at this location; therefore, impacts to the recreational resources are not anticipated. Agricultural lands typifying the area surrounding the lake are characterized by open fields and patches of forest with interspersed residential and agricultural land uses. Topography surrounding the lake can be characterized as flat to gently undulating, allowing for some distant views across the landscape.

Typical Agricultural Landscape Southeast of Mark Twain Lake

South of Mark Twain Lake, visible features of the transmission line associated with Alternative Routes D, E, and G would be introduced into an agricultural and forested area and may create new visual disturbances in the area. Steel structures and lines will be visible to residents and motorists travelling along local roadways, however, forest cover throughout much of the area would provide some degree of natural shielding from public vantage points. Recreational uses at the reservoir would be unaffected because of existing forest cover and topography, which would limit views from the reservoir. As a result, impacts associated with recreational uses of the reservior are not anticipated.

5.2.5 Cultural Resources

Archaeological Resources

The Routing Team reviewed the Missouri Cultural Resource Inventory, maintained by the Missouri SHPO, for archaeological sites, architectural resources, and historic properties listed on the National Register. Prehistoric development within Missouri was heavily influenced by the variation in the natural environments across the state and by the presence of the Mississippi and the Missouri rivers and their associated valleys. Archaeologists have divided the history of human occupation of Missouri into five major periods: Paleoindian Period (circa 12,000 to 8,000 years Before Christ (B.C.); Dalton Period (circa 8,000 to 7,000 years B.C.); Archaic Period (circa 7,000 to 600 B.C.); Woodland Period (circa 600 B.C. to 900 Anno Domini [A.D.]); and Mississippian Period (circa 900 A.D. to post-1700 A.D.)

Evidence of the Paleoindian occupation of Missouri has been confined to isolated fluted projectile point finds generally along major watercourses and interfluvial divides. The Dalton Period coincides with a climactic shift to warmer, drier weather. Coincident with the weather changes, the prehistoric inhabitants of Missouri developed a greater diversity of stone tools suggesting adaptation to a more diverse environment with a variety of natural resources. The Archaic Period is marked by continued technological developments reflecting an increasing reliance on a range of faunal and floral resources. By the latter part of the Archaic Period, the percentage of ground stone tools used within sites had increased, and prehistoric ceramics began to appear.

The Woodland Period within Missouri is marked by an increasing reliance on domesticated plants as a resource, the increasing use and production of ceramic vessels, and the introduction of a complex burial process including the creation of corporate burial grounds and earthen mounds. Trade became increasingly important during the Woodland Period with trade goods featuring prominently in the elaborate burials associated with the Middle Woodland period. These burials are typically referred to as Hopewellian after the Hopewell site in Ohio. The Late Woodland Period experienced a retraction in interregional trade, a diminishment of the elaborate mortuary rituals, and a simplification of ceramic design and motifs.

The Mississippian Period constitutes the most complex period of cultural development within the prehistory of the midwestern United States. This period witnessed the development of ranked societies, an increasing reliance on maize agriculture, the construction of platform and burial mounds, and a revival in long-distance trade. Fortified town and temple complexes dating to this period have been identified in the Mississippi and Missouri River valleys. Initial European contact with the indigenous inhabitants of the Midwest occurs during the Mississippian Period. The Proto-historic tribal affiliations of these groups include the Oneota, Kansa, Missouri, Osage, Sac, and Fox tribes.

By the early nineteenth century, the native population within Missouri had significantly declined. Coincident with the declining indigenous population, a large influx of Euro-American settlers began moving west, following major waterways and intent on cultivating the newly acquired Missouri territory. Eventually these settlers spread across the state, and by the mid-nineteenth century the economy of the state was characterized by farming and industrial centers of commerce and trade. These communities flourished, creating many of the successful urban centers of industry that continue to shape and define Missouri. Archaeological excavations in many of these city centers and surrounding rural landscapes document the history of urban and rural immigrant communities and the development of an industrial society.

Two archaeological sites have been previously identified within the ROW of the Alternative Routes in Segment 1 of the Project. These sites consist of a Middle Woodland Period habitation site and a Woodland Period habitation site. Approximately 10 previously identified archaeological sites have been identified within 1,000 feet of Segment 1. These sites are predominantly prehistoric habitation or lithic scatter sites. Two previously identified prehistoric sites within Segment 1 also consist of mound/cairn sites. Such sites are generally associated with the Early to Middle Woodland periods. The previously identified prehistoric sites suggest that Segment 1 may be particularly sensitive for Woodland Period archaeological sites, including burial mounds. Historic archaeological sites that have been identified within the vicinity of Segment 1 consist of Antebellum Period commercial/industrial sites and Early Industrial Period habitation sites.

A total of 12 archaeological sites have been previously identified within the ROW of the Alternative Routes in Segment 2 of the Project. These sites consist predominantly of historic period sites, undateable habitations sites, or habitations sites dating to the Early Industrial or Antebellum periods. One Paleo-Indian site has been identified within Segment 2. Approximately 72 archaeological sites have been identified within 1,000 feet of Segment 2. These sites consist of a nearly equivalent number of prehistoric, historic, and unknown archaeological sites. The prehistoric sites consist of habitation sites, lithic scatters, two cemeteries, and two cairn/mound sites. The majority of the prehistoric sites could not be identified with a period of occupation. The proximity of the Missouri River to portions of Segment 2 suggests the potential for Paleo-Indian deposits. Paleo-Indian sites have been associated with major river valleys in Missouri, including the Missouri and Mississippi rivers. In addition, Early to Middle Woodland Period sites, including burial mound sites, have been identified in the Salt and Chariton drainage basins. The portions of Segment 2 that extend through these drainage basins, particularly within Chariton, Randolph, and Monroe counties, are considered particularly sensitive for prehistoric deposits associated with the Early to Middle Woodland periods. The historic archaeological sites identified within the vicinity of Segment 2 consist of Early Industrial and Antebellum Period habitation and commercial/industrial sites.

Architectural Resources

Segment 1 of the Project running through Buchanan County and the west half of Clinton County has few known architectural resources (**Figure 5-6**). Scattered rural farmsteads are the primary architectural resources identified. The farmsteads generally appear to have frame barns and residences or other workshops that have been altered with modern materials.

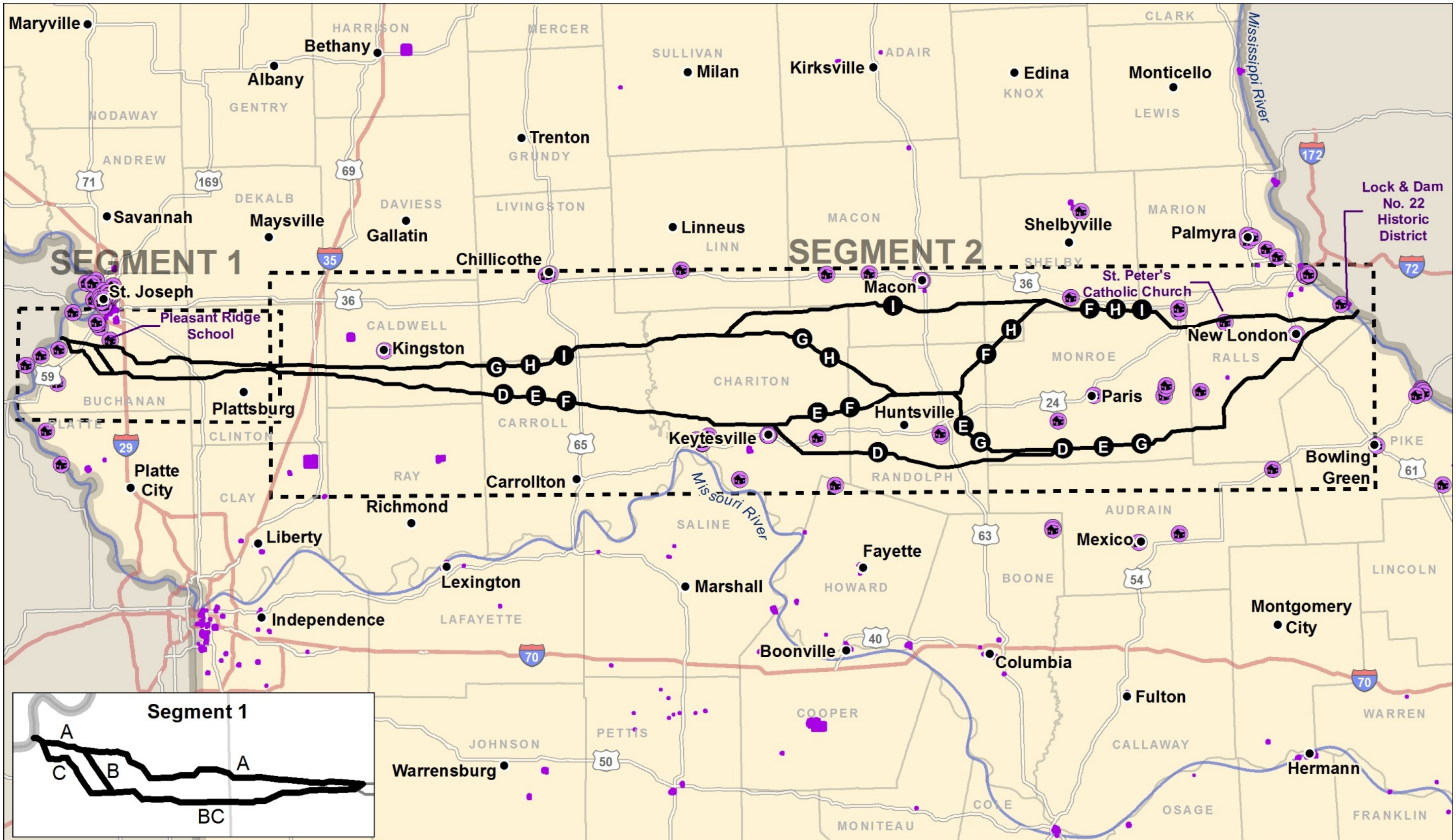
Towns located within or near Segment 1 include St. Joseph, Plattsburg, Agency, Faucett, Turney, and Gower.

