Missouri River Freight Corridor
Assessment and Development Plan

Missouri River Historic Timeline and Navigation Service Cycle

(Section 4, from Technical Memo 2)

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Section 4.0

Missouri River Historic Timeline & Navigation Service Cycle

4.0 Missouri River Historic Timeline and Navigation Service Cycle

4.1 Objectives

The history of freight and navigation on the Missouri River is long and complex. Many variables affect how much tonnage has been moved and how much will move in the future. This section seeks to present some of the discreet historic factors that have apparently impacted use of the river. Two specific objectives were developed in the project work plan to assist in providing a baseline understanding of river freight and navigation history:

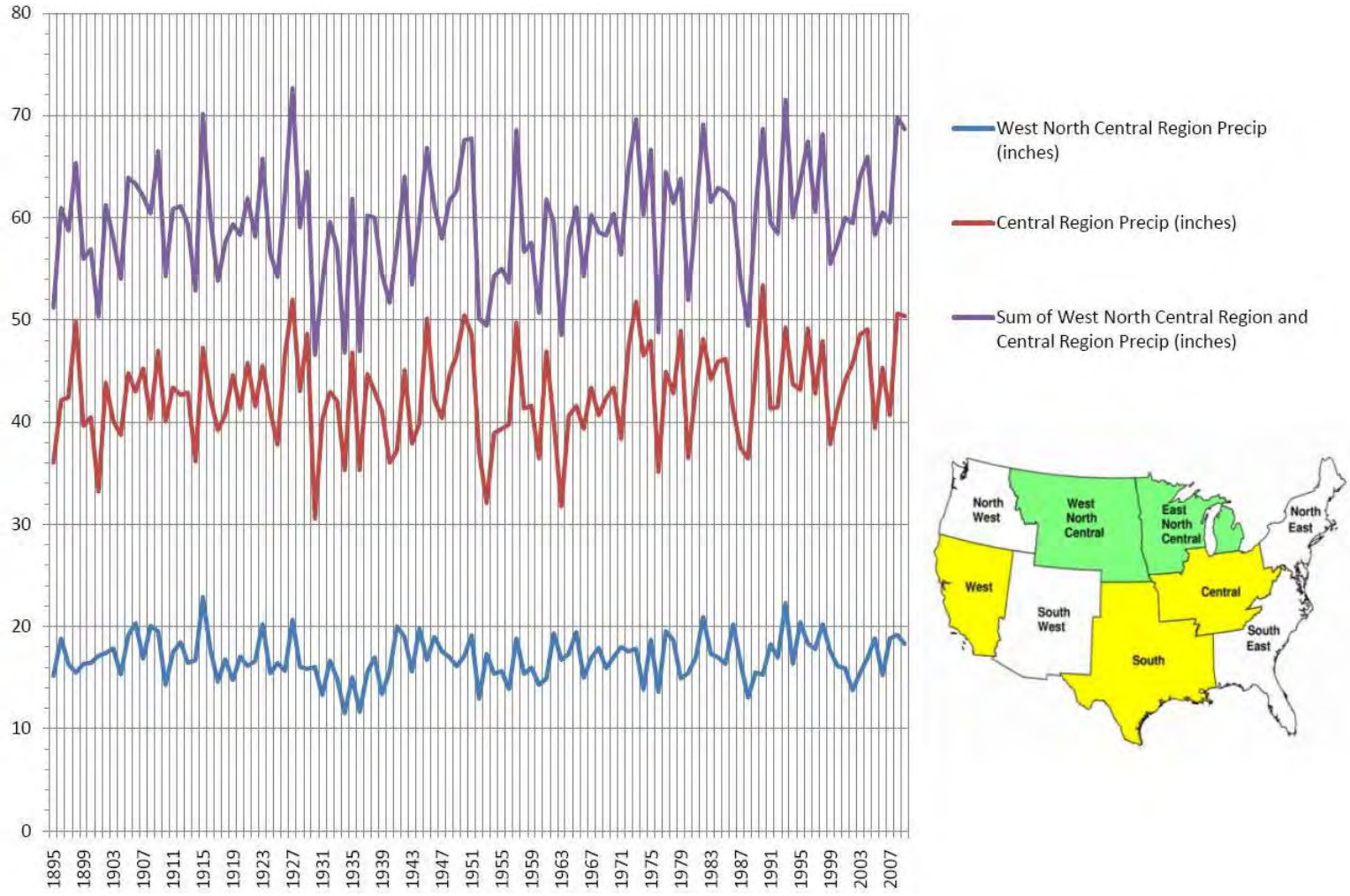
1) Develop a historic timeline of river freight history including overlay of historic climate cycle, significant events such as opening of the McClellan-Kerr Arkansas River Navigation System, master manual changes, etc., then add tons of freight moved. The purpose is to attempt to develop a tool that can bring insight into what is driving business on the river.

