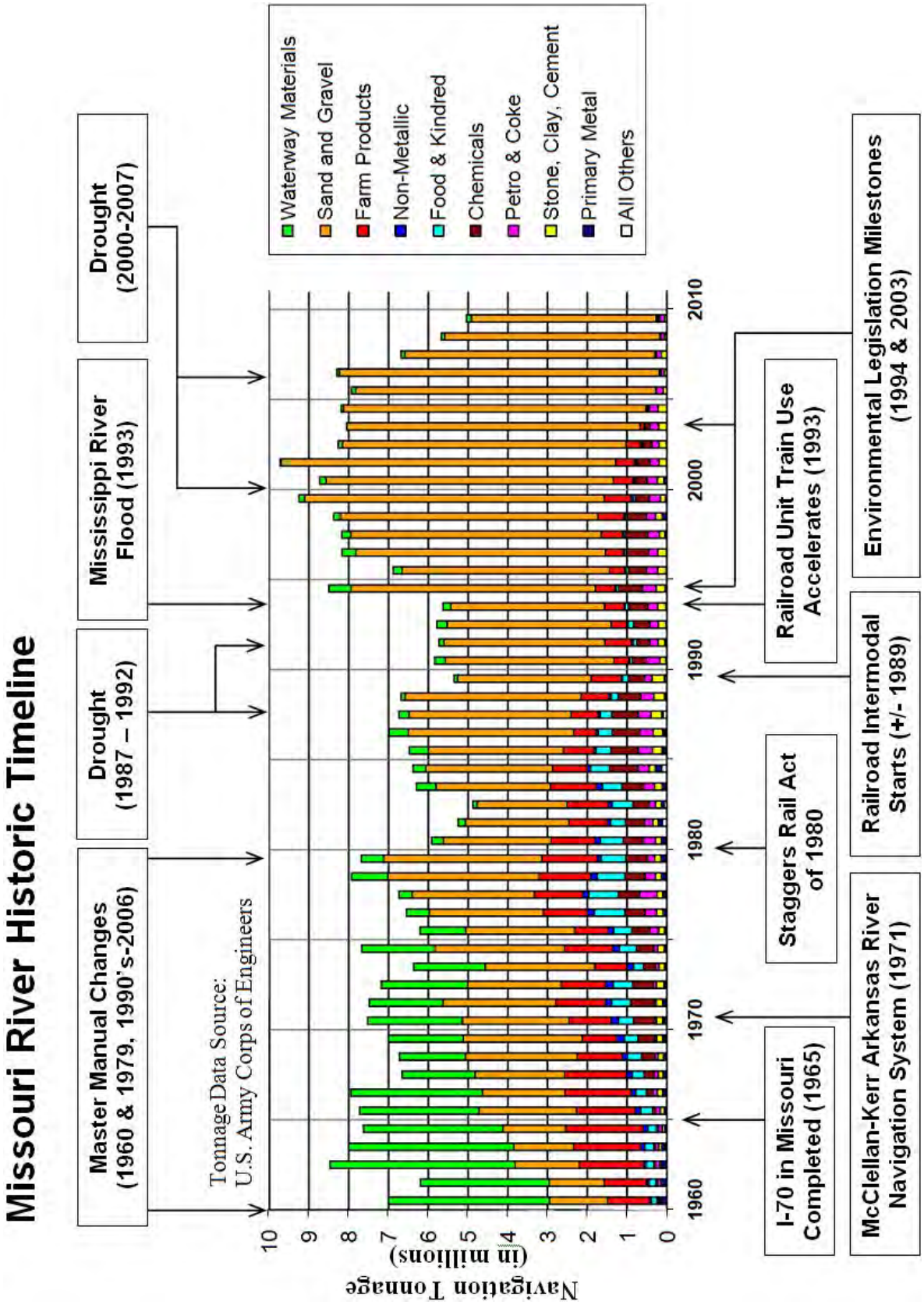

Missouri River Historic Timeline
Master Manual Changes (1960 & 1979, 1990's-2006)
Drought (1987 – 1992)
Mississippi River Flood (1993)
Drought (2000-2007)
Tonnage Data Source: U.S. Army Corps of Engineers
Waterway Materials
Sand and Gravel
Farm Products
Non-Metallic
Food & Kindred
Chemicals
Petro & Coke
Stone, Clay, Cement
Primary Metal
All Others
Navigation Tonnage (in millions)
0
1
2
3
4
5
6
7
8
9
10
1960
1970
1980
1990
2000
2010
I-70 in Missouri Completed (1965)
McClellan-Kerr Arkansas River Navigation System (1971)
Staggers Rail Act of 1980
Railroad Intermodal Starts (+/- 1989)
Railroad Unit Train Use Accelerates (1993)
Environmental Legislation Milestones (1994 & 2003)

Exhibit 3.1

- Master Manual[5] Changes

    - The Master Manual was first published in December 1960. The first Master Manual and its subsequent versions were developed in consultation with state governments within the Missouri River basin and federal agencies having related authorities and responsibilities. Selected pages were revised in November 1973, and a revised water control manual was published in 1975. Regulation criteria for flood control were revised and the Master Manual was republished in 1979. The Master Manual was reprinted several times with no additional changes using the 1979 date.

    - Public concern over the drought conservation plan presented in the 1979 version of the Master Manual surfaced early during the drought that lasted from 1987 to 1993. This drought was the first major drought to occur within the basin since the system was originally filled and became fully operational in 1967. The Northwest Division of the USACE initiated an update of the water control plan in 1989 because of this concern. The update to the existing water control plan was considered a major revision that required extensive coordination with basin interests.

    - As part of the subsequent review and update process for the Master Manual, an EIS under the auspices of NEPA was prepared. Numerous supporting technical reports and five versions of the EIS (preliminary draft: May 1993; draft: July 1994; preliminary revised draft: August 1998; revised draft: August 2000; and final: March 2004) were prepared. The basis for the selection of the water control plan included in the current Master Manual is outlined in the Final EIS and the subsequent Record of Decision. Extensive coordination activities were conducted by the Northwest Division during the 14-year process of updating the current Master Manual, which represents the culmination of those coordination efforts**.**

    - The current Master Manual (revised March 2006) was prepared as directed in the USACE's Water Management Regulation, ER 1110-2-240, which prescribes the policies and procedures to be followed in carrying out water management activities, including establishment and the updating of water control plans for USACE and non-USACE projects, as required by federal laws and directives.

- I-70 completion[6] – The opening of the interstate highway can be considered both a competitive advantage and a disadvantage for Missouri River freight, but it is certainly a milestone.

[5] http://www.nwd-mr.usace.army.mil/rcc/reports/mmanual/MasterManual.pdf
[6] http://www.modot.mo.gov/interstate/InterstateQuiz.htm

- Completion of the McClellan-Kerr (MKARNS) System[7] – The MKARNS has likely had an impact on the competitive position of the Missouri River for shipping agricultural products, especially from the southwestern quadrant of the state, but it also represents a complimentary navigation connection (for example, clay freight movements). Note, 1971 is the date of the act naming it McClellan-Kerr, but it actually opened in 1969-1970.

- Staggers Rail Act[8] – The Act impacted government regulation of the railroads, giving much more control of routing, services, and pricing to the industry. This altered the competitive picture for barge freight. Similar to the opening of I-70, this can be viewed as an advantage or a disadvantage relative to barge freight, depending on whether the railroad compliments or competes for specific freight movements.

- Intermodal – It is generally recognized in industry that the intermodal boom in the US began around 1989. One source for information is: Railway Age Magazine, February 2004, "The Magnificent 7: BNSF: First in a Series" by William C. Vantuono

- Mississippi River Flood of 1993 – The "Great Flood" of 93, perhaps better known as the Missouri River flood of 93 within the state of Missouri. This event caused the suspension of barge activity between late June and mid August of 1993.[9]

All of these milestones have impacted tonnage on the Missouri River in one way or another, but the two issues currently perceived as most significantly affecting the future success of freight growth are the service level and environmental challenges. These two issues are discussed below.

3.0.2 Missouri River Navigation Flows

Service Level

River flow is controlled by a series of six dams and reservoirs that make up the Missouri River Water Control System. The dams and associated reservoirs, in order from upstream to downstream, are:

1. Fort Peck Dam (Fort Peck Lake) near Glasgow, Montana
2. Garrison Dam (Lake Sakakawea) near Garrison, North Dakota
3. Oahe Dam (Lake Oahe) near Pierre, South Dakota
4. Big Bend Dam (Lake Sharpe) near Fort Thompson, South Dakota
5. Fort Randall Dam (Lake Francis Case) near Pickstown, South Dakota
6. Gavins Point Dam (Lewis and Clark Lake) near Yankton, South Dakota

[7] http://www.swt.usace.army.mil/PROJECTS/civil/civil_projects.cfm?number=78
[8] http://www.aar.org/~/media/aar/Background-Papers/The-Impact-of-Staggers.ashx
[9] http://www.mvr.usace.army.mil/PublicAffairsOffice/HistoricArchives/Floodof1993/fl-8.htm

The Missouri River Basin Water Management Division (MRWMD), which is part of the USACE Northwestern Division, controls operations on the River to meet the authorized purposes during flood and drought periods. A system has been developed by the MRWMD, which indicates the level of navigation that can be supported on the river at a specific point in time. This system refers to the service level, and it is based on the total reservoir storage and the discharge rate. This number estimates the water volume needed to support a normal 8-month Missouri River navigation season, with average downstream tributary flow contributions.

The service level system provides for the release of flood control storage before the next flood season while serving navigation to the full capability of the 9-foot downstream channel depth (8.5-foot draft), which is called Full-Service. Minimum-Service usually provides a minimum level of navigation service (7.5-foot draft), in order to conserve water in the Missouri River reservoir system in case of long-term drought. The reservoir system storage is checked twice a year on March 15 and July 1, and service levels are determined based on long-term computer simulations by MRWMD. Table 3.1 summarizes the relationship between service level, discharge, and reservoir system storage.

Table 3.1 – Relation of Service Level to Volume of Water in System Storage

Date	Service Level (cfs)	Water in System Storage (MAF)
Mar. 15	35,000 (Full-Service)	54.5 or more
Mar. 15	35,000 - 29,000 (Intermediate-Service)	54.5 - 49.0
Mar. 15	29,000 (Minimum-Service)	49.0 - 31.0
Mar. 15	No Service	31.0 or less
July 1	35,000 (Full-Service)	57.0 or more
July 1	29,000 (Minimum-Service)	50.5 or less

Table VII-2 from the USACE Master Water Control Manual. Intermediate-Service has been added for clarity.

According to the Master Manual, a straight-line interpolation defines the service levels between Full-Service and Minimum-Service. If the system storage is at or below 31 million acre-feet (MAF) on March 15 when the first storage level check occurs, navigation on the River is suspended (No Service). Storage below 31 MAF would coincide with a nationwide drought emergency.

Season Length

Similar to the service level, navigation season length is determined every year on March 15 and is checked again on July 1. Depending on the River status, the season starting date progresses from March 23 at the upstream end near Sioux City, Iowa, to April 1 at the mouth near St. Louis. If the Missouri River storage reservoirs are at or above 51.5 MAF, then an 8-month season will be supported. For an 8-month season, the closing date would vary from November 22 at Sioux City to December 1 at St. Louis. If the reservoir storage drops below 51.5 MAF by July 1, the season will be reduced to

conserve water in the reservoirs against long-term droughts. Table 3.2 summarizes the relationship between system storage and season length.

Table 3.2 – Relation of System Storage to Season Length

Date	System Storage (MAF)	Season Closure Date	Season Length
Mar. 15	31.0 or less	No Season	---
July 1	36.5 or less	Oct. 1	6 months
July 1	46.8 - 41.0	Nov. 1	7 months
July 1	51.5 or more	Dec. 1	8 months
Sept. 1	60.0 or more	Dec. 11	8.33 months

Table VII-3 from the USACE Master Water Control Manual, Revised March 2006. Sept. 1 data added based on an analysis of the USACE's MCP300 data.

Straight-line interpolation should be used for storage values between 51.5 and 46.8 MAF for a season length between 8 and 7 months, as well as for storage values between 41.0 and 36.5 MAF for season lengths between 7 and 6 months. If the reservoir storage is below 36.5 MAF on July 1, a 6-month season is provided. As with service level, if the system storage is at or below 31.0 MAF on March 15, Missouri River navigation is suspended (No Service).

The season may be extended to provide additional flood control storage in the reservoirs, as well as extending the navigation season and enhancing hydropower production. Season extensions are typically limited to ten days, which results in a season closure date of December 11. The Master Manual does not state when this determination is made or what reservoir storage level is required to extend the season.

Winter releases are also an authorized purpose for hydropower production from December to February. This storage check occurs on September 1. If the reservoir storage is at or above 58.0 MAF, then the average winter release is 17,000 cubic feet per second (cfs) from Gavins Point. If the reservoir storage is at or above 55.0 MAF, then the average winter release is 12,000 cfs from Gavins Point.

Analysis of Corps Data

Data was provided by the USACE which contains monthly service level (discharge rates), system storage volumes, and navigation season lengths from January 1898 to December 2009. The data is an output component of the computer program that the USACE uses to model and forecast river and reservoir operations. These values were compared against the operational rules presented in Tables 3.1 and 3.2, which the USACE presented in the March 2006 version of the Master Manual. This comparison was performed in order to understand the rules themselves, their sensitivity to changes in reservoir storage, and to identify any patterns that may exist within the data. Table 3.3 is a summary of this analysis, and Exhibit 3.2 shows the navigation season length from 1898 to 2009.

Table 3.3 – Summary of Service-Level and Season Length

MCP300 Calculated Navigation Service Data							
Year	**March Service**	**July Service**	**Season Length**	**Year**	**March Service**	**July Service**	**Season Length**
1898	Full	Full	8.33	**1954**	Full	Intermediate	8.00
1899	Full	Full	8.33	**1955**	Intermediate	Intermediate	8.00
1900	Full	Full	8.33	**1956**	Minimum	Intermediate	7.81
1901	Full	Full	8.00	**1957**	Minimum	Minimum	7.67
1902	Full	Full	8.00	**1958**	Minimum	Minimum	7.71
1903	Full	Full	8.00	**1959**	Minimum	Intermediate	7.86
1904	Full	Full	8.33	**1960**	Intermediate	Intermediate	8.00
1905	Full	Full	8.00	**1961**	Minimum	Minimum	7.08
1906	Intermediate	Full	8.00	**1962**	Minimum	Intermediate	8.00
1907	Full	Full	8.33	**1963**	Intermediate	Intermediate	8.00
1908	Full	Full	8.33	**1964**	Intermediate	Intermediate	8.00
1909	Full	Full	8.33	**1965**	Intermediate	Full	8.33
1910	Full	Full	8.33	**1966**	Full	Full	8.00
1911	Full	Full	8.00	**1967**	Intermediate	Full	8.33
1912	Intermediate	Full	8.33	**1968**	Full	Full	8.00
1913	Full	Full	8.33	**1969**	Full	Full	8.33
1914	Full	Full	8.33	**1970**	Full	Full	8.33
1915	Full	Full	8.33	**1971**	Full	Full	8.33
1916	Full	Full	8.33	**1972**	Full	Full	8.33
1917	Full	Full	8.33	**1973**	Full	Full	8.00
1918	Full	Full	8.33	**1974**	Full	Full	8.33
1919	Full	Full	8.00	**1975**	Full	Full	8.33
1920	Intermediate	Full	8.00	**1976**	Full	Full	8.33
1921	Full	Full	8.00	**1977**	Full	Intermediate	8.00
1922	Intermediate	Full	8.00	**1978**	Intermediate	Full	8.33
1923	Intermediate	Full	8.33	**1979**	Full	Full	8.33
1924	Full	Full	8.33	**1980**	Full	Full	8.00
1925	Full	Full	8.33	**1981**	Intermediate	Intermediate	8.00
1926	Full	Full	8.00	**1982**	Intermediate	Full	8.33
1927	Full	Full	8.33	**1983**	Full	Full	8.33
1928	Full	Full	8.33	**1984**	Full	Full	8.33
1929	Full	Full	8.33	**1985**	Full	Full	8.00
1930	Full	Full	8.00	**1986**	Full	Full	8.33
1931	Intermediate	Minimum	7.45	**1987**	Full	Full	8.33
1932	Minimum	Minimum	7.00	**1988**	Full	Intermediate	8.00
1933	Minimum	Minimum	7.00	**1989**	Minimum	Minimum	7.43
1934	Minimum	Minimum	6.24	**1990**	Minimum	Minimum	7.00
1935	None	None	0.00	**1991**	Minimum	Minimum	7.27
1936	Minimum	Minimum	6.00	**1992**	Minimum	Minimum	7.00
1937	None	None	0.00	**1993**	Minimum	Intermediate	7.79
1938	None	None	0.00	**1994**	Full	Full	8.00
1939	Minimum	Minimum	6.71	**1995**	Full	Full	8.33
1940	Minimum	Minimum	6.00	**1996**	Full	Full	8.33

MCP300 Calculated Navigation Service Data (continued)							
Year	**March Service**	**July Service**	**Season Length**	**Year**	**March Service**	**July Service**	**Season Length**
1941	None	None	0.00	**1997**	Full	Full	8.33
1942	Minimum	Minimum	7.00	**1998**	Full	Full	8.33
1943	Minimum	Intermediate	8.00	**1999**	Full	Full	8.33
1944	Intermediate	Full	8.33	**2000**	Full	Full	8.00
1945	Full	Full	8.00	**2001**	Intermediate	Intermediate	8.00
1946	Intermediate	Intermediate	8.00	**2002**	Minimum	Minimum	7.33
1947	Intermediate	Full	8.33	**2003**	Minimum	Minimum	7.00
1948	Full	Full	8.33	**2004**	Minimum	Minimum	6.82
1949	Full	Full	8.00	**2005**	Minimum	Minimum	6.55
1950	Intermediate	Full	8.33	**2006**	Minimum	Minimum	6.50
1951	Full	Full	8.33	**2007**	Minimum	Minimum	6.67
1952	Full	Full	8.33	**2008**	Minimum	Minimum	7.00
1953	Full	Full	8.33	**2009**	Minimum	Intermediate	8.00

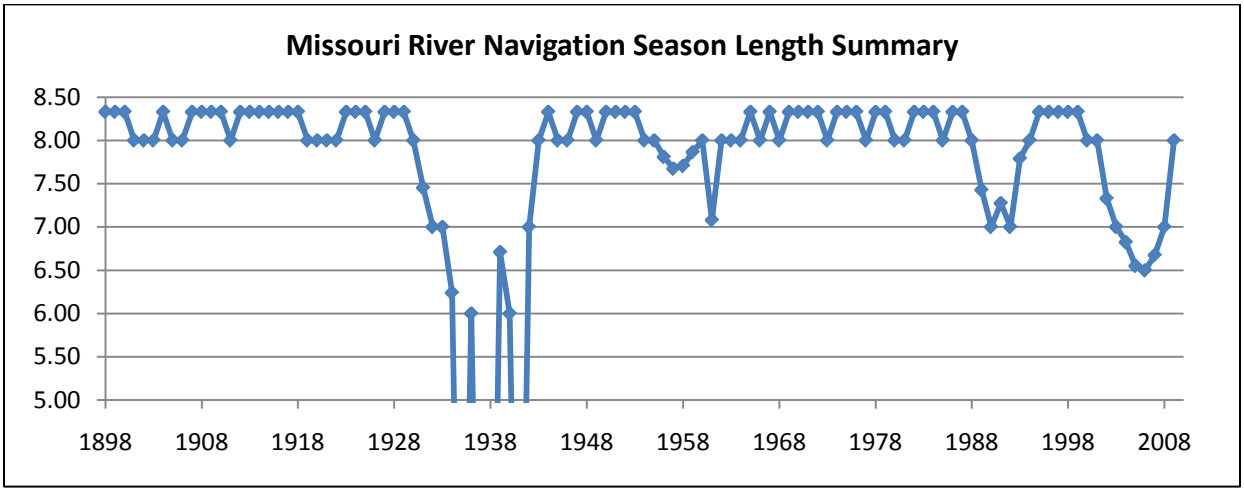


Exhibit 3.2

As part of this analysis, the season lengths in Table 3.3 were compared against season lengths presented in the *Summary of Actual 2008 Regulation*, dated April 2009, for 1967 through 2008. The results of this comparison are presented in Table 3.4, which shows that there were some discrepancies in season length. Despite these discrepancies, the actual and calculated season lengths were the same 57% of the time from 1967 to 2008, and when a difference occurred, the average difference was only 0.11 months (3.35 days).

The discrepancies are due to a combination of factors, including revisions to the operating plan. The data from 1967 to 2003 is based on the 1975 version of the Master Manual, while the data from 2004 to 2008 is based on the 2006 revision. The analysis presented in Table 3.3 is based only on the 2006 revision. Other causes for discrepancies include decisions by the USACE based on information not presented in the MCP300 data. An example of this can be found when looking at Table 3.3 under

2009 – the MCP300 data at the July check shows that the River could only support an Intermediate-Service level, yet a full 8-month season was supported. This decision was based on forecasting data that predicted the proper discharge and storage levels for a full season within several days of the July check.

Table 3.4 – Comparison of Calculated and Published Season Length

Year	Season Length	Calculated	Difference
1967	8	8.33	0.33
1968	8.33	8.00	-0.33
1969	8.33	8.33	0.00
1970	8.33	8.33	0.00
1971	8.33	8.33	0.00
1972	8.33	8.33	0.00
1973	8	8.00	0.00
1974	8	8.33	0.33
1975	8.33	8.33	0.00
1976	8.33	8.33	0.00
1977	8	8.00	0.00
1978	8.33	8.33	0.00
1979	8.33	8.33	0.00
1980	8	8.00	0.00
1981	7.25	8.00	0.75
1982	8.33	8.33	0.00
1983	8.33	8.33	0.00
1984	8.33	8.33	0.00
1985	8.33	8.00	-0.33
1986	8.33	8.33	0.00
1987	8	8.33	0.33
1988	7.5	8.00	0.50
1989	6.75	7.43	0.68
1990	6.75	7.00	0.25
1991	6.75	7.27	0.52
1992	6.75	7.00	0.25
1993	8	7.79	-0.21
1994	8	8.00	0.00
1995	8.33	8.33	0.00
1996	8.33	8.33	0.00
1997	8.33	8.33	0.00
1998	8.33	8.33	0.00
1999	8.33	8.33	0.00
2000	8	8.00	0.00
2001	8	8.00	0.00

Year	Season Length	Calculated	Difference
2002	8	7.33	-0.67
2003	8	7.00	-1.00
2004	6.5	6.82	0.32
2005	6.5	6.55	0.05
2006	6.5	6.50	0.00
2007	6.75	6.67	-0.08
2008	6.75	7.00	0.25

3.0.3 Environmental Challenges

The Missouri River provides habitat for 301 species of birds, 156 species of fish, 60 species of mammals, and 52 species of reptiles and amphibians. Habitats provided by the River include wetlands, riparian corridors, riverine habitat, and reservoirs. Historically, the Missouri River experienced violent floods producing erosion, turbidity, and sandbar formation. To manage the social and economic benefits of the River, the USACE implemented programs to remove snags, protect banks, construct navigation channels, and build flood management structures. While providing valuable protection of human life, property, and commerce, the man-made management of the River has resulted in the alteration and elimination of natural river habitat and the decline of native fish and bird species. Three species are currently on the threatened and endangered species list: pallid sturgeon, least tern and piping plover.