Segment 2 consists of the east half of Clinton, Caldwell, Carroll, Livingston, Chariton, Macon, Randolph, Shelby, Monroe, and Ralls counties (**Figure 5-6**). These counties are likely to include rural farmsteads, residences, commercial buildings, cemeteries, churches, bridges, and schools. All of the counties are part of a 13 to 17 county area known as Little Dixie. Settlers in this area came from the upper south states of Kentucky, Virginia, and Tennessee in addition to immigrants from Germany. There is a strong antebellum influence in the folk architecture of these counties. The principal architectural types that dominate the recorded architectural resources in Chariton County are frame single-pen, double-pen hall-and parlor, central-hall, and I-houses. Schools and churches in some areas are constructed of brick and are generally two stories high. A couple of significant concrete form block houses are located within Chariton County. These structures in the Study Area tend to be in various states of disrepair or ruin. The farmsteads within the Study Area also follow folk types and styles. Numerous Civil War skirmish sites are documented throughout central Missouri. No known sites are located in the Study Area, but there could be undocumented sites and/or cemeteries. The towns located near or within Segment 2 are discussed in **Table 5-15**. The hamlet of Wein, in Chariton County, could be eligible as a rural historic district.

General Impacts and Mitigation

Transmission lines tend not to have significant indirect impacts on archaeological resources, which are usually located entirely below the ground surface. However, some sites have surface expression, such as burial mounds, effigies and intaglios, stone circles or alignments, foundations and walls, and cemeteries. The new transmission structures might detract from the setting or feeling of a site, particularly if the significance of the site relates in part to a sense of wildness, openness, primitiveness, or sacredness. Whenever possible, adverse impacts on identified sites would be avoided by strategically locating access roads, staging areas, and structures.

Impacts on archaeological properties may be physical and/or visual, depending on the type of site. Visual impacts, such as those described for architectural historic properties, can occur where the physical setting, location, or feeling contributes to the significance of the resource. Frontier military posts or homesteads, battlefields, historic trails, cemeteries, burial mounds, or landforms that are identified as sacred places are some examples. Adverse physical impacts can include ground disturbance by excavation to construct transmission line support structures and



- City
- Alternative Routes
- Interstate Highway
- U.S. Highway
- National Register of Historic Places Site
- National Register of Historic Places District

Figure 5-6
Architectural Historic Properties in the Study Area

GRAIN BELT EXPRESS CLEAN LINE

Sources: ESRI, NPS, MO DNR, MO SHPO, MSDIS.

N

0 10 20 30 Miles

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

substations, compression and/or rutting by heavy machinery, grading/constructing access roads, pulling stumps, material storage, or surface collection of artifacts by construction crew persons.

Impacts on architectural historic properties would be primarily visual, created by the construction of new structures where none exist, the addition of a second transmission line next to an existing transmission line corridor (generally a lesser impact), and clearing of forested land. Impacts would vary based on local relief, height of existing vegetation, and any intervening recent development. Any physical impacts on architectural historic properties would be avoided, where possible, by strategically locating access roads, staging areas, and structures.

Alternative Route Comparison

A review of archaeological resources from the Missouri SHPO identified several recorded archaeological sites along the Project ROW, including all of the Alternative Routes (MSHPO 2013). Generally, archaeological resources are only a concern when located within the ROW and can usually be spanned or avoided, eliminating any impacts.

A review of the National Register from the Missouri National Register files was completed for each segment. Spatial information was collected on all previously identified architectural and archaeological resources within 0.25, 0.5, and 1 mile of each Alternative Route. A review of the National Register shapefiles from the Missouri SHPO identified three National Register-listed properties within 0.5 to 1 mile of the Alternative Routes.

Segment 1

Alternative Routes A and B each have one archaeological resource within the ROW and several resources within 1,000 feet (see **Table 5-18**). Alternative Route C has the fewest resources within the ROW and within 1,000 feet. It should be noted that the Rockies Express/Keystone pipelines had an extensive archaeological survey completed as part of the environmental permitting required for those projects. Therefore, more resources may be associated with the pipeline parallel because the adjacent area was previously surveyed for cultural resources. Other areas of the state lack previous surveys, therefore, resources may still be present but have not been located. Alternative Route C does not parallel existing infrastructure and most likely lacks the same survey intensity that has been conducted along the pipeline.

Table 5-18. Archaeological Resources for Alternative Routes in Segment 1			
	A	B	C
Resources within the ROW[1]	1	1	-
Resources within 1,000 feet[2]	6	5	1

[1]The ROW is 100 feet on either side of centerline.

[2]Resources are measured from the centerline of the Alternative Routes.

The National Register-listed Pleasant Ridge School was identified approximately 1 mile from Alternative Route A. Alternative Routes B and C do not have any National Register-listed resources within 1 mile of the centerline.

Segment 2

A total of 12 archaeological resources are located within the ROW for Alternative Routes in Segment 2 (**Table 5-19**). Alternative Routes D and E have the greatest number of previously identified archaeological resources, with 12 and 11 archaeological resources, respectively. As noted for Segment I, the Rockies Express/Keystone pipelines underwent extensive archaeological survey prior to their construction. Therefore, although it may appear that more resources are located along these Alternative Routes, it is likely a reflection of the extensive surveys completed for those projects.

Table 5-19. Archaeological Resources for Alternative Routes in Segment 2						
	D	E	F	G	H	I
Resources within the ROW[1]	12	11	8	4	1	2
Resources within 1,000 feet[2]	44	48	43	23	18	18

[1]The ROW is 100 feet on either side of centerline.

[2]Resources are measured from the centerline of the Alternative Routes.

Two National Register-listed sites are located within 1 mile of the Alternative Routes in Segment 2. The National Register-listed St. Peter's Catholic Church is approximately 3,000 feet from Alternative Routes F, H, and I. The Lock and Dam No. 22 Historic District is approximately 1.4 miles from all Alternative Routes and is also listed on the National Register.

5.3 Engineering

Converter Station

As discussed in Section 1.4.3, three converter stations would ultimately be constructed for the Project. The first converter station would take the power generated from the wind farms in southwest Kansas and convert it to DC electricity. The intermediate converter station would be located in Ralls County, Missouri, and would convert DC electricity back to AC for distribution in the electric grid. The final converter station would be located near the Sullivan Substation in Indiana and would also convert DC electricity back to AC for distribution in the electric grid.

