

Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, US EPA, KDWP, KPRA, KS DASC, KARS, KS Biological Survey, MODNR, MDC, ISGS, ILPRA, IN DNR, The Nature Conservancy

0 20 40 60 80 100 Miles

Coordinate System: North America Equidistant Conic
 Projection: Equidistant Conic
 Datum: North American 1983

• City	▲ Converter Stations	Conservation Land	■ Metropolitan Area
- - - Study Area	Existing Transmission	■ Local/Private	■ Water Body
— Interstate	— <math>< 138\text{ kV}</math>	■ State	■ Tallgrass Heartland
— U.S. Highway	— $138\text{ kV} - 230\text{ kV}$	■ Tribal	■ Lesser Prairie Chicken Habitat
- - - Gas Pipeline	— $> 230\text{ kV}$	■ Federal	■ CHAT Categories 1-3
			■ Wind Farm

Figure 4-4
Conceptual Route Development
in the Southern Portion of the Study Area

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Routing Team considered crossings near Barnhart, along the northern edge of the Mark Twain National Wildlife Refuge; north of the Rush Island Power Plant adjacent to the recently constructed 345 kV line crossing; near Chester, Illinois, at the crossing of Missouri State Route 51; and farther south near Grand Tower, Illinois. Each of these crossings was either highly encumbered by nearby development (Barnhart and Chester crossings) or a combination of state and federal conservation lands (the Shawnee National Forest lands near Grand Tower and the Mark Twain National Wildlife Refuge Complex near Rush Island).

Once in Illinois, the network of Conceptual Routes south of St. Louis continued east and northeast toward the eastern converter station, generally east of the suburbs of St. Louis and Carlyle Lake. Three major Conceptual Routes were developed from the Mississippi River crossing to Sullivan Substation with additional route links developed to connect sections of the three or to avoid highly constrained areas. Two of these major Conceptual Routes followed a series of existing transmission lines across the state. The first route followed the existing 345 kV lines from Rush Island to Baldwin, West Mt. Vernon, Louisville, Newton, Casey, and into Sullivan Substation. The second route followed a more southerly path along a mixture of 345 kV and 138 kV lines from Grand Tower to West Frankfort, Norris City, Albion, Olney, Lawrenceville, Hutsonville, and into Sullivan Substation in Indiana. The third Conceptual Route followed a pipeline from southwest of Steelville, Illinois, and continued northeast past Oakdale, Nashville, and Centralia before turning east at Kinmundy and joining the first Conceptual Route near Louisville, Illinois.

In general, the density of residential and commercial development in Illinois was highest near East St. Louis, in the suburbs extending east of the city toward Belleville, and along the Interstate 70 and U.S. Highway 40 corridor.³ In addition, residential development near Centralia, Mt. Vernon, and West Frankfort also encumbered route development forcing the development of several new routes that only loosely parallel existing section/ parcel boundaries. Overall, residential density was highest in Illinois in the central and southern portions of the Study Area, when compared to the northern portion of the Study Area.

4.2.4 Comparison of Conceptual Routes in the Study Area

Once the network of Conceptual Routes for the entire Study Area was developed, the Routing Team conducted a comparative review of the Conceptual Routes. The analysis considered the likelihood for potential impacts from the Project through comparisons of key environmental, land use, and engineering factors for a given route or segment of route.

³ Like the remnants of Historic Route 66 found along Interstate 40 in Missouri, historic features of the Historic 'National Road' created in 1806 by legislation signed by President Thomas Jefferson are found along the Interstate 70/40 corridor. This corridor is listed as a National Scenic Byway by the U.S. Department of Transportation, Federal Highway Administration.