2) Utilizing available historic hydrographic information and data since 1896, attempt to identify patterns to describe a Navigation Service Cycle (NSC). The purpose of identifying an NSC for this study is to aid in understanding historic periods where navigation has tended to be feasible and infeasible under defined criteria relative to recent navigation requirements. NSC assumptions projected into the future may assist in forming strategies that can be undertaken to adjust market or operational effort during down segments (navigation less feasible) of an NSC and to maximize opportunity during up segments of an NSC.

During the development of Concepts of Operations later in the project, the baseline information developed in Task 2 aided in understanding challenges and describing strategies for making efficient use of the river's potential to move freight.

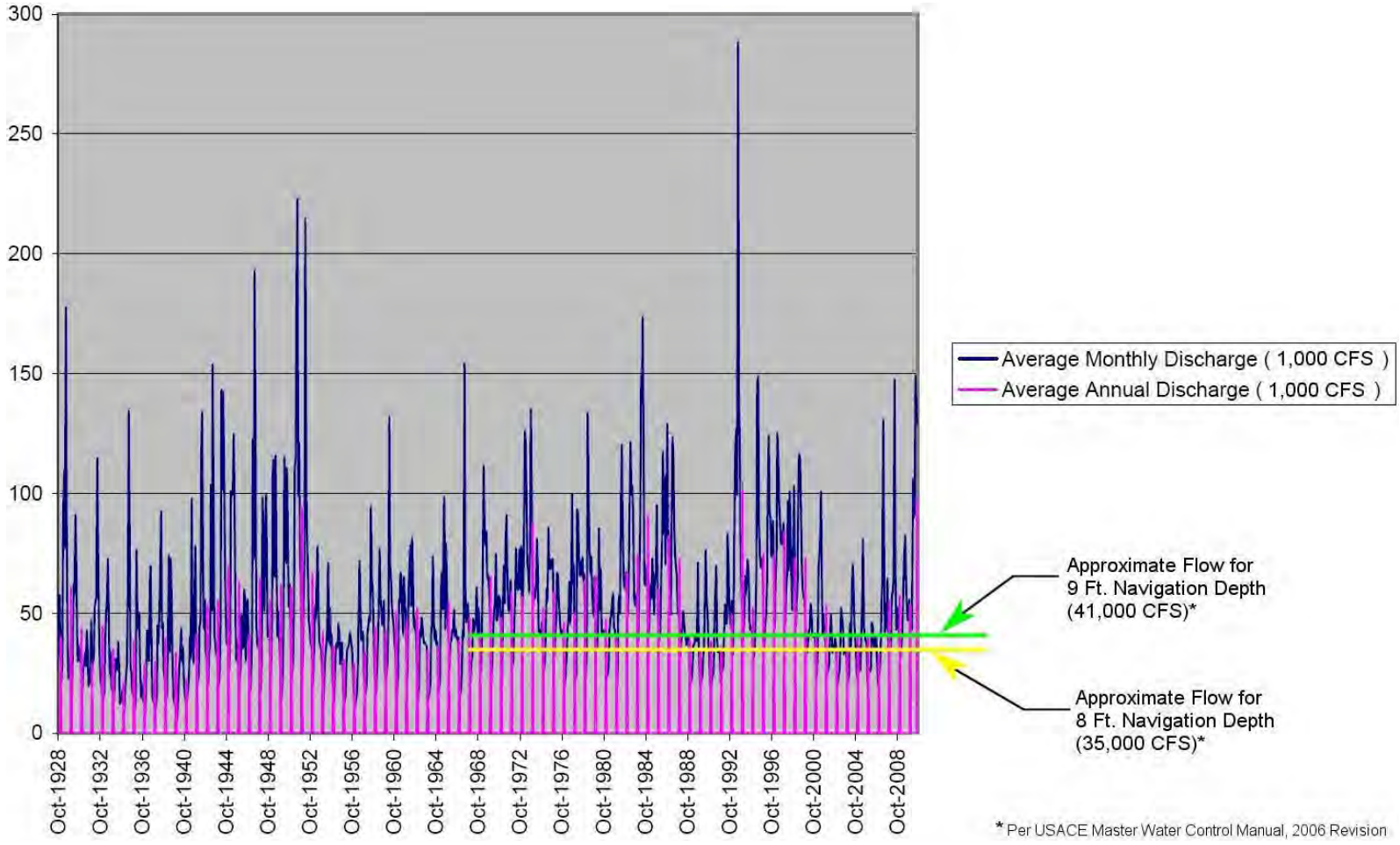
4.2 Historic Precipitation, Discharge, River Stage, Freight Tonnage & Key Events

