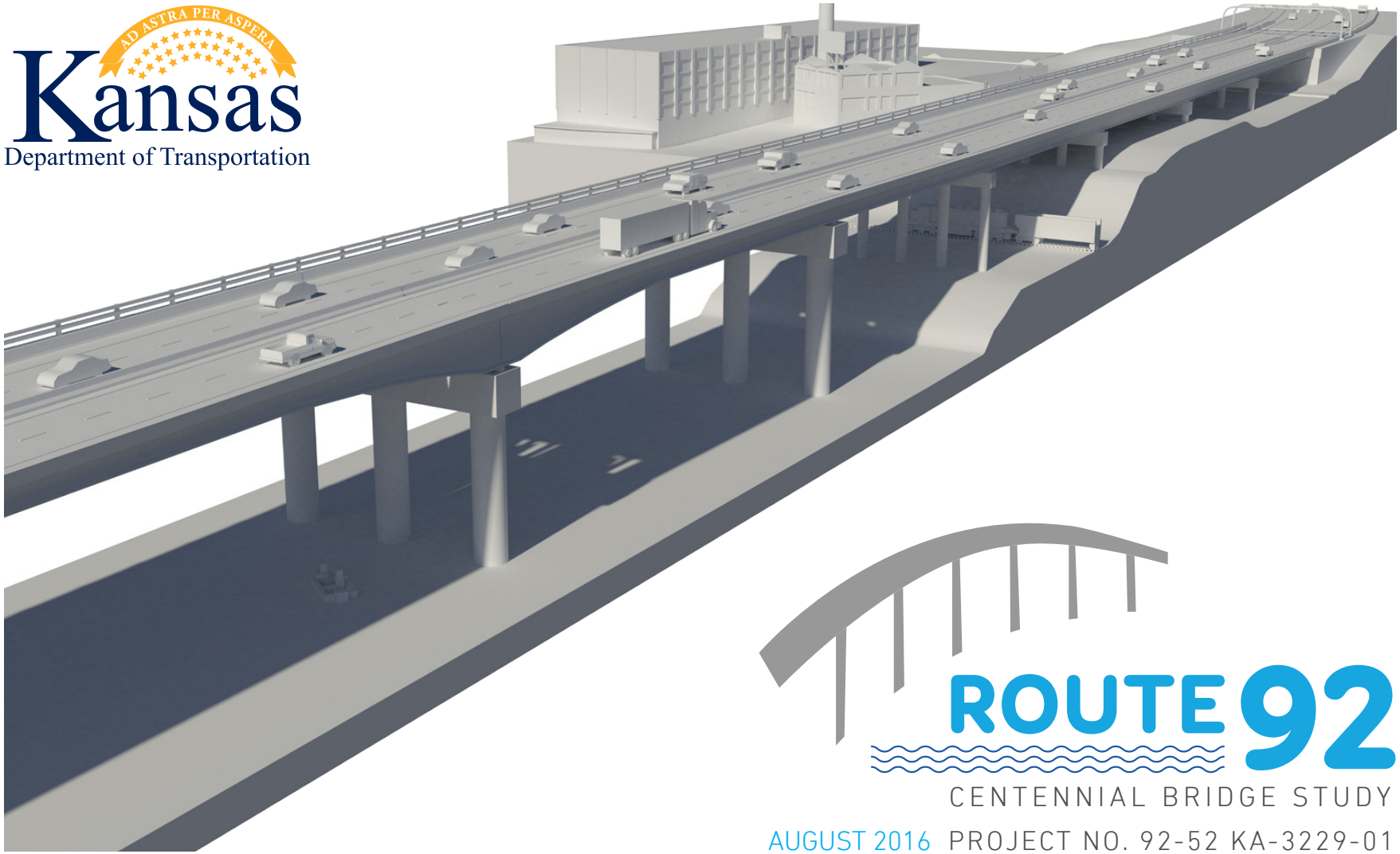
ROUTE 92 CENTENNIAL BRIDGE STUDY

Kansas
Department of Transportation



ROUTE 92
CENTENNIAL BRIDGE STUDY

AUGUST 2016 PROJECT NO. 92-52 KA-3229-01

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ROUTE 92 CENTENNIAL BRIDGE STUDY

Leavenworth County, Kansas and Platte County, Missouri
Project No. 92-52 KA-3229-01
August 2016

Kansas Department of Transportation

Kansas Department of Transportation
Eisenhower State Office Building
700 SW Harrison Street
Topeka, KS 66603-3754

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ACKNOWLEDGMENTS

The Kansas Department of Transportation would like to acknowledge the following organizations and individuals for their participation and commitment throughout the Route 92 Centennial Bridge Study.

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EXECUTIVE SUMMARY

INTRODUCTION

Through the Kansas Department of Transportation (KDOT) T-WORKS program, a local consultation process was developed to seek regional input. The City of Leavenworth proposed that the replacement for the Centennial Bridge be developed with the investigation of tolling as a potential funding source, similar to the financing of the Centennial Bridge in the 1950s.

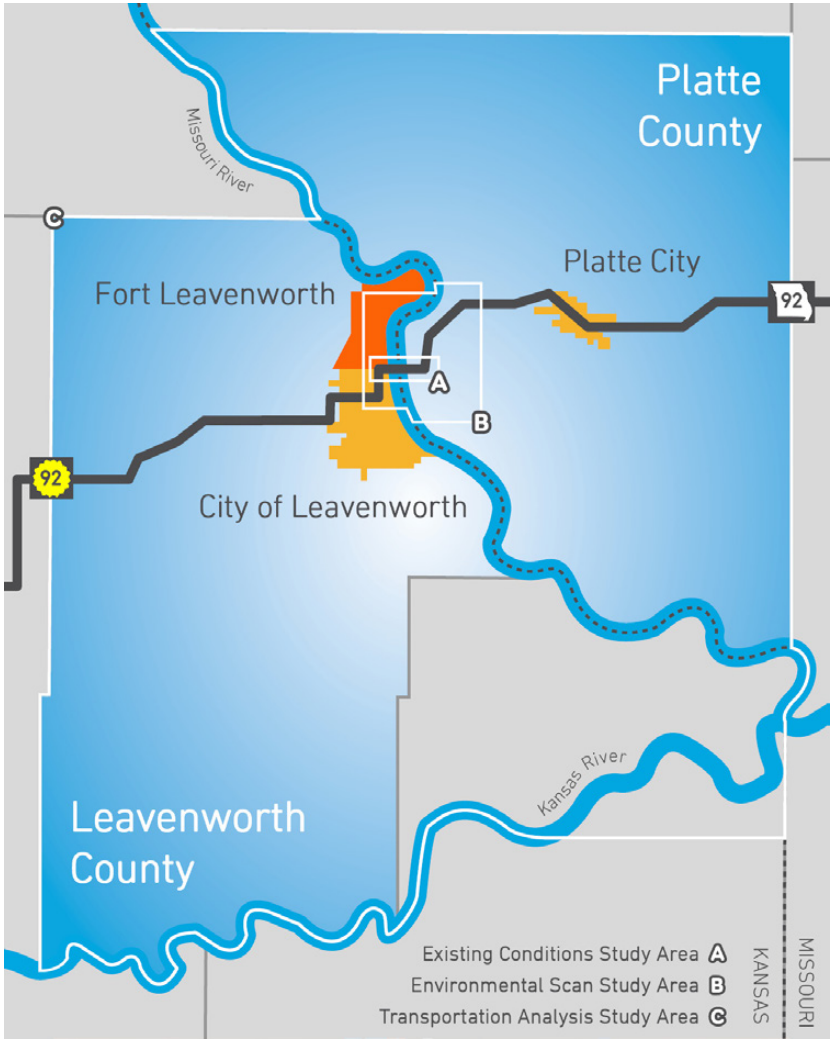
Therefore, KDOT conducted an Advanced Preliminary Engineering study to replace the functionally obsolete Centennial Bridge (Bridge No. 92-52-18.48 (026)) over the Missouri River connecting Leavenworth County, Kansas and Platte County, Missouri. The general purpose of the Advanced Preliminary Engineering study is to provide a feasible solution for a replacement bridge including:

- Bridge type, size, and location
- Probable costs
- Potential funding mechanisms
- Preliminary environmental review

The study also has a Tolling & Revenue (Level 2) component to continue the exploration of potential tolling for the replacement bridge. The Level 2 analysis places an emphasis on determining the appropriate revenue stream to offset associated construction costs as well as Operation & Maintenance (O&M) costs.

The study area for the Route 92 Centennial Bridge Study places an emphasis on three boundaries (existing conditions study area, environmental scan study area, and transportation analysis study area) as shown in Exhibit E.1.

Exhibit E.1 | Study Area



The Route 92 Centennial Bridge Study outlines existing conditions, forecasted conditions, corridor selection process, Tolling & Revenue study, and next steps. Key public involvement activities included the engagement of an Advisory Committee and three Public Open House meetings conducted throughout the study. Meetings were held in Leavenworth, Kansas and Platte City, Missouri. The study schedule is displayed in Exhibit E.2.

EXISTING CONDITIONS

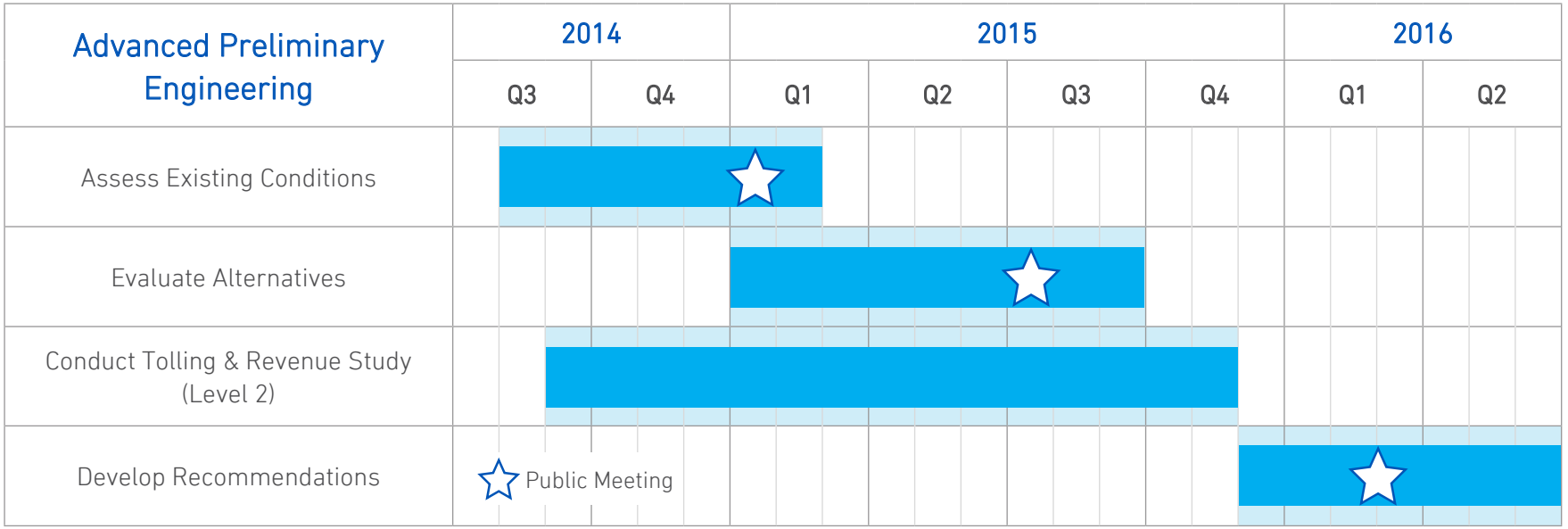
The Existing Conditions phase examined the following elements:

- Multimodal transportation network
- Traffic characteristics
- Bridge conditions
- Environmental features

The existing Centennial Bridge is a two-lane roadway with limited shoulder. The traffic characteristics of the east-west Highway 92 corridor are influenced by intersecting arterials and Interstate routes, which is an important consideration when assessing competitive routes under future conditions as well as potential diversion associated with the option for tolling. These regional connecting roadways include US-73/K-7, Spur 45, Route 45, and Route 273. Consideration is also given to bicycle and pedestrian transportation as the existing Centennial Bridge does not provide a dedicated means of travel for either mode.

Traffic data was collected to support capacity analysis on existing facilities and calibration of a travel demand model. Traffic counts indicate that the Centennial Bridge carries approximately 14,000 vehicles per day with pronounced peaking characteristics westbound in the morning and eastbound in the evening. The peaking characteristics influence the level of service experienced on roadway segments and intersections within the study area. Fort Leavenworth is a major traffic generator.

Exhibit E.2 | Study Schedule



Based on the 2015 inspection of the Centennial Bridge, the superstructure is in satisfactory condition and the deck and substructure are in good condition. Therefore, the bridge does not meet federal guidelines to be classified as structurally deficient. However, the bridge is identified as fracture critical (a steel member in tension, or with a tension element, whose failure would cause a portion of or the entire bridge to collapse) and functionally obsolete (built to outdated standards). Per KDOT, the estimated additional service life for the existing bridge is twenty to thirty years. As the bridge ages, there is generally an increase in maintenance and repairs, particularly due to steel deterioration.

The study area was also evaluated for environmental features such as known noise, archaeological resources, floodplains, wetlands, streams, wildlife, hazardous waste, farmland, historic resources, and public parks. These elements influence future decisions regarding corridor selection, bridge and roadway alignment, and bridge design.

Public Input: The focus of public involvement at this phase was to explain the study process and discuss existing conditions along the corridor and their potential influence upon the study. Most comments were related to tolling, bicycle and pedestrian access, and design (aesthetic treatments) of the bridge and roadway approaches.

FORECASTED CONDITIONS

The Forecasted Conditions phase examined the following elements:

- Committed developments
- Committed transportation projects
- Future traffic volumes

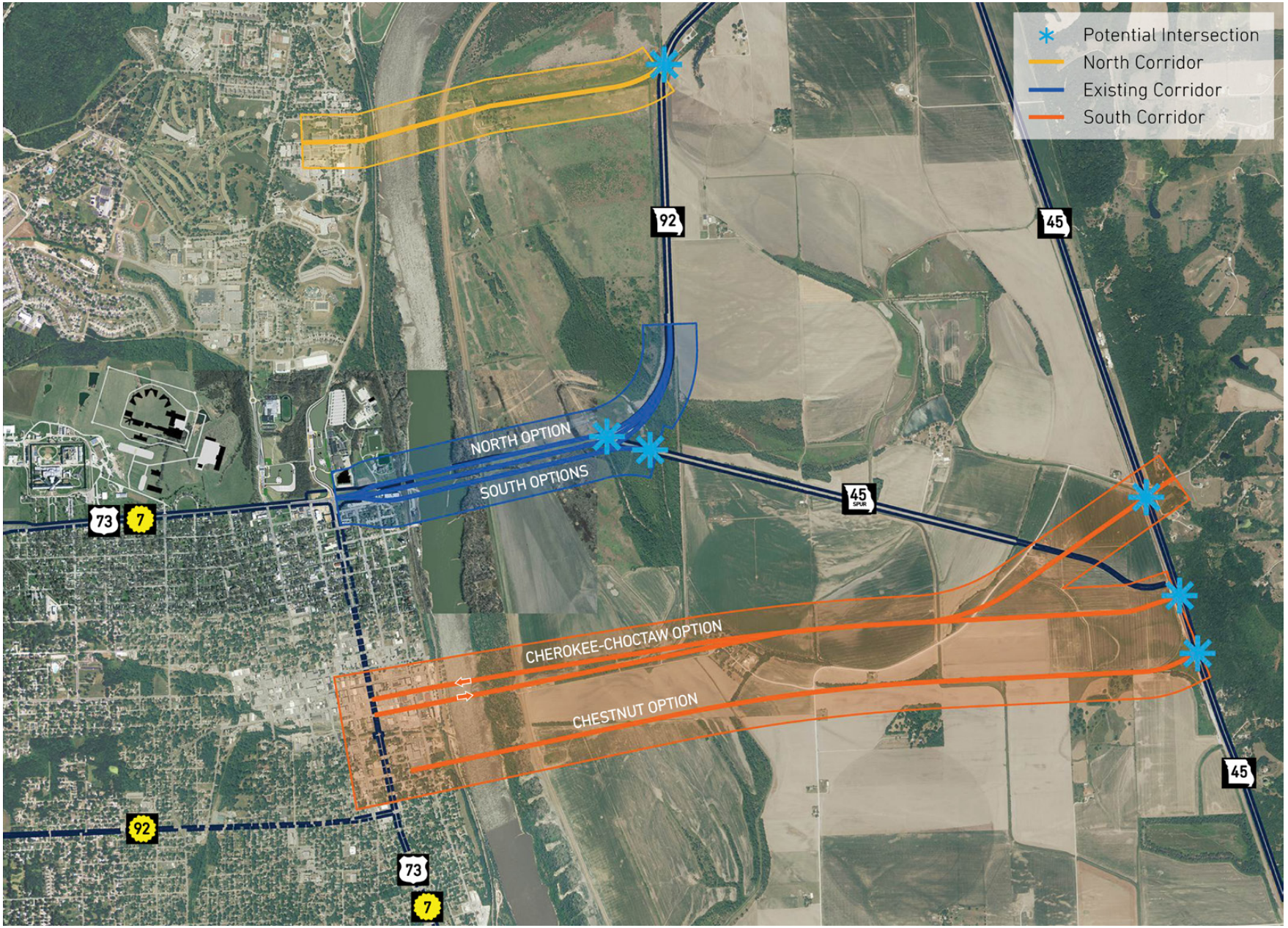
Physical and operational developments at Fort Leavenworth, the Bureau of Prisons, and the National Guard were incorporated into the study in an effort to reflect future traffic conditions. These developments will also influence the future traffic analysis of access points along Metropolitan Avenue.

Several roadway projects are also proposed over the next few decades. Projects of significance in Missouri are in response to socio-economic growth indicative of potential increases in trip exchanges with the City of Leavenworth via the Centennial Bridge. In Kansas, the most significant project is the ring road concept of improvements to K-5 and McIntyre Expressway from two to four lanes coupled with the West Leavenworth/Lansing K-7 Bypass from McIntyre Road to a connection near 20th Street and Metropolitan Avenue at the west edge of the City of Leavenworth. While potentially constructed in phases, the ring road concept can be considered an alternate route for trips. Consequently, the review of future year forecasts are conducted with a sensitivity test with and without these improvements to assess any effect it could have on the Centennial Bridge replacement.

Three scenarios were developed to forecast future traffic volume in 2040, the final year in the Travel Demand Model: No-Build, Build + No Tolling, and Build + Tolling. Similar to the Level of Service analysis conducted for the existing conditions, a Level of Service analysis was also conducted for roadway segments and intersections under the three scenarios.

In general, the level of service between the bridge and Spur 45 significantly improved under the Build + No Tolling and the Build + Tolling scenarios. Increased traffic volumes under the current configuration at Route 92 and Spur 45 exacerbate operations. Therefore, the analysis warranted improvements for both capacity and safety reasons at the intersection. Analysis of the intersection along Metropolitan Avenue also indicate the need for some improvements and monitoring of conditions. The results from the analysis were used in the next phase of the study to consider options to improve capacity and safety along the corridor.

Exhibit E.3 | Corridors Considered



CORRIDOR SELECTION

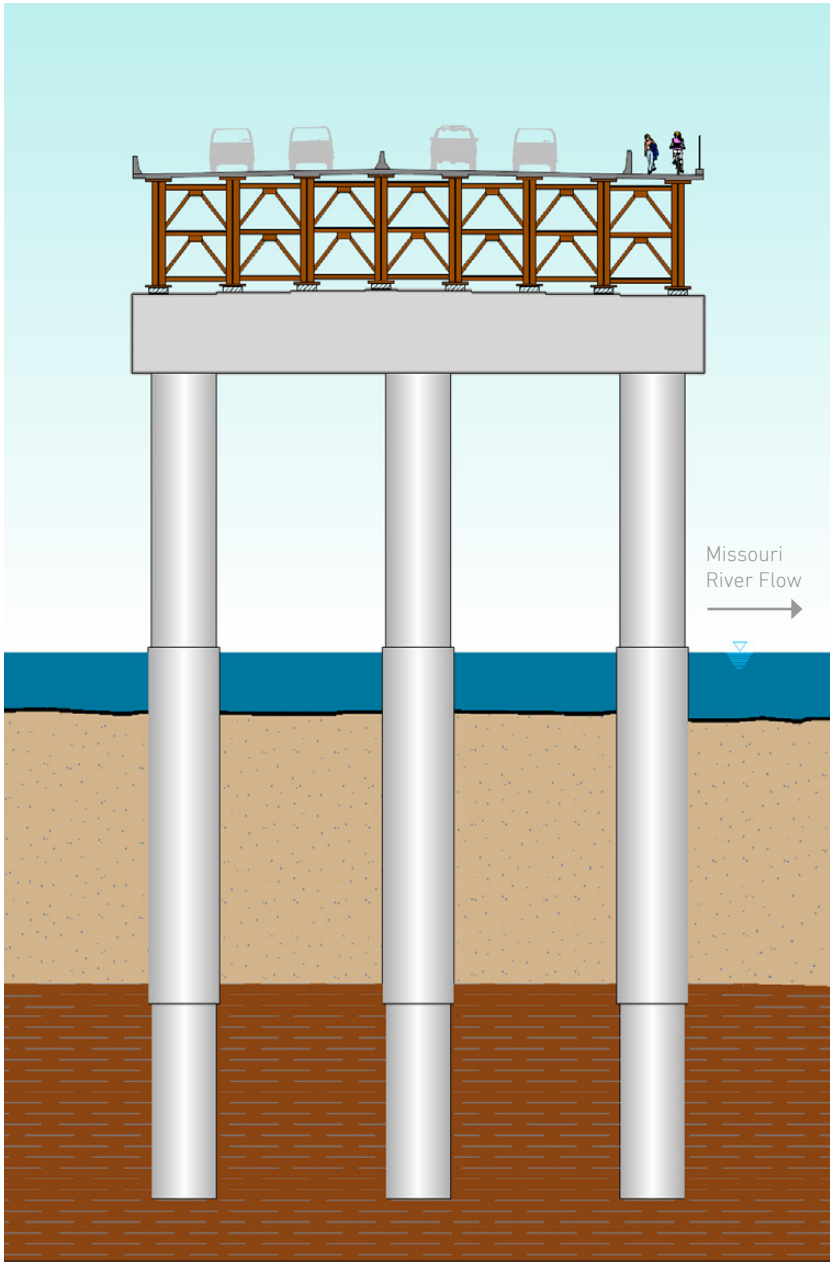
The Corridor Selection phase examined the following elements:

- Bridge coordination elements
- Bridge and roadway approaches
- Corridor recommendations
- Cost estimates for the selected alignment.

The corridor selection process considered possible structure types and estimated cost to select a preferred option. Elements including navigation clearance, hydraulics, levee system, railroad, aviation, utilities, shared-use path, and aesthetics were assessed to identify constraints and/or requirements. As displayed in Exhibit E.3, three corridors (north, existing, and south) were considered to screen alternatives before selecting a specific corridor. A comparative assessment of environmental, traffic, and financial elements suggested that only the existing corridor be advanced. An alignment north of the existing bridge was selected for further advancement to reduce direct impacts to the historic Abernathy Furniture Complex and other environmental concerns.

The recommended replacement of the Centennial Bridge is a new three structure unit bridge (2,348 feet), crossing the Missouri River upstream of the existing bridge. The bridge alignment has been set based upon the offset necessary to construct new bridge piers without interfering with the existing bridge piers or its foundation system. The new bridge deck cross section includes four 12-foot traffic lanes, two 4-foot inside shoulders, and two 8-foot outside shoulders. Eastbound and westbound traffic is separated by a median barrier. The replacement configuration includes a 10-foot wide shared-use path. The main span consists of a haunched steel plate girder structure with horizontal clearance for the Missouri River's navigational channel. The design incorporates a shift in the navigational sailing line, which as been coordinated with the U.S. Coast Guard. The typical cross section of the main span is shown in Exhibit E.4.

Exhibit E.4 | Typical Cross Section of Main Span

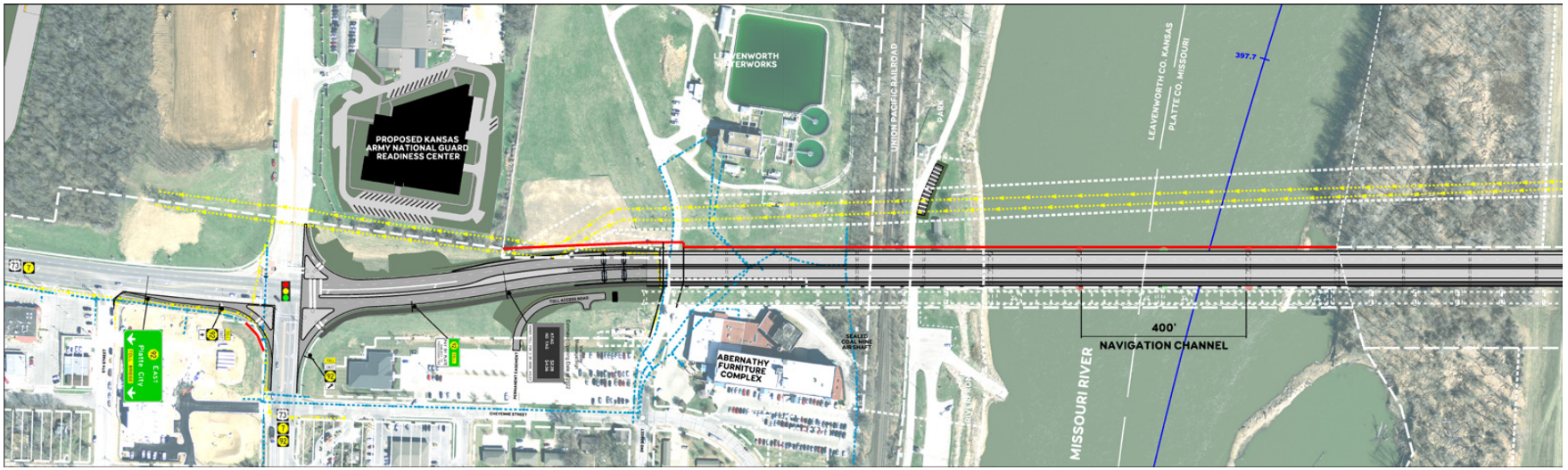


The approach roadways were also designed to transition back into the existing roadway network. A range of intersection improvement concepts at Route 92 and Spur 45 were explored including a roundabout, traffic signal, or grade separation. Continued coordination is also needed to monitor traffic operations on Metropolitan Avenue at the 4th Street and 7th Street signalized intersections with particular attention to the extent of queuing vehicles traveling in the westbound direction in the AM peak period. The potential toll collection system is envisioned to use All Electronic Tolling collection. Therefore, conceptual signing and improvements to accommodate the tolling collection system were also considered. A strip map of the bridge and roadway approach alignment is shown in Exhibit E.5.

Cost estimates are provided for construction activities as well as programming elements such as design, construction engineering, and right-of-way. The project assumes the removal of the existing bridge and roadway approaches and construction of the replacement bridge, associated roadway approaches, and tolling facilities. The construction cost estimate, when rounded to the nearest $5 million, is $80 million (FY 2016). While funding associated with aesthetics has not yet been negotiated, the rounding of costs allows for the inclusion of aesthetic treatments yet to be determined.

After accounting for programming costs, the total project cost is approximately $90 million (FY 2016). Bridge costs are expected to be shared evenly by each state while roadway approaches and other line items are expected to be the responsibility of the respective state. Because of the Tolling & Revenue component of the study, operations and maintenance costs for a 40-year period were also developed. The costs for the bridge, roadway, and tolling equipment apply periodic maintenance and/or repair followed by replacement at the end of the equipment life cycle.

Exhibit E.5 | Bridge and Roadway Approach Alignment (Part 1 of 2)



Disclaimer: These concepts depict potential improvements to Route 92 and the roadway network. The exact location, design, and right-of-way for this project cannot be determined from these concepts and could be different from that shown. Preliminary design will need to be completed to refine the improvements and right-of-way requirements.

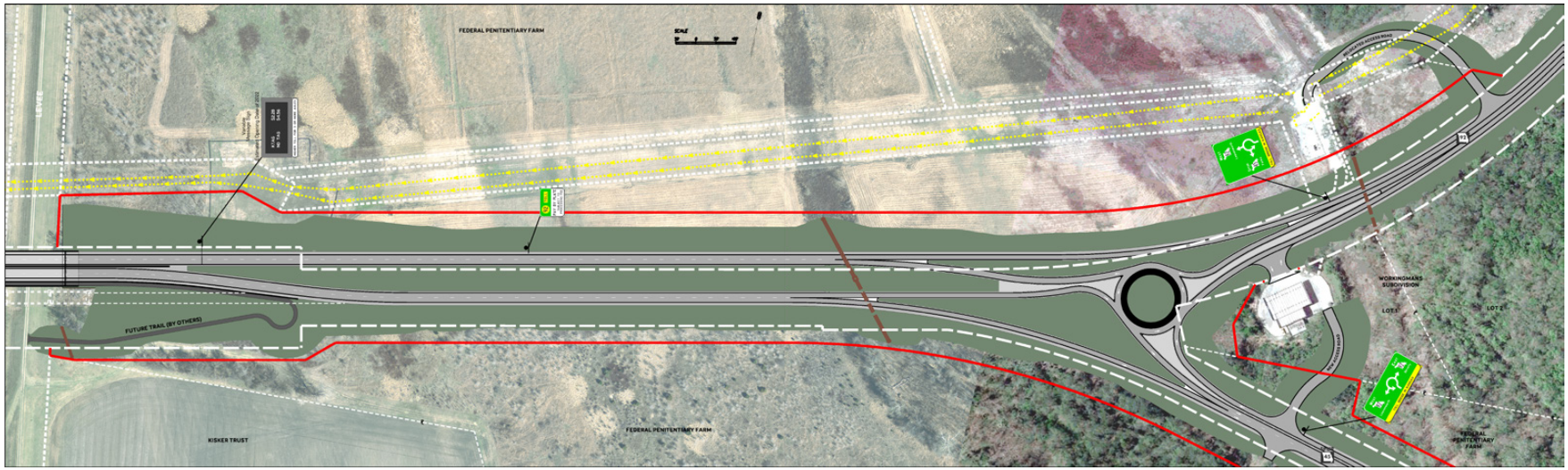
Public Input: The focus of public involvement at this phase was to explain the process of developing and evaluating alternatives while providing a direction for recommended location, type, and cost of the replacement bridge. Detailed survey information was collected regarding demographic information, frequency of travel, reasons for travel, location of a replacement bridge, bicycle and pedestrian accommodations, and aesthetic treatments. The most popular choice expressed for the location of a replacement bridge was adjacent to the current bridge, and bicycle and pedestrian access was deemed important.

TOLLING & REVENUE STUDY

Tolling & Revenue studies are typically conducted at three levels. Level 1 is a high-level feasibility study with generic assumptions and limited data collection. If the project passes Level 1, it proceeds to a more detailed study at Level 2 that utilizes a travel demand model and establishes specific assumptions regarding costs and revenue. The investment-grade Level 3 analysis is only performed when a project is ready to be financed with tolling and seeking a bond rating from banks. Without the use of tolling as a supplemental funding source, and in consideration of the current structural condition of the Centennial Bridge, a replacement bridge through traditional funding methods would likely be constructed in the early-to-mid 2030s.

An Intermediate (Level 2) Tolling & Revenue study was conducted for the proposed Centennial Bridge replacement project. The analysis is an ongoing effort to evaluate the financial feasibility of a potential toll bridge through use of travel demand modeling tools and refined traffic and revenue assumptions. Supporting data collection efforts included historical traffic growth, existing traffic counts, an intercept origin-destination survey, a stated preference survey, an AirSage survey (real-time GPS technology to capture the movement of anonymous cell phone data), and a

Exhibit E.5 | Bridge and Roadway Approach Alignment (Part 2 of 2)



Disclaimer: These concepts depict potential improvements to Route 92 and the roadway network. The exact location, design, and right-of-way for this project cannot be determined from these concepts and could be different from that shown. Preliminary design will need to be completed to refine the improvements and right-of-way requirements.

socio-economic review. The analysis is preliminary and subject to changing market conditions; therefore, the Tolling & Revenue analysis is not a guarantee.

A series of assumptions were developed in order to assess financial feasibility. A key assumption is the potential opening date of the facility when tolls could be collected. The earliest opening date is assumed to be 2022. The toll rate for the Tolling & Revenue base scenario was assumed to be $2.00 (FY 2016). Missouri law excludes the tolling of an existing state highway; therefore, only the bridge cost in Missouri is included for tolling cost coverage in the financial assessment. Missouri statutes may also require the potential for a statewide vote to enact tolling. The assessment considered future characteristics of the transportation network and a toll sensitivity curve that accounts for a portion of travelers that will divert from the toll facility to alternate routes. Toll collection is assumed to be All Electronic Tolling, which utilizes detection equipment to read electronic transponders or record license plates via camera. One of the benefits of All Electronic Tolling is that vehicles do not need to stop or travel at slower speeds to interact with the equipment.

The financial feasibility was assessed for two cases with an opening date of 2022. Using a standard municipal toll road revenue bond (Case 1), the project is only 80 percent feasible with a financing gap of approximately $15 million. However, with the incremental debt capacity gained by using a federal loan (Case 2), the project is fully feasible.

Public Input: The focus of public involvement at this phase was to obtain feedback to potential bridge, roadway, and tolling recommendations. Concerns displayed included duration of toll collection, tolling authorities, and project elements covered by tolling revenue. Public involvement activities are displayed in Exhibit E.6 and Exhibit E.7.

NEXT STEPS

The replacement of the Route 92 Centennial Bridge is not yet funded for construction. This study process, including Advanced Preliminary Engineering and a Tolling & Revenue (Level 2) study, developed a preferred concept and appropriate costs. Then, if tolling were deemed financially feasible, an implementation plan can be outlined.

Next steps include three intrinsically interrelated elements:

- Design recommendations
- Costs and funding
- Environmental documentation

In an era of reduced transportation investments coupled with increasing transportation needs, exploring alternate means of funding becomes critical to advance projects from study to design to construction. For a project to be feasible, it must be technically feasible, financially feasible, and politically feasible. With the project being located in two states, it is important to be aware of institutional issues associated with tolling and any cost-share agreements between both states.

The design concept is technically feasible and tolling is financially feasible; however, tolling has several political challenges to overcome. There are institutional issues that this study has attempted to address including the process to establish a tolling authority and the types of requirements that may apply.

During the Next Steps phase of the study, input from the series of Advisory Committee meetings and Public Open Houses was reviewed. Since the project concept and funding mechanism was initiated through the local consultation process, KDOT sought direct input from the City of Leavenworth regarding the Advanced Preliminary Engineering and the Tolling & Revenue study process. KDOT presented a summary of findings at a City

of Leavenworth Study Session in June 2016 and asked for a vote of support or non-support on the design and location of the replacement bridge and tolling as a funding mechanism. The City Commission gathered feedback on these matters. In July 2016, the Commission endorsed the general characteristics, design, and location of the bridge. Questions remained about incorporating aesthetic treatments. Regarding the funding mechanism, the City Commission did not support the option of tolling the replacement bridge. The decision was influenced by the remaining useful life of the bridge coupled with the lack of short- or medium-term improvements to highways on the Missouri side of the bridge.

In August 2016, the KDOT Program Review Committee received an overview of the study process, findings, and stakeholder and community feedback. KDOT staff asked the Program Review Committee to provide direction on whether to pursue any legislative action regarding tolling as well as continuing any environmental documentation for the bridge replacement project. The Program Review Committee decided not to pursue legislative authorization for tolling or any environmental documentation at this time. The Program Review Committee did approve the technical engineering concepts of the Advanced Preliminary Engineering study.

With the approval of the general location of the replacement bridge immediately to the north of the existing bridge and associated network improvements, KDOT requests that the local entities having jurisdiction work cooperatively to ensure corridor preservation within and adjacent to the proposed right-of-way as defined through this Advanced Preliminary Engineering effort. Corridor preservation through the less-formal means of intergovernmental cooperation will assist in providing an environmentally-sound and cost-effective approach for avoiding and minimizing impacts when the transportation project is necessary and financially feasible.