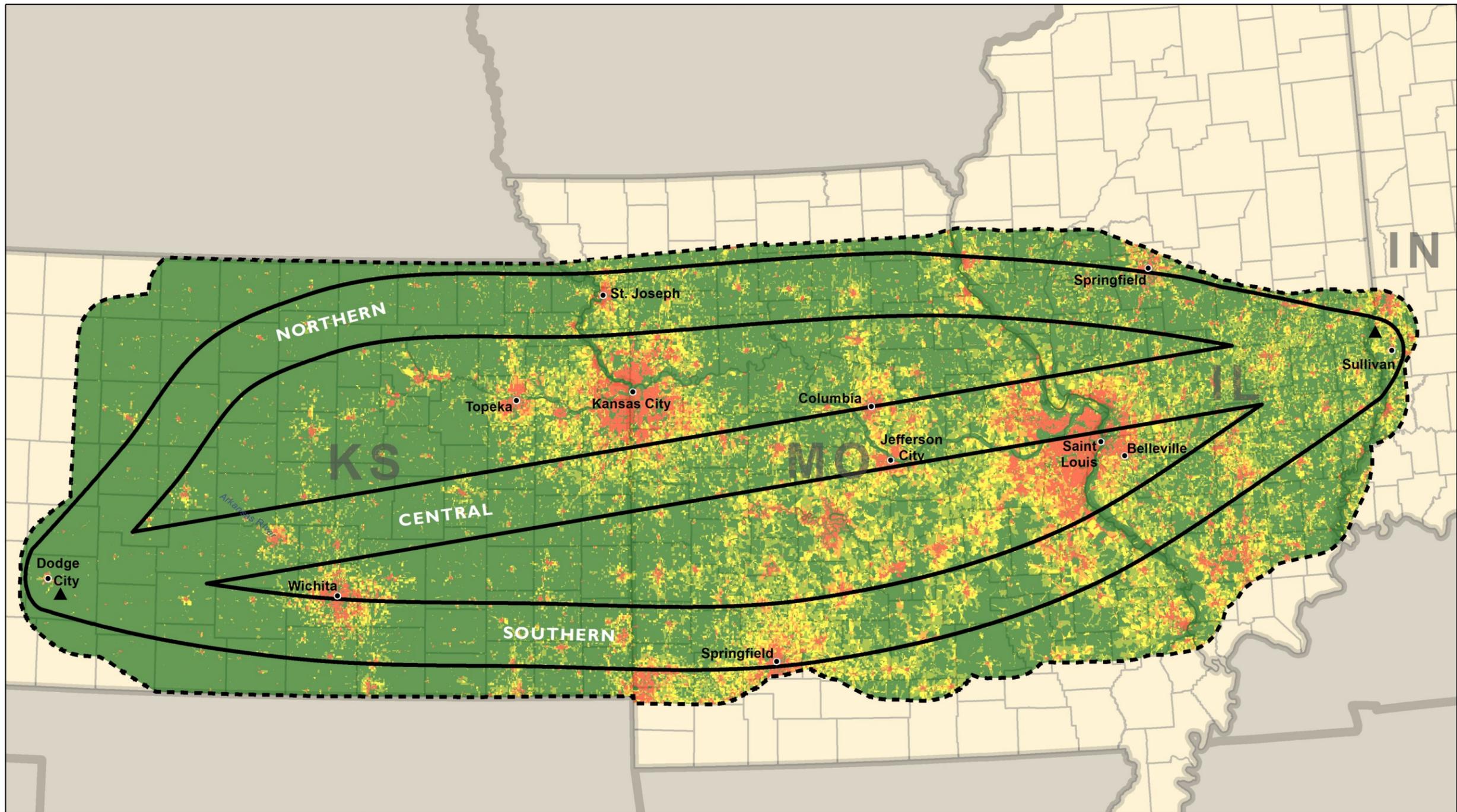
Initially, comparisons were conducted at the individual Conceptual Route or route segment level to eliminate routes that were not likely suitable as a result of new insight derived from ongoing public and agency coordination efforts, newly acquired data sources, or route reconnaissance efforts. Similar to a fatal flaws analysis, this effort removed those Conceptual Routes that were not likely to reasonably meet the routing guidelines, or simply resulted in likely impacts that were inconsistent with the majority of other routes considered. Several of these removals were referenced in the preceding sections.

The Routing Team then compared the overall feasibility of siting the Project in either the northern, central, or southern portion of the Study Area based on major differences between groups of Conceptual Routes in each. These analyses identified the broad scale challenges and limitations of each portion of the Study Area, and ultimately led to the selection of the portion of the Study Area that the Routing Team would continue to pursue by developing Potential Routes.

Residential density was one of the most notable differences between the northern, central, and southern portions of the Study Area. Given the importance of residences in the siting process, it was a key factor in the comparison. During the development of Conceptual Routes, the Routing Team recognized significant differences in the density of residential development and its effect on developing reasonable alignments along existing transmission lines and pipelines and allowing for relatively straight alignments along section/parcel boundaries.