Pallid Sturgeon (*Scaphirhynchus albus*)[10, 11]

The pallid sturgeon was listed as an endangered species in 1990 and is considered threatened by many factors, including habitat loss and degradation, hybridization, commercial fishing, and contaminants/pollutants. Although the habitat needs of the pallid sturgeon throughout its life cycle are poorly understood, the perceived needs of this fish are having an increasing influence on River management decisions.[12] Dredging operations and commercial navigation represents an unknown threat to the pallid sturgeon.[13] Several studies and reports have been released, including the US Fish and Wildlife Service's (USFWS) biological opinion (2000 and 2003) hypothesizing that man-made changes, such as channelization of the Missouri River, are responsible for the

[10] US Fish and Wildlife Service. (2000). *US Fish & Wildlife Service Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River bank Stabilization and Navigation Project and Operation of the Kansas River Reservoir System*
[11] US Fish and Wildlife Service. (amended 2003). *US Fish & Wildlife Service Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River bank Stabilization and Navigation Project and Operation of the Kansas River Reservoir System*
[12] *Hydroecological Modeling of the Lower Missouri River*. Harold Johnson, Robert Jacobson and Aaron DeLonay. In Proceedings of the Third Federal Hydrologic Modeling Conference, Reno, Nevada. April 2006.
[13] *Appendix I: Baseline Status and Cumulative Effect to the Pallid Sturgeon*, US Environmental Protection Agency Office of Pesticide Programs, August 31, 2007.

overall decline of the pallid sturgeon.[14] To date, there has been no evaluation of the baseline effects of current navigation traffic in the Missouri River to the pallid sturgeon, so it is unknown if channelization is a critical or even dominant factor in the decline of the sturgeon population on the Missouri River.[14]

Channel modification of the Missouri River began in the early 1800's with clearing and snagging to improve conditions for steamboat navigation.[12] The predevelopment River was predominantly shallow and wide.[14] In the 1950's, the USACE further changed the River for navigation and flood control. There is a broad ecological agreement that slow, shallow water habitat is important to support rearing of young fish.[12] However, little is known about specific habitat and spawning needs for the pallid sturgeon. Actual spawning has not been observed in the sturgeon[15] in the wild for over 30 years.[16] Although the requirements for reproduction and spawning of the pallid sturgeon are not well understood, they are thought to spawn in swift water over gravel, cobble, or other hard surfaces.[16] Results of recent studies show adult sturgeon prefer areas with high gradients of depth and velocity, typically found in wakes, downstream of wing dikes, and along steep banks and margins of sandbars.[12] Some biologists believe pallid sturgeon spawn on hard substrate and select habitat based on availability. If pallid sturgeons prefer hard substrate for spawning, the loss of sandbars downstream of Gavin Point should not adversely affect them with respect to river habitat.[15] Due to the potential preference for deep water and high velocities, some studies have suggested the pallid sturgeon has always been rare on the Missouri River, even prior to development of the River system.[14] To date, no reliable population estimates exist for the pallid sturgeon.[15]

The pallid sturgeon's rarity could also be due to biological competition or a potential contaminant and not the changes in habitat.[15] An introduction of non-native species into the Missouri River basin started as early as the 19th Century and continues today. Of 27 known fish species to become extinct in the Missouri River basin, non-native fish have been responsible for more than 70% of those extinctions.[14] Over the last several years, Asian carp have increased dramatically in the Missouri and Mississippi Rivers. These species compete with native fish for food and habitat, and may present a significant long-term threat to the pallid sturgeon.[13] Big head carp and silver carp have become the most abundant large fish in portions of the lower Missouri River. The abundance of these fish, coupled with their ability to consume massive quantities of phytoplankton and zooplankton, presents a great risk to the productivity of the Missouri River's aquatic food web. In addition, pallid sturgeon larvae may be preyed upon by bighead and silver carp.[13]

[14] *Anthropogenic Changes in the Lower Missouri River Basin, Their Effect on Pallid Sturgeon, and Management Implications*, Donald G. Jorgenson, P.E. Prepared for the Missouri River Technical Committee of the Siouxland Chamber of Commerce. May 22, 2006.
[15] *Using GIS to Create a Pallid Sturgeon Habitat suitability Model in the Fort Randall Segment of the Missouri River, USA Basin on Historical Habitat and Modern Telemetric Studies.* David Kadlec. Saint Mary's University of Minnesota University Central Services Press. 2010.
[16] *Appendix C: Status and Life History of the Pallid Sturgeon (Scaphirhynchus albus)*, U.S. Environmental Protection Agency Office of Pesticide Programs, August 31, 2007.

Also, to date there is little information to support the hypothesis that native fish of the Missouri River, including the pallid sturgeon, are cued to spawn by flood pulses.[14] Two successful spawning events for sturgeon occurred in 1999. The first occurred in May and the second in June, with both occurring during periods of relative flow stability. These results strongly indicate that flood pulses are not cueing spawning.[14]

Many of the reports written about the fish species in the Missouri River conclude with the hypotheses that the physical and flow changes in the Missouri River, especially since the USACE involvement in the 1950's, are responsible for the overall decline of the native fish species, including the pallid sturgeon. The USFWS biological opinion in 2000 and 2003 considered other possible causes for the decline of native fish species, but in general dismissed these causes as possibly important but requiring more study. It is possible that some of the native fish, including the pallid sturgeon, cannot be recovered by physical modification of the mainstem of the Missouri River and/or by a change in the manner in which the river flow is managed.[14]

Least Tern (*Sterna antillarum athalassos*) and Piping Plover (*Charadrius melodus*)[10,11]

Least tern and piping plovers are opportunistic nesters and migrate to and through the Missouri River area from late April to early June. If not interrupted by River flooding, the least terns reproduce in about 50 days, and piping plovers reproduce in about 60 days. If the nests are flooded, the birds may leave the area, or they may seek more suitable nesting locations either near or just off the River.[17] Sandbars along the river provide good nesting and rearing habitat, due to their sandy and barren nature. The sandbars provide food for plover chicks foraging along the shorelines, and least tern chicks are fed fish caught by adults in the shallow water surrounding the sandbars.[18] Least terns start migrating south in August and typically are gone by September, and piping plovers start migrating in late July and are gone by late August.[17]

It was assumed in the USFWS' biological opinion (2000 and 2003) that the least tern and piping plover breeding populations on the Missouri River were much larger prior to the construction of impoundments. This statement was made without quantitative data or substantial observations.[17] A survey of scientific papers over the last 200 years relating to the presence and nesting of the least tern and piping plover demonstrated the birds were uncommon on the Missouri River pre-impoundment and were present in small numbers only during drought years.[19] In the report *Birds Migration in the Mississippi River Valley, 1884-1885*, there is no mention of piping plovers or least terns on the Missouri River. Neither bird is mentioned as being observed on the Missouri River until 1929 in the journals *Iowa Bird Life* and *The Nebraska Bird Review*. Many

[17] *Analysis of the Missouri River Natural Hydrograph at Sioux City, Iowa*. Donald G. Jorgensen. Prepared for the Missouri River Technical Committee of the Siouxland Chamber of Commerce. December 8, 2003.
[18] *Least Tern and Piping Plover: Endangered and Threatened Species.* The Missouri Recovery Program Fact Sheet.
[19] *A Review of 200 Years of Information about the Least Tern and Piping Plover Relative to the Missouri River (1803-2003)*, William M. Beacom. Prepared for the Missouri River Technical Committee of the Siouxland Chamber of Commerce. November 4, 2003.

observations of least terns and piping plovers were made during the droughts of the 1930's.[19]

Comparison of data for the pre-impoundment years of 1929 to 1955 (representing the natural Missouri River hydrograph) suggests conditions were very unfavorable to the successful reproduction of the least terns and piping plovers on the island sandbars of the Missouri River.[17] The natural hydrograph of the Missouri River is one of nearly constant change.[20] The pre-impoundment hydrograph typically consisted of an initial spring rise in March, followed by a second rise in June before the river would decline in the summer. The period of April through June was typically referred to as the wet months on the Missouri River.[20] It was usually about the first of August before the River had receded sufficiently to expose sandbars and islands, which form nesting grounds.[19] It is possible that when the birds arrived from late April through early June, some may have tried nesting; however, the June rise in all but one of the years from 1929 to 1955 was greater than 7 feet, which would have completely submerged all sandbar islands and early nests would have been flooded. Since the birds are opportunistic nesters, they would have likely searched out other nesting sites off-river or, if they found the islands flooded in early spring, would have continued migrating north in search of suitable nesting sites.[17] Hence, the natural hydrograph of the Missouri River was very inhospitable to the least terns and piping plovers.[17]

Since impoundment, the hydrograph of the Missouri River has largely been characterized by significantly reduced fluctuations, which have been beneficial to the nesting and fledging of least terns and piping plovers.[19] The moderation of the spring rise has resulted in the sandbars not typically being completely flooded during the reproduction season for the birds. For two decades, the USACE has implemented a "flat" hydrograph by strictly controlling the discharges from Gavins Point Dam. More attention has been given to the lower Missouri River, below Gavins Point Dam, because the unchannelized reach from Gavins Point Dam to Ponca, Nebraska, contains the sandbar islands that are nesting sites for the least tern and piping plover.[17] This management scheme has resulted in increased fledging rates and, correspondingly, an increase in the population of the birds. The "flat" hydrograph is very beneficial to the least tern and piping plover.[17]

It is commonly reported that a spring rise is needed to create barren sandbars in the reach between Gavins point Dam and Ponca, Nebraska. Examination of the proposed spring rise hydrograph shows the least tern and piping plover, mating, nesting, and rearing interval is during the proposed spring rise, and this would likely flood the nests and cause harm to the birds.[20] The logic in the USFWS biological opinion that a series of spring rises over the long term will result in more sandbars suitable for tern and plover habitat is not consistent with the tenets of alluvial geomorphology or with data collected.[20] Accelerated degradation will occur each time a flood pulse occurs. The degradation will, in effect, increase the difference in elevation between the normal river

[20] *The Missouri River below Gavins Point – The Least Tern, Piping Plovers, Sandbars and the Natural Hydrograph.* Donald G. Jorgensen. Prepared for the Missouri River Technical Committee of the Siouxland Chamber of Commerce. September 26, 2003.

water level and the top of the island or sand bar. In many cases this will require a greater flood pulse to overtop the sandbars to cause cleaning. The process of scouring sandbars by flood pulses is ultimately self-defeating.[20] After the spring pulse, a summer low flow is suggested in the USFWS biological opinion to expose more sandbars from mid-June through August. Following the spring pulse, the summer low flow would not be of any value to nesting and rearing of the least tern or piping plovers, because they likely would have moved on from the area due to the spring flooding.[20] Streambed degradation, which has many negative and environmental impacts, will be enhanced by a summer low flow, because the water retained to cause the low flow would be released later in a more erosive fall high flow. The net result would be excessive streambed incisement and an overall reduction of sandbar areas.[20]

3.0.4 Environmental Benefits

While it is undoubtedly true that the man-made operational structures and channel improvements have impacted the habitat of various species, it should not be ignored that one of those species is humans. The life and property saving flood control purpose alone could arguably justify having built the system in the first place. Regardless of one's point of view, the system exists today. To eliminate the control system would have catastrophic effects on the social, economic, and environmental characteristics that have developed since the original decision was made to build it. So, assuming the system will continue to exist for the foreseeable future, it is important to strike an optimal balance between the authorized purposes. Finding that balance includes, in part, recognizing the specific benefits that navigation activities and the multipurpose infrastructure that support them contribute to the total environment. The following excerpts from the USACE's strategic plan provide some key points:

> ***Navigation Program***[21] *– In a global economy, America's oceans and navigable waterways are essential to the Nation's economic growth and prosperity. The Civil Works Navigation Program plays a critical role in promoting America's economic strength. The system of coastal harbors and inland, intracoastal, and Great Lakes waterways remains one of the most important parts of the Nation's transportation system. Our ports and waterways help American farmers compete in the world market. Most of our corn and soybean exports move by inland waterway to deep water harbors for export. The Corps strives to sustain the ability of the inland waterways, ports, and harbors to keep commerce moving. The Corps spends about $500 million annually to operate and maintain the inland waterway system. Ninety-eight percent of America's international trade moves through America's ports, and 20 percent of American jobs depend to some extent on this trade. Navigation infrastructure saves $7 billion annually in transportation costs by providing a more energy-efficient and environmentally friendly form of conveyance than road and rail transportation modes. For example, a barge that carries 1,500 tons of cargo delivers the equivalent of 15 jumbo rail hopper-cars with less*

[21] *Civil Works Strategic Plan FY2004-FY2009*, Department of the Army Corps of Engineers

adverse pollution impacts – equivalent to taking 58 large semi-trucks off the highways. The waterways can move 500 ton-miles compared to the 400 ton-miles per gallon that rail transportation achieves. Waterways are by far the safest way to move large quantities of hazardous chemicals and other cargo, and to protect this cargo from security threats.

Failure to respond to the navigation challenges means a second-class marine system with less competitive ports, higher prices for consumers, less income for farmers, less economic growth, and fewer jobs. Our nation's Marine Transportation System must be ready for 21st Century requirements. We must maintain the contribution of the MTS to our economic engine.

Flood and Coastal Storm Damage Reduction Program[21] *– The second largest Civil Works program is Flood and Coastal Storm Damage Reduction… This program is aimed at saving lives in the event of floods and storms and reducing the property damage they cause. Flood protection authorities provide for dams and related hydropower construction and operation, levee construction, large-scale pumping systems, and the protection and stabilization of shorelines through beach replenishment…The Flood Program has an impressive record. Through Fiscal Year 2000, the Nation prevented an estimated $419 billion ($709 billion adjusted for inflation) in riverine and coastal damages for the $43.6 billion ($122 billion, adjusted for inflation) it invested in flood damage reduction projects. This translates into a $6 return on investment for every dollar spent for flood protection.*

In addition to the recognition of the value of protecting life and property, there are specific environmental benefits provided when freight moves on the water. Based on the market analyses completed in this study, calculations were completed in an attempt to partially quantify some of the environmental benefits of shifting some of Missouri's freight to the water.

3.0.5 Environmental Analysis of Potential Modal Shift

Note that the following analysis represents the potentially shifted freight tonnage identified in both traditional and emerging markets (Sections 3.1 and 3.3, respectively). It does not include the freight already moving on the Missouri River.

The Texas Transportation Institute (TTI) published the final report of its investigation *A Modal Comparison of Domestic Freight Transportation Effects on the General Public* in December 2007 and was subsequently amended in March 2009. The TTI Report was prepared for MARAD and the National Waterways Foundation (NWF) in an effort to evaluate and quantify the environmental, select societal, and safety impacts of barge transportation in comparison to highway (truck) and rail transportation. Specifically, study areas included the following:

- Cargo capacity
- Congestion
- Emissions
- Energy efficiency
- Safety impacts
- Infrastructure impacts

The following analysis aims to evaluate a similar study area with respect to the potential modal shift of freight from highway and/or rail to barge on the Missouri River with connectivity at St. Louis. The TTI Report primarily evaluated the theoretical shift of freight from barge to the other two modes; however, many of the assumptions, constants, and methodologies are applicable to the approach used herein. The TTI Report targeted barge transportation on the main stems of the inland waterway system. The Missouri River is not a main stem system. The tonnage differential between a 15-barge tow on the Mississippi River and a 6-barge tow on the Missouri River is about 20% less volume per barge. Despite this difference and acknowledging the limitations presented by the source data, barge transportation on the Missouri River compares favorably to trucks due to the significant increase in capacity, and barges offer relatively favorable economies of scale to rail transportation.

Based on the forthcoming traditional and emerging market freight shift discussions in Sections 3.1 and 3.3, respectively, a total of more than 1.3 million tons of freight could feasibly shift from highway and/or rail to barge transportation. In order to compare the different modes of transportation, freight was converted to ton-miles to account for both shipment weight and shipping distance. Thus, evaluating O/D data in relation to the total freight shift above, this equates to a potential shift of about 1.4 billion ton-miles to barge transportation annually. The shifted volume and shifted ton-miles are summarized in Table 3.5.

Table 3.5 – Freight Shift Summary

Mode	Shifted Volume (tons)	Shifted Ton-Miles (x1000) by Current Mode	Shifted Ton-Miles (x1000) by River
Truck	681,560	403,626	---
Rail	643,921	647,755	---
Barge	---	---	1,407,121
TOTAL	**1,325,481**	**1,051,380**	**1,407,121**

Cargo Capacity

Standard cargo capacities were required in order to quantitatively compare the three freight transportation modes. The standard capacities for truck trailers and rails cars (25 tons and 110 tons, respectively) used in the TTI Report were appropriate for this study and are shown in Table 3.6. However, the TTI Report used a 15-barge tow configuration with a 1,750 ton per barge capacity, which is not representative of typical operations on the Missouri River. Due to typically shallower waters encountered in the Missouri River (compared to major rivers such as the Mississippi River), barge operators commonly

limit capacity to about 1,400 tons. The factors developed in the TTI Report accounted for barge size/capacity, but the calculations herein were not likely affected by this differential, or at least not significantly, and the overall public benefits of a potential freight shift are expected to be significant.

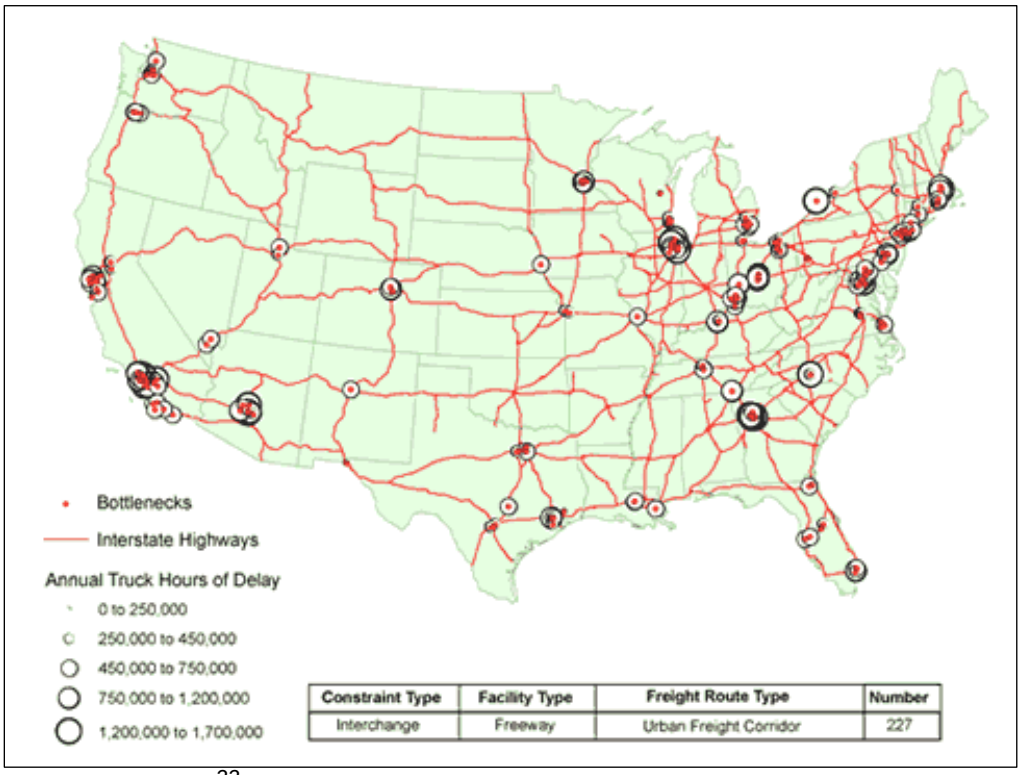
Table 3.6 – Capacity Summary

Mode	Unit Capacity (tons)	Typical Configuration	Total Capacity (tons)
Truck *	25	1 tractor w/ 53-ft. trailer	25
Rail *	110	3 locomotives w/ 108 cars	11,880
Barge	1,400	6-barge tow (3x2)	8,400

* *SOURCE: TTI Report, Tables 2 & 3*

Congestion

Congestion on the US highway system, including Missouri, is a well-documented issue that will further degrade as populations and freight continues to grow. On average, heavy truck traffic accounts for approximately 15% of total daily traffic on US highways. Further, two of the major truck freight bottlenecks are located in Missouri (St. Louis and Kansas City), as shown in Exhibit 3.3.



SOURCE: FHWA[22] ***Exhibit 3.3***

[22] http://www.fhwa.dot.gov/policy/otps/bottlenecks/execsum.htm#figes_1

However, from a modal capacity perspective, one 6-barge tow on the Missouri River is roughly equivalent to 336 truck trips potentially removed from Missouri highways. Thus, any freight moving by barge on the Missouri River instead of by truck will provide a net benefit by reducing highway congestion, and at the same time providing additional highway capacity to a currently strained network.

Although the capacity of a 6-barge tow is less than that of a typical train (approximately 29% less capacity), potentially shifting freight from rail to barge on the Missouri River may still provide a net benefit to the overall transportation system by reducing congestion. For example, fewer trains would decrease vehicular congestion/delays at railroad crossings. Further, fewer train trips and trains on the rail network would likely result in increased average rail speeds, which is a typical railroad industry measure of rail network efficiency.

Emissions

The primary air pollutants tracked by the Environmental Protection Agency (EPA) and evaluated in the TTI Report include the following:

- Hydrocarbons (HC)
- Carbon Monoxide (CO)
- Nitrogen Oxides (NO_X)
- Particulate Matter (PM)
- Carbon Dioxide (CO_2)

Several analyses and conversions were made in the TTI Report, based on data obtained from various agencies, to develop the summary of emissions factors shown in Table 3.7.