Exhibit E.6 | Public Open House in Platte City, Missouri

Exhibit E.7 | Public Open House in Leavenworth, Kansas

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1 | INTRODUCTION

Through the Kansas Department of Transportation (KDOT) T-WORKS program, a local consultation process was developed to see regional input. The City of Leavenworth proposed that the replacement for the Centennial Bridge be developed with the investigation of tolling as a potential funding source, similar to the construction and financing of the Centennial Bridge in the 1950s. The project's overall score, based upon engineering, local consultation, and economic impact, resulted in the project's selection for Preliminary Engineering.

Consequently, KDOT is conducting this Advanced Preliminary Engineering and Tolling & Revenue study to replace the functionally obsolete Centennial Bridge (Bridge No. 92-52-18.48 (026)) over the Missouri River connecting Leavenworth County, Kansas and Platte County, Missouri. The Centennial Bridge marks the eastern endpoint of Kansas Highway K-92 and the western endpoint of Missouri Route 92. Opened in 1955, the Centennial Bridge over the Missouri River was initially a toll facility connecting the City of Leavenworth, Kansas and Platte County, Missouri. The bridge is jointly owned by the State of Kansas and State of Missouri.

ADVANCED PRELIMINARY ENGINEERING

The general purpose of the Advanced Preliminary Engineering is to provide a feasible solution for a replacement bridge including:

- Bridge type, size, and location
- Probable costs
- Potential funding mechanisms
- Preliminary environmental review

The Advanced Preliminary Engineering also has a Tolling & Revenue (Level 2) component to continue the exploration of potential tolling for the replacement bridge. The Level 2 analysis placed an emphasis on determining the appropriate revenue stream to offset associated construction costs as well as Operation & Maintenance (O&M) costs.

The overall study schedule for the Advanced Preliminary Engineering and the Tolling & Revenue (Level 2) components is displayed in Exhibit 1.1.

BRIDGE TYPE, SIZE, AND LOCATION

Determining the type, size, and location of the bridge, as well as its associated roadway approaches, affects the other study tasks. The process to determine the replacement bridge type, size, and location included a review of existing conditions, forecasting for future conditions, and a corridor screening and selection process to provide a recommendation for a feasible solution.

PROBABLE COSTS

A primary purpose of determining the replacement bridge characteristics is to reasonably understand probable costs for the project. The probable costs inform the Tolling & Revenue study and project programming.

POTENTIAL FUNDING MECHANISMS

A potential funding mechanism for the replacement bridge is tolling. A Tolling & Revenue study, which determines how much funding can be generated, is conducted at three levels of intensity:

1. A sketch-level study to determine if a project has enough merit to perform an in-depth study.
2. A mid-level, more refined study that includes location, type and cost analysis, and funding mechanisms.
3. An investment-grade level that develops a forecasting model necessary for lending institutions to fund a project.

Beyond the Tolling & Revenue analysis, there are institutional aspects associated with potential implementation of a tolling facility. For example: Who might be the Tolling Authority and how might the Tolling Authority operate the facility? These and other questions need to be acknowledged throughout the study to consider next steps and schedule should a potential implementation plan be advanced.

PRELIMINARY ENVIRONMENTAL REVIEW

While this report is not intended as a formal environmental document, it provides a preliminary assessment to identify future environmental steps and the appropriate timing of such actions. Consequently, the environmental process investigates and attempts to understand the various constraints or areas to avoid. If necessary, mitigation to specific impacts are identified. The level of necessary environmental documentation can influence the implementation schedule as well as project costs.

PUBLIC INVOLVEMENT

A comprehensive public involvement plan was developed for the Route 92 Centennial Bridge Study. The plan outlined specific activities yet was flexible and adaptable as the study progressed. Key public involvement activities included the development of project branding and informational materials, the formation and engagement of an Advisory Committee, and a series of Public Open Houses. At the beginning of the study, a project logo and communication guidelines were developed in order for materials to be recognized by the public.

ADVISORY COMMITTEE

A thirteen-member Advisory Committee, plus alternates, was formed at the beginning of the study to provide vital feedback regarding study concepts and materials. Key stakeholders were contacted by mail and by phone and invited to appoint a representative to the Advisory Committee. The KDOT project manager served as the Advisory Committee Chair.

Organizations initially invited to provide representation on the Advisory Committee are listed below. Organizations identified with an asterisk (*) chose to appoint a representative and/or alternate to the Advisory Committee.

Advisory Committee Organizations:

- Missouri Department of Transportation (MoDOT)*
- Kansas Turnpike Authority (KTA)*
- Mid-America Regional Council (MARC)*
- Platte County*
- Platte County Economic Development Council*
- City of Leavenworth*
- Leavenworth County
- Leavenworth WaterWorks*
- Leavenworth Parks & Recreation
- Leavenworth-Lansing Chamber of Commerce
- Leavenworth County Economic Development Corporation*
- Leavenworth Convention & Visitors Bureau
- Fort Leavenworth*
- Federal Bureau of Prisons
- Veterans Affairs Hospital
- Kansas Army National Guard - 35th Infantry Division*
- U.S. Coast Guard
- Local Bicycle-Pedestrian Groups*

The Advisory Committee served as a sounding board for proposed design concepts and as communication liaisons with their

respective constituencies. The Advisory Committee was engaged five times throughout the study to discuss the following topics:

1. Introduction and Existing Conditions (December 2014)
2. Initial Alternatives (April 2015)
3. Alternative Evaluation (October 2015)
4. Tolling & Revenue and Recommendations (February 2016)
5. Recommendations and Next Steps (August 2016)

Additional Advisory Committee materials such as meeting agendas, meeting summaries, handouts, presentations, and sign-in sheets are provided in the appendix. The appendix includes materials from all five Advisory Committee meetings held throughout the study.

Members of the study team also met with various stakeholders to present study information. Stakeholder meetings included representatives of County Commissioners, County Parks Departments, County Economic Development Corporations, the Mid-America Regional Council (MARC), regional bicycle/pedestrian committee, Kansas City International Airport, Fort Leavenworth, and the Federal Bureau of Prisons.

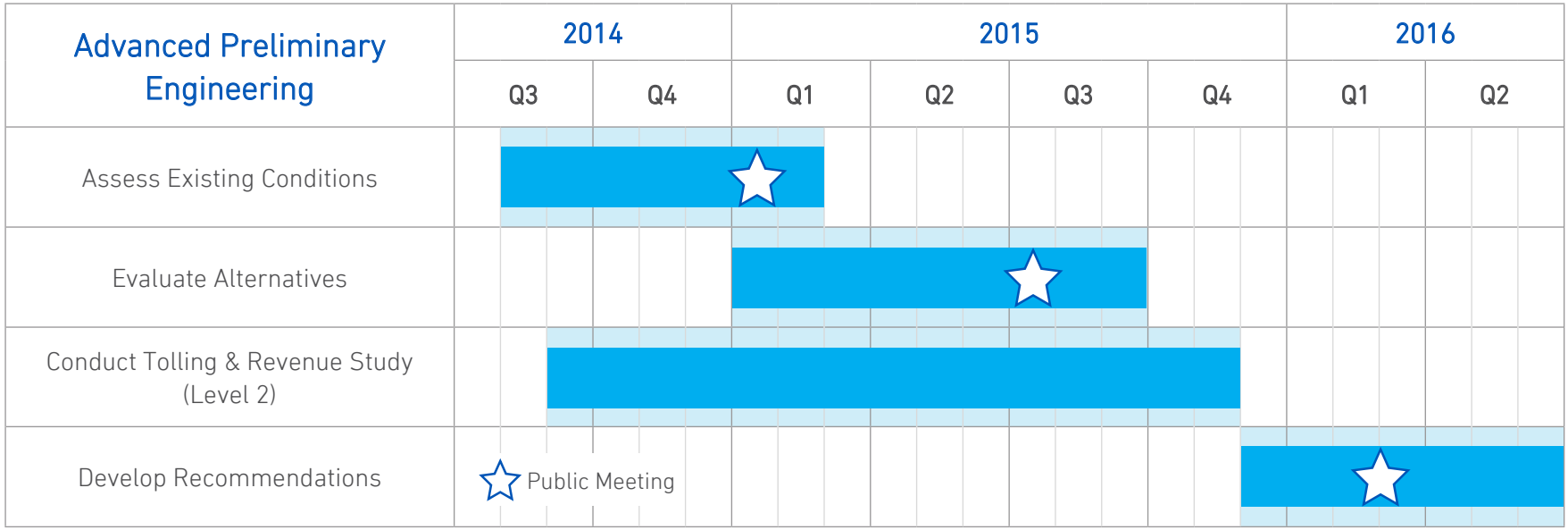
PUBLIC OPEN HOUSES

Six public meetings were held in open house format throughout the study to cover the following topics:

1. Existing Conditions (January 2015)
2. Alternatives (July 2015)
3. Recommendations (February 2016)

All meetings were held at the Platte County Community Center in Platte City, Missouri and the Riverfront Community Center in Leavenworth, Kansas. The Public Open House meetings were promoted through media outreach, social media outlets, KDOT website, electronic message boards, postcards mailed to nearby

Exhibit 1.1 | Study Schedule



property owners, and email invitations to a master stakeholder list. Public Open House meetings were also promoted by Advisory Committee members to their constituencies through their individual communication channels. The Public Open House meetings are outlined in the study schedule in Exhibit 1.1. Materials from all Public Open House meetings are included in the appendix.

PROJECT UPDATES

Project updates were provided in Spring 2015 and Fall 2015. The updates were distributed at Advisory Committee meetings and sent via Survey Monkey to individuals on the project's master stakeholder list. Project updates were also displayed on the KDOT website and shared through social media outlets. A project *Fact Sheet* was created, periodically updated, and made available at Advisory Committee meetings and Public Open House meetings as well as available on the KDOT website. Local media outlets were invited to attend all Public Open House meetings. These supporting materials, including exhibit boards and attendee feedback forms, are included in the appendix.

STUDY CONTEXT

HISTORIC CONTEXT

The history of any community, particularly an established community like the City of Leavenworth, is tied to the transportation network, including river traffic, railroads, and vehicles. The establishment of Fort Leavenworth (1827), the City of Leavenworth (1855), and the crossing of the Missouri River are intrinsically linked.

Exhibit 1.2 displays the general layout of Route 92 in Kansas and Missouri in 1953. The map illustrates the meandering path of Route 92 into and through Fort Leavenworth along Grant Avenue. The map also illustrates the extensive highway realignment for Route 92 (3.3 miles) and the addition of Spur 45 (2.3 miles).

Funding for the bridge was provided by KDOT and MoDOT while the City of Leavenworth Tolling Authority constructed and maintained the highway network in Missouri until 1977. The bi-directional toll booth was located between 4th Street (Sherman Avenue) and 2nd Street.

PROJECT CONTEXT

The study area for the project places emphasis on three boundaries as displayed in Exhibit 1.3. The first boundary (A) is the immediate area around the existing bridge used to establish existing physical and operational conditions. The second boundary (B) is a larger environmental screening area used to develop and assess other potential bridge crossings. The third and largest boundary (C) encompasses the regional transportation network generally in Leavenworth and Wyandotte Counties in Kansas and Platte County in Missouri.

This Advanced Preliminary Engineering and Tolling & Revenue (Level 2) study is a potential transition document to next steps. These next steps have uncertainty based upon elements outside the project's control; therefore, the steps must remain flexible. At this time, construction of the replacement bridge is not funded. However, for assessment purposes, an earliest opening date of 2022 has been used to evaluate financial feasibility. However, during the course of the study and in discussion with project funding availability and bridge condition, an alternate schedule began to emerge that could push implementation further into the future. The alternate schedule will be further discussed in Chapter 6.

Exhibit 1.2 | Relocated Route 92 in 1953

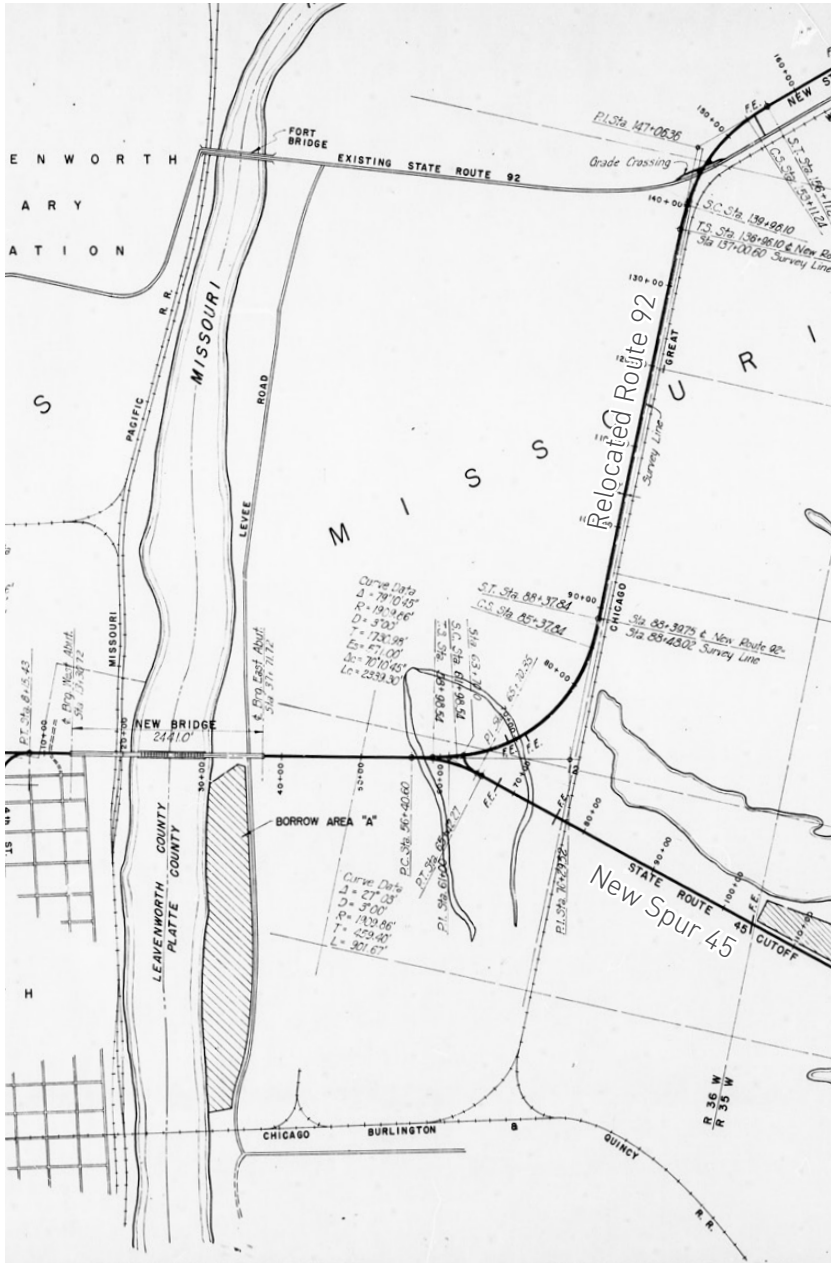
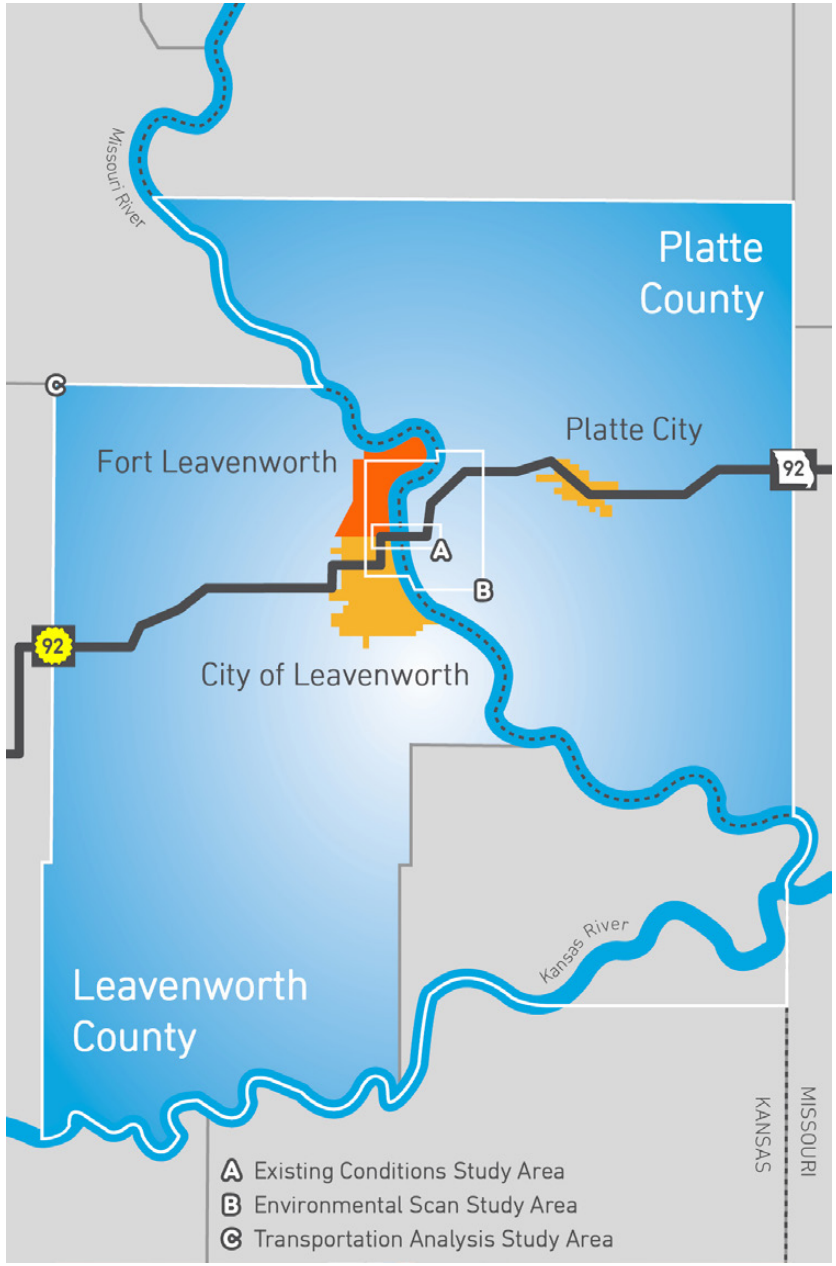


Exhibit 1.3 | Study Area



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2 | EXISTING CONDITIONS

The Existing Conditions phase examined the following elements:

- Multimodal transportation network
- Traffic characteristics
- Bridge conditions
- Environmental scan

Public input associated with the Existing Conditions phase was documented from Advisory Committee Meeting #1 and Public Open House #1.

MULTIMODAL TRANSPORTATION NETWORK

The transportation network is discussed within the study area that encompasses key highways within the travel demand model area with a focus on the existing Centennial Bridge and its roadway approaches. The documentation of existing conditions provides insights into the transportation network and its traffic patterns, which is important when considering competitive routes under future conditions as well as potential diversion associated with the option for tolling. The regional trail network, particularly its connectivity and concepts for expansion, are also explored.

HIGHWAY NETWORK

The existing Centennial Bridge is designated as Route 92. Route 92 is an east-west highway classified as a secondary arterial. In Kansas, Route 92 begins at K-4 south of Rock Creek in Jefferson County. The highway continues easterly through Oskaloosa, crosses US-59, and combines with K-16 for a portion until McLouth where K-92 turns north. K-92 enters Leavenworth County from 118th Street through Springdale before entering the City of Leavenworth on Spruce Street. At 4th Street, also designated US-73 and K-7, K-92 turns northerly continuing to Metropolitan Avenue before heading easterly across the Missouri River.

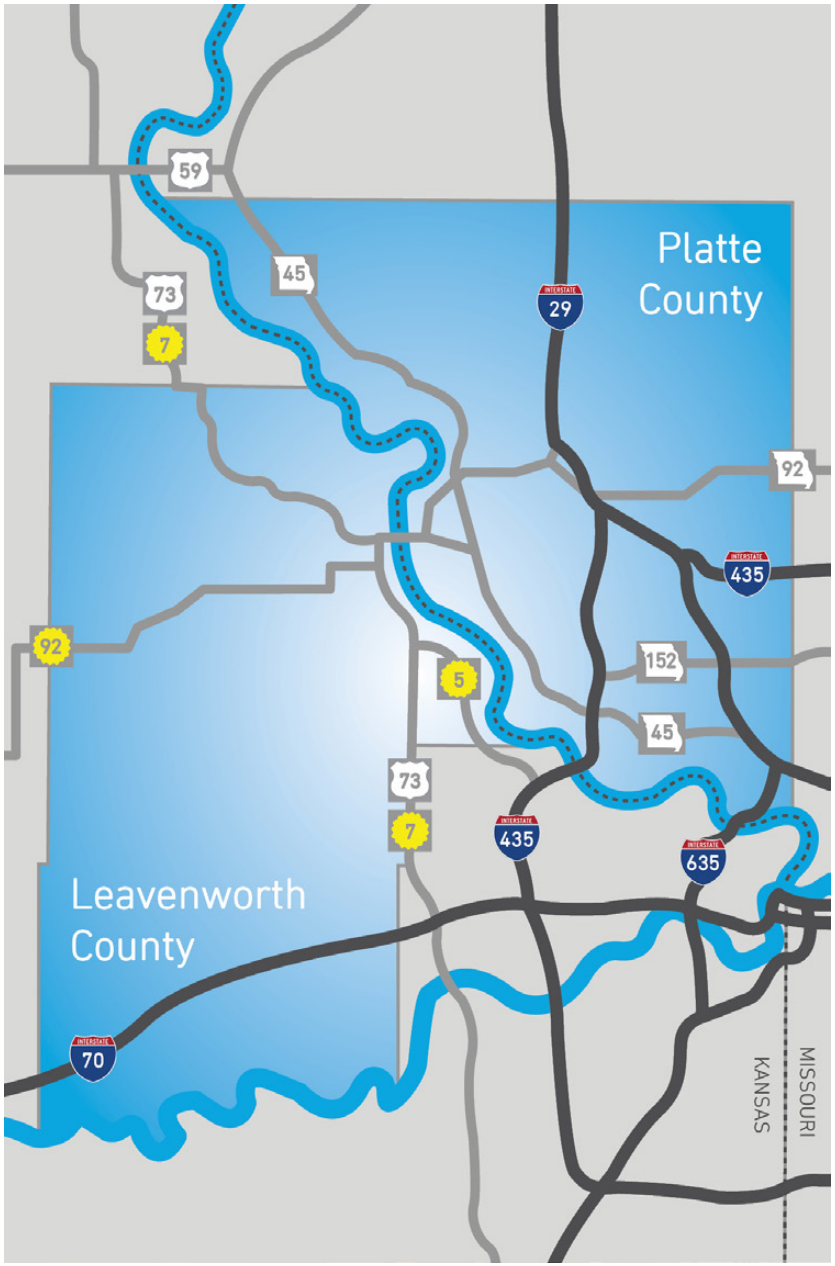
In Platte County, Missouri, immediately after crossing the Missouri River, Route 92 turns northerly yet continues easterly through Beverly before heading southeasterly through Platte City. After an interchange with I-29, Route 92 continues easterly into Clay County crossing US-169 south of Smithville. The highway continues easterly with an interchange at I-35 near Kearney. Route 92 crosses Route 33 in Kearney and continues easterly until ending at US-69 north of Excelsior Springs.

While Route 92 is a continuous route for nearly 68 miles, traffic characteristics indicate that intersecting arterials and Interstates strongly influence the patterns of east-west traffic movement. For purposes of this study, Route 92 is studied within Leavenworth County and Platte County, as displayed in Exhibit 2.1. Other regional highways of significance are also described below.

US-73 / K-7

Within the study area, the US-73 and K-7 highway carry a dual designation. This highway connects Atchison to the north in Atchison County to Bonner Springs in Wyandotte County. From US-59 in Atchison, the US-73/K-7 highway is a two-lane facility until entering the City of Leavenworth near 20th Street at the western edge of Fort Leavenworth. From this point south, within the study area limits, the US-73/K-7 roadway is a four-lane facility. The US-73/K-7 corridor is also designated as a strategic

Exhibit 2.1 | Highway Network



military highway leading to major military installations on the Strategic Highway Network (STRAHNET) to I-70. Therefore, the portion of Route 92 in Kansas that is combined with US-73 is a STRAHNET connector. However, Route 92 in Missouri west of I-29 is not on the STRAHNET network.

K-5

K-5 begins at the signalized junction of US-73/K-7 (Muncie Road) and continues southeasterly for nearly ten miles through Wolcott. K-5 has an interchange with I-435 near the Missouri River. K-5 then shares designation with I-435 until continuing easterly along Leavenworth Road.

Route 273

While Route 92 turns south at Tracy to enter into Platte City, Route 273 travels northeasterly and has an interchange with I-29. This path provides direct access to I-29 in both the north and south directions. It is generally quicker to use Route 273 to access I-29 rather than travel along Route 92 through Platte City due to the several traffic signals and lower posted speed limits.

Route 45 / Route273 (North) and Route 45

Route 45 combines with Route 273 and US-59 in Buchanan County at the Missouri River crossing from Atchison. Route 45/Route 273 continues southerly along the east side of the Missouri River through Iatan and Weston. Route 45 splits from Route 273 passing through Beverly (beneath the grade separation of Route 92) and continues through Farley. Route 45 has an interchange with I-435 near the Missouri River. Route 45 continues easterly crossing Route K and Route 9 before ending with an interchange at I-29.

Spur 45

Spur 45 is a one-mile, two-lane highway built in the mid-1950's as part of the Centennial Bridge construction, which required relocation of Route 92.

Other Local Roadways

Other local roadways of east-west importance include Humphreys Access Road and Jones-Meyer Road. Both roadways are two-lane local county roadways. Humphreys Access Road crosses Route N and provides access into southern Platte City. East of Route N, the corridor becomes 136th Street before turning into Prairie View Road, a frontage road paralleling I-29. Prairie View Road terminates at Mexico City Avenue with its interchange at I-29. Jones-Meyer Road connects Route 45 to I-435 via Route N. While a curvy and hilly roadway, Jones-Meyer Road is a locally popular way to access Route 152 and other major arterials.

REGIONAL TRAIL NETWORK

The transportation network encompasses more than vehicular travel. Consequently, consideration is given to the non-motorized elements of bicycle and pedestrian transportation. The existing Centennial Bridge does not provide a dedicated means of travel for either bicyclists or pedestrians. However, it is recognized that both pedestrians and bicyclists currently use the bridge. This discussion of existing conditions focuses upon nearby available bicycle and pedestrian facilities and amenities as well as review of regional trail plans and their proposed network within the study area.

Existing Facilities and Amenities

Along the Kansas side of the Centennial Bridge, there are sidewalks on both sides of Metropolitan Avenue that begin at 4th Street and continue westerly to 20th Street and Sportsman Field. The nearest existing trail to the Centennial Bridge in the City of Leavenworth is along the Esplanade Street and Riverfront Park. Riverfront Park passes beneath the Centennial Bridge. Access to Riverfront Park requires crossing two track of the Union Pacific Railroad. The trail also passes through Bob Dougherty Memorial Park south of Dakota Street. Continuous sidewalks are provided along Dakota Street and 4th Street to Metropolitan Avenue.

Along the Missouri side of the Centennial Bridge, there are no immediately adjacent designated bicycle or pedestrian facilities. Platte County along Route 92 and Spur 45 are rural with adjacent farmland uses and gravel roads. The nearest designated non-motorized facility is the Weston Bluffs Trail in Weston Bend State Park to the north of Beverly. A trailhead and parking area for the Weston Bluffs Trail is provided on Bluff Road.

With the recent reconstruction of the Route 45 bridge over the Platte River south of Farley, wider shoulders and a *Share the Road* sign are provided. The recent reconstruction of the Route 92 bridge over Route 45 and the BNSF Railway is not signed as a bicycle-friendly facility as it does not provide the necessary railing protection for bicyclists.

Regional Trail Plans

Platte County Parks Department prepared a *Park System Master Plan* in May 2009. The plan, which is funded through a dedicated sales tax in Platte County, identifies a 2.5-mile extension of the Weston Bluffs Trail to connect the south trailhead to the Centennial Bridge. This includes a portion of the Platte County Levee route along the Missouri River. The distance along the levee from the south trailhead to the underside of the Centennial Bridge is approximately 3.9 miles. The distance along Route 92 to the trailhead on Bluff Road is approximately 4.2 miles.

The City of Leavenworth *City-Wide Trail Plan* identifies the multi-use Riverfront Trail connecting to Riverfront Park and includes a small trailhead. The existing Riverfront Trail, city sidewalks along Metropolitan Avenue, and the proposed Platte County trail connection to the existing south trailhead at Weston Bend State Park are shown in Exhibit 2.2.

MARC issued and adopted a *Regional Trail and Bikeway Plan* in January 2015. The plan identifies the Centennial Bridge as part

Exhibit 2.2 | Regional Trail Network

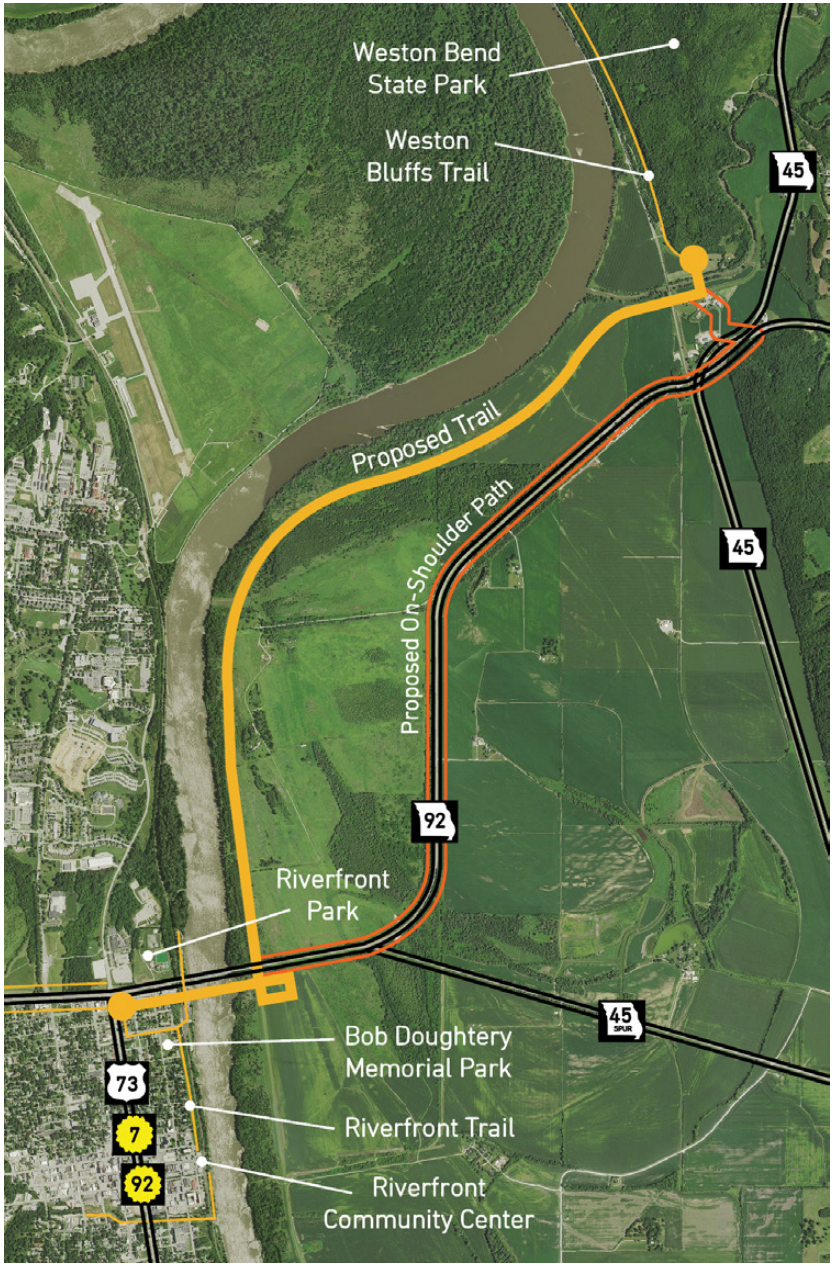


Exhibit 2.2 | Weston Bluff Trail in Weston Bend State Park

Exhibit 2.2 | Riverfront Trail in Riverfront Park

of the Lewis and Clark National Route. A component of the plan was to collect data on trail usage. MARC conducted counts along the trail in Riverfront Park south of the railroad crossing near Cherokee Street from May 2015 through July 2015. The data indicates a daily, weekly, and monthly variation. The mathematical average of daily trips is 189 trips with a range from a low of 57 trips to a high of 381 trips. Based upon the data collected and adjustment factors for season and weather, MARC estimated nearly 70,000 annual trips.

TRAFFIC CHARACTERISTICS

Traffic data was collected to support a variety of needs ranging from calibration of the travel demand model to capacity analysis on existing facilities. Historic traffic volumes are discussed in a later chapter when developing future conditions.

TRAFFIC VOLUMES

This section focuses upon the traffic volumes along and adjacent to the existing Centennial Bridge. Traffic counts were conducted at more than a dozen locations. The specific locations and data collected are shown in the appendix.

A major traffic generator in the study area is Fort Leavenworth. The Fort, as a military base with controlled access, has three access points (referred to as gates): Hancock Gate, Grant Gate, and Sherman Gate. Through the course of the study, the Fort altered its operations at Sherman Gate in February 2015. With the change in operations, additional traffic counts were collected to account for the change in traffic patterns. Metropolitan Avenue was also reconstructed from May 2015 to December 2015.

Based on the location determined for the replacement Centennial Bridge, traffic patterns on either side of the bridge may change. On the Kansas side, the signalized intersection of Metropolitan Avenue (west), 4th Street (south), and Sherman Avenue (north) distributes traffic in different directions. On the Missouri side, the unsignalized intersection of Route 92 and Spur 45 distributes traffic northerly and southerly. A discussion of traffic volumes, peaking characteristics, and travel patterns helps identify the potential effects of shifting the replacement bridge north or south of its existing location. Traffic volume characteristics are displayed in Exhibit 2.3, Exhibit 2.4, Exhibit 2.5, and Exhibit 2.6.

Metropolitan Avenue

Traffic volumes along Metropolitan Avenue are directly affected by turning movements at the signalized intersections of 4th Street and 7th Street. The Fort has a major influence upon traffic volumes on Metropolitan Avenue. In the AM peak period, 4th Street (US-73/K-7/K-92) has a heavy northbound left-turn movement and a reverse pattern (eastbound right-turn movement) in the PM peak period.

Centennial Bridge

Traffic counts conducted on three occasions indicate that the Centennial Bridge carries approximately 14,000 vehicles per day. The peaking characteristics are pronounced with the AM and PM peak hours representing 10 percent of the daily traffic volume. When considering directional traffic volumes, westbound traffic toward the City of Leavenworth is predominant in the morning (75%) while eastbound traffic toward Platte County is predominant in the evening (76%). Daily traffic variations were also observed throughout the week. Traffic volumes on Saturday and Sunday are generally lower than weekday volumes.

Route 92 and Spur 45

Traffic volumes east of the Route 92 and Spur 45 junction are additive, as the surrounding rural land uses do not generate significant traffic before the junction of Route 45. These highways also exhibit similar peaking and directional characteristics to those observed on the Centennial Bridge.