At the four-state scale, digitizing individual residences was not practical, so the Routing Team used census information to provide numerical evidence to support the challenges it observed during development of the Conceptual Routes. The 2010 census data include an estimate of the number of residences within each census block, allowing the Routing Team to derive a residential density (residences/square mile). The results of this analysis, with an overlay of the three generalized portions of the Study Area, are presented in **Figure 4-5**. To provide the color categorization for the density ranges, the Routing Team evaluated the difficulty of developing routes in areas with varying numbers of residences per square mile. This was accomplished by sampling Public Land Survey System sections (each roughly 1 square mile) throughout the Study Area, assessing the overall difficulty of routing a transmission line through it, and then counting the number of houses to derive a density.

As is clearly shown in **Figure 4-5**, the Conceptual Routes through the central portion of the Study Area in Missouri, although generally shorter, impact areas with significantly greater residential density. Areas of higher residential density begin south of Kansas City and continue to Sedalia, Columbia, Jefferson City, St. Peters, and the metro area north of St. Louis. Moreover, where low residential areas appear in the central portion of the Study Area south of Kansas City, reservoirs and conservation areas occupy key areas. In addition to high residential densities, the Conceptual Routes in the central portion of the Study Area also had fewer miles



Sources: ESRI, U.S. Census Bureau 2010

0 20 40 60 80 100 Miles

Coordinate System: State Plane Kansas North (feet)
 Projection: Lambert Conformal Conic
 Datum: North American 1983

- City
- - - Project Study Area

<ul style="list-style-type: none"> 0 - 5 Households per square mile 6 - 10 Households per square mile 11 - 20 Households per square mile 	<ul style="list-style-type: none"> 12 - 40 Households per square mile > 40 Households per square mile
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Figure 4-5
U.S. Census Residential Density
in the Four State Study Area

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parallel to existing transmission lines or pipelines; fewer suitable crossings of the Missouri River that did not impact either federal, state, or private conservation lands; and no suitable locations for crossing the Mississippi River without diverting north to reach crossings in the northern portion of the Study Area—all of these issues increased overall length. For these reasons, the Routing Team removed the Conceptual Routes in the central portion of the Study Area from further consideration and did not hold Roundtables in these areas.

Conceptual Routes in the southern portion of the Study Area also had higher residential densities in Missouri and Illinois than in the northern portion of the Study Area. Residential density north of Springfield, Missouri, along Interstate 44 (Lebanon and Rolla), and into the St. Francois Substation near Farmington made Conceptual Route development difficult. In addition, the extensive and irregular sprawl of the Harry S. Truman, Lake of the Ozarks, Pomme De Terre, and Stockton Lake reservoirs significantly limited the potential for reasonable alignments. The presence of the U.S. Department of Agriculture, Forest Service's Mark Twain National Forest, U.S. Army's Fort Leonard Wood, National Park Service's Ozark National Scenic Riverway, and extensive state and private conservation lands in the southern portion of the Study Area further constrained the development of reasonable Conceptual Routes. Discussion with MDC and USFWS revealed the southern portion of the Study Area to be least suited for Conceptual Route development because of the amount of land already protected for sensitive species and habitats.

Despite these notable challenges in the southern portion of the Study Area, the Routing Team considered the southern portion more reasonable than the central portion of the Study Area and held a series of Roundtables in southern Illinois to add to data gathered at Roundtables from southern Kansas and Missouri. However, additional routing challenges were identified during meetings with community leaders and regulatory agency representatives in Illinois, and based on further review and consideration of the few suitable Mississippi River crossings south of St. Louis, the Conceptual Routes in the southern portion of the Study Area were also removed from further consideration.

Ultimately, the Routing Team considered the Conceptual Routes in the northern portion of the Study Area to be the most suitable for the Project and focused its route development efforts there. As is clearly shown in **Figure 4-5**, Conceptual Routes through the northern portion of the Study Area fall largely within areas with low overall residential density for the majority of the route. In addition, although public lands and reservoirs are common in the northern portion of the Study Area, they tend to be smaller and more dispersed, preventing the concentration of residential development in the lands between and generally provide multiple routing options to consider through an area. At the same time, sensitive habitats are generally limited in northern Missouri and Illinois, and those that are present are either largely avoidable or would result in impacts that could be minimized or mitigated. Lastly, an array of opportunity features of different types are available for the development and refinement of Potential Routes,

and multiple suitable river crossing locations were identified for each of the major river crossings.