The location of the intermediate converter station, which depends on the final alignment of the Proposed Route, would be near Ameren's Maywood-Montgomery 345 kV Line transmission line. This transmission line would connect the converter station to the surrounding grid. Grain Belt Express would work with landowners near the Proposed Route to determine a suitable location for the converter station. Several potential converter station locations were considered near the Alternative Routes in the vicinity of the Ameren transmission line. Ideal converter station locations include areas outside of floodplains and wetlands with relatively flat topography, close to major roads or highways and railroads, and sufficient enough space to accommodate the 40- to 60-acre site. The construction and maintenance of the converter station requires paved roads and railroads to move transformers and other heavy pieces of equipment.

Alternative Routes D, E, and G intersect the Maywood-Montgomery 345 kV transmission line at the same location. This area is flat and consists of agricultural fields. The town of Center is located approximately 1 mile east of the Maywood-Montgomery 345 kV transmission line. Despite the proximity to the town, few residences are located west of Center near the area of the existing transmission line, and parcel sizes in this area are generally large. State Highway 19 is parallel to the Alternative Routes and provides a suitable road for hauling heavy equipment. In addition, a railroad is located approximately 20 miles south of the intersection of the Alternative Routes and the existing transmission line, near the town of Bowling Green.

Alternative Routes F, H, and I all intersect the Maywood-Montgomery 345 kV transmission line at the same location. This area is generally characterized as moderately sloped with flat agricultural fields. Residential density in this area is low, but several residences are scattered throughout the area. There are also several large tracts of forest that are associated with drainages. Most roads in this area are gravel roads. State Highway H is the major paved road in the area and is located approximately 1mile east. A railroad is located approximately 2 miles north of the Alternative Routes, although the closest rail station may still be several miles further away in Monroe City, which is the closest town to the converter station area.

Both areas have suitable locations for the converter station. However, more potential sites are located near the Alternative Routes D, E, and G. The flat topography and nearby highway are both benefits to siting the converter station in this location, in addition to the larger parcel sizes, which are ideal for the 40- to 60-acre site.

5.3.1 Transportation

Local and county roads are the dominant mode of transportation throughout the Study Area; however, two interstates (Interstate 29 and Interstate 35) cross north-to-south through the Study Area. There are also numerous private and public airfields used for municipal, agricultural, and recreational activities. The Routing Team avoided crossing directly over all public and private airfields; however, all Alternative Routes do fall within an estimated obstruction zone. The estimated obstruction zones were calculated using the same requirements as the Federal Aviation Administration (FAA) approximated notification zone requirements (Code of Federal Regulations, Title 14, Part 77 Subpart B). Many of the larger towns and cities in the Study Area are connected by railroads, several of which are crossed by Alternative Routes in both segments.

General Impacts and Mitigation

Numerous U.S. highways, state highways, and county and local roads transect the Study Area. Highways and roadways can be spanned with the transmission line and impacts are generally minimal. During construction, it may be necessary to close portions of roads to allow the stringing of the conductor over the road. Coordination with the Missouri Department of Transportation would occur for all highway crossings associated with the Project. Similarly, the crossing of rail lines results in minimal impacts, although coordination with railway operators would be necessary during construction of the railway crossings.

Generalized notification zones for public and military airports and heliports are determined per FAA regulations (Code of Federal Regulations, Title 14, Part 77, Subpart B). The generalized zones are designed to identify potential flight obstructions and are based on the projected height of structures and the airport runway length. Impacts from structures located within a notification zone can be mitigated by lighting or marking the structure or by situating the new structure adjacent to an existing obstruction (such as an existing transmission line or tree line). Similar generalized notification zone buffers were considered around verified private airfields to avoid negatively impacting their operations, even though these regulations do not apply to private airfields.

Alternative Route Comparison

Segment 1

All of the Alternative Routes in Segment 1 cross Interstate 29, two U.S. highways, and two state highways (**Table 5-20**). U.S. highways crossed by all three of the Alternative Routes include Highways 169 and 59. State highways crossed by all three Alternative Routes include State Highways 33 and 371. All Alternative Routes cross the same number of railroads and U.S. and state highways. No impacts to transportation are expected from any of the Alternative Routes.

Table 5-20. Transportation Infrastructure Crossed by Alternative Routes in Segment 1

	A	B	C
Public airfields (miles of FAA Notification Zones crossed)	-	-	-
Private airfields (miles of estimated obstruction zone crossed)	3.5	5.9	4.8
Railroad crossings	1	1	1
Interstate crossings	1	1	1
U.S. highway crossings	2	2	2
State highway crossings	2	2	2

No public airfields are located in close proximity to any of the Alternative Routes in Segment 1 (**Figure 5-7**). All three Alternative Routes are within the estimated notification zone for private airfields, based on the notification zone as calculated by the runway length and the average height of structures (**Table 5-21**).

All three Alternative Routes are within the 15,000-foot estimated obstruction zone for the private Booze Island Airport. The Alternative Routes' crossing of the Missouri River is approximately 12,800 feet from the end of the unimproved runway surface. Any impacts from the Alternative Routes on the operation of Booze Island Airport would be assessed as part of the FAA Part 77 notification.

All three Alternative Routes are within the estimated 7,500-foot obstruction zone for a private landing strip. Alternative Routes A and B are approximately 3,100 feet from the northern end of the landing strip. After the aircraft are above the tree cover, which is approximately 100 feet from the northern end of the landing strip, impacts to the operation of the airfield from Alternative Routes A and B would not be anticipated. Alternative Route C is approximately 5,400 feet from the southern-most end of the landing strip, and at this distance, impacts to the operation of the airfield are not anticipated.

