

# **Electricity Transmission, Pipelines, and National Trails**

An Analysis of Current and Potential Intersections on Federal Lands  
in the Eastern United States, Alaska, and Hawaii

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**Environmental Science Division**

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by

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## Definitions

ANOI	Advance Notice of Intent
Argonne	Argonne National Laboratory
BLM	U.S. Bureau of Land Management
BOR	U.S. Bureau of Reclamation
COE	U.S. Army Corps of Engineers
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EISPC	Eastern Interconnection States' Planning Council
EPAct	Energy Policy Act of 2005
ESRI	Environmental Systems Research Institute
FWS	U.S. Fish and Wildlife Service
NHT	National Historic Trail
NST	National Scenic Trail
NTSA	National Trail System Act
NPS	U.S. National Park Service
ROW	right-of-way
SMA	surface management agency
USFS	U.S. Department of Agriculture, Forest Service

## Executive Summary

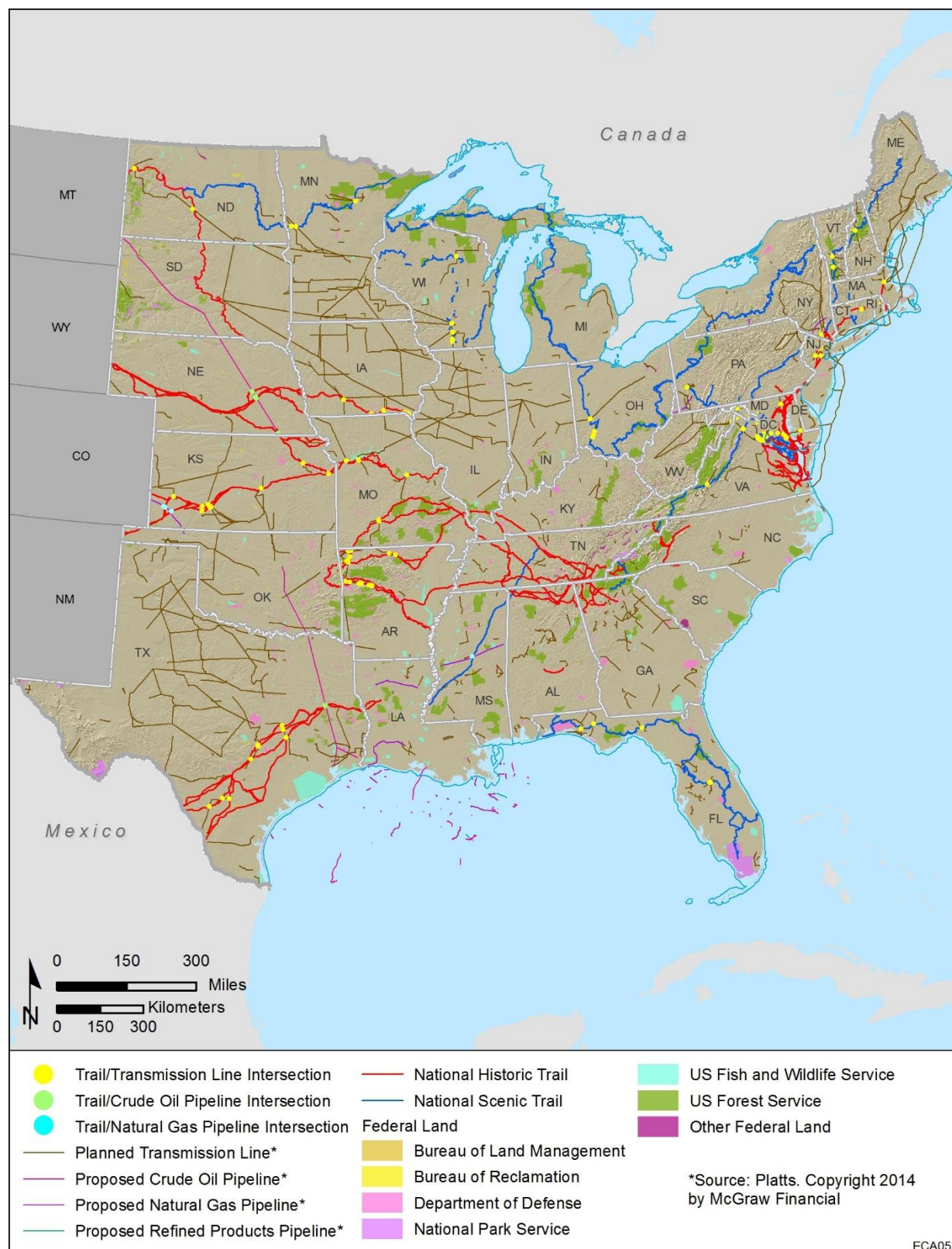
As has been noted in many reports and publications, acquiring new or expanded rights-of-way for transmission is a challenging process, because numerous land use and land ownership constraints must be overcome to develop pathways suitable for energy transmission infrastructure. In the eastern U.S., more than twenty federally protected national trails (some of which are thousands of miles long, and cross many states) pose a potential obstacle to the development of new or expanded electricity transmission capacity. However, the scope of this potential problem is not well-documented, and there is no baseline information available that could allow all stakeholders to study routing scenarios that could mitigate impacts on national trails.

This report, *Electricity Transmission, Pipelines, and National Trails: An Analysis of Current and Potential Intersections on Federal Lands in the Eastern United States*, was prepared by the Environmental Science Division of Argonne National Laboratory (Argonne). Argonne was tasked by DOE to analyze the “footprint” of the current network of National Historic and Scenic Trails and the electricity transmission system in the 37 eastern contiguous states, Alaska, and Hawaii; assess the extent to which national trails are affected by electrical transmission; and investigate the extent to which national trails and other sensitive land use types may be affected in the near future by planned transmission lines. Pipelines are secondary to transmission lines for analysis, but are also within the analysis scope in connection with the overall directives of Section 368 of the Energy Policy Act of 2005, and because of the potential for electrical transmission lines being collocated with pipelines.

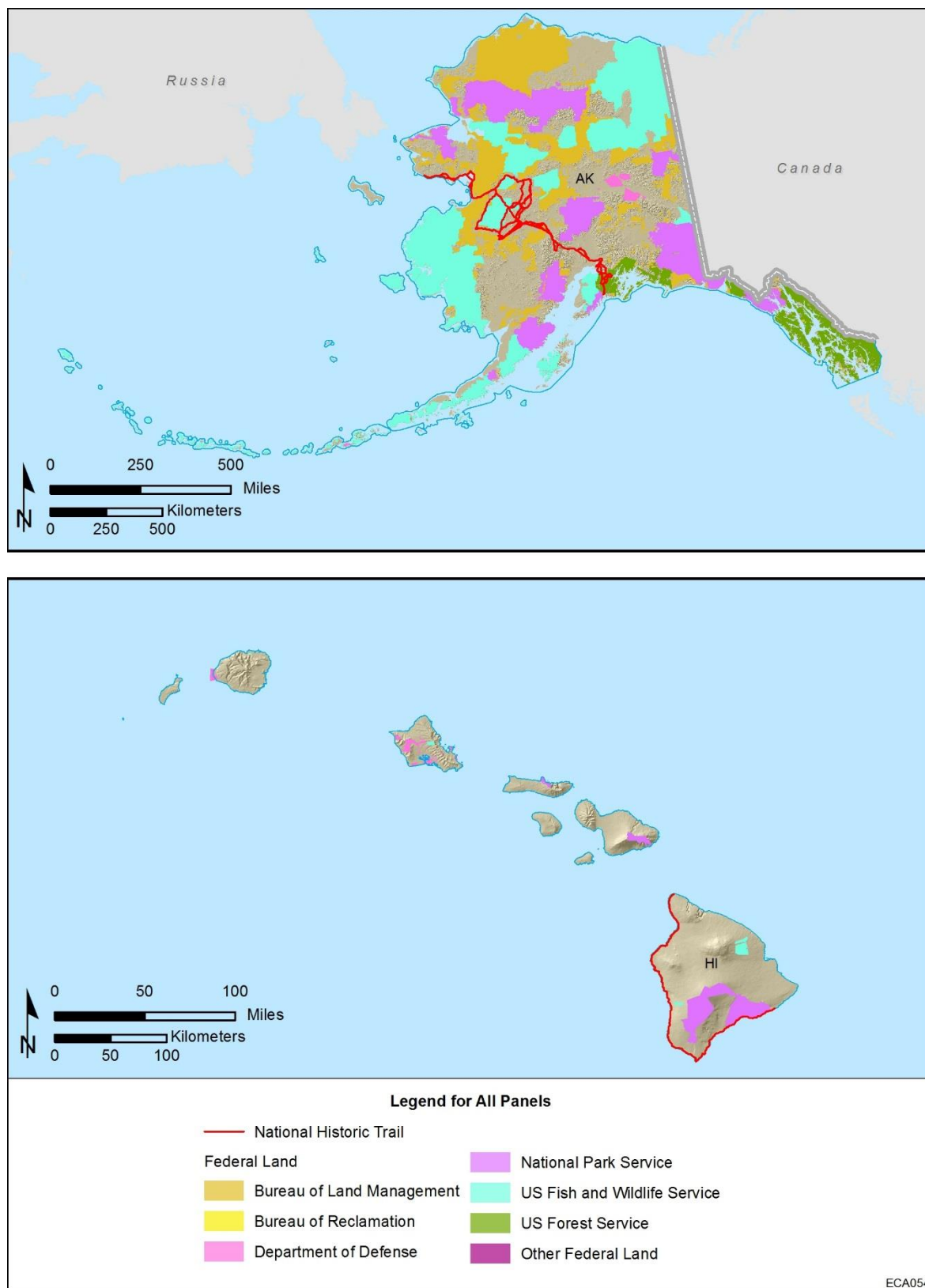
Figure ES.1 shows the contiguous Section 368(b) states with federal land, proposed high-voltage electrical transmission lines and pipelines, and national trails. Points where planned transmission lines and pipelines would potentially cross national trails on federal land are highlighted. Based on Platts electrical transmission line data, a total of 101 existing intersections with national trails on federal land were found, and 20 proposed intersections. Figure ES.2 shows Alaska and Hawaii with federal land, and national trails. Proposed transmission lines and pipelines are shown in Alaska; however there are no locations that intersect national trails. Source data did not indicate any planned transmission lines or pipelines in Hawaii. The map atlas in Appendix B provides more detailed mapping of the topics investigated in this study, and the accompanying GIS database provides the baseline information for further investigating locations of interest.

In many cases the locations of proposed transmission lines are not accurately mapped (or a specific route may not yet be determined), and accordingly the specific crossing locations are speculative. However since both national trails and electrical transmission lines are long linear systems, the characteristics of the crossings reported in this study are expected to be similar to both observed characteristics of the existing infrastructure provided in this report, and of the new infrastructure if these proposed projects are built. More focused study of these siting challenges is expected to mitigate some of potential impacts by choosing routes that minimize or eliminate them.

The current study primarily addresses a set of screening-level characterizations that provide insights into how the National Trail System may influence the siting of energy transport facilities in the states identified under Section 368(b) of the Energy Policy Act of 2005. As such, it initializes gathering and beginning analysis of the primary environmental and energy data, and maps the contextual relationships between an important national environmental asset and how this asset intersects with energy planning activities. Thus the current study sets the stage for more in-depth analyses and data development activities that begin to solve key transmission siting constraints. Our recommendations for future work incorporate two major areas: (1) database development and analytics and (2) modeling and scenario analysis for energy planning. These recommendations provide a path forward to address key issues originally developed under the Energy Policy Act of 2005 that are now being carried forward under the President's Climate Action Plan.



**Figure ES.1 Contiguous Section 368(b) States with Federal Land, Proposed Electrical Transmission Lines and Pipelines, National Trails, and Potential Transmission Line and Pipeline Intersections with National Trails**



**Figure ES.2 Alaska and Hawaii with Federal Land, Proposed Electrical Transmission Lines and Pipelines, and National Trails**

## 1. Background and Introduction

On August 8, 2005, the President signed into law the Energy Policy Act of 2005 (EPAc) (42 USC §13201 et seq.). Section 368 of EPAc requires, among other things, the designation of energy corridors on federal lands, first in the western 11 contiguous states (Section 368a), and later in the remaining states (Section 368b). Section 368 also requires establishment of procedures to ensure that additional corridors are identified and designated as necessary and to expedite applications to construct or modify oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities. Corridor designation and associated plan amendments were based on the following direction provided in Section 368:

*The Secretary of Agriculture, the Secretary of Commerce, the Secretary of Defense, the Secretary of Energy, and the Secretary of the Interior (in this section referred to collectively as “the Secretaries”), in consultation with the Federal Energy Regulatory Commission, states, Tribal or local units of governments as appropriate, affected utility industries, and other interested persons, shall consult with each other and shall—*

*(1) designate, under their respective authorities, corridors for oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities on Federal land in the 11 western states (as defined in Section 103(o) of the Federal Land Policy and Management Act of 1976 (43 USC 1702(o));*

*(2) perform any environmental reviews that may be required to complete the designation of such corridors; and*

*(3) incorporate the designated corridors into the relevant agency land use and resource management plans or equivalent plans.*

The Department of Energy (DOE) and the Department of the Interior (DOI), Bureau of Land Management (BLM), were the lead agencies that prepared a Programmatic Environmental Impact Statement (PEIS) related to the Section 368a Corridors (DOE 2008). This addressed item 2 listed above for the western 11 contiguous states. Records of Decision designating the corridors were issued by the BLM (2009) and U.S. Forest Service USFS (2009).

Congressional direction under Section 368(b) of EPAc differs from that provided under Section 368(a). Specifically, Section 368(b) requires:

*the secretaries of the Agencies, in consultation with the Federal Energy Regulatory Commission (FERC), affected utility industries, and other interested persons, to jointly—*

*(1) identify corridors for oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities on Federal land in States other than the 11 western states other than those described in subsection (a); and*

*(2) schedule prompt action to identify, designate, and incorporate the corridors into the applicable land use plans. (42 USC §13201 et seq.)*

While Section 368(a) clearly directed designation as a necessary first step for energy transportation corridors in the 11 western states, Section 368(b) directed the Agencies to first identify corridors and then schedule prompt action to identify, designate, and incorporate the corridors into applicable land use plans.

To comply with the congressional direction provided in Section 368(b), the Agencies investigated corridor identification issues in the Section 368(b) states, and commissioned a report to Congress (Krummel et al. 2011) providing information that could be relevant to possible future designation of energy corridors. The introduction to the 2011 report describes the actions taken by the Agencies related to Section 368(b), and their conclusions, briefly summarized in the following paragraph.

In October 2008, the DOE issued a Federal Register notice to solicit public comments and determine public and stakeholder interest in energy transportation corridors in the Section 368(b) states. There was a relatively indifferent and minor response to the information requests outlined in the Advance Notice of Intent (ANOI). One organization, a tribal government, identified a potential need for corridors in the panhandle of the State of Alaska to transport electricity between Canada and Alaska, but later withdrew its request because a tribal official identified potential solutions that would not require new corridor designation under Section 368(b). No other responses identified potential specific or general corridor locations within the Section 368(b) states. The Agencies ultimately determined that they would not, at that time, develop a proposed action or decision to identify and designate Section 368(b) energy transportation corridors on federal lands within the Section 368(b) states.

The EPA Act Section 368(b) states include the contiguous 37 eastern U.S. states, Alaska, and Hawaii as listed below:

Alabama	Illinois	Massachusetts	New York	South Dakota
Alaska	Indiana	Michigan	North Carolina	Tennessee
Arkansas	Iowa	Minnesota	North Dakota	Texas
Connecticut	Kansas	Mississippi	Ohio	Vermont
Delaware	Kentucky	Missouri	Oklahoma	Virginia
Florida	Louisiana	Nebraska	Pennsylvania	West Virginia
Georgia	Maine	New Hampshire	Rhode Island	Wisconsin
Hawaii	Maryland	New Jersey	South Carolina	

Federal attention to energy corridors was again emphasized in a 2013 Presidential Memorandum (U.S. President 2013). Excerpts from the presidential memo include the following:

*“In order to ensure the growth of America’s clean energy economy and improve energy security, we must modernize and expand our electric transmission grid [...]*

*“An important avenue to improve these processes is the designation of energy right-of-way corridors (energy corridors) on Federal lands. Section 368 of the Energy Policy Act of 2005 (the*

*"Act") (42 U.S.C. 15926), requires the Secretaries of Agriculture, Commerce, Defense, Energy, and the Interior (Secretaries) to undertake a continued effort to identify and designate such energy corridors [...]*

*"the Secretary of Energy shall provide to the Steering Committee a Transmission Corridor Assessment Report."*

While the 2011 report provides the rationale for Section 368(b) corridors not being designated, siting transmission line and pipeline projects remains a challenging process. Prominent among federally managed resources with unique challenges is the National Trails System, with linear features sometimes extending thousands of miles, and a sensitivity to impacts, particularly scenic impacts. Accordingly, Argonne National Laboratory (Argonne) was tasked by DOE to do the following:

- (1) Analyze the "footprint" of the current network of national trails and the electricity transmission system in the 37 eastern contiguous states, Alaska, and Hawaii;
- (2) Assess the extent to which national trails are affected by electrical transmission; and
- (3) Investigate the extent to which national trails and other sensitive land use types may be affected in the near future by planned transmission lines.

Pipelines are also within the scope of analysis due to the overall directives of Section 368 of EPAct, and because of the potential for electrical transmission lines to be collocated with pipelines.

This report provides the methodology of the analysis for these tasks in Section 4, results in Section 5, and a discussion of the conclusions in Section 6. Additional analyses to be undertaken in the future are described in Section 7. Appendix B provides a large-format map atlas with maps of federal land, existing and planned energy transport infrastructure, and the National Trails System. Results are organized into the following topic areas:

- Federal land jurisdictions,
- Existing and planned electrical transmission and pipeline infrastructure, and
- National historic and scenic trails.

Results are also tabulated, and mapped in Appendix B, by the following sub-regions, consistent with the 2011 report:

- |                |                       |                          |
|----------------|-----------------------|--------------------------|
| • Alaska,      | • Gulf Coast,         | • New England,           |
| • Appalachian, | • Hawaii,             | • Southern Atlantic, and |
| • Central,     | • Lower Great Plains, | • Upper Great Plains.    |
| • Great Lakes, | • Mid-Atlantic,       |                          |

The results presented in this report provide baseline information to characterize current and planned energy transport infrastructure in the context of federally administered lands, particularly where they coincide with the National Trails System, which presents challenges to siting energy transport projects. Recommendations for a path forward are provided in Section 7.

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## 2. Scenic Resources and Visually Sensitive Areas

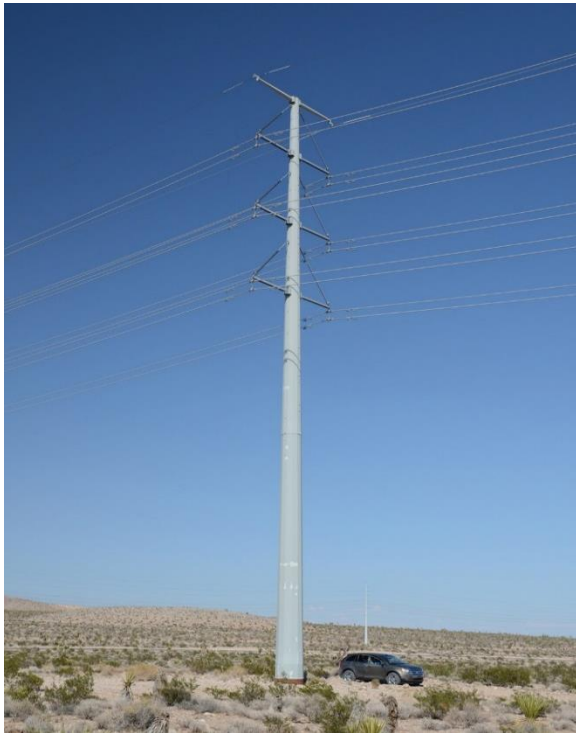
The National Trails System includes many important and sensitive visual resource areas. Because both national trails and energy transmission rights-of-way (ROWs) are linear systems that may extend thousands of miles, intersections between trails and transmission ROWs are nearly inevitable and present unique siting challenges. For this reason, the report is focused primarily on analyzing these systems, especially from a scenic resource perspective. However, the National Trails System is only one example of scenic resources. Federally managed scenic resources and other visually sensitive areas potentially affected by electricity transmission and pipeline infrastructure include those listed below. Scenic attributes or sensitivities are generally mentioned in the statement of purpose or management objectives for the federally managed areas or, as in the case of wildlife refuges, the areas are enjoyed for their scenic attributes. Populated places and roads are not scenic resource areas but are visually sensitive areas because they are subject to extended and/or frequent viewing. Because there is no standard definition of what constitutes a sensitive visual resource area, Argonne developed the following list of resource areas as its minimum standard for inclusion in its programmatic environmental assessments (Sullivan 2012):

- National parks;
- National monuments;
- Wilderness areas;
- Wilderness study areas;
- National recreation areas;
- National conservation areas;
- Other NPS units;
- National natural landmarks;
- National historic landmarks;
- National scenic trails;
- National historic trails;
- National, state, and agency-designated scenic byways;
- National scenic areas;
- National scenic research areas;
- National wild and scenic rivers;
- Wild and scenic river study areas;
- National wildlife refuges;
- Agency-designated scenic areas, such as BLM areas of environmental concern, designated for outstanding scenic values;
- National and state highways; and
- Populated places.

While the focus of this study is on federal land, most major existing and planned energy transport facilities include non-federal land, and potential impacts on scenic resources are also significant in these areas. Examples include state parks, residential areas, privately owned recreation facilities, and tribal land.

A detailed discussion of the visual contrasts and impacts of high-voltage electrical transmission facilities is available in the *West-Wide Energy Corridor PEIS* (DOE 2008). Section 3.9, Visual Resource Analysis, in that PEIS describes visual contrasts of transmission facilities covering all phases of project development, operation, and decommissioning. Analyses of potential visual impacts and example mitigating measures of some projected projects would use similar methodology in a more comprehensive follow-on to this exploratory study. The discussion below describes visual contrasts associated with the operations phase of high-voltage electrical transmission facilities, which could affect corridor location and use. In addition, although pipelines lack tower structures, ROW clearing for pipeline facilities results in visual contrasts similar to contrasts associated with ROW clearing for electrical transmission facilities. A visual contrast assessment approach generally similar to that employed for the PEIS, but including potential visibility analysis is proposed as a future task to analyze potential impacts from energy transport facilities.

Transmission towers vary widely in design, size, and structural materials employed. The three major transmission tower types are lattice towers, H-frames, and monopoles (see Figure 2.1). While there is overlap in the size range by voltage, in general, the majority of operating higher voltage towers in the United States (500 kV and above) are lattice towers and the majority of lower voltage towers are H-frames or monopoles, although H-frames and monopoles are sometimes employed for higher voltage lines. A recent study found that 500-kV lattice transmission towers in western landscapes are sometimes plainly visible at distances of up to 10 miles, although the individual towers appear very small at that distance (Sullivan et al. 2014). In addition, the study found that 500-kV lattice towers may be a major focus of visual attention at distances of up to 3 miles; however, smaller H-frame towers are substantially less visible than larger lattice or monopole towers. Visibility distances are likely shorter in the Midwestern and eastern states because of higher average humidity and poorer average air quality. Visible access roads and cleared ROWs in forested landscapes can greatly increase the visibility of transmission facilities. At long distances, a cleared ROW may be visible even though the towers are not. Figure 2.2 shows a cleared transmission ROW. Cleared ROWs have been observed at 40 miles, and individual towers at distances of 23 miles, but in these observations the objects were at the limit of visibility, that is, barely discernible (Jones and Jones 1976).