4.3 Potential Routes

4.3.1 Developing the Potential Route Network

Once the Routing Team focused on the northern portion of the Study Area, the Study Area was effectively reduced for the continued siting of the Project and additional route revisions.

Because of the multi-state nature of the Project, Alternative Routes were developed and analyzed in Kansas first to determine the Proposed Route (detailed in the Kansas Route Selection Study, 2013). Once the Kansas Proposed Route was selected, Potential Routes in Missouri were refined based on the known location of the Missouri River crossing. Additional agency coordination and field reconnaissance was conducted to further refine Potential Routes.

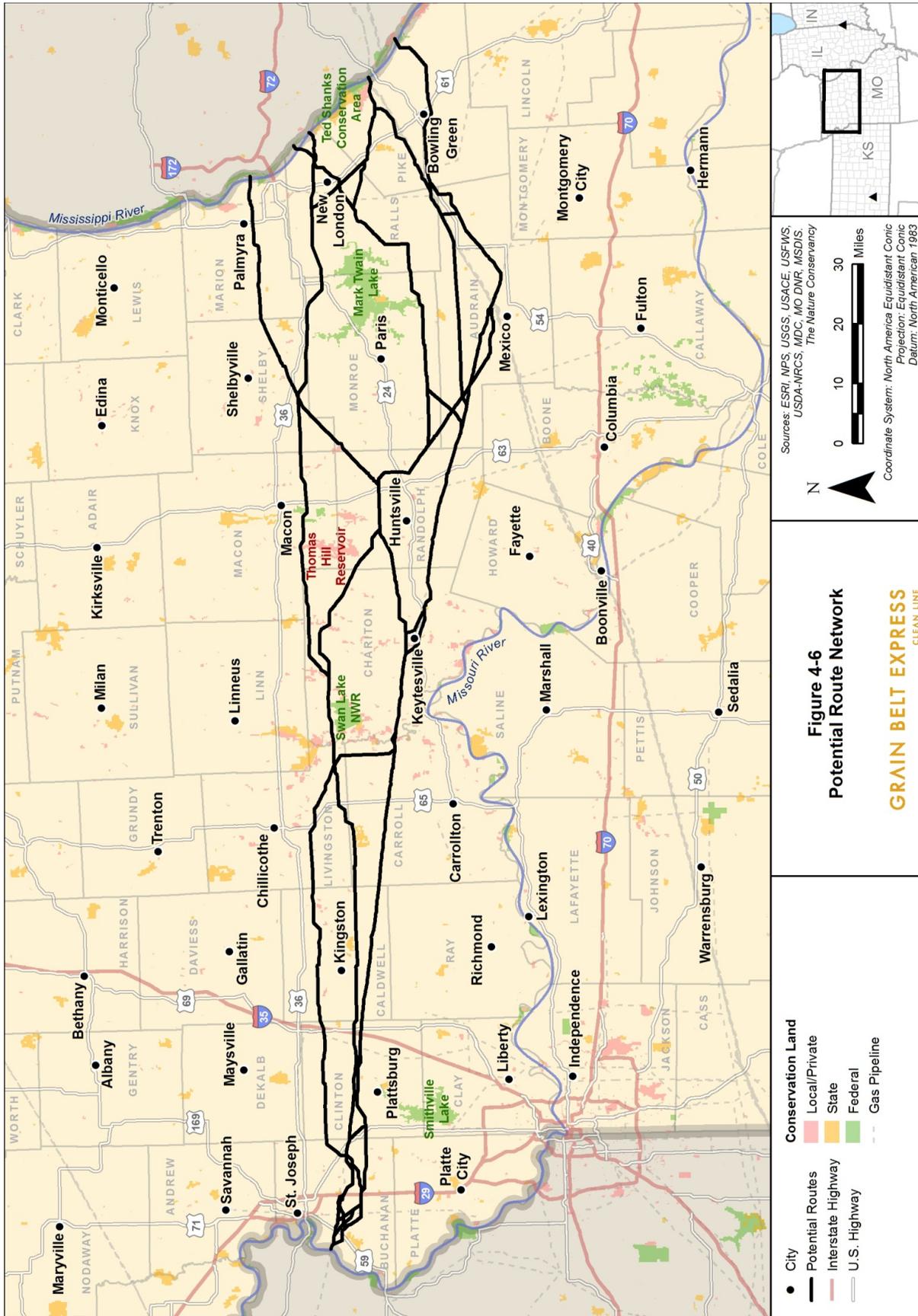
In some cases, input from regulatory agencies informed route revisions; in others cases, comparative review of routes with similar start and endpoints eliminated or forced the revision of other routes. Potential Routes were added or modified as a result of suggestions received at the Roundtables. Ultimately, the Routing Team identified the Potential Route Network (**Figure 4-6**) that would be suitable for presentation to the general public at Open House meetings. As discussed in Section 3.3.2, the Routing Team assisted attendees in locating their property or other features of concern on aerial photography maps showing the array of Potential Routes under consideration. Participants were provided pens and markers and were encouraged to document the location of their houses, places of business, properties of concern, or other sensitive resources on the printed maps. After the Open Houses, all of the maps were scanned, geo-referenced, and integrated into the GIS database, and comments received via comment card were correlated with landowner addresses.