Annual Precipitation Trends – Approximate Missouri River Basin Area



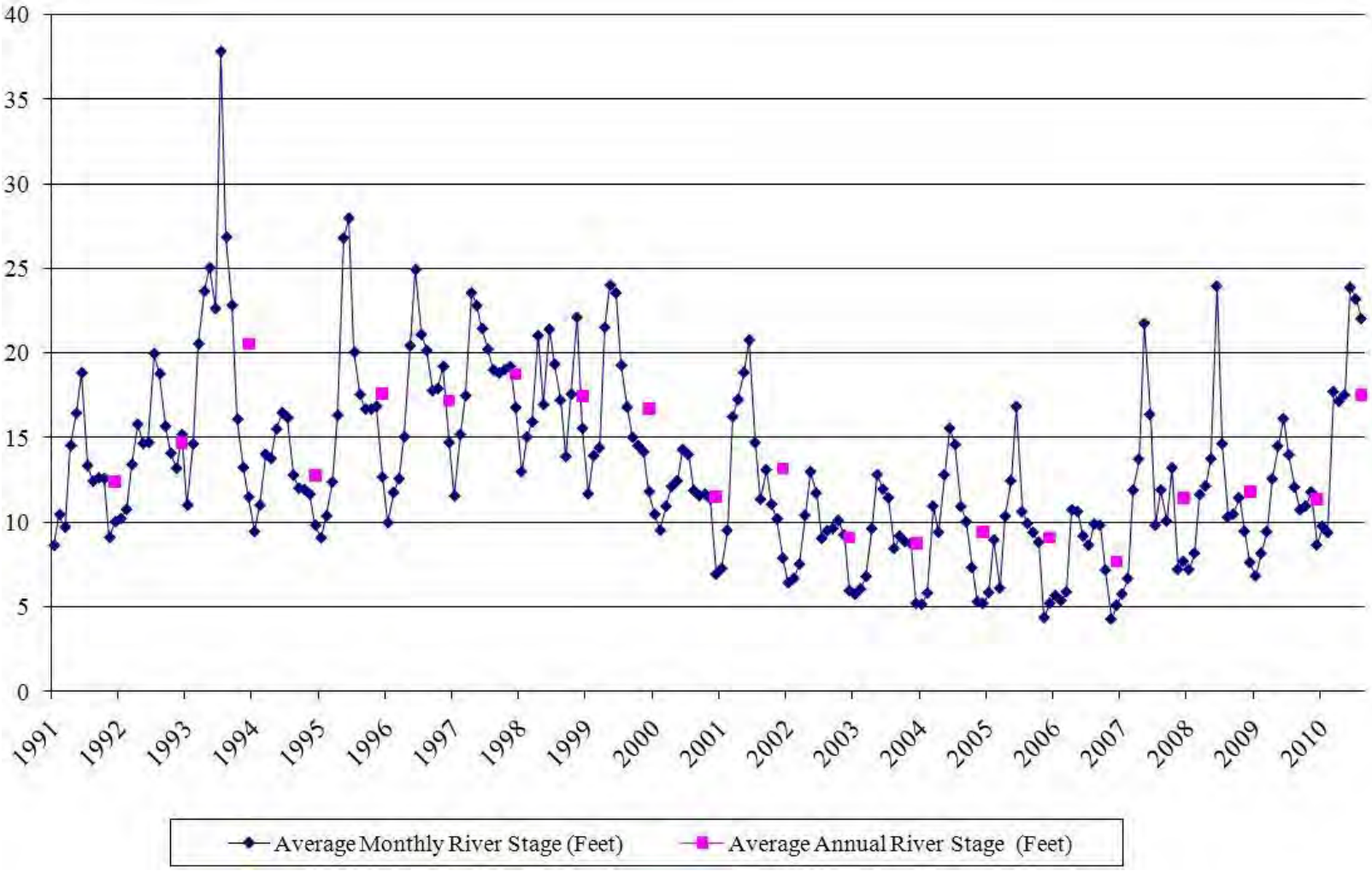
Data Source: National Climate Data Center;
http://www.ncdc.noaa.gov/oa/climate/research/cag3/regional.html