**Figure 2.1 Major High-voltage Electrical Transmission Tower Types (Clockwise from Upper Left: Lattice, H-Frame, Monopole for 500-kV Line, and Monopole for 235-kV Line) (Source: Robert Sullivan, Argonne National Laboratory)**



**Figure 2.2 Example of a Cleared Electrical Transmission ROW (Source: BLM)**

### 3. The National Trails System

The National Trails System was established in 1968 with The National Trails System Act (NTSA) (16 USC §1241 et seq.), which was last amended March 30, 2009 (NPS 2014). The NTSA begins with a statement of policy and declaration of purpose, with part (a) describing the rationale for the trails:

*(a) Considerations for determining establishment of trails:*

*In order to provide for the ever-increasing outdoor recreation needs of an expanding population and in order to promote the preservation of, public access to, travel within, and enjoyment and appreciation of the open-air, outdoor areas and historic resources of the Nation, trails should be established (i) primarily, near the urban areas of the Nation, and (ii) secondarily, within scenic areas and along historic travel routes of the Nation, which are often more remotely located.*

The NTSA describes the composition of the National Trails System, as follows:

*The national system of trails shall be composed of the following:*

*(1) National recreation trails, [...] which will provide a variety of outdoor recreation uses in or reasonably accessible to urban areas.*

*(2) National scenic trails, [...] which will be extended trails so located as to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass. National scenic trails may be located so as to represent desert, marsh, grassland, mountain, canyon, river, forest, and other areas, as well as landforms which exhibit significant characteristics of the physiographic regions of the Nation.*

*(3) National historic trails, [...] which will be extended trails which follow as closely as possible and practicable the original trails or routes of travel of national historical significance. Designation of such trails or routes shall be continuous, but the established or developed trail, and the acquisition thereof, need not be continuous onsite. National historic trails shall have as their purpose the identification and protection of the historic route and its historic remnants and artifacts for public use and enjoyment. Only those selected land and water based components of an historic trail which are on federally owned lands and which meet the national historic trail criteria established in this chapter are included as Federal protection components of a national historic trail. The appropriate Secretary may certify other lands as protected segments of an historic trail upon application from State or local governmental agencies or private interests involved if such segments meet the national historic trail criteria established in this chapter and*

*such criteria supplementary thereto as the appropriate Secretary may prescribe, and are administered by such agencies or interests without expense to the United States.*

*(4) Connecting or side trails, [...] which will provide additional points of public access to national recreation, national scenic or national historic trails or which will provide connections between such trails.*

The national trails are variously listed as “corridors,” “trails,” “routes,” or “systems” in the NTSA, and frequently do not have a single or continuous centerline. The NTSA indicated they can also include non-Federal segments as indicated in the description of the NHTA in (3) above.

Section 1246 of the NTSA provides guidance about the administration and development of the National Trails System, including other land management priorities near the trails, such as these excerpts:

*(1)(A) The Secretary charged with the overall administration of a trail pursuant to section 1244(a) of this title shall, in administering and managing the trail, consult with the heads of all other affected State and Federal agencies.*

*In selecting the rights-of-way full consideration shall be given to minimizing the adverse effects upon the adjacent landowner or user and his operation. Development and management of each segment of the National Trails System shall be designed to harmonize with and complement any established multiple-use plans for that specific area in order to insure continued maximum benefits from the land.*

*Other uses along the trail, which will not substantially interfere with the nature and purposes of the trail, may be permitted by the Secretary charged with the administration of the trail. Reasonable efforts shall be made to provide sufficient access opportunities to such trails and, to the extent practicable, efforts shall be made to avoid activities incompatible with the purposes for which such trails were established.*

Section 1248 of the NTSA describes procedures for easements and ROWs related to the National Trails System, including the excerpts below. The procedures in this section primarily require other federal agencies to assist in protecting the national trails from conflicting land uses. Directives about energy transport ROWs, or related infrastructure development near the national trails are not included in this section.

*The Secretary of the Interior or the Secretary of Agriculture as the case may be, may grant easements and rights-of-way upon, over, under, across, or along any component of the national trails system in accordance with the laws applicable to the national park system and the national forest system, respectively: Provided, That any conditions contained in such easements and rights-of-way shall be related to the policy and purposes of this chapter.*

*[...] the Secretary of Energy, and other Federal agencies having jurisdiction or control over or information concerning the use, abandonment, or disposition of roadways, utility*

*rights-of-way, or other properties which may be suitable for the purpose of improving or expanding the national trails system shall cooperate with the Secretary of the Interior and the Secretary of Agriculture in order to assure, to the extent practicable, that any such properties having values suitable for trail purposes may be made available for such use.*

Figure 3.1 shows the National Trails System in the Section 368(b) states, and Figure B-4.1 in Appendix B provides a more detailed version in a map from the NPS (2014). Table 3.1 lists the national trails partially or fully falling within the Section 368(b) states, with the trail name; type; approximate total and federal land lengths in miles within the Section 368(b) states calculated from Geographic Information System (GIS) data; Section 368(b) states they cross; and descriptions from NPS web pages (NPS 2014) and the NTSA. Note that differences in the distances reported in the narrative columns are often different from the distances computed from the GIS data. This is due to several factors, including how trails are depicted in the available source mapping data, and the presence of multiple parallel routes in a trail system.

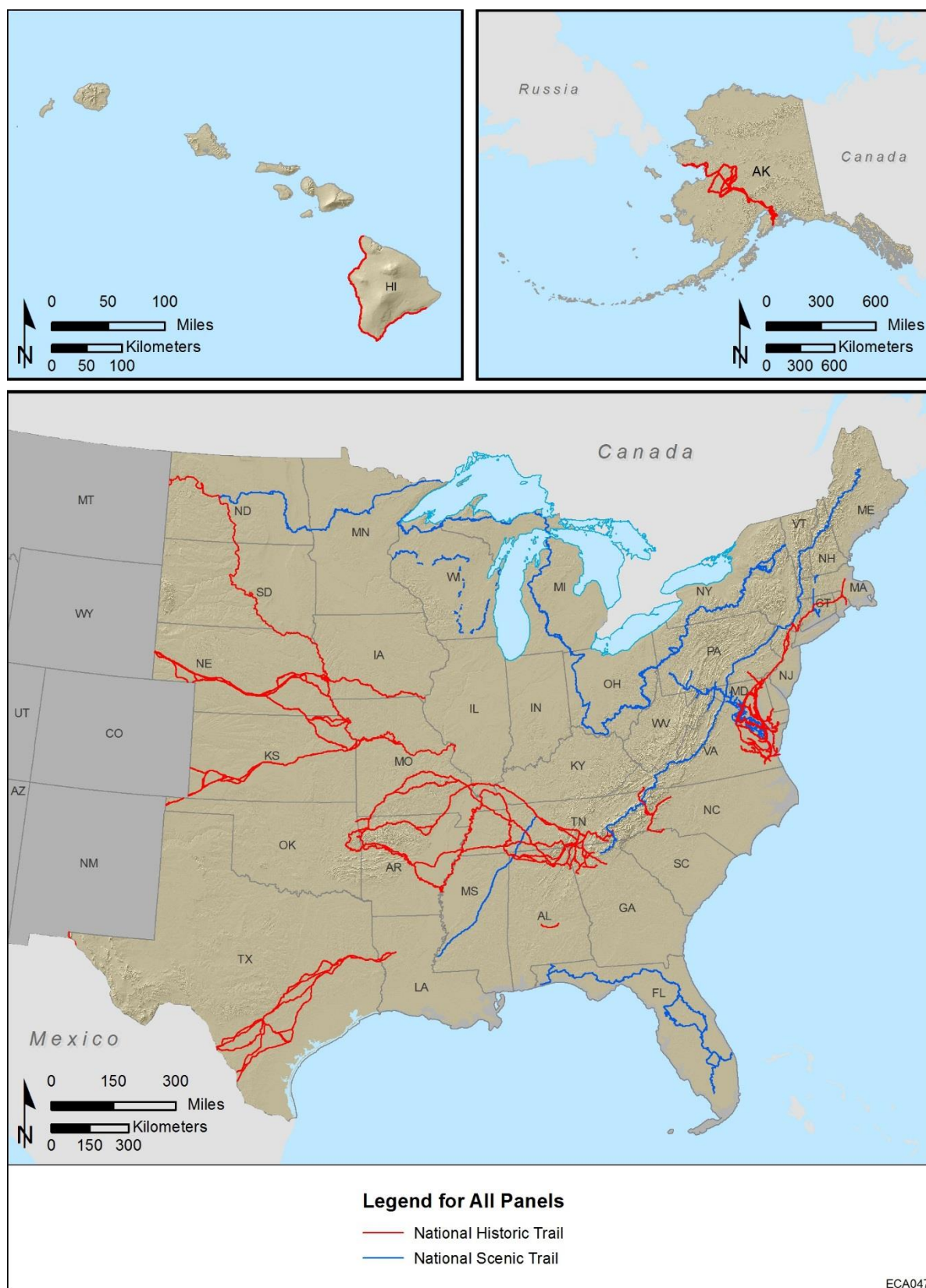


Figure 3.1 National Trails System in the Section 368(b) States

**Table 3.1 National Trails in the Section 368(b) States, with the Trail Name; Type; Computed Total and Federal Land Lengths in Miles within the Section 368(b) States and Narratives**

Name	Type	Section 368(b) States	Length (mi) <sup>a</sup>	Length on Federal Land (mi) <sup>a</sup>	Description from the National Trails System Act <sup>b</sup>	Description Adapted from NPS.gov and Associated Website Descriptions <sup>b</sup>
Ala Kahakai	Historic	HI	180	31	A 175-mile-long trail extending from 'Upolu Point on the north tip of Hawaii Island down the west coast of the Island around Ka Lae to the east boundary of Hawai'i Volcanoes National Park at the ancient shoreline temple known as "Waha'ula."	Established in 2000 for the preservation, protection, and interpretation of traditional Native Hawaiian culture and natural resources. It is a 175-mile corridor and trail network of cultural and historical significance that traverses through hundreds of ancient Hawaiian settlement sites and over 200 ahupua'a (traditional sea-to-mountain land divisions).
Appalachian	Scenic	CT, GA, MA, MD, ME, NC, NH, NJ, NY, PA, TN, VA, VT, WV, KS, MS, NE	2,107	1,090	A trail approximately 2,000 miles long, extending generally along the Appalachian Mountains from Mount Katahdin, Maine, to Springer Mountain, Georgia. Administered primarily as a footpath by the Secretary of the Interior, in consultation with the Secretary of Agriculture.	The Appalachian Trail is a 2,184-mile-long public footpath that traverses the scenic, wooded, pastoral, wild, and culturally resonant lands of the Appalachian Mountains. Conceived in 1921, built by private citizens, and completed in 1937, today the trail is managed by the National Park Service, U.S. Forest Service, Appalachian Trail Conservancy, numerous state agencies, and thousands of volunteers.
California	Historic	KS, MO, NE	2,104	5	A route of approximately 5,700 miles, including all routes and cutoffs, extending from Independence and Saint Joseph, Missouri, and Council Bluffs, Iowa, to various points in California and Oregon.	Traces the route of 250,000 emigrants who traveled to the gold fields and rich farmlands of California during the 1840s and 1850s: the greatest mass migration in American history. More than 1,000 miles of trail ruts and traces can still be seen across 10 states on the California National Historic Trail.
Captain John Smith Chesapeake	Historic	DE, DC, MD, PA, VA	2,313	95 <sup>c</sup>	A series of water routes extending approximately 3,000 miles along the Chesapeake Bay and the tributaries of the Chesapeake Bay in the States of Virginia, Maryland, and Delaware, and in the District of Columbia, that traces the 1607–1609 voyages of Captain John Smith to chart the land and waterways of the Chesapeake Bay.	Four hundred years ago, Englishman John Smith and a small crew of adventurers set out in an open boat to explore the Chesapeake Bay. Between 1607 and 1609, Smith and his crew mapped nearly 3,000 miles of the bay and rivers and documented American Indian communities. Smith's map and journals are a remarkable record of the 17th-century Chesapeake.

Table 3.1 (Cont.)

Name	Type	Section 368(b) States	Length (mi) <sup>a</sup>	Length on Federal Land (mi) <sup>a</sup>	Description from the National Trails System Act <sup>b</sup>	Description Adapted from NPS.gov and Associated Website Descriptions <sup>b</sup>
El Camino Real De Los Tejas	Historic	LA, TX	2,517	46	A combination of historic routes (including the Old San Antonio Road) totaling approximately 2,580 miles, extending from the Rio Grande near Eagle Pass and Laredo, Texas, to Natchitoches, Louisiana.	Highlights 300 years of Louisiana and Texas frontier settlement and development on a Spanish colonial "royal road" that originally extended from Mexico City, Mexico, to the Red River Valley.
El Camino Real De Tierra Adentro	Historic	TX	29	0	A 404-mile-long trail from the Rio Grande near El Paso, Texas, to San Juan Pueblo, New Mexico.	Highlights 300 years of heritage and culture in the Southwest. This Spanish colonial "royal road" extended from the interior of New Mexico and Texas to Mexico City, Mexico.
Florida	Scenic	AL, FL	1,781	397	A route of approximately 1,300 miles extending through the State of Florida.	The Florida Trail begins on the edge of the everglades ecosystem in Big Cypress National Preserve. Over a thousand miles farther north, its end point lies in the white sands of Gulf Islands National Seashore at historic Fort Pickens. It showcases the incredible biodiversity, history, and rich culture of Florida.
Ice Age	Scenic	WI	546	36	A trail of approximately 1,000 miles, extending from Door County, Wisconsin, to Interstate Park in Saint Croix County, Wisconsin.	A mere 15,000 years ago during the Ice Age, much of North America lay under a huge glacier. Mammoths, saber tooth cats and cave lions roamed the earth! Some of the best evidence of this glacier is found in Wisconsin, including the state's many lakes, river valleys, gently rolling hills, and ridges. The nearly 1,200-mile Ice Age National Scenic Trail, established in 1980, traces the glacier's edge.
Iditarod	Historic	AK	2,710	605	A route of approximately 2,000 miles extending from Seward, Alaska, to Nome, Alaska.	The Iditarod National Historic Trail commemorates a 2,300-mile system of winter trails that first connected ancient Native Alaskan villages, opened up Alaska for the last great American gold rush, and now plays a vital role for travel and recreation in modern day Alaska.
Lewis and Clark	Historic	IA, IL, KS, MS, NE, ND, SD	1,540	808	A trail of approximately 3,700 miles, extending from Wood River, Illinois, to the mouth of the Columbia River in Oregon, following the outbound and inbound routes of the Lewis and Clark Expedition.	Between May 1804 and September 1806, 31 men, one woman, and a baby traveled from the plains of the Midwest to the shores of the Pacific Ocean. They called themselves the Corps of Discovery. In their search for a water route to the Pacific Ocean, they opened a window into the west for the young United States.

Table 3.1 (Cont.)

Name	Type	Section 368(b) States	Length (mi) <sup>a</sup>	Length on Federal Land (mi) <sup>a</sup>	Description from the National Trails System Act <sup>b</sup>	Description Adapted from NPS.gov and Associated Website Descriptions <sup>b</sup>
Mormon Pioneer	Historic	IA, IL, NE	832	1	A route of approximately 1,300 miles extending from Nauvoo, Illinois, to Salt Lake City, Utah, following the primary historical route of the Mormon Trail.	Features the route 70,000 Mormons traveled from 1846 to 1869 to escape religious persecution. The Pioneer Company of 1846–1847 established the first route from Nauvoo, Illinois, to Salt Lake City, Utah, covering about 1,300 miles.
Natchez Trace	Scenic	AL, MS, TN	462	13	A trail system of approximately 694 miles extending from Nashville, Tennessee, to Natchez, Mississippi.	The 450-mile foot trail that became known as the Natchez Trace was the lifeline through the Old Southwest. Today there are five separate trails totaling over 60 miles, and they are administered by the Natchez Trace Parkway.
New England	Scenic	CT, MA, NH	189	0	A continuous trail extending approximately 220 miles from the border of New Hampshire in the town of Royalston, Massachusetts, to Long Island Sound in the town of Guilford, Connecticut.	From the Sound to the Summits: the New England Trail covers 215 miles from Long Island Sound across long ridges to scenic mountain summits in Connecticut and Massachusetts. The trail offers panoramic vistas and close-ups of New England's natural and cultural landscape: traprock ridges, historic village centers, farmlands, unfragmented forests, quiet streams, steep river valleys, and waterfalls.
North Country	Scenic	MI, MN, ND, NY, OH, PA, VT, WI	8,587	1,424	A trail of approximately 3,200 miles, extending from eastern New York State to the vicinity of Lake Sakakawea in North Dakota.	The North Country National Scenic Trail extends from New York to North Dakota. When completed, the trail will be the longest continuous hiking trail in the United States. The trail links scenic, natural, historic, and cultural areas across seven states, allowing visitors to experience a variety of northern landscapes.
Oregon	Historic	KS, MS, NE	635	1	A route of approximately 2,000 miles extending from near Independence, Missouri, to the vicinity of Portland, Oregon.	More than 2,000 miles of trail ruts and traces can still be seen along the Oregon National Historic Trail in six states, as reminders of the sacrifices, struggles, and triumphs of early American settlers.

Table 3.1 (Cont.)

Name	Type	Section 368(b) States	Length (mi) <sup>a</sup>	Length on Federal Land (mi) <sup>a</sup>	Description from the National Trails System Act <sup>b</sup>	Description Adapted from NPS.gov and Associated Website Descriptions <sup>b</sup>
Overmountain Victory	Historic	NC, SC, TN, VA	324	81	A system totaling approximately 272 miles of trail with routes from the mustering point near Abingdon, Virginia, to Sycamore Shoals (near Elizabethton, Tennessee); from Sycamore Shoals to Quaker Meadows (near Morganton, North Carolina); from the mustering point in Surry County, North Carolina, to Quaker Meadows; and from Quaker Meadows to Kings Mountain, South Carolina.	The Overmountain Victory National Historic Trail recognizes the Revolutionary War Overmountain Men. About 2,000 patriots eventually joined up along the trail to create the militia army. On the last day, 900 of the best armed and mounted men then fought in the Battle of Kings Mountain in South Carolina to stop the loyalist force before they were reinforced, or reached Charlotte and the main British army.
Pony Express	Historic	KS, MS, NE	570	3	A route of approximately 1,900 miles, including the original route and subsequent route changes, extending from Saint Joseph, Missouri, to Sacramento, California.	This relay system along the Pony Express National Historic Trail in eight states was the most direct and practical means of east–west communications before the telegraph.
Potomac Heritage	Scenic	DC, MD, PA, VA, WV	2,369	549 <sup>c</sup>	A corridor of approximately 704 miles.	Linking the Potomac and upper Ohio river basins, the Potomac Heritage Trail network follows the paths explored by George Washington.
Santa Fe	Historic	KS, MS, OK	1,245	52	A trail of approximately 950 miles from a point near Old Franklin, Missouri, through Kansas, Oklahoma, and Colorado to Santa Fe, New Mexico.	Follows the route of freight wagons carrying cargo through five states between western Missouri and Santa Fe, New Mexico.
Selma to Montgomery	Historic	AL	51	0	A trail consisting of 54 miles of city streets and United States Highway 80 from Brown Chapel A.M.E. Church in Selma to the State Capitol Building in Montgomery, Alabama, traveled by voting rights advocates during March 1965 to dramatize the need for voting rights legislation.	On August 6, 1965, President Lyndon Johnson signed the Voting Rights Act of 1965, which extended equal voting rights for African-Americans. Both white and black nonviolent supporters led by Dr. Martin Luther King Jr. marched this 54-mile route to fight for the right to vote in Central Alabama.

Table 3.1 (Cont.)

Name	Type	Section 368(b) States	Length (mi) <sup>a</sup>	Length on Federal Land (mi) <sup>a</sup>	Description from the National Trails System Act <sup>b</sup>	Description Adapted from NPS.gov and Associated Website Descriptions <sup>b</sup>
Star-Spangled Banner	Historic	DC, MD, VA	576	576 <sup>c</sup>	A trail consisting of water and overland routes totaling approximately 290 miles, extending from Tangier Island, Virginia, through southern Maryland, the District of Columbia, and northern Virginia, in the Chesapeake Bay, Patuxent River, Potomac River, and north to the Patapsco River, and Baltimore, Maryland, commemorating the Chesapeake Campaign of the War of 1812 (including the British invasion of Washington, District of Columbia, and its associated feints, and the Battle of Baltimore in summer 1814).	For 3 years, the young United States was embroiled in the War of 1812 and the Chesapeake Bay region felt the brunt of it, choked by shipping blockades and ravaged by enemy raids. Through sites and landscapes in Virginia, the District of Columbia, and throughout Maryland, this trail tells the stories of the events, people, and places that led to the birth of our national anthem.
Trail of Tears	Historic	AL, AR, GA, IL, KY, MO, MS, NC, OK, TN	5,040	643	A trail consisting of water routes and overland routes traveled by the Cherokee Nation during its removal from ancestral lands in the East to Oklahoma during 1838 and 1839.	This trail commemorates the survival of the Cherokee people, forcefully removed from their homelands in Georgia, Alabama, and Tennessee to live in Indian Territory, now Oklahoma. They traveled by foot, horse, wagon, or steamboat in 1838–1839.
Washington- Rochambeau Revolutionary Route	Historic	CT, DE, DC, MA, MD, NJ, NY, PA, RI, VA	808	14	A corridor of approximately 600 miles following the route taken by the armies of General George Washington and Count Rochambeau between Newport, Rhode Island, and Yorktown, Virginia, in 1781 and 1782.	By 1780, the Americans found their War for Independence at a stalemate. France had previously provided America with supplies and money, but now French ground forces were sent to help turn the tide of the war. General Rochambeau and the French Army allied with General Washington and the Continental Army, journeying hundreds of miles along this route to a victory at Yorktown and, ultimately, winning the war.

<sup>a</sup> Lengths in these columns were computed from the GIS data used in the study.

<sup>b</sup> Lengths in these columns are based on narrative trail descriptions.

<sup>c</sup> The Captain John Smith Chesapeake National Historic Trail (NHT), Potomac Heritage NHT, and Star-Spangled Banner NHT each have significant offshore portions that are not included in the federal land distance computation.

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## 4. Methods

Most results in this study were produced using GIS data and software. Available GIS data were collected for the study extent and compiled in a project repository. Computations of areas and intersections were derived from GIS data processing. All GIS data used for this study are included in the electronic files accompanying this report, with the exception of the licensed commercial energy infrastructure data.