4.3.2 Revisions to the Potential Route Network

The Routing Team spent several months reviewing the hundreds of comments received during and after the Open House meetings (see Section 3.3), making adjustments to individual route segments and refining the Potential Route Network. Below is a discussion of the key revisions made to the Potential Route Network after the Open Houses.

Key Revisions to Potential Route Links

Revisions were made to the Potential Routes following Open Houses in Missouri to respond to comments, consider new information, and as a result of ongoing reviews of engineering challenges and solutions. Most of these revisions were relatively small (on the order of 50 feet to about 200 feet); however, several were larger in scale (on the order of miles) and deserve

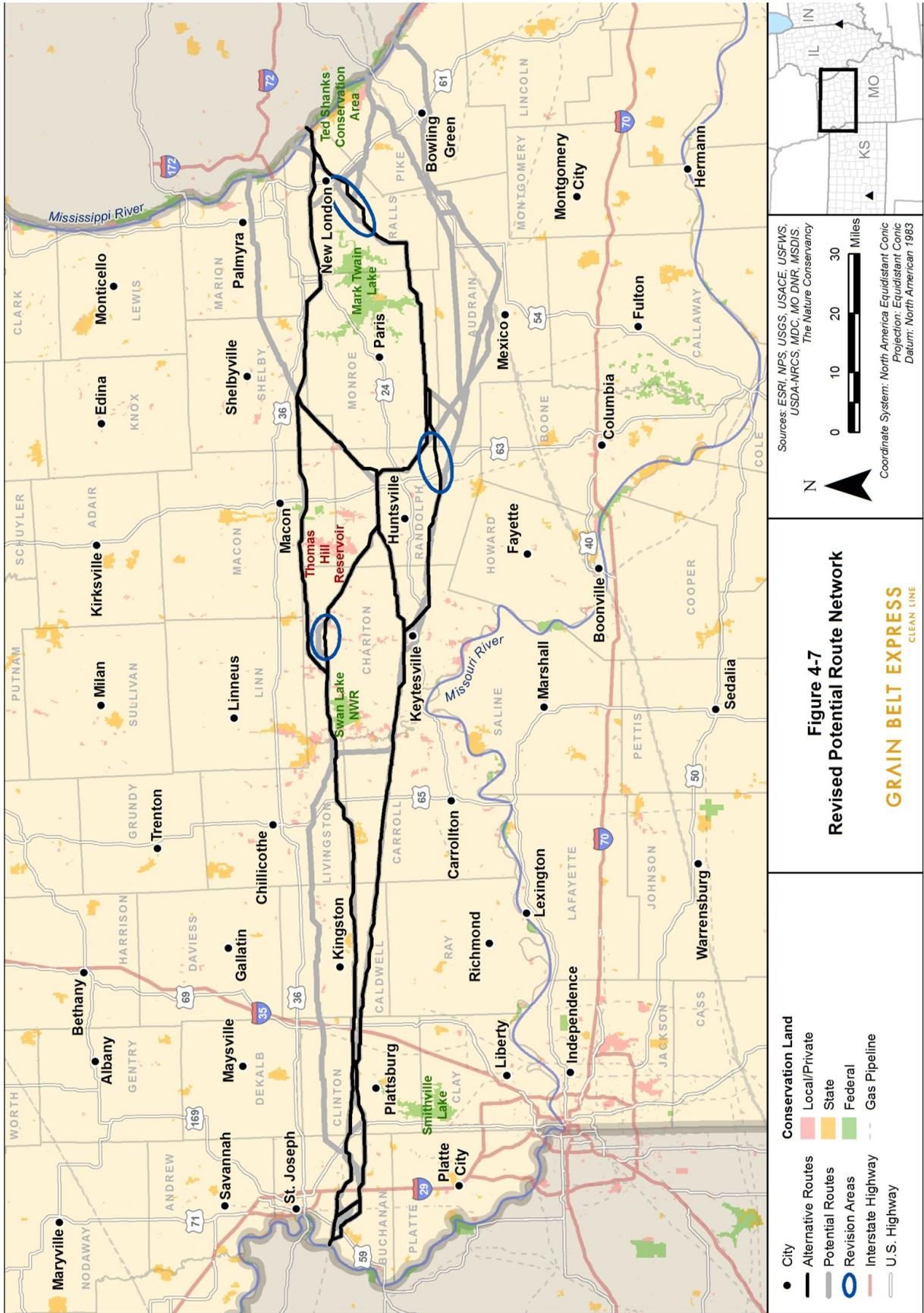


specific mention for those who may have reviewed slightly different alignments at the Open House meetings (see **Figure 4-7**).

1. *Southeast of Moberly:* After the Open Houses, a new Potential Route link was added southeast of Moberly that connected the Potential Route along the Rockies Express/Keystone Pipeline to Potential Routes in southern Monroe County. The new link provided a more direct path to the other potential routes, eliminated the circuitry of the Potential Route near Mexico, and decreased the overall length of routes in this area. An additional Open House (as discussed in Section 3.3.2) was held for this new Potential Route.
2. *East of Rothville:* The Potential Route presented at the Open Houses diverted from the transmission line to the northeast approximately 2 miles before heading east for 3.5 miles to the Thomas Hill 161 kV transmission line. The Potential Route paralleled the Thomas Hill line for less than 1 mile before deviating southeast for 1 mile to avoid Natural Resources Conservation Service (NRCS) wetland conservation easements. The Potential Route then rejoined the Thomas Hill 161 kV transmission line and continued to parallel the existing transmission line southeast.