Discharge Data for Missouri River at Kansas City



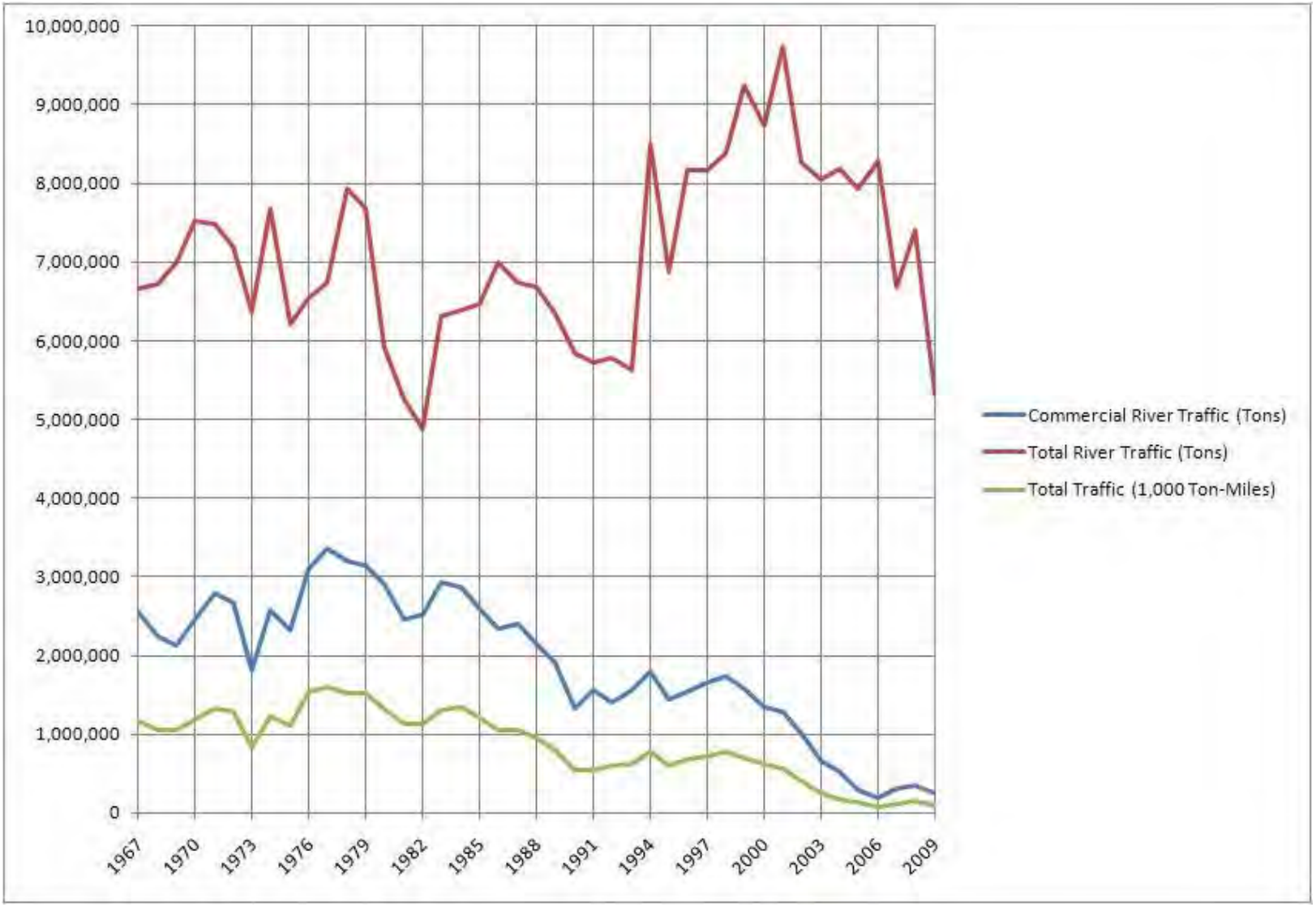
Data Source: USGS http://www.waterdata.usgs.gov/nwis