Exhibit 2.3 | Average Daily Vehicles Per Hour on Bridge

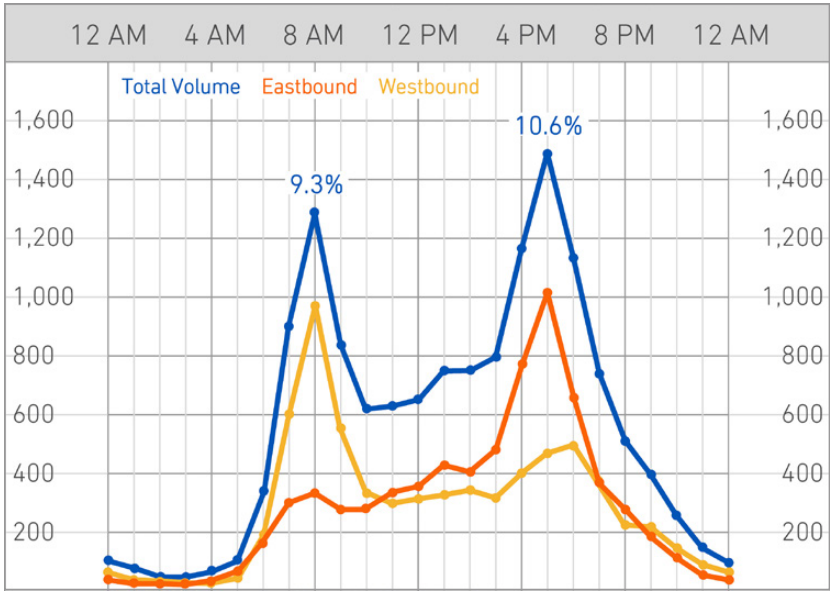


Exhibit 2.4 | Average Daily Vehicles Per Day on Bridge

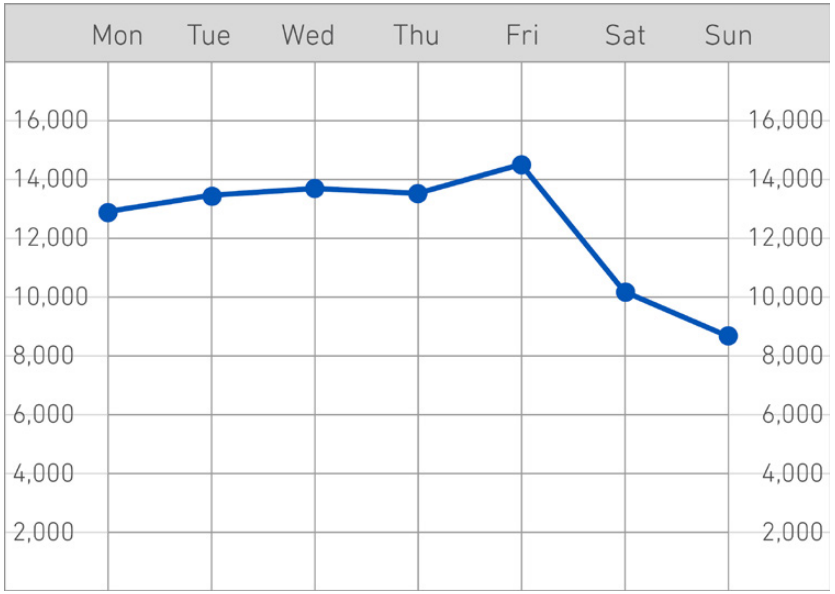


Exhibit 2.5 | Average Daily Weekday Traffic

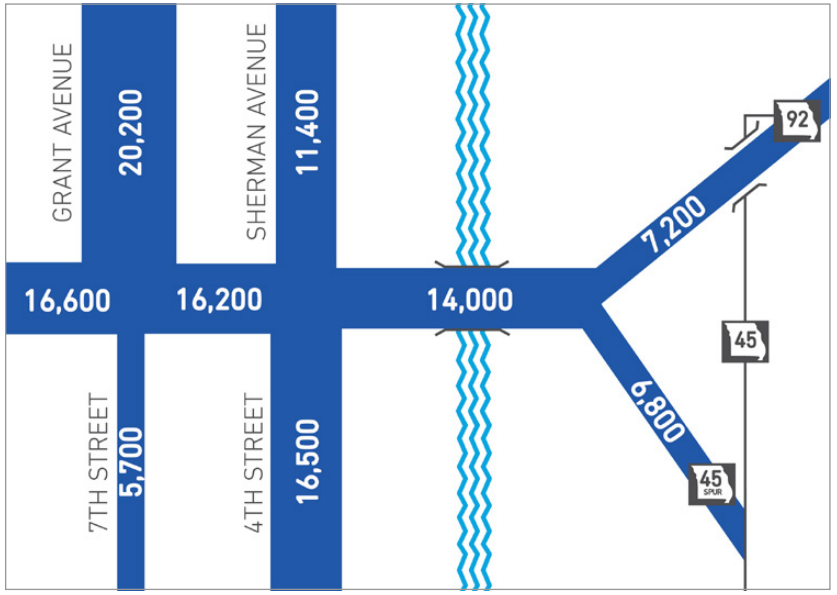
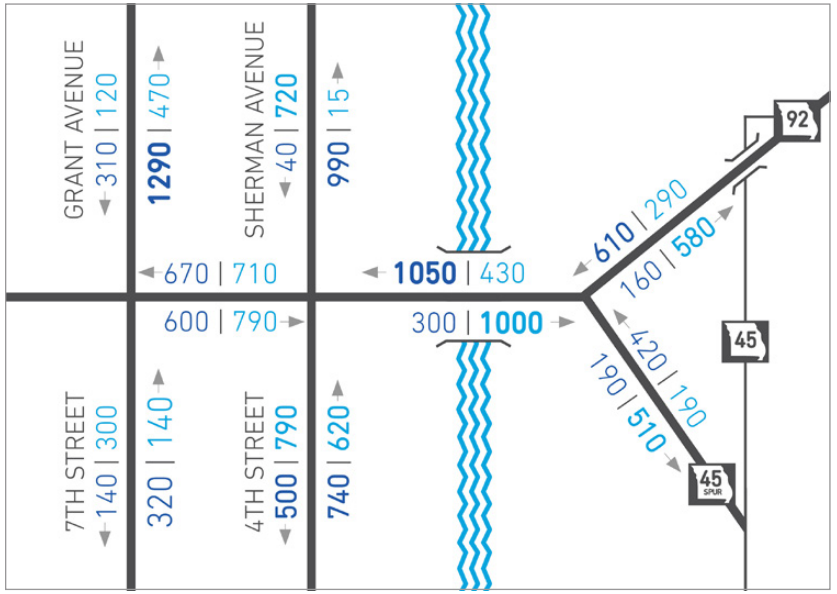


Exhibit 2.6 | Peak Hour Directional Traffic



TRAFFIC CONTROL DEVICES

In Kansas, Metropolitan Avenue is a four-lane arterial with exclusive turn lanes. Major intersections at 7th Street and 4th Street are signalized intersections.

In Missouri, Route 92 and Spur 45 are both rural highways. Both segments are two-lane highways with minimal shoulders and passing opportunities. The junction of Route 92 and Spur 45 is an unsignalized intersection with a stop sign on Spur 45. The junction of Spur 45 and Route 45 is also an unsignalized intersection with a stop sign on Spur 45.

Traffic control devices and lane configurations are displayed in Exhibits 2.7 and Exhibit 2.8, respectively.

ROADWAY AND INTERSECTION CAPACITY

The capacity of the transportation network was assessed for both segments and intersections. Each type of traffic operation was assessed by a level of service (LOS) ranging from free flow (LOS A) to stop-and-go traffic (LOS F). Calculations of the varying levels of service and their corresponding values, either by delay in seconds or volume-to-capacity ratios, are provided in the appendix.

Highway Segments

In Missouri, the rural highway segments control the capacity of the roadway network. Peak hour LOS was assessed for three segments that vary by volume as well as the percentage of passing zones. The segments are:

- Route 92 from Centennial Bridge to Spur 45 (25% no-passing)
- Route 92 from Spur 45 to Route 45 (50% no-passing)
- Spur 45 from Route 92 to Route 45 (20% no passing)

The AM and PM peak hour LOS for each roadway segment is displayed in Exhibit 2.9. The segment of Metropolitan Avenue was too short to assess as an arterial segment.

Signalized Intersections

The two signalized intersections along Metropolitan Avenue, 4th Street, and 7th Street, operate as isolated intersections. Observations indicate the movement from Grant Gate's southbound left to Metropolitan Avenue's eastbound through and right-turn movement is coordinated in the PM period. Capacity analysis takes this coordinated movement into account.

Where applicable, free-flowing movements not under signal control were run as a free right-turn. Capacity can be expressed as either a total intersection operation, by approaches, or by movement. This section of the report presents the overall intersection LOS. Additional information on more detailed capacity analysis can be found in the appendix.

The signal system is a series of phases with some overlaps and split phases, typically for the northbound and southbound movements, to allow for dual use of a combined through and left-turn lane. The signal cycle lengths can reach as long as 120 seconds. Consequently, some approaches and movements can experience lengthy delays although the overall intersection balances delays.

The AM and PM peak hour LOS for each signalized intersection is discussed below and displayed in Exhibit 2.10.

Metropolitan Avenue and 4th Street (Sherman Gate): Peak period traffic counts were initially conducted in October 2014 when the Sherman Gate was open throughout the day for both entry and exit. With the change in gate operations at the Sherman Gate in February 2015, peak hour traffic volumes were recounted in April 2015. Sherman Gate currently only allows exiting traffic from the Fort from 3:30 PM to 6:00 PM. Based on the change in traffic patterns, the overall intersection capacity at this intersection is LOS C in the AM peak and LOS D in the PM peak.

Exhibit 2.7 | Traffic Control Devices

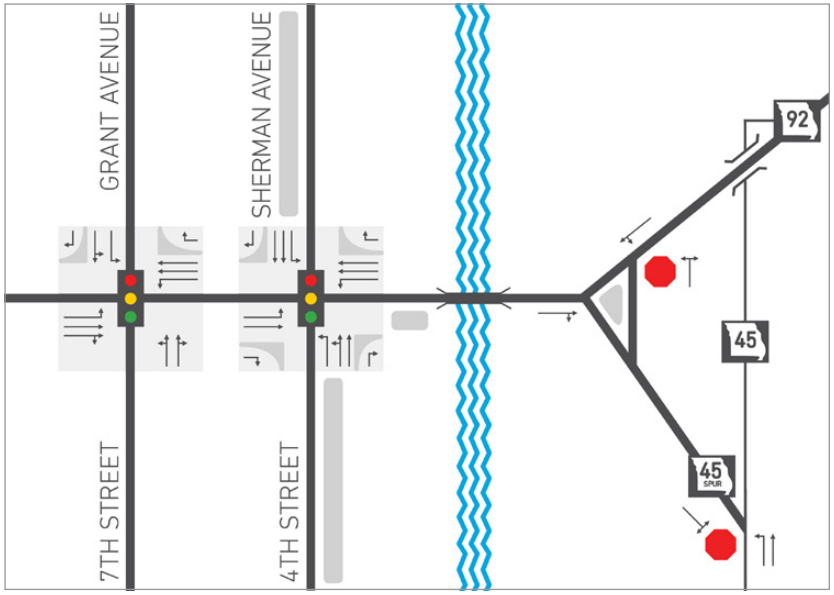


Exhibit 2.8 | Lane Configuration

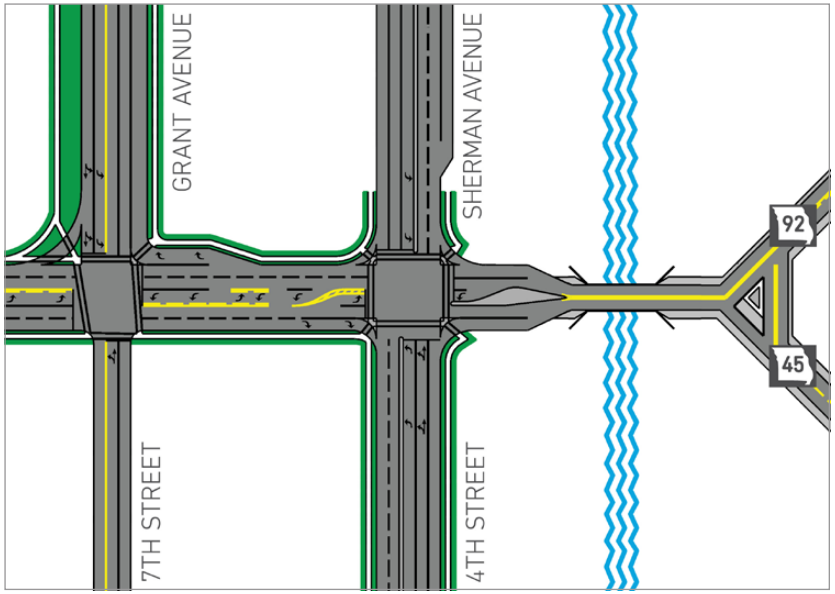


Exhibit 2.9 | Roadway Level of Service

Roadway		AM Peak Hour	PM Peak Hour
92	Between Bridge and Spur 45	E	E
92	Between Spur 45 and Route 45	D	D
45 SPUR	Between Route 45 and Route 92	C	D

Exhibit 2.10 | Intersection Level of Service

Intersection		AM Peak Hour	PM Peak Hour
	Metropolitan Avenue and 4th Street	C	D
	Metropolitan Avenue and 7th Street	C	D
STOP	Route 92 and Spur 45	F	E
WB	Route 92 and Spur 45	A	A

Metropolitan Avenue and 7th Street (Grant Gate): Overall intersection capacity at this intersection is LOS C in the AM peak and LOS D in the PM peak. With the change in traffic patterns at the Sherman Gate, the Grant Gate in the morning now has significantly more traffic entering the gate. Observations of driver behavior indicated that the exclusive westbound right-turn lane into the Grant Gate is at capacity as drivers treat the channelizing island with yield control. Observations also noted that the queue in the right-turn lane on westbound Metropolitan Avenue extended beyond the lane length and spilled over into the westbound through lane. If the channelizing island were treated as a free flowing movement, then the capacity analysis would improve.

Unsignalized Intersections

The unsignalized intersections of Route 92 and Spur 45 as well as Spur 45 and Route 45 operate as isolated intersections. For unsignalized intersections, the major movement is assumed to operate at LOS A. Only side street movements and main line turning movements are assessed. As three-legged intersections, only two main line turning movements occur.

The AM and PM peak hour LOS for each unsignalized intersection is discussed below and displayed in Exhibit 2.10.

Route 92 and Spur 45: Route 92 is the major movement at the Spur 45 junction. The Route 92 eastbound right-turn has a large channelizing island which effectively removes this movement from capacity analysis. The Spur 45 westbound approach operates LOS F during the AM peak hour and LOS E during the PM peak hour. As a result, the Spur 45 westbound approach experiences significant delays at the intersection and often results in extensive queues, particularly in the AM period. The Route 92 westbound left-turn movement was also assessed. This movement operates at a LOS A during both AM and PM peak hours due to the low traffic volume on this movement.

Spur 45 and Route 45: Route 45 is physically the through travel way at the intersection with Spur 45; however, from a volume perspective, Spur 45 and the south leg of Route 45 comprise the major movements. This intersection is further complicated by the BNSF Railway crossing of Spur 45. The BNSF rail corridor is heavily traveled with up to 36 trains per day. The trains are typically unit trains (1.0 to 1.5 miles long) that carry coal. While the speed of the track is listed at 60 mph, a siding track just south of Spur 45 can reduce travel speeds when the siding is used. Consequently, traffic crossing Spur 45 can often be delayed while a train passes. Overall intersection capacity at Spur 45 and Route 45 is LOS C in both the AM and PM peak hours.

SAFETY

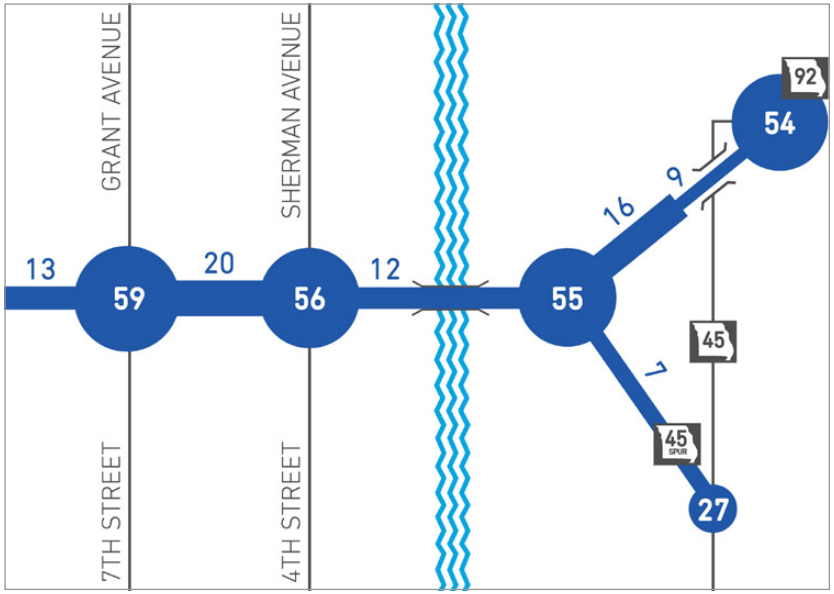
The safety assessment of the highway segments and intersections discussed above included accident data from a five-year period from 2008 to 2013. The safety assessment calculated rates to compare to statewide averages of similar types of roadways as well as the percentage of injury accidents and the most common types of accidents. The accidents are discussed at a macro-level for the transportation network as well as at a micro-level for individual intersections.

At the macro-level, there were more than 300 accidents over the five-year period. Trends over the five-year period are relatively stable with the number of accidents ranging between 50 to 70 accidents per year. Accidents along Route 92 decreased in 2008, which may have been associated with the construction and closure of the Route 92 bridge over Route 45 and the BNSF Railway. The majority of accidents occur at intersections. The most common type of accidents vary by location but include angle (side impact), rear end, and animal collisions. The overall injury percentage is greater than 20 percent. The calculated accident rate is less than average for the Kansas roadways while greater than the statewide average for Missouri roadways.

Exhibit 2.11 | Accident Summary by Segment

Characteristic	Metropolitan Ave	Route 92
Average Annual Accidents (2009 - 2013)	20 accidents	21 accidents
Intersection and Related Accidents	81%	72%
#1 Accident Type	Angle: Side Impact	Rear End
#2 Accident Type	Rear End	Deer
Top 2 Accident Types Account for:	70%	55%
Injury Rate	24% Less than state average	21% More than state average

Exhibit 2.12 | Accident Location by Segment/Intersection



At the micro-level of highway segment and intersection safety evaluation, the signalized intersections along Metropolitan Avenue exhibit the typical pattern with a propensity of rear-end accidents and a relatively low injury rate. The unsignalized intersection of Route 92 and Spur 45 has a high injury rate, which can be associated with higher speeds along Route 92.

Accident information by highway segment is summarized in Exhibit 2.11. Accident location by highway segment and intersection is displayed in Exhibit 2.12

BRIDGE CONDITIONS

The existing Centennial Bridge consists of three units with an overall length of 2,446.5 feet. The Kansas (west) approach is 732.5 feet and Missouri (east) approach is 865 feet. See the appendix for the *General Plan and Elevation* sheet for the existing bridge.

The existing foundations for the approaches are generally supported by steel piling driven to a sandstone layer. The main span piers are supported by caissons founded on either a limestone or shale formation. The superstructure for the west and east approaches are comprised of a concrete deck supported by steel plate girders, stringers, and floor beams. The main spans consist of two spans totaling 840 feet and are classified as a through steel arch bridge. The 26-foot wide roadway carries two lanes of traffic, one in each direction, with 2.5-foot wide curb and 1.08-foot wide barrier. The complete width of the bridge is 33.17 feet. The overhead vertical clearance of the arch is 18.58 feet. Due to the geometrics of the roadway, the existing bridge has been deemed functionally obsolete.

Several abandoned and active utilities are attached to the existing bridge. Two gas lines have been abandoned (formerly Williams Natural Gas) and replaced by deep bore gas lines beneath the Missouri River (constructed by Southern Star) north of the

existing bridge. There are also active electrical conduits for the navigational lighting and two active 3-inch telephone conduits are affixed to the bridge. The Union Pacific Railroad passes beneath Unit 2 between existing Bents 6 and Bent 7 on the west approach.

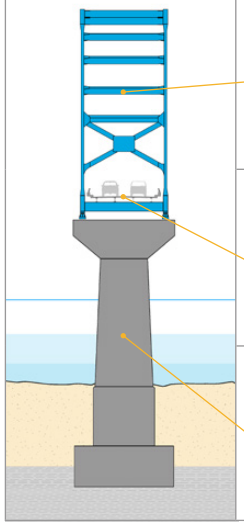
BRIDGE RATINGS

The biennial inspections and the rating of the existing bridge is the responsibility of KDOT. The most recent bridge inspection and condition rating occurred in 2015. According to the *National Bridge Inspection Standards*, condition ratings are used to describe an existing bridge condition compared with its condition if it were new. The ratings are based on materials, physical condition of the deck (driving surface), superstructure (supports immediately beneath the driving surface), and substructures (foundation and supporting posts and piers). The general condition ratings range from the a numerical value of 0 (bridge closed) to the a numerical value of 9 (superior to present desirable criteria).

Federal guidelines define a bridge as structurally deficient if certain key components (superstructure, substructure, or deck) are rated a numerical value of 4 (meets minimum tolerable limits to be left in place as is) or lower. Structurally deficient means that the condition of the bridge includes a significant defect, which often means that speed or weight limits must be put on the bridge to ensure safety. Deficient bridges require significant maintenance, rehabilitation, or replacement.

The existing Centennial Bridge is not classified as structurally deficient as all of the key components of the bridge are rated above a 4. The ratings of the components of the Centennial Bridge from the *2015 Kansas Bridge Inspection Form* are summarized in Exhibit 2.13. The improvement in the rating between 2011 and 2015 is attributed to a major rehabilitation project that occurred in 2011. One major aspect of the multi-million dollar rehabilitation project was concrete surface repair to the visibly

Exhibit 2.13 | Historical Bridge Inspection Ratings

Bridge Component		2015	2014	2013	2012	2011
	Superstructure	6 Satisfactory Condition	6 Satisfactory Condition	6 Satisfactory Condition	6 Satisfactory Condition	6 Satisfactory Condition
	Deck	7 Good Condition	7 Good Condition	7 Good Condition	7 Good Condition	7 Good Condition
	Substructure	7 Good Condition	7 Good Condition	7 Good Condition	5 Fair Condition	5 Fair Condition

deteriorated piers and pier caps. The rehabilitation of concrete piers dramatically improved the condition of these elements and is reflected in the improved rating.

Another contributing factor to the rating of the existing Centennial Bridge is the migration of the element level data to a new rating system. In 2013, the American Association of State Highway and Transportation Officials (AASHTO) adopted the *National Bridge Elements,* which maintained the primary structure of the *Commonly Recognized Elements* but changed inspection criteria for significant elements such as bridge decks and structural steel elements. With the passage of *Moving Ahead for Progress in the 21st Century Act (MAP-21)* in 2012, states are required to submit element level bridge data to the Federal Highway Administration (FHWA) annually for bridges on the National Highway System along with the information for the *National Bridge Inspection Standards.* FHWA has chosen to adopt the *National Bridge Elements* standard for data submission. In response, KDOT no longer uses the *Commonly Recognized Elements* but rather the new *National Bridge Elements* standards.

The existing Centennial Bridge is identified as fracture critical. A fracture critical bridge has a steel member in tension, or with a tension element, whose failure would likely cause a portion of or the entire bridge to collapse. Fracture critical bridges lack redundancy, which means that in the event of a failure there is no path for the transfer of the load being supported by that steel member to hold up the bridge. Therefore, failure occurs rapidly.

Designed and constructed in the 1950s, the existing Centennial Bridge is characterized as functionally obsolete. A functionally obsolete bridge is one that was built to standards that are not used today. These bridges are not automatically rated as structurally deficient nor are they inherently unsafe. Functionally obsolete bridges are those that do not have adequate lane widths, shoulder widths, or vertical clearances to serve current traffic demand or those that may be occasionally flooded.

Sufficiency ratings were developed by FHWA to serve as a prioritization tool to allocate funds for major rehabilitation or replacement. The rating varies from 0 percent (poor) to 100 percent (very good). The formula not only considers structural adequacy but functional obsolescence and level of service provided to the public as well. The 2015 sufficiency rating of the existing Centennial Bridge was 56.6 percent.

The 2015 sufficiency rating can be improved, but most likely only by small increments as the functional obsolescence is the major contributing factor to the lower sufficiency rating. It would be challenging and costly to improve the structure width constraints in a practical manner because the through truss configuration precludes the deck widening. The main span is 26'-0" curb-to-curb roadway width. As such, the appraisal of the deck geometry has a numerical value of 3 (basically intolerable requiring high priority of corrective action).

It is possible to widen to the outside of a through truss with structural brackets; this is occasionally done to add pedestrian walkways to a truss structure. However, there is a corresponding increase in weight due to the steel brackets and live load on the brackets. Widening the superstructure would potentially reduce the load carrying capacity and likely not improve roadway geometrics. Similarly, conversion of the existing bridge to either westbound or eastbound movement for two lanes of traffic does not address the issue of shoulder widths.

SERVICE LIFE

As the existing Centennial Bridge ages, there is generally an increase in long-term maintenance and repairs, particularly due to steel deterioration. However, based on the current

condition of the bridge, there is no need for immediate significant expenditures for maintenance or rehabilitation. The existing bridge will continue to be considered functionally obsolete due to the roadway geometric constraints.

A condition rating of 4 qualifies a structure as structurally deficient. The existing deck and substructure has a condition rating of 7 (better than present minimum criteria). The superstructure condition rating is 6 (equal to present minimum criteria). As the existing Centennial Bridge is not structurally deficient and funding for a replacement structure may be programmed in the future, expenditures for on-going maintenance and major repairs would be minimal to maintain the bridge for traffic.

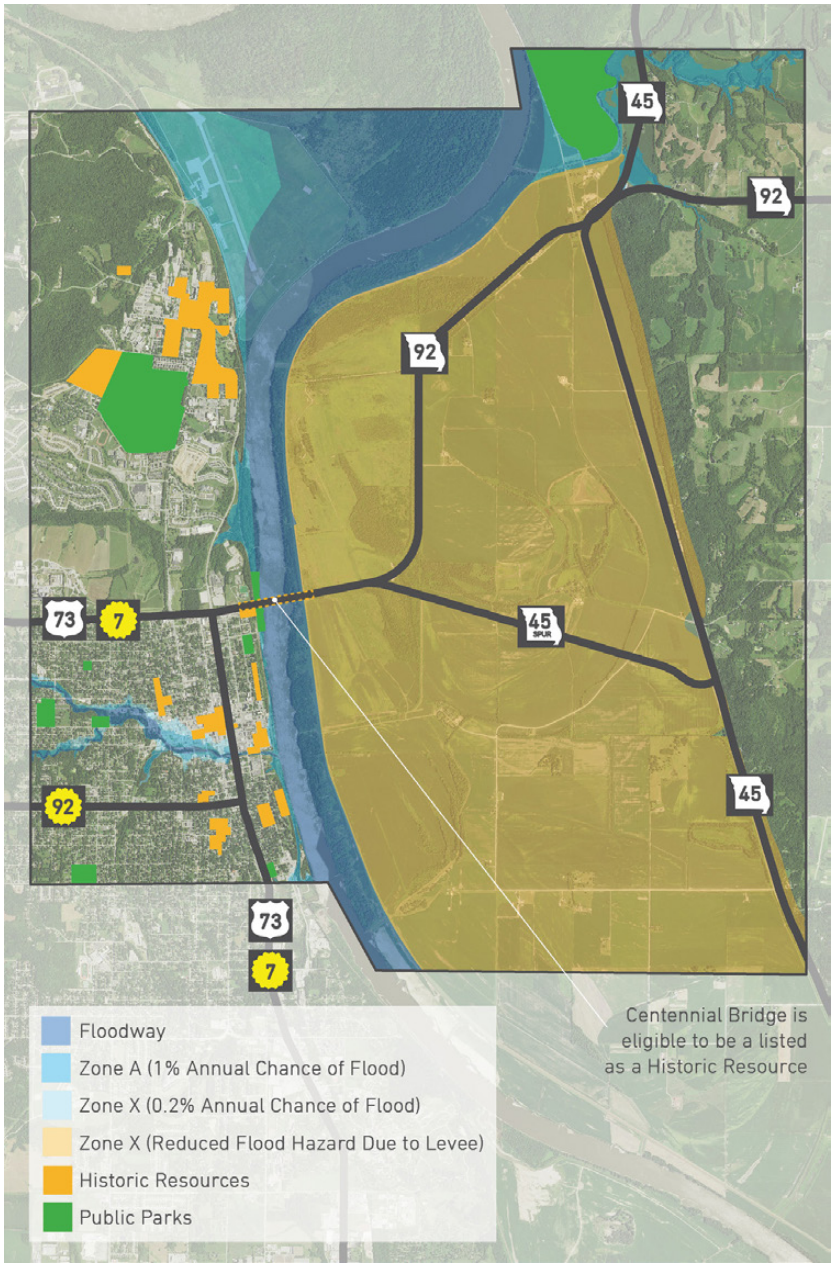
A major rehabilitation project was performed on this structure in 2011 at a cost of $3 million (2011 dollars). The rehabilitation project included pier rehabilitation, replacement of bearings, replacement of the expansion joints, drainage improvements, and electrical repairs for navigational lighting. Excluding the major rehabilitations, KDOT has spent an average of $3,880 per year (FY 2016 dollars) between 1996 and 2015 on the bridge for maintenance and various repairs. Exhibit 2.14 summarizes the cost of the previous major rehabilitation projects.

KDOT anticipates typical repairs to the deck and strip seal expansion joints over the next ten to fifteen years, and there are no foreseeable needs for major rehabilitation of the Centennial Bridge within the next ten to fifteen years. It should be noted that due to the sensitive nature of fracture critical bridges such as this one, unexpected and costly repairs outside of routine maintenance and projected rehabilitations are more likely to occur as the structure ages. It is possible that unforeseen emergency repairs could close the structure to traffic for days or even weeks while a structural solution is investigated and performed. The previous

Exhibit 2.14 | Historical Bridge Costs

Year	Age (Years)	Expenditure (2015 dollars)	Construction and Rehabilitation Description
1954	0	$22,000,000	Approximate initial construction
1979	33	$2,566,100	Deck resurfacing
1994	40	$1,976,700	Painting of superstructure
2004	50	$2,043,900	Deck resurfacing
2011	57	$3,342,560	Replace expansion joints, structure modifications (rehabilitation of piers), and general maintenance

Exhibit 2.15 | Environmental Scan



rehabilitation and continued maintenance has and will continue to deter the development of structural issues. Per KDOT, the estimated additional service life for the existing Centennial Bridge is twenty to thirty years.

ENVIRONMENTAL SCAN

The environmental screening area includes portions of Leavenworth County, Kansas and Platte County, Missouri. The corridor was evaluated for known noise, archaeological resources, floodplains, wetlands, streams, wildlife, hazardous waste, farmland, historic resources, and public parks. Preliminary consultations with MoDOT regarding environmental impacts to the Missouri side have been completed. An overview of select elements in the environmental scan is displayed in Exhibit 2.15.

NOISE

A noise study will be required if the project meets Type I criteria. Type I criteria includes, but is not limited to, the addition of through traffic lanes. If impacts are identified, noise abatement analysis will be conducted. If abatement measures are deemed feasible and reasonable, according to criteria, they must be incorporated into the project.

ARCHAEOLOGICAL RESOURCES

The location of known archaeological sites were reviewed and Phase I archaeological investigations are recommended once the study corridor is further defined. Preliminary consultations with MoDOT revealed no known archaeological sites of significance within the study area. However, there have been several shipwrecks in the area and it is possible there may be others within the study area.

FLOODPLAINS

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs) of 100-year floodplains were reviewed. In

Leavenworth County, the Division of Water Resources in the Kansas Department of Agriculture has jurisdiction over fill that is placed in a floodplain to an average height greater than one foot above the existing ground for streams having a drainage area over 640 acres. In Platte County, the Floodplains Management Section of the State Emergency Management Agency in the Missouri Department of Public Safety administers the National Flood Insurance Program. A no-rise certificate is required for FEMA Regulatory Floodway impacts.

WETLANDS

The U.S. Fish & Wildlife Service identifies wetland locations using high-altitude aerial photographs and provides maps through the National Wetlands Inventory (NWI). Such wetlands may or may not qualify as U.S. Army Corps of Engineers jurisdictional wetlands. Wetlands may also have developed in wet areas not shown on the maps. Section 404 of the Clean Water Act prohibits the discharge of dredged or fill material into waters of the U.S. without a permit from the U.S. Army Corps of Engineers and mitigation may be required.

STREAMS

The study corridor crosses multiple intermittent streams as defined by the U.S. Geological Survey. In Kansas, there are three named streams listed in the Kansas Department of Health and Environment's Kansas Surface Water Register as Expected Aquatic Life Use Water: Three Mile Creek, Corral Creek, and Quarry Creek. In Leavenworth County, the Division of Water Resources in the Kansas Department of Agriculture has jurisdiction over streams having a drainage area over 640 acres, which, dependent upon activities, would require a Stream Obstructions or Channel Changes permit.

In Missouri, there are also three named streams: Bee Creek, Moppin Branch, and Odie Branch. In Platte County, the Missouri Department of Natural Resources administers issuance of stream permits. The Missouri River is the state line between Leavenworth County, Kansas and Platte County, Missouri and is listed as Special Aquatic Life Use water. The Missouri River is a navigable water; therefore, by federal law, the U.S. Coast Guard and Army Corps of Engineers must authorize any bridge construction or modification with bridge permits.

WILDLIFE

The Kansas Department of Wildlife, Parks & Tourism lists several state threatened and endangered species in the Missouri River or its tributaries. An Action Permit will be required for any construction activities that impact the Missouri River. Date restrictions for the listed species have a combined span from April 1 through August 31. The Missouri Department of Conservation lists other state endangered species where a conservation plan will need to be developed prior to construction. U.S. Fish & Wildlife has recommended no work in the Missouri River June 1 through July 31 during the Pallid Sturgeon spawning period. Potential tree clearing restrictions may be imposed if suitable habitat is disturbed.

HAZARDOUS WASTE

There are several hazardous waste liabilities located within the study area to be considered in future stages. A Hazardous Material Review should be conducted as the project advances.

FARMLAND

Because the potential replacement bridge may convert farmland to non-agricultural uses, a farmland conversion impact rating review will be completed when project plans are available.

HISTORIC RESOURCES

A number of properties within the study area are listed in the National Register for Historic Places. Encroachment on these

sites may constitute an adverse effect. The Centennial Bridge was opened in 1955 and was evaluated under National Register criteria. It was determined that the bridge is eligible for listing under Criterion C (Engineering or Architecture) with concurrence by the Kansas State Historic Preservation Office.

PUBLIC PARKS

Within Leavenworth, several adjacent and interconnected parks are present including Riverfront Park (directly beneath the existing bridge), Bob Dougherty Memorial Park (located in the southeast corner of Dakota Street and 2nd Street), and Leavenworth Landing Park which includes the Riverfront Trail along the east side of Esplanade Street. Elements of a proposed bridge, such as bridge piers, may impact park areas and may require mitigation.

PUBLIC INPUT

During the Existing Conditions phase of the study, Advisory Committee Meeting #1 and Public Meeting #1 were held. The major focus was to explain the study process and discuss existing conditions and their potential influence upon the study. Copies of material distributed at each meeting including agendas, presentations, public meeting display boards, sign-in sheets, and raw comment forms are included in the appendix.

ADVISORY COMMITTEE MEETING #1

Advisory Committee Meeting #1 was held in December 2014 at the Leavenworth County Public Library. The study team discussed the purpose of the study, an overview of the study process and public involvement activities, tentative study schedule, and a synopsis of existing conditions. The project *Fact Sheet* was also distributed. The Advisory Committee's role was also explained at the first meeting:

- Identify and provide guidance on addressing issues important to the community
- Assist in gaining access to key stakeholders through standing organizations
- Review and comment on preliminary materials prior to public release

Questions and concerns at the first meeting included:

- Timeframe for actual bridge construction
- Bridge sufficiency rating
- Recent increase in Fort Leavenworth security measures
- Reconstruction of base airfield
- Construction of Sherman Gate and Grant Gate in 2021
- Desire for improved aesthetics
- Fort personnel's use of Kansas City International airport
- Policies for bi-state bridges

PUBLIC OPEN HOUSE #1

Approximately 140 individuals attended the first set of Public Open House meetings in January 2015. One meeting was held in Platte County while another was held in Leavenworth County. Photos from the two meetings are displayed in Exhibit 2.16 and Exhibit 2.17.