Table 3.7 – Emissions Factors

Mode	Emissions (g/ton-mile)				
	HC	CO	NO_X	PM	CO_2
Truck	0.0200	0.1360	0.7320	0.0180	64.96
E Rail	0.0242	0.0643	0.6531	0.0162	24.39
W Rail	0.0242	0.0645	0.6542	0.0162	24.39
Rail (Avg.)	0.0242	0.0644	0.65365	0.0162	24.39
Barge	0.0174	0.0462	0.4691	0.0116	17.48

SOURCE: TTI Report, Table 10

The emissions factors above were used in conjunction with the shifted ton-miles previously presented in Table 3.5 to determine the anticipated effects of shifting freight from truck and rail to barges on the Missouri River. The anticipated total emissions are summarized in Table 3.8. Although barge traffic obviously produces emissions, the potential freight shift produces less total emissions than if that freight remained on truck and rail, with the exception of hydrocarbons. Greenhouse gases receiving the most attention are typically CO_2 emissions. As shown in Table 3.8, the potential freight shift from truck and rail to barge transportation on the Missouri River may reduce CO_2

emissions by 19,204 tons annually, or almost 42%, a favorable environmental benefit of the potential freight shift.

Table 3.8 – Emissions Summary

Mode	Emissions (tons)				
	HC	CO	NO_X	PM	CO_2
Truck	8.9	60.5	325.7	8.0	28,902.1
Rail	17.3	46.0	466.7	11.6	17,415.1
Truck + Rail	26.2	106.5	792.4	19.6	46,317.2
Barge	27.0	71.7	727.6	18.0	27,113.0
% Change	3.1%	-32.7%	-8.2%	-8.1%	-41.5%

Energy Efficiency

Energy efficiency of freight transportation is typically measured by fuel efficiency. The TTI Report provided a summary of fuel efficiency by transportation mode, which is included in Table 3.9. The fuel consumption resulting from the potential freight shift from truck and rail to barge was determined by using the shifted ton-miles from Table 3.5. As shown, shifting freight from truck and rail to barge transportation on the Missouri River has the potential to reduce fuel consumption by over 1.7 million gallons annually, another favorable environmental benefit of the potential freight shift.

Table 3.9 – Fuel Efficiency Summary

Mode	Efficiency * (ton-miles/gal)	Fuel Consumption (gal)
Truck	155	2,604,036
Rail	413	1,568,414
Truck + Rail	---	4,172,450
Barge	576	2,442,919
% Change	---	-41.5%

* *SOURCE: TTI Report, Table 13*

Safety Impacts

Similar to the TTI Report, safety impacts of the potential freight shift from truck and rail to barge transportation on the Missouri River were evaluated with regards to injuries, fatalities, and hazardous materials spills. In order to facilitate comparison across the transportation modes, the TTI Report used various source data to develop an incident rate (injuries per billion ton-miles, for example). The incident rates are summarized in Table 3.10.

As shown, injuries and fatalities related to barge transportation represent a small fraction of those incidents related to rail and particularly truck transportation. Although shifting freight to barges on the Missouri River will increase the number of incidents

related to barge traffic, the overall number of injuries will be reduced by about 100% and fatalities by almost 100%. Hazardous materials spills will potentially increase by about 2.4% as compared to truck and rail freight. However, this potential impact is a result of the statistical application of additional ton-miles compared to the other modes and does not necessarily indicate that additional spills will occur.

Table 3.10 – Safety Impacts Summary

Mode	Injuries		Fatalities		HazMat Spills	
	Rate * (injuries per B ton-miles)	Annual Total w/ Freight Shift	Rate * (fatalities per B ton-miles)	Annual Total w/ Freight Shift	Rate * (gallons per M ton-miles)	Annual Total w/ Freight Shift
Truck	99.044	39.98	4.351	1.76	6.06	2,446
Rail	5.814	3.77	0.649	0.42	3.86	2,500
Truck + Rail	---	43.74	---	2.18	---	4,946
Barge	0.045	0.06	0.028	0.04	3.60	5,066
% Change	---	-99.86%	---	-98.19%	---	2.41%

* *SOURCE: TTI Report, Tables 14, 15, & 16*

Infrastructure Impacts

The TTI Report evaluated the capital investment in pavement (i.e. resurfacing and roadway widening) necessary to accommodate a theoretical shift of barge traffic to highways. Similarly, the impacts to the rail network were evaluated from a capital investment (maintenance and/or network expansion) and overall system efficiency perspectives.

However, for purposes of the subject study, virtually no additional capital investment or increased maintenance will result from the potential modal shift of freight from highways and rail to barges on the Missouri River. Further, if total highway traffic is unchanged, highway maintenance costs will be reduced, due to the reduced number of truck trips on Missouri area highways. Similarly, fewer trains on the rail network will potentially increase rail network efficiency on Missouri region railways.

3.1 CONCEPT 1: TRADITIONAL MARKETS ON THE MISSOURI RIVER

Definition – Establish the priorities and strategies required to implement a freight shift and recovery of traditional Missouri River markets that were historically composed of high-tonnage commodities and were negatively impacted by recent low-water conditions.

Intent – Develop a comparative analysis of identified commodities using a defined set of criteria focused on elements necessary to achieve a recovery of traditional markets. The methodology and output of the following analysis will assist stakeholders in making business decisions regarding opportunities for growth within traditional markets.

Interdependency – This Concept of Operations is based on the output of previous Task 3 and 4 analyses. Section 2 of this report presented detailed analyses of specific commodity groups and market nodes. Section 2 also initiated discussion of specific requirements, timelines, and anticipated volumes that could shift to a waterborne transportation option. Review and understanding of the preceding traditional markets analyses (Section 2.2) is essential to understanding the following analysis and how it represents a complete Concept of Operations. Previous work will be the foundation for helping to prioritize specific target markets and identifying specific elements by which stakeholders can evaluate market opportunities, both now and in the future.

3.1.1 Evaluating Target Markets

Ranking Criteria – The following is a discussion of the criteria identified as metrics for a comparative analysis of potential target markets, and each criterion is briefly explained below. The criteria are classified under four primary groups:

a. Market Characteristics
b. Terminal Capability Needs
c. Competitive Position
d. General Commodity Characteristics

Specific traditional commodity markets previously identified as shiftable will be evaluated in relation to each criterion. It is important to note that the analysis and results given here do not consider the cost of infrastructure improvements. Suggested infrastructure improvements are addressed in the next Concept of Operations (Section 3.2).

a. Market Characteristics

- Size of Market – The size of the potential market is obviously a key component of the investment decision making process.
- Compatibility with other Commodity Markets
  - Terminal Needs – Does this commodity group require dedicated terminals, or will a terminal that serves this group be well-suited for other commodity groups?

  - Seasonal Timing – Some potential commodities are constrained by timing (e.g. harvest time, or other seasonal demand or production realities), while others can move anytime during the navigation season.
  - Waterborne Equipment – Some potential commodities require dedicated barges, while others can use a wide variety of equipment.
  - Freight Balance – Is there a "front-haul" and backhaul identifiable for this market group?
- Geographic Location Appropriate to Serve the Market
  - Proximity to Origins/Destinations – If inbound commodities arrive at a barge terminal but still have a long distance to reach the end user, there may be additional cost and/or a competitive disadvantage. The same is true for outbound commodities that are relatively distant from a terminal.
  - Connectivity to Other Necessary Modal Systems – A number of commodity groups have the capability to move via a number of modes. Does the location of the identified node(s) for this commodity group provide adequate modal choice for moving the freight to/from the terminal? A lack of choices and availability can be a pricing and/or service flexibility challenge.

b. Terminal Capability Needs

- Load/Unload Capacity – Is there adequate capacity within the Missouri River system to handle the anticipated volume for this commodity group?
- Load/Unload Experience – Do Missouri River operators have current or historic experience with this commodity group?
- Necessary Storage Capacity – Once the freight is unloaded from a barge, it often needs to be stored at the terminal prior to delivery. Is there adequate capacity within the Missouri River system to handle the anticipated volume for this commodity group?
- Necessary Transfer Capacity – Transfer refers to moving freight from its original unloaded location (or storage) to the next mode of conveyance (probably truck or rail). Is there adequate capacity within the Missouri River system to handle the anticipated volume for this commodity group?
- Throughput Rate – Throughput rate is the amount of a particular commodity that can be loaded/unloaded within a specific timeframe, which is an important factor in operations and profitability. Are the current capabilities within the Missouri River system sufficient to handle the anticipated volume?
- Material Handling Equipment – Can this commodity group be handled with the same equipment as numerous other commodities, or does it require special equipment for loading, unloading, and storage?
- Necessary Service Proximity – Refers to the availability of operating support services. In addition to the three services specified below, vessel fueling and repair are also required, but are negligibly different for various commodities and are, therefore, not used as metrics.
  - Fleeting – A "parking lot" for barges before and/or after they are loaded/unloaded or while tows are configured. If a complete tow cannot be

accommodated at the specific dock or terminal where freight is handled, a fleeting area is required to temporarily store barges.
  - Stevedoring – Contract operating services that can include loading, unloading, storage, modal transfer, etc.
  - Cleaning – Some commodities require barge cleaning between loads of different commodities to avoid contamination.

c. Competitive Position

- Trucking Comparison
  - Availability of Trucking Service – Assess the modal preference of a given commodity group between water and truck service.
  - Number of System or Modal Transfers Door-to-Door – A relative comparison of the assumed number of transfers required to ship freight via water versus truck. It is assumed that more transfers add cost.
  - Trucking Price
- Rail Comparison
  - Availability of Rail Service – Assess the modal preference of a given commodity group between water and rail service.
  - Number of System or Modal Transfers Door-to-Door – A relative comparison of the assumed number of transfers required to ship freight via water versus rail. It is assumed that more transfers add cost.
  - Rail Price
- Compatibility with Other Modes – Does the commodity typically move door-to-door using a variety of modes, or does it typically favor one mode over others?
- Competitive Position vs. Other River Systems – If Missouri River conveyance is available, how likely is this commodity to move on the River? Will Missouri River movements compete with movements on another river system?

d. General Commodity Characteristics

- Risk
  - Inherent Commodity Risk – What is the relative risk associated with the commodity group? Risk could be associated with hazmat, high value, etc.
  - Past Experience with this Commodity Group – What is the experience level with this commodity group on the Missouri River?
- Complexity of Service and Contracting
  - Regulatory Compliance – What is the level of effort required for regulatory compliance in order to move this freight?
  - Service Expectations – Does moving this freight entail expectations of more complex services, such as third-party logistics (3PL), etc.?
- Ability to Operate 24/7 – Does effective movement and handling of this commodity group typically require 24-hour operations to remain viable?
- Compatibility with Waterborne Equipment – Does servicing this commodity group entail use of standard, common equipment, or might it require investment in specialized equipment of limited use?
- Economies of Scale

- Number of Barges in Tow – Will the anticipated volumes for this commodity group typically fill a tow, or will it move in smaller volumes, potentially costing more?
- Draft vs. Load Capacity – Will this commodity typically maximize volume regardless of draft, or might it be especially vulnerable to low-flow conditions?

Method of Analysis – The criteria above are summarized in Table 3.11, which provides a framework for the analysis in Section 3.1.3. As shown, each criterion is assigned a weighting factor representative of its relative importance in the overall evaluation of a particular shiftable market opportunity. The resultant weight as a percentage of the total number of factors is also provided for reference. In addition to the weighting factors, evaluation numbers between -1 and 3 are described for each criterion.

For example, the “market size” criterion is assigned a weighting factor of 20, or 22.5% of the total weighting. Comparatively, all of the remaining criteria are assigned a weighting factor of 1, 2, or 3, or a resultant weight between 1.1% and 3.4%. This heavy weighting factor is justified for the “market size” criteria, considering there must be an available market before any of the other criteria are relevant. Continuing the “market size” example, a commodity group with a high tonnage potential would then be assigned an evaluation number of 3, medium tonnage potential would be assigned a 1, and a low tonnage potential would be assigned a -1 evaluation number. In a few cases, an evaluation number of 0 was given if that specific criterion was not applicable.

Table 3.11 was then used as a guide for two analyses of each traditional commodity group target according to the criteria above. The first analysis evaluated each target according to the existing capabilities on the Missouri River system. The second analysis evaluated the same targets using the same criteria, weighting factors, etc., but assumed specific conditions (e.g., market characteristics). Those conditions are presented in the following Table 3.11.

Table 3.11 – Summary of Evaluation Criteria

	Criteria	Weighting Factor	Resultant Weight	Evaluation Number 3	1	-1
Market Characteristics						
	Market Size	20	22.5%	High tonnage potential	Medium tonnage potential	Low tonnage potential
Compatibility with other Commodity Markets	Terminal Needs	3	3.4%	Terminal needs very similar to other commodities	Somewhat similar needs	Needs are particular to this commodity
	Seasonal Timing	3	3.4%	Timing enhances other commodities	No impact on other commodity opportunities	Timing conflicts with serving other commodities
	Waterborne Equipment	3	3.4%	Equipment needs very similar to other commodities	Somewhat similar needs	Needs are unique to this commodity
	Freight Balance	3	3.4%	Potential "front-haul" and backhaul identified	"Front-haul" and backhaul are possible	"Front-haul" and backhaul unlikely
Geographic Location	O/D Proximity	2	2.2%	First or last mile are in a county adjacent to the river	First or last mile is within 2 counties of the river	First or last mile is more than 2 counties away
	Modal System Connectivity	2	2.2%	Multiple modal connections are available	Modal connections might be available	Modal connections are not readily available
Terminal Capability Needs						
	Load/Unload Capacity	3	3.4%	Sufficient capacity exists to handle regional volume potential	Some capacity currently exists	No capacity currently exists
	Load/Unload Experience	1	1.1%	MoRiv Operators/carriers are experienced with this commodity	Other rivers move this commodity group	This commodity group does not typically move by water
	Necessary Storage Capacity	2	2.2%	Sufficient capacity exists to handle regional volume potential	Some capacity currently exists	No capacity currently exists
	Necessary Transfer Capacity	3	3.4%	Sufficient capacity exists to handle regional volume potential	Some capacity currently exists	No capacity currently exists
	Throughput Rate	2	2.2%	Current capabilities can efficiently handle regional volume potential	Some improvement will aid throughput	Major upgrades are needed to compete
	Material Handling Equipment	2	2.2%	Equipment needs are very similar to other commodities	Somewhat similar needs	Needs are unique to this commodity
Service Proximity	Fleeting	2	2.2%	Current service appears adequate to handle anticipated volume	Some service exists in relative proximity	Service does not appear adequate
	Stevedoring	2	2.2%	Current service appears adequate to handle anticipated volume	Some service exists in relative proximity	Service does not appear adequate
	Cleaning	2	2.2%	Current service appears adequate to handle anticipated volume	Some service exists in relative proximity	Service does not appear adequate

Page 1 of Table

Table 3.11 (continued) – Summary of Evaluation Criteria

	Criteria	Weighting Factor	Resultant Weight	Evaluation Number 3	1	-1
Competitive Position						
Trucking Comparison	Availability of Trucking	2	2.2%	This commodity clearly favors water over truck, if water is an option	This commodity may favor water	This commodity typically favors truck
	No. of Transfers Door-to-Door	2	2.2%	Fewer or no difference in number of transfers, if this commodity moves by water	Minor additional effort if waterborne	Much more transfer effort required to move by water
	Price Comparison	2	2.2%	Waterborne pricing appears favorable	Comparative pricing info is not known	Waterborne pricing appears unfavorable
Rail Comparison	Availability of Rail	2	2.2%	This commodity clearly favors water over rail, if water is an option	This commodity may favor water	This commodity typically favors rail
	No. of Transfers Door-to-Door	2	2.2%	Fewer or no difference in number of transfers, if this commodity moves by water	Minor additional effort if waterborne	Much more transfer effort required to move by water
	Price Comparison	2	2.2%	Waterborne pricing appears favorable	Comparative pricing info is not known	Waterborne pricing appears unfavorable
	Compatibility with Other Modes	1	1.1%	This commodity is commonly moved by multiple modes working together	Sometimes moved by multiple modes	Highly dependant on only one mode
	Competitive Position vs. Other River Systems	3	3.4%	If MoRiv transportation is available, this commodity will likely favor MoRiv	Unknown competitive position	Other river systems will likely compete with MoRiv
General Commodity Characteristics						
Risk	Inherent Commodity Risk	2	2.2%	Low risk commodity group	Somewhat risky	Relatively high risk
	Past Experience	1	1.1%	MoRiv currently moves this or similar commodities	MoRiv previously moved this commodity	MoRiv has little or no experience with this commodity
Complexity	Regulatory Compliance	2	2.2%	Low regulatory compliance complexity	Moderate regulatory complexity	High regulatory complexity
	Service Expectations	2	2.2%	Service expectations are simple and easy to meet	Moderately complex service requirements	Highly complex service expectations to compete
	24/7 Operations	2	2.2%	Effective operation does not require 24/7 capability	Operation less than 24/7 probably sufficient	Effective operation may require 24/7 capability
	Compatibility with Waterborne Equip.	3	3.4%	This commodity can move on standard, common equipment	Standard equipment, but not necessarily common	Requires specialized equipment
Economy of Scale	No. Barges per Tow	3	3.4%	The market area and commodity will allow maximum tow configurations (5 +)	Tows likely to be 3-4 barges	Tows unlikely to be more than 2 barges
	Draft vs. Load Capacity	3	3.4%	Commodity and market may result in max loading during most conditions	May required lighter loading during common conditions	Loading likely to be limited by draft
Page 2 of Table						
	Total	89	100.0%			

3.1.2 Strategies for Enhancing Target Markets

Agricultural Dry Bulk

Agricultural dry bulk market potential is represented by the movements in approximately 18 O/D route combinations. The routes all have a connection to the baseline market area, with most movements characterized as area exports. The routes have a combined shiftable potential of approximately 5.7 million tons, with the majority (4.4 million tons) moving through regions that are international trade gateways of the Pacific Northwest (PNW) and Gulf of Mexico. Rail is the predominant modal base for these foreign gateways. Market shifts will be guided by the following strategic actions:

> **Strategy 1** – Commitment to restoration and/or upgrade of material handling equipment at appropriate facilities to accommodate barge activity.
>
> **Strategy 2** – Improvements made at specific terminal storage facilities and installation of appropriate material handling equipment, as well as fleeting improvements.
>
> **Strategy 3** – Domestic and international shipping changes resulting in improved waterborne rate development at Lower Mississippi River (LMR) ports (ocean shipping rate enhancement based on expanded Panama Canal, improved channel depth at the LMR, and increased growth in markets not specifically served well by PNW ports, such as India and Africa).

Non-Metallic Mineral Products

In order to develop Missouri River freight markets for cement and salt, the following strategies should be implemented to gain momentum for success.

Cement – Facilities in Kansas City must complete minor facility upgrades to begin any cement handling. These upgrades include the review and maintenance of material handling equipment and adding a barge puller system to accommodate any dockside movement of barges. Assuming specialized or dedicated barge service will be required, an opportunity may exist for a barge fleet owner to service both previously identified market nodes under separate transportation agreements. Although scheduling and service areas must be defined, this would enhance utilization of specialized equipment within the MRB Region, assuming service capacity and timing exists that are compatible with multiple firms.

Salt – The development of a salt opportunity could bring in significant tonnage, primarily in the Kansas City Region, but potentially in other areas as well. This inbound freight could potentially provide outbound barge capacity for other freight opportunities on the Missouri River. Potential carriers may consider leveraging existing MoDOT road salt contracts for all significant population centers within close proximity to the River to assist in developing this market.

Fertilizers

Near-term strategies involve backhaul opportunities from outbound movements of clay to the McClellan-Kerr system and loading fertilizer on barges returning to the Missouri River. Long term, the need for fertilizer warehousing in proximity to existing dock facilities at Jefferson City and St. Joseph should be addressed. Fleeting improvements are needed throughout the system. Investment in port infrastructure is needed in the Kansas City Region, as would be required for other similar commodity groups. Development of liquid fertilizer facilities has limited strategic benefit, but insufficient data is available to suggest market potential; therefore, this commodity is included in the emerging markets discussion of Section 3.3.

Petroleum Products

Although asphalt is the primary petroleum product likely to move on the Missouri River in the future, it is not strategically envisioned as a market with significant growth opportunity in the near to medium term. The petroleum product market is a complex business, typically involving long-term contracts and requiring long lead times to develop. Petroleum products are included in the analysis, primarily because of the historic demand and movement on the River. No specific, relatively short-term (one to five years) strategies were identified to increase tonnage, and accordingly, the overall score for petroleum products does not change between the first and second analysis in the following section.

Gravel & Crushed Stone; Natural Sands

Future gravel and crushed stone freight volumes are directly tied to available budgets and annual expenditures for USACE maintenance projects on the Missouri River. As overall freight movement on the River grows beyond the recent “low commercial use” threshold, capital expenditures related to this commodity are anticipated to increase. This “indirect strategy” is reflected as a negligible difference between the following first and second analysis.

As discussed in Section 2.2, the natural sands market on the Missouri River is limited by USACE dredging permits, but it is anticipated to continue moving within the baseline market area (intra-regional movement). The movement of natural sands is very important, but it is excluded from the following analysis due to the dredging permit limits.

3.1.3 Analysis of Target Markets

Tables 3.12 through 3.15 present the analytical evaluation of each of the target commodity groups based on the criteria discussed above, both before and after implementation of specific strategies over the first five years.