The Routing Team evaluated the area and determined the Potential Route did not need to divert as far north in this area and could be refined to provide a better trajectory to the Thomas Hill 161 kV transmission line and avoid NRCS conservation easements. Thus, the Potential Route was shifted 0.5 mile north and then east along section/parcel boundaries for approximately 2.5 miles before shifting north another 0.5 mile, just east of Missouri Highway 5. After approximately 1.5 miles, the Potential Route moved south to follow section/parcel boundaries to the east for approximately 2 miles. The route then turned southeast and east to begin paralleling the Thomas Hill 161 kV transmission line. By refining the route in this location, the Routing Team was able to eliminate the circuitry of the route and decrease its overall length.

3. *Center to New London:* The Potential Route presented at the Open Houses paralleled an existing 115 kV transmission line diagonally to the northeast from the town of Center to a point southwest of New London. During the Open Houses, the Routing Team discovered that the existing transmission line was being relocated to parallel Missouri Highway 19. Therefore, the Potential Route as shown at the Open Houses would not be parallel to the existing line as intended. The Routing Team opted to reevaluate the area to determine if another location was more suitable for the Potential Route. Residential development north of the town of Center along Missouri Highway 19 did not provide adequate space for both the relocated transmission line and the Potential Route. Therefore, routes along the highway were not carried forward north of Center. A new Potential Route was added that parallels Missouri Highway 19 to a point just south of Center before turning east for 2.5 miles and northeast for 7.5 miles where it rejoins the original Potential Route that was



presented at the Open Houses.