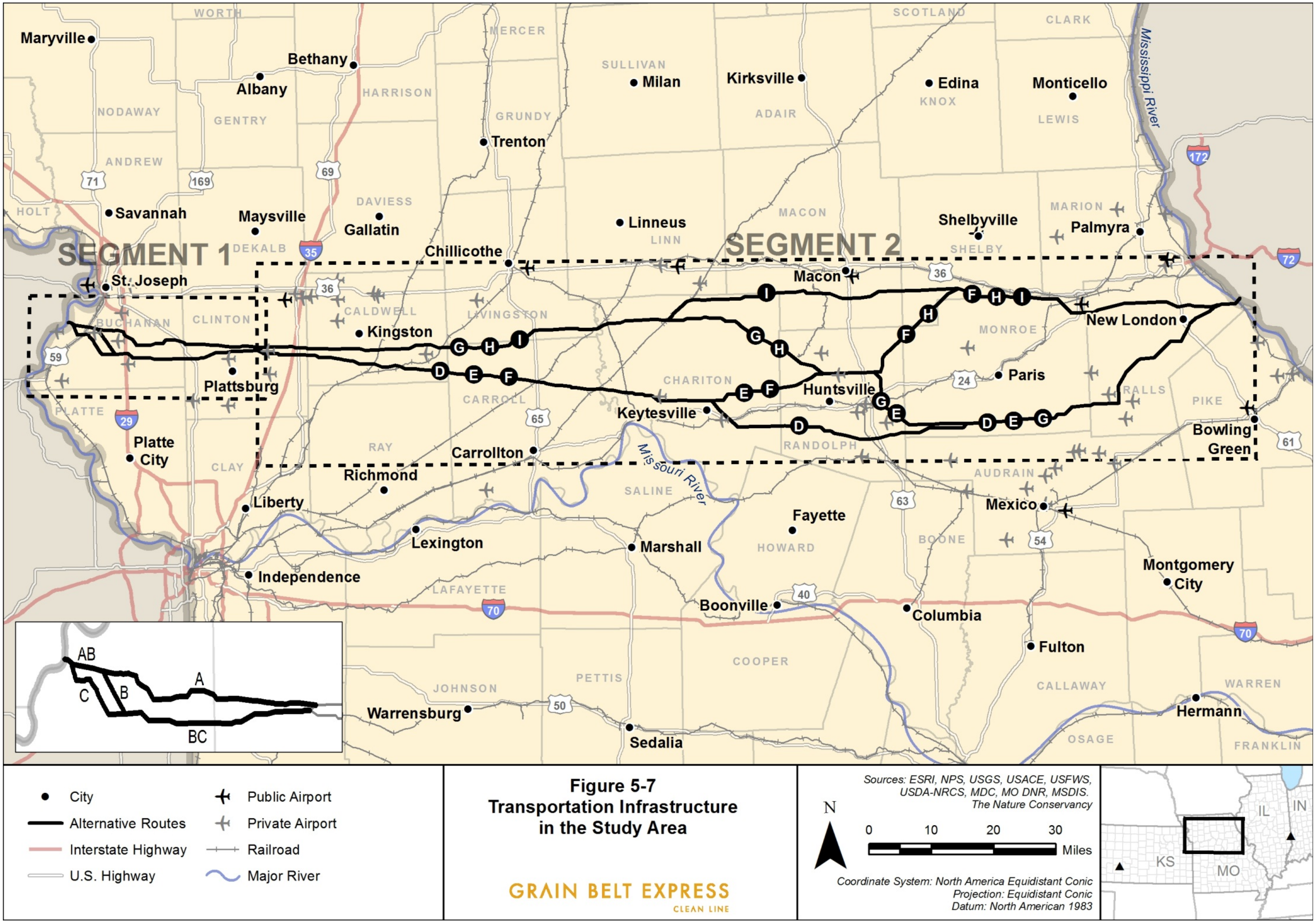


Figure 5-7
Transportation Infrastructure in the Study Area

Table 5-21. Public and Private Airstrips in Segment 1							
Alternative Route	**Airfield Name**	**Ownership**	**Runway Type**	**Runway Length (feet)**	**Distance from Alternative Route**	**Orientation of Runway**	**Orientation of Alternative Route from Runway**
A, B, C	Booze Island Airport	Private	Grass	3,260	12,840 feet from the northern end of the runway to Alternative Routes A, B, and C	NE–SW	Perpendicular
A, B, C	Unnamed	Private	Grass	1,470*	3,120 feet from the northern end of the runway to Alternative Routes A and B; 5,390 feet from the southern end of the runway to Alternative Route C	N–S	Perpendicular (A, B), Perpendicular (C)
B, C	Farris	Private	Paved	2,100	8,450 feet from the northern end of the runway to Alternative Routes B and C	N–S	Perpendicular (8,450 feet) Parallel (6,970 feet)

B, C	Plattsburg Airpark	Private	Paved (deteriorate d)	2,100	4,730 feet from the northern end of the runway to Alternative Routes B and C	N–S	Perpendicular
A	Unnamed (Clinton County)	Private	Grass	1,650*	4,700 feet from the northwestern-most end of the runway to Alternative Route A	NW–SE	Perpendicular

*Runway information was not available from FAA and was measured using aerial imagery.

Alternative Routes B and C are within the estimated 7,500 foot obstruction zone for the private Farris Strip. While these routes are approximately 6,900 feet from the vicinity of the airfield (within the FAA notification zone), they are approximately 8,400 feet from the northern end of the runway. Due to the distance of the Alternative Routes to the end of the runway, impacts to the operation of the airfield are not anticipated. Interstate 29 and several residences are located between the runway and the Alternative Routes.

Alternative Routes B and C are within the estimated 7,500 foot obstruction zone for the private Plattsburg Airpark. The Alternative Routes are approximately 4,700 feet from the northern end of the unimproved landing strip. Any impacts from the Alternative Routes on the operation of Plattsburg Airpark would be assessed as part of the FAA Part 77 notification.

Alternative Route A crosses the estimated 7,500 foot obstruction zone for a private, unnamed landing strip on the far eastern edge of Segment 1. This unimproved landing strip is approximately 4,700 feet from the termination of Alternative Route A. This landing strip is not listed on the FAA's list of certified and non-certified private-use facilities.

Segment 2

All of the Alternative Routes in Segment 2 cross Interstate 35. **Table 5-22** lists the number of times U.S. highways and state highways are crossed by each Alternative Route.

Table 5-22. Transportation Infrastructure Crossed by Alternative Routes in Segment 2

	D	E	F	G	H	I
Public airfields (miles of FAA Notification Zones crossed)	-	4.3	6.9	4.3	6.9	6.2
Private airfields (miles of estimated obstruction zone crossed)	10.4	8.4	5.9	4.6	2.1	2.1
Railroad crossings	8	7	7	8	8	10
Interstate crossings	1	1	1	1	1	1
U.S. highway crossings	6	5	5	5	5	5
State highway crossings	12	11	10	10	9	9

Alternative Route D crosses the most U.S. and state highways (6 and 14 crossings, respectively), while Alternative Routes E, F, G, H, and I all cross five different U.S. highways. These remaining Alternative Routes do not cross any U.S. highway more than once. Alternative Routes H and I cross the fewest number of state highways.

There are few public airfields in proximity to any of the Alternative Routes (**Figure 5-7**). Alternative Route D is the only Alternative Route that does not cross the estimated FAA

Notification Zone of a public airfield (**Table 5-23**). Alternative Routes E, F, G, and H are within the estimated 15,000 foot FAA notification zone for Omar N. Bradley Airport in Moberly, MO. The Alternative Routes are approximately 18,150 feet and 12,400 feet from the northern and southern ends of the main runway, respectively, and approximately 13,400 feet from the eastern end of the second runway. Additionally, as these Alternative Routes traverse the notification zone, existing transmission lines are paralleled in an effort to minimize the impact to the airport's flight paths.

Alternative Routes E, F, G, H, and I are within the general 15,000 foot FAA notification zone for Captain Ben Smith Airfield (Monroe City Regional Airport). The Alternative Routes are approximately 13,500 feet from the westernmost end of the runway. Due to the distance of the Alternative Routes to the end of the runway, impacts to the operation of the airfield are not anticipated.

All Alternative Routes cross the estimated 7,500 foot estimated obstruction zone for a private, unnamed landing strip on the far western edge of Segment 2. This unimproved landing strip is approximately 3,200 feet from Alternative Routes G, H, and I. Alternative Routes D, E, and F are approximately 1,500 feet from the southernmost end of the landing strip. This landing strip is not listed on the FAA's list of certified and non-certified private-use facilities.

Alternative Routes D, E, and F cross the estimated 7,500 foot obstruction zone for the private landing strip, Shiloh Airpark. The far southernmost end of the landing strip is approximately 3,300 feet from the Alternative Routes. Because of the distance of the Alternative Routes from the runway and the preexisting tree cover on the runway approach, impacts to the operation of the airfield are not anticipated. This landing strip is not listed on the FAA's list of certified and non-certified private-use facilities.

Alternative Route D crosses the estimated 7,500 foot obstruction zone for an additional private, unnamed landing strip on the southern edge of the Study Area. The eastern edge of the landing strip is approximately 6,300 feet from Alternative Route D. Following the same trajectory towards Alternative Route D, aircraft operators would first encounter an existing 161 kV transmission line approximately 1,000 feet from the eastern edge of the landing strip. Because of the distance of the Alternative Route to the end of the runway and the proximity of the existing transmission line to the airfield, impacts to the operation of the airfield are not anticipated.

Alternative Routes D, E, and G cross the estimated 7,500 foot obstruction zone for a private, unnamed grass airfield in Monroe County. The Alternative Routes are approximately 3,100 feet from the southwestern end of the runway. This landing strip is not listed on the FAA's list of certified and non-certified private-use facilities.