Table 3.12 – Analysis based on Market Characteristics

		NON-INFRASTRUCTURE CRITERIA FOR RANKING COMMODITY MARKET OPPORTUNITY						
		Market Characteristics						
		Market Size	Compatibility with other Commodity Markets				Geographic Location	
			Terminal Needs	Seasonal Timing	Waterborne Equipment	Freight Balance	O/D Proximity	Modal System Connectivity
	Weighting Fcator	20	3	3	3	3	2	2
Commodity Group	**Commodity Group Score Subtotal**							
		Existing Conditions						
Bulk Agricultural Commodities								
Combined Grains	**92**	3	3	1	3	1	1	3
Other Commodities								
Clay	**-10**	-1	-1	1	1	1	3	-1
Cement	**32**	1	1	1	-1	-1	3	3
Salt	**12**	-1	1	1	3	3	3	1
Fertilizers	**52**	1	1	1	3	3	3	1
Petroleum Products	**22**	1	-1	1	-1	-1	3	1
Gravel & Crushed Stone	**23**	1	0	1	-1	-1	3	0
		Post Strategy Implementation						
Bulk Agricultural Commodities								
Combined Grains	**92**	3	3	1	3	1	1	3
Other Commodities								
Clay	**-10**	-1	-1	1	1	1	3	-1
Cement	**44**	1	3	1	1	-1	3	3
Salt	**58**	1	3	1	3	3	3	1
Fertilizers	**58**	1	3	1	3	3	3	1
Petroleum Products	**22**	1	-1	1	-1	-1	3	1
Gravel & Crushed Stone	**23**	1	0	1	-1	-1	3	0

Table 3.13 – Analysis based on Terminal Capability Needs

		NON-INFRASTRUCTURE CRITERIA FOR RANKING COMMODITY MARKET OPPORTUNITY								
		Terminal Capability Needs								
		Load/Unload Capacity	Load/Unload Experience	Necessary Storage Capacity	Necessary Transfer Capacity	Throughput Rate	Material Handling Equipment	Service Proximity		
								Fleeting	Stevedoring	Cleaning
	Weighting Fcator	3	1	2	3	2	2	2	2	2
Commodity Group	**Commodity Group Score Subtotal**									
		Existing Conditions								
Bulk Agricultural Commodities										
Combined Grains	**37**	3	3	3	3	-1	3	1	3	-1
Other Commodities										
Clay	**51**	3	3	0	3	3	3	3	3	3
Cement	**23**	1	3	3	1	1	1	-1	3	0
Salt	**-5**	-1	1	-1	-1	-1	3	-1	1	-1
Fertilizers	**9**	1	3	1	1	-1	1	-1	-1	1
Petroleum Products	**37**	3	3	3	3	3	-1	0	3	0
Gravel & Crushed Stone	**0**	0	0	0	0	0	0	0	0	0
		Post Strategy Implementation								
Bulk Agricultural Commodities										
Combined Grains	**57**	3	3	3	3	3	3	3	3	3
Other Commodities										
Clay	**51**	3	3	0	3	3	3	3	3	3
Cement	**51**	3	3	3	3	3	3	3	3	0
Salt	**51**	3	1	3	3	3	3	3	1	3
Fertilizers	**53**	3	3	3	3	3	3	3	1	3
Petroleum Products	**37**	3	3	3	3	3	-1	0	3	0
Gravel & Crushed Stone	**0**	0	0	0	0	0	0	0	0	0

Table 3.14 – Analysis based on Competitive Position

		NON-INFRASTRUCTURE CRITERIA FOR RANKING COMMODITY MARKET OPPORTUNITY							
		Competitive Position							
		Trucking Comparison			Rail Comparison			Compatibility with Other Modes	Competitive Position vs. Other River Systems
		Availability of Trucking	No. of Transfers Door-to-Door	Price Comparison	Availability of Rail	No. of Transfers Door-to-Door	Price Comparison		
	Weighting Factor	2	2	2	2	2	2	1	3
Commodity Group	**Commodity Group Score Subtotal**	**Existing Conditions**							
Bulk Agricultural Commodities									
Combined Grains	**36**	3	3	1	1	3	1	3	3
Other Commodities									
Clay	**40**	3	3	3	2	3	1	1	3
Cement	**26**	3	3	3	1	1	1	-1	1
Salt	**26**	1	2	1	3	3	1	1	1
Fertilizers	**40**	3	3	3	3	3	1	-1	3
Petroleum Products	**40**	3	3	3	3	3	1	-1	3
Gravel & Crushed Stone	**48**	3	3	3	3	3	3	3	3
		Post Strategy Implementation							
Bulk Agricultural Commodities									
Combined Grains	**44**	3	3	3	1	3	3	3	3
Other Commodities									
Clay	**40**	3	3	3	2	3	1	1	3
Cement	**36**	3	3	3	1	1	3	-1	3
Salt	**40**	3	2	3	3	3	1	1	3
Fertilizers	**42**	3	3	3	3	3	1	1	3
Petroleum Products	**40**	3	3	3	3	3	1	-1	3
Gravel & Crushed Stone	**48**	3	3	3	3	3	3	3	3

Table 3.15 – Analysis based on General Commodity Characteristics

		NON-INFRASTRUCTURE CRITERIA FOR RANKING COMMODITY MARKET OPPORTUNITY							
		General Commodity Characteristics							
		Risk		Complexity		24/7 Operations	Compatibility with Waterborne Equip.	Economy of Scale	
		Inherent Commodity	Past Experience	Regulatory Compliance	Service Expectations			No. Barges per Tow	Draft vs. Load Capacity
	Weighting Fcator	2	1	2	2	2	3	3	3
Commodity Group	**Commodity Group Score Subtotal**	**Existing Conditions**							
Bulk Agricultural Commodities									
Combined Grains	**48**	3	1	3	3	1	3	3	3
Other Commodities									
Clay	**48**	3	3	3	3	3	3	1	3
Cement	**36**	1	3	3	1	1	1	3	3
Salt	**54**	3	3	3	3	3	3	3	3
Fertilizers	**46**	3	3	1	3	1	3	3	3
Petroleum Products	**10**	1	3	1	1	-1	-1	3	-1
Gravel & Crushed Stone	**42**	3	3	3	3	3	-1	3	3
		Post Strategy Implementation							
Bulk Agricultural Commodities									
Combined Grains	**48**	3	1	3	3	1	3	3	3
Other Commodities									
Clay	**48**	3	3	3	3	3	3	1	3
Cement	**36**	1	3	3	1	1	1	3	3
Salt	**54**	3	3	3	3	3	3	3	3
Fertilizers	**46**	3	3	1	3	1	3	3	3
Petroleum Products	**10**	1	3	1	1	-1	-1	3	-1
Gravel & Crushed Stone	**42**	3	3	3	3	3	-1	3	3

3.1.4 Target Market Analysis Results

Based on the analyses presented in Tables 3.12 through 3.15, the commodity group ranking results are summarized in Exhibit 3.4.

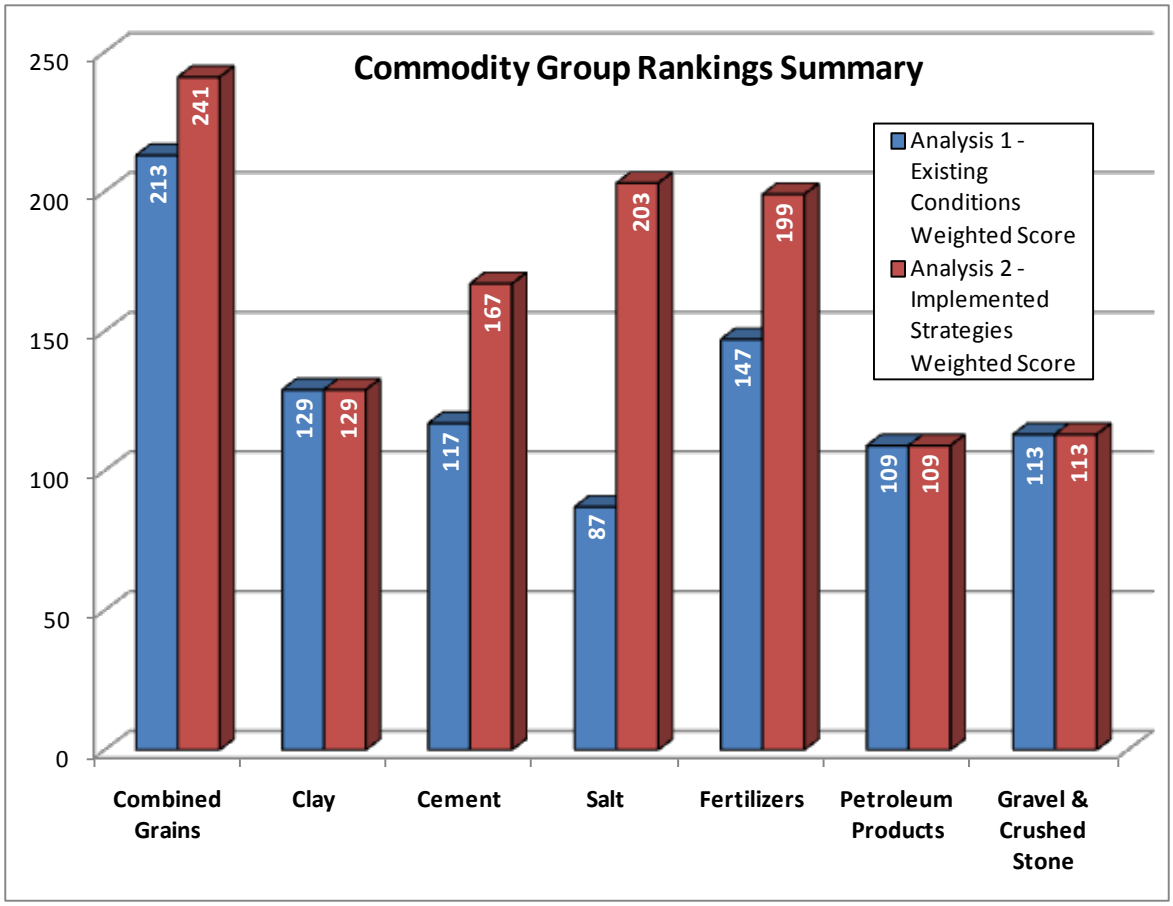


Exhibit 3.4

The first analysis indicates the agricultural dry bulk and other agricultural products (collectively referred to as "combined grains") commodity groups rank the highest of the traditional shiftable commodity groups based on existing Missouri River system capabilities. This is expected given the agricultural freight history on the River. In order, the commodity groups ranked as follows in the first analysis:

1. Combined Grains
2. Fertilizers
3. Clay
4. Cement
5. Gravel & Crushed Stone
6. Petroleum Products
7. Salt

The second analysis assumed the strategies discussed above were implemented within the first five years of shiftable market growth. This analysis indicates the combined grains commodity group still ranks the highest of the traditional shiftable commodity groups. After combined grains, the ranking order and comparative total score changed

for the remaining commodity groups. In order, the commodity groups ranked as follows in the second analysis:

1. Combined Grains
2. Salt
3. Fertilizers
4. Cement
5. Clay
6. Gravel & Crushed Stone
7. Petroleum Products

The preceding commodity group analysis and rankings provide stakeholder guidance in targeting the most applicable traditional Missouri River markets, with regards to shiftable freight. About 808,000 tons of traditional market shiftable tonnage was previously identified in Section 2.2 and is summarized in Table 3.16. This represents only the identified tonnage from traditional Missouri River markets and does not include emerging markets. The emerging markets were initially presented in Section 2.3 and are further addressed in Concept of Operations 3 (Section 3.3).

It is also important to note that the traditional market shiftable tonnage estimate does not include volumes that are anticipated to take longer than five years to develop. It also does not include commercial tonnage already moving on the Missouri River (324,000 tons in 2010) or the significant sand and gravel tonnage (over 4.6 million tons in 2010). In other words, 808,000 tons is intended to be a relatively conservative estimate of shiftable commercial freight. Aggressive stakeholder activity and improved economic conditions could result in much higher volumes, especially over the long term.

Table 3.16 – Total Identified Traditional Markets Shiftable Freight (First 5 Years)

Origin	Destination	River Region	Freight Type	Current Mode	Current Volume (NT)	Shifted Volume (NT)	Shift Period (yrs.)
STL (IL)	Central MO	CM	Fertilizer	Rail	56,700	17,010	1
Central MO	STL (IL)	CM	Ag Dry Bulk	Rail	72,300	21,690	1
Chicago	Jefferson City	CM	Fertilizer	Truck	78,100	23,430	3
OK	Jefferson City	CM	Fertilizer	Truck	39,300	15,720	5
Minneapolis	KC Region	KC	Fertilizer	Truck	97,900	19,580	5
Tulsa	KC Region	KC	Fertilizer	Truck	159,500	15,950	5
OK	KC Region	KC	Fertilizer	Truck	104,100	0	5
AR	KC Region	KC	Fertilizer	Rail	14,300	1,430	5
Tulsa	KC Region	KC	Fertilizer	Rail	55,700	0	5
Houston	KC Region	KC	Fertilizer	Rail	35,600	0	5
KC Region	Mobile, AL	KC	Ag Dry Bulk	Truck	137,000	27,400	3
STL (IL)	KC Region	KC	Ag Dry Bulk	Truck	205,100	82,040	3
KC Region	NOLA	KC	Ag Dry Bulk	Truck	75,400	15,080	1
KC Region	Houston	KC	Ag Dry Bulk	Truck	216,000	4,320	1
KC Region	NOLA	KC	Ag Dry Bulk	Rail	118,300	23,660	1
KC Region	LA	KC	Ag Dry Bulk	Rail	55,400	11,080	1
KC Region	Corpus Christi	KC	Ag Dry Bulk	Rail	73,100	7,310	5
KC Region	Sabine, TX	KC	Ag Dry Bulk	Rail	14,700	441	1
Central KS	KC Region	KC	Salt *	Truck	52,000	0	5
Chicago	KC Region	KC	Cement	Rail	120,000	50,000	1
NW MO	Mobile, AL	NW	Ag Dry Bulk	Truck	11,500	2,300	3
NW MO	STL (IL)	NW	Ag Dry Bulk	Rail	153,300	45,990	3
NW MO	NOLA	NW	Ag Dry Bulk	Truck	396,800	79,360	1
NW MO	Portland	NW	Ag Dry Bulk	Truck	13,900	2,780	5
NW MO	Sea/Tac	NW	Ag Dry Bulk	Truck	596,000	59,600	5
NW MO	NOLA	NW	Ag Dry Bulk	Rail	755,100	151,020	1
NW MO	Portland	NW	Ag Dry Bulk	Rail	71,100	14,220	5
NW MO	Houston	NW	Ag Dry Bulk	Rail	1,424,900	28,498	1
NW MO	Sabine, TX	NW	Ag Dry Bulk	Rail	1,282,400	38,472	1
Central KS	NW MO	NW	Salt *	Truck	26,000	0	5
KC Region	STL	IR	Asphalt	Truck	122,200	0	5
STL	KC Region	IR	Salt *	Truck	28,000	28,000	5
STL	NW MO	IR	Salt *	Truck	14,000	14,000	5
STL	Central MO	IR	Salt *	Truck	40,000	8,000	5
Tulsa	Sunders Cty, NE	NE	Fertilizer	Truck	89,900	0	5
Tulsa	Sarpy Cty, NE	NE	Fertilizer	Rail	54,700	0	5
Houston	Sarpy Cty, NE	NE	Fertilizer	Rail	35,200	0	5
Louisville	Nebraska	NE	Asphalt	Truck	43,100	0	5
Beaumont	Nebraska	NE	Asphalt	Truck	88,600	0	5
					TOTAL	**808,381**	

*IR = Intra-regional. * Data obtained from DOT's & local governments.*

3.1.5 Implementation

The following implementation initiatives are intended to assist stakeholders with the commencement of a business planning process and resulting in the development of traditional market freight shift opportunities for select commodity groups.

1. Establish Communication
    a. Agricultural Dry Bulk – Establish communication between key players (farmers, shippers, carriers, 3PL's, etc.) in shiftable agricultural dry bulk markets (combined grains) with commodities *leaving* the region and grain elevator owners identified in Task 2.
    b. Non-Agricultural Dry Bulk – Establish communication between key players (manufacturers, brokers, shippers, carriers, etc.) in shiftable non-agricultural dry bulk markets (salt, fertilizer, cement, etc.) with commodities *entering* the region and covered dry bulk facility owners identified in Task 2.
    c. Petroleum Products – Establish communication between liquid commodity carriers and petroleum product distributors/retailers with waterside tank terminals identified in Task 2, or other potential facilities.
2. Working with identified key players and facility owners, evaluate needed facility improvements, freight movement timing, and the agreement terms required to shift freight to a waterborne transportation alternative.
3. Evaluate specific O/D points, shipment volume and schedule projections, regulatory requirements, timing for completion of facility improvements, and prepare criteria for supply chain modification to support the modal shift.
4. Communicate the specific potential opportunity and shipping criteria to carriers, customs brokers, freight forwarders, and/or regional 3PL's, in order to initiate development of freight rates and movement optimization, including any "plus-up" potential ("plus-up" is discussed in Section 3.5.5).
5. After initial freight rate development, communicate shared risk and outcome objectives to all supply chain partners to ensure adequate understanding of all information exchanged.
6. Complete commercial terms/contracts, complete facility improvements, fulfill regulatory requirements, schedule shipments, and initiate tow activity, thereby executing the agreement.

3.2 CONCEPT 2: INFRASTRUCTURE & REQUIRED TERMINAL CAPABILITIES

Definition – Provide infrastructure and terminal capability recommendations to match required infrastructure with freight opportunities. Suggest appropriate infrastructure and material handling modifications necessary to create a competitive advantage, improved distribution networks, and enhanced service capability.

Intent – Identify the infrastructure and terminal capability enhancements necessary to respond to a potential freight shift from land transportation modes to the Missouri River system. The overall purpose is to guide stakeholders in making the appropriate capital investments necessary to promote long-term sustainable maritime commercial activity.

Interdependency – The physical assets along the Missouri River baseline market area were evaluated, in order to assess the ability of servicing the freight volumes that will potentially shift to a waterborne transportation option. The information compiled in the Task 2 inventory facilitated the review of infrastructure location, condition, capabilities, and needs. Market penetration estimates were developed utilizing the market output from Tasks 3 and 4 that classified commodity types, identified market nodes, and projected overall market size. Together, the Task 2, 3, and subject Task 4 outputs provide a solid foundation for analyzing terminal requirements, material handling conveyance, and intermediate storage of freight on the Missouri River.

As previously presented, a wide variety of commodity types appear shiftable to a Missouri River waterborne transportation option. The specific commodity types dictate storage and material handling requirements, so compatible commodities will be grouped in the following discussions. Due to the fact that most existing facilities are owned and/or operated by private entities and the public facilities are somewhat limited in capability at this time, the following discussions are on a regional basis to avoid inadvertently creating the perception that one facility is more capable than another. Although that may be true based on the Task 2 inventory, the choice to take advantage of any identified opportunity is limited only by the vision of the individual stakeholder.

3.2.1 Facility & Handling Requirements by Commodity Group

<u>Agricultural Dry Bulk</u>

The agricultural dry bulk market is characterized by freight movements that are almost exclusively outbound, as well as its dominance in the Northwest Missouri Region on a tonnage basis. This market is also closely affiliated with private sector facility ownership in the form of bulk elevators used for product handling. Table 3.17 provides a summary of the shiftable agricultural dry bulk market, estimated facility throughput capacity, and a projection of barge activity necessary to accommodate the identified shiftable tonnage. As shown in Table 3.17, the Northwest Missouri Region has, within the context of shiftable market tonnage, significant waterborne transportation demand potential. Most of the freight in this market is currently moving by rail. One (1) waterside facility in the region has significant capacity; however, this facility does not appear to have any

connectivity to the Missouri River and was, therefore, not included in Table 3.17. This facility may explain the significant differences in the shiftable market-to-throughput capacity ratios shown.

Table 3.17 – Agricultural Dry Bulk Market Summary

Region	No. of Facilities	Shiftable Market (tons)	Throughput Capacity (tons)	Ratio (Throughput/ Shift)	Barge Activity (units)
Central MO	6	21,700	1,078,400	50/1	16
Kansas City	5	171,300	3,566,600	20/1	122
NW MO	5	422,300	909,500	2/1	302

In order to capitalize on the identified shiftable market, a few facilities would have to dedicate a significant portion of throughput capacity to waterborne freight or develop new infrastructure. If connectivity to the Missouri River is developed at the facility mentioned above, significant additional throughput capacity would be provided.

Other Dry Bulk Markets

Inside Storage

The non-agricultural dry bulk market requiring inside storage consists of materials that are almost exclusively inbound to the system. These materials require dry shipping in covered barges and dry storage in sheds or domes. The market primarily consists of various grades of fertilizer for agriculture use, as well as cement and salt/chloride blends primarily used for winter snow melt. Existing storage can be found at private facilities within the baseline market area, but storage could also be included at a public port complex in underserved market areas. Table 3.18 provides a summary of the shiftable non-agricultural dry bulk market requiring inside storage, estimated facility throughput capacity, and a projection of barge activity necessary to accommodate the identified shiftable tonnage.

Table 3.18 – Other Dry Bulk Markets Summary

Region	No. of Facilities	Shiftable Market (tons)	Throughput Capacity (tons)	Ratio (Throughput/ Shift)	Barge Activity (units)
Central MO	2	64,100	280,000	4/1	46
Kansas City	1	64,900	0	---	46
NW MO	0	14,000	0	---	10

The Central Missouri Region has adequate capacity at one operational facility that can receive material by barge. Another facility exists, but the dock structure appears to require replacement and no dockside material handling equipment is present at this time. If the dock structure and suitable material handling equipment was available dockside, the regional capacity would be more robust. The Kansas City Region has not

had non-agricultural dry bulk capacity since the closure of the MWT Bulk Services terminal presently controlled by the City of Kansas City (MO). The Port Authority of Kansas City, MO, is reported to be searching for an appropriate site for riverside port development to respond to regional waterborne freight service demand. Although a future port development for the region should be multi-modal and diverse in freight services, a portion of the demand can be met in Kansas City through an existing facility's upgrade and placement into operation.

As shown in Table 3.18, the Northwest Missouri Region does not have any identified throughput capacity in this commodity group, but 14,000 tons of shiftable freight was identified. Regardless, the regional agricultural market is large, and accordingly, the Task 3 output shows significant fertilizer tonnage moving into Nebraska by rail. Due to this large agricultural demand, shifting fertilizer to waterborne transportation likely could be competitive after the recovery of Missouri River marine transportation begins, but riverside facilities (possibly in St. Joseph) would have to be built to store and distribute commodities.

In addition to the more traditional, higher volume dry bulk commodities discussed above, other markets warrant consideration, specifically including alfalfa pellets and the emerging DDGS market. These commodities share handling equipment and storage requirements with the traditional dry bulk commodities.

Outside Storage

The primary non-agricultural dry bulk commodity within this classification is coal, which could be transported in open or covered hopper barges. Coal could be handled by similar material handling means as the other dry bulk materials requiring inside storage, but product cross-contamination would have to be addressed. Additionally, storm water runoff from coal storage areas would require consideration with regards to water quality standards.

A coal market shift of 114,000 tons from existing modes to waterborne transportation may be feasible. Four (4) coal-fired power plants were previously identified in the Central Missouri Region. Of those facilities, one has limited dock infrastructure and approximately 100,000 tons of storage capacity. But this facility would require significant investment in material handling equipment in order to accommodate riverside coal handling. Due to their close proximity to each other, two other facilities could potentially be serviced from a single Central Missouri Region river terminal location (possibly near Jefferson City or Columbia), but no specific location has been identified at this time. The fourth power plant could potentially be serviced from the Brunswick/Miami area.

General Facility & Handling Requirements

Although dry bulk commodities may have various storage requirements, the material handling equipment is generally the same. Facility and handling requirements consist of a cell/marginal wharf with an operating area sufficient to accommodate a lattice boom

crawler crane with capacity of 80 to 110 tons. The dock should accommodate a duty-cycle crane with space and design allowances made for handling of bulk material via hopper and conveyor transfer methods. If space and dock dimensions allow, consideration for truck or rail interface should be included. Other improvements specific to product storage (open or covered) would be required, and fleeting improvements will be a necessity to meet potential demand.

Liquid Bulk Market

The primary commodities within the liquid bulk market include those that are typically transported and stored in tanks. Examples consist of petroleum products (asphalt), petrochemicals, liquid fertilizer, ethanol, and biodiesel. Although all liquid commodities have long-term merit, emphasis should be placed on asphalt and the emerging ethanol market opportunities. Asphalt is a mature liquid bulk market with its own market challenges, as discussed in Section 2.2. And as previously discussed in Section 2.3, the Corn Belt ethanol market is potentially significant, and the feasibility of shifting ethanol transportation to the Missouri River should be considered by stakeholders.