An open-ended comment form was provided and more than 60 percent of attendees provided written feedback. The primary comment topics related to tolling, bicycle and pedestrian access, and the bridge itself. Over 50 percent of respondents indicated they are against tolling. About 38 percent indicated they are for tolling with conditions. Of those in favor of tolling, many indicated the need for reasonable rates, compatibility with the current K-TAG transponder, maintaining tolling revenue locally, and the potential for beginning tolling now to accumulate revenue for a future bridge.

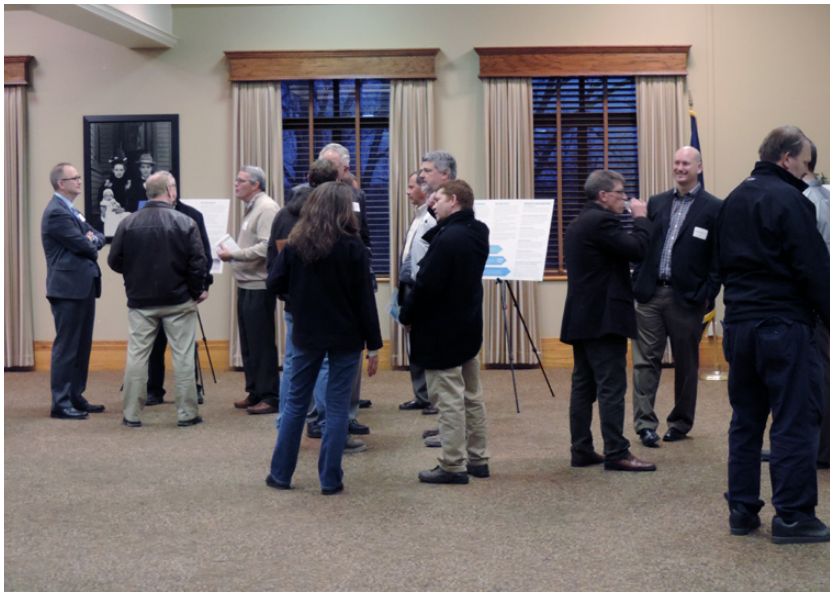
There was overwhelming support to include bicycle and pedestrian accommodations in the bridge design. Nearly half of

the respondents commented on bicycle and pedestrian issues with some offering specific comments on the type, width, and location of potential facilities.

There was support for a four-lane bridge but also concern that it will be connecting to only two lanes on the Missouri side. A number of respondents indicated the need to keep the bridge open during construction of a new bridge.

Exhibit 2.16 | Public Open House #1 in Platte County

Exhibit 2.17 | Public Open House #1 in Leavenworth County



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3 | FORECASTED CONDITIONS

The Forecasted Conditions phase examined the following elements:

- Committed developments
- Committed transportation projects
- Future traffic volumes

COMMITTED DEVELOPMENTS

Several major developments are proposed within the immediate study area that could influence future conditions. These developments include both physical and operational changes at three institutions: Fort Leavenworth, the Bureau of Prisons, and the National Guard.

While these developments are in close proximity to each other along the northern side of Metropolitan Avenue, each is in a different stage of implementation. The latest available site plans for the proposed developments were collected and incorporated into base mapping in an effort to reflect future conditions with committed developments.

Through the course of the study, the specific nature of the potential developments and the degree of certainty concerning their implementation changed. Independent of future configurations or implementation, including discussions about these future developments is valuable to the overall planning process. The site plans for the three committed developments are shown in Exhibit 3.1:

1. Bureau of Prisons Correction Institution and Prison Camp
2. Fort Leavenworth Grant Gate (A) and Sherman Gate (B)
3. National Guard Readiness Center

FORT LEAVENWORTH

Two recent reports were reviewed associated with Fort Leavenworth including:

- Access Control Point Transportation Engineering Assessment Final (2010)
- Army 2020 Force Structure Realignment, Supplemental Programmatic Environmental Assessment (June 2014) [Chapter 4 Section 4.15, Fort Leavenworth, Kansas]

Access Control Points

The purpose of the Access Control Point (ACP) study was to identify deficiencies at the ACPs and provide short-term and long-term alternatives to bring the ACPs into compliance with applicable standards and criteria. The long-term alternatives considered infrastructure requirements needed to support planned growth. Three gates were evaluated at Fort Leavenworth including the Grant Gate, Sherman Gate, and Hancock Gate. The following activities were included:

- Verified compliance with standards and guidelines
- Identified short-term and low-cost enhancements
- Identified long-term needs to support future growth
- Assessed manpower issues and ACP hours of operation
- Identified costs and provided guidance on programming

The study team's preferred long-term alternatives are:

- Grant: Alternative 1B ($14.3 million)
- Sherman: Alternative 1 ($13.4 million)
- Hancock: Alternative 1 or variation based on available real estate ($11.1 million)

As described in the Existing Conditions phase concerning traffic volumes, Fort Leavenworth implemented a change with gate operations in February 2015 that effectively closes Sherman Gate for inbound traffic and restricts outbound traffic to a limited duration in the afternoon. Discussions with Fort personnel indicate that this change in traffic pattern can be considered permanent. It is worth noting that the Sherman Gate and Sherman Avenue intersection are separate locations with Sherman Avenue providing access to the National Guard facility. The recommended design options being advanced as depicted from these reports have been incorporated into the project's base mapping in an effort to reflect future committed development conditions.

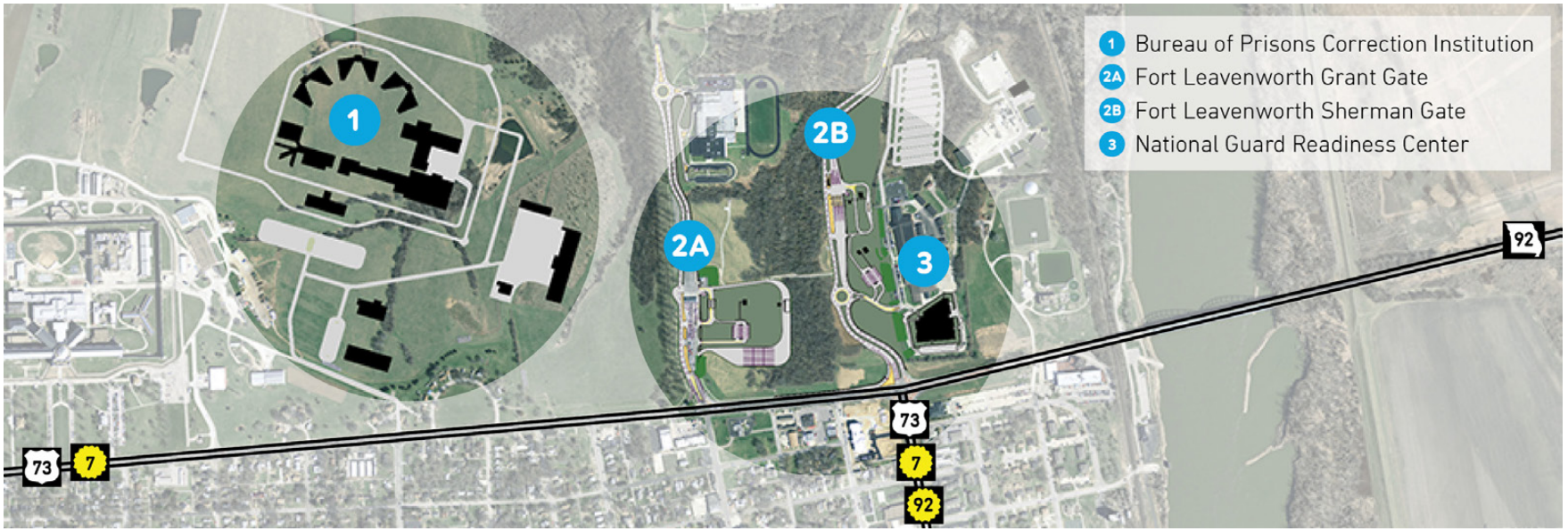
Recent comments from Fort personnel indicate that, with the limited use of the Sherman Gate, the modifications as shown in the report are unlikely to be implemented.

Supplemental Programmatic Environmental Assessment

Fort Leavenworth, established as a frontier outpost in 1827, provided protection to the northwest fur trade and developing trade with Santa Fe. Throughout the 20th century, officer education became the installation's primary mission and it is now the Army's center for advanced tactical education and combat development and training. Fort Leavenworth's military mission also includes the confinement and rehabilitation of military criminals.

Fort Leavenworth's 2013 baseline permanent party population was 5,004. In the *Supplemental Programming Environmental Evaluation,* Alternative 1 assesses a potential population loss of 2,500 including approximately 1,789 permanent party soldiers and 735 Army civilians. Significant socio-economic impacts are anticipated under *Alternative 1: Implement Force Reductions.* Alternative 1 would result in the loss of 2,524 Army positions

Exhibit 3.1 | Committed Developments



(soldiers and civilians) each with an average annual income of $46,760 and $63,875, respectively. In addition, this alternative would affect an estimated 3,831 family members. The total number affected under Alternative 1 is projected to be 6,355.

At meetings with Fort Leavenworth personnel, a *2015 Installation Fact Sheet* was provided to the study team. Data listed total military, civilian, and base population for FY 2011 through FY 2021. While the document shows total population dropping from its current peak, the A*rmy Stationing and Installation Plan* suggests a less drastic reduction of approximately 13 percent.

BUREAU OF PRISONS

Committed development at the Bureau of Prisons includes the Federal Correctional Institution and the Federal Prison Camp The *Final Environmental Impact Statement (EIS) (April 2015)* that was prepared for the U.S. Department of Justice for the development was reviewed by the study team. As proposed, the new facility would house a total population of approximately 1,408 inmates with about 350 full-time staff upon operation. The project budget is approximately $290 million to be expended over 36 months.

The EIS states that the proposed action is expected to impact traffic operations on the primary access route by the addition of employee, visitor, and service vehicle traffic. During the planning and design process, the Bureau of Prisons will consider the need to improve roadway access by installation of various traffic controls and other improvements to and from the project site.

Section Q of the EIS discusses the transportation system with a series of tables depicting existing, employee, and project-generated trips during the AM and PM peak periods, although no specific turning movements are provided. The project would have three shifts with the morning peak at 7:30 AM to 8:30 AM and the afternoon peak at 3:30 PM to 4:30 PM. It is acknowledged that the project would have a potential significant traffic impact during the AM peak hour. The directional distribution of traffic is assigned 35 percent to the east along Metropolitan Avenue, 7.3 percent to the west along Metropolitan Avenue, and 57.7 percent south along 10th Street and 4th Street (via Metropolitan Avenue).

Comments by the City of Leavenworth on the draft EIS noted the need for a traffic study to be performed at the time the facility is approved for construction to verify the need for a traffic signal at 10th Street. The Bureau of Prison's response was that it is not anticipating the need to install any traffic signals; however, based upon discussions with KDOT in December 2011, it was concluded that a traffic study will need to be performed.

Other key items from the EIS are as follows:

- Review of the document did not find a timeline for construction, although the proposed action can be assumed to be in place by 2020.

- The main access to the new facility would be opposite 10th Street at Metropolitan Avenue. Currently, 10th Street is a three-legged junction with 10th Street under stop control with a northbound left-turn lane and (by default) an exclusive right-turn lane. 24-hour traffic volumes on 10th Street collected in April 2015 indicate 5,600 vehicles per day.

- A review of traffic volumes during the identified peak hours can be used to develop an estimate of additional traffic through the 7th Street intersection and 4th Street intersection. It is not part of the current scope of work to assess an additional intersection (such as 10th Street) or to determine if it meets signal warrants. Bureau of Prison generated traffic is expected to follow existing traffic patterns and can be accounted for in a general percent increase in traffic volumes.

- The increase in traffic associated with the new prison facility may represent one-third of projected traffic over the next 25 years at a 1.5 percent compounded growth rate.

- New total trips from the facility can be projected at approximately 700 trips per day. About 35 percent of the trips are assigned to the east along Metropolitan Avenue and would add about 250 vehicles per day to the bridge crossing the Missouri River.

NATIONAL GUARD READINESS CENTER

The *Environmental Assessment (EA) (September 2013)* prepared for the Kansas Adjutant General's Department Kansas Army National Guard for the proposed 35th Infantry Division Headquarters Readiness Center was reviewed by the study team. As proposed, the new facility would be sited near the existing Readiness Center that it shares with the National Guard Bureau Mission Training Complex, formerly known as the Battle Command Training Center. The purpose is to provide a new facility with the greatest efficiency and lowest overall costs at the same licensed area as the Mission Training Complex.

The action is being proposed because the Army National Guard 35th Infantry Division is currently operating at a deficit for functional area. The proposed action includes:

- Construct, occupy, and operate a 120,450 square-foot Readiness Center facility at the currently privately-owned vehicle parking lot located south of Tice Hall.

- Construct a 62-space privately-owned vehicle parking lot along Sherman Avenue.

- Construct a 500-space privately-owned vehicle parking area in an approximate five acre area north of Greenlief Hall.

- Construct access roads and entry points to the new Readiness Center and privately-owned vehicle parking areas.

Impacts associated with the proposed action were reported as less than significant. In terms of infrastructure (transportation and traffic), increased operational traffic could occur during weekend training events.

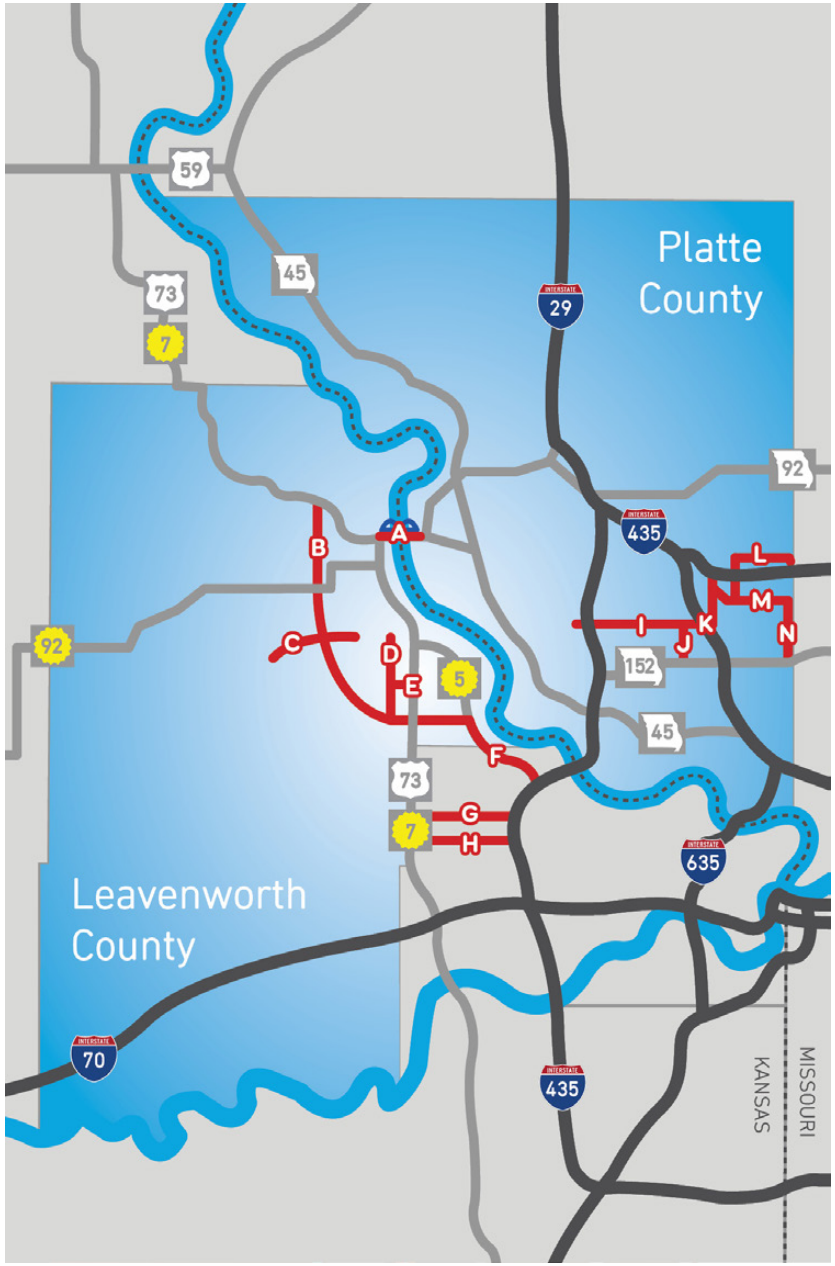
A new Sherman ACP on Sherman Road is currently being planned by Fort Leavenworth and would function as the main gate for the installation with full inspection and over-watch capabilities. Construction of the new Sherman ACP is not included in any of the proposed Readiness Center alternatives. The EA recommended implementation of the proposed action in FY 2015.

COMMITTED TRANSPORTATION PROJECTS

Clusters of significant roadway infrastructure are proposed over the next several decades in the study area. A few of these improvements can be considered competing improvements with Route 92 bridge traffic. Other improvements are a reflection of land use development and the need to accommodate projected growth in traffic. The improvements are displayed in Exhibit 3.2.

No additional improvements are proposed to either Route 92 or Route 45 beyond those associated with the bridge replacement project. Recent modifications to the Route 273 and Route 371 junction immediately west of I-29 are associated with a 29-acre commercial development south of the junction. Tentative plans call for a truck stop or convenience store, farm supply store, small-unit storage, and a new headquarters for Hoy Excavating. While improving accessibility and general traffic flow through the intersection with Route 371, the improvements are not necessarily adding roadway capacity with additional through lanes. A new roadway, which will connect to 1st Street in Tracy, will create a four-way intersection at Route 273 and Route 371.

Exhibit 3.2 | Regional Transportation Projects



Planned Project		Year
A	Centennial Bridge Replacement	2022
B	West Leavenworth / Lansing K-7 Bypass	2030
C	Eisenhower Road	2020
D	147th Street / DeSoto Road	2030
E	4-H Road	2040
F	McIntyre Expressway (K-5 Realignment)	2025
G	Donahoo Road Parkway	2040
H	Leavenworth Road Improvements	2040
I	Tiffany Springs Parkway	2040
J	Amity Road	2030
K	Congress Avenue / Tiffany Springs Parkway	2020
L	Cookingham Road / Skyview Avenue	2040
M	NW 108th Street	2030
N	Platte Purchase Drive	2040

COMMITTED PROJECTS OF REGIONAL SIGNIFICANCE

The majority of the committed transportation projects of regional significance in Missouri appear in response to socio-economic growth indicative of potential increases in trip exchanges with the City of Leavenworth and Leavenworth County via the Centennial Bridge. A new Kansas City International Airport single terminal concept should not alter access to or from the airport. A previous south terminal concept had investigated a new main entrance via Route 152 which could result in a significant change in travel patterns associated with the airport.

The remaining list of transportation improvements are within an area bounded by Congress Avenue on the west, Cunningham Drive on the north, US-169 on the east, and Route 152 on the south. These roadway improvements, which mostly add capacity by widening from two to four lanes, are internal roadways. Only major east-west roadways, such as the extension of Tiffany Springs Parkway westerly to and across I-435 to Route N, which assumes an interchange at I-435 that does not currently exist, may put travel demand pressure on local Platte County roads connecting to Route 45, such as Farley Hampton Road.

The majority of the committed transportation projects of regional significance in Kansas could be considered competing projects with adding capacity to the Centennial Bridge replacement. Traffic signal and intersection improvements were studied as part of the *K-7 North Interim Strategies Study* between Gilham Road and Parallel Parkway. Two alternative designs were explored that would utilize u-turn lanes to help drivers make left turns. The most significant project would be the ring road concept of improvements to K-5 and McIntyre Expressway from two to four lanes coupled with the West Leavenworth/Lansing K-7 Bypass from McIntyre Road to a connection near 20th Street and Metropolitan Avenue at the west edge of Fort Leavenworth. While potentially constructed in phases, the ring road concept can be considered an alternate route for trips. Consequently, the review of future year forecasts are conducted with a sensitivity test with and without these improvements to assess any effect it could have on the Centennial Bridge replacement.

Other improvements in Kansas side include:

- Eisenhower Road (C) from two to four lanes
- 147th Street / DeSoto Road (D) from two to four lanes
- 4-H Road (E) from two to four lanes

It is not anticipated that the above listed improvements would have an impact upon traffic patterns with the Centennial Bridge replacement.

FUTURE TRAFFIC VOLUMES

Future traffic volume forecasts to 2040, the final year in the travel demand model, were made with and without tolling. As such, there are three forecast scenarios to assess capacity.

No-Build: This forecast assessed capacity conditions with increased traffic but without proposed improvements or changes to the roadway network.

Build + No Tolling: This forecast assessed capacity conditions with proposed improvements and increased traffic.

Build + Tolling: This forecast assessed capacity conditions with proposed improvements, increased traffic, and tolling. The influence of tolling will divert a portion of traffic and effectively reduce overall traffic volumes on selected roadway segments. Therefore, two different forecasts, a base case and a high case, were developed. The base case for tolling is about 70 percent of the no-build forecast. The high case for tolling is about 85 percent of the no-build forecast. For capacity analysis purposes, the high case was assessed.

Information presented on the capacity analysis was completed in a factual manner independent of recommendations presented in later sections of the report regarding tolling (Chapter 5) or next steps for implementation (Chapter 6).

2040 HIGHWAY CAPACITY ANALYSIS

The travel demand model provides appropriate traffic volumes on three highway segments for use with capacity analysis:

- Route 92 from Bridge to Spur 45
- Route 92 from Spur 45 to Route 45
- Spur 45 from Route 92 to Route 45

The capacity analysis results for the segments are summarized in Exhibit 3.3. The scenarios assessed include a No-Build analysis with existing lane configurations, a Build + No Tolling scenario with a four-lane bridge, and a Build + Tolling scenario that includes the four-lane bridge yet with reduced traffic volumes associated with traffic diversion. To assess worst-case conditions, the high case rather than the base case for toll traffic volumes is used.

Route 92 from Bridge to Spur 45

This segment is evaluated under the current two-lane highway conditions as well as a four-lane divided expressway. A similar directional distribution as occurs with current conditions during the peak hours is assumed. Daily traffic volumes are forecasted to reach as high as 16,000 vehicles per day without tolling and approximately 13,700 vehicles per day with tolling. Physical conditions are adjusted according to the proposed design.

The results of the capacity analysis for the two-lane highway indicated a LOS E for both AM and PM peak hours under the No-Build scenario while the Build + No Tolling scenario with slightly higher traffic volumes has a LOS B in the AM peak. The results of the capacity analysis for the four-lane highway Build + Tolling scenario indicated a LOS A for both AM and PM peaks.

Exhibit 3.3 | 2040 Level of Service

Forecasted Scenarios		No-Build Scenario		Build + Tolling Scenario		Build + No Tolling Scenario	
Roadway		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
92	Between Bridge and Spur 45	E	E	A	A	B	A
92	Between Spur 45 and Route 45	D	D	D	D	D	D
45 SPUR	Between Route 45 and Route 92	D	D	C	D	D	D

Route 92 from Spur 45 to Route 45
This segment is evaluated under the current two-lane highway conditions. A similar directional distribution as occurs with current conditions during the AM and PM peak hours is assumed. Daily traffic volumes are forecasted to reach as high as 8,000 vehicles per day without tolling and approximately 7,300 vehicles per day with tolling. The results of the capacity analysis for the two-lane highway indicated a LOS D for both AM and PM peaks under the No-Build scenario. Operations under the Build + No Tolling and Build + Tolling scenarios continue at LOS D for both AM and PM peaks.

Spur 45 from Route 92 to Route 45
This segment is evaluated under the current two-lane highway conditions. A similar directional distribution as occurs with current conditions during the AM and PM peak hours is assumed. Daily traffic volumes were forecasted to reach as high as 18,200 vehicles per day without tolling and approximately 6,500 vehicles per day with tolling. The results of the capacity analysis for the two-lane highway indicated a LOS D for both AM and PM peaks under the No-Build scenario. Operations under the Build + Tolling scenario improve to LOS C in the AM peak yet would otherwise remain at LOS D.

2040 INTERSECTION CAPACITY ANALYSIS

The travel demand model forecasts turning movement volumes based upon an overall growth factor applied to all movements, which does not provide appropriate forecasted traffic volumes. Therefore, intersection capacity is discussed qualitatively based upon potential changes with diversion and reduction of discretionary trips if tolling were to be implemented. Three intersections were evaluated:

- Metropolitan Avenue and 7th Street
- Metropolitan Avenue and 4th Street
- Route 92 and Spur 45

Metropolitan Avenue and 7th Street
Increased traffic volumes at this intersection under the No-Build and Build scenarios are not expected to result in any changes to overall peak hour operations. Capacity issues are still expected in the AM peak hour with extensive queuing of westbound right-turning traffic into Fort Leavenworth. Grant Gate operations for exiting traffic moderate traffic flow in the PM peak period. Operations with the tolling scenario is projected to increase traffic along 7th Street, which would lower the level of service. The amount of traffic that may divert to the 7th Street approach will impact intersection operations.

Metropolitan Avenue and 4th Street
Increased traffic volumes at this intersection under the No-Build scenario would exacerbate operations for the eastbound movements during the PM peak hour with only one eastbound through lane. Build operations assume a second eastbound through lane while still providing an exclusive eastbound right-turn lane. With tolling and diversion of traffic, the intersection operations would need to be closely monitored in conjunction with traffic patterns and operations at 7th Street/Grant Gate. Diverted traffic may attempt to utilize 7th Street, yet its limited capacity may send traffic to 4th Street. It could be expected that, over time, traffic would reach a balance between the 7th Street and 4th Street roadways.

Route 92 and Spur 45
Increased traffic volumes under the current configuration for this intersection exacerbate operations for the Spur 45 approach with a LOS F projected for both AM and PM peak hours under both traffic scenarios. This intersection warrants improvements for both capacity and safety reasons. Chapter 4 discusses options considered to improve capacity and safety and its anticipated operations.

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4 | CORRIDOR SELECTION

The Corridor Selection phase examined the following elements:

- Bridge coordination elements
- Bridge and roadway approaches
- Corridor recommendations
- Cost estimate for selected alignment

Public input associated with the Corridor Selection phase was documented from Advisory Committee Meeting #2 and Public Open House #2.

BRIDGE COORDINATION ELEMENTS

The goal of the corridor selection process was to consider possible structure types and estimated costs to select the preferred option. A range of location options for spanning the Missouri River as well as conventional bridge types for the east and west approach spans were reviewed. Throughout the process, elements were identified as constraints and/or requirements:

- Navigation clearance
- Hydraulics
- Levee system
- Railroad
- Utilities
- Aviation
- Shared-use path
- Aesthetics

NAVIGATION CLEARANCE

The sailing line along the Missouri River swings from side to side. The line is closer to the Kansas bluffs at River Mile (RM) 399 (also referred to as Fort Bend) before swinging easterly to the Missouri side near RM 398 (Leavenworth Reach) and then back again to the Kansas side at RM 396 (near Leavenworth Bend). The Centennial Bridge is located at RM 397.6. The primary navigation span is located along the left bank (Missouri side) although it is also identified with a *Caution: Dike Downstream of Bridge* sign. Vertical clearance tables list a light list vertical clearance of 71.2-foot elevation with a low steel of 816.4 feet (based on a 2012 survey) and a reference elevation of 742.2 feet. Other U.S. Army Corps of Engineers charts list a Centerline Reference Plane (CRP) Elevation of 748.578 feet and a CRP clearance of 68.122 feet (dated February 2014).

Navigation clearance and requirements are under the jurisdiction of the U.S. Coast Guard (8th District) in St. Louis, Missouri. The existing navigational clearance envelope at Missouri River Mile 397.61, was obtained from *Chart No. 20A* developed by the U.S. Army Corps of Engineers (Northwestern Division). The existing Centennial Bridge provides 400 feet of horizontal clearance under both channel spans and the existing vertical clearance is"71.2 feet above zero on gauge at Railway Bridge."

In a letter dated May 8, 2015 from the U.S. Coast Guard, in response to an email dated April 15, 2015 requesting the review of the conceptual realignment of the navigational channel, the U.S. Coast Guard provided direction regarding the navigational opening. The replacement bridge would provide a single 400-foot opening for the navigational opening, thus eliminating the two openings provided by the existing bridge.

The conceptual layout was well received by the operators on the Missouri River. The U.S. Coast Guard stated that the "drawings show the new navigational channel piers being shifted approximately 200 feet towards the middle of the river. The resulting clearance of 400-foot horizontal clearance would meet the reasonable needs of navigation." In addition, the U.S. Coast Guard stated, "Vertical clearance shall, at a minimum, match the existing vertical clearance. Our files show that this is 814.54 feet." A Coast Guard Bridge Permit would be required for this bridge replacement. In the design phase of the project, once the pier locations and bridge profile are finalized, a formal permit application must be submitted to the U.S. Coast Guard. Issuance of a permit is subject to their review and approval of the finalized low steel profile and pier locations.

HYDRAULICS

Per the Federal Emergency Management Agency, an increase in the 100-year water surface elevation due to construction of the new bridge is prohibited. The U.S. Army Corps of Engineers has defined the 100-year water surface elevation as 774.6 feet. An Engineering "No Rise" Certificate must be obtained by demonstrating through hydrological and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels during the occurrence of the 100-year flood. A hydraulic modeling and analysis shall be performed during the design phase and will serve as documentation for the Floodplain Development Permit.

"No Rise" for a replacement bridge can most likely be achieved by the following means. First, the projected area of the new piers below the 100-year water surface and within the Missouri River floodplain are set equal to or less than the area of the existing bridge piers. Second, the existing Centennial Bridge piers are removed below the mud line of the Missouri River.

In correspondence with the U.S. Coast Guard, the U.S. Army Corps of Engineers provided minimum removal elevations for the existing piers. Existing Pier No. 2 shall be removed to elevation 722.26 feet The existing piers between the high banks shall be removed five feet below the mud line and five feet below the top of the bank for existing piers on the bank.

LEVEE SYSTEM

The farmland along the east bank of the Missouri River adjacent to Route 92 is protected by a levee system managed by an independent levee district, Farley Levee District, with oversight provided by the U.S. Army Corps of Engineers. This levee was constructed in 1969 after the construction of the existing Centennial Bridge. The U.S. Army Corps of Engineers general requirements are no construction or permanent structures within 500 feet of the land side and 300 feet on the river side. However, approval has been granted to construct deep foundations within this no-build zone for recently constructed bridge projects within the region provided U.S. Army Corps of Engineers requirements for design and construction are met. The bridge construction methods adjacent to the levee will be closely reviewed by these agencies prior to the start of work.

Additional requirements and inspection during construction may include levee stability, settlement and seepage analysis, site monitoring during construction, contingency flood condition measures, and special backfill measures. At a minimum, the existing vertical clearance over the levee's maintenance road will need to be maintained. A minimum vertical clearance over the levee of 16'-6" was established for this design phase of the replacement bridge.

A levee system does not exist on the west bank of the Missouri River in Kansas.

RAILROAD

The Falls City Subdivision of the Union Pacific Railroad runs along the west side of the Missouri River. Immediately south of the Centennial Bridge, there is one main track and one siding track. Immediately north of the bridge is a single track. Right-of-way width for the railroad varies from 100 to 150 feet. The nearest at-grade crossing is at Dakota Street (FRA No. 437427M) with up to 14 trains per day. Union Pacific Railroad uses the Falls City and Hiawatha Subdivisions for northwest directional running to Upland. The Kansas Subdivision, through Topeka, is used for southeast directional running into Kansas City.

The minimum clearance for railroad grade separations should meet the requirements of American Railway Engineering and Maintenance-of-Way Association (AREMA) or be in accordance with the requirements of the railroad having jurisdiction. In general, clearances for the Union Pacific Railroad are as follows; no permanent obstructions shall be within a horizontal distance of 18 feet from the centerline of tracks and no permanent obstructions shall be within a vertical height of 25 feet above the top of rails to avoid the need for heavily designed crashwall piers.

The existing track passes between Bent 6 and Bent 7 of the existing bridge. The existing bridge previously accommodated industry trains that served the former coal plant between the mainline tracks and 2nd Street. These former tracks have been removed and no further railroad design accommodations are anticipated. All options evaluated for the replacement bridge position substructure elements (permanent obstructions) outside of the Union Pacific Railroad right-of-way and outside of the desirable design clearances for new construction.

UTILITIES

Abandoned gas lines, active electrical conduits for the navigational lighting, and two active 3-inch telephone conduits are affixed to the existing bridge. Options for the displaced active utilities include attachment to the new structure or off-bridge relocation. Conduits for the utilities could be exposed and placed below the bridge deck between girders or encased within the concrete for the superstructure. For attachment to the new bridge, details must be closely coordinated between the utility and the bridge designer. For relocation off the bridge, these utility companies would need substantial advanced notice to make arrangements to bore beneath the river channel. Communication with the utilities requiring relocation should occur during the design phase.

Major utilities in the study area include the Leavenworth Waterworks plant and several high pressure gas lines owned by Southern Star that cross beneath the Missouri River. Numerous other utilities are located within the study area and can include communication lines, overhead electric, storm drainage, and sanitary sewer. These existing utilities are shown on plans in the appendix. Coordination with affected utilities will be required as the design progresses. The 12.47 kV electric line crossing over the existing bridge near the west abutment is envisioned to be buried along 2nd Street beneath the proposed bridge.

A sealed coal mine air shaft is located immediately south of the existing bridge and west of the railroad in the Abernathy Furniture Complex property. The Kansas Department of Health and Environment sealed the shaft in November 1994.

AVIATION

The Sherman Army Airfield (FLV), while located within the confines of the United States Army Post, has an agreement with the City of Leavenworth to permit civilian use at all hours. The airfield covers an area of 234 acres at an elevation of 772 feet above mean sea level. It has one runway with an asphalt/concrete surface measuring 5,318 feet by 102 feet. Aeronautical approach charts are included in the appendix.

The airport is at the foot of the Missouri River bluffs. Often endangered by floods, the levee protecting the airport was compromised with the Great Flood of 1951, Great Flood of 1993, and 2011 Missouri River floods, causing Sherman Army Airfield to be inundated.

SHARED-USE PATH

The existing bridge does not accommodate bicyclists or pedestrians. MARC, the metropolitan planning organization for the bi-state Kansas City region, has a policy regarding bicycle and pedestrian accommodations on major river bridges. In summary, the policy states that safe, practical, and appropriate bicycle and pedestrian accommodations will be considered in the planning and design of all surface transportation projects that cross major rivers. There are a number of conditions that need to be met in order to justify a shared-use path as well as consideration of the cost of the shared-use path (typically no more than 15 percent of the total cost of the structure). KDOT and MoDOT concurred that the policy is applicable to this project and it was agreed to provide a shared-use path as part of replacement bridge design.

For the design of the shared-use path on the replacement bridge, the *AASHTO Guide for the Development of Bicycle Facilities: 4th Edition (2012)* provides guidance in determining the requirements of the shared-use path. Given the design speeds of the traffic on the bridge adjacent to the shared-use path, a 42-inch tall barrier separating the shared-use path from vehicular traffic on the bridge is a requirement for the safety of bicyclists and pedestrians. A minimum width of 10 feet was selected for the bi-directional shared-use path. The 10-foot wide shared-use path will potentially serve a dual purpose as it also accommodates some types of bridge inspection units, as demonstrated in the example in Exhibit 4.1. These types of bridge inspection units allow the bridge to be inspected with limited impacts to traffic on Route 92.

AESTHETICS

The topic of aesthetics was raised during Advisory Committee meetings and explored at a basic level at this stage of design development. KDOT's position is that if local entities can provide and commit to funding for aesthetics, then KDOT is willing to work to include such aesthetic treatments in design plans. A list of aesthetic opportunities ranging from treatments to the surrounding area to specific bridge elements were discussed. Potential cost magnitude was also discussed as shown in Exhibit 4.2. If one percent (1%) for aesthetics were applied to the bridge structure costs, the amount would exceed $500,000. Decisions on the type and extent of any aesthetic treatments will be made during future design phases when commitments to funding are provided. It should be noted that navigation lighting for the Missouri River will be provided by the State.