Potential Route Links Removed from Further Consideration

Following the Open Houses, the Routing Team reviewed the Potential Route Network in detail with respect to a variety of environmental and land use factors, public input on area constraints near the Potential Routes, and engineering input, and began eliminating those Potential Route links that were considered less suitable for the Project.

Potential Route links in Segment 1 were encumbered by residential development near St. Joseph. Potential Route links in this area were refined to minimize the number of residences near the Potential Routes, while still maximizing the use of existing linear features. In addition, one Potential Route link was removed due to a private airstrip that was identified near a Potential Route and perpendicular to the end of the runway. Individual Potential Route links in Segment 1 that would likely result in greater impacts were removed from the network. The resulting configuration of routes is presented in **Figure 4-7**.

Potential Route links in Segment 2 generally followed three main alignments across the remainder of Missouri. The northernmost Potential Routes were developed to consider alignments near U.S. Highway 36, but ultimately followed along section/parcel boundaries just south of the highway due to residential and commercial development. The southernmost Potential Routes were developed to consider suitable alignments along the existing Rockies Express/Keystone Pipeline corridor. Lastly, Potential Routes were developed along a central path following section/parcel boundaries between the northern and southern Potential Routes.

Numerous Potential Route links were also considered that connected these three main west-to-east routes. In general, Potential Route links in Segment 2 of the Study Area were encumbered by development near U.S. Highway 36, Moberly, and Hannibal, as well as by numerous public lands and conservation easements along the Grand River, Mark Twain Lake, and the Mississippi River. The Potential Routes in Segment 2 were also highly dependent on the identification of a suitable crossing location for the Mississippi River. For example, Potential Route links in Audrain County were ultimately removed from further consideration in part because they unnecessarily increased the circuitry and length of the line (in addition to having more homes in close proximity) given the trajectory of the river crossings under consideration.

Identification of the Mississippi River Crossing Location

Although many river crossings were considered during the Conceptual Route phase, Potential Route crossings of the Mississippi River were primarily focused between a stretch of the Mississippi River from Hannibal to Clarksville, Missouri. Initial siting efforts focused on locations along the river with existing infrastructure crossings. However, those few sites that were identified with existing crossing locations were either encumbered by residential and commercial development, existing infrastructure, sensitive cultural and recreational resources,

or environmentally sensitive federal lands. Thus, the Routing Team also considered an array of crossing locations where no existing infrastructure currently crosses the river. For these crossings, the team considered a variety of factors in the identification of these crossings, including (but not limited to): potential for impacts on public land resources, existing irrigation infrastructure, sensitive species habitats, historic resources, and the technical design requirements of the crossing itself.

Of the many potential Mississippi River crossings considered, the Routing Team identified five from which the preferred crossing location was ultimately selected (**Figure 4-8**). The northernmost crossing was just north of Hannibal, Missouri, while the southernmost was just north of Clarksville, Missouri. All potential river crossing locations were presented at the Open Houses for comment and feedback. In addition, several agency meetings were held with MDNR, MDC, USFWS, USACE (Rock Island and St. Louis Districts), IDNR, and Missouri SHPO to discuss each river crossing and receive feedback for incorporation into the final decision. A brief description of each river crossing along with the feedback received from the agencies is discussed below.

1. *Northern Hannibal Crossing (River Mile 313–314)*: The northernmost river crossing is located approximately 3.5 miles north of Hannibal, Missouri. This location crosses approximately 14,300 feet of floodplain on the Missouri side before crossing the Mississippi River with an approximate span (from bank to bank) of 5,800 feet. On the Illinois side, the Potential Route crosses approximately 16,150 feet of floodplain. The Potential Route crosses McDonald and Schaffer islands, both of which are administered by USACE Rock Island District. Land use on either side of the river within the floodplain is agricultural with few residences located near the Potential Route. Outside the floodplain, the topography increases with steep slopes and varying terrain.

The agencies identified several potential concerns with this crossing. USFWS raised an increased concern for the Indiana bat (a federally listed endangered species) along all of the northern river crossings (including this crossing and the two crossings north and south of Saverton). Forested lands along the northern crossings have a higher potential occurrence for both winter hibernacula and summer maternity colony presence. In addition, USACE Rock Island District noted its ownership of the two islands and stated that these areas are leased to USFWS and the state of Illinois. USACE also noted that crossing Pool 22 may be incompatible with its current designated use as a Natural Area.