General Facility & Handling Requirements

Liquid bulk products are typically transferred via pipeline or hose between tank barges and truck/rail tanks or terminal storage tanks. Waterside facilities are generally purpose-built for liquids and require different structural qualities than non-liquid facilities. Unlike the need to anticipate future uses with dry bulk, the loads and structural demand to handle liquid bulk can usually be established well in advance. Depending on the commodity type(s), special attention is required with regards to transfer component quality, maintenance access, spill prevention, fire suppression, and other regulatory requirements. Contractual volume commitments are usually required to support this type of purpose-built infrastructure investment.

General Cargo

General cargo, or breakbulk, commodities typically consist of steel, machinery, pallets, cases, super sacks, containers, and any other cargo that is generally compatible with hook work by crane. Although only a small amount of this cargo was identified as shiftable, many of the emerging markets will require general cargo infrastructure. Infrastructure requirements for general cargo and other bulk commodities are generally similar, except increased operating area is recommended for general cargo to accommodate the landing and hook-up of cargos, versus the smaller footprint of bulk hoppers and conveyors.

General Facility & Handling Requirements

General cargo facilities consist of a cell/marginal wharf with a sufficient operating area to accommodate a lattice boom crawler crane with a capacity on the order of 150 tons. A crane such as this should accommodate a variety of hook work, with physical space

and design capacity allowances made for the loading/unloading of almost any crane-compatible cargo.

The cell/marginal wharf area must consider appropriate river stage, in order to conduct operations at all river stages supporting navigation. Suitable barge moorings are required to safely secure multiple barges alongside for operations, including on-site or nearby fleeting. Land availability is required for truck scales/queuing and/or rail car accommodations to meet specific cargo requirements. Appropriate storage areas (open or covered) will be needed for the anticipated cargo types and volumes.

Over-Dimensional/Over-Weight

The OD/OW market consists of commodities for which the physical size would typically require special accommodations for highway (truck) or rail transportation. OD/OW examples include stamping presses, power generation equipment, oil and gas industry equipment, large diameter tanks, and process units. None of these commodities have been traditionally transported on the Missouri River with significant frequency, thus required riverside infrastructure does not generally exist.

General Facility & Handling Requirements

OD/OW commodities are typically handled utilizing one of two methods. The first method, roll-on/roll-off (Ro/Ro), involves a rolling conveyance between a deck barge and the wharf area, commonly consisting of a wheeled transporter (with or without self-contained power) or a trailer with significant structural support. The second method, lift-on/lift-off (Lo/Lo), involves lifting the freight to/from a barge using a crane of sufficient capacity to safely handle loads typically accommodated at a general cargo facility.

Facilities that handle OD/OW commodities by Ro/Ro methods typically do so through a sloped cut in the landside river embankment that is stabilized to prevent river current erosion during high water. The slope should be modest from the low water point to the high water point. If river stage variation is not extreme, a bulkhead can be constructed in lieu of a sloped area. Deck barges are typically used for this market, and barges up to 60 feet wide should be considered in facility planning. Since OD/OW commodities are usually transferred across the ends of a barge, barges are typically docked perpendicular to the transfer area, or “head in.” Transfers usually involve portable ramps to assist with and level commodity transfer between the barge and bank. If necessary, water ballast on the barge can be used to improve safety during cargo transfer under unusual conditions. Due to its unique size characteristics, sufficient transfer and staging area must be available to hold OD/OW freight, as it does not typically move on/off facility property quickly.

Gravel & Crushed Stone; Natural Sands

As previously discussed in Section 2.2, these commodities primarily consist of materials used for river navigation maintenance (Gravel & Crushed Stone) or materials dredged

(Natural Sands) from the Missouri River itself. This market is relatively stable, and it is not expected to develop significantly beyond the current volumes. Thus, existing facilities are capable of handling the expected demand, and the need for additional infrastructure is not anticipated.

3.2.2 Regional Facility Improvement & Development

In addition to the facility and handling requirements discussed above, a number of system improvements are recommended in order to accommodate the potential shift of commodities to barge transportation on the Missouri River from other transportation modes. In general, material handling capabilities will require improvements at all private facilities in all market regions. Also, fleeting capacity will be needed near facilities, or at least regionally, to accommodate the higher tempo of barge activity. Additional improvements and considerations are summarized by region below and illustrated in Exhibit 3.5.

Central Missouri Region

- Elevator improvements should consider increased loading speed to reduce barge time at dock.
- Dry bulk and general cargo facility improvements in/around Jefferson City, or possibly elsewhere, could serve multiple commodities.

Kansas City Region

- Elevators immediately upriver and/or downriver of Kansas City proper can take advantage of water transportation in lieu of poor or inefficient rail connections to achieve economies of scale.
- Dry bulk and general cargo facilities can potentially be consolidated into one terminal capable of serving many traditional and emerging markets, including COB and OD/OW.
- Transloading capabilities should be incorporated into material handling planning, due to the large volume of containers being handled through the greater Kansas City area.

Northwest Missouri Region

- Dry bulk and general cargo facilities are recommended, which could possibly be developed as a single facility with the capability to handle fertilizer and DDGS.
- Liquid bulk facilities, including ethanol and liquid fertilizer, are needed in the region and should also be considered north of the Missouri state line, which is a market with very high potential demand.

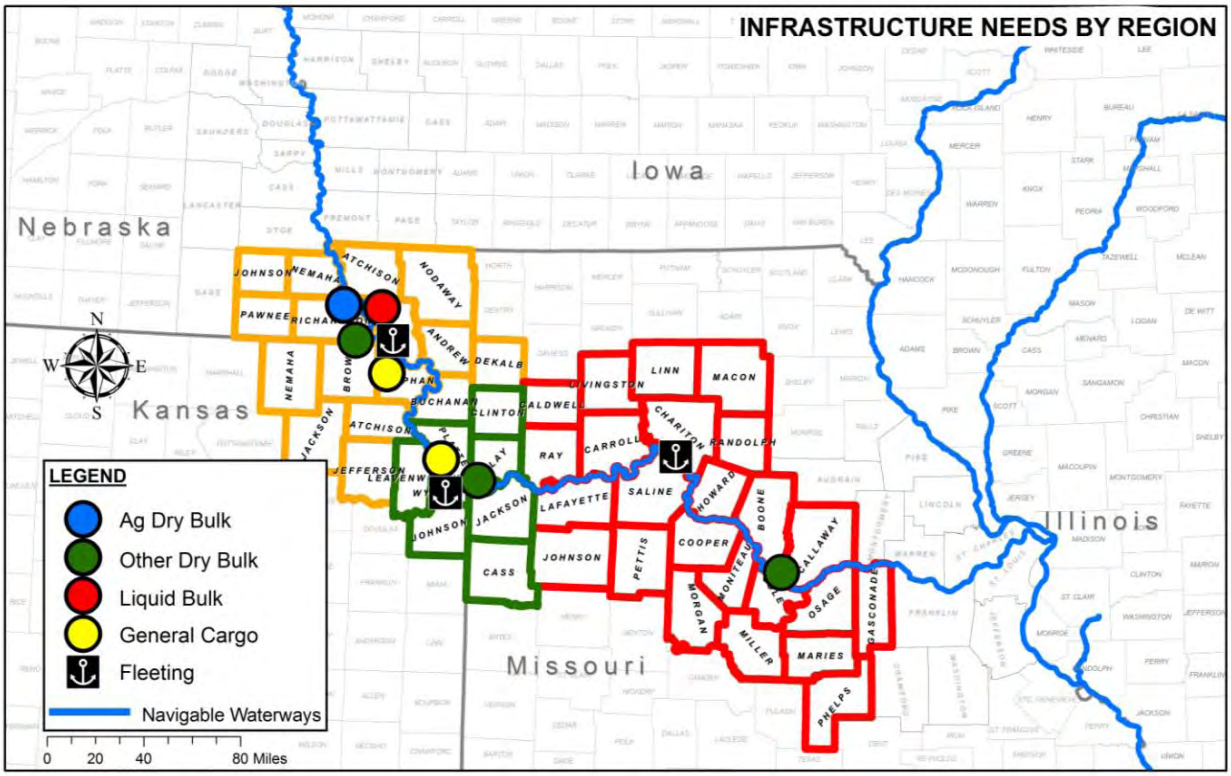


Exhibit 3.5

3.2.3 Implementation

The following implementation initiatives are intended to assist stakeholders with the identification of infrastructure-related capacity and/or deficiencies, as well as providing guidance with regards to site selection and the design process.

1. In order to begin scoping infrastructure requirements, stakeholders must first match existing or projected shiftable market with regional throughput capacity.
2. Depending on commodity type and based on the facility/handling requirements presented above, a generalized terminal design can be developed and prompt stakeholders to identify professional service providers, if needed, to prepare preliminary cost estimates, engineering design criteria, traffic analyses, etc.
3. Referring to Concept 4 (Section 3.4.1), identify an appropriate site(s), considering factors such as ingress/egress, channel location, etc.
4. After identification or acquisition of a proposed site, commence site-specific professional engineering design development, including detailed cost estimates to secure financing.
5. Once financing is secured, the construction process can be initiated with the development of specifications and bid packages. Professional services can also be engaged to assist with developing criteria/specifications related to rolling stock, material handling, and/or installed equipment.
6. Based on the results of the steps above, the stakeholder should reevaluate the business plan to confirm the potential project meets appropriate financial criteria.

3.3 CONCEPT 3: EMERGING MARKETS ON THE MISSOURI RIVER

Definition – Establish the recommended priorities and strategies necessary to develop emerging market freight opportunities, those markets not historically composed of high-tonnage commodities on the Missouri River.

Intent – Develop a comparative analysis of identified commodities using a defined set of criteria focused on a potential shift of emerging market freight to a waterborne option. Additionally, this section provides information regarding America's Marine Highway Program. The methodology and output of the following analysis will assist stakeholders in making business decisions regarding emerging market opportunities.

Interdependency – This Concept of Operations is based on the output of previous Task 3 and 4 analyses. Section 2 of this report presented a detailed analysis of specific commodity groups and market nodes. Section 2 also initiated discussion of specific requirements, timelines, and anticipated volumes that could shift to a waterborne transportation option. Review and understanding of the preceding emerging markets analyses (Section 2.3) is essential to understanding the following analysis and how it represents a complete Concept of Operations. Previous work will be the foundation for helping to prioritize specific target markets and identifying specific elements by which stakeholders can evaluate market opportunities, both now and in the future.

3.3.1 America's Marine Highway Program

The marine highway concept is an effort within MARAD that recognizes that freight, particularly in the form of truck traffic, has and will continue to grow significantly in the next twenty years. Discussions regarding truck traffic growth primarily started a decade ago when imports, specifically containers, were projected to double by 2020. Although the recent economic downturn has slowed that growth somewhat, the more recent pace of economic recovery indicates the forecast freight momentum will return. With the increase of freight imports and shifts to more centralized domestic distribution, highway congestion is expected to continue to be an issue throughout the national highway network. America's Marine Highway Program is a direct effort by MARAD to promote the shift of commercial freight from land-based conveyance to inland waterways, with the primary focus of reducing highway truck traffic.

The State of Missouri has a significant interest in the truck traffic congestion issue and, through MoDOT, has taken a supportive role in the Marine Highway Program objective of shifting traditional and emerging freight to underutilized waterways. As previously introduced in the Highway OD/OW discussion of Section 2.3, two interstate/marine highway corridors are located in Missouri: the I-55/M-55 corridor of the Mississippi River and the I-70/M-70 corridor of the Missouri River. The importance of truck traffic reduction is recognizable in the freight shift evaluations and environmental benefits discussed previously in this report. Shiftable traditional market tonnage was identified as significant, and preliminary emerging market tonnage projections indicate that further reductions in truck traffic may be feasible.

3.3.2 Evaluating Target Markets

Ranking Criteria – Similar to the Concept 1 analysis, the following is a discussion of the criteria identified as metrics for a comparative analysis of potential target markets, and each criterion is briefly explained below. The criteria are classified under four primary groups:

a. Market Characteristics
b. Terminal Capability Needs
c. Competitive Position
d. General Commodity Characteristics

Specific emerging commodity markets previously identified as shiftable will be evaluated in relation to each criterion. Unlike the Concept 1 analysis, less specific information was available regarding the emerging markets for a variety of reasons, but primarily because they are *emerging* rather than traditional markets. The lack of specific information leads to less certainty regarding evaluation criteria, and therefore, the analysis below is based on 19 criteria as opposed to the 32 criteria used to evaluate the traditional markets of Concept 1. It is important to note that the analysis and results given here do not consider any required infrastructure improvements – infrastructure improvements were addressed in Concept of Operations 2 (Section 3.2).

a. Market Characteristics

- Size of Market – The size of the potential market is obviously a key component of the investment decision making process.
- Compatibility with other Commodity Markets
  - Terminal Needs – Does this commodity group require dedicated terminals, or will a terminal that serves this group be well-suited for other commodity groups?
  - Seasonal Timing – Some potential commodities are constrained by timing (e.g. harvest time, or other seasonal demand or production realities), while others can move anytime during the navigation season.
  - Waterborne Equipment – Some potential commodities require dedicated barges, while others can use a wide variety of equipment.
  - Freight Balance – Is there a “front-haul” and backhaul identifiable for this market group?
- Geographic Location Appropriate to Serve the Market
  - Proximity to Origins/Destinations – If inbound commodities arrive at a barge terminal but still have a long distance to reach the end-user destination, there may be additional cost and/or a competitive disadvantage. The same is true for outbound commodity origins that are relatively distant from a terminal.
  - Connectivity to Other Necessary Modal Systems – A number of commodity groups have the capability to move via a number of modes. Does the location of the identified node(s) for this commodity group

provide adequate modal choice for moving the freight to/from the terminal? A lack of choices and availability can be a pricing and/or service flexibility challenge.

b. Terminal Capability Needs

- Load/Unload Capacity – Is there adequate capacity within the Missouri River system to handle the anticipated volume for this commodity group?
- Load/Unload Experience – Do Missouri River operators have current or historic experience with this or a similar commodity group?
- Necessary Storage Capacity – Once the freight is unloaded from a barge, it often needs to be stored at the terminal prior to delivery. Is there adequate capacity within the Missouri River system to handle the anticipated volume for this commodity group?
- Necessary Transfer Capacity – Transfer refers to moving the freight from its original unloaded location (or storage) to the next mode of conveyance (probably truck or rail). Is there adequate capacity within the Missouri River system to handle the anticipated volume for this commodity group?
- Material Handling Equipment – Can this commodity group be handled with the same or similar equipment as numerous other commodities, or does it require special equipment for loading, unloading, and storage?

c. Competitive Position

- Trucking Comparison
  - Availability of Trucking Service – Assess the modal preference of a given commodity group between water and truck service.
- Rail Comparison
  - Availability of Rail Service – Assess the modal preference of a given commodity group between water and rail service.

d. General Commodity Characteristics

- Risk
  - Inherent Commodity Risk – What is the relative risk associated with the commodity group? Risk could be associated with hazmat, high value, etc.
  - Past Experience with this Commodity Group – What is the experience level with this commodity group on the Missouri River?
- Complexity of Service and Contracting
  - Regulatory Compliance – What is the level of effort required for regulatory compliance in order to move this freight?
  - Service Expectations – Does moving this freight entail expectations of more complex services, such as 3PL, etc.?
- Compatibility with Waterborne Equipment – Does servicing this commodity group entail use of standard, common equipment, or might it require investment in specialized equipment of limited use?

Method of Analysis – The criteria above are summarized in Table 3.19, which provides a framework for the analysis in Section 3.3.3. Similar to the analysis of traditional markets in Concept 1, each criterion is assigned a weighting factor representative of its relative importance in the overall evaluation of a particular shiftable market opportunity. The resultant weight as a percentage of the total number of factors is also provided for reference. In addition to the weighting factors, evaluation numbers between -1 and 3 are described for each criterion.

For example, the “market size” criterion is assigned a weighting factor of 20, or 26% of the total weighting. Comparatively, all of the remaining criteria are assigned a weighting factor ranging from 1 to 5, or a resultant weight between 1.3% and 6.5%. This heavy weighting factor is justified for the “market size” criteria, considering there must be an available market before any of the other criteria are relevant. Continuing the “market size” example, a commodity group with a high tonnage potential would then be assigned an evaluation number of 3, medium tonnage potential would be assigned a 1, and a low tonnage potential would be assigned a -1 evaluation number.

Table 3.19 was then used as a guide for the analysis of each emerging commodity group target according to the criteria above. Unlike the traditional market analysis of Concept 1, only a single, existing conditions analysis was completed, because the emerging markets are less defined.

Table 3.19 – Summary of Evaluation Criteria

	Criteria	Weighting Factor	Resultant Weight	Evaluation Number * 3	1	-1
Market Characteristics						
	Market Size	20	26.0%	High tonnage potential	Medium tonnage potential	Low tonnage potential
Compatibility with other Commodity Markets	Terminal Needs	3	3.9%	Terminal needs very similar to other commodities	Somewhat similar needs	Needs are particular to this commodity
	Seasonal Timing	3	3.9%	Timing enhances other commodities	No impact on other commodity opportunities	Timing conflicts with serving other commodities
	Waterborne Equipment	3	3.9%	Equipment needs very similar to other commodities	Somewhat similar needs	Needs are unique to this commodity
	Freight Balance	3	3.9%	Potential "front-haul" and backhaul identified	"Front-haul" and backhaul are possible	"Front-haul" and backhaul unlikely
Geographic Location	O/D Proximity	2	2.6%	First or last mile are in a county adjacent to the river	First or last mile is within 2 counties of the river	First or last mile is more than 2 counties away
	Modal System Connectivity	2	2.6%	Multiple modal connections are available	Modal connections might be available	Modal connections are not readily available
Terminal Capability Needs						
	Load/Unload Capacity	3	3.9%	Sufficient capacity exists to handle regional volume potential	Some capacity currently exists	No capacity currently exists
	Load/Unload Experience	1	1.3%	MoRiv Operators/carriers are experienced with this commodity	Other rivers move this commodity group	This commodity group does not typically move by water
	Necessary Storage Capacity	2	2.6%	Sufficient capacity exists to handle regional volume potential	Some capacity currently exists	No capacity currently exists
	Necessary Transfer Capacity	3	3.9%	Sufficient capacity exists to handle regional volume potential	Some capacity currently exists	No capacity currently exists
	Material Handling Equipment	2	2.6%	Equipment needs are very similar to other commodities	Somewhat similar needs	Needs are unique to this commodity
Competitive Position						
Trucking Comparison	Availability of Trucking	5	6.5%	This commodity clearly favors water over truck, if water is an option	This commodity may favor water	This commodity typically favors truck
Rail Comparison	Availability of Rail	5	6.5%	This commodity clearly favors water over rail, if water is an option	This commodity may favor water	This commodity typically favors rail
General Commodity Characteristics						
Risk	Inherent Commodity Risk	5	6.5%	Low risk commodity group	Somewhat risky	Relatively high risk
	Past Experience	5	6.5%	MoRiv currently moves this or similar commodities	MoRiv previously moved this commodity	MoRiv has little or no experience with this commodity
Complexity	Regulatory Compliance	2	2.6%	Low regulatory compliance complexity	Moderate regulatory complexity	High regulatory complexity
	Service Expectations	5	6.5%	Service expectations are simple and easy to meet	Moderately complex service requirements	Highly complex service expectations to compete
	Compatibility with Waterborne Equip	3	3.9%	This commodity can move on standard, common equipment	Standard equipment, but not necessarily common	Requires specialized equipment
	Total	77	100.0%			

3.3.3 Analysis of Target Markets

Tables 3.20 through 3.23 present the analytical evaluation of each commodity group based on the criteria discussed above. The specific commodity groups analyzed in this Concept of Operations include:

- Waste/Scrap
- Coal
- Liquid Fertilizer
- Ethanol
- DDGS
- Alfalfa Pellets
- COB
- OD/OW

Most of these commodities were identified as emerging markets in Section 2.3, with the exception of alfalfa pellets, which was presented in the traditional markets discussion in Section 2.2 based on the fact that it has moved recently on the Missouri River. Alfalfa pellets is included in this Concept of Operations for two reasons: 1) insufficient information was obtained from the Task 3 and 4 output to project a shiftable volume with the same degree of confidence as the other traditional markets, and 2) this commodity appears to have the potential to be an emerging market on the Missouri River.

Table 3.20 – Analysis based on Market Characteristics

		CRITERIA FOR RANKING EMERGING MARKET OPPORTUNITIES						
		Market Characteristics						
		Market Size	Compatibility with other Commodity Markets				Geographic Location	
			Terminal Needs	Seasonal Timing	Waterborne Equipment	Freight Balance	O/D Proximity	Modal System Connectivity
	Weighting Factor	20	3	3	3	3	2	2
Commodity Group	**Commodity Group Score Subtotal**	**Existing Conditions**						
Waste/Scrap	**98**	3	3	3	3	1	3	1
Coal	**60**	1	3	3	3	3	1	1
Liquid Fertilizer	**14**	1	-1	1	-1	-1	1	-1
Ethanol	**54**	3	-1	1	-1	-1	1	-1
Dried Distillers Grains	**92**	3	3	1	3	1	1	3
Alfalfa Pellets	**4**	-1	3	1	3	1	-1	1
Container-on-Barge	**-2**	-1	3	1	1	1	1	-1
Over-Dimensional/Over-Weight	**-20**	-1	-1	1	-1	1	-1	1

Table 3.21 – Analysis based on Terminal Capability Needs

		CRITERIA FOR RANKING EMERGING MARKET OPPORTUNITIES				
		Terminal Capability Needs				
		Load/Unload Capacity	Load/Unload Experience	Necessary Storage Capacity	Necessary Transfer Capacity	Material Handling Equipment
	Weighting Factor	3	1	2	3	2
Commodity Group	Commodity Group Score Subtotal	Existing Conditions				
Waste/Scrap	5	1	1	1	-1	1
Coal	5	1	1	1	-1	1
Liquid Fertilizer	-5	-1	1	1	-1	-1
Ethanol	-11	-1	-1	-1	-1	-1
Dried Distillers Grains	31	3	1	3	3	3
Alfalfa Pellets	20	2	3	1	1	3
Container-on-Barge	-7	-1	-1	-1	-1	1
Over-Dimensional/Over-Weight	-5	-1	1	1	-1	-1

Table 3.22 – Analysis based on Competitive Position

		CRITERIA FOR RANKING EMERGING MARKET OPPORTUNITIES	
		Competitive Position	
		Availability of Trucking	Availability of Rail
	Weighting Factor	5	5
Commodity Group	Commodity Group Score Subtotal	Existing Conditions	
Waste/Scrap	10	1	1
Coal	30	3	3
Liquid Fertilizer	10	1	1
Ethanol	10	1	1
Dried Distillers Grains	30	3	3
Alfalfa Pellets	30	3	3
Container-on-Barge	0	1	-1
Over-Dimensional/Over-Weight	30	3	3

Table 3.23 – Analysis based on General Commodity Characteristics

		CRITERIA FOR RANKING EMERGING MARKET OPPORTUNITIES				
		General Commodity Characteristics				
		Risk		Complexity		Compatibility with Waterborne Equip.
		Inherent Commodity	Past Experience	Regulatory Compliance	Service Expectations	
	Weighting Factor	5	5	2	5	3
Commodity Group	Commodity Group Score Subtotal	Existing Conditions				
Waste/Scrap	40	3	-1	3	3	3
Coal	40	3	1	3	1	3
Liquid Fertilizer	25	1	1	1	2	1
Ethanol	-16	-1	-1	1	-1	-1
Dried Distillers Grains	30	3	-1	3	1	3
Alfalfa Pellets	50	3	3	3	1	3
Container-on-Barge	10	1	-1	3	-1	3
Over-Dimensional/Over-Weight	20	1	3	1	-1	1

3.3.4 Target Market Analysis Results

Based on the analyses presented in Tables 3.20 through 3.23, the commodity group ranking results are summarized in Exhibit 3.6.