BRIDGE AND ROADWAY APPROACHES

This section of the corridor selection process presents the methodology of developing and screening the alternative corridors before selection of a specific corridor to advance. The corridors include not only the Missouri River bridge crossing location but also the approach roadways leading up to the bridge on both the Kansas and Missouri approaches.

CORRIDORS CONSIDERED

The corridors considered, displayed in Exhibit 4.3, include the:

- North corridor (upstream of existing bridge location)
- Existing Route 92 corridor
- South corridor (downstream of existing bridge location)

A corridor is defined as encompassing a sufficient width to explore alignment variations as necessary. Both the existing corridor and south corridor have a broad corridor width resulting in multiple alignments for the bridge as well as the roadway approach tie-in points. The corridors upstream and downstream

of the existing bridge corridor were selected based in part on prior river bridge crossings.

The north corridor is the location of the initial Route 92 bridge crossing directly into Fort Leavenworth. This initial bridge over the Missouri River, built in 1872, was replaced by the current Centennial Bridge in 1955. The Centennial Bridge project included constructing approximately three miles of two-lane highway to connect to the Centennial Bridge. The old bridge was removed and the former roadway approach became a gated private roadway serving the Bureau of Prison's farm. It is worth noting that the junction with this former route was raised nearly 15 feet above the former roadway elevation. At that time the internal roadway network within the Fort traveled via Grant Avenue to Metropolitan Avenue. The junction of Metropolitan Avenue with Sherman Avenue Gate did not occur until the mid-1990s.

The south corridor is the location of the former Chicago Northwestern railroad swing bridge crossing directly into Choctaw Street near the current Community Center (former Missouri Pacific Railroad depot). This railroad bridge, built in 1872, was removed in the 1970s. Numerous rail lines crossed over land on both the Missouri and Kansas sides.

In general terms, the bridge type is assumed to remain consistent for any of the bridge crossing locations. Variable elements that affect costs include the length of bridge structure, length of roadway approaches (including earthwork), and other associated highway improvements based upon travel patterns.

North Corridor

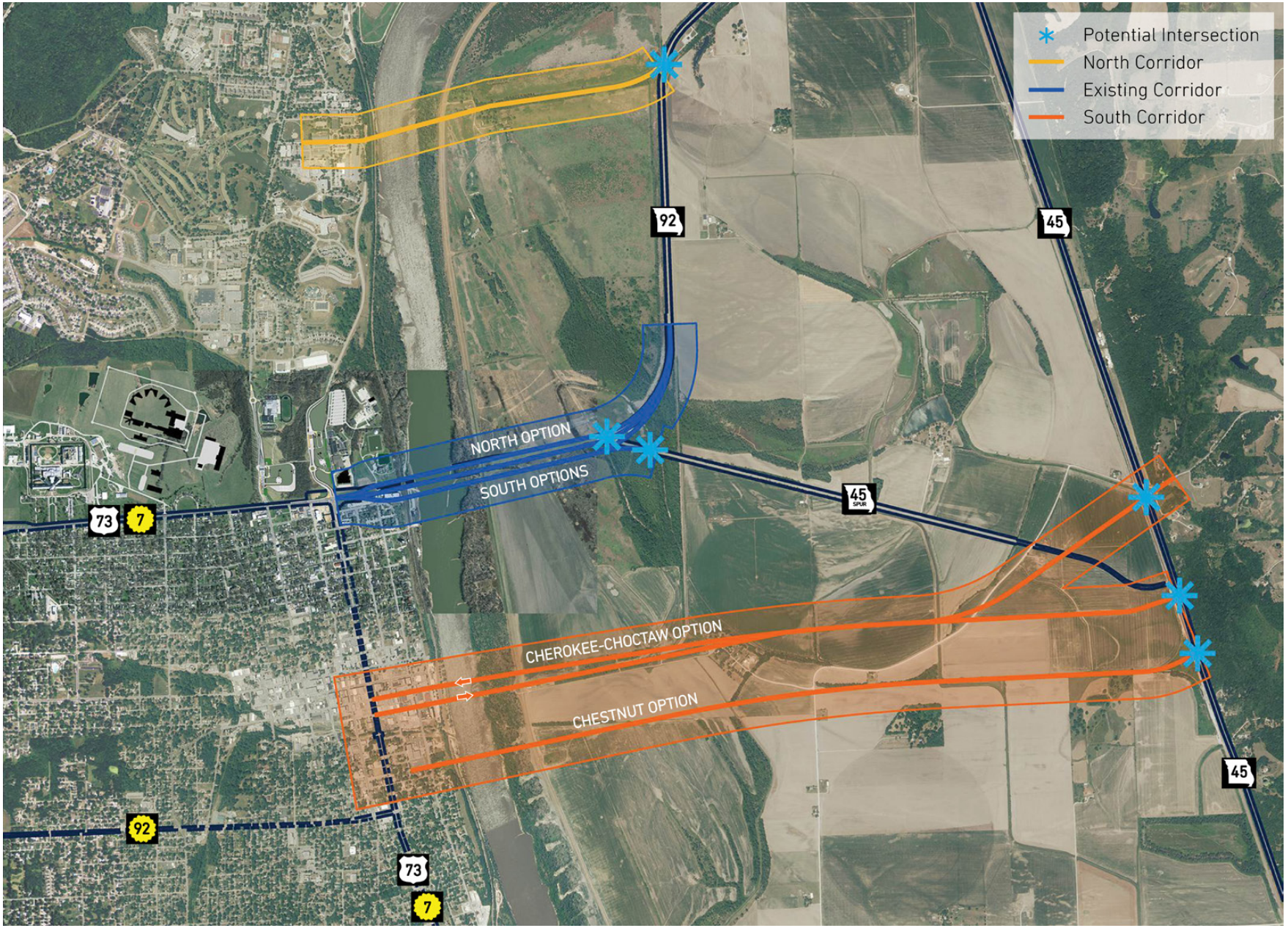
This corridor considers one alignment. With entry directly into Fort Leavenworth, a secured gate system would be necessary to limit public access. With limited physical space on the bluff side of the Missouri River, the gate would need to be located either on

Exhibit 4.1 | Example Bridge Inspection Unit

Exhibit 4.2 | Aesthetic Treatment Costs

Treatment Cost	Low	Medium	High
Formliner	■		
Concrete Staining	■		
Overlook (On Land)	■		
Landscaping	■	■	
Roadway Lighting	■	■	
Toll Equipment Canopy		■	
Ornamental Fence		■	
Pier Cap Shape		■	
Monuments/Gateways		■	■
Pier Column Shape		■	■
Overlook (On Bridge)		■	■
Bridge Lighting		■	■

Exhibit 4.3 | Corridors Considered



the bridge or in Missouri. Both locations require additional area to accommodate a gate system and therefore have additional cost.

Existing Corridor
This corridor is subdivided into two basic alignments. One alignment is immediately north of the existing Centennial bridge while the other alignment is immediately south of the existing Centennial Bridge. With the Abernathy Furniture Complex immediately south of the existing Centennial Bridge, an alternate south alignment was considered that would avoid directly impacting the buildings.

South Corridor
This corridor is subdivided into two alignments. One alignment illustrates the difficulties of tying into a developed area with limited right-of-way along the existing street while another alignment utilizes natural elevation differences to cross over the Union Pacific Railroad. However, both options require extensive new roadway connections to the east within Missouri.

CORRIDOR EVALUATION

The north, existing, and south corridors have been evaluated based upon three basic aspects:

- Environmental
- Traffic
- Financial

A comparative analysis, summarized in Exhibit 4.4, determined if an alignment is better than, no different, somewhat worse, or significantly worse than other alignments. The environmental evaluation considers the numerous elements noted in the environmental scan in the Existing Conditions phase in Chapter 2. A brief comparison amongst the north, existing, and south corridors is provided for each element with a focus upon differences, if any, between the three corridors.

Environmental
In terms of overall environmental impacts, the matrix indicates that the south corridor has a greater potential for impacts to numerous resources due to its location and longer route.

Noise: A noise study will be required with the addition of through traffic lanes. As each corridor provides additional through lanes, there is no difference amongst the corridors.

Archaeology: An archaeological resource investigation will be conducted once a corridor is selected. At the screening stage, shipwreck locations in the Missouri River should be avoided. Only the south corridor is in close proximity to known shipwreck locations. Consequently, the south corridor is rated as somewhat worse in terms of impact.

Floodplains: A no-rise certificate is required for FEMA Regulatory Floodway impacts. As each corridor provides a new bridge, there is no difference amongst the corridors.

Wetlands: The National Wetlands Inventory maps show the location of wetlands which may or may not qualify as jurisdictional wetlands. The south corridor with its extensive approach roadway network on the Missouri side would impact more wetlands than the north or existing corridors. Consequently, the south corridor is rated somewhat worse in terms of impact.

Streams: The Missouri River is a navigable water. Therefore, by federal law, the U.S. Coast Guard must authorize any bridge construction or modification with a U.S. Coast Guard Bridge Permit. As each corridor provides a new bridge, there is no difference amongst the corridors. Each state has a Division of Water Resources that administers issuance of permits. The south corridor, with its extensive approach roadway network on the Missouri side, would impact more streams than the north

Exhibit 4.4 | Corridor Assessment

Corridor Assessment			N NORTH	E EXIST	S SOUTH
Environmental	Noise	Local Noise Study			
	Archaeology	Abandoned Shipwrecks			
	Floodplain	Federal Emergency Management Agency			
	Wetlands	National Wetlands Inventory			
	Streams	U.S. Coast Guard			
		Kansas Division of Water Resources			
		Missouri Division of Water Resources			
	Wildlife	Kansas Dept. of Wildlife, Parks, Tourism			
		Missouri Department of Conservation			
		U.S. Fish and Wildlife Service			
	Hazardous Waste	Sites			
		Underground Storage Tanks			
		Landfills			
	Farmland	Conversion			
	Historic	District			
		Bridge			
Traffic	Traffic Service	Intersection Capacity			
		Design Criteria			
		Mobility and Access			
		Maintenance of Traffic			
Financial	Financial Cost	Construction of Bridge/Roadway			
		Right-of-way			
		Land Use Impacts			
		Operations and Maintenance			
Comparative Summary		Environmental			
		Traffic Service			
		Financial Cost			

Somewhat Better
No Difference
Somewhat Worse
Significantly Worse

or existing corridors. Consequently, the south corridor is rated somewhat worse in terms of impact

Wildlife: Each state has permits that will be required for wildlife impacts. In addition, each state has restrictions on construction activity that may affect endangered species or their habitat. As each corridor involves construction in the Missouri River, there is no difference amongst the corridors.

Hazardous Waste: There are several hazardous waste liabilities including sites, underground storage tanks, and landfills located in the study area. Based upon the proximity to such sites, without any known direct impacts, the south corridor is rated as significantly worse for the Kansas approach with regard to hazardous waste sites while the existing corridor is rated somewhat worse for the Missouri approach with regards to underground storage tanks.

Farmland: A farmland conversion impact rating review will be completed when a corridor is selected. At the screening stage, farmland impacts are associated with the length of roadway approaches. Consequently, the south corridor is rated as somewhat worse in terms of impact.

Historic Resources: One resource that each of the three corridors affects is historic resources. There are several existing National Register sites and districts in the City of Leavenworth that could be adversely affected by the corridors. Consequently, the north corridor is rated as significantly worse because of the Fort Leavenworth Historic District. The existing corridor is rated as somewhat worse for the immediately south alignment that would impact the historic Abernathy Furniture Complex (at the time of review, the property was potentially eligible for the National Registrar of Historic Places). The south corridor is rated significantly worse because of the Cherokee Historic

District. The Centennial Bridge has also been reviewed by the State Historic Preservation Office and was found to be an eligible resource meeting the criterion of Engineering and Architecture. Consequently, mitigation options will be explored including potential reuse, finding a willing buyer, or documentation according to the appropriate process. As each corridor provides a new bridge, there is no difference amongst the corridors.

Traffic

In terms of traffic service operations, the corridors are assessed based upon intersection capacity, design criteria, mobility and access, and maintenance of traffic. A common element for all corridors is the need for the existing Centennial Bridge to remain in service while the new bridge is built. Consequently, there is no difference amongst the corridors. With regards to intersection capacity, the north and south corridors are rated somewhat worse because they create new intersections as well as distribute additional traffic along routes that are capacity constrained. With regards to design criteria, the south corridor is rated somewhat worse because the roadway profile grades on the Kansas approach would be steeper and the vertical clearance over the designated truck route of 3rd Street would be limited to less than 16.5 feet. In terms of mobility and access, both the north and south corridors are rated somewhat worse because of the redistribution of traffic patterns and additional travel distances for portions of the bridge users.The matrix indicates that combined traffic service for both the north and south corridors have a significantly worse rating than the existing corridor. There is no difference in impact for the existing corridor.

Financial

In terms of financial impacts, the corridors are assessed based upon probable costs for construction of the bridge and roadway, probable costs for right-of-way acquisition, potential land use impacts, and cost for operations and maintenance.

In terms of probable costs for construction of the bridge and roadway, the south corridor is rated significantly worse because of its extensive length of roadway approaches. The rating of significantly worse for the south corridor based upon extensive length of roadway approaches is applied to probable costs for right-of-way acquisition and potential land use impacts. The existing corridor is rated somewhat worse in terms of land use impacts associated with yet undetermined impacts to adjacent development on both the Kansas and Missouri approaches. Both the north and south corridors are rated significantly worse for costs of operations and maintenance because of lengthy roadway approaches. The north corridor would also require greater operation and maintenance costs due to the need for secured access via a gate into Fort Leavenworth.

CORRIDOR RECOMMENDATIONS

Consideration of environmental, traffic service, and financial elements suggests that the north and south corridors be removed from further consideration. The comparative assessment suggests only the existing corridor should be advanced.

Issues to be addressed with the existing corridor and its three potential alignments (immediately north, immediately south, and farther south) include potential land use and historic impacts as well as potential hazardous impacts with underground storage tanks. Consequently, an alternate alignment was developed to reduce direct impacts to the Abernathy Furniture Complex, yet significant indirect impacts would still occur. Additional potential impacts to accessing the boat launch ramp from Riverfront Park could also occur.

Consequently, the alignment immediately north of the existing bridge corridor was selected for further advancement. The transition within Missouri from a four-lane bridge approach to two lanes along both Route 92 and Spur 45 also requires

further development. A series of intersection configurations were considered before selecting to advance one concept. With the potential for tolling, physical requirements for the necessary equipment to collect tolls were also investigated.

The primary purpose of advancing the design in a selected location is to gain a better understanding of the potential costs to implement. Design adjustments and value engineering may alter the final design.

BRIDGE AND ROADWAY APPROACHES ALIGNMENT

The bridge alignment has been set based upon the offset necessary to construct the new bridge piers without interfering with the existing bridge piers or its foundation system (footings or piles). The approach roadways were then developed to transition back into the existing roadway network. On the Kansas side, the desired tie-in point is at or before the 4th Street intersection. The transition requires a reverse curve along the roadway and bridge's central alignment. The horizontal alignment is further complicated by the continuously varying transitions of both inside and outside shoulder widths from the bridge to the curb and gutter section along Metropolitan Avenue, including its exclusive westbound left-turn lane.

On the Missouri side, the desired tie-in point is before the Route 92 and Spur 45 junction. The eastbound lanes have a reverse curve to tie into the existing Route 92 roadway. While several alignment options exist for the new westbound lanes, the preferred alignment continues the bridge's westbound lanes on tangent before transitioning through a curve and tying into Route 92 east of the Spur 45 junction.

A strip map of the bridge and roadway approach alignment is shown in Exhibit 4.5. Further discussion of vertical differences and profile is provided in the appendix.

BRIDGE STRUCTURE AND TYPE

The recommended replacement of the Centennial Bridge, displayed in Exhibit 4.6, is a new three structural unit bridge, 2,348-feet in length, crossing the Missouri River upstream of the existing bridge. The Kansas approach (Unit 1) consists of a five-span precast pre-stressed concrete beam structure, all with an equal span length of 165'-6". The main river span (Unit 2) is a total of 860 feet (220-feet, 420-feet, 220-feet) and consists of a three-span haunched steel plate girder structure. The main span provides 400 feet of horizontal clearance for the navigational envelope or opening. The Missouri approach (Unit 3) consists of a four-span precast pre-stressed concrete beam structure, all with an equal span length of 165 feet for an overall unit length of 660 feet. The superstructure units are supported by non-integral abutments at each end of the bridge and by multi-column piers.

For both the main span composite steel haunch plate girders and the composite precast pre-stressed concrete beam approaches, the deck and girders act in combination to resist the applied loads. These girder type bridges, where the main structure coincides with the deck line, primarily carry the loads in shear and flexural bending. From a cost effective perspective, composite slab-on-girder bridges provide an economical and durable solution. The regional construction industry is also capable of providing this bridge type. The advantages inherent to a composite steel haunch plate girder bridge are as follows:

- The use of continuous span, multi-girder bridge units provides redundant bridge systems without fracture critical members or cable elements that would require specialized inspection personnel and/or equipment.

- The nature of composite girder structures is that structural function of the deck is limited to aid in carrying vehicular loads and to act as a diaphragm for wind loads. In contrast

to cable stayed bridges, the deck of a girder bridge can be easily and economically replaced. By replacing the deck slab half of the bridge width at a time, traffic flow can be maintained and the need for temporary wind bracing eliminated.

- The concrete deck slab naturally covers and protects the girder systems which effectively provides global bending capacity to the deck system.

- The substructures, which are primarily compression elements, make the most effective use of concrete in a manner which naturally limits cracking and inherently provides durability.

The Kansas approach span (Unit 1) accommodates 2nd Street and the entrance to the Leavenworth Waterworks Plant, places substructure elements outside of the Union Pacific Railroad right-of-way, and minimizes the impacts to Riverfront Park. Based on recent survey information and the proposed roadway profile grade, the vertical clearance provided over 2nd Street will be no less than the existing posted vertical clearance of 13'-9" (a 14-foot vertical clearance has been targeted) and well in excess of the necessary 23'-6" clearance over Union Pacific Railroad track (approximately 46 feet provided). Future phases of the project have the potential to increase the clearance over 2nd Street through changes to the vertical profile. Substructure elements are to be reinforced concrete pier caps and columns supported by drilled shafts or steel piling supported footings.

The center span (Unit 2) provides the navigational envelope required by the U.S. Coast Guard. Preliminary engineering of the substructure advocates the use of reinforced concrete pier cap and columns supported by drilled shafts. The preliminary substructure elements can most likely achieve a "No Rise" if the existing bridge substructure is removed to or below the riverbed. For the deep foundations, AASHTO vessel collision forces will need to be considered in future analysis of the piers. These forces typically control the design of the foundation elements. The types of vessel tows and impact velocities appropriate for foundation design at this location should be coordinated with the bridge owner in future phases of the design.

The Missouri approach span (Unit 3) transverses the Farley Levee and provides 20.3-feet of vertical clearance. The substructure elements, reinforced concrete pier caps and columns supported by drilled shafts or steel piling supported footings, are not in direct conflict with the levee system. However, future design phases will need to address additional requirements for the replacement bridge such as levee stability and seepage analysis, site monitoring during construction, contingency flood condition measures, and special backfill measures.

Exhibit 4.6 | Bridge Elevation

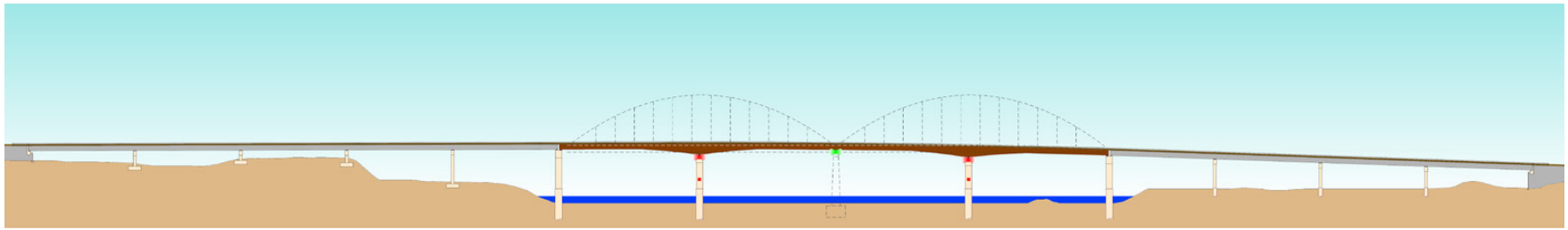
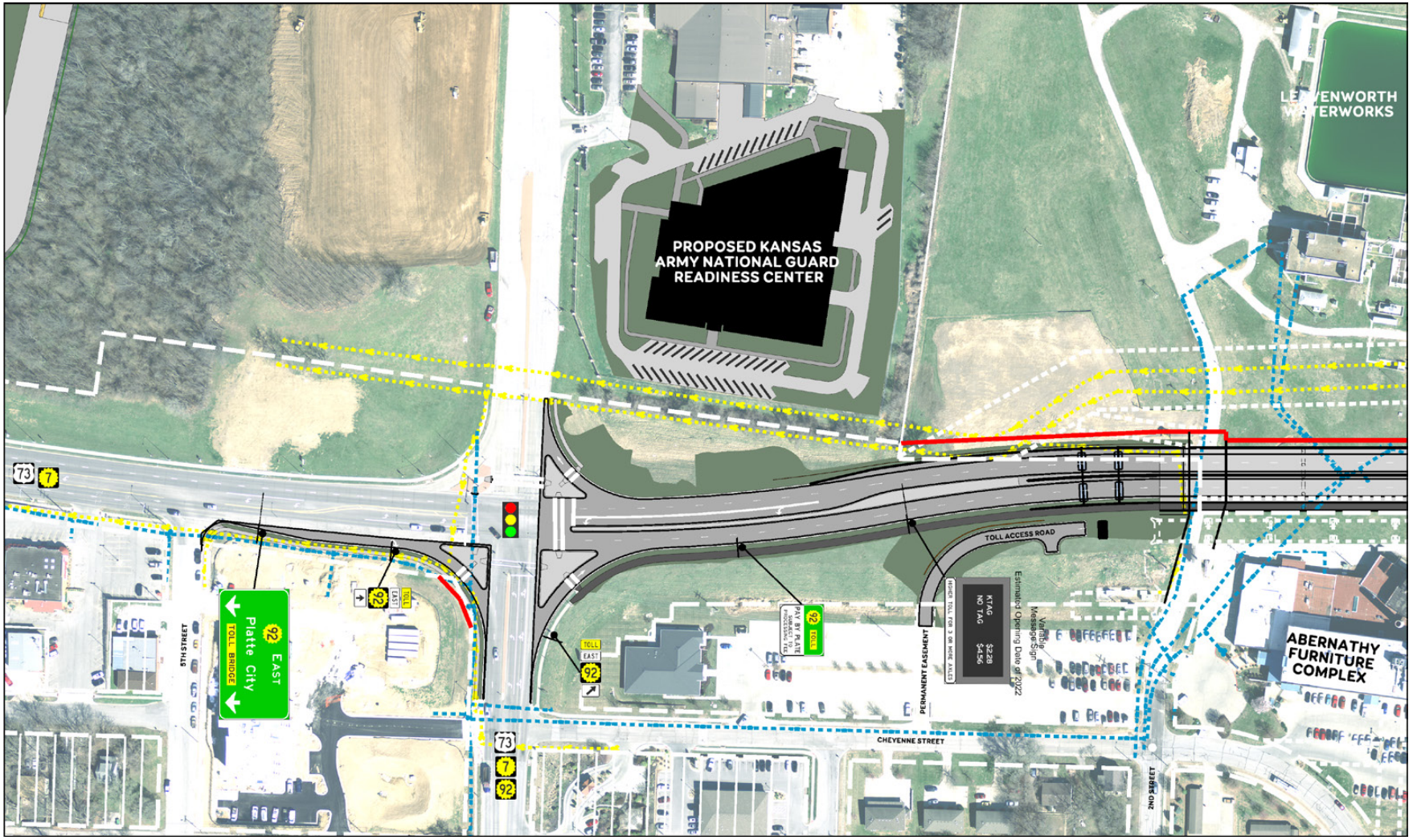


Exhibit 4.5 | Bridge and Roadway Approach Alignment (Part 1 of 4)



Disclaimer: These concepts depict potential improvements to Route 92 and the local street network from Metropolitan Avenue (US-73/K-7) at 5th Street across the Missouri River to and through the Route 92 and Spur 45 junction. The exact location, design, and right-of-way for this project cannot be determined from these concepts and could be different from that shown. Preliminary design will need to be completed to refine the improvements and right-of-way requirements. At the time of design, all applicable guidelines will be utilized and could be different from that shown. The aerial photograph along the highway in Kansas is current as of Fall 2014 and in Missouri is current as of Spring 2012.

Exhibit 4.5 | Bridge and Roadway Approach Alignment (Part 2 of 4)

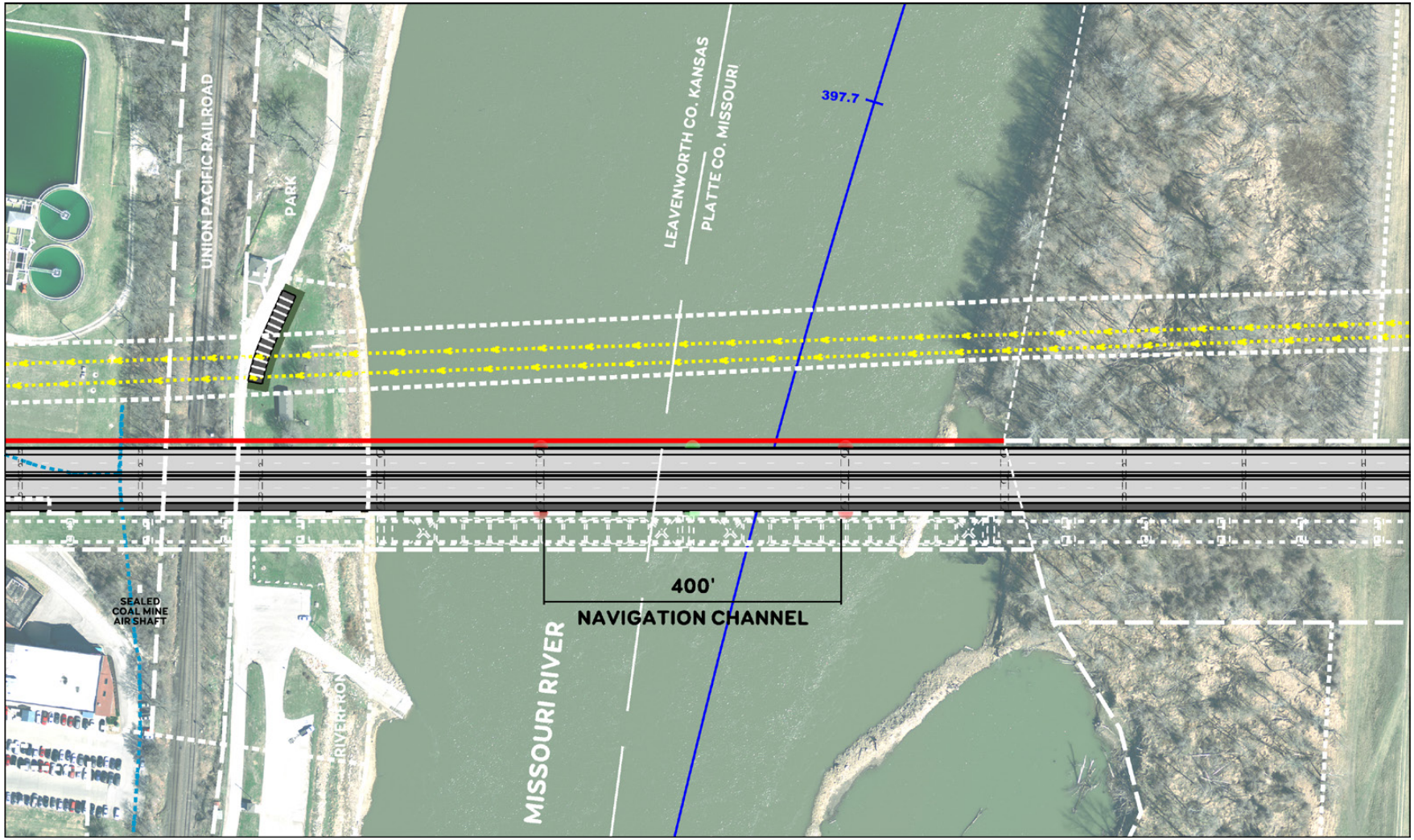


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Exhibit 4.5 | Bridge and Roadway Approach Alignment (Part 3 of 4)

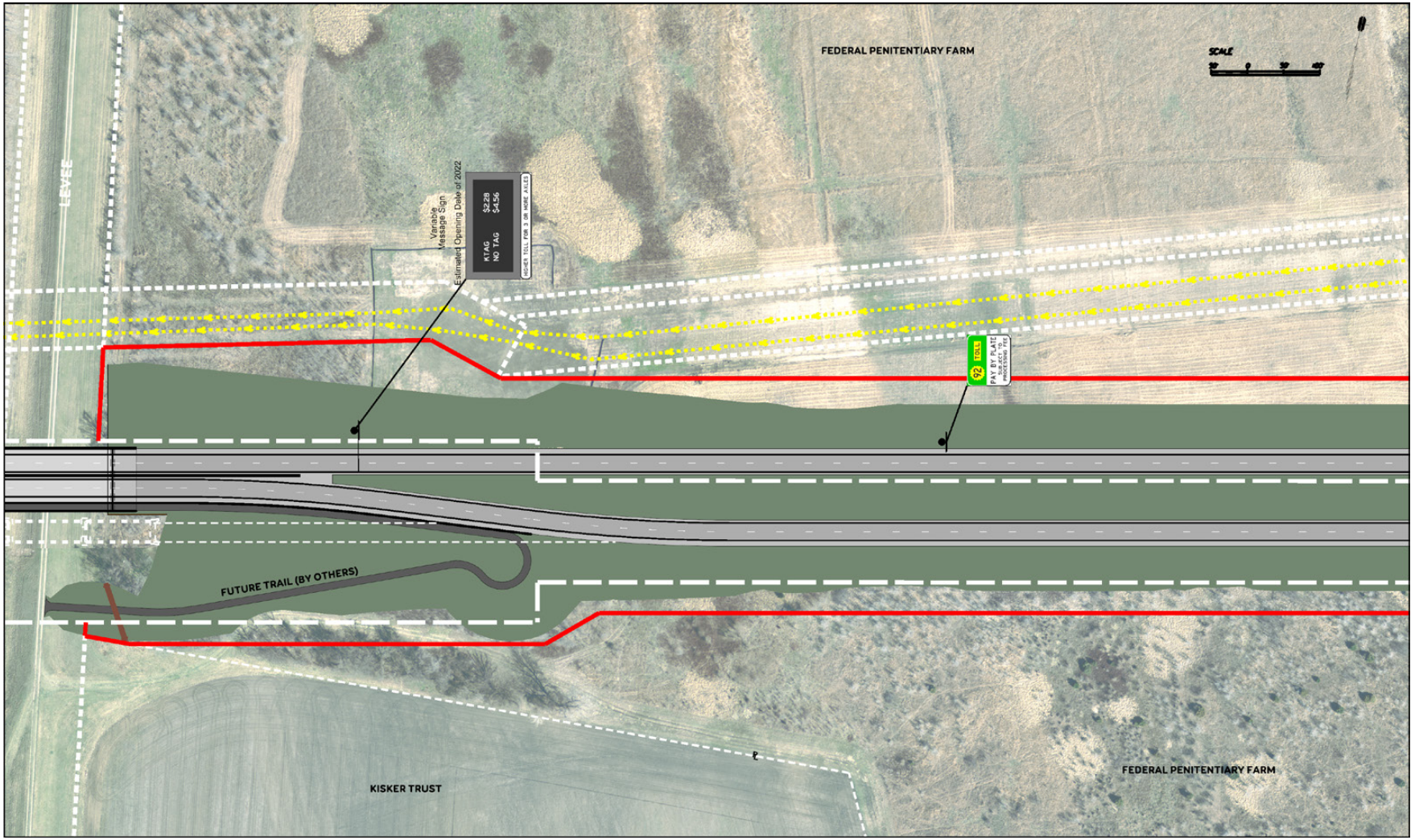

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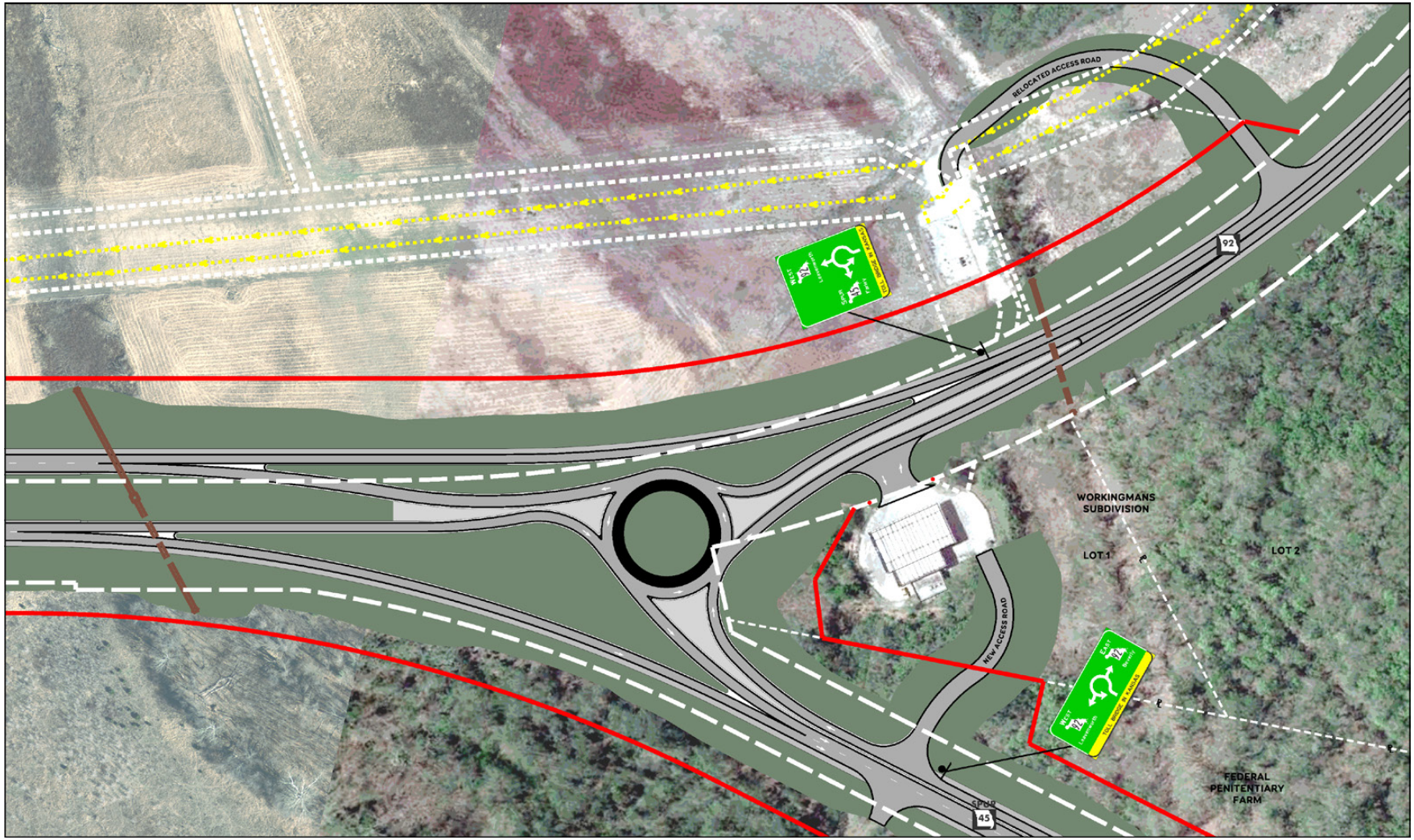
Exhibit 4.5 | Bridge and Roadway Approach Alignment (Part 4 of 4)



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TYPICAL SECTION

The new bridge deck 87'-8" cross section includes four 12-foot traffic lanes, two 4-foot inside shoulders, and two 8-foot outside shoulders over the full length of the bridge. The eastbound and westbound traffic is separated by a 2'-1" wide median barrier. The replacement configuration includes a single 10-foot wide shared-use path, which is the minimum width recommended for two-directional use per the *AASHTO Guide for the Department of Bicycle Facilities: 4th Edition (2012)*. Users of the shared-use path are separated from vehicular traffic by a 42-inch safety barrier curb. A 32-inch safety barrier curb on the upstream edge and a railing with a minimum height of 42 inches on the upstream edge complete the 87'-8" deck cross section. Additional fencing will be required on each side of the bridge over the Union Pacific Railroad right-of-way. Per the BNSF Railway – Union Pacific Railroad *Guidelines for Railroad Grade Separation Projects*, the minimum combined height of a barrier rail with a straight fence shall be 10 feet and extend to the limits of the railroad right-of-way. The typical cross sections for the approaches and main span are displayed in Exhibit 4.7 and Exhibit 4.8, respectively.