Table 5-23. Public and Private Airports in Segment 2							
Alternative Route Affected	**Airfield Name**	**Ownership**	**Runway Type**	**Runway Length (feet)**	**Distance from Alternative Route**	**Orientation of Runway**	**Orientation of Alternative Route from Runway**
D, E, F, G, H, I	Unnamed (Clinton County)	Private	Grass	1,650*	3,220 feet from the northwestern end of the runway to Alternative Routes G, H, and I; 1,450 feet from the southern end of the runway to Alternative Routes D, E, and F	NW - SE	Perpendicular (GHI) Perpendicular (DEF)
D, E, F	Shiloh Airpark	Private	Grass	1,300*	3,290 feet from the southern end of the runway to Alternative Routes D, E, and F	N -S	Perpendicular (3,290 feet) Parallel (2,800 feet)
D	Unnamed (Salisbury, MO)	Private	Grass	2,050*	6,300 feet from the eastern end of the runway to Alternative Route D	E - W	Perpendicular
E, F, G, H	Omar N Bradley Airport	Public	(A) Paved (B) Paved	(A) 5,000 (B) 3,350	18,150 feet from the northwestern end of runway A to Alternative Routes E, F, G, and H; 12,470 feet from the southeastern end of	(A): NW - SE (B): NE - SW	Perpendicular (A) Perpendicular (B)

Table 5-23. Public and Private Airports in Segment 2							
Alternative Route Affected	**Airfield Name**	**Ownership**	**Runway Type**	**Runway Length (feet)**	**Distance from Alternative Route**	**Orientation of Runway**	**Orientation of Alternative Route from Runway**
					runway A to Alternative Routes E and G; 13,460 feet from the northeastern end of runway B to Alternative Routes E and G		
D, E, G	Unnamed (Monroe County)	Private	Grass	1,380*	3,150 feet from the southwestern end of the runway to Alternative Routes D, E, and G.	SW-NE	Perpendicular
F, H, I	Captain Ben Smith Airfield (Monroe City)	Public	Paved	3,515	13,460 feet from the western end of the runway to Alternative Routes F, H, and I; 7,430 feet from runway to parallel of Alternative Routes F, H, and I	E - W	Perpendicular (13,460 feet) Parallel (7,430 feet)

*Runway information was not available from the FAA and was measured using aerial imagery.

5.3.2 Other Existing Infrastructure

Cellular and Radio Towers

Cellular and radio towers exist throughout the Study Area. Although these structures have a relatively small base, many have guy wires that extend 150 feet or more from the base of the structure. To avoid interference with the maintenance and operation of these features, transmission lines typically avoid crossing over or under guy wires.

Alternatives Comparison

Segment 1

One cellular tower is located within 500 feet of Alternative Routes B and C. No impacts to the operations or maintenance of the cellular/radio tower are expected because the base of the guy wires is more than 200 feet from the centerline of the Alternative Routes.

Segment 2

See **Table 5-24** for the number of cellular/radio towers within 500 feet of the Alternative Routes in Segment II. As discussed in Segment 1, no impacts are expected to cellular towers from any of the Alternative Routes.

Table 5-24. Cellular/Radio Towers in Segment 2

	D	E	F	G	H	I
Cell/radio towers (within 500 feet)	3	3	2	2	1	-

5.3.3 Existing Utility Corridors

Efforts were made to have Alternative Routes parallel existing transmission lines or pipeline corridors where feasible. Paralleling existing infrastructure is generally considered an acceptable practice for siting new transmission lines. However, there are a few construction and engineering considerations to consider when paralleling existing infrastructure. Existing infrastructure paralleled throughout the Study Area includes:

- Nashua–Lake Road 161 kV transmission line
- Gower–Plattsburg 115 kV transmission line
- Northwest Missouri Electric Coop 69 kV transmission line
- Chillicothe–Thomas Hill 161 kV transmission line
- Kansas City Power & Light Co 161 kV transmission line

- Salisbury–Thomas Hill 161 kV transmission line
- Central Electric Power Coop 115 kV transmission line
- Ameren Missouri 69 kV transmission line
- Keystone Gas Pipeline
- Kinder Morgan Interstate Gas Transmission Pipeline
- Rockies Express Pipeline
- Platte Pipeline
- Transource Sibley- Nebraska City 345 kV transmission line (In-Service date 2017)

General Mitigation Measures

During construction, outages may be required when working near other transmission lines. Outages are often difficult to schedule due to peak use seasons (summer and winter) when utilities are unable to take lines out of service and could result in a longer construction time. In addition, there are areas where existing transmission lines would be crossed. The proposed line would be constructed over the top of existing transmission lines and require taller structures to provide for adequate clearance between the conductors.

Existing pipelines are similar to existing transmission lines in terms of ROWs. The utilities can abut ROWs but not overlap them. Subsurface surveying may be required to determine the exact location of the pipelines prior to construction. Steel plating or matting may also be required when crossing over the top of pipelines to protect them from large construction vehicles.

Alternative Comparison

Segment 1

The number of transmission and pipeline crossings for the Alternative Routes in Segment 1 is shown below in **Table 5-25**. All Alternative Routes cross the same number of <115 kV, 161 kV, and 345 kV transmission lines and cross pipeline corridors. Alternative Route C crosses the least number of pipelines and pipeline ROWs. The pipeline corridors would likely be able to be crossed by a single span at the crossing locations.

Table 5-25. Transmission and Pipeline Crossings for Alternative Routes in Segment 1			
Transmission Lines Crossed	**A**	**B**	**C**
<115 kV	3	3	3
161 kV	1	1	1
345 kV	2	2	2
Pipeline ROW crossings (approximate)	4	6	3
Pipelines crossed (approximate)	10	12	3
Total Crossings	10	12	9

Segment 2

Transmission and pipeline crossings for the Alternative Routes in Segment 2 are shown in **Table 5-26**. Alternative Route G has the most total transmission line crossings, 20 of which are of 69 kV and 115 kV transmission lines. Although engineering challenges still exist when crossing any transmission line, crossing lower voltage lines is typically less of a challenge. Alternative Route I has the fewest transmission line crossings overall, and it also crosses the fewest higher voltage transmission lines (345 kV). Overall, engineering challenges associated with any Alternative Routes would be comparable, given the tradeoffs in crossing lower and higher voltage transmission lines.

Table 5-26. Transmission and Pipeline Crossings for Alternative Routes in Segment 2						
Transmission Lines Crossed	**D**	**E**	**F**	**G**	**H**	**I**
<115 kV	11	16	11	20	15	10
161 kV	7	7	8	8	9	7
345 kV	3	3	3	3	3	2
Pipeline ROW crossings (approximate)	21	19	17	14	12	16
Pipelines crossed (approximate)	42	36	34	17	15	19
Total Crossings	42	45	39	45	39	35

6. Identification of the Proposed Route

6.1 Rationale for the Selection of the Proposed Route

As stated in the introductory chapters, the goal in selecting a suitable route for the Project is to minimize impacts on the natural, cultural, and human environment while avoiding circuitous routes, extreme costs, and non-standard design requirements. However, in practice, it is not usually possible to optimally minimize all potential impacts at all times. There are often inherent tradeoffs in potential impacts to every routing decision. For example, in heavily forested study areas, a route that avoids the most developed areas would likely require the greatest amount of forest clearing, while the route that has the least impact on vegetation and wildlife habitats often impacts more residences or farm lands. Thus, an underlying goal inherent to a routing study is to reach a reasonable balance between minimizing potential impacts on one resource versus increasing the potential impacts on another. The following section presents the rationale for selection of the Proposed Route and, thus, the route that the Routing Team considered to best minimize the impacts of the Project overall. The rationale is derived from the accumulation of the routing decisions made throughout the process, the knowledge and experience of the Routing Team, comments from the public and regulatory agencies, and comparative analysis of potential impacts presented in Chapter 5.

6.2 Summary of Alternative Route Comparison

6.2.1 Segment 1

Alternative Route A

Advantages

- Requires the fewest number of total stream crossings (53)
- Crosses through the shortest length of the estimated obstruction zones for private airfields (3.5 miles)
- Parallels the most miles of existing pipelines (6.3 miles)
- Crosses the fewest number of pipeline ROWs (4)

Disadvantages

- Requires the greatest number of waterbody crossings (9)
- Crosses the most developed acreage (11 acres)
- Contains the most acres of total wetlands within the ROW (41 acres)
- Contains the most acres of forested wetlands within the ROW (21 acres)
- Crosses the largest number of total parcels (127)
- Greatest number of houses within 250 feet (3) and 500 feet (27)

Alternative Route B

Advantages

- Contains the fewest acres of forested wetlands within the ROW (11 acres)
- Contains the fewest acres of potential Indiana and northern long-eared bat habitat within the ROW (124 acres)
- Parallels the most miles of existing transmission line (4.4 miles or 13%)
- Crosses the fewest number of parcels <10 acres in size (5, tied with C)
- Crosses the fewest number of total parcels (115)
- No residences within 250 feet of the ROW (same as C)
- Most cell towers within 500 feet (1, same as C)

Disadvantages

- Crosses the greatest number of pipeline ROWs (6)
- Contains the greatest acres of agricultural land within the ROW (501 acres)
- Contains the fewest acres of grassland/pasture within 200 feet of the ROW (163 acres)
- Crosses through the greatest length of the estimated obstruction zones for private airfields (5.9 miles)