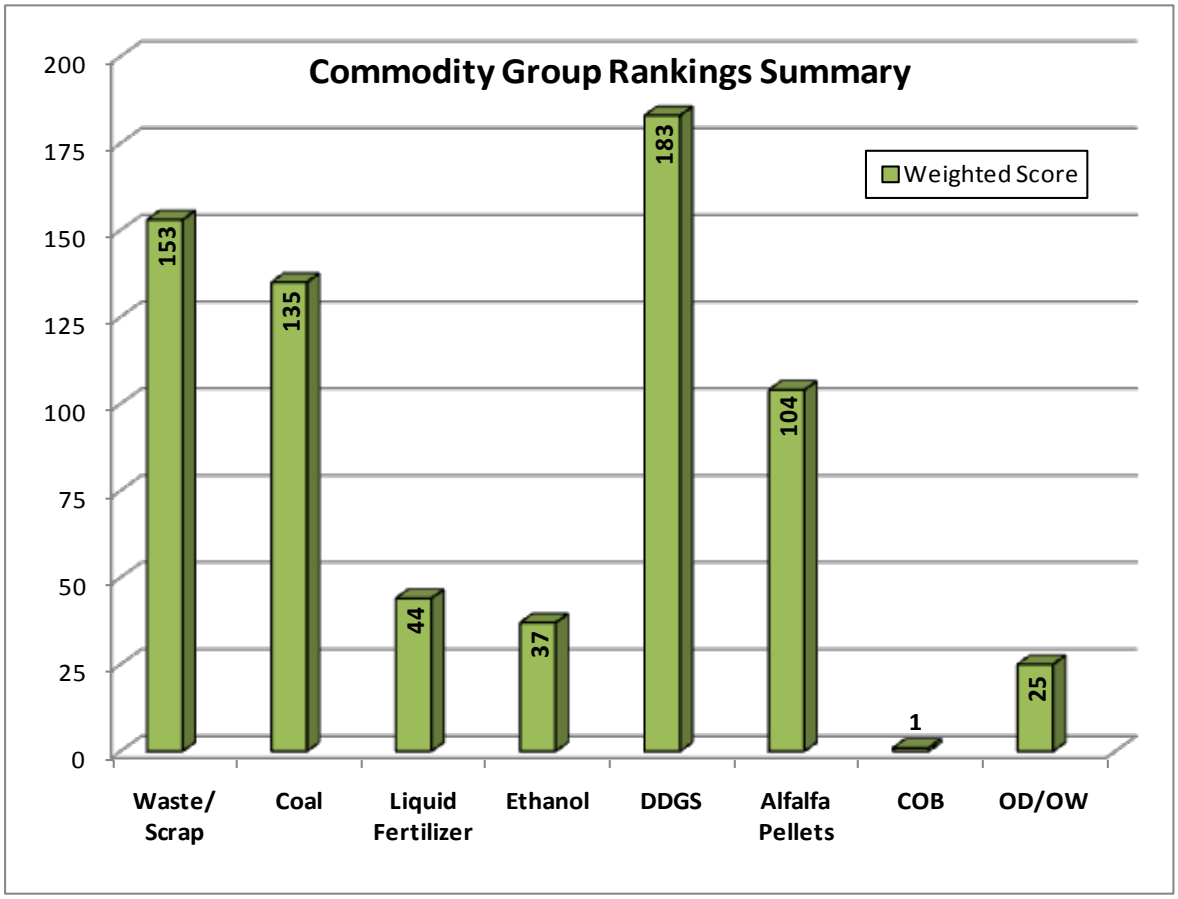


Exhibit 3.6

The results of the analysis indicated the relative attractiveness of the eight emerging markets based on the criteria examined and the information available. As shown, the DDGS market appears to have a high potential for development and accordingly ranked the highest. In order, the commodities ranked as follows:

1. DDGS
2. Waste/Scrap
3. Coal
4. Alfalfa Pellets
5. Liquid Fertilizer
6. Ethanol
7. OD/OW
8. COB

The rankings are not intended to suggest that lower ranked commodities may not be viable markets, nor do they suggest that higher ranked markets will be easy to develop. Since none of the emerging markets are fully defined, effort by stakeholders will be required to collect additional information to make informed decisions. The purpose and value in the analysis presented is the identification of potential targets, as well as

describing the challenges, advantages, and suggested strategies for enhancing the potential to develop specific emerging markets.

3.3.5 Strategies for Enhancing Target Markets

Unlike the strategies presented in Concept 1 for enhancing the traditional market commodities, the strategies for emerging markets are intended to fully identify the market potential and the relationships necessary to create a viable freight opportunity on the Missouri River.

Waste/Scrap

As part of a potential Kansas City terminal development, the capability to service this primarily scrap steel market should be included. In general, any facility capable of typical hook work could serve the market, so long as crane capacity is suitable for efficient load rates. Assuming the shipments previously discussed in Section 2.3 are currently moved by truck to the St. Louis area and then loaded to barge for shipment downstream to mini-mills on the Mississippi River or for export from Gulf of Mexico ports, shifting to barge on the Missouri River should create a competitive advantage by bypassing re-handling at St. Louis marine facilities.

Coal

In order to sustain a modal shift of coal shipments to a waterborne transportation alternative, regular barge service would be required throughout the 8-month navigation season. Safety stock buildup, with attention to good material handling, and intermediate truck service would also be necessary. Further, interested stakeholders will have to initiate direct discussion with the facilities discussed in Section 2.3 or other power plants that are not committed to rail contracts. Waterborne transportation options may also make other origins/coal sources more competitive than those being utilized today. Should the potential be established, coal receipt and storage infrastructure would have to be built or improved at appropriate Missouri River locations.

Liquid Fertilizer

Redevelopment of a liquid fertilizer market on the Missouri River will require soliciting demand interest from potential users, as well as determining appropriate site selection criteria and infrastructure needs. Given sufficient market demand, infrastructure would have to be built or refurbished to handle this commodity.

Ethanol

In order to capitalize on the potential for transportation of ethanol by barge, waterside terminal facilities must be developed and located in close enough proximity to production facilities to receive ethanol by truck or through a modest-length dedicated pipeline. Note, there is limited compatibility of ethanol with other liquid commodities,

thus dedicated terminal infrastructure and possibly vehicles (tank rail cars, truck trailers, and barges) are required to transport ethanol. Infrastructure investment and resolution of other supply-chain barriers will probably require long-term shipper commitment. Infrastructure development should also consider the potential synergy of ethanol transfer and DDGS movement from the same waterfront location. The advantages for such a strategy include economies of scale and marine terminal development cost allocation based on the volume of two commodities.

Dried Distillers Grains

DDGS could theoretically be handled through existing agricultural dry bulk facilities. Projected volumes could potentially support modest-sized, dedicated storage facilities that could be linked through existing dock and material handling infrastructure. However, a market analysis and understanding of the supply chain variables should be fully investigated, and a business model/plan should be developed.

Container-on-Barge

The opportunity to secure a COB market for the Missouri River is not immediate. The River's reliability must develop, in addition to the requirements of container availability, suitable cargo type, infrastructure capability to handle loaded containers, and sufficient volume. The COB market will not likely be tapped on a regular basis until sometime late in a five year horizon. However, spot opportunities for container shipments of large tonnage may be available, as well as empty container repositioning for ocean carriers. These opportunities are likely in agricultural-related commodity markets.

Over-Dimensional/Over-Weight

The previously evaluated OD/OW data (see Section 2.3) is believed to underestimate the total market potential, and analysis of operational, financial, and facility details is recommended for this highly specialized market. Should a Missouri River OD/OW market develop, the net reduction of "permitted" vehicle loads on the I-70 corridor during a traditional navigation season could be substantial. Specific commodities to potentially target include wind energy components, project cargoes, and materials/equipment associated with oil and gas exploration.

3.3.6 Emerging Markets Potential Freight Shift

Based on the preceding emerging market analyses, anecdotal information obtained from various stakeholders, and assuming the strategies discussed above are implemented, an estimate of the emerging markets shiftable freight was developed (Table 3.24). As shown, over 517,000 tons of freight may potentially shift to a Missouri River transportation option over a 5-year period.

Table 3.24 – Total Identified Emerging Markets Shiftable Freight (First 5 Years)

Origin	Destination	River Region	Freight Type	Primary Current Mode	Current Volume Estimate (NT)	Shifted Volume (NT)	Shift Period (yrs.)
S. IL	Jefferson City	CM	Coal	Truck	250,000	114,000	3
KC Region	NOLA	KC	COB*	Truck/Rail	150,000	70,000	5
NW MO	NOLA	NW	DDGS	Rail	790,000	50,000	3
LMR	NW MO	NW	Liquid Fertilizer	Truck	150,000	50,000	5
NW MO	LMR	NW	Ethanol	Rail	763,000	63,100	5
LMR	NW MO	NW	OD/OW*	Truck/Rail	50,000	20,000	3
NW MO	LMR	NW	Alfalfa Pellets	Rail	150,000	50,000	1
KC Region	STL	IR	Waste/Scrap	Truck	335,400	100,000	5
					TOTAL	**517,100**	

* *Estimated in tons; however, cubic capacity has more direct relevance.*

3.3.7 Implementation

Various Emerging Market Commodities

The following implementation initiatives are intended to assist stakeholders with the commencement of a business planning process and resulting in the development of emerging market freight shift opportunities for select commodity groups.

1. Establish Communication
    a. Dried Distillers Grains – Establish communication between dry bulk carriers, geographic-specific ethanol producers (DDGS source), and regional terminal operators with an interest in handling DDGS.
    b. Coal – Establish communication between power providers (potential end-users) and regional facility owners identified in Task 2 with open dry bulk storage capacity.
    c. Waste/Scrap – Establish communication between scrap traders and regional terminals to discuss the feasibility of transporting bailed, cut, crushed, or shredded scrap to mini-mills or Gulf ports for export.
    d. Alfalfa Pellets (and other NE/IA Bulk Agricultural Commodities) – Establish communication between key players (farmers, carriers, 3PL's, etc.) in shiftable agricultural dry bulk markets with commodities leaving the region and bulk grain elevator owners identified in Task 2.
    e. Liquid Fertilizer – Establish communication between liquid commodity carriers and regional terminal operators with an interest in handling liquid fertilizer.
    f. Ethanol – Establish communication between liquid commodity carriers seeking long-term growth, ethanol producers/retailers, and regional terminal operators with an interest in handling ethanol.
2. Working with identified key players and facility owners, evaluate needed facility improvements, as well as intermediate storage and transportation requirements to shift freight to a waterborne freight alternative.

3. Evaluate specific origin and destination points, agreement terms, shipment volume and schedule projections, regulatory requirements, completion of facility improvement timing, and prepare criteria for supply chain modification to support the modal shift.
4. Communicate the specific potential opportunity and shipping criteria to carriers, customs brokers, freight forwarders, and/or regional 3PL's, in order to initiate development of freight rates and movement optimization.
5. After initial freight rate development, communicate shared risk and outcome objectives to all supply chain partners to ensure adequate understanding of all information exchanged.
6. Complete commercial terms/contracts, complete facility improvements, fulfill regulatory requirements, schedule the shipments, and initiate tow activity, thereby executing the agreement.

Container-on-Barge & Over-Dimensional/Over-Weight

Although included in the emerging market, COB and OD/OW are not commodities themselves, but more appropriately, a means of shipping commodities and a freight classification, respectively. The COB and OD/OW markets were ranked herein as having the most challenge to development, as compared to other emerging market opportunities. The market development timeline and challenges are significant; however, responding to occasional demand in the interim can potentially be leveraged into long-term scheduled service at some point in the future. The following steps provide guidance for market, infrastructure, and operational development necessary to establish sustainable COB and OD/OW movements on the Missouri River.

Market Development – COB

1. Establish communication links with ocean container carriers that serve the Missouri River region and have water connectivity to the Gulf coast, focusing on the points of contact for inbound/outbound cargoes, container equipment control, container storage depots and terminals, existing train/truck service format, and terms of shipment.
2. Identify commodities that have regional relevance and sufficient volumes that may take advantage of economies of scale. These commodities tend to be of lower value and do not have tight shipment timelines, and they can take full advantage of lower transport costs.
3. Identify service demand drivers that match container compatible movements for exports, such as Identity Preserved (IP) grains, DDGS, hazardous materials, ISO 20' tanks, waste paper, scrap electronics, high-density commodities, and bagged goods (USDA-PL480 cargo, for example).
4. Compile a list of candidate commodities and obtain market movement data from public and private contacts, or other business development interests.
5. Determine the market size and estimate the level of penetration expected, based on shipping requirements and meeting other identified needs.

6. If possible and depending on the involvement and business intent of individual stakeholders, structure the overall movement pricing based on a door-to-door approach. This may vary somewhat based on the individual stakeholder, as well as contract terms with a shipper or the ocean carrier.

Infrastructure Development – COB

1. At a suitable location in a region of interest, evaluate the capability to move a loaded container between barge and proposed landside facilities.
2. Define the level of service required to facilitate appropriate utilization of an identified dock or marine facility (or a facility to be developed).
3. Identify existing capabilities and/or required investment in material handling equipment to support COB throughput. Also consider yard jockeys, scales, cranes, rolling stock, etc.

Operational Development – COB

1. Determine the land connection and routing between the cargo's origin/destination and the identified marine facility.
2. Determine if a need exists for transloading capabilities at the marine facility to defray potential additional costs (compared to truck/rail) or to improve service.
3. Identify solutions for any chassis/flatbed requirements to move carrier/shipper-owned equipment or for intra-terminal operations.
4. Develop protocols for movement on/off terminal property including gate activity, security, land use, hours of service, stevedoring, and documentation.
5. With an inland waterway carrier, determine the schedule, transit time, service structure, barge tonnage requirements, boat height-of-eye, stowage plan, and stability requirements.
6. Structure contracts with conditions/intentions expressed in detail, considering responsible parties for all operational requirements.

Market Development – OD/OW

1. In order for the Missouri River to serve as an OD/OW transportation gateway option and to establish communication links for market development, the market network must first be identified. Participating in organizations that specialize in OD/OW movements will provide access to this network of ocean and inland carriers, port and trade gateways, project cargo intermediaries, and logistics providers. For example, the Railway Industrial Clearance Association (RICA) specializes in OD/OW movements.
2. Develop a marketing/sales campaign to promote Missouri River access, terminal capabilities, local towboat support service, dock infrastructure, and position as a gateway for large project equipment staging and distribution (wind energy components, for example). A broad Missouri River marketing message may be more effective than a campaign targeting a specific commodity.

3. Participate in organizations such as RICA and attend the Journal of Commerce's Breakbulk Transpo, as well as other heavy-lift industry conferences. Such events provide ideal networking opportunities with others in the OD/OW industry and distribution of Missouri River freight promotional material.
4. Follow up regularly with networking connections to communicate the advantages offered by a Missouri River option.
5. Identify a specific role in the logistics service chain desired by the stakeholder: towing services, assist tugs, Ro/Ro or Lo/Lo terminal availability, stevedore services or assistance, cranes and equipment, distribution center for project equipment, intermediate site storage, local re-handling for inland movement, etc.
6. Formulate a pricing strategy in advance that has a framework that considers the following: infrastructure investment, value of the project, site advantages over transportation alternatives, risk assessment, and the opportunity for multiple moves planned for the same account. Generally, a fee structure can consist of 1) a fixed facility-use charge with a daily use component, 2) a weight or cubic volume assessment, and/or 3) charges for services provided, such as storage, stevedoring, transloading, utilities, shifting, fleeting, etc.

Infrastructure Development – OD/OW

1. Identify stakeholder interest in specific OD/OW freight and existing facility infrastructure capability, including docks, ramps, and/or fleeting areas.
2. Determine the requirements for Ro/Ro or Lo/Lo capability, as well as service accommodations for the potential market (see Concept 2).
3. Evaluate a specific terminal location with respect to highway access, intended origin/destination, rail transloading capability, and intermediate storage space.
4. Based on the existing infrastructure assessment, determine if any improvements could be made to increase site attractiveness for OD/OW. Investments should be limited to multi-use improvements to maximize utilization. Improvements to consider include appropriate moorings for securing a "head-in" deck barge, stabilized/reinforced open ground storage, or a stabilized river bank to meet limited Ro/Ro requirements with secure moorings.
5. When evaluating potential investments, recognize that most heavy haulers may make some improvements at a "suitable" site as part of a use agreement. A stakeholder may gain value if improvements made are left behind after the project, such as bank stabilization or staging area improvements. Once a site is integrated into the OD/OW network, it may be used again by others.
6. Advertise in the context of understanding the OD/OW industry's needs and providing the basic infrastructure for this unique market.

Operational Development – OD/OW

1. Frequently, an OD/OW move is bid by multiple heavy haulers trying to secure the most favorable transport option for the shipper, well in advance of the actual shipment. Upon notification of a potential move, obtain the point of contact's information, freight dimensions/weight/piece count, responsible parties, schedule

estimate, and the date by which a response is needed. Also inquire about potential additional services.

2. If indications are favorable that the opportunity can be contracted, provide a rate "indication" based on the information obtained in Step 1.
3. Develop final contract terms considering schedule, required services, hold-harmless clauses, shipment insurance information, facility insurance coverage language, etc. Contract language should include removal of equipment and site cleanup, unless agreed upon otherwise. Perform any other appropriate due diligence necessary to complete the contract.
4. Anticipate and accommodate pre-staging and assembly of equipment necessary to handle the load/unload activity. Pre-staging may require assistance from the terminal to unload trucks, stage pumps, set ramps, and other spot needs. Normally, heavy haulers or contractors for OD/OW moves are well prepared, but occasionally some deficiency is identified and problems are worked out at the site. A good experience with the parties involved usually results in repeat business and additional opportunities.

3.4 CONCEPT 4: ECONOMIC DEVELOPMENT & ADVOCACY

Definition – Identification of appropriate locations and funding mechanisms for business development opportunities. Discuss advocacy/interest groups and their potential influence on Missouri River freight.

Intent – Provide stakeholders with suggested locations appropriate for development, or redevelopment, of the overall Missouri River freight market. Also provide an overview of potential public and private funding mechanisms, as well as describing the potential role of advocacy/interest groups in promoting long-term sustainability.

3.4.1 Regional Locations Identified for Development

As shown in Exhibit 3.7 (previously presented as Exhibit 2.6), three regions were identified and discussed in the context of understanding freight movement, markets, and capacities. In addition to the three regions, the following specific areas may prove most conducive to the development of freight activity and related commerce: Jefferson City, Kansas City, and St. Joseph. The following discussion is intended to provide information and recommendations regarding the challenges and advantages of those specific areas, based on the previously presented market and node analyses (Sections 2.2 and 2.3), infrastructure inventory (Task 2), and a general understanding of freight growth strategies.

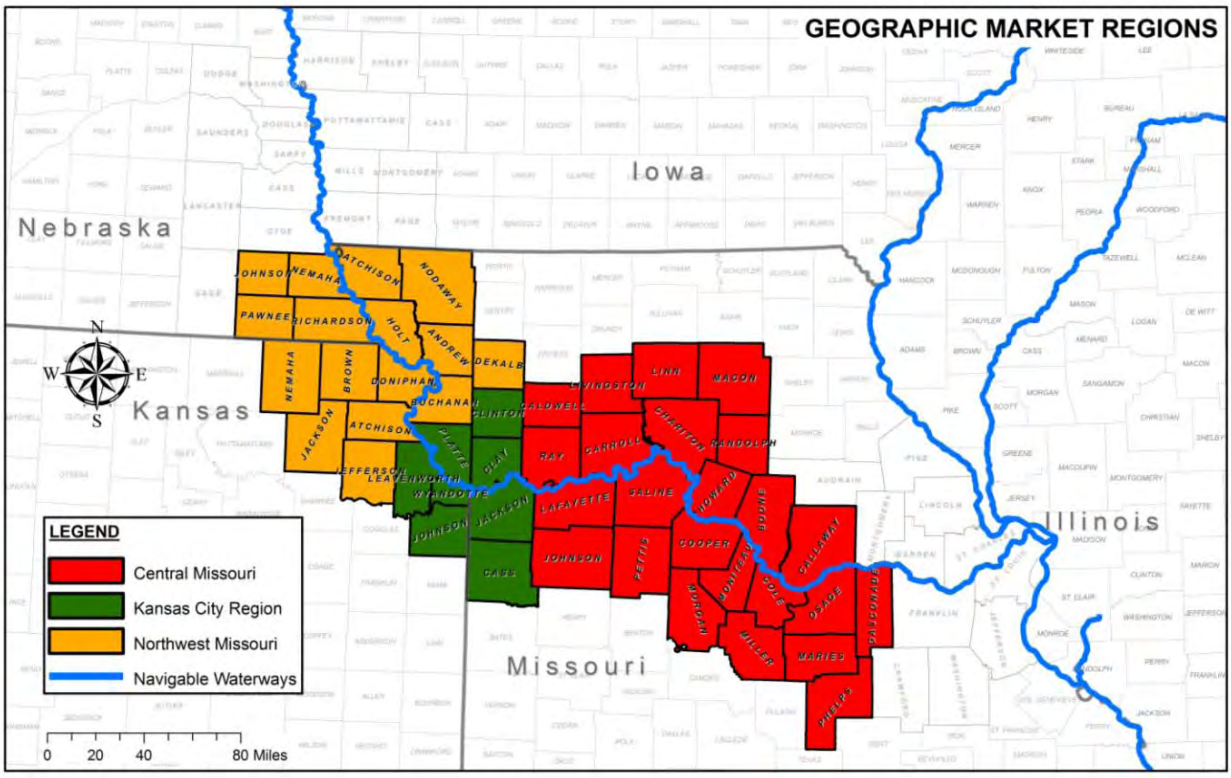


Exhibit 3.7

The three specific areas identified are, appropriately, three of the main population centers in Missouri. Note, St. Louis is obviously a main population center as well, but it is not included due to its proximity to the Mississippi River. Population is a key element to anticipated growth and supporting commercial activity. Commerce diversity in these population centers is an important factor in determining where a particular business venture might be successful and remain sustainably competitive. Population centers provide ready access to an employment base, basic needs for a business, and relatively close proximity to suppliers and potential customers, all of which often leads to less business cost. Further, major population centers typically include access to major transportation systems across multiple modes, another important factor for freight growth.