INTERSECTION CONFIGURATIONS

Metropolitan Avenue and 4th Street

With gate operations at the Sherman Gate in Fort Leavenworth permanently altered as of February 2015, lane configurations on the north leg of the Metropolitan Avenue and Sherman Avenue intersection were reviewed to respond to significantly less traffic volumes entering the Sherman Gate. Northbound traffic on Sherman Avenue is nominal and does not warrant an exclusive westbound right-turn lane or two northbound lanes, even when considering the traffic impact of the proposed National Guard Readiness Center.

Responding to this change in traffic usage results in removing the channelizing island in the northeast quadrant of the intersection as well as allowing for a reduction from two lanes to one northbound through lane from 4th Street. The extra northbound through lane can be converted to an exclusive northbound right-turn lane onto the proposed bridge. Assuming tolling operations, this change facilitates signing and pavement markings associated with advance information about tolling on the replacement Centennial Bridge.

The southbound lane configuration on Sherman Avenue can also be modified to remove the channelizing island in the northwest quadrant and provide a single southbound right-turn lane, a single southbound through lane, and a single southbound left-turn lane. The changes can also include striping out the second southbound through lane, thereby allowing the exclusive eastbound right-turn lane to access its own dedicated southbound through lane.

Operational analysis with these lane configurations indicate an overall improvement in the intersection level of service as well as benefits to approach levels of service. While the current configuration of Sherman Avenue would operate at a similar level of service, the described modifications respond to the traffic volumes using the intersection and their limited duration of use. Consequently, it is suggested that such modifications be considered when future improvements are made to this intersection.

It is acknowledged that signal operation at the 4th Street intersection is directly linked with the 7th Street intersection. Consequently, continued coordination is needed to monitor traffic operations with particular attention to the extent of queuing vehicles traveling in the westbound direction on Metropolitan Avenue in the AM peak period. Extending the exclusive right-turn lane into the Grant Gate further to the east could assist in removing motorists from spilling over into the westbound through curb lane. The Metropolitan Avenue and 4th Street intersection configuration is displayed in Exhibit 4.9.

Route 92 and Spur 45

The Route 92 and Spur 45 junction is currently a three-legged intersection with approach Spur 45 traffic under stop control. Current and future no-build operations indicate that the capacity of this intersection needs to be improved. Historic crash experience also indicates a need for improvements. A range of improvement concepts, from a roundabout to a traffic signal to a grade separation, were considered at this junction.

- Traffic signal warrants were reviewed for current traffic volumes for peak-hour and eight-hour warrants. Peak-hour warrants are met although eight-hour warrants are unlikely to be met.

- A grade separation concept could be considered though the cost with extensive fill, retaining walls, and a bridge structure is significant for the level of traffic volumes.

Exhibit 4.7 | Typical Cross Section for Bridge Approach

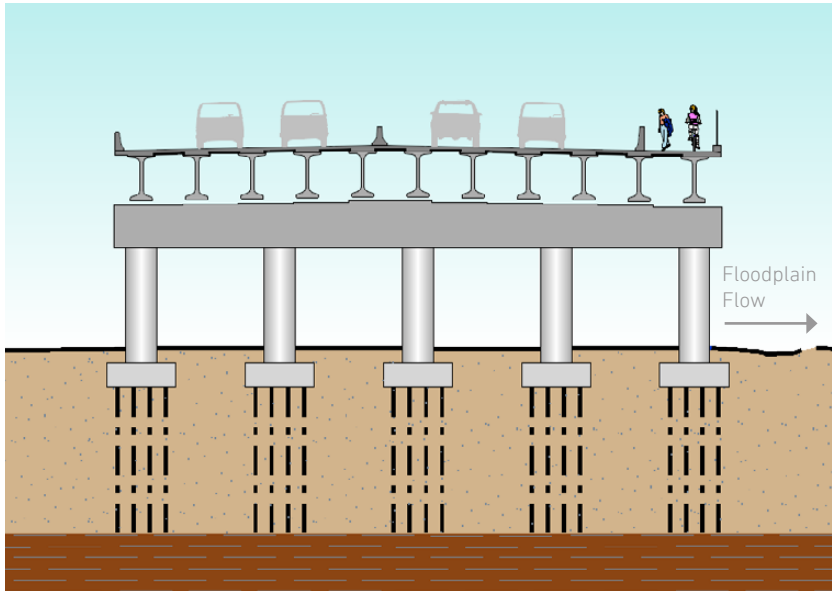


Exhibit 4.8 | Typical Cross Section for Bridge Main Span

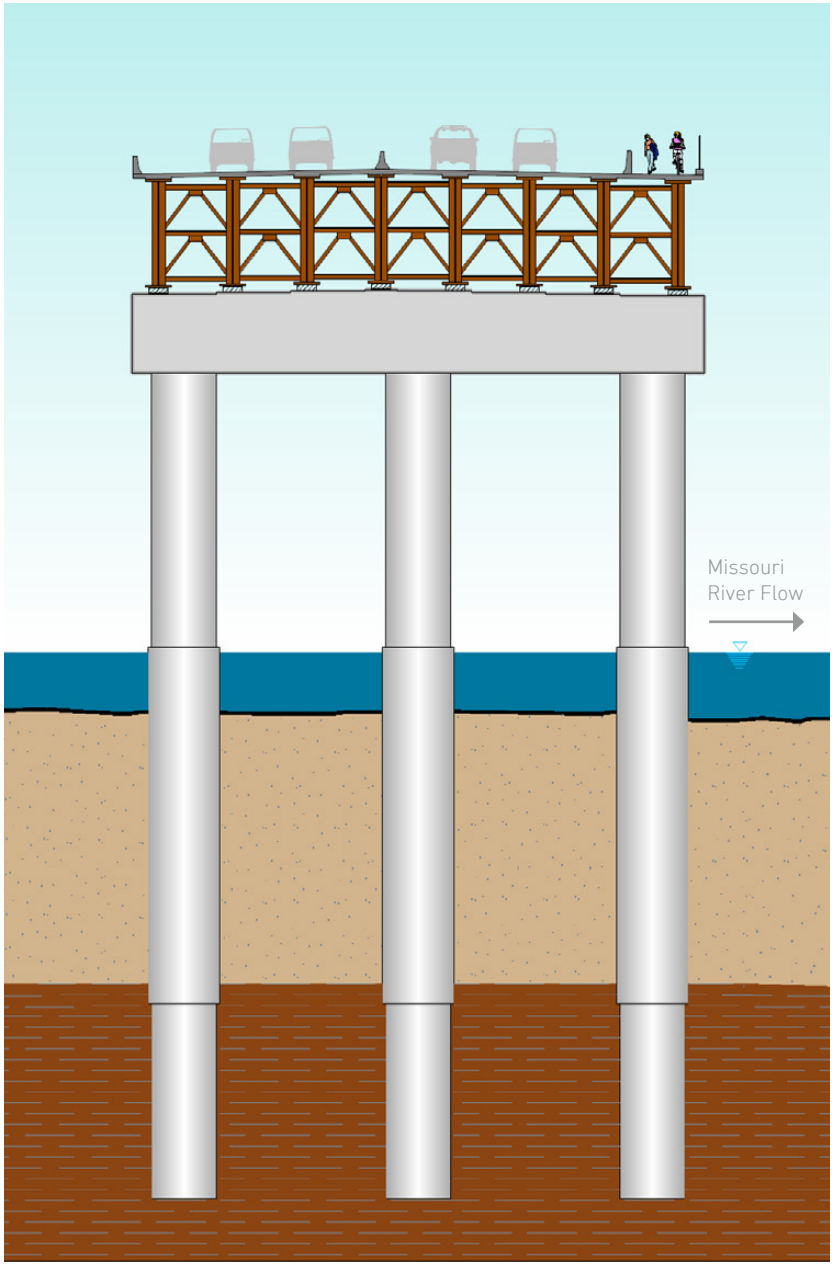
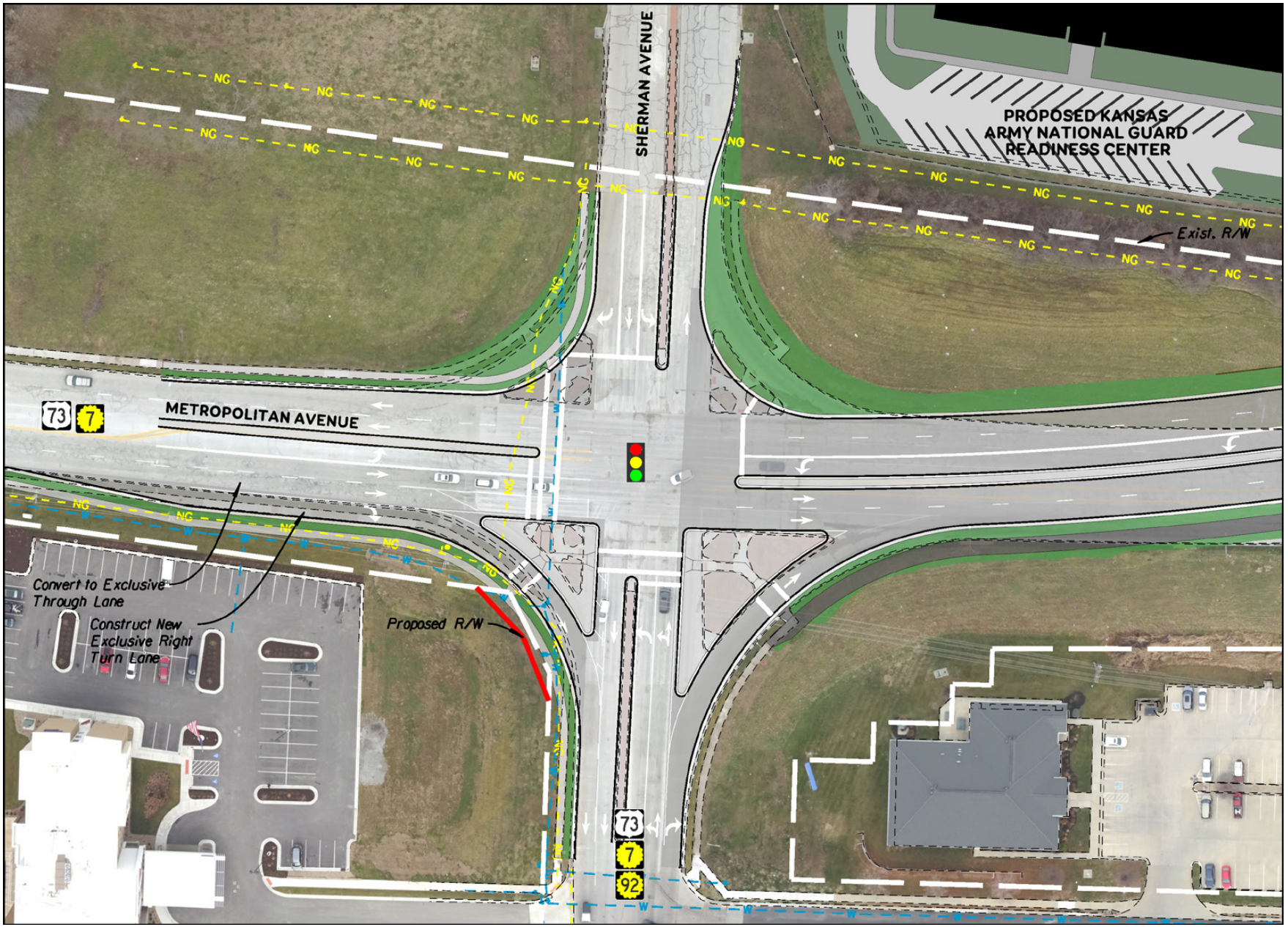


Exhibit 4.9 | 4th Street and Metropolitan Avenue Intersection



– A roundabout concept was also considered. Because of heavy directional traffic movements at various times of the day, bypass lanes were also considered in the roundabout design. Roundabout capacity analysis suggests that operations would be acceptable with the exception of the westbound Route 92 movement to Spur 45 southbound. This traffic movement is very low (less than ten vehicles in the PM peak hour) and observations suggest that it is associated with pass-by trips to the adjacent gas station/ convenience store. The roundabout concept with the bypass lanes has the added benefit of integrating the transition to and from the four-lane bridge approach to the split of traffic between Route 92 and Spur 45. Additional design elements associated with the roundabout concept include relocating access to several adjacent properties.

Safety issues at this intersection suggest that improvements may need to occur before the construction of the bridge replacement. Consequently, it is suggested that the roundabout design be developed in a manner that could be implemented with the current two-lane bridge approach configuration while being adaptable to the future four-lane bridge approach. The roundabout concept is displayed in Exhibit 4.10.

TOLLING EQUIPMENT AND SIGNING

The potential toll collection system is envisioned to use All Electronic Tolling collection. This includes an overhead gantry to support the detection and monitoring equipment to collect tolls through an established transponder or though license plate reading and follow-up mailings. The gantries are proposed immediately west of the west bridge abutment. The equipment would require various utility connections for power, cameras, and computers. A secured equipment pad site would be located nearby on the Kansas side of the Missouri River. The pad would require maintenance access, though not directly from Route 92. With the new bridge proposed on the north side, the existing roadway offers a location for the equipment pad and maintenance access. Signing and notification of tolling as one approaches the bridge are also important considerations. Conceptual signing locations and types have been considered on both approaches to provide advance information to motorists. The concepts include overhead signing along with pavement markings for the eastbound through lanes on Metropolitan Avenue. Overhead changeable message signs are proposed on both approaches. The conceptual signing associated with tolling is displayed on the plans in Exhibit 4.5.

COST ESTIMATE FOR SELECTED ALIGNMENT

Cost estimates are provided for construction activities as well programing elements such as design, construction engineering, and right-of-way. Because of the Tolling & Revenue component of the study, Operations & Maintenance (O&M) costs for a 40-year period are also provided. Until the project is programmed, all costs are expressed in current fiscal year dollar (FY 2016). It would be appropriate to inflate the current cost to the mid-point of the earliest construction period (FY 2021) at a later time.

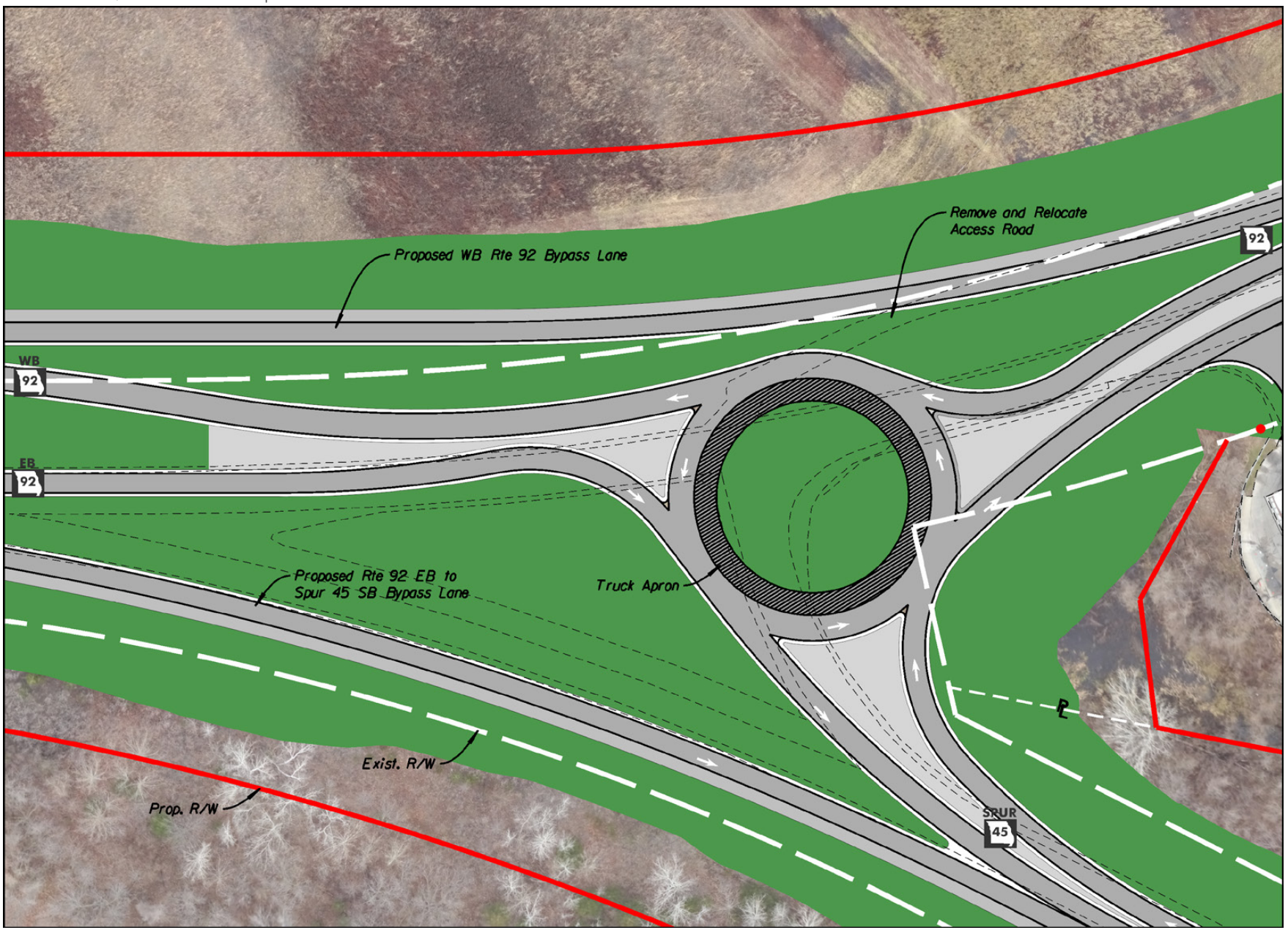
The project assumes the removal of the existing bridge and roadway approaches and construction of the replacement bridge, associated roadway approaches, and tolling facilities as displayed in Exhibit 4.5. Probable project costs, including contingencies, are summarized in Exhibit 4.11. Additional information concerning the various line items is provided in the appendix.

CONSTRUCTION COSTS

Construction costs in Exhibit 4.10 are discussed by major categories such as bridge, roadway, and tolling line items. The items are summarized by roadway approach:

– Kansas (roadway approach from 4th Street to bridge)
– Missouri River Bridge
– Missouri (roadway approach from bridge to Spur 45)

Exhibit 4.10 | Route 92 and Spur 45 Roundabout



Unit costs are based upon recent KDOT bid tabs. Contingency percentages have been applied though the rates vary by line item. Bridge costs are expected to be shared evenly by each state. Roadway approaches and other line items are expected to be the responsibility of the respective state. The construction cost estimate, when rounded to the nearest $5 million, is $80 million.

Missouri River Bridge

The cost estimates for the bridge focused on obtaining costs from ongoing or recently completed projects and current market conditions. The cost estimate is based on a square-footage quantity take-off, which reflects historical pricing information of similar bridge types within the nearby region. The historical costs were based on bid or construction unit prices for the materials necessary to construct a bridge. Therefore, these bridge costs represent a rolled-up summary of a large number of cost items and required some judgment in using historical unit price values to account for differences between projects.

Roadway

The roadway elements focus upon construction of the new roadway approaches that include grading and surfacing. The grading consists of earthwork and erosion control. Earthwork quantities were developed utilizing the roadway profile and applying the roadway section to a topographic model of the area. The earthwork component of the project needs significant quantities of fill and is likely to require contractor-furnished borrow pits. Surfacing includes all the roadway and its pavement. The traffic line item includes signals and signing.

Roadway lighting costs are assumed to be the responsibility of the local agency. The City of Leavenworth owns and maintains the existing street lights. Additional items such as existing pavement removal, maintenance of traffic during construction, and miscellaneous items with mobilization are also included, often as

Exhibit 4.11 | Probable Project Costs (FY 2016 million dollars)

Construction Costs	Kansas	Bridge	Missouri
Roadway	3.5	-	12.5
Bridge Removal	-	2.0	-
Bridge Structure	-	44.8	-
Bridge Shared-Use Path	-	6.4	-
Tolling Equipment	3.3	-	-
Miscellaneous	0.6	3.8	1.3
Construction Cost (by Element)	**7.4**	**57.0**	**13.8**
Construction Cost (by State)	**35.9**		**42.2**
Construction Cost (Total)	**$78.1 million**		
Construction Cost (Rounded)	**$80 million**		
Tolling Coverage	Kansas	Bridge	Missouri
Tolling Coverage (Kansas/Bridge)	$65 million		-
Programming Costs	Kansas		Missouri
Right-of-Way	0.06		0.06
Utilities	0.30		0.01
Construction Engineering	11.5		
Programming Cost (Total)	**$11.9 million**		
Total Project Costs (Rounded)	**$90 million**		
Other Costs	Kansas	Bridge	Missouri
Aesthetics	TBD		-
Off-Bridge Shared-Use Path	0.1	-	0.2
Roadway Lighting	0.2		-

a percentage of the subtotal of construction items. Retaining walls and other structures such as drainage are provided.

PROGRAMMING COSTS

Programming costs consist of additional project-related items such as right-of-way, utilities, and construction engineering. Construction engineering is estimated at 15 percent of the subtotal of construction costs.

The right-of-way costs are estimated based upon a cost per acre or cost per square foot depending upon the size of the area to be acquired. Unit costs can vary by the type of land use and whether the impacts affect improved or unimproved property. In addition to right-of-way acquisition, mitigation for impacts to relocate parking stalls in Riverfront Park can be included. A separate sheet with properties affected and current valuations as available through County Assessor's offices is included in the appendix. Right-of-way costs can vary through negotiations. At this time the right-of-way costs should be considered a placeholder subject to further evaluation as the design proceeds.

A utility access corridor is anticipated to be provided along the proposed bridge. This utility access corridor would replace the current service lines on the bridge. It is also proposed that spare lines be provided for potential future utility use. Utility relocation costs have been estimated for those affected utilities in separate easements or utilities directly affected by the bridge construction.

The majority of affected utilities are located in the immediate area of the Kansas approach. The extent and degree of any relocation will need to be coordinated with the affected utility. At this time, utility relocation costs are associated with Southern Star and Leavenworth WaterWorks. Discussions with Leavenworth WaterWorks acknowledge the potential for consolidating water lines into one larger main. Consolidation could assist in creating a protected utility corridor passing beneath the proposed bridge, which could address drainage beneath and alongside the proposed bridge. Further coordination is recommended to develop a comprehensive design plan for the area beneath the proposed bridge. An overhead electric crossing near 2nd Street is recommended to be relocated underground passing beneath the proposed bridge. Cost sharing for utility relocation and construction will be negotiated during future design phases.

Construction engineering costs are estimated at approximately 15 percent of the subtotal of construction items. Elements such as surveying, nontechnical investigations, design, permitting, and construction inspections are included in the Construction Engineering category.

OPERATIONS & MAINTENANCE COSTS

The inclusion of Operation & Maintenance (O&M) costs as part of the Tolling & Revenue analysis necessitates establishing and documenting various costs for the project. The O&M costs are divided into three categories: bridge, roadway, and tolling. Each are described separately though the principles of periodic maintenance and/or repair followed by replacement at the end of the life cycle remain the same for each. Each of the elements under consideration have different life cycles. For example, the life of a bridge is longer than the pavement approaches. With technological changes to software and other electronic equipment upgrades, the life cycle for tolling equipment may occur even more frequently. The Tolling & Revenue study is forecasting a forty-year revenue stream after the opening date of the facility and the start of toll collection. Once an element's life cycle is complete, the element is assumed to be replaced and the life cycle repeated. Probable costs have been developed in FY 2016 and then inflated to future year expenditure. Costs over the forty-year period are summarized in Exhibit 4.12 while O&M costs by type are summarized and Exhibit 4.13.

For consistency with cost estimating and agency responsibility, lighting, whether on the bridge or roadway, is assumed to be funded by the local agency. Consequently, any repairs or replacements throughout the O&M period are the responsibility of the local agency and are not included within this cost assessment.

Missouri River Bridge

The bridge's life cycle is assumed to be 100 years. Major and minor maintenance elements are considered and tracked separately.

Elements assumed to need repairs include:

- Wearing surface (every 5 years)
- Barrier (every 5 and 10 years)
- Substructure (every 5 and 10 years)
- Deck (every 20 years)
- Main span drainage systems (every 20 years)
- Approach span drainage systems (every 25 years)
- Miscellaneous repairs ($40,000 every year)
- Biennial inspection (every 2 years)

Elements assumed to need replacement include:

- Wearing surface (every 20 years)
- Bearings (every 25 years)
- Expansion joints (every 25 years)

It is recommended that future life cycle cost evaluations follow the FHWA recommendations and those presented in *National Cooperative Highway Research Program (NCHRP) Report 483 - Bridge Life Cycle Cost Analysis* in the performance of a life cycle cost analysis. For future analysis, the life cycle cost analysis should be evaluated with a range of discount rate values. Current recommendations from the U.S. Office of Management and Budget are to use a three percent real discount rate.

Exhibit 4.12 | 40-Year Operation & Maintenance Costs

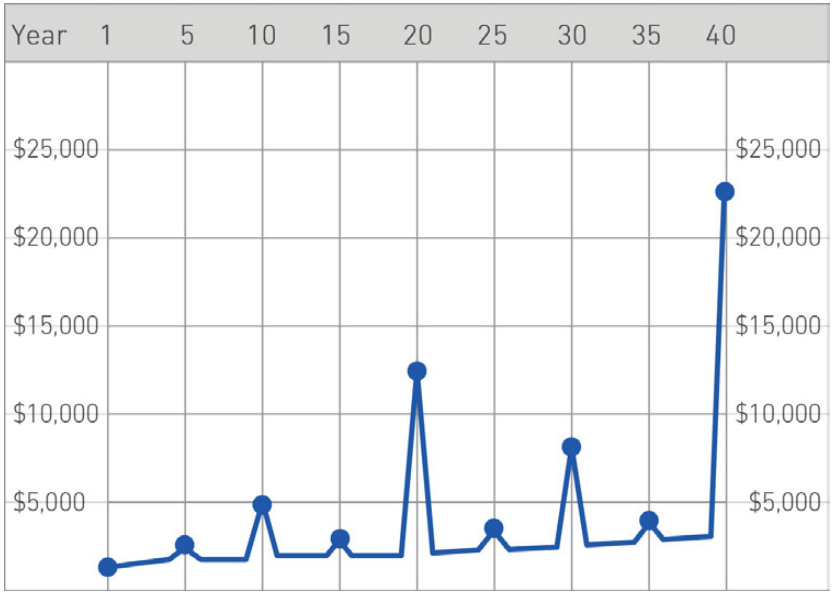
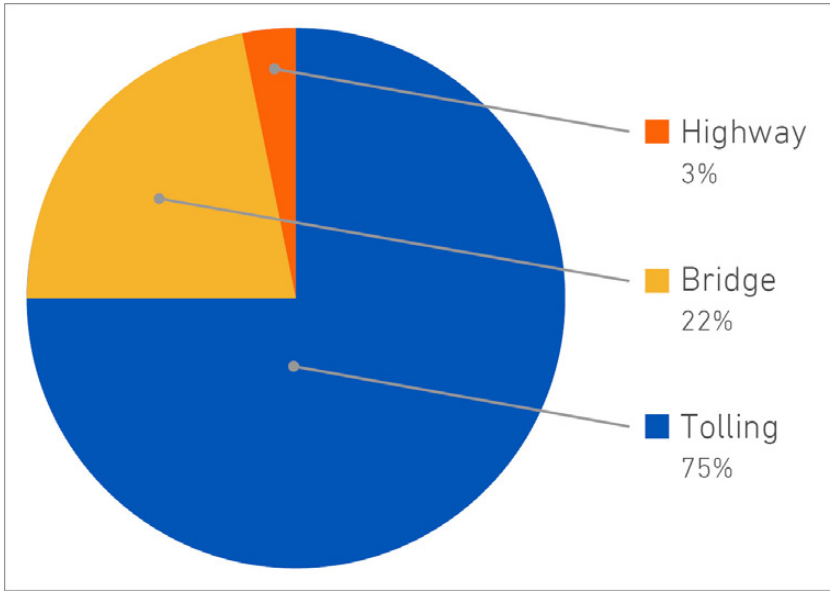


Exhibit 4.13 | 40-Year Operation & Maintenance Costs by Type



Roadway
The roadway's pavement life cycle is assumed to be 40 years. The pavement design assumes concrete with a life cycle of 40 years on a 30-year design. Through rehabilitation, the pavement's life is extended another ten years. Elements assumed to require maintenance include striping with a replacement every two years. General maintenance costs for snow plowing and mowing are also accounted for in the estimate.

Tolling
Tolling has an operations cost as well as an administrative cost. These costs are dependent upon the type of toll collection system and the Tolling Authority's business practices. Any roadway infrastructure around, adjacent, or inclusive with the tolling infrastructure is accounted for with the roadway O&M costs. The tolling facility's equipment life cycle varies depending upon element type and their replacement schedule, including:

- Toll equipment (every 10 years at $100,000 per lane)
- Toll system excluding software (every 10 years at $200,000)
- Toll software (update every 10 years at $1.2 million)

In addition, high-speed Internet or fiber communications will be utilized. While the contracted tolling vendor would provide their existing Customer Service Center, additional staff is anticipated to review violation images and assist with transponder mailings. Various unit costs were developed for mailings and fulfillment as well as Department of Motor Vehicles lookup charges for out-of-state violators.

PUBLIC INPUT

During the Corridor Selection phase of the study, Advisory Committee Meeting #2 and Public Open House #2 were held. The major focus was to explain the process of developing and evaluating alternatives while providing a direction for recommended location, type, and cost of the replacement bridge.

Copies of material distributed at each meeting including agendas, presentations, public meeting display boards, sign-in sheets, and raw comment forms are included in the appendix.

ADVISORY COMMITTEE MEETING #2

Advisory Committee Meeting #2 was held in April 2015 at the Leavenworth County Public Library. Handouts included an Initial Alternatives Map and Comparative Summary. The Advisory Committee was updated regarding feedback from the January Public Open House #1 meetings and on one-on-one stakeholder discussions. Alternative locations for a replacement bridge and bridge types and features were presented and compared during the meeting.

Questions and concerns at the second meeting included:

- Details on the proposed cross section of the bridge
- Bicycle and pedestrian accommodations
- Aesthetic enhancements
- Preserving the Centennial Bridge in addition to constructing a new bridge

PUBLIC OPEN HOUSE #2

Approximately 65 individuals attended the second set of Public Open House meetings in July 2015. One meeting was held in Platte County while another was held in Leavenworth County. Photos from the two meetings are displayed in Exhibit 4.14 and Exhibit 4.15, respectively.

A general information handout was distributed. A detailed survey was provided to attendees with specific questions regarding demographic information, frequency of travel, reasons for travel, location of a replacement bridge, bicycle and pedestrian accommodations, and aesthetic enhancements. Space was also provided at the end of the survey for general comments. Approximately 50 meeting attendees completed a survey.

To supplement the survey provided at Public Open House #2, an online version of the survey was made available. The survey link was emailed to all stakeholders on the project's master contact list. The survey was available on KDOT social media outlets and on the KDOT website. It was also provided to the Advisory Committee to share with their respective constituencies. The online survey, which was accessible from July 24 through August 31, collected 290 responses.

Highlights from the Public Open House and surveys included:

- The most common frequency of bridge travel among survey respondents was less than three times per week.
- The most popular reason selected for bridge travel was shopping, recreation, and restaurants.
- The most popular choice for the location of a replacement bridge was adjacent to the current bridge.
- Bicycle and pedestrian access was deemed important with safety being the number one reason.

A common question asked by many attending the Public Open Houses and through comments on the website centered on the perception that the existing bridge would be closed while the replacement bridge was under construction. The construction sequencing envisions building the new four-lane bridge while maintaining traffic on the existing two-lane bridge. This would be the case for the majority of the construction period. Some closures or land restrictions may be necessary when tie-ins to existing roadways occur.

Exhibit 4.14 | Public Open House #2 in Platte County

Exhibit 4.15 | Public Open House #2 in Leavenworth County

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5 | TOLLING & REVENUE STUDY

An Intermediate (Level 2) Tolling & Revenue (T&R) study was conducted for the proposed Centennial Bridge replacement project. The analysis is part of KDOT's ongoing efforts to evaluate the financial feasibility of the proposed toll bridge. The T&R study includes an overview of the project location, existing travel conditions, data collection, and assumptions. It also provides Intermediate (Level 2) traffic and toll revenue forecasts for the proposed Centennial Bridge replacement under a toll bridge assumption.

Available regional travel demand models were used to reflect the most recent regional transportation plans and socio-economic datasets developed for the region. This chapter provides long-term T&R estimates for the proposed toll bridge and supports the financial feasibility analysis.

The T&R phase includes the following elements:

- Tolling & Revenue Study Overview
- Project Description
- Existing Conditions and Data Collection
- Socio-Economic Review
- Travel Demand Model Calibration
- Traffic and Revenue
- Traffic and Toll Revenue Estimates
- Financial Feasibility

TOLLING & REVENUE STUDY OVERVIEW

Based on the level of detail, time, and resources required, most T&R studies are grouped into the following three categories:

- Sketch-Level (Level 1): This level involves using generic input assumptions, high-level analysis tools and is reliant on limited data collection to develop high-level T&R estimates.

- Intermediate (Level 2): This level involves some data collection, use of validated travel demand modeling tools, refined T&R and other assumptions, updated socio-economic data, and limited corridor origin-destination data.

- Investment-Grade or Comprehensive (Level 3): This level involves extensive data collection efforts including a detailed traffic count program, detailed assumptions related to project configuration, origin-destination data, corridor-specific value of time data, independent socio-economic reviews, and calibrated travel demand models.

As displayed in Exhibit 5.1, the level of precision and confidence range improves with each level of the T&R study. The toll revenue potential of the Centennial Bridge replacement included traffic and revenue estimates that are consistent with an Intermediate (Level 2) T&R analysis. This chapter describes the data collection efforts within the corridor and along the adjacent competing and feeder routes, the methodology used to modify and develop the models used to estimate future year traffic forecasts, and the 30-year Intermediate T&R forecasts for the proposed facility.