Average River Stage at Kansas City



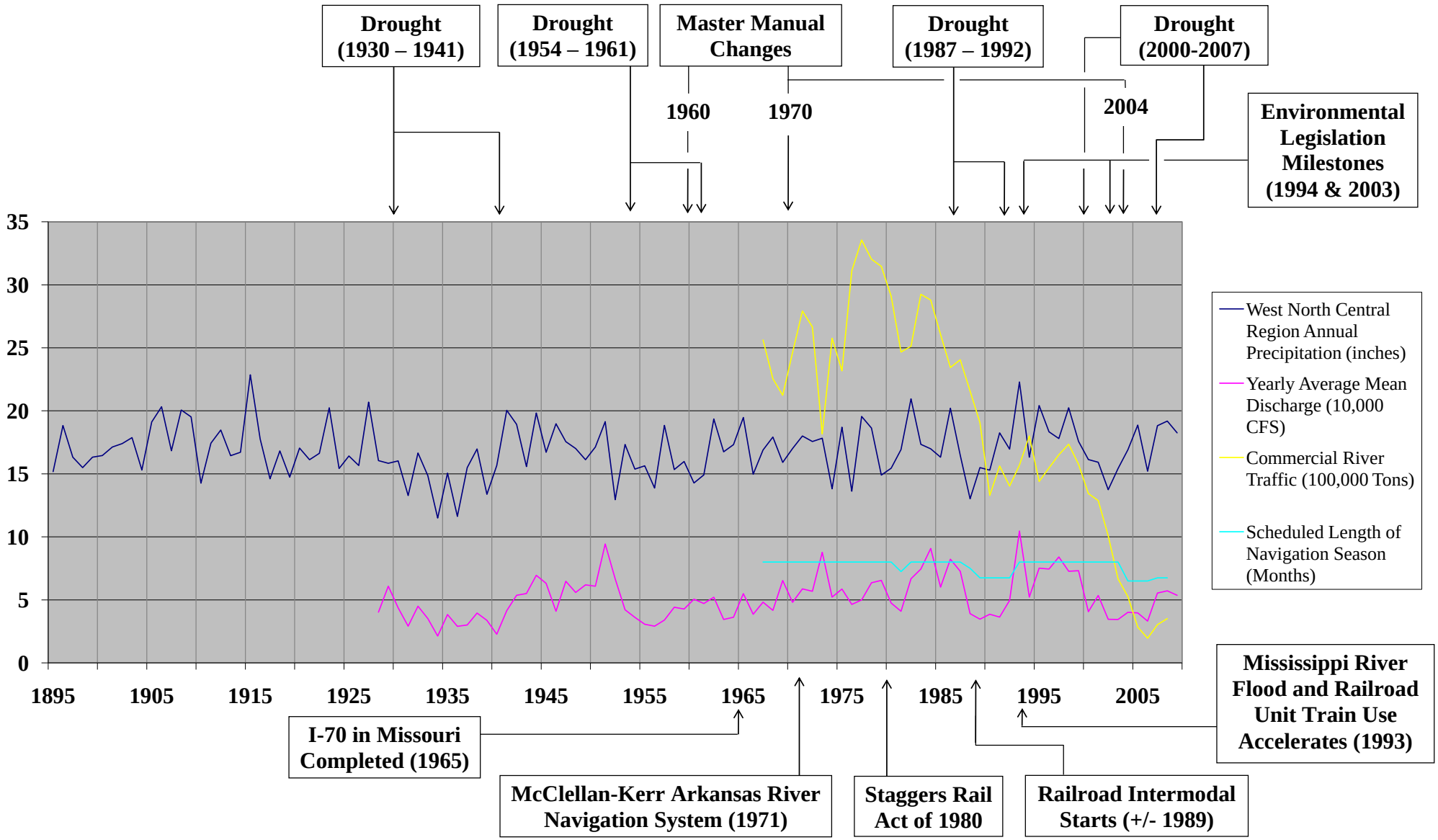
Data Source: USGS http://www.waterdata.usgs.gov/nwis