Jefferson City

Jefferson City, the capital of Missouri, is located in the Central Missouri Region, ideally situated at the approximate midpoint between Kansas City and St. Louis, as well as near the Columbia population center. As of 2009, the Jefferson City MSA had an estimated population of about 150,000. Potentially beneficial qualities found in the area include very good local roads connecting several major highways, along with rail service from a Class I operator.

The Jefferson City area also has a terminal development that includes bulk capacity, dry cargo warehousing, and a marginal wharf capable of supporting crane operations for most commodity groups. The development also maintains fleeting and tug capability through an operator that is experienced on the Missouri River and maintains a large complement of material handling equipment. These facilities are located on the left descending bank, which at this site is the north side of the Missouri River. Unfortunately, the rail service is located on the south side of the River and, therefore, the terminal development and its ample property is not fully served by all transportation modes.

Kansas City

The Kansas City area has a vibrant logistics network of highways and rail, as well as water access opportunities. The greater bi-state region of Kansas City, made up of five adjoining counties, has a population of approximately 1.7 million. As a commercial center and attractive environment for competitive transportation options, the ability to capitalize on waterborne freight transportation is extremely important. Much of the Kansas City waterfront is lined with private industry development that has been linked to barge transportation for decades. Unfortunately, areas surrounding these facilities have, in some cases, been built-out or have other development encroaching on available industrial properties.

The Port Authority of Kansas City, MO (PAKC-MO) appears to be the most logical vehicle to initiate a regional response to the Kansas City Region port development need. Regrettably, it is constrained geographically in its ability to secure and develop an appropriate port site. Potential sites (those possessing the qualities conducive to

infrastructure development and sufficient property to fuel related business and job creation) are found in outlying areas, such as Independence and Sugar Creek, MO. A regional approach to port development should be considered in the greater Kansas City area, either through the PAKC-MO or creation of another entity.

St. Joseph

The St. Joseph area is an attractive Northwest Missouri location for growth-oriented new business (emerging markets) and traditional markets in an all-modal competitive environment. As of 2009, the St. Joseph MSA population was estimated to be about 127,000. The area has connectivity by all modes, including I-29 and two Class I railroads.

Unique to the area is the existing marine terminal owned by the St. Joseph Regional Port Authority and operated by a third party. The Port is situated at the north end of the Stockyards area, near the US Highway 36 bridge crossing the Missouri River into Kansas. This location provides strategic access to the Nebraska and Iowa portions of the Corn Belt and wind energy corridor, which could allow it to be responsive to emerging markets such as ethanol, DDGS, and OD/OW. The Stockyards area is particularly advantageous to businesses engaged in agricultural enterprises, with numerous grain elevators and agribusiness processors.

The Port consists of 14 acres for operations, of which 8 acres are fully stabilized for marine operations. The facility has the physical space and dock structure required to conduct Lo/Lo operations and could service barges by crane and material handling equipment; however, the facility does not currently appear to have any material handling equipment to allow loading/unloading dockside. Inside storage capability would have to be developed, should that type of freight opportunity suggest those improvements are necessary. Anecdotally, it is reported that the Port fields relatively frequent inquiries into waterborne freight movements originating/terminating in St. Joseph.

Development at Other Locations

In addition to the three metropolitan areas discussed above, it is important to note that there have been and likely will continue to be key riverside developments in locations that don't necessarily fit the typical scenario (high population density, access to multiple major transportation systems, etc.). Successful marine businesses can exist outside the accepted norms, and one example of this is the existing facilities at Brunswick near River Mile 256. The Brunswick population is less than 1,000, and the facility is about 30 miles from I-70. However, immediate access is available via US Highway 24 to connect with US Highways 63 and 65, and there is a mainline Norfolk Southern rail track with service to a marine terminal. Most importantly, with its location at the northernmost point of the River within the Central Missouri Region and centrally located between Kansas City and St. Louis, it provides key accessibility to some of the highest producing agricultural counties in the state (as shown in the agricultural and related production

activity illustrated in the appendix exhibits). Developable property is available in this area, and similar advantages may exist at other locations as well.

Site Selection Criteria

When analyzing the advantages and disadvantages of developing a new site versus expanding or redeveloping an existing facility, specific site selection criteria can assist in identification of challenges and opportunities. The following criteria are intended to guide potential investment decisions by business owners, as well as providing a tool for understanding how to attract outside investment. Some of the most important criteria for site selection include:

- Available land of suitable size and physical characteristics to support efficient development. The property should be sufficiently distant or separated from potentially conflicting uses, such as residential areas, parks, etc.

- Specific to development of inland river terminals, the site should be a location with minimal challenges related to initial or maintenance dredging, currents, nearby underwater structures, or other impediments to waterside operations.

- Ideally, the property should be free of natural or historical features that may be of special interest to the public or regulatory agencies. Issues such as hazardous waste, culturally significant resources, wetlands, or other elements should be well defined with a clear path for development approval. Review of potential issues should include nearby properties that may affect development of the primary property (airport height restrictions, for example). Further, geotechnical and environmental studies should be completed and any issues addressed prior to marketing a particular site for outside investment.

- Any site under consideration should have direct access to major transportation networks. From a potential customer perspective, the more options available as to mode and route, the better. Alternatively, it may be advantageous to locate a site where competing modes are not available, but only if a specific market is identified and can be served. Either way, any necessary traffic and location studies should be completed and coordinated with the appropriate agencies. It is important to understand how the site will be accessed and what impacts it represents to the surrounding area, both for the public and for efficient operation of the site.

- Master planning, zoning, and local regulations/procedures should be clearly addressed prior to marketing the site. Investment decision-makers tend to shy away from potential sites if they perceive a risk of not being able to proceed efficiently – assuming alternative sites are available, they will simply go where the property and process is clearly defined and supported by stakeholders. Efforts should also include plans for providing all appropriate site utilities, who will pay for them, and how long it will take to permit and build.

- Available additional properties in reasonable proximity suitable for development by other investors who may undertake supporting or complementary activities.

- Adequate proximity of necessary services such as stevedoring, fleeting, repair facilities, suppliers, etc.

3.4.2 Funding Mechanisms

The development of sustainable freight movements on the Missouri River will require investment by a variety of stakeholders. Financial resources will be needed for infrastructure, equipment, loan programs, tax abatements, and/or other mechanisms to assist freight volume growth on the River. Financial sources will certainly include the private sector, and arguably, it should also include the public sector – if for no other reason than the many public benefits of waterborne freight previously discussed. Waterways have long been recognized as a key component of economic development throughout history, as evident by the fact that most of the major cities in the world are located near waterborne transportation networks of some sort. In general, the private sector and the market forces that drive it will figure out where to commit their resources, but the public sector will likely require some guidance. The following discussion presents various funding concepts intended to enhance waterway freight growth.

Federal & State Programs

Federal Transportation Bill – Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) provided funding for transportation projects that improve efficiency, safety, and intermodal connectivity, as well as protecting the environment. It included a program to fund transportation infrastructure projects which were deemed capable of producing benefits on a national or regional level. Currently, there is much debate and no apparent resolution to what the federal role will be in future transportation investment, or if there will even be a federal transportation bill. However, there is frequent mention of the value of waterways as a "green" mode of efficient and congestion-mitigating transportation. America's Marine Highway Program is currently funding studies aimed at increasing waterway use. As of this writing, it is anyone's guess as to what the federal position will be on inland waterway investment in the future, but recent comments from the USDOT acknowledge the value and importance of moving freight on the waterways.

> *America's Marine Highway offers the potential of significantly enhancing the environmental sustainability of the nation's transportation system. In particular, water transportation is often the most energy-efficient means of moving cargo between two points, with corresponding reductions per ton-mile in greenhouse gas (GHG) emissions. Similarly, with appropriate technology and regulation, water transportation is an environmentally-friendly transportation mode that can reduce noise and air pollution and have minimal impacts on water quality.*

> *Transportation is the thread that knits the country together, providing the mobility that is such an important part of overall quality of life and is so deeply embedded in our culture and history. Highways, transit, rail, and water systems provide unprecedented access to jobs, recreation, education, health care, and the many other activities that sustain and enrich the lives of American families.*
>
> *Without strong leadership from the Federal government, however, the nation's rivers and coastal waterways will continue to be underutilized for domestic container and trailer freight transportation. It is difficult for private operators to support the scale of investment needed to initiate large scale operations. Private operators are particularly disadvantaged by the fact that many of the important public benefits of water transportation, including congestion reduction, environmental sustainability, and system resiliency, cannot be captured in the form of higher revenues or lower costs to company profits. Government action is required to help overcome these challenges and assist the expansion of Marine Highway services in a significant manner.*[23]

CMAQ – The Congestion Mitigation and Air Quality Improvement (CMAQ) program (most recently funded under SAFETEA-LU) provided funding for transportation projects that reduce mobile source air emissions in areas that do not meet federal air quality standards for ozone, particulate matter, or carbon monoxide. The metropolitan area of St. Louis was designated as non-attainment for ozone in December 2008. The main focus has been on "diesel engine retrofits and cost-effective emission reduction and congestion mitigation projects that also provide air quality benefits."[24] CMAQ also provided limited funding for states that didn't have non-attainment issues.

As with many areas throughout the country, truck traffic in Missouri is steadily increasing. Towboats produce the least amount of pollutants per ton-mile than other surface modes of freight transportation. Therefore, an argument might be made to reduce the number of trucks on the state's highways by effectively using the inland waterway system to obtain CMAQ funds, assuming it or some similar program exists in the future. Examples of CMAQ funds used to establish COB service include the James River Barge Line, Red Hook Container-on-Barge Service, and the Albany Express Barge. One similar program administered through the Diesel Emissions Reduction Act (DERA) funded more than $5.1 million to various states, including Missouri, in 2010.[25]

TIGER[26] – The American Recovery and Reinvestment Act of 2009 was intended to preserve and create jobs to promote economic recovery, assisting those most affected by the economic downturn. A portion of the "Recovery Act" appropriates $1.5 billion in

[23] *America's Marine Highway Report to Congress,* USDOT MARAD, April 2011
[24] http://www.fhwa.dot.gov/environment/air_quality/cmaq/
[25] http://www.ccjdigital.com/dera-grants-5-1-million-to-reduce-diesel-emissions/
[26] http://www.dot.gov/recovery/ost/faqs.htm

grants for capital investments in transportation projects that will provide long-term economic benefits. The USDOT administers these grants through the Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grants program.

Highway Maintenance Savings

An 80,000-lb truck, historically the maximum allowed on highways in many states, is reported to do 10,000 times or more damage than a single passenger auto.[27] Studies repeatedly show that fuel taxes paid by heavy trucks barely cover half the wear these trucks impose on public highways, and a few very overweight trucks impose even more inordinate costs on bridges. According to the Federal Highway Administration (FHWA), combination trucks, defined as tractor-trailers weighing over 50,000 lbs., accounted for 58% of the cost responsibility for pavement preservation on the nation's highways. This could equate to a substantial portion of MoDOT's highway maintenance budget, but additional research outside the scope of this study would be required to determine an estimate of highway maintenance dollars saved through a freight shift to the River.

The US Government Accountability Office (GAO) has released a study comparing modal costs of shipments, entitled *Surface Freight Transportation: A Comparison of the Costs of Road, Rail, and Waterways Freight Shipments That Are Not Passed on to Consumers*. In noting that government tax, regulatory, and infrastructure investment policies can affect the costs that shippers pass on to their customers, the report finds that the overall efficiency of the nation's economy is reduced if government policy gives one mode a cost advantage over another, including, for example, not recouping all of the costs of that mode's use of infrastructure. Further, the study finds that:

> *GAO's analysis shows that on average, additional freight service provided by trucks generated significantly more costs that are not passed on to consumers of that service than the same amount of freight service provided by either rail or water. GAO estimates that freight trucking costs that were not passed on to consumers were at least 6 times greater than rail costs and at least 9 times greater than waterways costs per million ton-miles of freight transport. Most of these costs were external costs imposed on society.*[28]

This conclusion clearly refutes claims by those opposed to the recapitalization of inland waterway systems that water is the most highly subsidized mode of transportation. To the contrary, the study reinforces the fact that waterborne transportation is efficient, economical, environmentally sound, and safe.

Examples from Other States

Many states have established programs that are specifically formulated to help public ports better serve the state's commerce and industry, which in turn promotes their

[27] Minnesota Regional Railroads Association
[28] http://www.gao.gov/products/GAO-11-134

waterways. Most funding is provided through either grants or loans with varied eligibility and repayment stipulations, depending on the needs and the purpose of the program. Some examples of past and current state-level programs are described below.

Florida[29]

The state created the Florida Seaport Transportation and Economic Development (FSTED) Council in 1990 to provide and encourage financing of port transportation projects on a 50-50 matching basis. The program was established as an alternative to the traditional Florida Department of Transportation (FDOT) program, because of the recognized importance of international trade to the state's economic progress and job creation. Also recognized was the urgency of building the transportation capacity needed for the state's 14 public deepwater seaports to satisfy their customer's demands and compete in the fast-paced global marketplace.

The program is driven by an approach to project development that recognizes ports as public entities but must function as businesses to fulfill their public purpose. In recent years, the privately operated Port of Fernandina Beach has been included in the program. Like any business, ports must demonstrate a service orientation, prompt response to customer demand, flexibility to meet changing market trends, and accountability to ensure sound investments. The FSTED program requires consistency with local comprehensive plans and matching funds from each seaport; thus seaport investments are driven by a local commitment to meet the community's strategic objectives. Ten (10) of the 14 seaport governing bodies are comprised of elected officials, while the other four include members appointed by state or local government.

Responsibility for project development through the FSTED program is initiated at the local level, based on an understanding of market demand, local port opportunity, and capacity to implement statewide goals. At the state level, project review is performed by three state agencies that are full voting members of the FSTED Council: FDOT, Department of Community Affairs (DCA), and the Governor's Office of Tourism, Trade and Economic Development.

Mississippi

In 2000, the Mississippi Water Resources Association (MWRA), a trade association that represents ports and waterway interests, tried to have a bill passed in the Mississippi Legislature to establish a grant program solely intended to fund the 16 public ports. However, MWRA quickly learned that there was not enough political support for passage of such legislation. A multimodal bill was subsequently introduced that included short line railroads, public airports, and mass transit, as well as ports. In 2002, it passed overwhelmingly as the Mississippi Multimodal Transportation Improvement Program.

The program awards approximately $10 million annually, of which the ports receive 38% ($3.8 million) for capital improvements. The fund is unique in that no local match is

[29] http://www.flaports.org/Sub_Content2.aspx?id=10&pid=2

required. Another novel part of the program is the actual participation of the ports in the review, evaluation, and prioritization of the funding applications. A Multimodal Fund Committee was created for each of the four modes that receive funding.

The Mississippi Department of Transportation (MDOT) also administers an Intermodal Connector Improvement Program that has been very beneficial to the ports. This grant program is included in the Mississippi Statewide Transportation Improvement Program (STIP), and it lists transportation projects in which federal funds are to be spent that generally reflects MDOT's multi-year construction program. For ports, the program is dedicated to access roads, marshalling areas, etc. So far, the ports have received approximately $14 million of these federal funds.

The Mississippi Development Authority (MDA) also administers a Port Revitalization Revolving Loan Program that provides low-interest loans to public port authorities for improvement of port facilities to promote commerce and economic growth in the state. The terms include a maximum loan amount of $750,000 for any single project, with an interest rate of 3% and a repayment period not to exceed 10 years.

Louisiana

The Louisiana Department of Transportation and Development (LA DOTD) administers a grant program to fund capital improvements at its 31 publicly owned ports, including intermodal facilities, maritime-related industrial development infrastructure, cargo handling equipment, railroads, utilities, and warehousing. The program has been funded at $25 million annually from the state's Transportation Trust Fund, and the local port pays 10% of the project cost. Grant applications are reviewed, evaluated, and prioritized within LA DOTD. Criteria used to establish which projects receive priority include the technical feasibility of the project, economic feasibility and impacts, environmental impacts, and port management considerations. The program also emphasizes the need to equitably distribute the funds and avoid duplication of port infrastructure. In 2007, a one-time only additional $47M of funding was secured for port construction and development.

In 2005, Louisiana took an aggressive approach to the growth and development of maritime commerce by creating the Governor's Maritime Advisory Task Force and the Louisiana Waterways Infrastructure and Development Fund, which is managed through a Waterways Infrastructure Bank. The goal was to expand trade by financing waterside infrastructure and development projects. Implemented just prior to the Hurricane Katrina disaster, the program has yet to be funded by Louisiana legislature.

Indiana

The state provided the initial capital investment for development of the three public ports. The issue of whether or not the state should make such an investment was a heavily debated issue, but it eventually came to fruition.

> *Today, the Ports of Indiana system handles more than $1.5 billion in waterborne cargo per year and provides annual intermodal exchanges for 150 ships, 3,500 barges, 40,000 railcars and 600,000 trucks. Private companies have invested $1.4 billion in distribution and manufacturing facilities at the ports, generating $5.4 billion in annual economic impact and more than 43,000 total jobs. Overall, the state invested $90 million constructing the ports - meaning that every state dollar has generated more than $15 in additional onsite investments in addition to extensive development surrounding the ports.*[30]

Indiana's desire to support their ports and freight development continues in 2011. A bill is currently in the state legislature that would provide a 50% tax credit to companies that "contribute to increased transportation volume, warehousing upgrades, logistics improvements as well as airport, rail, truck and river terminal development."[31]

In addition to state and federal programs, many local governments have provided seed money for port and waterways development. Successful examples include the Tulsa Port of Catoosa in Oklahoma and the Owensboro Riverport Authority in Kentucky. Both of these examples were initially funded by local government and have since become meaningful and productive economic engines for their communities. Regardless of how continued freight development occurs in Missouri, there will be investment required – but with a committed group of stakeholders leading the way, the benefits are expected to far exceed the costs.

Appropriation of Missouri State Funds

Missouri has historically invested in its ports and waterways. For example, $6.65 million was allocated in FY 2009 for a variety of port infrastructure improvements along the Mississippi and Missouri Rivers.[32] Additionally, based on the support for this project, MoDOT is obviously a champion of the Missouri River, and it appears to have the drive and commitment to continue to support stakeholders. Numerous other state agencies are also very supportive and appear to be solid allies moving forward. However, Missouri is facing many of the same fiscal challenges as other states.

The state may decide to continue to invest tax revenue from the general fund in Missouri River freight development. Funding to support the services provided by MoDOT comes from fees/taxes collected by the state and federal government. Sources can include vehicle registration fees, gasoline and diesel fuel taxes, airline ticket taxes, and other fees and taxes paid by individuals, as well as private companies that use the transportation system. In some states, a percentage of gas tax revenue is dedicated to funding ports and waterways, but increased economic activity generated by the state's

[30] http://www.portsofindiana.com/poi/about_us/history.cfm
[31] "Indiana Senate Considers Bill that Would Provide Tax Credit for Terminal Development," Waterways Journal, 2/21/2011
[32] The Economic Value of Investment in Freight Transportation: Missouri Ports, MoDOT Organizational Results, 2008

waterway industry ultimately reimburses the general fund anyway. The state may also consider offering volume credits for water transport, tax abatements or credits on fuel, or similar incentives. Similar to Essential Air Service (EAS), "Essential Water Service" may be another concept that warrants consideration to promote freight growth on the Missouri River.

3.4.3 Advocacy & Interest Groups

A typical requirement for sustainable development and continuing viability of most waterways systems is active advocacy and interest groups. Some of the more widely known and active national groups include:

- National Waterways Conference
- Inland Rivers, Ports & Terminals
- Waterways Council, Inc.
- American Waterways Operators

Examples of regional or system-specific groups include:

- Coalition of Alabama Waterways Associations
- Tennessee River Valley Association

Unfortunately, advocacy groups specific to the Missouri River appear to be very limited and currently include only the St. Louis River Industry Club, which holds a monthly lunch meeting, and the Missouri-Arkansas River Basin Association (MO-ARK), which promotes navigation interests as part of its mission. Although these two entities are obvious supporters of Missouri River navigation, a formal organization solely charged with organizing the waterborne freight stakeholders and working full-time to achieve specific freight development goals does not exist but is highly recommended. Such a group should be formalized and made up of a range of stakeholders, with no agenda other than Missouri River freight development and sustainability. Many groups and interested individuals have spent a great deal of time and energy attempting to eliminate navigation on the River, and they are not likely to quit that pursuit any time soon. Therefore, Missouri River freight development stakeholders need to stay organized and stay involved.

3.4.4 Implementation

The following describes general implementation steps for facility development, obtaining necessary funding, and promoting Missouri River freight through advocacy groups.

Facility Development

1. Identify Target Markets
    a. Jefferson City – Identify target markets within the general dry bulk commodity groups. Specific O/D pairs are suggested herein for coal and

fertilizer movements, but others likely exist. Networking with existing shippers and economic development groups at origins/destinations may assist in finding additional opportunities.

b. Kansas City – Identify target markets within the Non-Agricultural Dry Bulk and General Cargo commodity groups. Specific O/D pairs are suggested herein, but more likely exist. Networking with existing shippers and economic development groups at origins/destinations may assist in finding additional opportunities.

c. St. Joseph – Identify target markets within the Agricultural Dry Bulk, Liquid, or General Cargo commodity groups. Specific O/D pairs are suggested herein, but more likely exist. Networking with existing shippers and economic development groups at origins/destinations may assist in finding additional opportunities.

2. Identify specific facilities capable of handling target market commodities. If inadequate facility capacity exists, identify preferred development sites.
3. Proceed with site selection and preliminary development, including site-specific professional engineering design development. Depending on commodity targets, specific needs include dock structures, material handling equipment, inside or open storage, and support services such as fleeting.