PROJECT DESCRIPTION

The Centennial Bridge originally opened as a toll bridge to traffic in 1955 with the tolls being discontinued in 1977. The existing

Exhibit 5.1 | Tolling and Revenue Study Levels

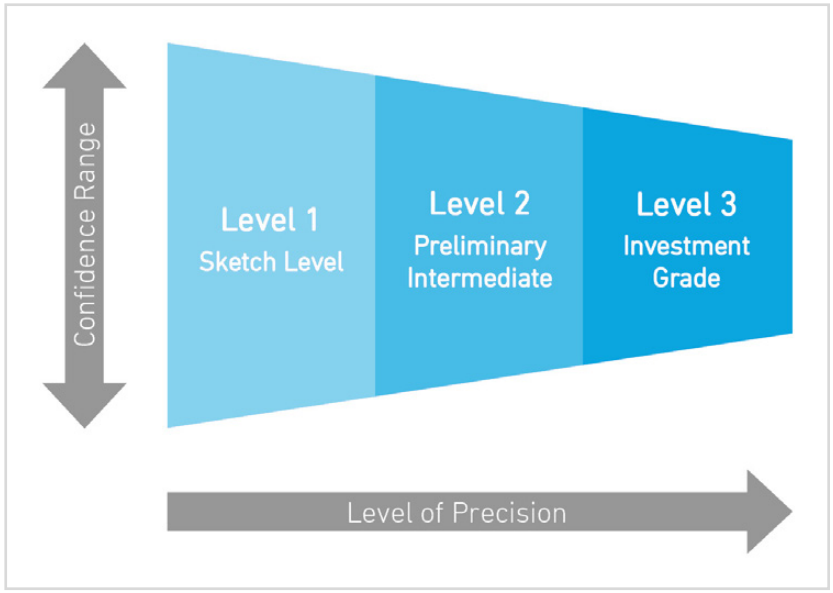
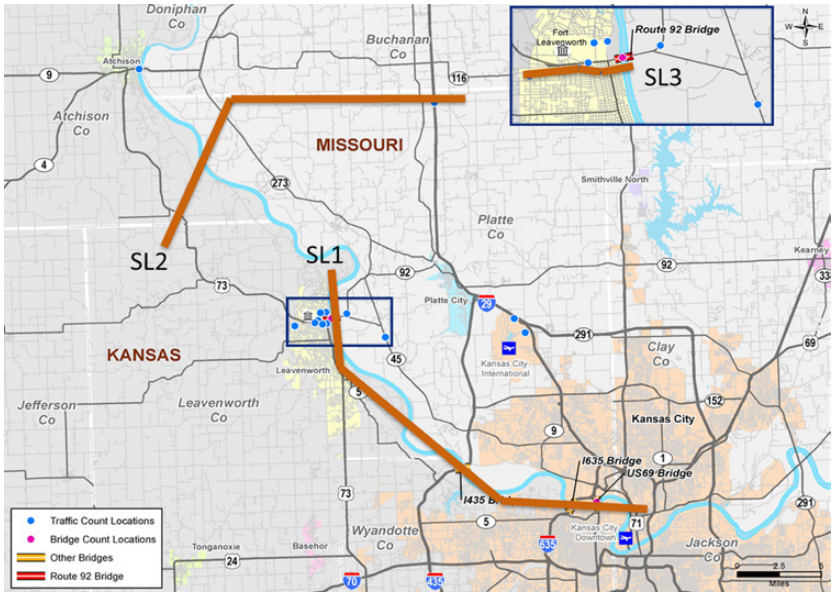


Exhibit 5.2 | Traffic Count Map



two-lane bridge is currently the only Missouri River crossing into the Leavenworth area. The Centennial Bridge replacement is a proposed four-lane tolled Missouri River crossing connecting Route 92 in Leavenworth, Kansas and Platte County, Missouri.

The forecasts reflect the latest socio-economic growth assumptions and updated assumptions on future highway improvements for the Kansas City region including planned highway, arterial, and toll road improvements. It also includes assumptions regarding future toll rates and other key variables. This analysis evaluates the proposed construction of a new toll bridge to replace the existing bridge and the tolling and revenue it can be expected to generate.

EXISTING CONDITIONS AND DATA COLLECTION

Extensive data collection efforts were completed to understand current traffic conditions and traffic patterns near the Route 92 study corridor and the roadway system within the surrounding study area. A series of data collection exercises were conducted in 2015 including:

- Traffic counts
- Historical traffic growth
- Intercept origin-destination survey
- Stated preference survey
- AirSage survey

The data was analyzed and used to refine the travel demand models and to develop T&R forecasts for the Centennial Bridge replacement. Detailed information about the data collection efforts is included in the appendix.

TRAFFIC COUNTS

Traffic count data were used to analyze the total corridor traffic trends and to ensure that the travel demand model outputs used in the traffic forecasting process reflected current traffic

characteristics. The traffic counts at the three screenlines (SL) displayed in Exhibit 5.2 were collected for the base year model calibration process. Traffic counts were collected for 48-hour periods in March 2015 and October 2015. Additionally, a few classification counts were collected in the vicinity of the study area. Classification counts indicated that only about two percent of vehicles on the Route 92 bridge had three or more axles.

Based on hourly traffic distribution described in Chapter 2, a typical commuting pattern is evident with a prominent AM peak traffic pattern in the westbound direction and PM peak in the eastbound direction. The AM peak occurs between 7:00 AM and 8:00 AM while the PM peak is between 4:00 PM and 5:00 PM.

HISTORICAL TRAFFIC GROWTH

Historical counts from KDOT and MoDOT were also reviewed. Traffic on Route 92, I-435, I-635 and U.S. 69 increased at average annual growth rates of 4.3 percent, 7.2 percent, 5.3 percent, and 7.2 percent respectively during the period between 1990 and 2000. With the exception of I-435, the growth rate was relatively modest for the period between 2000 and 2013. Route 92 showed minimal growth between 2000 and 2013 compared to an annual growth of 2.8 percent on I-435 (the nearest Missouri river crossing located south of Route 92).

INTERCEPT ORIGIN-DESTINATION SURVEY

An origin-destination survey was conducted on April 1, 2015 along both Route 92 and Spur 45 in Missouri in the eastbound direction from 7:00 AM to 6:00 PM. Survey data was collected using mobile devices that allowed interviewers to instantly geocode origin and destination locations and verify those locations with the driver of the vehicle. Based upon hourly traffic counts, a percentage of vehicles was surveyed in order to achieve statistically valid results. The survey was designed to gather the following information: trip origin, trip destination, trip route, trip purpose, vehicle type, number of occupants, state of vehicle registration, time of day when vehicle crossed the Centennial Bridge, and if a return trip would be made in the opposite direction.

Over 700 motorists were interviewed, which resulted in a precision of +/- three percent at the 95 percent confidence level. About 91 percent of surveyed trips originated in the City of Leavenworth with 22 percent directly from Fort Leavenworth. Another three percent originated in Atchison, Kansas while two percent originated in Lansing, Kansas. About 47 percent of the vehicles were registered in the State of Kansas with 38 percent registered in the State of Missouri. The remaining 15 percent were registered in various other states.

STATED PREFERENCE SURVEY

A stated preference survey was administered during Summer 2015. The purpose of the survey was to assess the willingness of people to pay a toll to use the Centennial Bridge replacement. The survey was administered to a stratified random sample of over 900 residents who made a 10-minute or longer trip that crossed the Centennial Bridge or I-435 river crossing during the past three months. The sample was stratified by geography to ensure that at least 300 surveys were completed in each of the following three areas: City of Leavenworth, Leavenworth County outside the city limits, and northwest Platte County.

AIRSAGE SURVEY

AirSage uses real-time Global Positioning System (GPS) technology to capture the movement of cell phones in an area that are connected to the wireless network. The movement of cell phone data was analyzed over a month-long period. Information was collected anonymously without inconvenience to the users. Data was aggregated by transportation analysis zone and provided additional origin-destination information to incorporate into the travel demand models.

SOCIO-ECONOMIC REVIEW

A socio-economic assessment was undertaken to evaluate the validity of the current and anticipated growth of population and employment within the Kansas City region. A series of checks of the underlying demographic data from MARC including growth rates at the zonal and county level, household sizes, and median household income comparisons were conducted to ensure reasonableness of the data across model years. Additional due diligence including a review of historical population and employment growth was conducted.

HISTORIC POPULATION AND EMPLOYMENT TRENDS

A review of historical trends of the region's economic indicators, including population and employment, was performed to assess growth patterns. The population of Leavenworth County and Platte County increased by an average annual growth rate of 0.8 percent and 1.5 percent, respectively, from 1990 to 2010, adding about 43,000 new residents to the area.

FUTURE POPULATION AND EMPLOYMENT TRENDS

Exhibit 5.3 and Exhibit 5.4 indicate that the population and employment growth in Leavenworth County from 2010 to 2040 will remain at an average of 0.9 percent and 0.3 percent respectively. Platte County is expected to grow at a rate of 1.5 percent in population and 2.7 percent in employment.

Anticipated growth in population and employment by traffic analysis zone were projected from 2020 to 2040. Exhibit 5.5 indicates that there is very modest population growth projected in Leavenworth County, while zones in Platte City and Platte County show some growth in population. Exhibit 5.6 displays employment growth by zone between 2020 and 2040. The employment projections in zones in the Leavenworth area around the bridge and in the general study area will not experience significant growth in this period.

TRAVEL DEMAND MODEL CALIBRATION

The latest version of the travel demand model provided by MARC was utilized. The regional travel demand model is a four-step model that is implemented using the Emme software platform and uses a detailed zonal structure of 951 traffic analysis zones and 30 external stations to represent the Kansas City region.

For the purposes of the T&R analysis, the Emme model was converted to CDM Smith's standard toll diversion modeling framework. The model was fine-tuned for base year conditions through an application of appropriate calibration measures which were then applied to the future year model datasets. Future year traffic assignments were conducted and several sensitivity scenarios were undertaken.

For each scenario, the future year network and trip tables were developed from the calibrated toll diversion model to produce the estimated traffic demand for the proposed toll bridge for future years. Toll transactions at the tolling location were then extracted from the calibrated model and annual estimates for interim and horizon years, 2022, 2030, and 2040 were developed. Transactions and revenue for the interim years between these model years and forecast years beyond 2040 were interpolated and extrapolated, respectively. Toll revenue estimates were then calculated by applying the appropriate toll rates to the estimated transactions.

The 2015 model network was used as the base year for model validation purposes and the model was calibrated to represent observed data. To model the travel conditions more accurately, the eight zones were disaggregated, missing roads added, free flow speeds updated, and network parameters such as the number of lanes, speeds, and centroid connections near the Centennial Bridge replacement reviewed. Origin and destination trip distributions for the Centennial Bridge and I-435 river crossing were adjusted based on AirSage and intercept survey

Exhibit 5.3 | County Population Growth

County	1990[1]	2010[1]	2040	1990 - 2010	2010 - 2040
Leavenworth County, Kansas	64,371	76,227	99,329	0.8% Average Annual Growth	0.9% Average Annual Growth
Platte County, Missouri	58,274	89,322	140,512	2.2% Average Annual Growth	1.5% Average Annual Growth

Exhibit 5.4 | County Employment Growth

County	1990[2]	2010[2]	2040	1990 - 2010	2010 - 2040
Leavenworth County, Kansas	64,371	76,227	99,329	0.8% Average Annual Growth	0.9% Average Annual Growth
Platte County, Missouri	58,274	89,322	140,512	2.2% Average Annual Growth	1.5% Average Annual Growth

[1] U.S. Census Bureau, 1990, 2010
[2] Bureau of Labor Statistics, 1990, 2010

Exhibit 5.5 | Population Change from 2020-2040

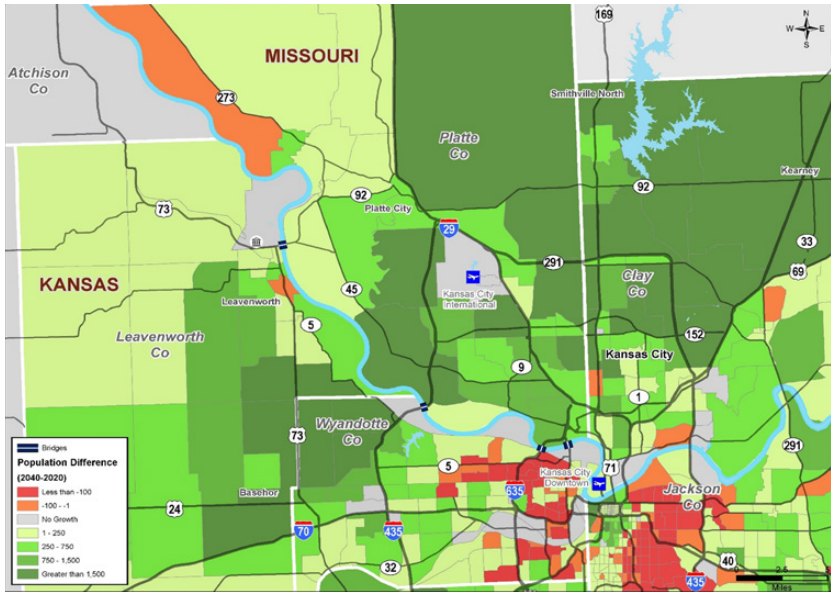
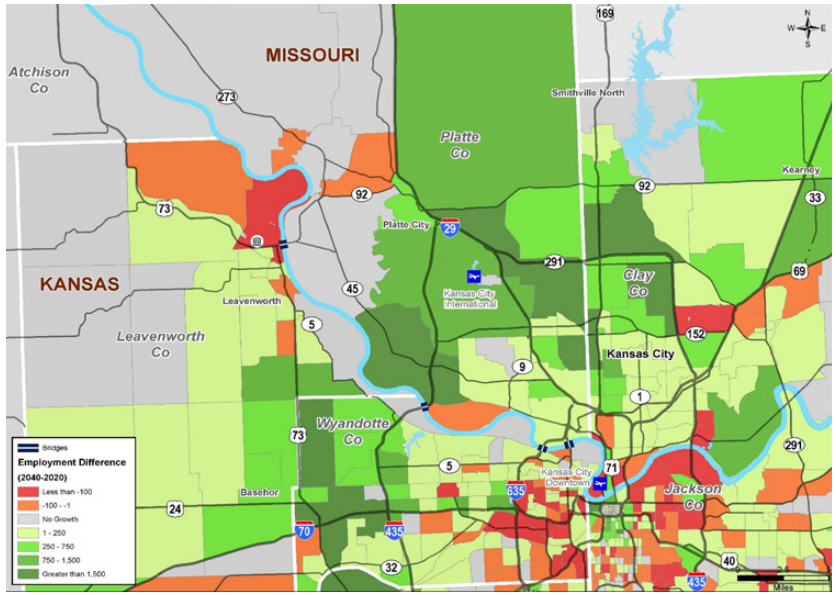


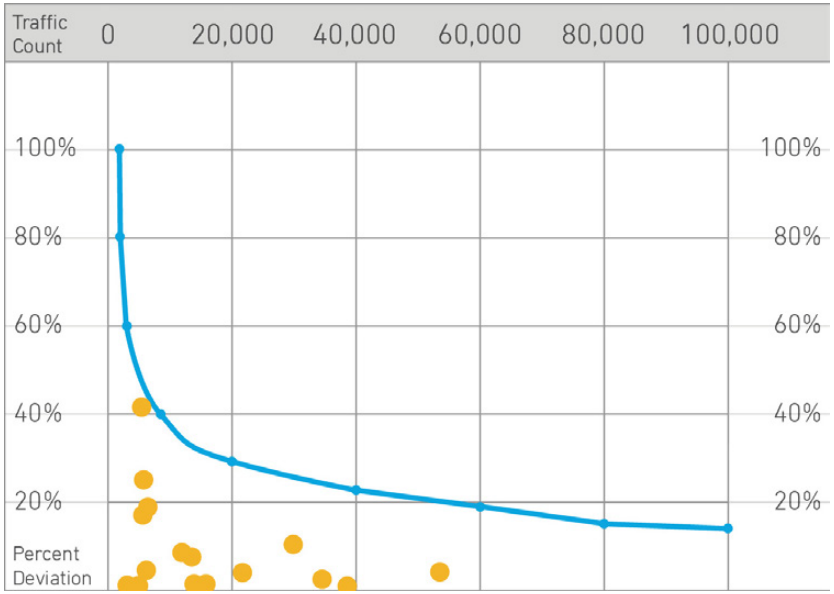
Exhibit 5.6 | Employment Change from 2020-2040



data. External zone and the airport zone trips were adjusted to match observed traffic. The modeled traffic volumes were compared to the traffic counts and actual toll transactions for various roadways to ensure that the screenline modeled volumes reasonably match the traffic counts. Exhibit 5.7 demonstrates that the model volumes at screenline locations match the traffic counts closely and the base year model calibration is within acceptable limits compared to the maximum desirable deviation specified in the *National Cooperative Highway Research Program (NCHRP) 255 Manual*.

All relevant committed transportation improvements outlined in Chapter 3 were incorporated into the future year models. These improvements were further refined after a detailed review of the region's *Transportation Outlook 2040* to ensure that major planned transportation improvements were reflected correctly in the future model networks.

Exhibit 5.7 | Comparison of Model Volumes to Traffic Counts



TRAFFIC AND REVENUE

ASSUMPTIONS

The annual traffic and toll revenue estimates for the base case were developed using the following assumptions. Any significant departure from the assumptions could materially affect the estimated T&R for the proposed project.

The proposed Centennial Bridge replacement was assumed to open to traffic in July 2022 with tolling beginning July 1, 2022. The bridge toll facility will be operational 24 hours a day and 365 days a year. The facility will be maintained, efficiently operated, and effectively signed and promoted to encourage maximum usage.

The tolls will be collected using transponder-based automatic vehicle identification (AVI) and video (VDO) tolling for vehicles without toll transponders, and there will be no provision for cash tolls. Tolling operations are assumed to be actively monitored and strictly enforced to minimize the potential revenue loss due to toll evasion. Toll leakage applied to the annual revenue estimates was zero percent for AVI and 50 percent for video tolling transactions The video toll surcharge is assumed to be 100 percent of the AVI toll charge. The starting AVI share was assumed to be 50 percent in the opening year of 2022, increasing to 75 percent by 2047.

The estimates of annual toll revenue included in this analysis have been adjusted to reflect "ramp-up" during the first three years of operation. The ramp-up assumes 70 percent in the opening year, 80 percent in the following year, 90 percent by the third year, 100 percent for fourth and all subsequent years.

The value-of-time (VOT) was estimated based on an analysis of the data from the stated preference survey efforts. The average value-of-time for 2015 was approximately $13.38 per hour. The value-of-time was escalated at an estimated average rate of two percent per year over the duration of the forecast horizon based

on the economic assessment of the region and thus reflects no real anticipated growth in the regional value-of-time.

The vehicle operating costs were assumed to be 17.3 cents per mile (in 2015 dollars) based on AAA Report, *Your Driving Costs (2015 Edition)*. Motor fuel and any other source of power for operating the motor vehicles will remain in adequate supply and increases in price will not substantially exceed overall inflation over the long-term. No change will occur in vehicle technology that will significantly affect the vehicle carrying capacity or vehicle operating speeds. No local, regional, or national emergency will arise that may abnormally restrict the use of motor vehicles.

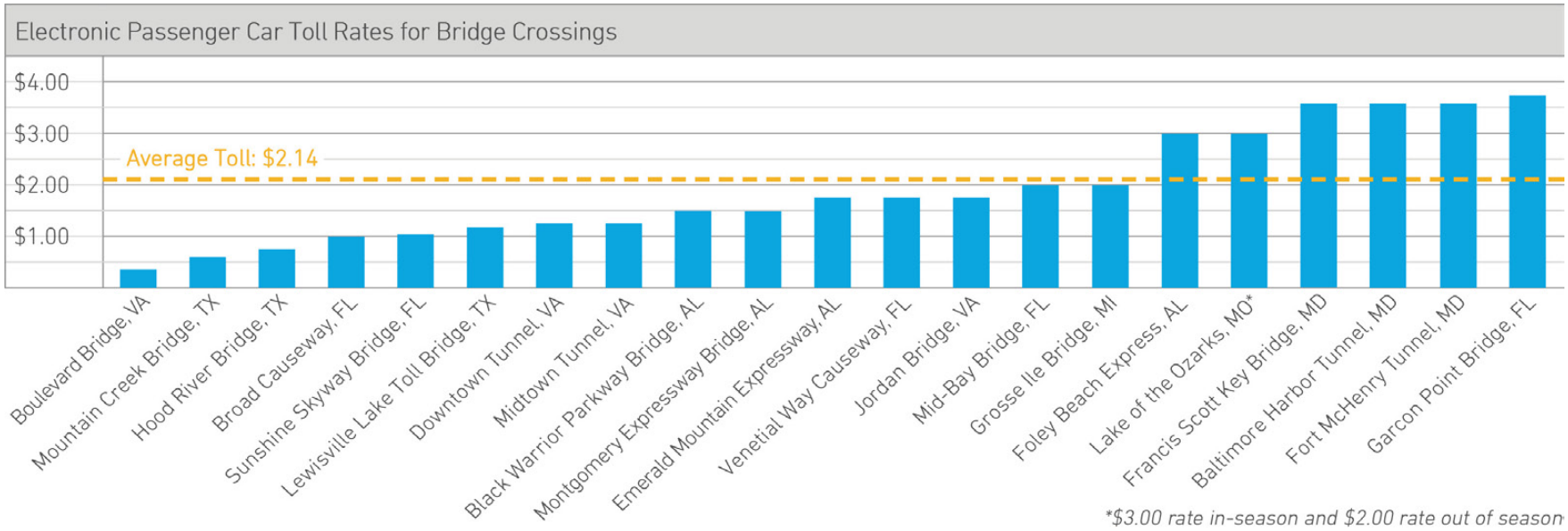
Economic growth in the study corridors is based upon projections and growth patterns as previously described in this chapter. No capacity expansion are assumed through the extent of the study period (2061) on I-435, I-635 and U.S. 69 bridges.

TOLL RATES AND TOLL SENSITIVITY

The toll rate for the base scenario was assumed to be $2.00 in 2015 dollars. Toll rates would escalate at a rate of five percent every three years. Exhibit 5.8 displays a comparison of electronic toll rates in 2015 dollars for similar bridge crossings in the United States. The toll of $2.00 is lower than the average toll ($2.14) of all the selected bridges. The base case toll rate selected reflects a reasonable assumption based on the location of the project and surrounding regional income characteristics. Several bridges with higher toll rates are located in regions with unique characteristics such as high year-round tourism or prominent affluence.

Toll sensitivity analysis involves testing a series of toll rates to determine how price affects traffic demand on the toll facility taking into account future characteristics of the transportation network and future willingness-to-pay tolls. A toll sensitivity curve suggests that when toll rates increase, a portion of

Exhibit 5.8 | Comparison of Passenger Car Toll Rates for Bridges (FY2015)



**$3.00 rate in-season and $2.00 rate out of season*

travelers will divert from the toll facility in favor of other alternate routes and thus decrease the captured toll transactions. The initial increases from a low toll rate level typically result in increased toll revenues until an optimal point where the maximum revenue is generated. Increases beyond this optimal toll rate level yields diminished revenues as the magnitude of diverted traffic increases.

T&R potential under a range of alternative toll rates was evaluated. Exhibit 5.9 illustrates the weekday revenue toll sensitivity curves for the proposed toll bridge for average weekday revenue before applying ramp-up for 2022. Several toll rates that were higher and lower than the assumed programmed toll rate were analyzed. The toll sensitivity analysis indicates that the projected toll rates on the proposed tolled bridge are below the estimated theoretical revenue maximization points. This demonstrates that, overall, there is potential for revenue enhancement through toll increases above current toll rate levels and the assumed escalated rates used for forecasting purposes, if warranted.

Exhibit 5.9 | Comparison of Passenger Car Toll Rates (FY2015)

TRAFFIC AND TOLL REVENUE ESTIMATES

The annual fiscal year T&R estimates for the proposed Centennial Bridge project base case scenarios are displayed in Exhibit 5.10. The toll bridge is anticipated to generate $5.3 million in revenue in 2023, its first full year of operation. It is expected to then grow to $11.3 million by 2040. Between 2023 and 2062, the toll bridge is anticipated to generate a total of $512.1 million in annual toll revenue. The average annual revenue growth between 2023 and 2030 was about 7.3 percent (includes ramp-up from 2023 to 2025), decreasing to 2.7 percent between 2030 and 2040.

SENSITIVITY ANALYSIS

The purpose of the sensitivity analysis was to evaluate the range within which the toll revenue generation potential may fall based on varying assumptions that influence the revenue potential. While a full account of the overall sensitivity associated with forecasting into the future is difficult, the analyses identified the impact of some of the key variables. Sensitivity tests were conducted to estimate the impact of lower VOT, higher VOT, higher and lower traffic demand due to higher socioec-onomic growth, reduced socioe-conomic growth assumptions, and higher truck percentage assumptions.

The results of sensitivity analyses, displayed in Exhibit 5.11, demonstrate that higher growth in assumed socio-economic growth in the region was the most influential parameter to the revenue potential. The higher socio-economic growth assumption (20 percent higher than base case) yielded a 20 percent increase in total revenue in 2023 and 2040 compared to the base case. Conversely, a reduction in traffic demand (50 percent lower traffic demand compared to base case) due to lower socio-economic growth will result in revenue reduction of nearly 50 percent.

Exhibit 5.10 | Traffic and Toll Revenue Forecasts (Base Scenario in millions of dollars)

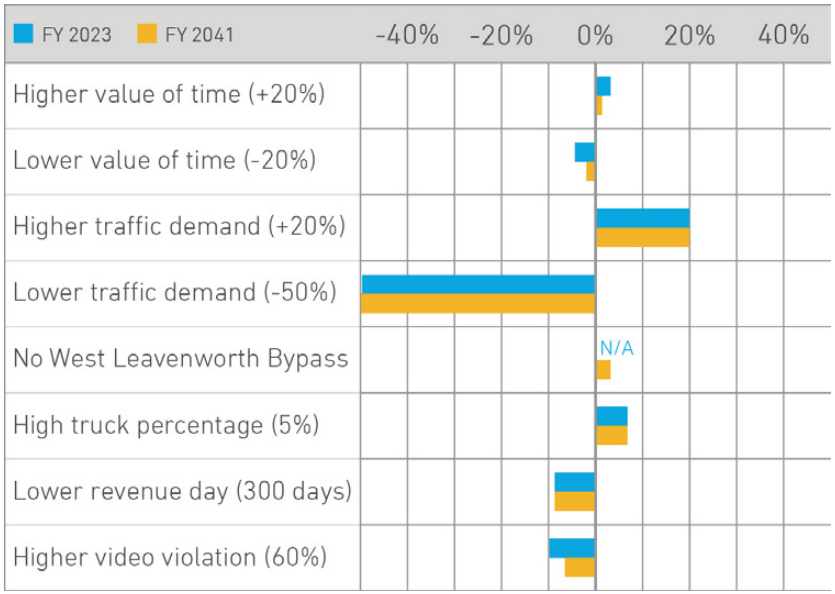
Fiscal Year	Annual Transactions			Annual Toll Revenue		
	AVI	VDO	Total	AVI	VDO	Total
2023	1.12	1.10	2.22	2.68	2.62	5.30
2024	1.32	1.24	2.56	3.15	2.96	6.11
2025	1.53	1.38	2.91	3.65	3.30	6.95
2026	1.67	1.45	3.12	4.19	3.64	7.83
2027	1.73	1.44	3.17	4.34	3.63	7.97
2028	1.79	1.44	3.23	4.50	3.61	8.11
2029	1.86	1.43	3.29	4.90	3.77	8.67
2030	1.89	1.40	3.29	4.99	3.69	8.68
2031	1.92	1.37	3.29	5.08	3.60	8.68
2032	1.98	1.35	3.33	5.50	3.74	9.24
2033	2.04	1.33	3.37	5.66	3.70	9.36
2034	2.10	1.31	3.41	5.83	3.65	9.48
2035	2.16	1.30	3.46	6.32	3.79	10.11
2036	2.22	1.28	3.5	6.50	3.73	10.23
2037	2.29	1.26	3.55	6.68	3.68	10.36
2038	2.35	1.24	3.59	7.22	3.80	11.02
2039	2.41	1.22	3.63	7.41	3.74	11.15
2040	2.49	1.20	3.69	7.63	3.67	11.3
2041	2.55	1.17	3.72	8.24	3.79	12.03
2042	2.62	1.15	3.77	8.46	3.71	12.17
2043	2.69	1.13	3.82	8.69	3.64	12.33
2044	2.77	1.10	3.87	9.39	3.74	13.13
2045	2.84	1.08	3.92	9.64	3.66	13.30
2046	2.92	1.05	3.97	9.90	3.57	13.47
2047	2.99	1.02	4.01	10.69	3.69	14.38
2048	3.05	1.02	4.07	10.90	3.63	14.53
2049	3.09	1.03	4.12	11.03	3.68	14.71
2050	3.13	1.04	4.17	11.76	3.92	15.68
2051	3.16	1.05	4.21	11.87	3.96	15.83
2052	3.18	1.06	4.24	11.95	3.98	15.93
2053	3.20	1.07	4.27	12.62	4.21	16.83
2054	3.22	1.07	4.29	12.70	4.23	16.93
2055	3.24	1.08	4.32	12.78	4.26	17.04
2056	3.26	1.09	4.35	13.51	4.50	18.01
2057	3.28	1.09	4.37	13.60	4.53	18.13
2058	3.30	1.10	4.40	13.68	4.56	18.24
2059	3.32	1.11	4.43	14.46	4.82	19.28
2060	3.34	1.11	4.45	14.55	4.85	19.40
2061	3.36	1.12	4.48	14.65	4.88	19.53
2062	3.38	1.13	4.51	15.48	5.16	20.64
Total	**102.76**	**47.61**	**150.37**	**356.78**	**155.29**	**512.07**

A 20 percent lower VOT and a 20 percent higher VOT resulted in a 4.1 percent decrease and 3.1 percent increase in toll revenue, respectively, for the Centennial Bridge compared to the base case in 2023. A similar decrease or increase in VOT in 2040 resulted in a 1.7 percent decrease and 1.3 percent increase in toll revenue for the proposed tolled bridge. Additional tests included removal of projects assumed to be in place, such as the Leavenworth Bypass, and increased assumed truck percentage. If the Leavenworth Bypass project is not included in the roadway network, the revenue on the bridge increased by 3.2 percent in 2040. An assumption of a higher truck percentage (5 percent) resulted in a revenue increase of about 6.8 percent compared to the base case.

FINANCIAL FEASIBILITY

A financial feasibility study was conducted for the Centennial Bridge project. Level 2 toll feasibility is indicative and useful in supporting a decision regarding whether a project has tolling potential. Debt coverage is the amount of the project cost that is estimated to be covered by tolling revenue. Based on state enabling legislation, only the construction cost of the Missouri River bridge crossing and the roadway approach in Kansas are eligible to be covered by tolling revenue. Financial feasibility was performed for three cases and the results, displayed in Exhibit 5.12, are described below:

Exhibit 5.11 | Sensitivity Analysis



Case 1 (standard tax-exempt toll revenue bond): Using a standard municipal toll road revenue bond finance approach with the base revenue case projections and associated cost projections, the project is only 80 percent feasible with a financing gap of approximately $15 million.

Case 2 (additional debt leverage): With the incremental debt capacity gained by using a federal loan, such as a Transportation Infrastructure Finance and Innovation Act (TIFIA) loan, the project is fully feasible.

Case 3 (delayed projections and timing): With a ten-year delay of both construction and the project's opening, the financial feasibility of the project increases to 93 percent with a financing gap of approximately $6 million.

Both Case 1 and Case 3 result in a project shortfall. The delayed projection in Case 3 has a much greater variability and therefore uncertainty associated with it. Case 2, which incorporates a TIFIA loan, results in a fully financially feasible project. The maturity date of the bonds varies for each case and is also dependent upon the type of long-term municipal bonds: current interest bonds, capital appreciate bonds, or convertible capital appreciation bonds.

PUBLIC INPUT

During the Tolling & Revenue phase of the study, Advisory Committee Meeting #3, Advisory Committee Meeting #4, and Public Open House #3 were held. The major focus of these events was to obtain feedback to potential bridge and tolling recommendations. Copies of material distributed at each meeting including agendas, presentations, public meeting display boards, sign-in sheets, and raw comment forms are included in the appendix.

ADVISORY COMMITTEE MEETING #3

Advisory Committee Meeting #3 was held in October 2015 at Leavenworth County Public Library. The project team summarized input from Public Open House #2 and the online survey. Due to the overwhelming preferences of the public, it was decided that a replacement bridge would be constructed adjacent to the existing bridge. From an engineering perspective, it is recommended that it be constructed immediately north of the existing bridge.

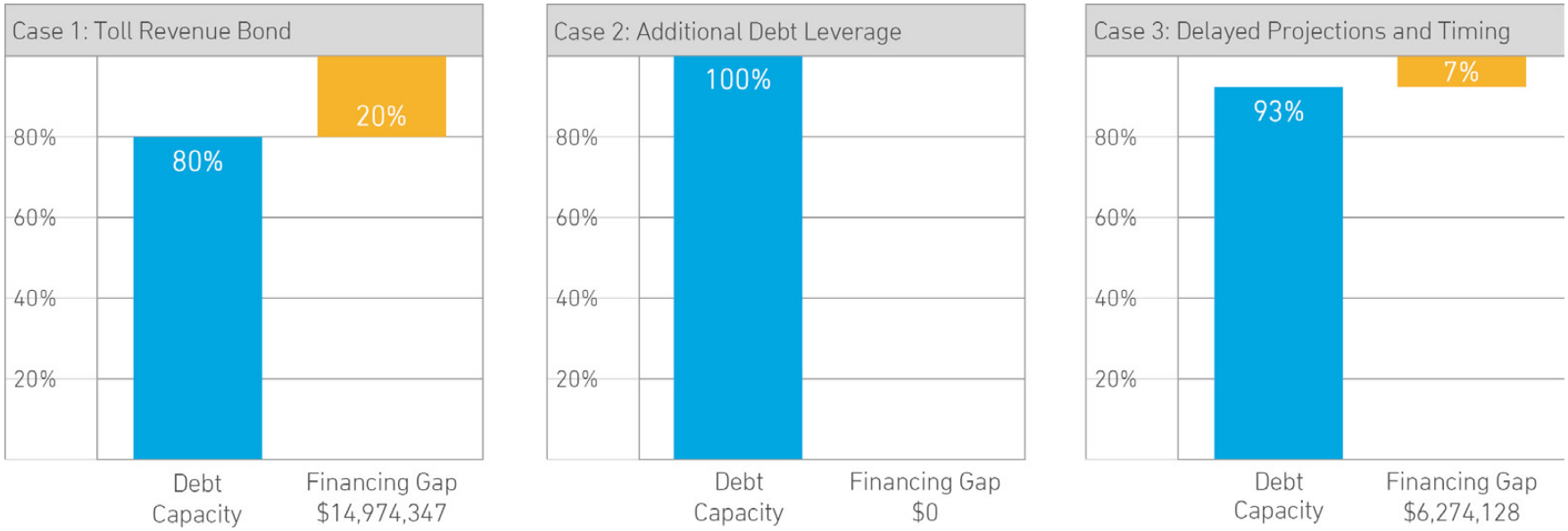
In addition, the project team also presented results of the stated preference phone survey, the intercept origin-destination survey, and AirSage data. The Advisory Committee also discussed examples of aesthetic enhancements preferred by stakeholders and the potential for including them in final design.

Estimated projects costs and potential tolling rates were a major item of discussion as well. Discussions about project cost responsibility and cost-share agreements are expected to continue.

Concerns discussed by the Advisory Committee included:

- Duration of toll collection
- Tolling authorities
- Project elements covered by tolling revenue
- Need for further detail concerning projects costs before making a decision regarding tolling

Exhibit 5.12 | Financial Feasibility



ADVISORY COMMITTEE MEETING #4

Advisory Committee Meeting #4 was held in February 2016 at the Leavenworth County Public Library. It was noted that with the latest investment in bridge maintenance (2011), the bridge sufficiency rating has improved. A design update was provided with a strip map of the bridge and surrounding properties, a 3D bridge model of the main river span, bridge renderings, and probable costs. Members of the project team gave a Tolling & Revenue and financial feasibility update.

The Advisory Committee was given an update of stakeholder meetings conducted since the last Advisory Committee meeting. Those included specific stakeholder meetings with the following organizations or personnel:

- Fort Leavenworth, Garrison Commander
- Leavenworth WaterWorks, Director
- Missouri Department of Transportation, Legal staff

Topics discussed by the Advisory Committee were:

- The need for political support and institutional authorization if tolling is to be advanced. Potential tolling revenue will also only cover specific construction elements and supplemental funds will need to be determined before the project advances. Project cost responsibility will need to be determined through agreements.