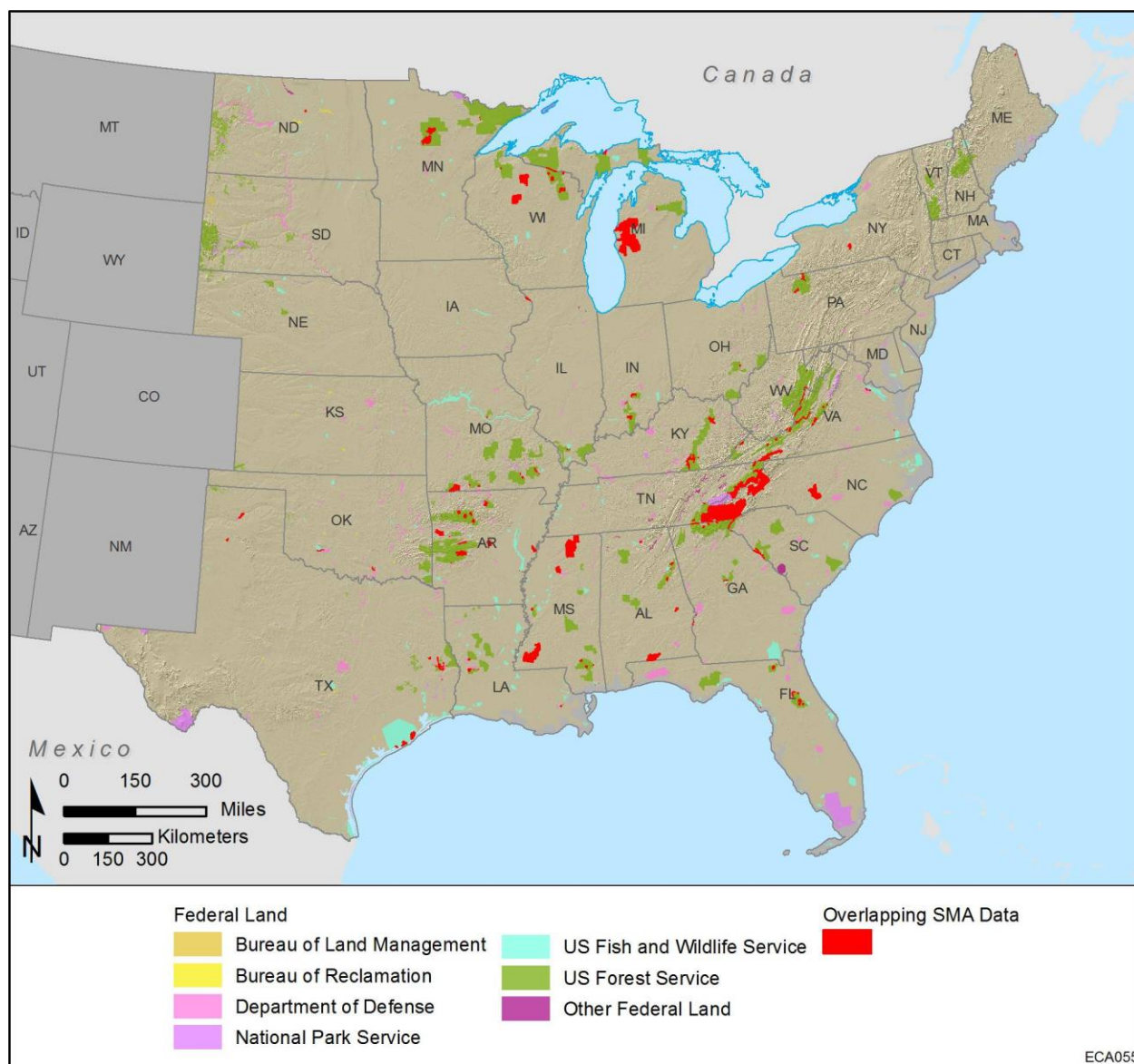
### 4.1 Federal Land

The 2011 report provided analysis of federal land extents in the Section 368(b) states and a detailed discussion contrasting the federal land characteristics and total area between the Section 368(a) and Section 368(b) states. Current GIS surface management agency (SMA) data from the BLM (2013) were used for this study to compute areas of federal lands by agency, state, and region, and to determine whether other features such as trails or energy infrastructure fall on federal land or not. This BLM dataset is a dynamic compilation of SMA data from multiple sources. The metadata states,

*Foundational to the SMA data is the expectation that it topologically align where possible and appropriate with the official published version of Bureau of Land Management (BLM) Public Land Survey System (PLSS) Cadastral National Spatial Data Infrastructure (CAD NSDI) GIS Data. Topology rules: SurfaceManagementAgency polys must not overlap.*

*These data are provided by Bureau of Land Management (BLM) “as is” and might contain errors or omissions. [...] The data are not better than the sources from which they were derived, and both scale and accuracy may vary across the data set. These data might not have the accuracy, resolution, completeness, timeliness, or other characteristics appropriate for applications that potential users of the data may contemplate. [...] These data are neither legal documents nor land surveys, and must not be used as such.*

Scale, accuracy, and the “must not overlap” topological alignment rule are all important considerations for the analyses in this report, including whether a location is on federal land or not, which agency administers the land, and computations of area. Data for Hawaii and Alaska were checked for “must not overlap” topology issues and overlaps were not found. However, over 2,000 overlaps were found in the data covering the contiguous Section 368(b) states, often due to scale and accuracy limitations in the source data, but also frequently due to multiple agency designations of the same land. The total of overlap in the contiguous Section 368(b) states was over 10,000 square miles: over 8% of the total federal land area. Figure 4.1 shows the locations where overlaps exist in the SMA data, with insets showing more examples of specific overlaps.

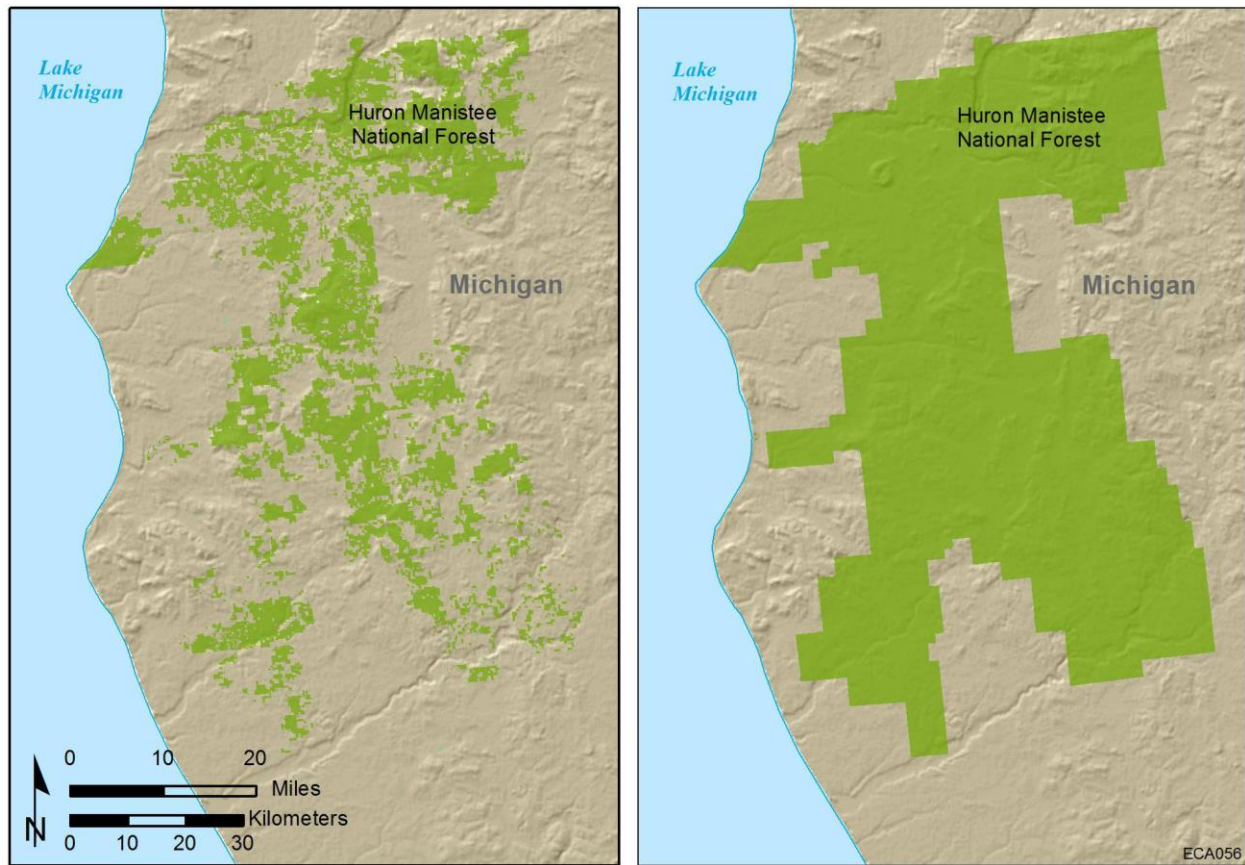


**Figure 4.1 Locations Where Overlaps Exist in the 2013 BLM Surface Management Agency Data**

Argonne manually reviewed the overlaps and assigned each overlapping area to one of the agencies listed for that location. In many cases this was inconsequential, such as different national forests being listed for the same parcel, since results were only computed to the agency level. Other overlap decisions were subjective, such as locations where a U.S. Army Corps of Engineers (COE) or U.S. Bureau of Reclamation (BOR) reservoir was also attributed to a surrounding national forest.

In some cases, federal land in the SMA data depicts acquisition boundaries rather than more detailed representations with non-federal inclusions. An example from the western coast of the Michigan Lower Peninsula is shown in Figure 4.2 where depiction of Huron Manistee National Forest was depicted with fragmented USFS-administered land in earlier versions of the SMA data, but is now depicted as a continuous area without non-federal inclusions. For these cases, federal land area and length

computations in the analysis results will be overestimated. Because of these data representation and quality issues, SMA-related results in this report represent screening-level estimates.



**Figure 4.2 Example of USFS Land in East Central Michigan Showing Change in Ownership Representation Between Prior BLM Surface Management Agency Data (Left) and BLM 2013 Surface Management Agency Data (Right)**

## 4.2 Existing and Planned Electrical Transmission and Pipeline Infrastructure

Existing and planned energy infrastructure data used in this study were obtained commercially from Platts McGraw Hill Financial data (Platts 2014). The data were loaded into the project geodatabase with the following content:

- Existing electrical transmission lines 230 kV and greater, or DC;
- Planned electrical transmission lines 230 kV and greater, or DC;
- Existing natural gas, crude oil, and refined product pipelines of 8 inches or greater diameter; and
- Planned natural gas, crude oil, and refined product pipelines of 8 inches or greater diameter.

The Platts data are compilations of data from many sources that vary in scale and accuracy, and are updated on a quarterly basis. The status and currentness of the planned infrastructure are not documented, and some proposed routes are very generally mapped. Positional accuracy is documented in the data for each feature in the following categories: within 40 feet, within 165 feet, within 1 mile, and not verified to be within 1 mile.

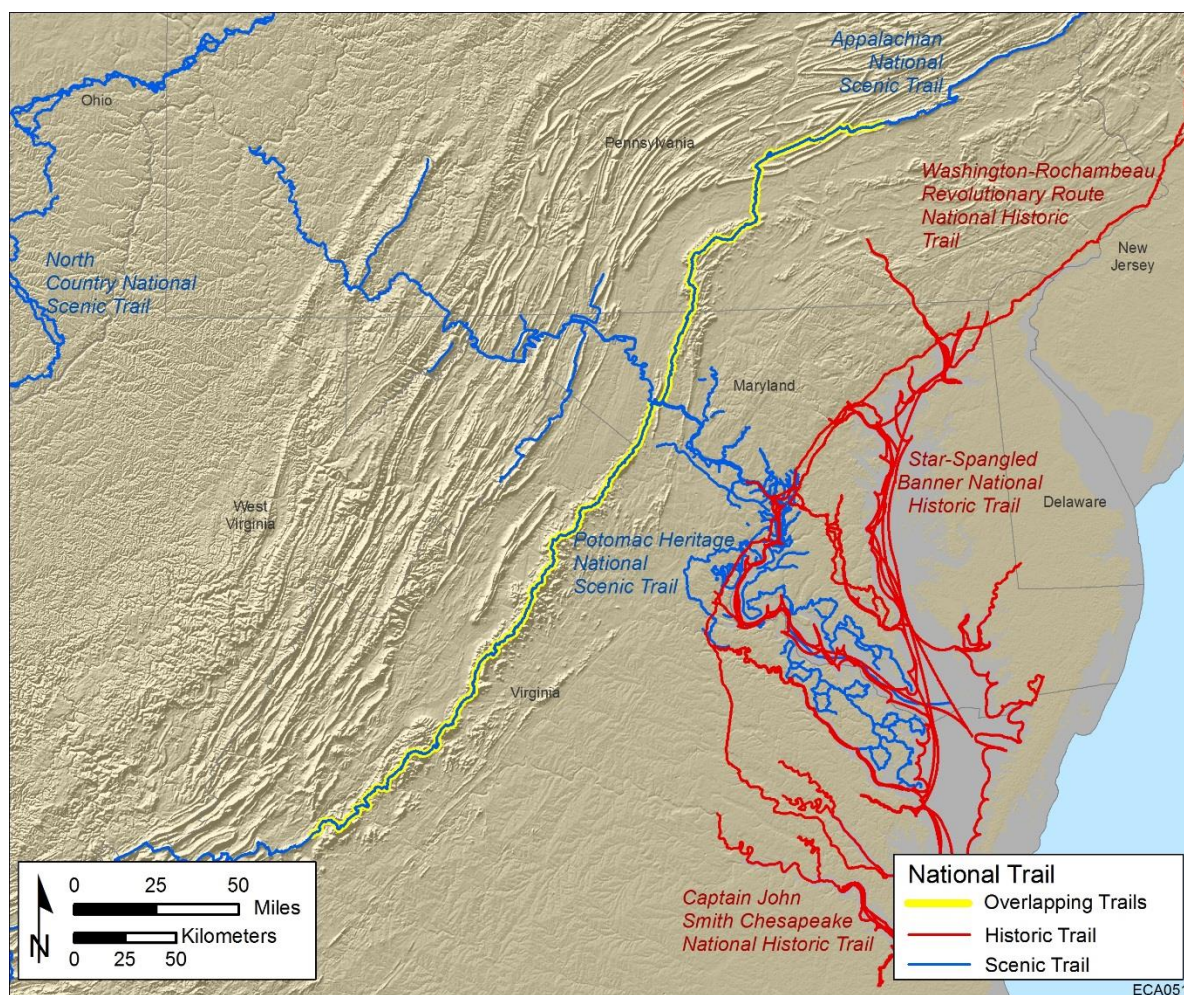
These data were used for analysis to compute numbers of national trail crossings, miles of existing or planned infrastructure within particular distances to trails, and for cross-tabulated summaries to characterize the distribution of the infrastructure. Maps depicting energy infrastructure appear throughout the results in Section 5, and the map atlas in Appendix B. More information is provided for electrical transmission lines than pipelines in the analysis results due to the abbreviated schedule of this phase of the study, but maps in Appendix B depict both existing and planned pipelines, and Section 7, Recommendations for Future Study, suggests steps needed for more complete analysis of pipelines.

## 4.3 National Trails System

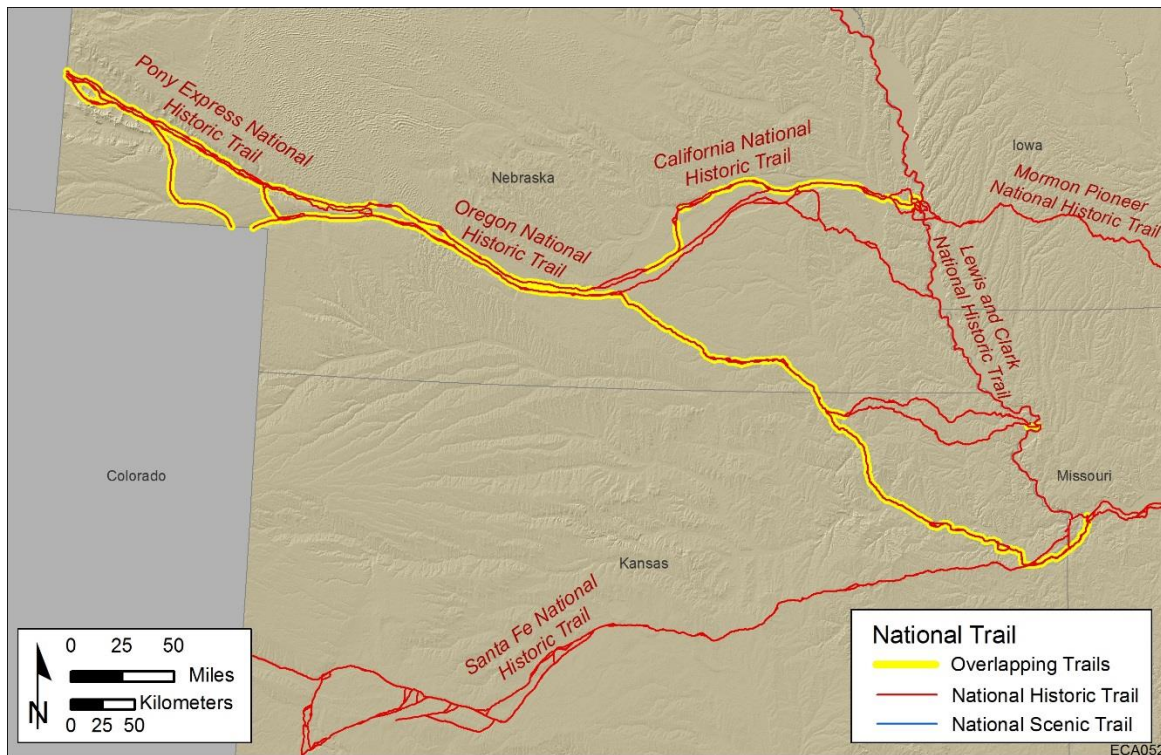
GIS data for National Trails System trails in the Section 368(b) states are not available from a single, comprehensive source. Data used for this analysis were compiled from multiple sources by Argonne for prior studies, and updated for this study (Cantwell and Hlava 2014). Trail data sources are coded on each trail in the data and include the National Park Service, U.S. Forest Service, Argonne, North Carolina State University, University of Florida GeoPlan Center, the Arizona Trail Association, a private individual, and the Pacific Northwest Trail Association. Source scale, locational accuracy, and depiction of the trails vary in terms of having continuous, discontinuous, or multiple “braided” or forking routes. Most are shown as continuous lines, although the actual trail may be discontinuous. Maps depicting the trails appear throughout the results in Section 5, and in all figures in the Appendix B map atlas.

Similar to the highway system in the United States, some portions of different national trails follow the same route for a distance before diverging. The shared routes among trails in the Section 368(b) states include the following:

- Approximately 300 miles of the Appalachian National Scenic Trail (NST) and Potomac Heritage NST in Pennsylvania, Maryland, West Virginia, and Virginia (Figure 4.3); and
- The majority of the routes of the California National Historic Trail (NHT), Oregon NHT, Mormon Pioneer NHT, and Pony Express NHT in Missouri west of Kansas City, Kansas, and Nebraska (Figure 4.4).



**Figure 4.3 Shared Route of the Appalachian National Scenic Trail (NST) and Potomac Heritage NST in Pennsylvania, Maryland, West Virginia, and Virginia**



**Figure 4.4 Shared Routes of the California National Historic Trail (NHT), Oregon NHT, Mormon Pioneer NHT, and Pony Express NHT in Kansas and Nebraska**

#### 4.4 Proximity Assumptions

Results from Sullivan et al. (2014) include distances for three degrees of visibility for the major transmission tower types in western U.S. landscapes. For example, skyline 500-kV lattice towers were visible to the unaided eye beyond 10 miles in 16 observations, with a maximum distance of approximately 17 miles. They were judged to be noticeable to casual observers at distances of up to 10 miles, and judged to strongly attract visual attention at distances of up to 3 miles. Skyline 230-kV H-frame tower facilities were visible to the unaided eye at distances up to 8 miles. They were judged to be noticeable to casual observers at distances of up to 3.5 miles, and judged to strongly attract visual attention at distances of up to 1.5 miles.

The results of the Sullivan et al. (2014) study have important implications for determining appropriate distances from transmission facilities for visual impact assessments, and for the siting of transmission facilities to reduce visual impacts on visually sensitive lands. The authors recommend that the limit of visibility for casual observers be used as a minimum distance for visual impact assessments. Beyond the minimum distances specified, the facilities would not likely be noticed by casual viewers. Beyond the more conservative distances specified, the facilities would not likely be seen, except in unusual circumstances.

In the analysis for this report, a conservative approach was taken to assess the existing and proposed energy transmission facilities that would have potential impacts to the scenic resources near the National Trails System. Impacts were assumed to be likely within 2.5 miles of a trail, and a distance of

7.5 miles was used for potential impacts. This is based on the assumption of large towers (500-kV lattice towers), unobstructed sightline, and favorable contrast conditions (backlit towers against a bright sky backdrop).

The conservative assumptions roughly bound the analysis to a worst-case assumption. In many cases, visual impacts would be lower. When viewed within complex backdrops, such as some types of vegetation or rocky terrain, towers can be much less visually noticeable, even at short distances. Different types and sizes of towers have very different visual properties. Vegetation and terrain can screen towers from lines of sight. Haze and other atmospheric conditions also reduce distances at which towers are visible, and distances in the contiguous Section 368(b) states would generally be short than in the clean dry air of the western states where the Sullivan study observations were made.

## 4.5 Electronic Products

To facilitate continued analysis, the GIS data used by Argonne for this study were compiled in a new database, and a GIS project to view these data was prepared. The files were provided as an addendum to this report, with the exception of the Platts (2014) transmission line and pipeline data, which cannot be redistributed. The GIS projects were provided in Environmental Systems Research Institute (ESRI) ArcGIS and ESRI ArcReader formats. ESRI ArcGIS is a commercially licensed GIS application, and ESRI ArcReader can be downloaded and installed without cost from <http://www.esri.com/software/arcgis/arcreader/download>. Appendix A describes how to install and use ArcReader with the provided files. Also included is a Keyhole Markup Language file containing the national trails and the intersection points used in this study. Appendix A also provides details about Google Earth which may be used to view the file, and an example 3D view from Google Earth.

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## 5. Results

The following sections describe the results of the analysis in Section 5.1, Federal Land Jurisdictions; Section 5.2, Existing and Planned Electrical Transmission and Pipeline Infrastructure; and Section 5.3, National Historic and Scenic Trails. Results are also tabulated, and mapped in Appendix B, by the sub-regions listed below, consistent with the Krummel et al. (2011) report. Figure 5.1 depicts the following regions in map form:

- Alaska,
- Appalachian,
- Central,
- Great Lakes,
- Hawaii,
- Lower Great Plains,
- Mid-Atlantic,
- New England,
- Southern Atlantic, and
- Upper Great Plains.



**Figure 5.1 Locations of Regions Used in the Study**

## 5.1 Federal Land Jurisdictions

The distribution of federal lands in the Section 368(b) states is shown in Figure 5.2, and the more detailed maps may be found in Figures B-1.1 through B-3.10 in Appendix B. The total amount of federal and non-federal land areas in the contiguous Section 368(b) States, and in Alaska and Hawaii, are presented in Table 5.1, which also shows the amounts of federal land among the federal agencies with the greatest amount of federal land jurisdiction (e.g., U.S. Fish and Wildlife Service). Lands under the jurisdiction of other federal agencies with much smaller land jurisdictions, such as the Agricultural Research Service, the Department of Energy, and the Tennessee Valley Authority, are included in the Other Federal category in Table 5.1. The amount of federal land in the contiguous Section 368(b) States, by geographic regions, is presented in Table 5.2, and Table 5.3 provides federal land amounts at the state level.

Federal land in the contiguous Section 368(b) states comprises only about 6% of the total land area (Table 5.2). Among the regions, the greatest amount of federal land may be in the Great Lakes, Gulf Coast, and Southern Atlantic regions, while within any specific region, the highest percentage of federal land occurs in the Appalachian, Mid-Atlantic, and Southern Atlantic regions (Table 5.2). Federal lands in Alaska and Hawaii account for 64% and 12% of the total areas of these states, respectively (Table 5.3). After Alaska, the contribution of federal land to the total area of any of the other states drops significantly, with New Hampshire having the next highest percentage, 15%.

The 2011 report to Congress (Krummel et al. 2011) provides a thorough analysis of the federal agencies administering land in the Section 368(b) states, including information on agency profiles, authorities, and missions; constraints and opportunities for energy transportation, and federal land characteristics; this information which is not repeated here.

The analysis in that report, coupled with the low response to the Advance Notice of Intent, provides background for the rationale that led to Section 368(b) corridors not being designated; however, other aspects of federal oversight are still important to energy transportation planning. New analysis in the current report is tied to federal land jurisdictions, but focuses specifically on the issues unique to the National Trails System, which is federally administered but has elements in both federal and non-federal jurisdictions.