Historic Missouri River Tonnage

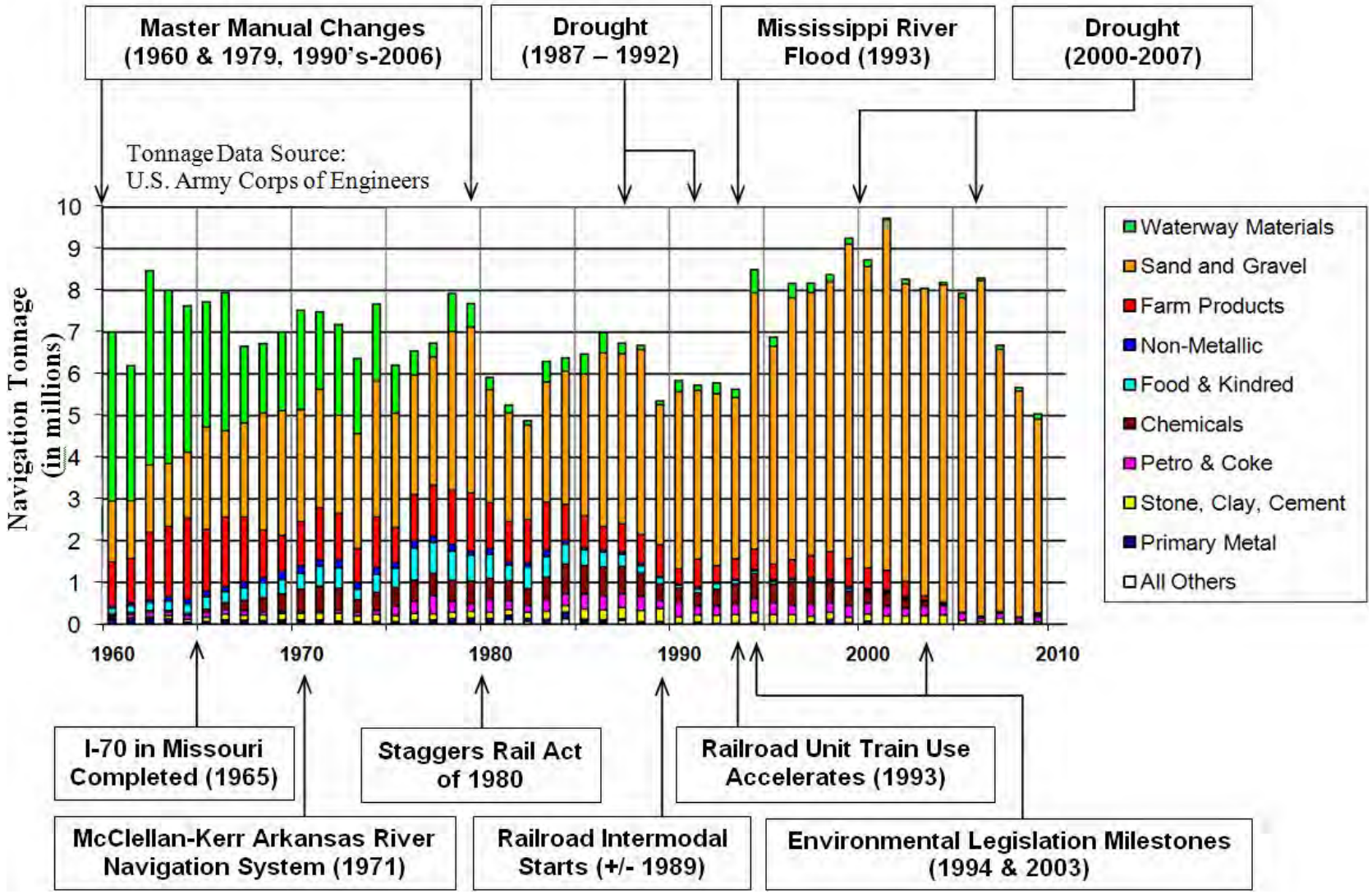


Data Source: Waterborne Commerce Statistics Center

Missouri River Historic Timeline



Missouri River Historic Timeline



4.3 Discussion

4.3.1 Data Utilized

Missouri River Historic Timeline Chart:

Chart data:

- Precipitation data: National Climatic Data Center; http://www.ncdc.noaa.gov/oa/climate/research/cag3/regional.html

- Yearly Average Mean Discharge: Hanson analysis of raw daily discharge data from for USGS Gage #06893000 Missouri River at Kansas City, MO (accessed at http://waterdata.usgs.gov/nwis/)

- Commercial River Traffic and Scheduled Length of Navigation Season: "Missouri River Mainstem Reservoir System -- Summary of Actual 2009 Regulation, Missouri River Basin", published in September 2010 by the U.S. Army Corps of Engineers, Northwestern Division, Missouri River Basin Water Management Division, Omaha, Nebraska (accessed at http://www.nwd-mr.usace.army.mil/rcc/reports/pdfs/rcc2009summary.pdf)

Description of Milestone Events

Callouts:

- Droughts:
  The data for the events and their duration was taken from a chart in the following document: *Missouri River Mainstem Reservoir System -- Summary of Actual 2009 Regulation, Missouri River Basin*, published in September 2010 by the U.S. Army Corps of Engineers, Northwestern Division, Missouri River Basin Water Management Division, Omaha, Nebraska (accessed at http://www.nwd-mr.usace.army.mil/rcc/reports/pdfs/rcc2009summary.pdf). The drought events are obviously the type of milestone that has negatively impacted navigation in recent years. Most notably, the 2000-2007 drought almost eliminated commercial navigation tonnage on the river. During that time and continuing into the present, environmental challenges and other competing uses have represented a significant challenge to the public perception of the value of allowing navigation at all.

- Master Manual Changes:
  (http://www.nwd-mr.usace.army.mil/rcc/reports/mmanual/MasterManual.pdf)
  - 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 U.S. Army Corps of Engineers 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 Environmental Impact Statement (EIS) under the auspices of the National Environmental Policy Act 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 U.S. Army Corps of Engineers' Water Management Regulation, ER 1110-2-240, which prescribes the policies and procedures to be followed by the USACE in carrying out water management activities, including establishment and the updating of water control plans for Corps and non-Corps projects, as required by Federal laws and directives.

- I-70 completion: http://www.modot.mo.gov/interstate/InterstateQuiz.htm. The opening of the interstate can be considered both a competitive advantage and a disadvantage for Missouri River freight, but it is certainly a milestone.

- Completion of the McClellan – Kerr (MKARNS) system: http://www.swt.usace.army.mil/PROJECTS/civil/civil_projects.cfm?number=78; note 1971 is the date of the act naming it McClellan-Kerr. It actually opened in 1969-1970. The MKARNS has likely had an impact on the competitive position

of the Missouri River for shipping agricultural products, but has also represented a complimentary navigation connection (e.g. clay freight movement).