- The earliest possible date that construction could begin on a new bridge is 2020 with completion in 2022. This is if tolling is enacted and the project is accelerated. The expected bridge service life of the existing bridge is until the mid-2030s before the bridge needs to be replaced for reasons related to structural condition.

- This historical importance of the bridge to the local community and residents was noted.

PUBLIC OPEN HOUSE #3

Approximately 80 individuals attended the third set of Public Open House meetings in February 2016. One meeting was held in Platte County with another was held in Leavenworth County. Photos from the two meetings are displayed in Exhibit 5.13 and Exhibit 5.14.An open-ended comment form was provided and 35 participants provided feedback. Highlights from the comment form included:

- Thirteen respondents indicated opposition to tolling while six respondents expressed support for a toll or reasonable toll. The remaining comments were general comments or questions on tolling. Most respondents opposed to tolling mentioned the added cost of travel. Two respondents noted that they thought tolling would result in congestion going into Fort Leavenworth. Six respondents expressed opinions that there is not a need for a new, four-lane bridge.

- Other opinions regarding tolling included interest in offering discounts for seniors and large employers. Some respondents worried that tolling would "be done on the backs of Missouri veterans that use the VA and the soldiers and workers of Fort Leavenworth."

- Three respondents expressed their approval of bicycle and pedestrian accommodations on a new bridge. One person suggested accommodations on both sides of the bridge.

- Two respondents indicated they would prefer aesthetic treatments on a new bridge. One respondent mentioned that the current bridge is the identity of the area and, along with another respondent, would like to keep the current bridge.

- One respondent indicated interest in a roundabout on 4th Street. Another respondent dislikes the roundabout concept on the Missouri side of the bridge.

Public Open Meeting Process

Attendees indicated that they were informed about the meetings via email, newspaper, posted flyers, social media, roadside message boards, word-of-mouth, and through their employer. One attendee indicated that they did not hear about the meeting in a timely manner. Several attendees indicated a positive Public Open House experience. Some comments were:

- "Everybody I talked to was knowledgeable and helpful and friendly. Very impressed with the 3D bridge and long map style bridge. Helps to visualize and put in perspective with current configuration and historical memory."

- "The people conducting the meeting are very knowledgeable and kind and patient explaining things to me that I did not understand. I really appreciate that. It is obvious that a lot of work has gone into this study and providing information to the public."

- "I have followed the public meetings at this process since its inception. I have always felt the KDOT staff and the consultants on this project have listened to public comments and incorporated them into the design process."

- "Impressive displays! Very relevant and informative. The aerial view map was helpful for me to visualize this project. KDOT personnel were engaging and answered my questions. Good use of modern technology in regard to tolling."

Additionally, several participants commented verbally that the Public Open House(s) have been helpful. However, three participants expressed on comment forms some frustration with the Public Open House format. These three participants would have preferred a public hearing format with the opportunity to approach a podium to offer feedback.

Exhibit 5.13 | Public Open House #3 in Platte County

Exhibit 5.14 | Public Open House #3 in Leavenworth County

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6 | NEXT STEPS

The replacement of the Route 92 Centennial Bridge is not yet funded for construction. This study process included Advanced Preliminary Design and a Tolling & Revenue (Level 2) study. The purpose of this study was to develop a preferred concept and appropriate costs. Then, if tolling were deemed financially feasible, and implementation plan can be outlined.

The Next Steps phase examined the following elements:

- Design recommendations
- Costs and funding
- Environmental documentation

The three elements are intrinsically interrelated. The design recommendations as far as bridge location and type have a direct influence upon potential environmental impacts. The environmental documentation schedule is dependent upon the project costs and funding commitments.

It was not the purpose of this study to develop agreements for financial commitments among potential project partners. However, it is acknowledged that several institutional actions, which could take a year or more to finalize, would need to occur for implementation to advance. Therefore, while an outline of the anticipated next steps is provided, a specific duration for events is unknown.

Public input associated with the Next Steps included an email update to the Advisory Committee as well as decisions by the City of Leavenworth and KDOT Programming Review Committee.

DESIGN RECOMMENDATIONS

The overall bridge design has been discussed in extensive detail in the previous chapters. The design work has helped to determine the bridge location of the proposed replacement bridge immediately to the north of the existing bridge. The proposed bridge type responds to the crossing of a major river by incorporating a shift in the navigation channel's alignment, which has been reviewed by the U.S. Coast Guard. Further coordination with the U.S. Coast Guard is necessary to identify any associated modifications, such as dredging, for river navigation. The span lengths for the viaduct approaches have been set to achieve a balance between form and cost.

Exhibit 6.1 and Exhibit 6.2 provide illustrated renderings of the proposed bridge including sections of the main river span. With the preliminary design in hand, coordination has progressed to address potential issues and costs associated with utility relocations and geotechnical investigations.

The Advanced Preliminary Engineering also encompasses the roadway approaches to the bridge and several adjacent intersections. The urban signalized arterial of Metropolitan Avenue from the 7th Street (Grant Avenue) intersection through the 4th Street (Sherman Avenue) intersection operates as an integrated network. Changes to gate operations at Fort Leavenworth significantly altered the traffic pattern between the Grant Gate and Sherman Gate. Other design modifications to the gates were previously envisioned but are now subject to change. With the inclusion of the four-lane bridge, continued coordination

Exhibit 6.1 | Bridge Rendering

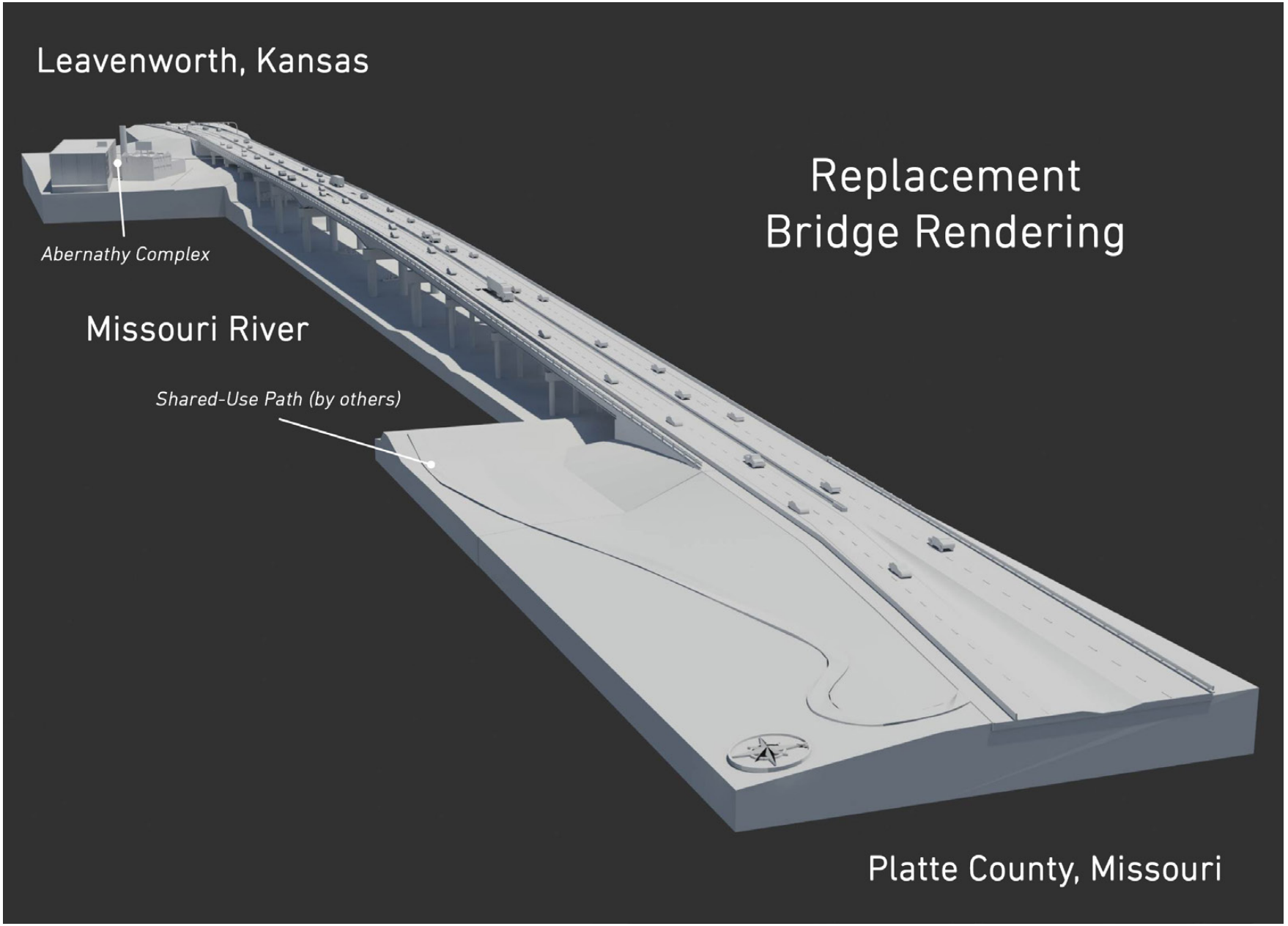
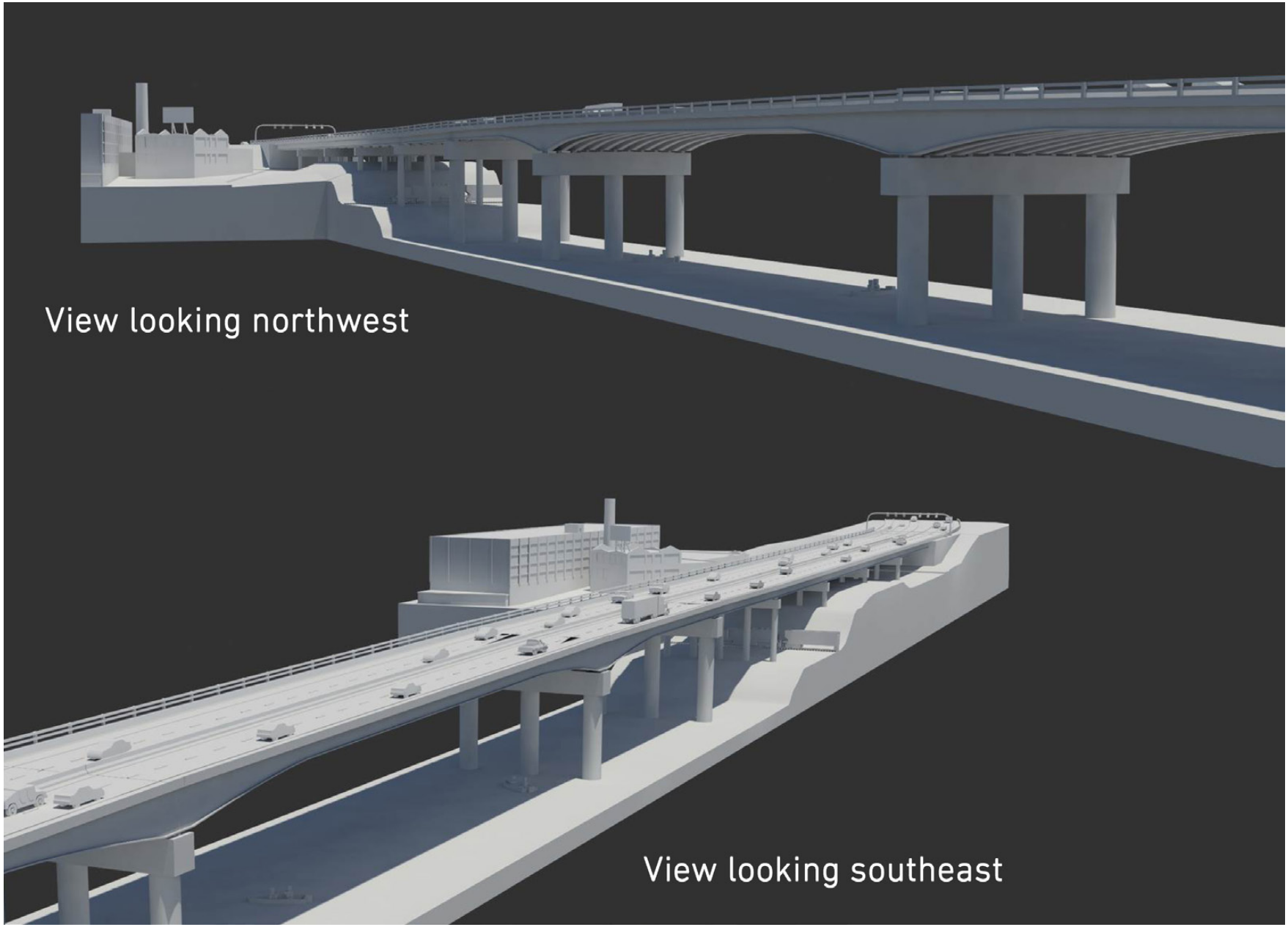


Exhibit 6.2 | Bridge Rendering



with the signal timing and traffic operations will be necessary. Improvements envisioned at the 4th Street intersection include adding an eastbound through lane, continuing to provide an exclusive eastbound right-turn lane to 4th Street and potentially extending the westbound exclusive right turn lane from the Grant Gate to the Sherman Gate intersection.

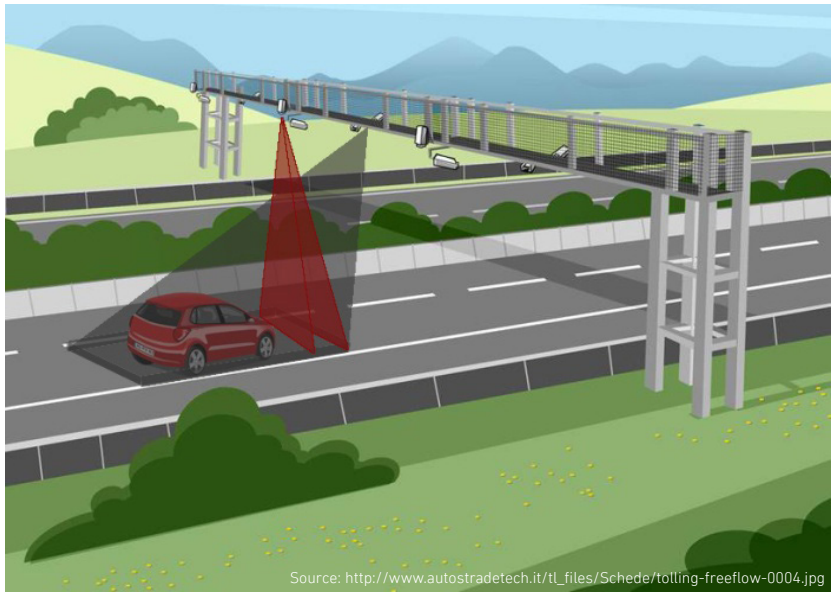
The rural unsignalized arterial junction of Route 92 and Spur 45 currently experiences a degree of congestion during the AM peak period, resulting in significant queue lengths for westbound Spur 45. Traffic forecasts indicate the potential for traffic patterns to continue their trend towards greater increase in traffic along Spur 45. The junction also exhibits safety concerns with a higher than statewide accident rate for similar facilities. The preferred intersection configuration for this location is a roundabout. The roundabout concept addresses capacity issues, potential for shifting traffic patterns, and safety issues. Discussions suggest that intersection improvements may be warranted prior to the implementation of the replacement bridge. It would be prudent to design the interim and ultimate roundabout to provide a seamless transition. The transition from the two-lane bridge approach to the four-lane bridge approach can be accomplished through the addition of bypass lanes associated with the ultimate roundabout concept. The interim project could also acquire the necessary right-of-way to assist in implementing the ultimate configuration.

A major component of Advanced Preliminary Engineering is assessing the viability of tolling as a financial tool. The implementation of tolling also has a design aspect of physical components. The tolling collection system is envisioned as All Electronic Tolling. All Electronic Tolling collection does not include toll booths but rather the equipment is located over the travel lanes with sensors in the pavement. The equipment detects transponders and vehicle type as well as reading license plates to charge account holders or send a bill via mail. The Kansas Turnpike Authority (KTA) with its KTAG transponder uses a form of electronic tolling. An example of typical equipment used with All Electronic Tolling is depicted in Exhibit 6.3. Key pieces of equipment include antennae, loops, cameras, and controllers.

The tolling equipment has been conceptually located on the Kansas side immediately west of 2nd Street. This location affords adequate secured space for installation as well as utility and maintenance access. As the design advances, additional tolling components may be considered. It is assumed that an off-site operations center would be utilized. A primary benefit of All Electronic Tolling is that vehicles do not stop for toll collection, thereby eliminating delays associated with toll collection. Normal travel speeds through the zone (35 to 45 mph) are readable.

Unlike a controlled access facility such as the Kansas Turnpike or a freeway system, Route 92 is an arterial roadway with public and

Exhibit 6.3 | All Electronic Tolling Equipment Example



private access within close proximity on either side of the bridge. Appropriate signing is needed to inform motorists of the toll bridge ahead, the collection method, and toll rates. To accurately reflect potential construction costs with the project, a conceptual signing layout has been developed to illustrate the type and location of signs in order to develop costs. The signing plan is not intended to show all signs yet focuses upon signing associated with the tolling facility. A major item included in the cost estimate is the inclusion of overhead changeable message boards to provide information to motorists. Other advance overhead signing as well as pavement markings are conceptually shown.

Future design phases can address the type and degree of aesthetic treatment. Through the course of this study, discussions were held about the potential types of aesthetic treatments as well as their probable costs. Further coordination is needed during the design stage to determine the exact nature of aesthetic treatments and their funding commitments.

COST AND FUNDING

In an era of reduced transportation investments coupled with increasing transportation needs, exploring alternate means of funding becomes critical to advancing projects from a study to design to construction. The purpose of this section is to assist in the development of an implementation plan for this major transportation investment. For a project to be feasible, it must be technically feasible, financially feasible, and politically feasible. All the aspects need to work together to achieve an overall feasible project and create a schedule that can be implemented.

One alternate funding source can be tolling. Tolling may not be applicable in every project situation, hence the importance of the T&R study phases. With the project being located in two states, it is important to be aware of institutional issues associated with tolling and any costs-share agreements between both states.

Missouri can allow tolling; however, new tolling facilities must be on new alignments and not existing state highways. This is the case with the Ozark Community Bridge constructed on new alignment. The tolling authority is a Transportation Development District or a Transportation Commission. However, a 1939 law provides for tolling of interstate bridges across major rivers. This allows for crossings of the Missouri River and the Mississippi River. The legislation allows for tolling only of the bridge and not the roadway approach. It is with this understanding of the ability to potentially use toll funds for the project with the exception of the Missouri roadway approach.

KDOT, when it deems necessary, can request the Kansas Legislature for tolling authority. For the replacement Centennial Bridge project, KDOT would continue to maintain the bridge structure and it could elect to contract tolling operations to a vendor. KTA qualifies as such a provider. KDOT's policy is to use tolling revenue to pay off the bonds issued to fund construction. At the retirement of the bonds, tolling operations would cease. With the use of All Electronic Tolling and collection of tolling from either a transponder or a pay-by-plate method, new Kansas laws will be necessary to allow for legal methods to collect unpaid tolls. These laws would be established in conjunction with the business policies for All Electronic Tolling. With the KTA's plan to move towards Open Road Tolling in the next five years, having KTA as the tolling administrator would be appropriate.

The project costs are discussed in several manners. As noted previously, an unfunded project by definition has an unknown schedule. While a schedule can be assumed in order to assess financial viability, the schedule remains subject to change. Costs have been developed and are presented typically in FY 2016 dollars. The project schedule displayed in Exhibit 6.4 assumes a potential earliest opening date of 2022. This means that construction would likely begin in 2020. For cost budgeting

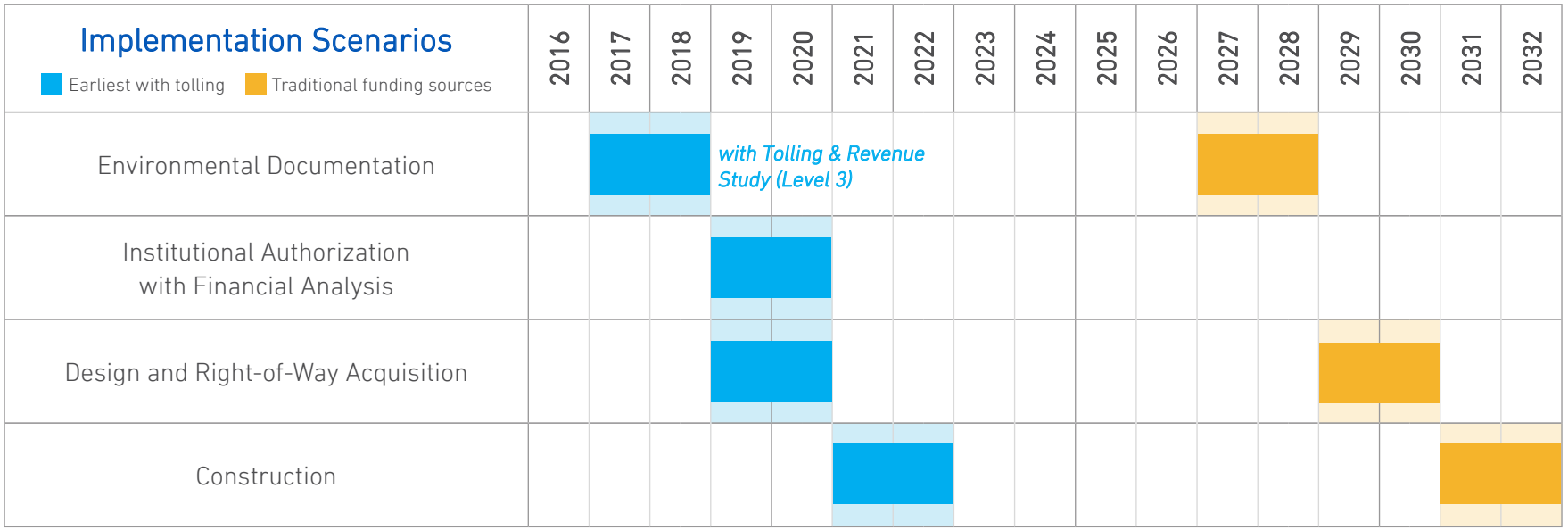
purposes, the midpoint of the construction duration (2021) could be a forecast year for the purpose of inflating construction values.

If a later opening date were to be evaluated, likely without tolling as indicated by the anticipated alternate implementation scenario in Exhibit 6.4, construction costs would need to be inflated. Inflated construction cost estimates are displayed in Exhibit 6.5 to illustrate the difference in costs over time.

Costs presented refer to construction, programming, and project costs as well as tolling coverage costs. A brief definition of each cost type is provided below:

- Construction costs: Costs developed based upon quantity estimates and unit costs for major construction items including roadway, bridge structure, bridge shared-use path, removal of bridge, tolling, and miscellaneous items such as maintenance of traffic during construction. These categories have also been delineated by the responsibility of each state Department of Transportation.
- Programming costs: Associated construction costs that include utility relocation, right-of-way acquisition, environmental documentation, design costs, and construction engineering costs.
- Project costs: Costs that include elements beyond the state Department of Transportation's responsibility, such as enhancement elements that could potentially include costs for aesthetics, lighting, and trails on the approaches to the bridge.
- Tolling Coverage costs: Construction costs that are eligible, according to legislation, to be covered by tolling revenue.

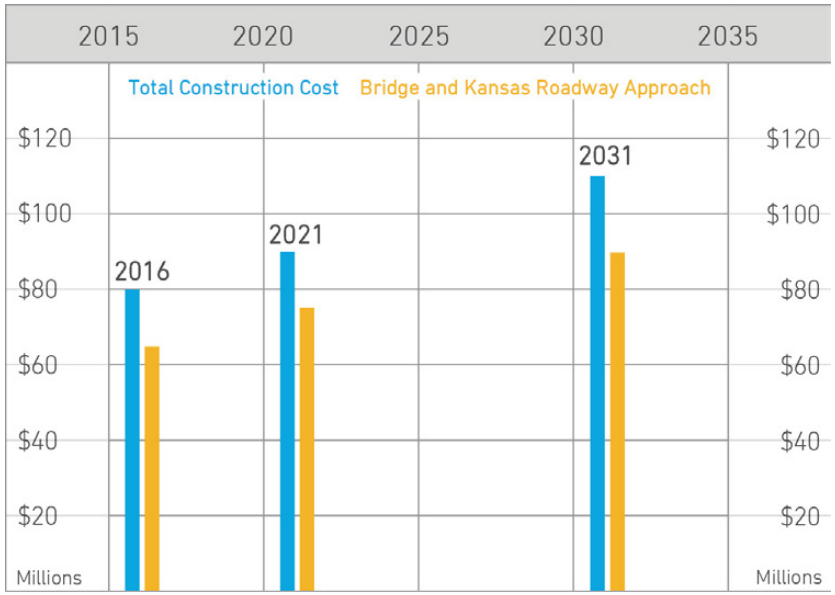
Exhibit 6.4 | Implementation Schedule Scenarios



The financial analysis from the T&R study indicates that tolling with the use of a TIFIA loan can result in a fully feasible project. Without a TIFIA loan, the project is 80 percent financially feasible. These levels of financial feasibility suggest that tolling can be a viable funding source for the bridge replacement project; however, it is acknowledged that additional funding sources, such as a TIFIA loan, would be necessary to achieve a fully financially feasible project.

The next step with the T&R study would be to advance to an Investment Grade (Level 3) analysis suitable for financial institutions to provide bonds. However, the timing of this next step must be integrated with an overall project schedule that includes institutional establishment of the tolling authority as well as environmental review, approval, and permitting. While the analysis may find that tolling is financially feasible, the issue of political support must also be acknowledged for tolling to be a feasible component of the project, particularly in order to advance the project's schedule to the earliest opening date of 2022.

Exhibit 6.5 | Construction Costs Over Time



Public input throughout this phase of the study acknowledges the high degree of passion and emotions expressed regarding tolling. While review of Missouri legislation for tolling interstate bridges across major rivers may remain on the books, the laws are subject to current legal opinion, clarification through interpretation, and potentially the need for a statewide vote. Consequently, MoDOT's focus with regard to tolling is pursuing a project with statewide significance such as along I-70. The condition of the Centennial Bridge does not place the facility in a critical priority for replacement when compared to other statewide (Missouri) interstate major bridges. This in turn could leave KDOT without a willing partner to pursue an accelerated financing option such as tolling.

ENVIRONMENTAL DOCUMENTATION

The determination of the appropriate type of environmental documentation is directly associated with the physical and financial components of the proposed action. The recommendation is to wait until funding commitments are reasonably in place before beginning the next phase in the environmental process. It is not recommended to advance preparation of an environmental document and allow it to become out-of-date due to of lack of project funding. Such an approach would require an update of the document after a period of time.

At this time, the level of environmental documentation is anticipated to be at an Environmental Assessment (EA) level, subject to agency review and scoping. However, determination of funding sources such as tolling have the potential to trigger review of other impacts such as environmental justice, which, depending upon agency perspective, could elevate the documentation to a higher level.

As necessary, all applicable permitting will be pursued. Such permitting may limit construction activities in various locations whether within the Missouri River or in vegetated areas, which could increase the duration of construction beyond the anticipated two-year construction period for a major river bridge. While all necessary elements would be addressed, three issues are worth noting that may require additional coordination and could affect the project's schedule:

- Historic resources
- Public parks
- Environmental justice

HISTORIC RESOURCES

The Kansas State Historic Preservation Office determined that the Centennial Bridge is eligible as a historic resource based upon architectural and/or engineering criteria. Consequently, impacts to this resource will need to be addressed. Historic bridges are unique because they are historic, yet the bridges are often also part of a Federal-aid highway system that has continued to evolve over the years. Even though these structures are included or are eligible for inclusion on the National Register of Historic Places, they must perform as an integral part of a modern transportation system. When they do not or cannot, they must be rehabilitated or replaced in order to assure public safety while maintaining system continuity and integrity.

In order for a programmatic Section 4(f) evaluation to be applied to a project, the following findings must be studied during the environmental documentation and be fully evaluated by FHWA:

- No action
- Build on new location while using the old bridge
- Rehabilitate bridge without affecting the historic integrity

The proposed action includes all possible planning to minimize harm. For bridges that are to be replaced, the existing bridge is made available for an alternative use, provided a reasonable party agrees to maintain and preserve the bridge. For bridges that are to be adversely affected, the agreements between the Kansas State Historic Preservation Office, the Advisory Council on Historic Preservation (if participating), and FHWA is reached through the Section 106 process on measures to minimize harm and those measures are incorporated into the project.

Repurposing the existing bridge, such as for dedicated pedestrian or bicyclist access as a shared-use path, is not considered practical. A major issue for alternate use is that the unidentified new bridge owner would be required to assume all liability and responsibility for the bridge structure. This includes the safety of any users and the safety of the structure itself: routine maintenance, routine structural inspections by qualified inspectors, and the maintenance of operable navigation lighting per U.S. Coast Guard requirements would all be necessary and potentially costly expenditures.

In February 2016, the Kansas Historic Sites Board of Review reviewed and approved the nomination for the National Register of Historic Places for the Abernathy Furniture Complex consisting of the main factory, the lumber building, the lumber kiln, and the power plant. This site, immediately south of the existing Centennial Bridge, is a boundary increase of the original Abernathy Furniture Complex nomination along Seneca Street in downtown Leavenworth, thereby creating a discontinuous district. The proposed location of the new bridge is north of the existing Centennial Bridge.

PUBLIC PARKS

Riverfront Park along the west bank of the Missouri River passes beneath the existing Centennial Bridge. The park includes amenities such as picnic shelters, restrooms, recreational vehicle (RV) parking, and a boat launch ramp. Similar to the existing

bridge, the proposed new bridge will be an elevated structure above Riverfront Park. The proposed piers for the river's main span will be within the park and will impact existing parking. The project will mitigate impacts parking and a free-standing marker by compensating for the relocation of the parking spaces and the marker to an agreed upon location within Riverfront Park. Preliminary discussions with the City of Leavenworth Parks Department have been held and KDOT is committed to working together with project partners to mitigate potential impacts to Riverfront Park.

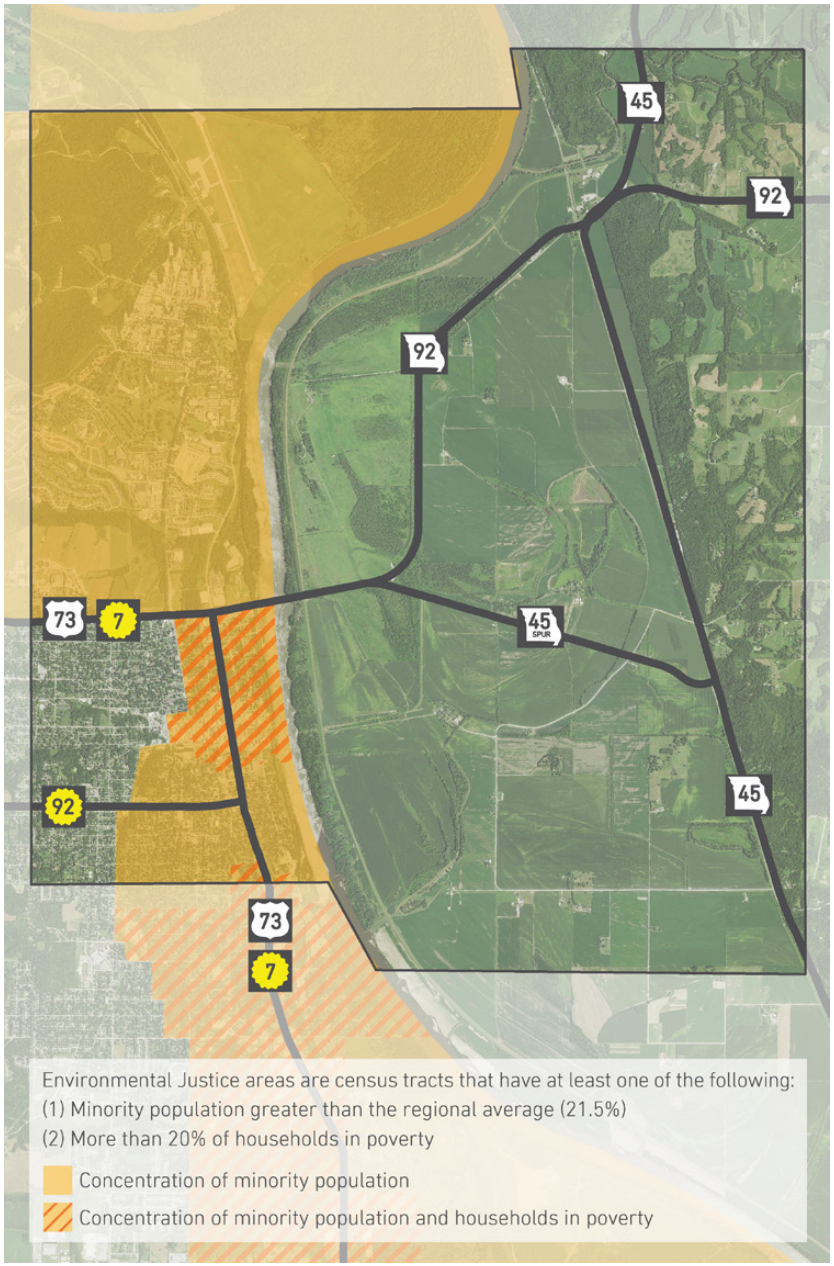
ENVIRONMENTAL JUSTICE

Executive Order 12898 on environmental justice directs that "programs, policies, and activities receiving federal funding not have a disproportionately high and adverse human health and environmental effect on minority and low-income populations." Environmental justice areas within the study area are displayed in Exhibit 6.6.

Environmental justice is "fundamentally about fairness toward the disadvantaged and often addresses the exclusion of racial and ethnic minorities from decision-making". Toll roads have a disproportionate impact on low-income commuters if their workplaces are not accessible by transit. The environmental justice analysis of toll roads is complex, whether the toll pricing structure is flat, dynamic, or differential.

Analysis methods for toll roads can include system or project levels as well as local toll policies. The system level of an interconnected network is not applicable in this study. Additional project level analysis may be required on issues such as increase in travel time or distance for non-toll facilities, availability of adequate travel corridors, or toll cost if there is a disproportionate burden to a class of users, income level of users, benefits from project, and the distribution of benefits.

Exhibit 6.6 | Environmental Justice



The five main ethical considerations with environmental justice analysis include:

1. Geographic equity
2. Income equity
3. Participation equity
4. Opportunity equity
5. Modal equity

A balance must be struck to address environmental justice issues while producing sufficient toll revenue to meet the bond obligations used to fund the project.

PUBLIC INPUT

During the Next Steps phase of the study, input from the series of Advisory Committee meetings and Public Open Houses was reviewed.

CITY OF LEAVENWORTH

Since the project concept and funding mechanism was initiated through the local consultation process, KDOT sought direct input from the City of Leavenworth regarding the Advanced Preliminary Engineering and the Tolling & Revenue study process. KDOT presented a summary of findings at a City of Leavenworth Study Session in June 2016 and asked for a vote of support or non-support on the design and location of the replacement bridge and tolling as a funding mechanism. The City Commission gathered feedback on these matters. During a Commission Meeting in July 2016 , the Commission endorsed the general characteristics, design, and location of the bridge. Questions remained about incorporating aesthetic treatments. Regarding the funding mechanism, the City Commission did not support the option of tolling the bridge. The decision was influenced by the remaining useful life of the bridge coupled with the lack of short- or medium-term improvements to highways on the Missouri side of the bridge.

PROGRAM REVIEW COMMITTEE

In August 2016, the KDOT Program Review Committee received an overview of the study process, findings, and stakeholder and community feedback. KDOT staff asked the Program Review Committee to provide direction on whether to pursue any legislative action regarding tolling as well as continuing any environmental documentation for the bridge replacement project.

The Program Review Committee decided not to pursue legislative authorization for tolling or any environmental documentation at this time. The Program Review Committee did approve the technical engineering concepts of the Advanced Preliminary Engineering study.

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