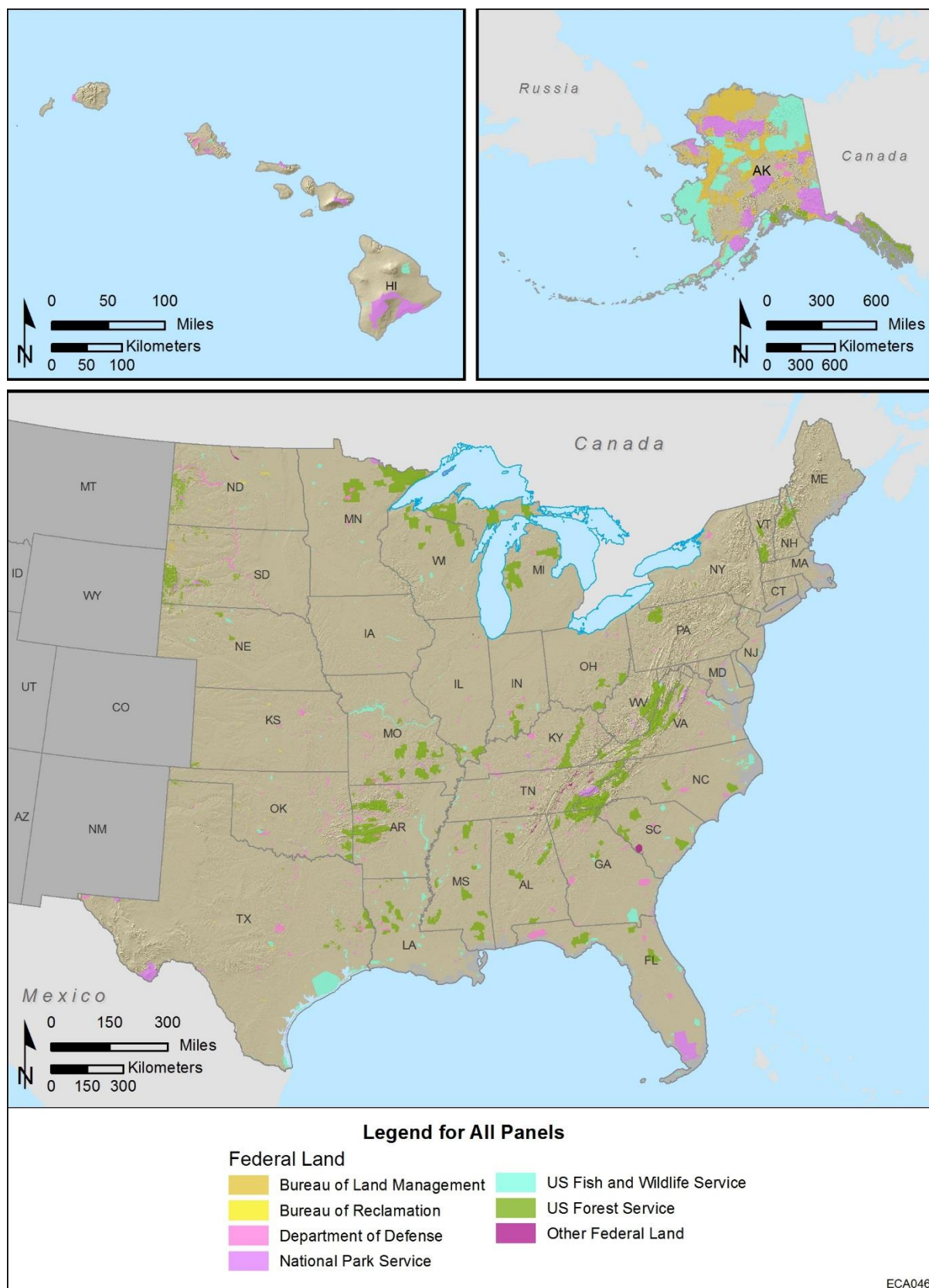


Figure 5.2 Federal Land in the Section 368(b) States

**Table 5.1 Federal and Non-Federal Land Areas in the Section 368(b) States**

Jurisdiction <sup>a</sup>	Land Area of the Section 368(b) States (mi <sup>2</sup> )			
	Contiguous 368(b) States	Alaska	Hawaii	All 368(b) States
Non-federal	1,703,950	212,051	5,632	1,921,633
Total Federal	117,275	370,103	798	488,176
BLM	546	113,270	0	113,815
BOR	557	0	0	557
DOD	14,942	3,227	103	18,272
FWS	16,697	139,690	71	156,458
NPS	8,247	81,834	624	90,705
Other Federal	1,198	0	0	1,198
USFS	75,089	32,083	0	107,172
Grand Total	1,821,225	582,155	6,430	2,409,810

<sup>a</sup> BLM = Bureau of Land Management; BOR = U.S. Bureau of Reclamation; DOD = U.S. Department of Defense; FWS = U.S. Fish and Wildlife Service; NPS = National Park Service; USFS = U.S. Forest Service.

Sources: ESRI (2010); BLM (2013)

**Table 5.2 Land Areas and Percentages of Federal Land in the Contiguous Section 368(b) States, by Region**

Region	Total Land Area (mi <sup>2</sup> )	Percent of Total Land Area <sup>a</sup>	Federal Land Area (mi <sup>2</sup> )	Percent Contribution of Federal Lands <sup>b</sup>
Appalachian	106,782	6%	10,159	10%
Central	179,154	10%	14,360	8%
Great Lakes	426,255	23%	27,084	6%
Gulf Coast	202,798	11%	17,428	9%
Lower Great Plains	416,960	23%	13,092	3%
Mid-Atlantic	59,487	3%	7,363	12%
New England	65,523	4%	3,337	5%
Southern Atlantic	139,093	8%	15,033	11%
Upper Great Plains	225,165	12%	9,421	4%
Total	1,821,216		117,275	6%

<sup>a</sup> Values are the percent contribution of the region land area to the total land area of the lower Section 368(b) states.

<sup>b</sup> Percentage of the region's total land area that is under federal ownership and management.

Sources: ESRI (2010); BLM (2013)

**Table 5.3 Land Areas and Percentages of Federal Land in the Section 368(b) States, by Region and State (Sources: ESRI 2010, BLM 2013)**

Region	State	Total Land Area (mi <sup>2</sup> )	Federal Land Area (mi <sup>2</sup> )	Percent Contribution of Federal Land
Alaska	Alaska	582,155	370,103	64%
Appalachian	Kentucky	40,410	3,197	8%
	Tennessee	42,143	3,668	9%
	West Virginia	24,230	3,293	14%
Total		106,782	10,159	10%
Central	Arkansas	53,179	7,276	14%
	Iowa	56,272	347	1%
	Missouri	69,703	6,737	10%
Total		179,154	14,360	8%
Great Lakes	Illinois	56,341	1,638	3%
	Indiana	36,184	1,423	4%
	Michigan	58,128	8,392	14%
	Minnesota	84,374	8,555	10%
	New York	48,578	394	1%
	Ohio	41,256	1,592	4%
	Pennsylvania	45,293	1,488	3%
	Wisconsin	56,103	3,603	6%
Total		426,257	27,084	6%
Gulf Coast	Alabama	51,650	2,735	5%
	Florida	56,696	6,858	12%
	Louisiana	46,777	3,190	7%
	Mississippi	47,676	4,645	10%
Total		202,799	17,428	9%
Hawaii	Hawaii	6,430	798	12%
Lower Great Plains	Kansas	82,278	856	1%
	Oklahoma	69,901	2,845	4%
	Texas	264,783	9,391	4%
Total		423,392	13,092	3%
Mid-Atlantic	Delaware	1,976	52	3%
	District of Columbia	62	7	11%
	Maryland	9,900	346	3%
	New Jersey	7,553	337	4%
	Virginia	39,997	6,620	17%
Total		59,487	7,363	12%

**Table 5.3 (Cont.)**

Region	State	Total Land Area (mi <sup>2</sup> )	Federal Land Area (mi <sup>2</sup> )	Percent Contribution of Federal Land
New England	Connecticut	4,963	8	< 1%
	Maine	32,489	410	1%
	Massachusetts	8,104	145	2%
	New Hampshire	9,266	1,382	15%
	Rhode Island	1,087	14	1%
	Vermont	9,614	1,378	14%
Total		65,523	3,337	5%
Southern Atlantic	Georgia	58,809	5,192	9%
	North Carolina	49,340	6,599	13%
	South Carolina	30,943	3,242	10%
Total		139,093	15,033	11%
Upper Great Plains	Nebraska	77,352	1,039	1%
	North Dakota	70,698	3,507	5%
	South Dakota	77,115	4,875	6%
Total		225,166	9,421	4%
Grand Total		2,409,810	488,176	6%

## 5.2 Existing and Planned Electrical Transmission and Pipeline Infrastructure

The locations of existing high-voltage (230-kV and greater capacity) transmission lines in the Section 368(b) states are shown in Figure 5.3, and in more detail in Figures B-2.1 through B-2.10 in Appendix B. The locations of planned high-voltage electrical transmission lines in the contiguous Section 368(b) states are shown in Figure 5.4, and are shown in more detail Figures B 1.1 to B 1.9 in Appendix B. No planned high-voltage transmission lines or pipelines over 8" diameter were identified for Alaska or Hawaii. The total mileage of planned high-voltage transmission lines, as determined using the Platts data, is presented in Table 5.4. It is important to note that the position of fully 77% of these transmission lines cannot be verified to within 1 mile of their mapped locations, and thus conclusions about where these lines may intersect national trails are very speculative. Only about 7% of the lines are mapped to a level (within 165 feet) that would allow specific planned trail crossing locations to be accurately determined, however the number and general locations of potential crossings are still informative.

The lengths of existing and planned high voltage electrical transmission lines on federal and non-federal lands in the Section 368(b) States are presented in Tables 5.5 and 5.6. On federal lands, the greatest amount of existing and planned transmission lines occur on federal land administered by the USFS, followed by FWS and DOD (Table 5.5). In Alaska, the only federal land with existing high-voltage transmission lines is DOD-administered, and no existing or planned high voltage electric transmission

lines occur in Hawaii. Of the more than 116,500 miles of existing and 24,800 miles of planned high-level transmission lines, only 2.4% of the existing, and 2.4% of the planned transmission line mileage falls on federal land, or about half of what would be expected based on the overall 6% percentage of federal land area in the Section 368(b) states if transmission line distances were directly proportional to total area, regardless of jurisdiction.

**Table 5.4 Length in Miles of Planned Electrical Transmission Lines, in the Contiguous Section 368(b) States, of 230-kV or Greater Capacity in Platts (2013) Data for Each Documented Positional Accuracy Level**

Positional Accuracy Level	Length (mi)	Percent of Total Length
Within 40 feet	1,252	5%
Within 165 feet	583	2%
Within 1 mile	3,935	16%
Not verified to be within 1 mile	19,059	77%
Total	24,830	

Existing natural gas, crude oil, and refined products pipelines in the Section 368(b) States are shown in Figure 5.5, and in greater detail in Figures B 3.1 to B 3.10 in Appendix B. These pipeline systems are most dense in Louisiana, Oklahoma, and Texas and sparser in the Upper Great Plains and New England regions, Alaska (with the exception of the North Slope and the Trans-Alaska Pipeline), and Hawaii.

Natural gas, crude oil, and refined products pipelines (8" diameter or greater) planned for the Section 368(b) States are shown in Figure 5.6, and in greater detail in Figures B-1.1 to B-1.9 in Appendix B. The prominent pipeline shown in South Dakota, Nebraska, Oklahoma, and Texas is the TransCanada Keystone Pipeline, which has a planned 36" pipeline diameter. The natural gas line shown in Mississippi is the Continental Connector project planned by El Paso Natural Gas Company, with a planned 42" pipeline diameter.

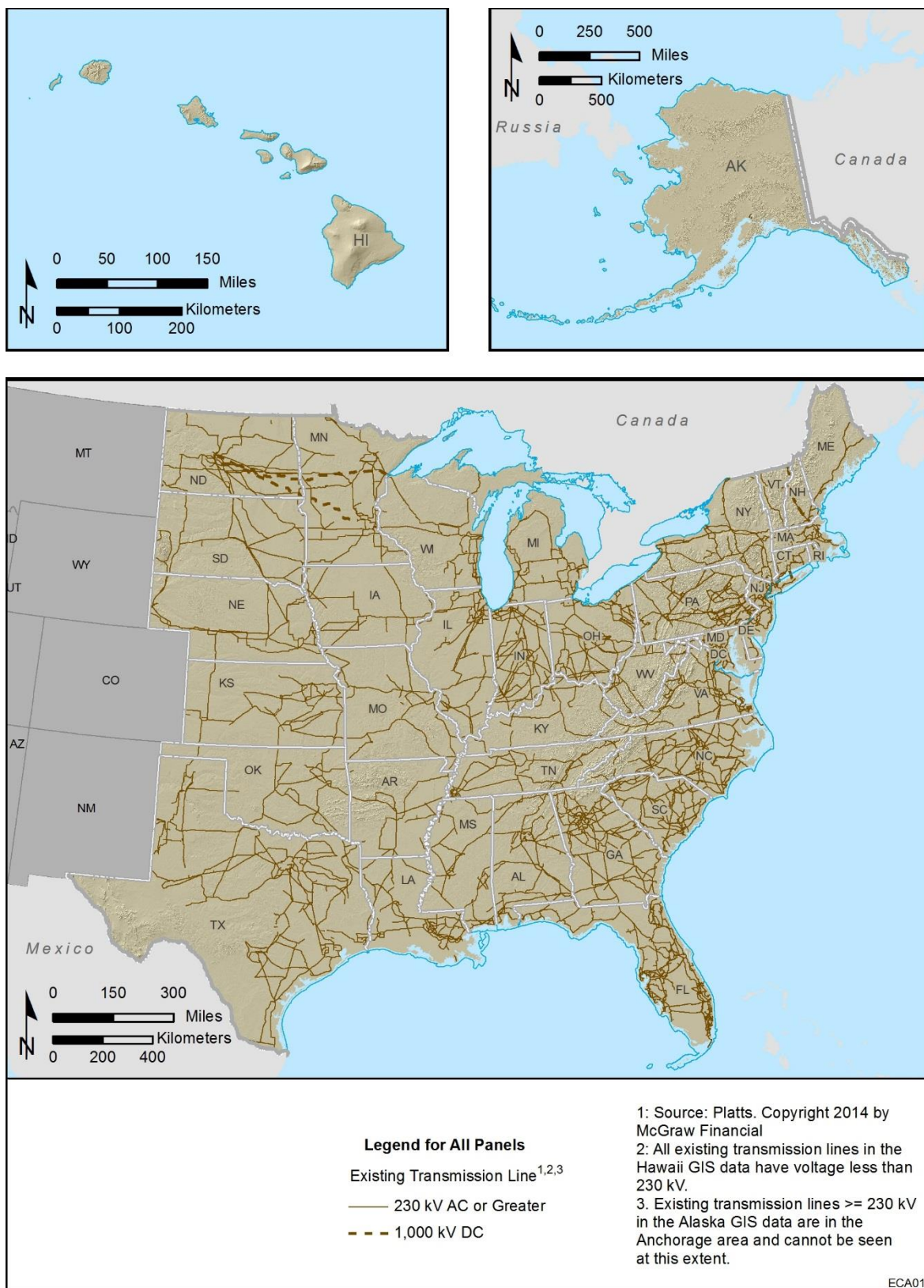
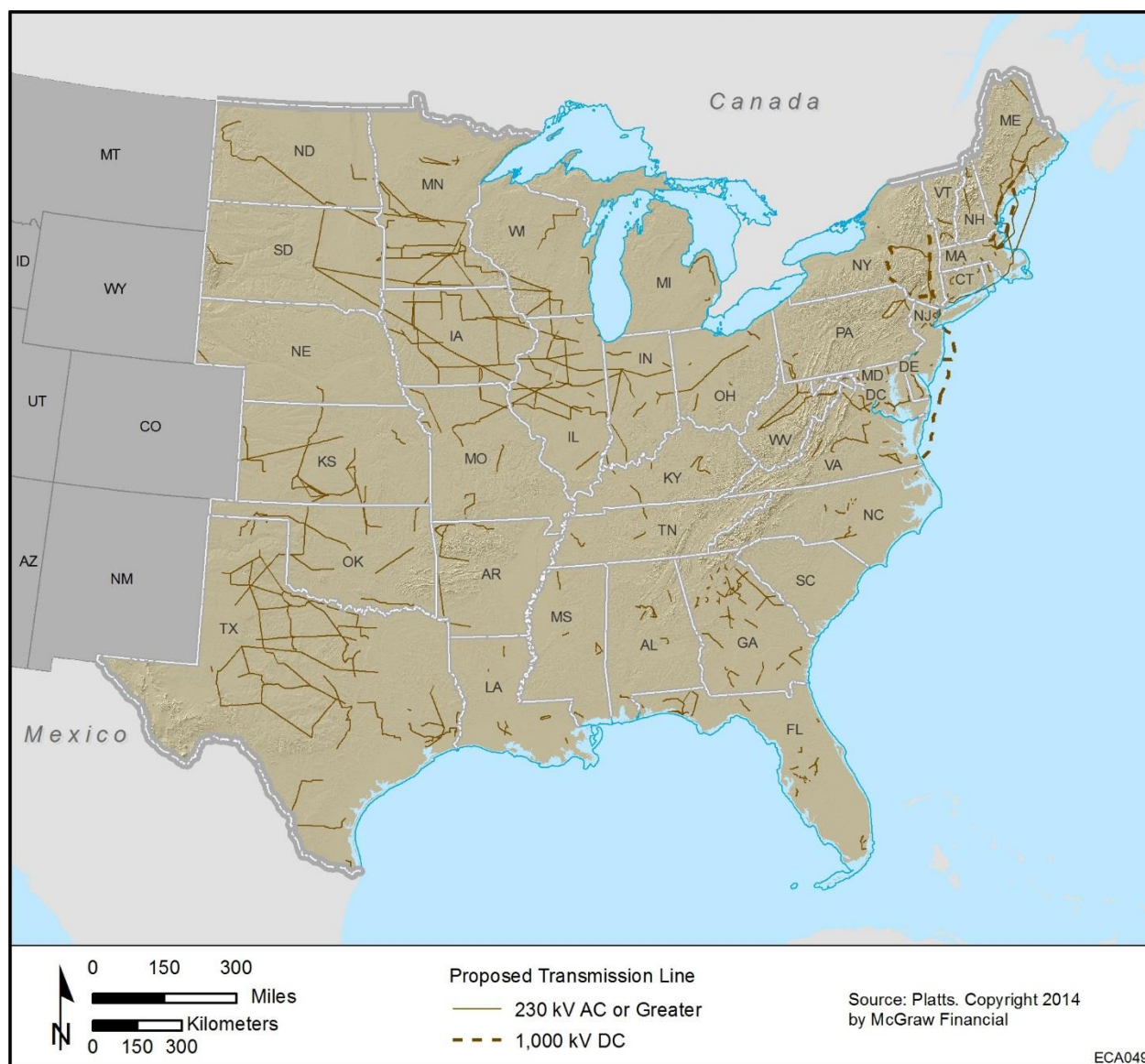
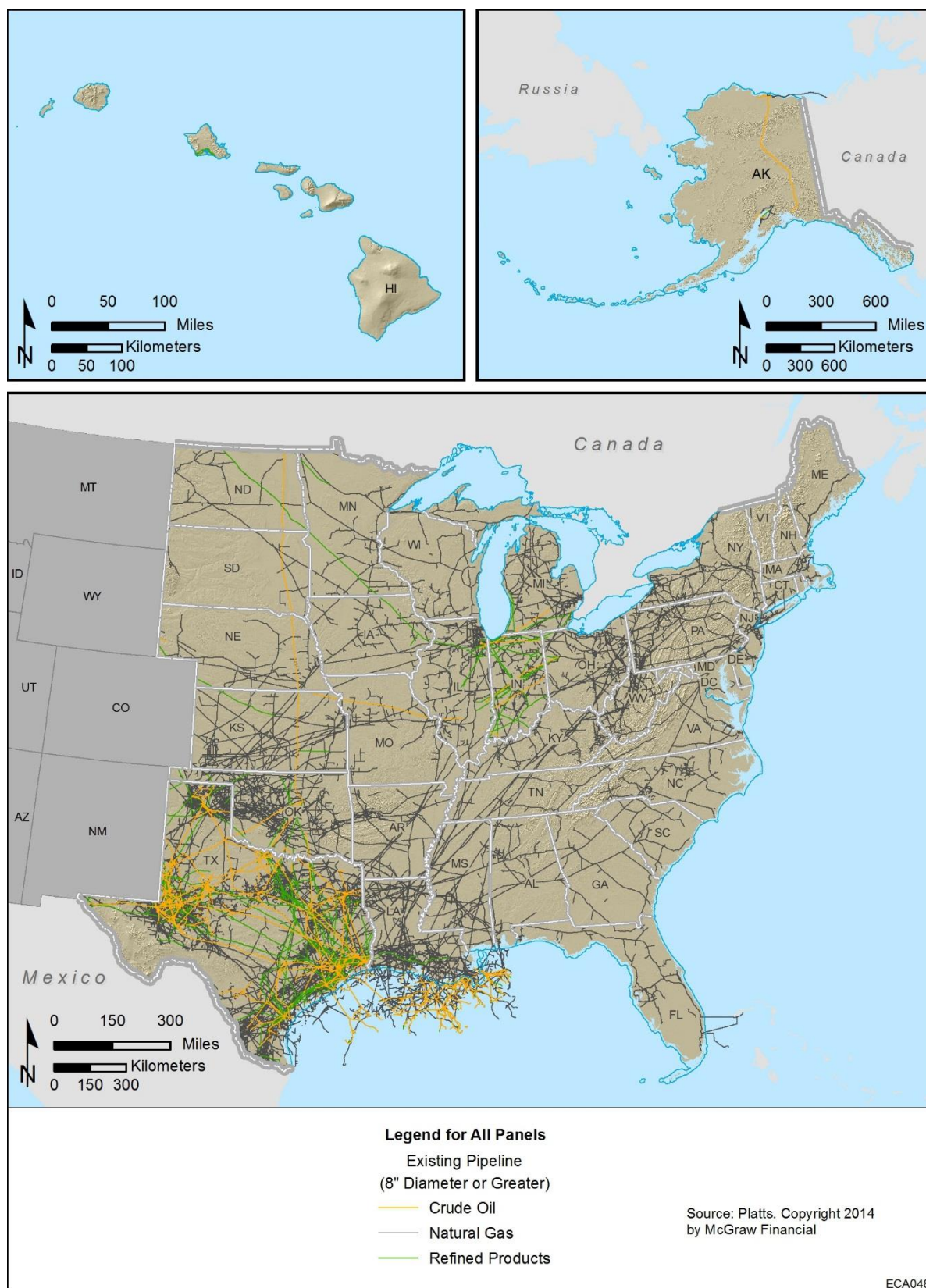


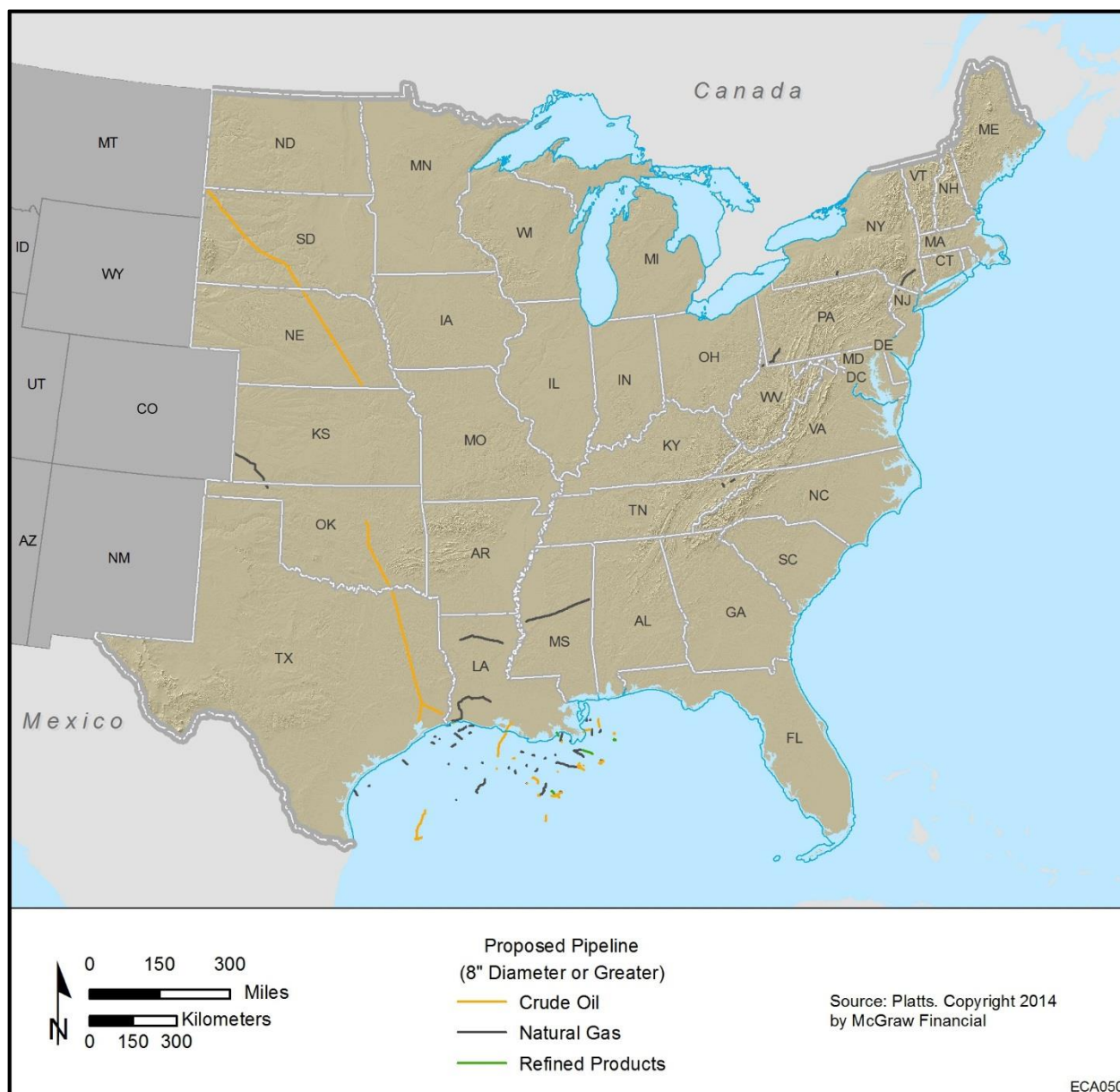
Figure 5.3 Existing High-Voltage Electrical Transmission Lines in the Section 368(b) States



**Figure 5.4 Planned High-Voltage Electrical Transmission Lines in the Contiguous Section 368(b) States**



**Figure 5.5 Existing Natural Gas, Crude Oil, and Refined Products Pipelines 8 Inches in Diameter or Greater in the Section 368(b) States**



**Figure 5.6 Planned Natural Gas, Crude Oil, and Refined Products Pipelines of 8 Inches in Diameter or Greater in the Section 368(b) States**

**Table 5.5 Total and Per-Federal-Agency Length of Existing and Planned Electric Transmission Lines with at Least 230-kV Capacity in the Section 368(b) States**

Agency	Length (mi) of Electric Transmission Lines with at Least 230-kV Capacity					
	Contiguous Section 368(b) States		Alaska		Hawaii	
	Existing	Planned <sup>a</sup>	Existing	Planned <sup>a</sup>	Existing	Planned <sup>a</sup>
Non-Federal	113,692	24,234	34	0	0	0
Total Federal <sup>b</sup>	2,796	597	16	0	0	0
BLM	4	1	—	—	—	—
BOR	5	1	—	—	—	—
DOD	419	124	16	—	—	—
FWS	876	123	—	—	—	—
NPS	75	19	—	—	—	—
OTHER	145	—	—	—	—	—
USFS	1,272	329	—	—	—	—
All land	116,488	24,830	50	0	0	0

<sup>a</sup> Planned status as mapped by Platts.