- Staggers Rail Act:
  http://www.aar.org/~/media/aar/Background-Papers/The-Impact-of-Staggers.ashx The Act impacted government regulation of the railroads, giving much more control of routing, services, and pricing. 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 issue, Article titled, "The Magnificent 7: BNSF: first in a series" by William C. Vantuono

- Mississippi River Flood of 1993 – common knowledge

River Stage Data:

- Hanson analysis of raw daily stage data from for USGS Gage #06893000 Missouri River at Kansas City, MO (accessed at http://waterdata.usgs.gov/nwis/)

Discharge Data:

- Hanson analysis of raw daily discharge data from for USGS Gage #06893000 Missouri River at Kansas City, MO (accessed at http://waterdata.usgs.gov/nwis/)

4.3.2 Historic Timeline & Navigation Service Cycle

The concept of a navigation service cycle establishes the approach to presenting the critical data required for evaluation and assessment of navigation reliability in the context of meteorological, USACE Master Manual control criteria and commercial multi-modal influences and milestones. Furthermore, it presents data in a manner that permits subsequent focus and sensitivity analysis based on discreet historical data output and extraction of similar situational criteria. It is the latter capability which holds potential for identifying future actions that may enhance reliability of navigation on the Missouri River system.

The development of the Missouri River Historic Timeline and freight movement history is the appropriate baseline from which to overlay the critical data useful in attempting to describe a Navigation Service Cycle. The commercialization and freight development history of the River establishes the point at which defining criteria related to reliability factors was identified.

The Missouri River has been used for multiple purposes throughout the history of the United States. The first exploration and survey of the Missouri River basin was made in

1804-1806 by Lewis and Clark. Following that, development of the basin's water resources began in the 1800's with single-purposed developments in response to specific needs for water supply, irrigation, navigation, or mining. In 1819, the first steamboat entered the river; traffic rapidly developed to meet the needs of the expanding West. In 1824, the Federal government became involved with the Missouri River when Congress appropriated funds to the United States Army Corps of Engineers (Corps) for a snag removal program to aid navigation. Steamboat navigation on the Missouri River reached its peak in about 1880 and subsequently dwindled to nothing by about 1890, mostly due to the coming of the railroads.

In 1884, Congress created the Missouri River Commission within the Corps for the purpose of improving the river channel and decreasing the transportation hazards. The year 1895 is the point at which meaningful meteorological data is found that provides the important building block to future analysis of navigation reliability.

In 1902, the Commission ceased to exist, at which time the Corps resumed its normal activities in the basin. Since then, multiple legislative actions have aided navigation of the Missouri River.

The Rivers and Harbors Act of 1912 authorized a 6-foot navigation channel for the Missouri River from the mouth to Kansas City, Missouri. The Rivers and Harbors Acts of 1927 and 1935 further supported navigation on the Missouri River. The latest act affecting navigation is the Rivers and Harbors Act of March 2, 1945, which provided for work to secure a 9-foot-deep by 300-foot-wide channel from the confluence with the Mississippi River to Sioux City, Iowa.

It is important to note that Section 9 of the 1944 Flood Control Act authorized the Missouri River System to be operated for the purposes of flood control, navigation, irrigation, power, water supply, water quality control, recreation, and fish and wildlife. In addition, operation of the System must also comply with other applicable Federal statutory and regulatory requirements. In order to achieve these multi-purpose benefits, six System reservoirs were constructed and are now operated as an integrated system. The Master Manual integrates the interrelated operation of these reservoirs to attempt to achieve all eight authorized purposes. Further, the Master Manual serves as a guide to the Reservoir Control Center in meeting the operational objectives of the System when regulating the six System reservoirs. This Master Manual integrates the operation of both System and tributary reservoir water control plans so that an effective plan for flood control and conservation operations also exist within the basin. System control has been established through theses various Acts and the Missouri River System development that have direct implications to commercial navigation reliability.

Many Missouri River System features can impact commercial navigation reliability. Navigation of the Missouri River for freight purposes is restricted above the general location of Sioux City, Iowa. From there to the mouth, numerous minor and major freight destinations exist both on, adjacent to, and nearby the Missouri River.

In considering navigation reliability on the Missouri River, it is important to remember that navigation is a function of many things, including available water. The water originates mainly from rainfall and snowmelt. To facilitate navigation, water must, in part, also be released from the reservoirs upstream to allow navigation along the navigable reaches on the lower portions of the Missouri River.

Flood flows greater than about a 25-year flood event have the potential to adversely affect navigation on the Missouri River as well. The duration of the interruption depends on the length of river affected and the magnitude of the flood. Navigation financial losses result from interrupted service, shortened season duration and reduced tonnage carried based on a less than nine foot draft capability.

The Missouri River Bank Stabilization and Navigation Project (BSNP) was authorized by Congress in the Rivers and Harbors Act of 1945 and is designed to secure a permanent, continuous, open-river navigation channel with a 9-foot depth and a width of not less than 300 feet under full navigation service conditions. The navigation project is accomplished by using river structures placed to confine and control the channel, instead of using locks, as is the case on most of the inland waterway systems. Under normal water release conditions, the use of these structures produces velocities high enough to prevent the accumulation of sediment in the channel and permits an open condition for the entire length of the project with no dredging required. As a result, the Missouri River has higher velocities than other inland navigation systems, which can present its own navigation challenges.