Funding

1. Recognize that the availability of waterborne transportation has a definite impact on the overall cost of transporting goods in and through Missouri. Costs will rise and the state's competitive position will suffer if the Missouri River is not a viable option. Also recognize that the issue of perceived River reliability is a critical risk potentially hindering private investment by interested stakeholders.
2. Explore the potential for establishing a guaranteed minimum volume of freight on the River – an "Essential Water Service" program might operate similar to the USDOT federally-subsidized Essential Air Service. Need and justification for such a program can at least partially come from the reality that federal support from the USACE and US Coast Guard (USCG) is heavily dependent on minimum activity levels.
3. Identify and prioritize specific projects for funding requests, which may include infrastructure, pilot programs or operational startup assistance, tax incentives, or other financial means of assisting the increase of waterborne freight.
4. Identify the specific project stakeholders, sponsors, and/or supporters.
5. Define the specific scope of the project(s), and quantify the benefit-to-cost relationships for inclusion in assistance applications.
6. Communicate with federal representatives/agencies in order to increase awareness of the importance and benefits of the project(s), to understand potential regulatory processes and challenges, and to identify potential funding opportunities.
7. Prepare basic data and documentation in order to respond quickly when funding programs are identified and become available. Some of the first opportunities for

the Missouri River may come through MARAD's M-70 designation and reported upcoming funding request procedures.

Advocacy

1. Identify key knowledgeable stakeholders for Missouri River freight development, and organize a willing group of stakeholders as "founders."
2. Define the mission of the organization, which should include focus on both specific freight interests and purposeful cooperation with other interest groups.
3. Identify potential members, formalize the structure and budgetary needs of the organization, collect initial funding, and install a board of directors. Also consider hiring an executive director.
4. Identify potential partner organizations and how this group will work effectively with those partners. The key is to understand and capitalize on how organization missions differ and how they complement each other.
5. On an ongoing basis, the organization should communicate the benefits of Missouri River freight transportation to parties outside the organization. Policy-makers in particular need to understand why Missouri River freight is so critical.
6. Communicate challenges and opportunities to the organization members, and solicit their help in continuing to stay organized, focused, and action-oriented.
7. Provide support, participation, and mass communication to special events such as "Season Opener," "Corn Days," "Missouri River Shipper Days," or similar. The objective is to increase awareness and potentially develop additional market movements.

3.5 CONCEPT 5: NAVIGATION SUSTAINABILITY

Definition – Establish a defined network of Missouri River stakeholders, particularly carriers, and a protocol for communication that includes specific action items to address navigational challenges. Identify target commodity groups, marine equipment, and other strategies that are more favorable for sub-optimal water conditions.

Intent – Provide stakeholders with recommended methodologies intended to maintain navigation for as long as possible when flow in the Missouri River is either above or below optimal levels. Also discuss markets and equipment conducive to a wide range of operating scenarios. The overall goal is to provide stakeholders, particularly carriers, with guidance for maintaining freight movement when water levels are on the margins of optimal.

3.5.1 Navigation Management Process Overview

Navigational conditions forecasting for the Missouri River entails a systematic process which is undertaken well in advance of the scheduled navigation season opening. The process commences with the USACE's review of existing water management variables, which is communicated to the public in a series of notices (navigation alerts or "Corps Clippings"). Typical notice content includes an overview of dam impoundment levels, winter snow pack, rainfall forecasts, flood/drought projections, and a description of how these factors may impact the Annual Operating Plan (AOP). Discussions also include the potential need for a spring pulse release and its timing, if a pulse release is planned.

Leading up to the navigation season opening, additional guidance is periodically issued by the USACE that is critical for shipper decision-making and for carrier planning. Carriers review this information and make projections as to if/when risk levels are low enough to commence towing operations. Carrier criteria for such a decision include:

- When is the clearance of ice conditions projected, and what is the relative risk in various River segments?
- If an early water release is appropriate, will it be at an adequate and sustainable rate to provide sufficient depth for effective navigation?
- Are shipments already booked for movement at the earliest operating dates?
- When is the USCG scheduled to complete setting of navigation aids?
- If water levels are high, is sufficient towboat power available to operate in the upstream direction?
- If water levels are too low, at what point are conditions expected to be more favorable for freight movement?

Although the official navigation season opening date is determined by the USACE, commencement of actual operations is ultimately determined by the carriers based on individual firms' assessment of their risk, as well as shipper demand and available opportunities. As discussed above, the determination of early season opening is almost always solely based on water impoundment conditions in reservoirs and concerns that

significant snow pack may result in future flood risk. As with low water, the occurrence of high water conditions can also undermine system reliability. Regardless, in order to build a reputation of improved River reliability, it is important to emphasize favorable freight movement messages and dampen the negative messages that often result from periods of sub-optimal conditions.

3.5.2 Navigational Issue Response

For the purposes of running a business, carriers on the Missouri River have reported that “minimum service” is essentially “no service.” While that may be true for a scenario in which the water level is always low, based on historical trends, water levels will not be low indefinitely. For example, during the drought from roughly 2000 to 2007, freight did not immediately cease to move on the Missouri River, but most of the commercial tonnage did eventually decrease to a level where confidence waned in the River as a viable freight transportation option.

Additionally, as freight tonnage on the River drops, the USACE and USCG devote fewer resources to maintaining navigation service. This leads to less shipper confidence and so on – it becomes a self-fulfilling negative trend. The lack of confidence is a key issue that must be addressed – public and potential shipper/carrier perception of Missouri River reliability is key to sustainable freight development, and all stakeholders must take an active role in building confidence and changing the perception of unreliability.

While it is not necessarily possible for an individual shipper or carrier to contact the USACE to demand additional water release when levels are down, it may be possible for the stakeholder network and regulatory agencies to work together in a systematic way to make the most of the water that is available. If potential freight shippers know that the various Missouri River stakeholders exhibit outstanding communication and work well together at resolving issues in a timely fashion, confidence in the system will build through the reality of stakeholders making the system work.

One way stakeholders can assist in making the system work is to develop specific protocols for reporting navigation problems and resolving them as efficiently as possible, before they degrade the actual or perceived serviceability of the overall system. Currently, the USACE and USCG meet periodically (at least annually) with carriers to share information about known issues and to work toward solutions. This coordination is extremely important, but would be much more effective if it were more frequent and more understood by all stakeholders. Stakeholder understanding will be especially important as Missouri River freight growth occurs, since new carriers and interests will likely be involved. While the USACE and USCG are obviously willing to provide whatever support their time, information, and budgets will allow, it seems apparent that the overall system of coordination could be greatly improved. But the responsibility for improvement does not rest solely on those agencies – it needs to involve all Missouri River freight stakeholders, particularly carriers.

The overall objective of this coordination is to establish an “all resource” response procedure for when Missouri River navigation may be negatively impacted due to a meteorological event, low or reduced reservoir impoundment, AOP adjustment to the Master Manual water release protocol, or a catastrophic or unforeseen event of short duration. The primary goals of the response procedures include establishing a systematic approach to the dissemination of information to stakeholders and engaging all necessary resources as efficiently and effectively as possible. In order to maintain safe and reliable navigation, “all resource” responses could include:

- Dredging
- Channel and aids to navigation marking
- Modification to carrier operations
- Special crew/assist resources
- Discretionary spot flow release
- Vessel traffic control
- Survey or safe channel verification

The response protocol will require coordination between two primary groups: regulatory agencies and carrier stakeholders. Specifically, regulatory agency representation should consist of appropriate personnel from both the USACE and USCG. Stakeholders could be represented by a carrier navigation committee, which is discussed in detail below. The groups are envisioned to function with minimal coordination during periods of normal water releases, but collaboration will be required to resolve potential issues during periods of sub-optimal conditions.

A navigation committee is a defined group of stakeholders dedicated to maintaining a reliable navigation system on a defined body of water. The Missouri River constitutes such a system, and a navigation committee exists in the form of the Missouri River Action Committee (MRAC). The MRAC meets annually and in conjunction with the regularly scheduled meeting of Missouri River USACE districts, USCG, and River carriers, typically held in Kansas City. At this critical juncture in Missouri River freight development, MRAC should maintain an active navigation committee role to ensure system reliability and advocate increased freight. A Missouri River navigation committee could function similar to the following suggested guidelines:

- Annually rotating leadership by a carrier’s operating manager or lead captain that is conversant and knowledgeable about the River system.
- Attendees should include carrier representatives, boat captains, USACE and USCG representation, MoDOT, and any other stakeholder with a critical interest in system reliability.
- Emailed announcements in advance of upcoming meetings, to include agenda items and other noteworthy comments, concerns, issues, etc.
- Conduct regularly scheduled meetings, at least every other month, and more frequently as needed (during periods of sub-optimal flow, for example).
    - Includes a system report from the USACE and/or USCG, a review of identified areas of concern, and the captains’/agencies’ feedback on

corrective action or changed conditions since the last meeting. Follow-up items or new actions needed to correct system deficiencies are identified, discussed, and planned for execution.

- Discuss new issues or identified areas of navigation risk, safety, concern, impediments, and/or channel integrity degradation. Based on observations provided by specific location, appropriate agencies investigate/validate the issue, suggest corrective action, and provide mitigating operating alternatives for carriers until the deficiency is permanently corrected.
- If a navigation committee meeting reports issues that directly impact channel integrity (primarily channel narrowing or reduction of draft), the USACE, USCG, and carriers attending will be called on to validate reported conditions, pin-point the problem area(s), report the date/time of observations, and suggest what actions may be utilized for mitigation. At this point, all resources need to be considered based on the complexity of the problem, operating procedures that can be identified to reduce risk, spot versus permanent mitigation, cost, and corrective action response time. Once an issue has been validated as an actual constraint to navigation, it is essential that corrective action is implemented as soon as practical. In most cases, the responsibility for correction will likely be that of the USACE or USCG.
- Special movements, commodity types, or other observations not necessarily related to navigation are communicated to agencies, other operators, and interested parties. This takes advantage of professional mariner input for the benefit of all users. Such observations could include: aids to navigation issues, deterioration of bridge fenders, bridge or landside lighting issues, unusual or dangerous current conditions, bank erosion, gauge/overhead clearance displays, security risks, pleasure craft risk points, etc.
- Meeting closure with a summary of new initiatives and valuable information for general benefit.
- All attendees report meeting highlights and action items to appropriate personnel within their respective organization. Emails summarizing urgent issues should be distributed by the navigation committee leader and/or applicable agency as soon as feasible.

In addition to establishing a navigation committee to manage communications and meetings, a process to address issues that surface outside of the regularly scheduled meetings is recommended. Currently, the USACE and USGC encourage stakeholders to contact them to report issues, so a process does exist. However, the deficiency appears to be the dissemination of information to other stakeholders. The following is a suggested process for reporting issues and distributing critical information:

1. Navigation-related issues are reported to USCG. At a minimum, the report would include location, date/time, and a brief description of the issue.
2. The report would then be distributed to the USACE and the chair of the navigation committee. Non-navigation-related issues would be reported directly to the USACE and distributed to the navigation committee chair.

3. The navigation committee chair would add the report item to the agenda for the next scheduled meeting, unless immediate dissemination of information is required, in which case the chair should immediately distribute pertinent information to all applicable stakeholders via email.
4. At the next meeting, a status report would be given including:
    a. Reported issue description, and
    b. Resolution, or if not already resolved, how it will be resolved and when.

3.5.3 Commodity Options for Sub-Optimal Conditions

Maximizing shipments that can fully utilize barge capacity during low water conditions is a critical component of the effort to establish Missouri River reliability. Although certain commodity groups may not be able to fully load a barge during spot interruptions of adequate flow, development of low-density freight movements is very attractive. In reviewing the various commodities discussed in Section 2, a few have density characteristics that would fully utilize a barge's volumetric space before attaining maximum draft. While these opportunities represent emerging markets and are discussed here in terms of low water potential, they also represent freight opportunities that can be moved on the River in most navigable conditions.

Over-Dimensional/Over-Weight

The OD/OW commodity group represents a wide range of freight with two common characteristics: 1) they are of extreme dimension (height, width, and/or depth) that poses difficulty in moving efficiently by truck or rail due to clearance requirements, and/or 2) they are of extreme weight that truck trailer configurations have difficulty meeting highway permit limits or rail car movement that is difficult due to the limited number of Schnabel or specialized railcars with the capability to handle such weights.

Another characteristic of the OD/OW commodity group is the significant amount of physical space typically required on the conveyance vehicle for stabilizing and securing the load. The advantages of waterborne transport of OD/OW commodities include long-distance unencumbered movement, reduced securing, space for additional project components, and potential access to relatively remote locations. The option to utilize deck or hopper barge equipment is also very useful, which is often decided based on handling requirements at the origin/destination. In terms of low water operations, it is extremely rare for the draft of barges transporting OD/OW commodities to approach the Missouri River controlling depth of 9'-00".

Container-on-Barge

Once established, the COB commodity group generally develops into a scheduled service, with regular O/D points and fixed intervals to match ocean carrier sailings. This trend results from a shipper tendency to secure a reliable supply chain for what is usually a higher value commodity being moved in this form for value-added reasons.

Without regard to the specific commodity in the container, it is extremely rare for a barge to be loaded to maximum draft when filled with containers.

To illustrate this point, a rake barge can stow a maximum of about 56 twenty-foot equivalent units (TEU's) and a box barge can stow a maximum of about 63 TEU's. The maximum typical gross weight of a container loaded to its maximum capacity is about 52,910 lbs. (26.46 tons). Utilizing this weight per TEU, a rake barge would load to 1,482 tons and a box barge would load to 1,667 tons. This extreme, worst-case scenario would result in a fully-loaded barge with TEU's filled to capacity drawing approximately 9'-00" of water.

Dried Distillers Grains

DDGS could move in bulk form in covered barges or loaded in containers (COB) for subsequent transfer. Regardless of conveyance method, DDGS have a relatively low density, with various sources indicating a range of 28 to 39 lbs/ft^3. Considering a typical rake barge has a capacity of 70,474 ft^3, a typical box barge has a capacity of 79,038 ft^3, and using a conservative estimate of DDGS density, a rake or box barge loaded with DDGS will reach volumetric capacity before reaching weight capacity and/or a 9'-00" draft. In fact, a fully loaded barge utilizing all available space would not exceed a draft of about 8'-06". Therefore, DDGS is an attractive commodity under all river conditions, commanding a freight rate typical of maximum or near maximum barge capacity.

3.5.4 Equipment Options for Sub-Optimal Conditions

As previously discussed, the process of maintaining adequate water flow for navigation on the Missouri River is dependent on many factors. High water events, unless operationally unsafe, can be managed with existing marine equipment that is utilized throughout the inland waterway system. Usually, an increase in towboat horsepower will result in continuing operations in these high flow periods, and existing barge equipment is not substituted in any way. During low water periods in which navigation is still viable within the context of the AOP, specialized equipment could be considered as an option to conduct freight transportation at tonnage levels considered economically sustainable. From a vessel/barge design perspective, maintaining acceptable economic performance while drawing a shallower draft creates issues that require a naval architectural solution.

Shallow Draft Barges

Many studies have been conducted in an attempt to address the issue of providing economically feasible freight service during sub-optimal conditions, similar to those periodically encountered on the Missouri River. The manufacture of specially designed shallow draft barges having length and/or width deviations from that of standard hopper barge dimensions could address the issue. However, an approach involving changes in barge manufacturing creates a significant downside, and for the following reasons, it is recommended to continue the use of standard barges:

- Barge deployment flexibility is reduced – barges with non-standard dimensions cannot be easily integrated into tow operations that are heavily dependent on standardization.
- Cost of operation increase – barge deployment and cost of operation may be negatively impacted, as lock dimensions are generally compatible with existing tow configuration width, as well as the issue of standardized fleet work.
- Construction cost increase – the cost of barge manufacturing would increase, since shipyards usually build standard barges in large quantities over a long period of time. A non-standard barge design manufactured for what could be a relatively short duration would cause inefficiencies and additional cost.

Technological advances or European designs/operating approaches may develop in the future for specific cargoes in high-utilization corridors. However, within the context of near-term freight growth strategies for the Missouri River, changing traditional barge characteristics would likely impose more downside than addressing the upside of increased reliability.

Shallow Draft Towboats

Towboat design alterations are a more practical approach to addressing Missouri River low water issues, as compared to shallow draft barges. Shallow draft boats have been in operation for decades, and the issue of low water operations is encountered on other river systems, including the Alabama, Flint, and Black Warrior Rivers. These rivers, as well as other systems, encounter drought conditions from time to time, and they are not fully controlled by lock structures that create precise navigation pools. Therefore, towboats have been purpose-built to maintain commerce during low water conditions.

For most carriers, the objective in selecting towboat design is to maximize performance in conditions that are typical for a particular river system and intended tow configuration. It should be recognized that a shallow draft boat design typically trades good low-water performance for less-than-optimal performance when pushing barges under normal operating depths. However, the reduction of shallow water grounding and vessel damage risk is significant. Shallow draft boats cost slightly more, but in most cases, new boats have some special characteristics (non-standard design options) requested by the owner to improve performance anyway. As indicated in the *Low-Flow Water Study for the Missouri River*,[33] the incremental cost of such a boat operating for several decades is economically feasible. This is particularly true when compared to traditional boat designs that may ground more frequently or not be able to operate at all. Continuous operating capability is critical to achieving system reliability. As freight volumes develop on the River, additional shallow draft boat capacity, with sufficient power to adequately operate under high water conditions, will likely be required.

[33] TranSystems and MoDOT, August 2008

3.5.5 Operational Strategies for Sub-Optimal Conditions

In river systems where water depth may vary significantly, alteration of loading strategies is an issue that requires accurate and reliable depth projection data for the entire operating range in order for carriers to make informed decisions. Operational reliability of the River cannot increase unless decision-making input is reasonably accurate and of consistent quality. In general, forecasts and notifications from the appropriate Missouri River agencies (primarily the USACE) appear to be adequate based on stakeholder comments.

Light Loading

The capability to load more or less tonnage has direct financial implications on carriers. For purposes of normal navigation, the Full-Service flow level for the Missouri River is designed to support a 9’-00” depth in the channel. At depths greater than this, a typical hopper barge can carry approximately 1,500 tons or more. The economics for most towing operations are built around this capacity per barge, and freight rates are generally associated with this tonnage as the minimum.

However, when Missouri River water levels are at or less than 9’-00”, light loading becomes necessary for most traditional commodities. At a River depth of 9’-00” and towboat/barge draft of 8’-06”, the capacity of a typical rake barge is reduced to about 1,400 tons. The reduction in barge capacity generally creates unfavorable carrier economic impacts. Occasionally, the USACE does find it necessary to reduce flows to a Minimum-Service level, which corresponds to a channel depth of 8’-00”. At this depth, towboat/barge drafts of less than 8’-00” are typically required for bottom and wheel clearance. These conditions would be even more detrimental to carrier economics, possibly making freight movements infeasible.

In high water situations, deeper draft barges could theoretically be accommodated on the Missouri River – if a barge is loaded heavier than normal, the economics are usually assumed to be favorably impacted. However, at a draft greater than 9’-00”, additional towboat power requirements of a faster flowing river must be considered. Also, many unmarked dike structures on the Missouri River would be covered during high water conditions, which is a source of additional risk in the event of a tow inadvertently traversing outside the channel.

“Plus-Up” Strategy

A top-off strategy could be implemented under certain economic conditions anytime the Mississippi River can support barge drafts greater than that on the Missouri River. A top-off, or “plus-up,” strategy involves loading additional cargo in St. Louis on a light-loaded outbound barge, since it has cleared the Missouri River draft limits. Some of the conditions that should be considered include:

- Commodity compatibility

- Contractual acceptance of the additional tonnage
- Stevedore throughput and/or other variable costs per ton
- Projected tonnage differential between Missouri and Mississippi Rivers' draft limitations
- Any demurrage, fleeting, and/or shifting of fixed costs

The "plus-up" strategy conditions above, given specific shipping rates and conditions, provide carriers with the information needed to determine if stopping to increase barge loads for movement to the LMR produces an economic benefit. This information can then be used by carriers in a breakeven (BE) analysis to determine at what point the cost associated with the "plus-up" strategy is economically beneficial on a per-ton basis. The BE analysis is based on the following equation:

$$\text{breakeven volume (Q)} = \frac{\text{fixed costs associated with "plus-up" per ton}}{\text{(per-ton rate for STL to LMR)} - \text{(variable cost of "plus-up" per ton)}}$$

or

$$Q = \frac{Fixed\ CostsRate\ Benefit - Variable\ Costs}{}$$

It may be feasible to control the costs associated with the "plus-up" strategy through contract mechanisms. Those methods could include establishing rates on a fixed or sliding scale, credits for service continuity and market growth (new business) for Missouri River freight destined for the LMR, credits for equipment specifically obtained for the purpose of operating on the Missouri River, and other methods of price security and partnership incentives.

Various stakeholders are involved in any given freight movement on the Missouri River in the form of merchandisers, facility operators, carriers, etc. The "plus-up" strategy discussion is intended to prompt thinking that will, when feasible, create a win-win scenario for all parties by recognizing that Missouri River business risk can be shared and/or reduced. This may allow the River to attract additional market opportunities and increase market share from truck and rail to the net benefit of all River stakeholders. However, when the Missouri River is experiencing low flow conditions, the Mississippi River may be low as well, in which case the "plus-up" strategy may not be feasible.

Some of the strategies and concepts (specific business decisions and methods of operation) that can be undertaken to increase Missouri River freight movements may not be especially profitable in the short term. However, as freight returns and the River overcomes "low commercial use" concerns, those less profitable methods may be left behind. Maintaining the ability to react and provide service during sub-optimal conditions will remain important for as long as the issue of flow reliability remains.

Whether the Missouri River water level is low, high, or normal, it is important to maintain the perception of freight movement reliability. Keeping freight on the River, even during periods of sub-optimal flow, keeps the mode active and protects the investments made to achieve that activity level and corresponding customer base. Each River stakeholder understands their own business and will make decisions based on their needs and goals. If they choose to undertake the challenge of maintaining capability when water levels are low, they may reap much higher rewards when the flow is optimal.

3.5.6 Implementation

Sustainable navigation on the Missouri River is dependent on a defined network of stakeholders (navigation committee); an effective protocol for communicating issues related to navigation; and the identification of target commodities, equipment, and operational strategies that may be necessary to maintain freight movement during sub-optimal conditions. Steps related to establishing a navigation committee and protocols for communication were listed above (Section 3.5.2). The following steps refer to the implementation of short-term strategies for maintaining operations during sub-optimal conditions.

1. Identify target commodity groups – suggested targets include OD/OW, COB, and DDGS. Based on the fact that these are all identified as emerging markets for the Missouri River, development of any or all of these markets will require additional analysis and coordination beyond that contained herein.
2. Emerging market freight opportunities may coincide with Marine Highway objectives, thus it may be prudent to pursue funding for development of these markets (studies and/or implementation efforts) through MARAD.
3. Consider investment in specialized equipment, such as shallow draft towboats. Appropriate shallow draft boat designs exist, and their increased use on the River may be appropriate.
4. Consider the use of light loading and/or “plus-up” strategies, if determined to be advantageous (economically or otherwise) compared to no freight movement.