<sup>b</sup> BOR = U.S. Bureau of Reclamation; BLM = Bureau of Land Management; DOD = U.S. Department of Defense; FWS = U.S. Fish and Wildlife Service; NPS = National Park Service; USFS = U.S. Forest Service.

Sources: BLM (2013); ESRI (2014); Platts (2014)

**Table 5.6 Total, Regional, and Per-State Lengths of Existing and Planned Electric Transmission Lines with at Least 230-kV Capacity in the Section 368(b) States**

Region	State	Length (mi) of Electric Transmission Lines with at Least 230-kV Capacity			
		Federal Land		Non-Federal Land	
		Existing	Planned	Existing	Planned
Alaska	Alaska	16	0	0	0
Appalachian	Kentucky	23	19	1,330	173
	Tennessee	118	1	2,466	116
	West Virginia	11	17	1,363	556
Total		168	38	5,159	845
Central	Arkansas	27	93	1,341	460
	Iowa	0	13	1,913	1,931
	Missouri	121	35	2,453	608
Total		149	141	5,707	2,999
Great Lakes	Illinois	57	5	3,949	1,671
	Indiana	81	0	4,865	741
	Michigan	86	0	3,150	141
	Minnesota	36	153	4,544	2,158
	New York	5	0	4,259	819
	Ohio	120	3	4,530	286
	Pennsylvania	132	4	6,017	325
	Wisconsin	3	25	1,729	612
Total		520	191	33,042	6,753
Gulf Coast	Alabama	45	0	3,209	251
	Florida	223	2	9,103	606
	Louisiana	107	0	3,203	178
	Mississippi	99	0	2,057	145
Total		475	2	17,571	1,179
Hawaii	Hawaii	0	0	0	0
Lower Great Plains	Kansas	3	4	2,719	1,377
	Oklahoma	13	18	1,856	1,112
	Texas	504	28	11,151	4,508
Total		519	50	15,726	6,997
Mid-Atlantic	Delaware	0	1	335	133
	District of Columbia	0	0	14	5
	Maryland	38	11	2,011	299
	New Jersey	50	13	2,163	224
	Virginia	278	21	3,596	609
Total		367	45	8,119	1,270

**Table 5.6 (Cont.)**

Region	State	Length (mi) of Electric Transmission Lines with at Least 230-kV Capacity			
		Federal Land		Non-Federal Land	
		Existing	Planned	Existing	Planned
New England	Connecticut	1	1	677	143
	Maine	6	6	549	807
	Massachusetts	13	1	1,132	204
	New Hampshire	37	12	758	191
	Rhode Island	0	0	93	52
	Vermont	38	45	509	88
Total		94	65	3,719	1,485
Southern Atlantic	Georgia	64	12	6,168	1,000
	North Carolina	198	9	4,790	196
	South Carolina	162	0	3,602	0
Total		424	21	14,560	1,196
Upper Great Plains	Nebraska	0	0	2,820	100
	North Dakota	43	16	4,159	538
	South Dakota	53	29	3,110	872
Total		97	44	10,088	1,510
Grand Total		2,812	597	113,692	24,234

Sources: BLM (2013); ESRI (2014); Platts (2014)

### 5.3 National Historic and Scenic Trails

There are many NHTs and NSTs throughout the eastern United States. Many (such as the Appalachian NST) are thousands of miles long and cross many states. The scenic and historic experience and enjoyment of trail users may be significantly affected by visual impacts of proximate electricity transmission infrastructure and cleared pipeline ROWs. A small-scale map of trails in the Section 368(b) states was provided in Figure 3.1.

Maps showing the locations of national trails and existing and proposed transmission facilities, as well as tables that document the extent and proximity of the relationship in each region, are presented in Appendix B. Figures B-1.1 through B-1.10 show planned high-voltage transmission lines and pipeline intersections with national trails; Figures B-2.1 through B-2.10 show existing high-voltage electrical transmission intersections with national trails; and Figures B-3.1 through B-3.10 show existing natural gas, crude oil, and refined product pipeline intersections with national trails. A large-format map of the National Trails System produced by the NPS is also available as Figure B-4.1 in Appendix B. Section 2 describes how scenic and visually sensitive resources, including national trails, are potentially affected by electricity transmission infrastructure.

Table 5.7 lists each national trail with statistics for existing and proposed crossings of each trail by high-voltage electrical transmission lines, including details by state. The number of intersections

(crossings) is given, with the subset on federal lands, and the total length within 2.5 miles and 7.5 miles of the trails is listed. Section 4.4 describes the basis for the two distances, with 2.5 miles representing likely impacts to trail-related scenic resources, and 7.5 miles representing for potential impacts. This is based on the conservative assumptions of large towers (500-kV lattice towers), an unobstructed sightline, and favorable contrast conditions (backlit towers against a bright sky backdrop).

Overall, 1,328 national trail crossings with existing, and 168 crossings with planned, high-voltage transmission lines were identified. Of these, only 101 existing and 20 planned crossings occur on federal land. The trails with crossings on federal land include the Appalachian NST (17 existing and 4 planned crossings), the Captain John Smith Chesapeake NHT (2 planned), the Florida NHT (10 existing), the Lewis and Clark NHT (17 existing, 3 planned), the North Country NHT (15 existing), the Potomac Heritage NHT (20 existing, 1 planned), the Star-Spangled Banner NHT (2 existing, 2 planned), the Trail of Tears NHT (16 existing, 8 planned), and the Washington-Rochambeau Revolutionary Route NHT (3 existing).

Figures 5.7 to 5.16 show the set of 20 intersections between planned high-voltage transmission lines and national trails on federal land in this study. As can be seen in Figure 5.8, some intersection locations indicated by the data are more speculative due to the general nature of the proposed transmission line routes. In this example the specific location of a crossing would be likely to be in a different place, but both the federally-administered area and the national trails would be very likely to be intersected.

Regarding the proximity of existing and planned high-voltage electric transmission lines to national trails, a total of 9,999 miles of existing and 1,234 miles of planned high-voltage transmission lines were found to be within 2.5 miles of national trails. A much greater amount of existing and planned transmission lines occur within 7.5 miles of a national trail (26,927 miles of existing lines and 3,277 miles of planned lines) (Table 5.7).

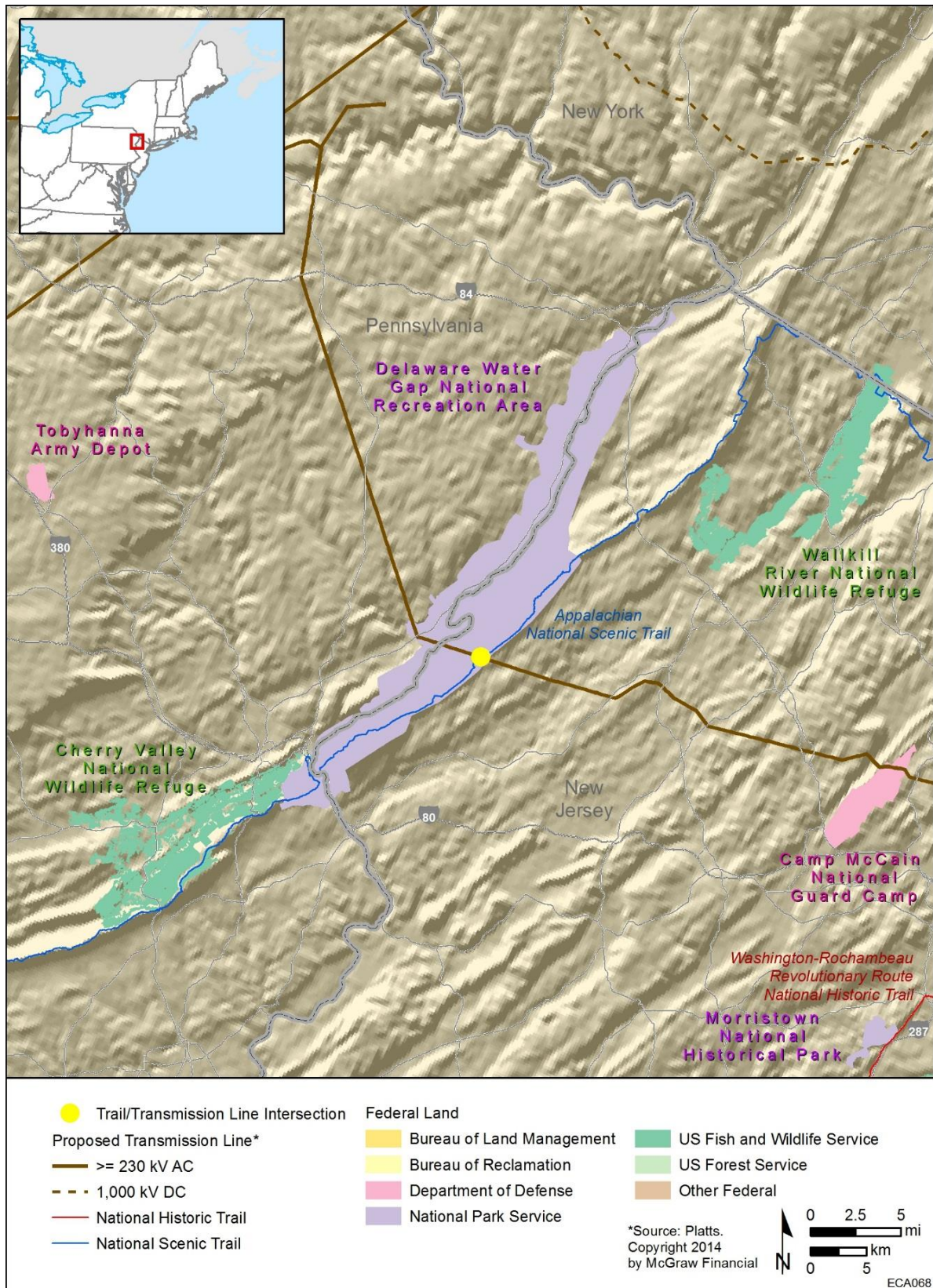
The only trail with no existing or planned high-voltage transmission line crossings is the Ala Kahakai NHT in Hawaii. (Hawaii does not have existing or planned transmission lines of the capacity analyzed.) Several trails have no planned crossings or proximity within 7.5 miles; these include the Iditarod NHT in Alaska, the Overmountain Victory NHT, and the Pony Express NHT, and include only a few miles of potential impacts for the Natchez Trace NHT and the Selma to Montgomery NHT.

Trails with large numbers of existing crossings include the North Country NST (207), the Potomac Heritage NHT (250), the Trail of Tears NHT (158), and the Washington-Rochambeau Revolutionary Route NHT (130). Eight of the trails have at least 10 planned crossings, including the Appalachian NHT (12), the El Camino Real de Los Tejas NHT (16), the Mormon Pioneer NHT (11), the North Country NHT (11), the Potomac Heritage NHT (27), the Star-Spangled Banner NHT (12), the Trail of Tears NHT (26), and the Washington-Rochambeau Revolutionary Route NHT(14).

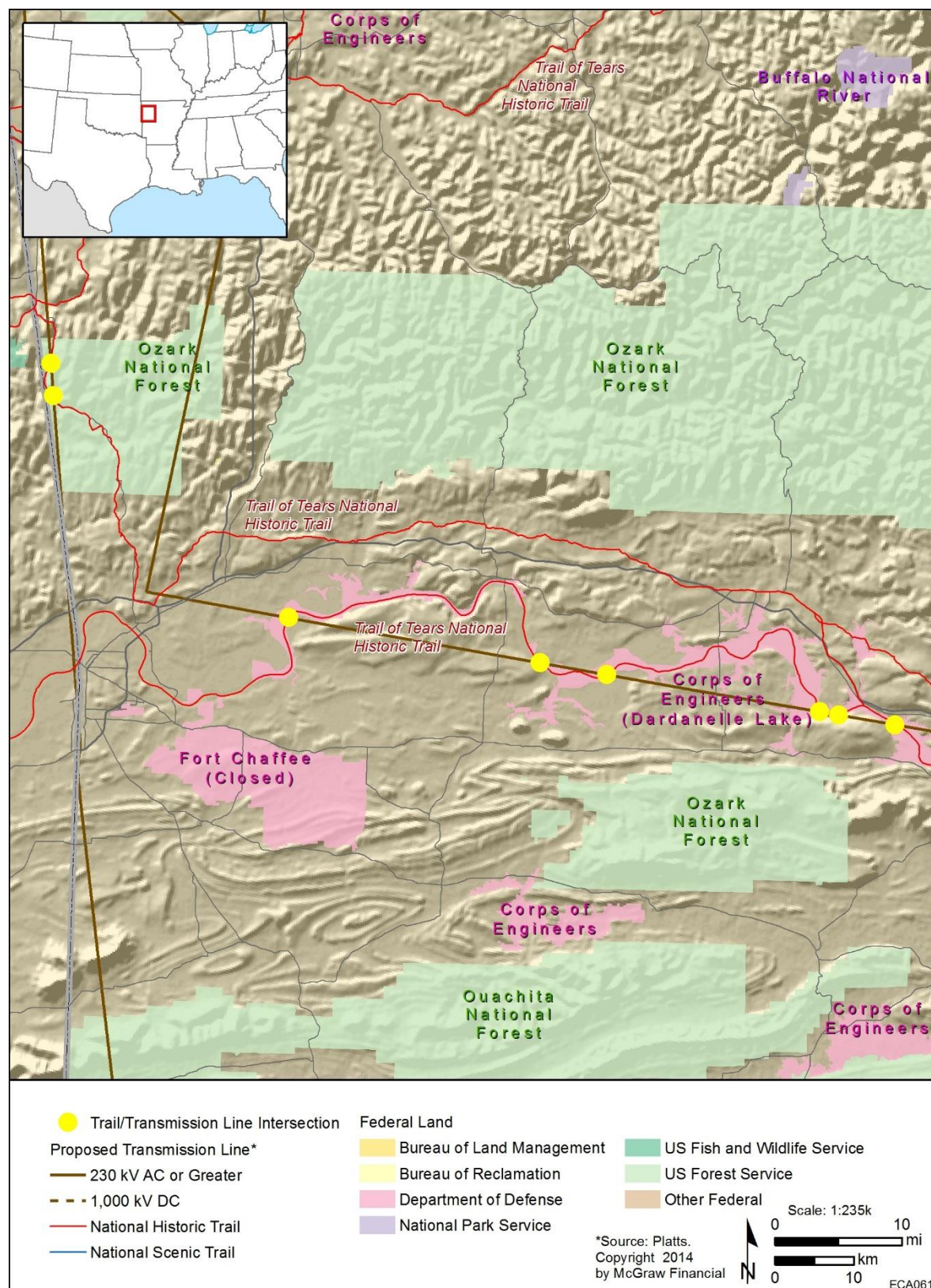
A more informative statistic is how frequently existing and proposed crossings occur per unit of trail distance; Table 5.8 lists each national trail with this information. It lists the computed GIS distance for each national trail, the number of crossings of existing and planned electrical transmission lines of 230 kV or greater, and national trail miles per crossing. The Iditarod NHT, Ice Age NHT, and Captain John Smith Chesapeake NHTs have the fewest existing crossings, with an average of nearly 400 miles between

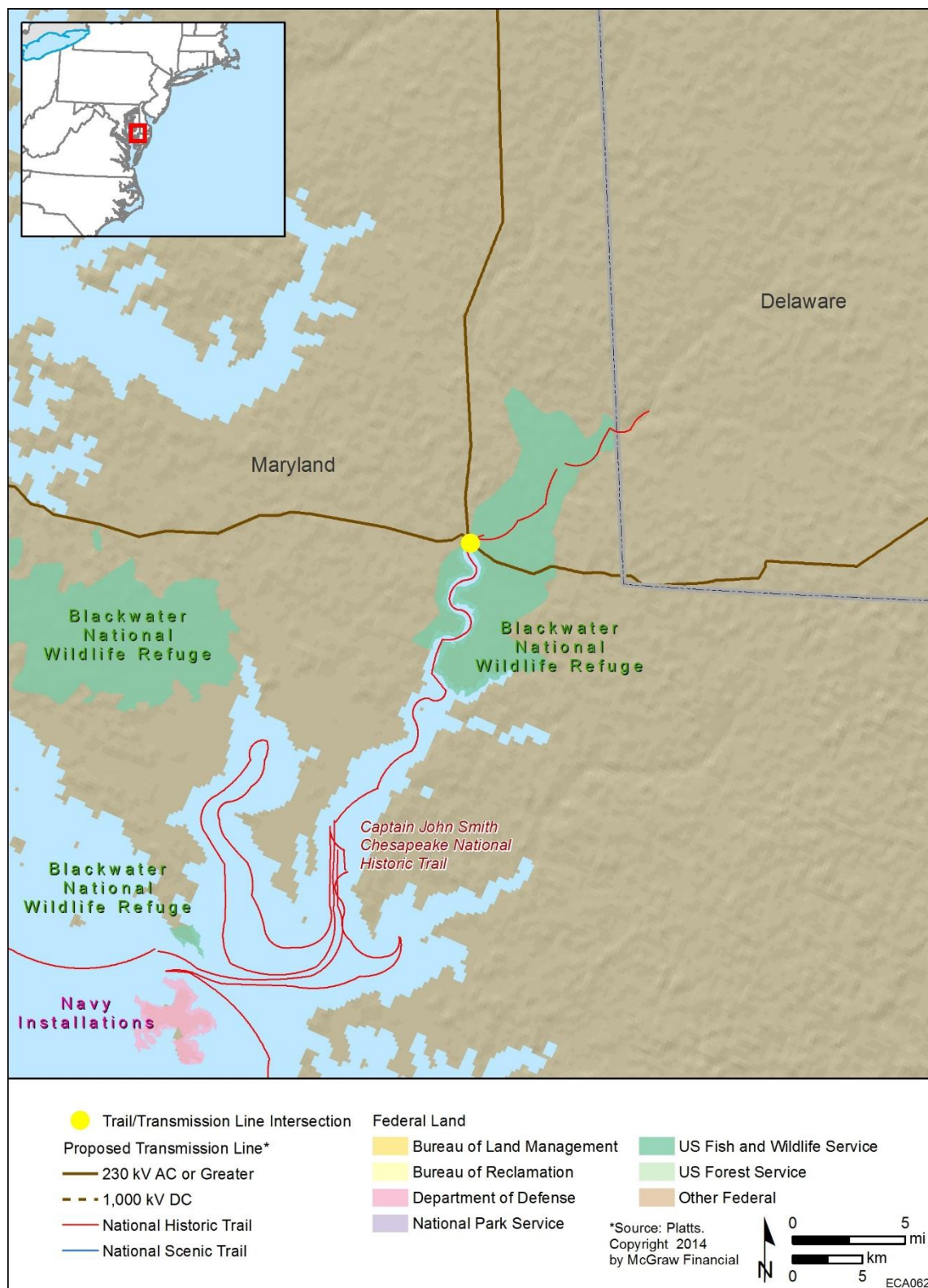
crossings of the Iditarod NHT, but smaller intercrossing distances for the other two trails. In contrast, the Washington-Rochambeau Revolutionary Route NHT, the New England NST, and the Potomac Heritage NHT each average less than 10 miles between existing transmission line crossings.

Nine of the 23 trails occurring in the study area have over 100 miles between planned crossings, and six trails have no planned crossings (Table 5.8). Consistent with existing crossings, the New England NST also has the shortest distance between planned crossings.