Alternative Route C

Advantages

- Requires the fewest number of waterbody crossings (3)
- Contains the fewest acres of total wetlands within the ROW (33 acres)
- Crosses the fewest number of parcels <10 acres in size (5, tied with B)
- No residences within 250 feet of the ROW (same as B) and the fewest residences within 500 feet (7)
- Crosses fewest number of total parcels (111)
- Parallels the most miles of parcel boundaries (7.5 miles)

Disadvantages

- Requires the greatest number of stream crossings (63)
- Contains the most acres of potential long-eared and Indiana bat forested habitat within the ROW (168 acres)
- Parallels no existing transmission or pipeline ROWs
- Contains the most cell towers within 500 feet (1, same as B)

6.2.2 Segment 2

Alternative Route D

Advantages

- Requires the fewest number of stream crossings (228)
- Requires the fewest number of waterbody crossings (24, same as E and G)
- Contains the fewest acres of total wetlands within the ROW (118 acres)
- Contains the fewest acres of forested and grassland habitat within the ROW (759 and 1,154 acres, respectively)
- Contains the fewest acres of potential Indiana and long-eared bat forested habitat within the ROW (759 acres)
- Crosses the second fewest number of small parcels (<10 acres in size) (13)
- Fewest number of residences within 250 feet (5)
- Fewest number of residences within 500 feet (50)
- Crosses through no FAA Notification Zones for public airfields
- Parallels the most miles of existing pipeline corridors (44.6 miles)
- No NR-listed architectural sites within 1 mile (same as E and G)

Disadvantages

- Crosses through the greatest length of the estimated obstruction zone for private airfields (10.4 miles)
- Highest number of U.S. highway crossings (6) and state highway crossings (12)
- Crosses the greatest number of pipeline ROWs (21)
- Crosses the second greatest length of agricultural lands (90.7 miles)
- Contains the most cell/radio towers within 500 feet (3, same as E)

Alternative Route E

Advantages

- Parallels the most miles of existing linear infrastructure (transmission lines and pipelines) (70.3 miles)
- Parallels the second most miles of existing pipelines (39.3 miles, same as F)
- Contains the second fewest acres of potential Indiana and long-eared bat forested habitat within the ROW (813 acres)
- Requires the fewest number of waterbody crossings (24, same as D and G)
- No NR-listed architectural sites within 1 mile (same as D and G)
- Requires the fewest railroad crossings (7, same as F)

Disadvantages

- Contains the greatest number of acres of NWI forested and scrub/shrub wetland acres within the ROW (70 acres)
- Crosses the most developed acreage (44 acres)
- Crosses the most miles of agricultural land (90.9 miles)
- Greatest number of residences within 250 feet (11, same as F and I)
- Greatest number of transmission line and pipeline ROWs (45)
- Crosses the most city and/or county public land (2614 feet, same as G)
- Second longest route (176.5 miles)
- Most cell/radio towers within 500 feet (3, same as D)

Alternative Route F

Advantages

- Crosses the fewest miles of Karst topography (46.1 miles)
- Crosses the greatest number of large (>80 acres) parcels (306)
- Fewest cemeteries within 500 feet (1, same as H)
- Contains the fewest railroad crossings (7, same as E)

Disadvantages

- Crosses the most streams (252)
- Crosses the most parcels (557)
- Greatest number of residences within 250 feet (11, same as E and I)
- Crosses through the most FAA Notification Zones for public airfields (6.9 miles, same as H)
- Is located in proximity to National Register-listed St. Peter's Catholic Church (3,000 feet, same as H and I)

Alternative Route G

Advantages

- Parallels the most miles of existing transmission line (39.0 miles or 22%)
- No NR-listed architectural sites within 1 mile (same as D and E)
- Requires the fewest number of waterbody crossings (24, same as D and E)

Disadvantages

- Is the longest Alternative Route (177.5 miles)
- Crosses the Lower Grand MDC-designated Heritage Hot Spot (4.5 miles, same as H and I)
- Crosses the most city and/or county public land (2614 feet, same as E)

- Crosses the most miles of karst topography (51.0 miles)
- Is located within 1 mile of Swan Lake National Wildlife Refuge (same as H and I)

Alternative Route H

Advantages

- Crosses through the fewest miles of the estimated obstruction zone for private airfields (2.1 miles, same as I)
- Crosses the fewest number of state highways (9, same as I)
- Parallels the greatest length of 161kV transmission lines (30.9 miles)
- Fewest cemeteries within 500 feet (1, same as F)

Disadvantages

- Contains the most acres of potential Indiana and long-eared bat forested habitat within the ROW (1,056 acres)
- Crosses the most small parcels (<10 acres in size) (22)
- Crosses the Lower Grand MDC-designated Heritage Hot Spot (4.5 miles, same as G and I)
- Crosses through the most FAA Notification Zones for public airfields (6.9 miles, same as F)
- Is located within 1 mile of Swan Lake National Wildlife Refuge (same as G and I)
- Is located in proximity to National Register-listed St. Peter's Catholic Church (3000 feet, same as F and I)

Alternative Route I

Advantages

- Is the shortest Alternative Route (163.2 miles)
- Crosses the fewest number of parcels (493)
- Crosses the fewest number of transmission line and pipeline ROWs (35)
- Crosses the fewest miles of agricultural land (67.3 miles)

Disadvantages

- Contains the greatest acreage of total wetlands within the ROW (acres)
- Greatest number of residences within 250 feet (11, same as E and F)
- Requires the greatest number of waterbody crossings (27)
- Contains the second most acres of potential Indiana and long-eared bat forested habitat within the ROW (1,054 acres)
- Crosses the Lower Grand MDC-designated Heritage Hot Spot (4.5 miles, same as G and H)
- Parallels the fewest miles of existing transmission line (4.3 miles)

- Parallels the fewest miles of existing linear infrastructure (transmission lines and pipelines) (4.3 miles)
- Is located within 1 mile of Swan Lake National Wildlife Refuge (same as H and G)
- Is located in proximity to National Register-listed St. Peter's Catholic Church (3000 feet, same as F and H)

6.2.3 Combined Proposed Route

The Routing Team recommends a combination of Alternative Routes B and D as the Proposed Route for the Project (**Figure 6-1**). This combination of routes meets the overall goal of minimizing impacts on the natural, human, and historic resources, while making best use of existing linear infrastructure ROWs and avoiding non-standard design requirements. The Proposed Route has a total length of 206 miles and parallels existing linear infrastructure ROWs for 28 percent of its total length.

Alternative Route B was selected in Segment 1. Alternative Route B parallels a combination of pipelines, an existing transmission line, and parcel boundaries. Initial alignments cross the eastern floodplain of the Missouri River and into the rolling hills along the pipeline. Approximately 3 miles beyond the eastern bluffs, the route turns southeast adjacent to an existing transmission line to avoid residential development along the pipeline and the town of Agency. The route continues along the existing transmission line for 4.5 miles and then turns due east, eventually joining the pipeline corridor. Alternative Route B has a range of benefits over other Alternatives. It has no residences located within 250 feet of the route centerline, avoids the residential congestion located farther east along the pipeline corridor, and avoids crossing through the town of Agency. Alternative Route B has the least impact on forested areas and parallels existing linear infrastructure, thereby reducing fragmentation of potential habitat for the Indiana bat and northern long-eared bat. Alternative Route B also reduces the fragmentation of area land use, by locating the line adjacent to existing utility infrastructure.

Alternative Route D was selected in Segment 2. It follows the Rockies Express/Keystone pipelines, existing transmission lines, and parcel boundaries for approximately 57 percent of its total length. Alternative Route D has the least number of residences within 250 and 500 feet. Alternative Route D is also located approximately 5 miles south of the Swan Lake National Wildlife Refuge, which is an important area for migratory birds. In addition, the area around Swan Lake National Wildlife Refuge has large complexes of wetlands, some of which are protected under the Natural Resource Conservation Service's Wetland Reserve Program. Considering Alternative Route D parallels existing linear infrastructure for a significant portion of the total length, new fragmentation in forested areas would be minimized. Furthermore, Alternative Route D also has the fewest acres of forested habitat within the right-of-way, which results in the least potential impact to the Indiana bat and northern long-eared bat habitat.