Maintenance and integrity of the channel dimensions requires releases from the System, as well as some infrequent dredging activity. Dredging requirements generally occur during periods of sub-normal water releases. The importance of the Missouri River linked with the Mississippi River waterway system is the availability of low-cost transportation from, many localities in the Missouri River valley to world markets through the Gulf of Mexico.

With navigation highly dependent on water releases and not the management of navigation pools as generally found in other waterways, precipitation is an important data element. Within the immediate boundaries of the Missouri River watershed, targeted precipitation data was not available. Climatic data for the approximate Missouri River watershed was available from the National Climatic Data Center beginning in 1895 and continuing up to 2009, the most recent full year. Within this data, the lower 48 United States is divided up into nine regions. The Missouri River watershed is generally covered by two of these regions: the West Central Region, which generally represents the upper watershed area, and the Central Region, which includes the lower watershed area (that located within Missouri). But this Central Region also includes significant area that is not part of the watershed, including the states of Illinois, Indiana, Ohio, West Virginia, Kentucky, and Tennessee. As such, the Central Region isn't as representative of the watershed since it contains significant area outside the watershed. Annual precipitation trends that are representative of the Missouri River Basin area, the West North Central Region, and the adjacent Central Region were plotted from 1895 through 2009.

To further develop the criteria for Navigation Service Cycle analysis, basic navigation and freight information must be secured. Based on information contained in the "Missouri River Mainstem Reservoir System -- Summary of Actual 2009 Regulation, Missouri River Basin", published in September 2010 by the U.S. Army Corps of Engineers, Northwestern Division, Missouri River Basin Water Management Division, Omaha, Nebraska; information on the length of navigation season supported by the reservoir system, commercial tonnage, total traffic tonnage, and total ton-mile traffic was secured. The tonnage information is compiled by the Waterborne Commerce Statistics Center (WCSC) under criteria established for all inland waterways. The "Commercial River Traffic (Tons)" is indicated to include commercial tonnage except for sand and gravel or waterway materials. The "Total River Traffic (Tons)" and "Total Traffic (1,000 Ton Miles)" are indicated to include commodities; sand, gravel, and crushed rock; and waterway improvement materials. This data is available beginning in 1967, which is the year when the Mainstem Reservoir System first reached its normal operating storage level, and continuing up to 2009.
This Historic Missouri River Tonnage chart above shows peak commercial river tonnage and total ton-mileage occurring back in the mid to late 1970's, with a general decline occurring in the 1980's and a general flat trend during the 1990's. In 1999, river tonnage and ton-mileage began to drop off more rapidly, followed by an even more rapid drop off beginning in about 2002, continuing generally through the present. It is interesting to note that total tonnage has generally increased since the recent low tonnage in 1993, mostly due to significant tonnage of sand and gravel materials. The year 2009 represented near historical lows in tonnage and ton-miles.

Even though the drought ended in 2007 per the Missouri River Mainstem Reservoir System – Summary of Actual 2009 Regulation, Missouri River Basin; system storage had not fully recovered in 2009. There was minimum navigation service for the first half of the 2009 season. On July 1, 2009, the reservoir system storage permitted releases were increased to provide full service navigation flows. These releases also provided a full 8 month system supported navigation season for the first time since 2003. In spite of this, total tonnage was still down compared to 2007, due in part to permit restrictions on the sand and gravel mining companies and reduced construction business concrete demand as a result of the economic recession. In addition tonnage was and is significantly impacted by the lack of confidence that shippers, carriers, and industry have in the future sustainability of navigation on the river.

Because discharge flows are critical to navigation reliability, the relationship between flow volume in cubic feet per second (CFS) and navigation draft at a specific gauge reference is critical to future analysis. As an example; the USACE Master Control Manual, 2006 Revised indicates the minimum 9 Ft. navigation depth is met at Kansas City when releases are 41,000 CFS and 8 Ft. depth at 35,000 CFS.

The precipitation, commercial tonnage, length of navigation season and yearly average mean discharge (CFS) data was plotted on the Missouri River Historic Timeline chart. The information and supporting data represented on the chart will be utilized along with other information to develop Navigation Service Cycle patterns relationships. From this

analysis, strategies may be identified to improve navigation reliability and to mitigate potential future navigation financial negative impacts.

In the broader view, the Missouri River Historic Timeline is useful for focusing on transportation and regulatory milestones that may have marked critical points that influenced freight shifts from the Missouri River. These milestones are added to the timeline to aid in visualizing some of the impacts on commercial navigation. Based on the random nature of the varied impacts and circumstances, it is not practical to specifically define an expected timeframe for recurrence of a Navigation Service Cycle (NSC). The NSC concept is intended to be a useful tool for development of Concepts of Operations and general understanding of influences on Missouri River freight development.