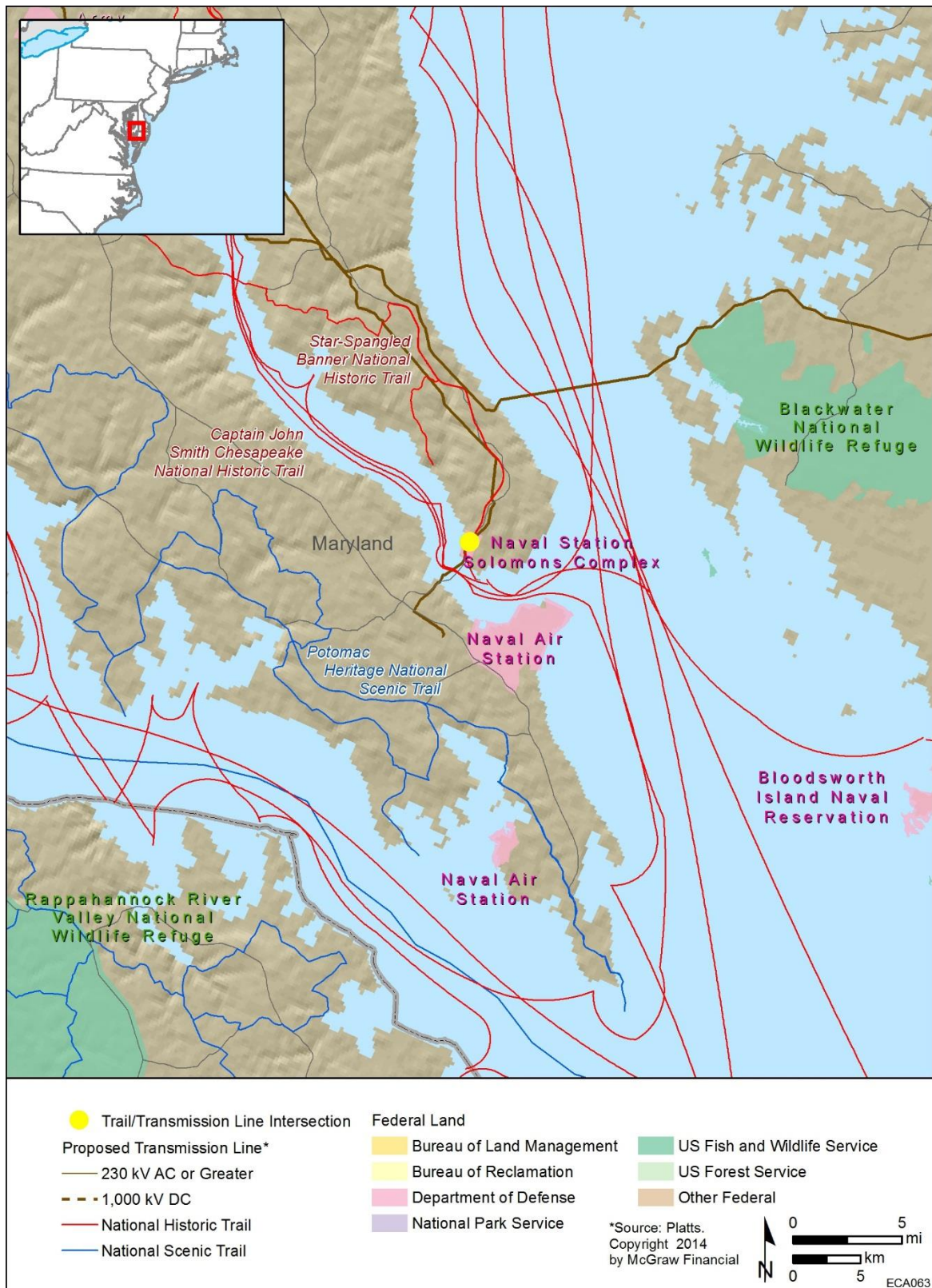


**Figure 5.7 Intersection of the Appalachian National Scenic Trail by a Planned Electrical Transmission Line within the Delaware Water Gap National Recreation Area in New Jersey**

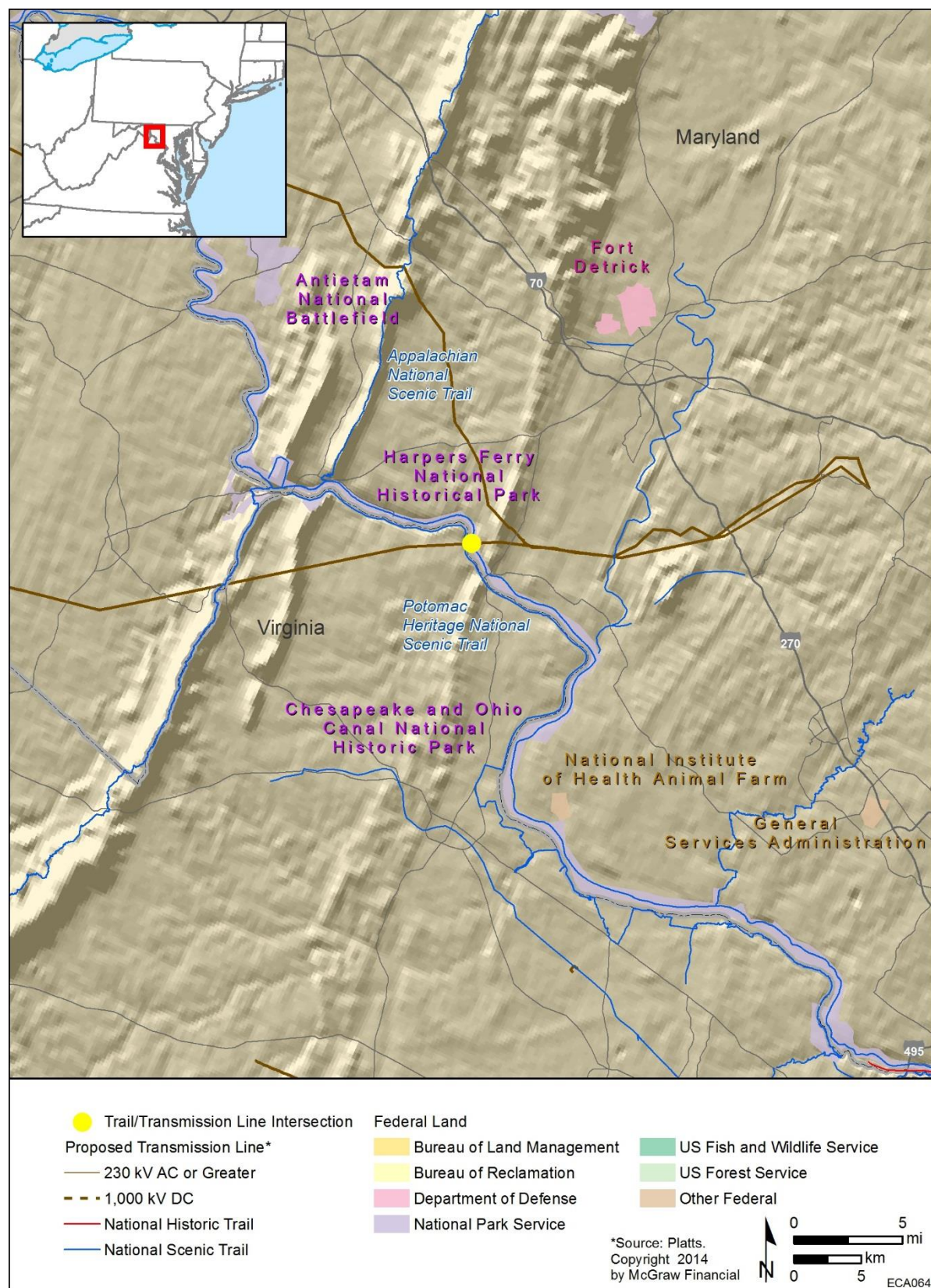




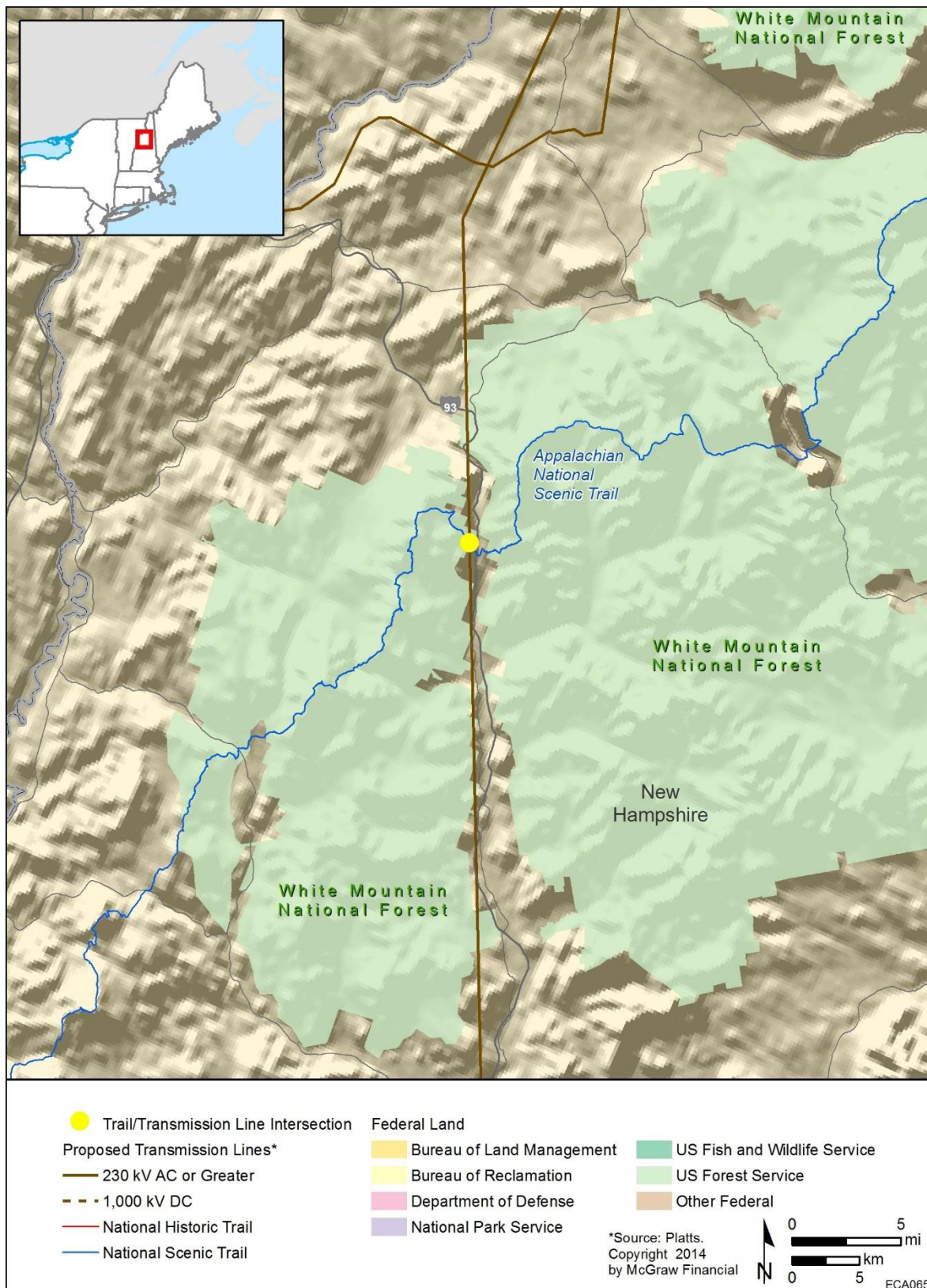
**Figure 5.9 Intersection of the Captain John Smith Chesapeake National Historic Trail by a Planned Electrical Transmission Line within Blackwater National Wildlife Refuge, in Maryland**



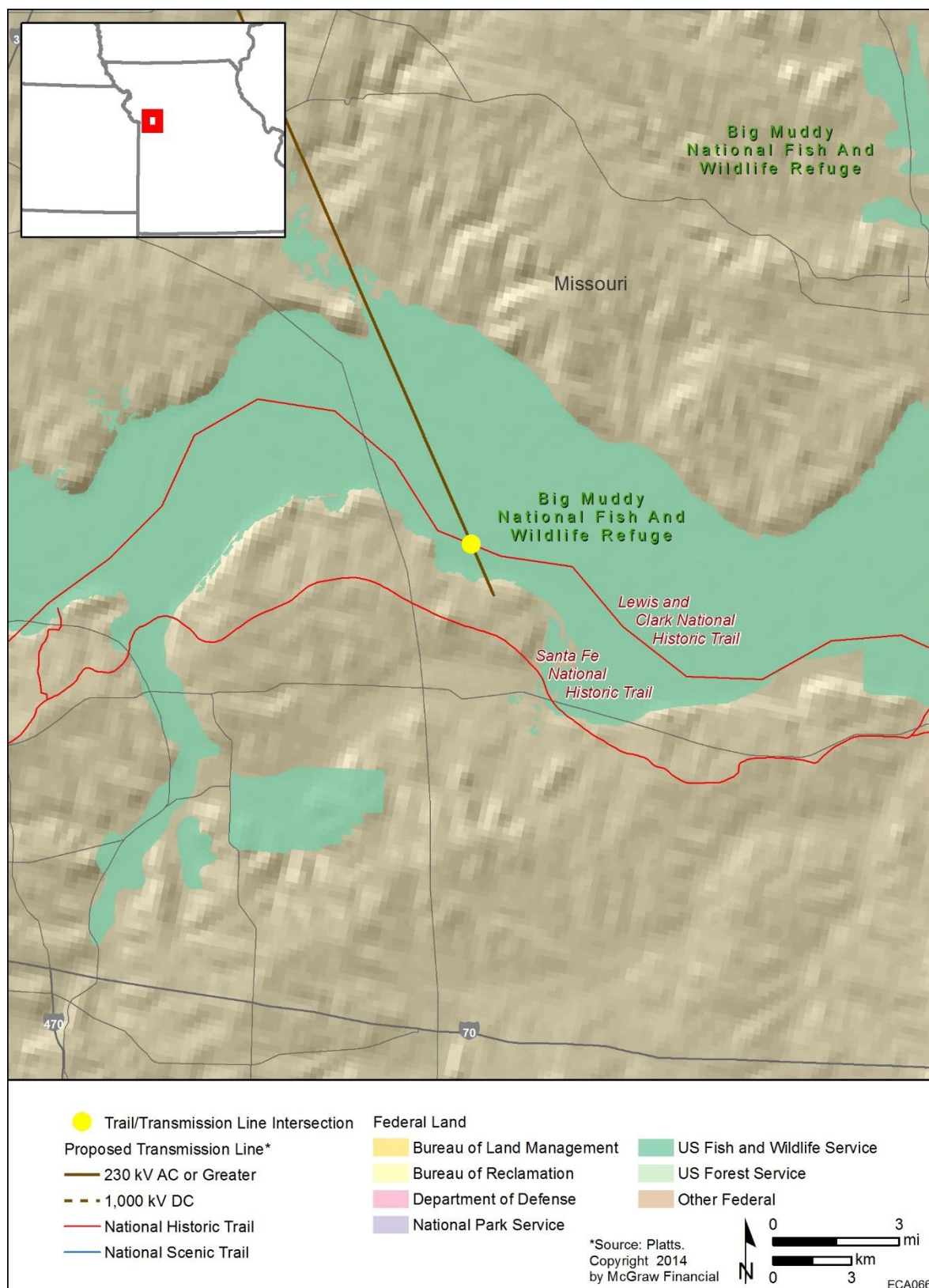
**Figure 5.10 Intersection of the Captain John Smith Chesapeake National Historic Trail by a Planned Electrical Transmission Line within Naval Station Solomons Complex, in Maryland**



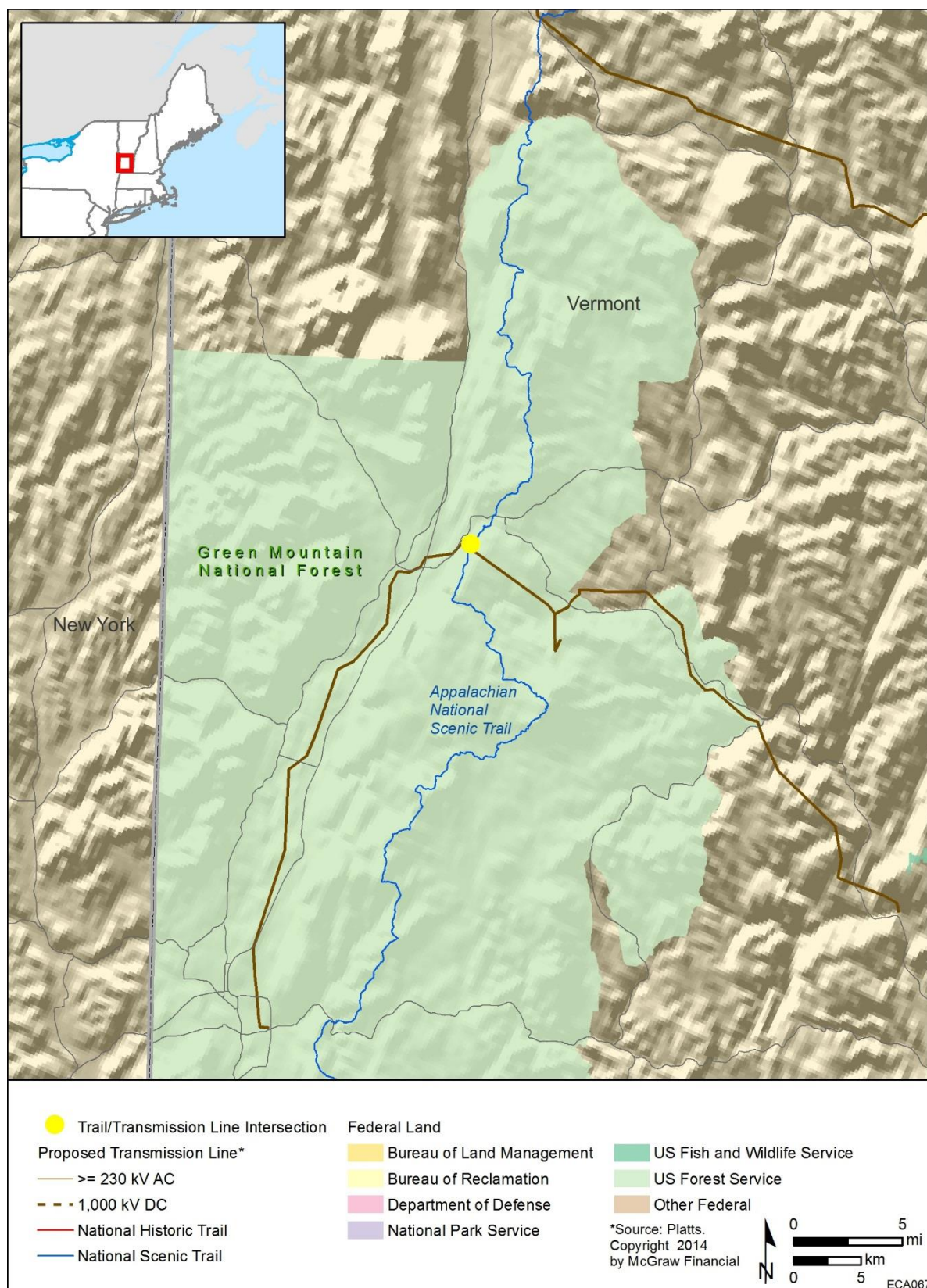
**Figure 5.11 Intersection of the Potomac Heritage National Scenic Trail by a Planned Electrical Transmission Line within Harper's Ferry National Historical Park, in Virginia and Maryland**



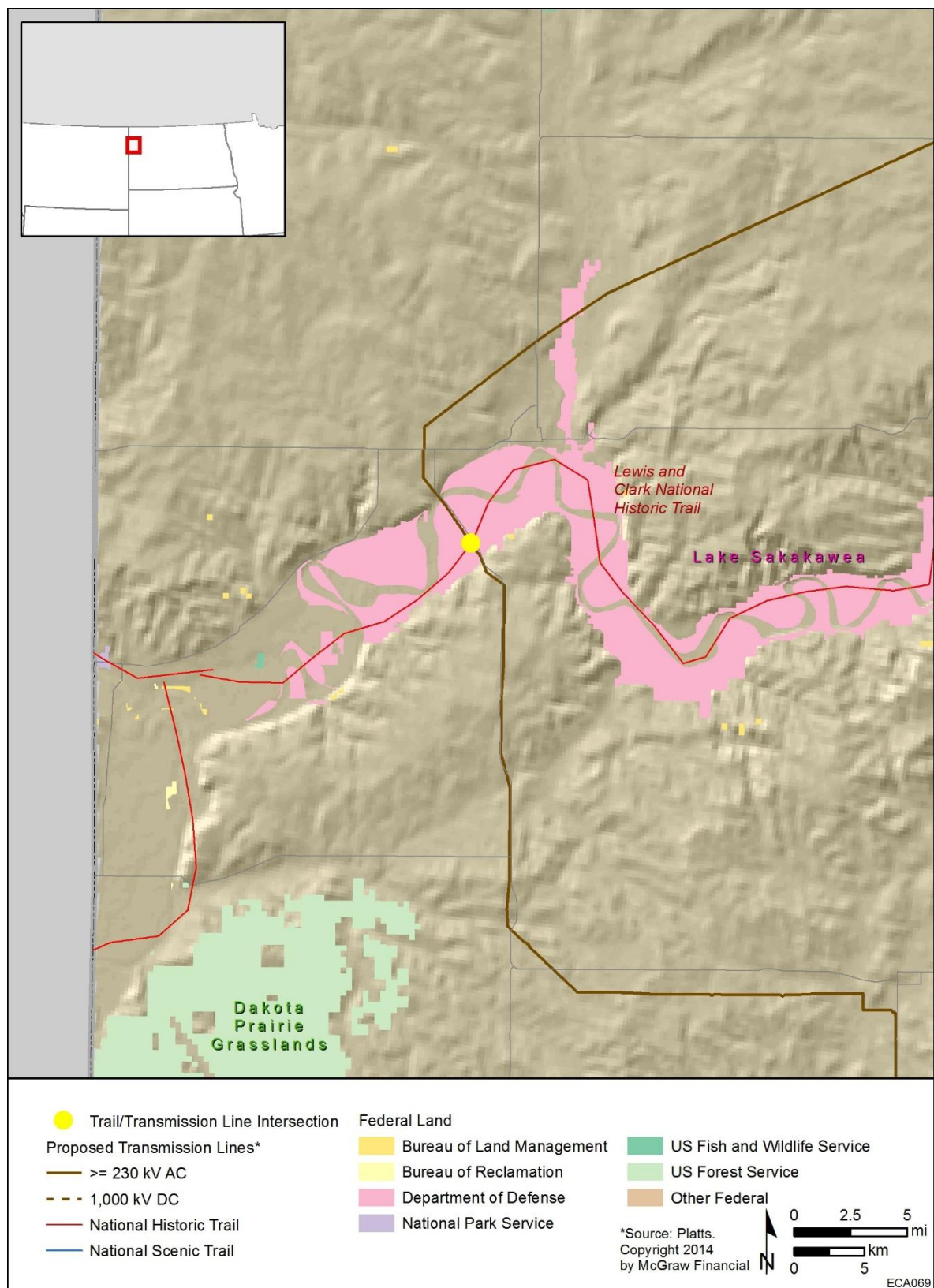
**Figure 5.12 Intersection of the Appalachian National Scenic Trail by a Planned Electrical Transmission Line within White Mountain National Forest, in New Hampshire**



**Figure 5.13 Intersection of the Lewis and Clark National Historic Trail by a Planned Electrical Transmission Line within the Big Muddy National Wildlife Refuge, in Missouri**



**Figure 5.14 Intersection of the Appalachian National Scenic Trail by a Planned Electrical Transmission Line within Green Mountain National Forest, in Vermont**



**Figure 5.15 Intersection of the Lewis and Clark National Historic Trail by a Planned Electrical Transmission Line within Lake Sakakawea, in North Dakota**



**Figure 5.16 Intersection of the Lewis and Clark National Historic Trail by a Planned Electrical Transmission Line within Big Muddy National Fish and Wildlife Refuge, in Missouri**

**Table 5.7 National Trails, with Number of Crossings, and Length (mi) of Nearby Planned and Existing Electric Transmission Lines with at Least 230-kV Capacity, by State**

Trail Name	State	Existing Electric Transmission Lines with at Least 230-kV Capacity					
		Existing			Planned <sup>a</sup>		
		Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance
Ala Kahakai NHT	Hawaii	0	0	0	0	0	0
Appalachian NHT	Connecticut	1	3	14	0	0	0
	Maryland	5	58	117	1	7	22
	Massachusetts	1	7	18	0	0	0
	New Hampshire	4 (4)	35	84	1 (1)	8	23
	New Jersey	2 (2)	33	68	2 (2)	11	25
	New York	7	58	225	1	10	31
	North Carolina	3 (3)	12	40	0	0	0
	Pennsylvania	15 (1)	121	531	0	1	12
	Tennessee	0	5	15	0	0	0
	Vermont	3 (1)	19	54	2 (1)	18	66
	Virginia	15 (6)	90	315	4	19	71
	West Virginia	0	8	19	1	3	9
Total		56 (17)	450	1,500	12 (4)	77	259
California NHT	Iowa	0	0	5	0	0	1
	Kansas	9	89	232	2	17	35
	Missouri	0	5	62	0	0	0
	Nebraska	72	567	1,085	0	0	2
Total		81	660	1,384	2	17	38
Captain John Smith Chesapeake NHT	Delaware	0	4	58	0	0	8
	District of Columbia	1	7	14	0	0	5
	Maryland	1	151	606	2 (2)	48	153
	Pennsylvania	5	63	166	0	0	0
	Virginia	18	320	1,338	2	23	77
Total		25	546	2,182	4 (2)	71	243
El Camino Real De Los Tejas NHT	Louisiana	4	25	57	0	0	0
	Texas	91	473	1,213	19	97	263
Total		95	499	1,270	19	97	263

**Table 5.7 (Cont.)**

		Existing Electric Transmission Lines with at Least 230-kV Capacity					
		Existing			Planned <sup>a</sup>		
Trail Name	State	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance
Florida NHT	Florida	114 (10)	807	1,968	6	52	153
Iditarod NHT	Alaska	7	30	50	0	0	0
Ice Age NHT	Minnesota	0	3	8	0	0	0
	Wisconsin	2	48	282	6	59	162
Total		2	51	289	6	59	162
Lewis and Clark NHT	Illinois	4	45	73	0	0	0
	Iowa	3	22	98	0	5	15
	Kansas	0	3	15	0	0	0
	Missouri	21 (15)	200	570	3 (2)	30	109
	Nebraska	0	98	279	1	2	2
	North Dakota	23 (2)	166	620	2 (1)	18	61
	South Dakota	14	95	618	0	0	30
Total		63 (17)	630	2,273	6 (3)	55	216
Mormon Pioneer NHT	Illinois	0	0	0	0	0	2
	Iowa	8	73	148	11	83	222
	Missouri	0	0	9	0	0	1
	Nebraska	18	160	517	0	0	0
Total		26	234	674	11	83	225
Natchez Trace NHT	Alabama	0	0	3	0	0	0
	Mississippi	17	199	427	0	0	4
	Tennessee	3	31	76	0	0	0
Total		20	230	506	0	0	4
New England NHT	Connecticut	21	142	214	5	28	37
	Massachusetts	14	40	77	0	4	23
	New Hampshire	0	0	26	0	0	0
	Vermont	0	0	2	0	1	0
Total		35	182	320	5	33	60