The combination of Alternative Routes B and D comprise a Proposed Route for the Project that is reasonable and sound because: 1) the selection of the Proposed Route integrated input from government agencies, local officials, and the general public into the route development, analysis, and selection process; and 2) the Proposed Route best minimizes the overall effect of the Grain Belt Express transmission line on the natural and human environment while avoiding unreasonable and circuitous routes, unreasonable costs, and special design requirements.

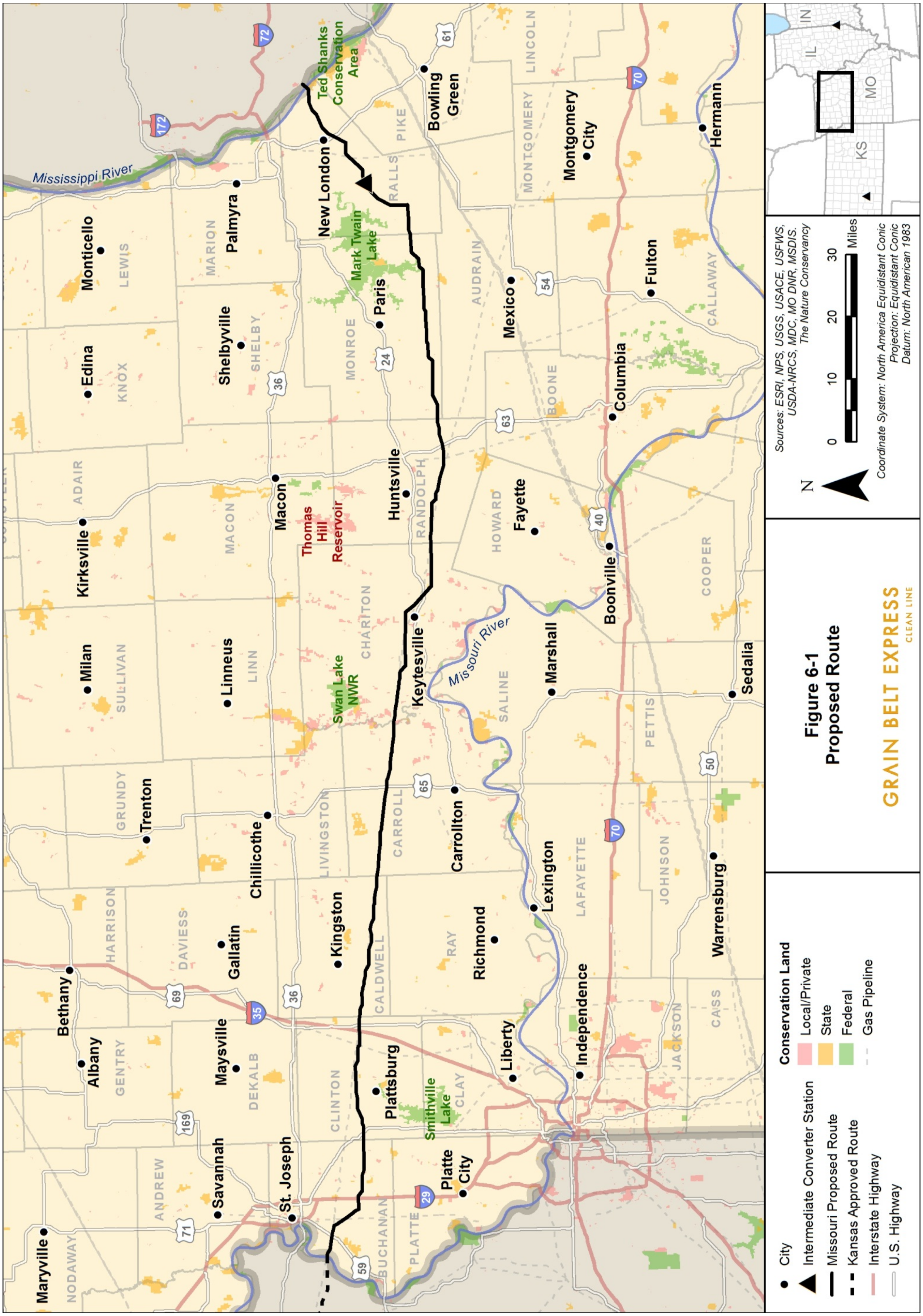


Figure 6-1
Proposed Route

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APPENDIX A: ROUTING TEAM

ROUTING TEAM			
Member	**Affiliation**	**Title**	**Specific Role**
Mike Skelly	CLE	President	Project oversight
Jason Thomas	CLE	Environmental Director	Environmental oversight
Wayne Galli	CLE	Executive Vice President – Transmission and technical services	Engineering support and oversight
Mark Lawlor	CLE	Director of Development	Siting support, public outreach, agency consultation
Diana Rivera	CLE	Project Development Manager	Siting support and public outreach
Adhar Johnson	CLE	Manager	Siting support Public outreach and relations
Ally Smith	CLE	Associate	Siting support Public outreach
John Kuba	CLE	Associate – Environmental Specialist	Siting support, agency consultation, environmental and sensitive species
Cari vanAmburg	CLE	Associate	Public outreach support
Daniel Hodges Copple	CLE	Associate	Public outreach support
Alex Landon	CLE	Associate	Public outreach support
Claire Richard	CLE	Associate	Public outreach support
Louisa Kinoshi	CLE	Associate, Communications	Public outreach support and graphics
Ty White	CLE	Associate	GIS support
Timothy Gaul	LBG	Associate Vice	Project Director, siting support,

ROUTING TEAM			
Member	**Affiliation**	**Title**	**Specific Role**
		President, Energy Services	agency consultation, public outreach
Laurie Spears	LBG	Environmental Planner	Project Manager, siting support, agency consultation, public outreach
James Puckett	LBG	GIS Specialist	Siting support, GIS Analysis and Mapping
Todd McCabe	LBG	Environmental Scientist	Siting support, public outreach, agency consultation, GIS support, sensitive species, land use
Emily Larson	LBG	Environmental Scientist	Siting support & public outreach
Brad Fine	LBG	Environmental Planner	Siting support, public outreach support and logistics, Engineering
Linda Green	LBG	GIS Specialist	GIS Analysis and Mapping, public outreach
Chris Flannagan	LBG	Environmental Scientist	Soils and Geology
Josh Schanbel	LBG	Environmental Planner	Visual and Recreational Resources
Camilla Deiber	LBG	Cultural Resource Specialist	Architectural resources
Tina Fortugno	LBG	Cultural Resource Specialist	Archaeological resources
Laura Totten	LBG	Environmental Scientist	Wildlife and habitat and sensitive species

ROUTING TEAM			
Member	**Affiliation**	**Title**	**Specific Role**
Mike Snyder	LBG	Environmental Scientist	Water resources
Neeli Landon	LBG	Communications Specialist	Public outreach
Phil Robertson	POWER Engineers	Engineer	Siting support and engineering
Kelsey Rockey	Parris Communications	Communications Specialist	Public outreach
Kelly Cooper	Parris Communications	Communications Specialist	Public outreach

APPENDIX B: DATA SOURCES

Category	Definition	Units	Data Source
Aerial Photography			
National Agricultural Imagery	Missouri NAIP 2008, 2010, 2012		The National Agricultural Imagery Program (NAIP) obtains aerial imagery during agricultural growing seasons. The most current imagery for the state of Missouri when the project began was taken in 2008. Imagery flown in 2010 and 2012 was used once it became available. Imagery is collected at the spatial resolution of one square meter and with the spectral resolution as natural color.
Natural Resources			
Hydrology			
Streams	National Hydrography Dataset flowlines	Number of streams crossed	A statewide subset of the National Hydrography Dataset (NHD) model version 2 was downloaded from the United States Geological Survey (USGS). Feature classes used for calculations included canal/ditch, stream/river (intermittent and perennial), artificial path, and any named features. A member of the routing team verified each stream/river crossing point using 2012 NAIP imagery.
Water bodies	National Hydrography Dataset waterbodies	Length of water body crossed by potential route	A statewide subset of the National Hydrography Dataset (NHD) model version 2 was downloaded from the United States Geological Survey (USGS).
Wetlands	National Wetlands Inventory	Length of wetlands crossed by potential route, Acres of wetland within 200' ROW	National Wetland Inventory (NWI) data was downloaded from the U.S. Fish and Wildlife Service's (USFWS) website.
Floodplains	100 and 500-year floodplains		The Federal Emergency Management Agency (FEMA) provides a digital version of their National Flood Hazard Layer on DVDs. Floodplain data for Missouri was requested on November 14, 2011. Where possible, unmapped flood areas near the Missouri River crossing were digitized from georeferenced FIRMettes. Floodplain data provided by the Illinois Geospatial Data Clearinghouse was used to approximate the length of floodplains crossed by potential routes on the Illinois side of the Mississippi River.
Protected and Public Lands			