**Table 5.7 (Cont.)**

		Existing Electric Transmission Lines with at Least 230-kV Capacity					
		Existing			Planned <sup>a</sup>		
Trail Name	State	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance
North Country NHT	Kentucky	0	0	24	0	0	0
	Michigan	30	97	431	0	0	0
	Minnesota	28	110	300	6	25	75
	New York	28	114	296	2	7	17
	North Dakota	19 (3)	102	392	0	0	10
	Ohio	153 (10)	528	1,336	5	42	59
	Pennsylvania	53 (3)	85	208	0	0	0
	West Virginia	0	0	30	0	0	0
	Wisconsin	3	10	46	0	0	0
	Vermont	0	0	0	0	0	2
Total		314 (16)	1,045	3,063	13	74	163
Oregon NHT	Kansas	7	88	232	2	17	35
	Missouri	0	5	20	0	0	0
	Nebraska	14	189	473	0	0	<1
Total		21	283	725	2	17	35
Overmountain Victory NHT	North Carolina	4	38	107	0	0	0
	South Carolina	3	25	58	0	0	0
	Tennessee	2	20	31	0	0	0
	Virginia	1	11	16	0	0	0
Total		10	93	213	0	0	0
Pony Express NHT	Missouri	0	0	31	0	0	0
	Nebraska	16	272	576	0	0	0
Total		16	272	607	0	0	0
Potomac Heritage NHT	District of Columbia	10	14	14	0	5	5
	Maryland	60 (5)	449	1,031	8 (1)	67	119
	Pennsylvania	24	154	470	1	8	13
	Virginia	257 (15)	474	788	17	93	190
	West Virginia	2	22	100	4	22	89
Total		353 (20)	1,113	2,402	30 (1)	195	416

**Table 5.7 (Cont.)**

		Existing Electric Transmission Lines with at Least 230-kV Capacity					
		Existing			Planned <sup>a</sup>		
Trail Name	State	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance
Santa Fe NHT	Kansas	36	292	744	9	53	134
	Missouri	6	69	222	1	9	26
Total		42	361	966	10	61	160
Selma to Montgomery NHT	Alabama	3	24	98	0	0	2
Star-Spangled Banner NHT	District of Columbia	4	13	14	4	5	5
	Maryland	39 (2)	284	804	9 (2)	58	112
	Virginia		29	192	0	4	13
Total		43 (2)	325	1,011	13 (2)	67	129
Trail of Tears NHT	Alabama	22 (4)	175	333	0	0	0
	Arkansas	25 (2)	141	395	27 (8)	137	286
	Georgia	57	261	530	0	0	12
	Illinois	2	39	80	0	0	0
	Kentucky	3	18	57	0	0	0
	Mississippi	0	20	120	0	0	0
	Missouri	6 (2)	57	300	2	15	42
	North Carolina	1 (1)	6	12	0	0	0
	Oklahoma	2	24	61	1	9	13
	Tennessee	49 (7)	421	968	0	0	0
Total		167 (16)	1,162	2,857	30 (8)	161	352

**Table 5.7 (Cont.)**

		Existing Electric Transmission Lines with at Least 230-kV Capacity					
		Existing			Planned <sup>a</sup>		
Trail Name	State	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance	Number of Crossings <sup>b</sup>	Length within 2.5-mile Distance	Length within 7.5-mile Distance
Washington-Rochambeau Revolutionary Route NHT	Connecticut	6	58	171	1	7	40
	Delaware	6	73	112	0	0	0
	District of Columbia	0	2	14	0	0	5
	Maryland	13	115	312	1	3	26
	Massachusetts	12	88	239	1	10	40
	New Jersey	30	226	736	6	61	147
	New York	30	118	208	1	16	60
	Pennsylvania	17	114	198	0	0	0
	Rhode Island	3	17	44	1	6	17
	Virginia	25 (3)	193	536	3	11	61
Total		142 (3)	1,004	2,569	14	115	395
Grand Total		1,637 (101)	9,999	26,927	184 (20)	1,234	3,277

<sup>a</sup> Number of crossings and lengths provided in the planned columns are approximate due to uncertainty in the locations of most planned transmission lines in the source data. See Sections 4.2 and 5.2, and Table 5.4, for more details.

<sup>b</sup> Number of crossings on federal land are indicated in parentheses.

**Table 5.8 National Trails with Total Computed Length, Number of Crossings of Existing and Planned Electrical Transmission Lines of 230-kV or Greater, and National Trail Miles per Crossing**

Trail Name	Trail Length (mi)	Existing		Planned <sup>a</sup>	
		Number of Crossings <sup>b</sup>	Trail Miles per Crossing	Number of Crossings <sup>b</sup>	Trail Miles per Crossing
Ala Kahakai NHT	180	0	N/A	0	N/A
Appalachian NST	2107	56 (17)	38	13 (4)	162
California NHT	2104	81	26	2	1,052
Captain John Smith Chesapeake NHT	2313	25	93	4 (2)	578
El Camino Real De Los Tejas NHT	2517	95	26	19	132
El Camino Real De Tierra Adentro NHT	29	0	0	0	0
Florida NST	1781	114 (10)	16	6	297
Ice Age NST	546	2	273	6	91
Iditarod NHT	2710	7	387	0	N/A
Lewis and Clark NHT	1540	65 (17)	24	6 (3)	257
Mormon Pioneer NHT	832	26	32	11	76
Natchez Trace NST	462	20	23	0	N/A
New England NST	189	35	5	5	38
North Country NST	8587	314 (16)	27	13	661
Oregon NHT	635	21	30	2	318
Overmountain Victory NHT	324	10	32	0	N/A
Pony Express NHT	570	16	36	0	N/A
Potomac Heritage NST	2369	353 (20)	7	30 (1)	79
Santa Fe NHT	1245	42	30	10	125
Selma to Montgomery NHT	51	3	17	0	N/A
Star-Spangled Banner NHT	576	43 (2)	13	13 (2)	44
Trail of Tears NHT	5040	167 (16)	30	30 (8)	168
Washington-Rochambeau Revolutionary Route NHT	808	142 (3)	6	14	58

<sup>a</sup> Values in the planned columns are approximate due to uncertainty in the locations of most planned transmission lines in the source data. See Sections 4.2 and 5.2, and Table 5.4, for more details.

<sup>b</sup> Number of crossings on federal land are indicated in parentheses.

## 6. Conclusions

To determine the “footprint” of the current network of National Historic and Scenic Trails and the electricity transmission system, a GIS database was populated with existing and proposed electricity transmission infrastructure, national trails, and other geospatial data needed for analysis. The extent and characteristics of both systems was first mapped, described, and tabulated. Section 3 introduces the National Trails System and its origin.

The extent to which national trails are affected by electrical transmission was then investigated, especially intersection points between the two systems. Background about scenic resources and visually sensitive areas was provided in Section 2, putting into perspective one of the most challenging planning areas when these systems intersect. In Table 5.10, the trails affected by 1,637 total existing high-voltage electrical transmission line intersections are listed, with 101 intersections on federally-administered land. Of the national trails and their extents in the Section 368(b) states, only the Ala Kahakai National Historic Trail in Hawaii lacked any intersections with high-voltage electrical transmission lines.

The third major goal of investigating the extent to which national trails and other sensitive land use types may be affected in the near future by planned transmission lines was investigated using data from Platts (2014). In Table 5.7, a total of 184 intersections are reported between proposed electrical transmission lines and national trails, involving nearly every national trail in the study area, and every region except Alaska and Hawaii. These intersections are depicted in the first series of maps in the Appendix B map atlas.

Twenty of the intersections between proposed electrical transmission lines and national trails occur on federally-administered land. These cases are highlighted in Figures 5.7 to 5.16 in addition to the Appendix B map atlas.

The analysis in this study helps bound the number, locations, and extent to which intersections between high-voltage electrical transmission lines and national trails occur, and identifies the additional data and issues that need to be addressed for a complete assessment. In the following section we propose a path forward for these issues, including concentrating on specific proposed transmission projects.

Pipelines were analyzed to a lesser degree in this study, but the maps of existing and proposed pipelines are provided in Section 5, and Appendix B depicts national trail intersections with proposed and existing pipelines. The intersections of existing and proposed pipelines were not tabulated, but it is clear from the maps that the Gulf Coast region, Texas, and some other areas have extensive pipeline systems and many intersections with national trails. Data for proposed pipelines in the Platts data were limited (see Figure 5.6) and may not fully represent the scope of future pipeline projects. The following section includes a recommendation of the next steps to addressing pipelines in connection to national trails.

Limits to the accuracy of the source data described in Section 4 need to be understood when interpreting the results, with some factors causing the total number of intersections to be less certain, and others only relating to the location and characteristics of the actual intersection. Particularly important is that most of the trails in the GIS data are depicted by continuous lines, while the actual trails are discontinuous in some cases, and the transmission line route may take advantage of a gap.

Federal land in the geographic extent of this study was gathered and included for this analysis for several reasons. First, it helps illustrate the significantly different characteristics of the regions addressed in EPLA Section 368(a) compared to Section 368(b). Second, although national trails are defined on both federally-administered and other areas, the federal approach to managing national trail intersections would have unique procedures in federally-administered areas, and also depend on the agency or agencies involved. For this reason, potential intersections on federally-administered areas were a specific focus in Section 5.3. Of the 184 intersections between proposed transmission lines and national trails in Table 5.10, 20 occurred on federal land areas. In some cases the intersections were coincidental because of the potential routes only being conceptual straight locations that happened to intersect the trail in a federally-administered area, but in nearly all of the 20 cases federally-administered land would be intersected by the proposed project even if the intersection location changed.

In the short timeframe of this phase of the study available data were used for analysis. As analysis continues and several key considerations about the data quality and sources need to be addressed:

- Available Platts data were used to identify planned high-voltage electrical transmission project locations; however only 7% of total length in the routes is estimated to be accurate to within 165 feet of the indicated location, and 77% of the total length is not verified to be within 1 mile. Platts data for proposed pipelines may be more incomplete. Future analysis should include seeking additional data sources and ways to improve locational accuracy.
- Limits to the accuracy of BLM Surface Management Agency data were observed. Future analysis should include more systematic investigation of data quality issues, and potentially using more local data or other data sources, especially for studies of particular project locations.

Refinements to GIS data depicting the national trails should continue, which would not only benefit this study, but also any other work for which national trail data are needed. One important refinement is determining where gaps in the trails exist.

## 7. Recommendations – A Path Forward

The current study primarily addresses a set of screening-level characterizations that provide insights into how the National Trail System may influence the siting of energy transport facilities in the states identified under Section 368(b) of the Energy Policy Act of 2005. As such, it initializes the primary environmental and energy data, and maps the contextual relationships between an important national environmental asset and how this asset intersects with energy planning activities. Thus the current study sets the stage for more in-depth analyses and data development activities that begin to solve key transmission siting constraints. Our recommendations for future work incorporate two major areas: (1) data base development and analytics and (2) modeling and scenario analysis for energy planning. These recommendations provide a path forward to address key issues originally developed under the Energy Policy Act of 2005 that are now being carried forward under the President's Climate Action Plan.

### Data Development and Analytics

- In the current study, natural gas, crude oil, and refined products pipelines were included in many of the maps, and intersections depicted, but a more in-depth analysis is needed to characterize and investigate pipeline siting issues as these are affected by sensitive environmental resources.
- A robust analysis of nationally-important scenic resources and visually sensitive areas, not captured under the national trails analysis, would provide a more complete and better quality assessment of how the visually-perceived landscape constrains energy infrastructure development.
- In the current study, data regarding high potential sites and segments of National Historic Trails were not considered. The cultural significance of these areas should be a component of future more robust analyses of the National Trail System in the context of energy transmission infrastructure. Impacts on these historic trail segments are not limited to visual effects; overall integrity of setting and presence of physical remains or features are considered in the classification of high potential trails segments.
- Besides scenic resource areas, there are a number of other federally-protected areas that are sensitive to impacts from energy transport facilities. For example, USFS roadless areas are protected from certain development actions but do not have a mandate for preserving visual resources. Including data and analyses of these other protected resources would provide a more robust analysis of energy infrastructure “pinch points” in the Section 368(b) states.
- In the Eastern Interconnection States’ Planning Council’s (EISPC) Energy Zones Study (Argonne 2013), the project team and stakeholders developed a composite map of habitat sensitivity that will readily provide screening-level analysis of habitat sensitivity in federal portions of planned electrical lines and pipelines. These areas are not necessarily within existing protected areas, but are needed when considering energy infrastructure siting issues.

## Modeling and Scenario Analysis

As outlined in the second phase of the trails study, Argonne, DOE, EISPC and other interested stakeholders will collaborate to develop and evaluate scenarios that could assist some key potential transmission projects to minimize impacts on national trails. It is necessary to undertake a modeling analysis that can derive a set of potential routes that can best mitigate impacts to trails and trail systems. Argonne will use the recently developed EISPC planning tool in combination with a set of routing algorithms to develop a set of alternative routes. Stakeholders will provide input to the models to evaluate sets of proposed routes in a collaborative manner. The expected outcomes are:

- 1) A process to bring stakeholders together to jointly develop alternative routing scenarios,
- 2) A set of data and associated models that allow collaborative analysis among stakeholders, and
- 3) Potential routing solutions on a small set of near-term electricity transmission projects that must address trail crossing issues.

This phase 2 project will analyze only a subset of the potential transmission projects that could affect national trails, so a more comprehensive analysis is proposed that will incorporate the lessons learned from the exploratory study. Further, the same techniques can be applied to minimize problems associated with pipeline crossings for national trails, and transmission lines and pipelines that must cross rivers that are boundaries between two states. Many states are partially bounded by rivers, and it frequently happens that adjacent states must negotiate to determine mutually acceptable crossing points for such facilities.

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## Appendix A: Supplemental Electronic Files

### A.1 Installing ArcReader and Navigating the Database

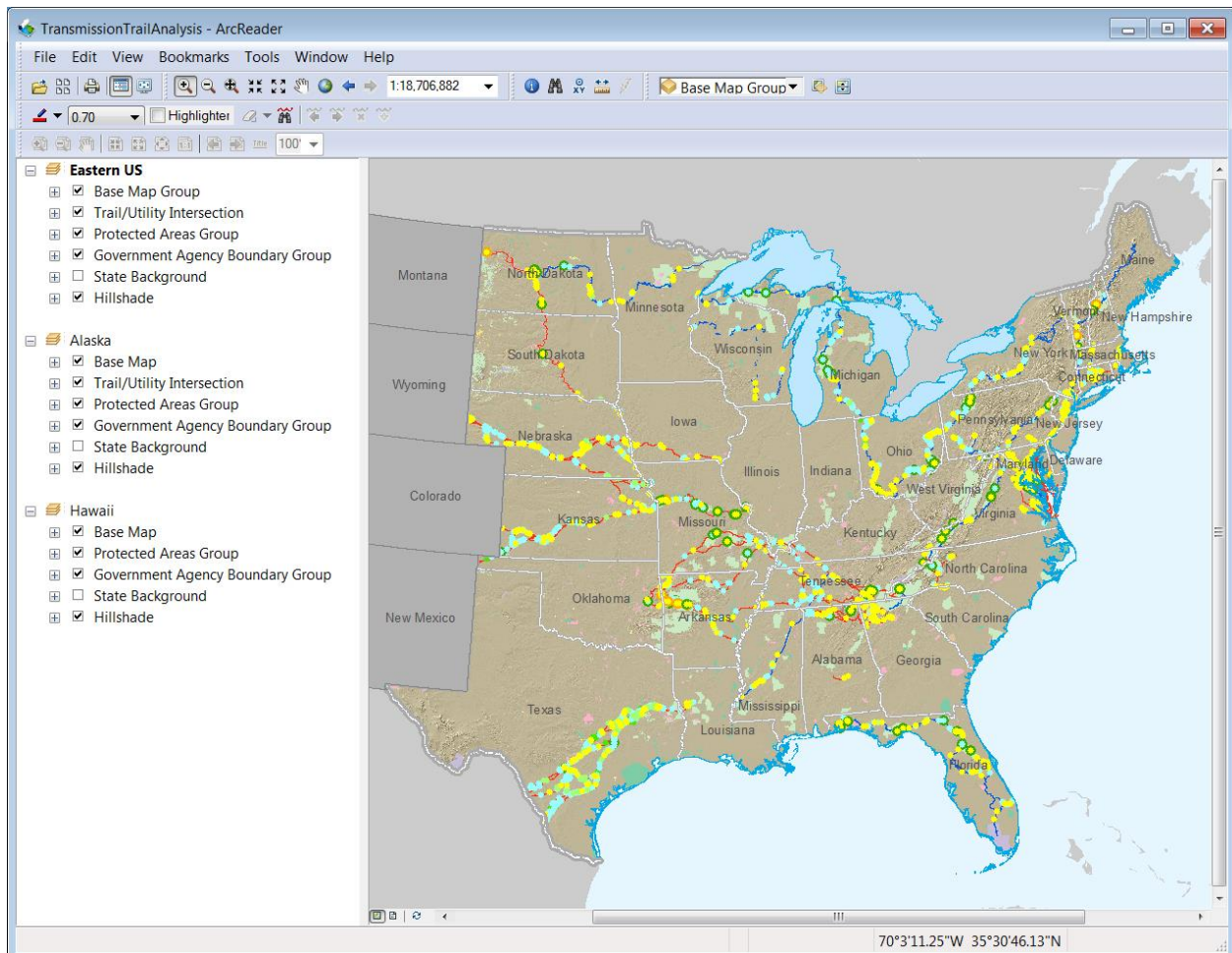
Environmental Systems Research Institute (ESRI) ArcReader 10.1, ArcGIS ArcView 10.1, or a more current version of either product is required to open the interactive map project files. ArcReader is a free application distributed by ESRI, and ArcView is a commercial product with more extensive capabilities. The instructions below assume ArcReader is the product in use. (When using ArcView, open the mxd files rather than the pmf files.) Because of the size and complexity of the database, ArcReader or ArcView may take a few minutes to open the interactive map project file on some computers.

- (1) Download ArcReader 10.1 (or a more current version) from <http://www.esri.com/software/arcgis/arcreader/download.html>.
- (2) Extract the contents of the downloaded zip file, run the ESRI.exe installation program with an administrator account, and install the software.
- (3) For better performance, copy the files to a local hard disk on your system.
- (4) Double-click on the TransmissionTrailAnalysis.pmf file to open the Atlas in ArcReader (or the TransmissionTrailAnalysis.mxd file if using ArcView). Figure A.1 shows a view of the default map content in ArcReader.
- (5) If you are not familiar with ArcReader, start by choosing the **Help → ArcReader Help** menu item for a guide on getting started with the software.

Below are some important considerations that will help improve your use of the electronic maps.

- Sometimes one map layer will obscure another layer of interest when both are displayed on the map. Layers in the map are drawn in reverse order of how they appear in the table of contents. In ArcView, drag a layer in the table of contents to a position higher than a layer obscuring it to make it draw above the ones listed after it. ArcReader does not provide this capability; however, the **Transparency** and **Swipe Layer** tools provide ways to view layers that might otherwise be obscured.
- Some layers have detailed information that require more time to display when the map is zoomed out. Scale dependency (a property where layers are only displayed at specified scale ranges) was avoided in ArcReader because the dependency cannot be changed by users. If a map display is taking too long to draw, press the **Escape (Esc)** key to stop the drawing process, then turn the layer off in the **Table of Contents**. Alternatively, **Zoom** the map into a smaller area.

- Most GIS layers include useful information beyond the information used to symbolize the map. The Surface Management Agency layer is symbolized by management agency; however, the tabular data for this layer also includes parcel names and types, such as “Death Valley” and “National Park,” respectively. In ArcReader, use the Information tool to access this information. In ArcView, right-click on a layer name in the **Table of Contents** and choose **Open Attribute Table**.
- The Online Basemap layer at the bottom of the table of contents is an Internet-based map service provided by ESRI. It requires an adequate Internet connection to work properly, and provides a high-quality base map at both general and detailed scales.



**Figure A.1 View of the Default Map Content in ArcReader Showing Surface Management Agency, National Trails, and Intersection Points with Existing Electrical Transmission Lines and Pipelines**

## A.2 Keyhole Markup Language File and Google Earth

Also provided is TransmissionTrailAnalysis.kml, a Google Earth KML file with national trails and intersection points with existing and proposed electrical transmission lines, and pipelines. Figure A.2 shows an example view of an existing transmission line intersection with a national trail.

Google Earth is a free software application displaying an interactive virtual globe. It can be downloaded from <http://www.google.com/earth/download/ge/agree.html>. Once installed, double-click on the TransmissionTrailAnalysis.kml to view the national trail and intersection point data used in this study.



**Figure A-2 Example 3D View from Google Earth Showing an Intersection Point Between a 230-kV Transmission Line and the Appalachian National Scenic Trail**





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## **Electricity Transmission, Pipelines, and National Trails**

An Analysis of Current and Potential Intersections on Federal Lands in the Eastern United States, Alaska, and Hawaii

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*Appendix B: Map Atlas*

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## **Electricity Transmission, Pipelines, and National Trails**

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### *Appendix B: Map Atlas*

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Office of Electricity Delivery and Energy Reliability, Washington, D.C.