Category	Definition	Units	Data Source
Public and Conservation Lands	Local, private, state, and federally owned lands	Length of public/conservation land crossed	This data layer represents features from a wide variety of sources, including the U.S. Geological Survey's Protected Areas Database (PADUS v1.2); U.S. Army Corps of Engineers; National Resource Conservation Service; U.S. Fish and Wildlife Service; U.S. Forest Service; The Nature Conservancy; National Conservation Easement Database; Illinois Department of Natural Resources; Illinois Parks and Recreation; Illinois Nature Preserve Commission; Illinois State Geological Survey; Missouri Department of Natural Resources; Missouri Department of Conservation; Missouri Spatial Data Information service, Indiana Department of Natural Resources; Kansas Department of Wildlife, Parks, and Tourism; Kansas Data Access and Support Center; Kansas Parks and Recreation Association; and many counties and municipalities. Where possible, the boundaries of these protected areas have been edited to match parcel boundaries provided by the counties in the study area.
Sensitive Species and Habitat			
Indiana Bat and Long-Eared Bat Habitat	Potential habitat crossed by route	Miles	The United States Fish and Wildlife Service (USFWS) publish a list of Federally-Listed Threatened, Endangered, Proposed, and Candidate species by county for Missouri. Because all study area counties are listed as potential habitat for the Indiana Bat and the Long-Eared Bat, habitat for these species was calculated using Forest and Forested Riparian areas as determined by the Photo-Interpreted Land Cover dataset.
Heritage Hotspot	Hotspot length crossed	Miles	Heritage Hotspot data was provided by the Missouri Department of Conservation and is part of the Comprehensive Wildlife Strategy (CWS) project data. The CWS data description says that hotspots "represent areas with a concentration of species of conservation concern."
Illinois Natural Areas Inventory, Threatened and Endangered Species, Illinois Nature Preserves Commission sites			The Illinois Department of Natural Resources (IDNR) provided shapefiles of threatened/endangered species, Illinois Natural Areas Inventory sites, and Illinois Nature Preserves Commission sites. This data was used to analyze potential impacts to protected species and protected areas at the Mississippi River crossing locations.
Important Bird Areas (IBA)			The MDC Comprehensive Wildlife Strategy project provided data showing areas identified as Important Bird Areas by the Missouri Audubon society. Important Bird areas provide crucial habitat for species of conservation concern and avian species vulnerable due to their limited range or high congregation density.
Soils and Land Use			
Karst		Miles crossed	Data depicting regions of karst topography were acquired from the USGS (via the National Atlas Map).

Category	Definition	Units	Data Source
NLCD Land Cover			The National Land Cover Database 2006 (NLCD 2006) compiled by the Multi-Resolution Land Characteristics (MRLC) Consortium (including the U.S. Geological Survey, Environmental Protection Agency, U.S. Forest Service, National Oceanographic and Atmospheric Association, National Aeronautics and Space Administration, Bureau of Land Management, National Park Service, Natural Resource Conservation Service, and the U.S. Fish and Wildlife Service). NLCD 2006 products include 16 classes of land cover from Landsat satellite imagery.
Steep Slopes	Slopes > 20%	Feet crossed	Slopes (in percent) were derived from a digital elevation model (DEM) consisting of terrain elevations for ground positions at regularly spaced horizontal intervals (10 meters). The data used for this analysis was derived from the National Elevation Dataset (NED) prepared by the USGS.
Human Environment			
Residences	Residences within 250, 500, and 1000'	Counts	Residences were digitized using high resolution aerial image interpretation as well as field reconnaissance. Aerial imagery provided by the National Agricultural Imagery Program (2008/2012).
Schools, Churches, Cemeteries	Features within 1000 feet of route	Counts	The locations of churches, schools, and cemeteries were derived from the United States Geological Survey's Geographic Names Information System (GNIS) and augmented through high resolution aerial photo interpretation, field reconnaissance and public outreach efforts. The GNIS database serves as the Federal Government's repository of information regarding feature name spellings and applications for features in United States and its Territories. The names listed in the inventory are often published on Federal maps, charts, and in other documents and have been used in emergency preparedness planning, site-selection and analysis, genealogical and historical research, and transportation routing. Through field reconnaissance, the Routing Team recorded local schools, churches, and cemeteries to augment and verify this data layer.
Parcels	Tax parcel boundaries	Number of parcels crossed	The routing team contacted counties in the study area (Buchanan, Clinton, Caldwell, Livingston, Carroll, Chariton, Macon, Randolph, Audrain, Shelby, Monroe, Marion, Ralls, Pike) and purchased parcel data during April, May, and June 2013. All counties except for Ralls County provided digital GIS parcel boundary data and associated ownership information. Ralls County provided scans of parcel maps and a spreadsheet with property owner name and address information.
Household Density		Miles crossed	Household density was derived at the census block level from census population data obtained from the US Census Bureau (2010).

Category	Definition	Units	Data Source
Pivot Irrigation Systems	Pivots impacted	Counts	Pivot irrigation systems were digitized using high resolution aerial image interpretation. Members of the public were also encouraged to provide information about existing or planned pivot irrigation systems on their land, and this data aided in digitizing and verifying pivot locations. A pivot is considered potentially impacted when a potential route crosses more than 1,500 feet of irrigated area in a single span.
Energy Infrastructure			
Transmission Lines		Length parallel to existing transmission lines. Count of existing transmission lines crossed.	Information on existing transmission lines was collected from Platts Transmission Lines geospatial data layer. . The information was augmented through aerial photo interpretation and field review.
Oil and Gas Pipelines		Length parallel to existing gas line corridors.	Major natural gas and oil pipeline in formation was obtained through the EV Energy Map of North America. Spatial accuracy of the data was augmented through field review of pipeline line corridors, and pipeline ownership information was improved by comparison with the National Pipeline Mapping System online viewer.
Oil and Gas Wells		Counts	The Missouri Department of Natural Resources, Division of Geology and Land Survey, and Geological Survey Program maintain a list of permitted oils and gas well information within the State of Missouri.
Transportation			
Major Roads	Interstates, U.S. Highways, State Highways	Number of each road type crossed	Major roads data was prepared by the Environmental Systems Research Institute (ESRI), (2012) Redlands, California, USA.
Airport and Heliport Notification Zones	Airport points and FAA Notification Zone	Length of route within FAA Notification Zone	The location of airports and heliports was gathered from FAA databases, aerial photograph interpretation, field reconnaissance, public input, and navigational charts. An approximation of the air navigation obstruction zone was developed based on the Code of Federal Regulations (CFR) Title 14 Part 77, (Aeronautics and Space, Objects affecting navigable airspace). This approximation was calculated based on aerial interpretation of runway length, the average height of the proposed transmission towers, and approach zone formulas for airports and heliports in the CFR. Note: this is a rough approximation performed based on aerial photo interpretation without the inclusion of topographic effects or precise knowledge of runway length.
Recreation			
Recreation Trails			The Missouri Department of Conservation publishes data showing recreational trails in the state.

Category	Definition	Units	Data Source
Scenic Byways		Crossings	Information and driving directions from the National Scenic Byways Program enabled mapping of scenic and historic byways in Missouri, Illinois, and Indiana.
Historic Resources			
Historic and Archaeological Sites		Sites within ¼ mile, ½ mile, and 1 mile	The Missouri State Historic Preservation Office provided shapefiles showing locations of sites and districts listed on the National Register of Historic Places and a geodatabase with spatial and tabular data for archaeological sites across the state.

APPENDIX C: FEDERAL AND STATE AGENCY COORDINATION