March 25, 2014

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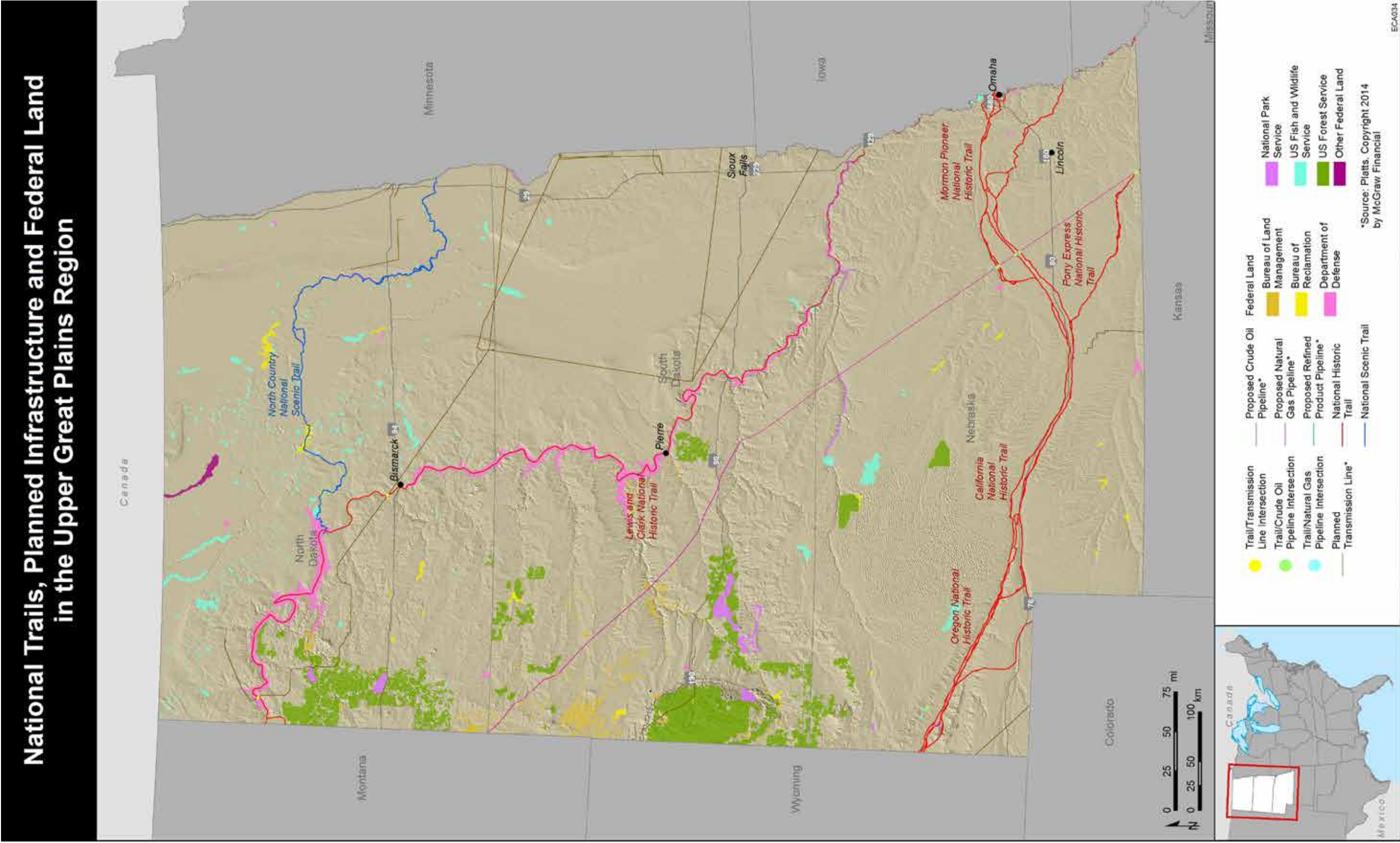


Figure B-1.1 Planned High-voltage Electrical Transmission Lines and Pipelines, National Trails, and Federal Land in the Upper Great Plains Region

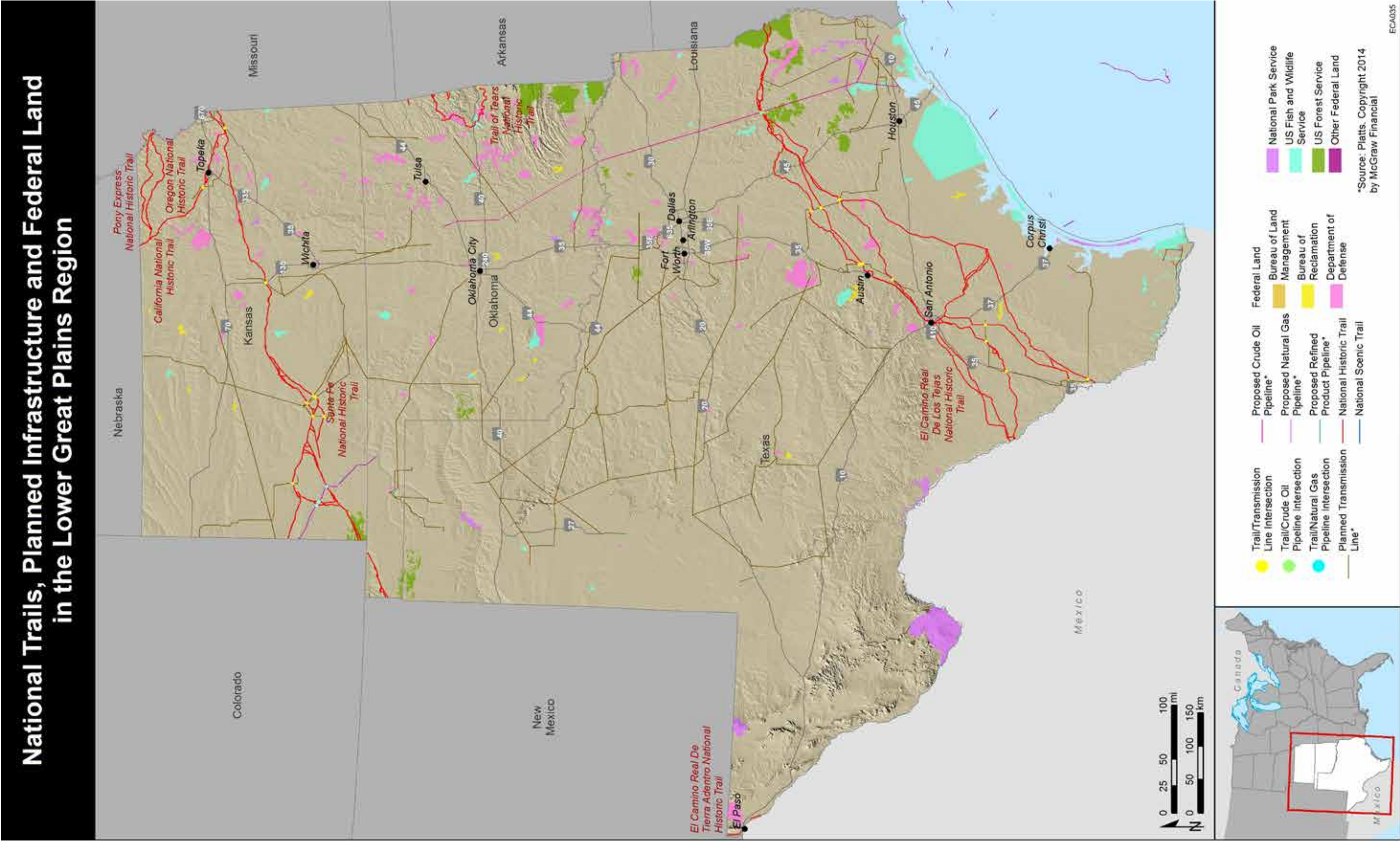


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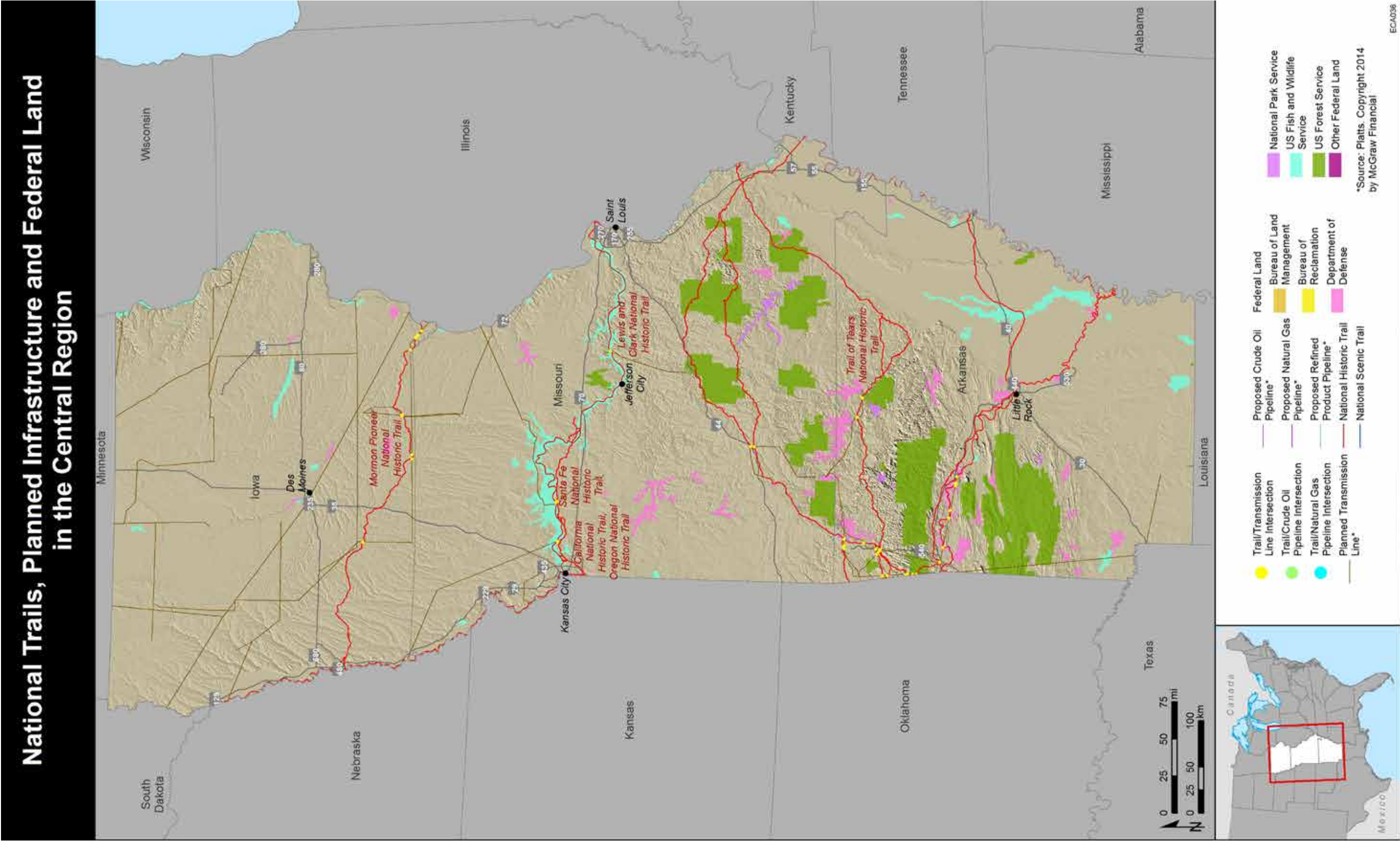


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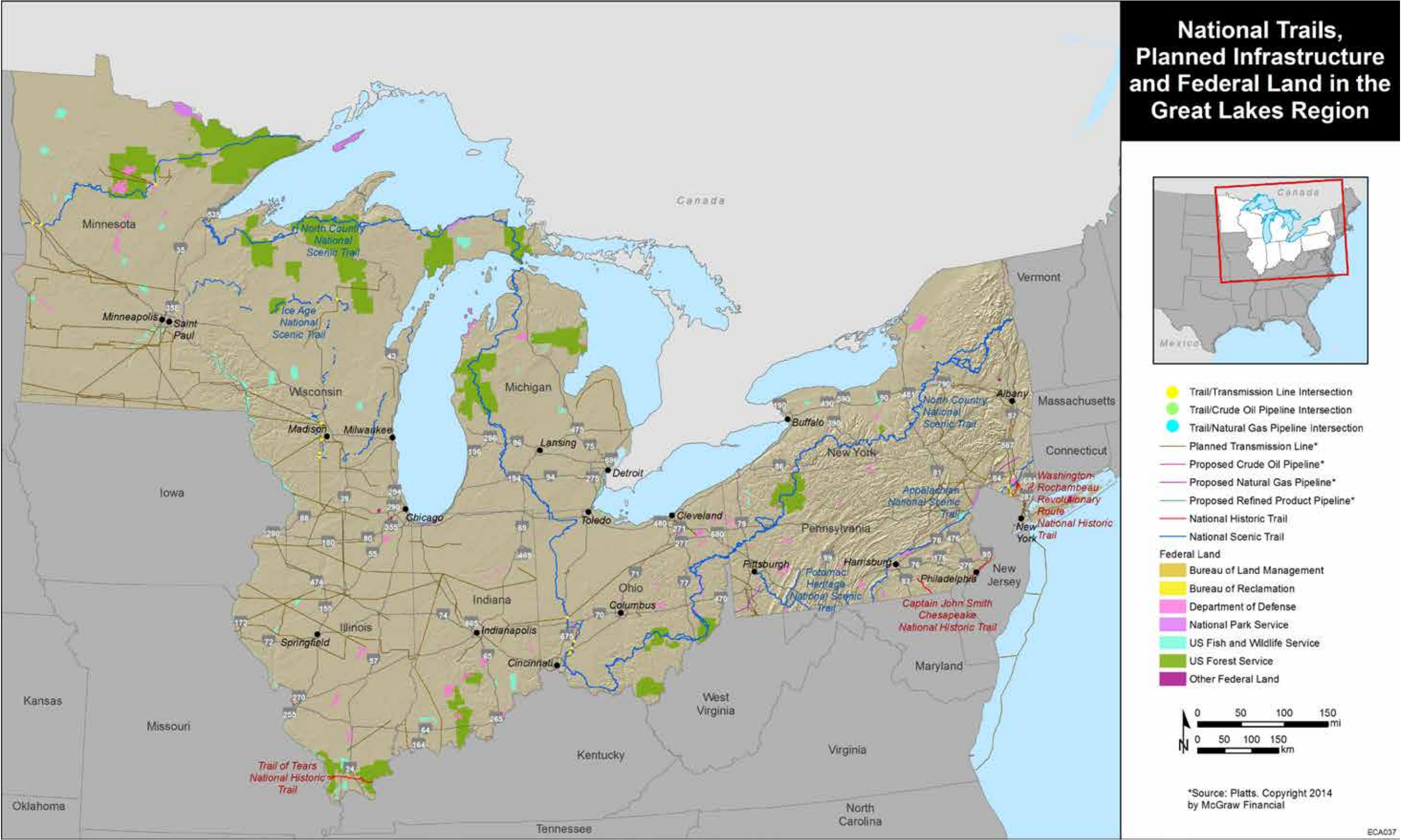


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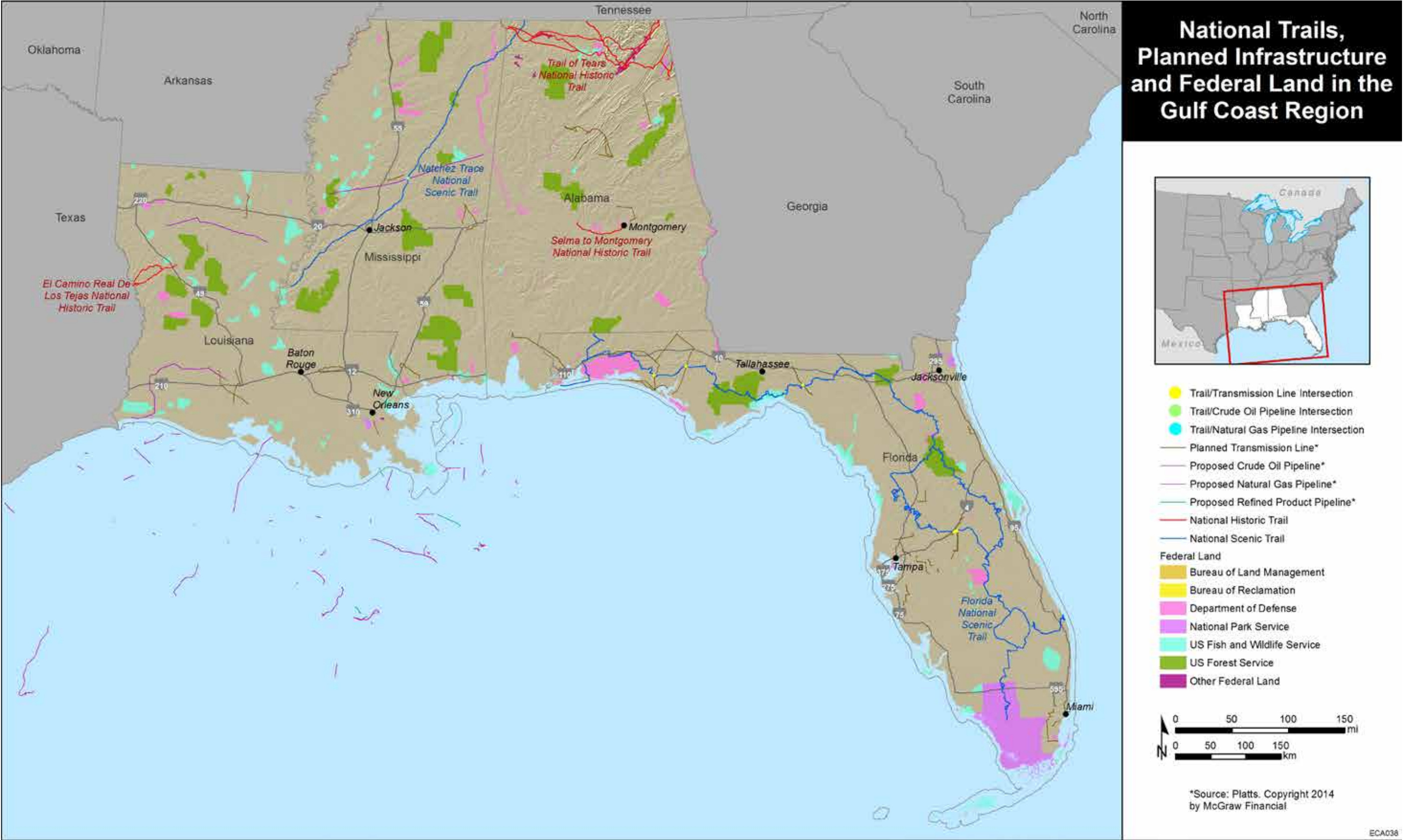


Figure B-1.5 Planned High-voltage Electrical Transmission Lines and Pipelines, National Trails, and Federal Land in the Gulf Coast Region

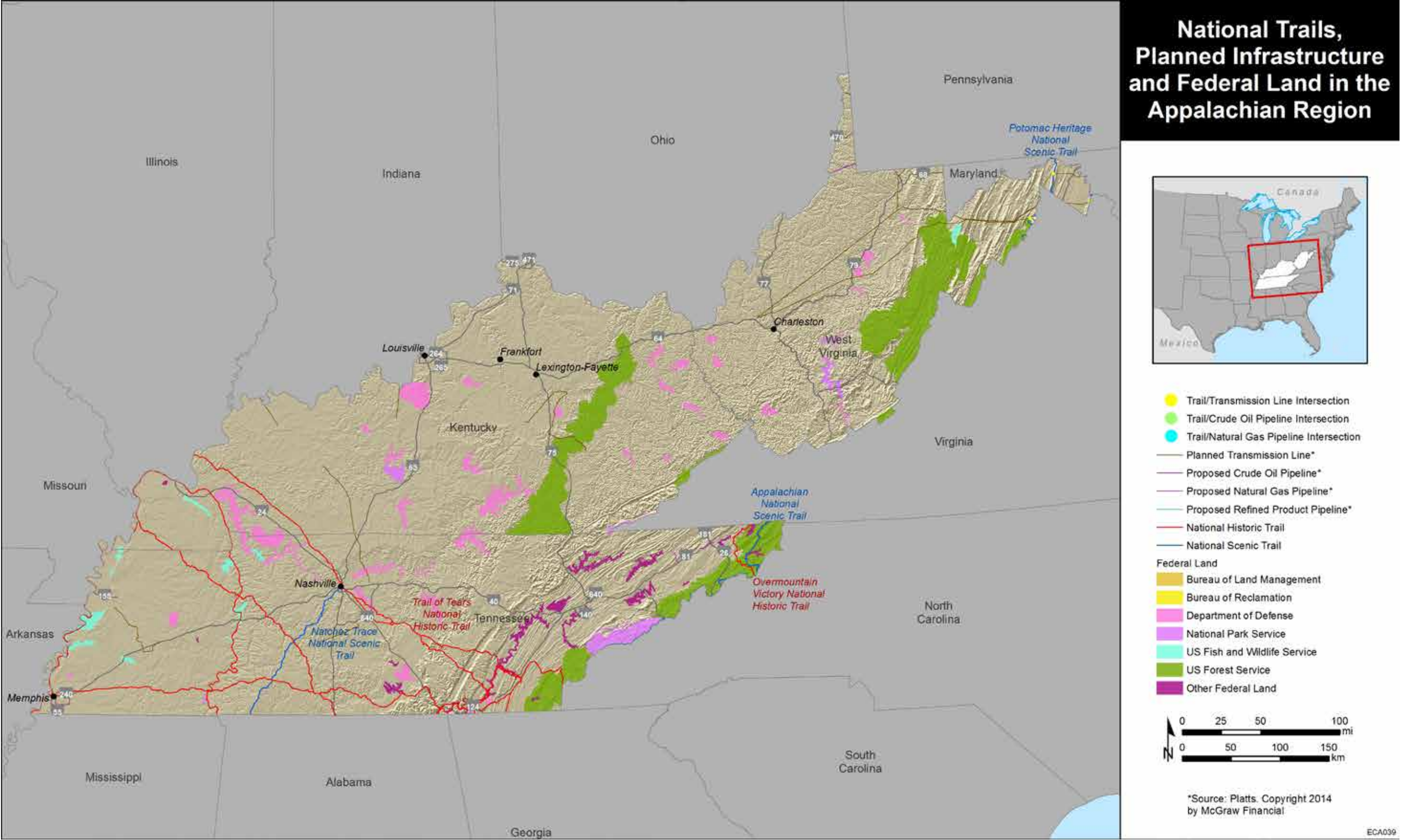


Figure B-1.6 Planned High-voltage Electrical Transmission Lines and Pipelines, National Trails, and Federal Land in the Appalachian Region

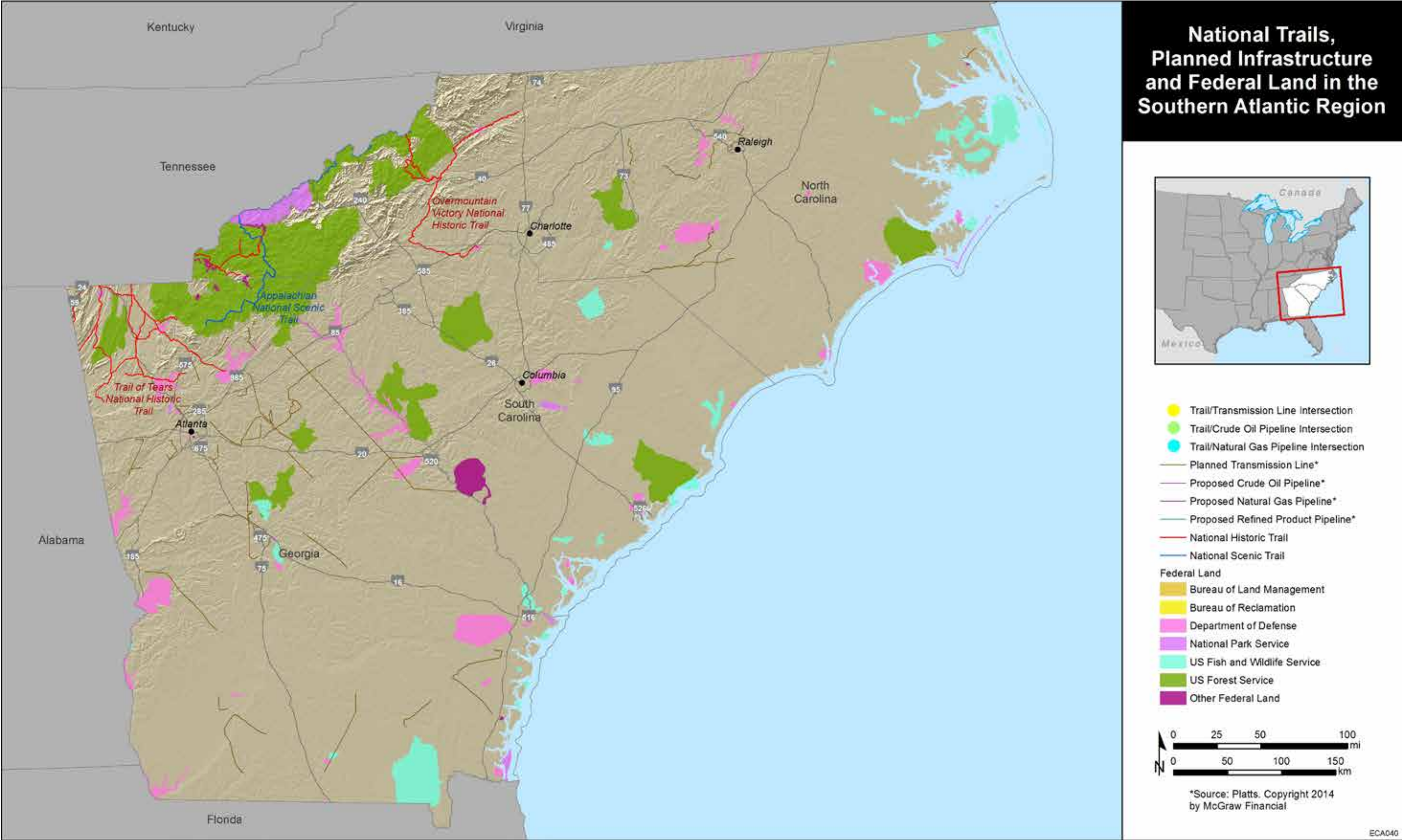


Figure B-1.7 Planned High-voltage Electrical Transmission Lines and Pipelines, National Trails, and Federal Land in the Southern Atlantic Region

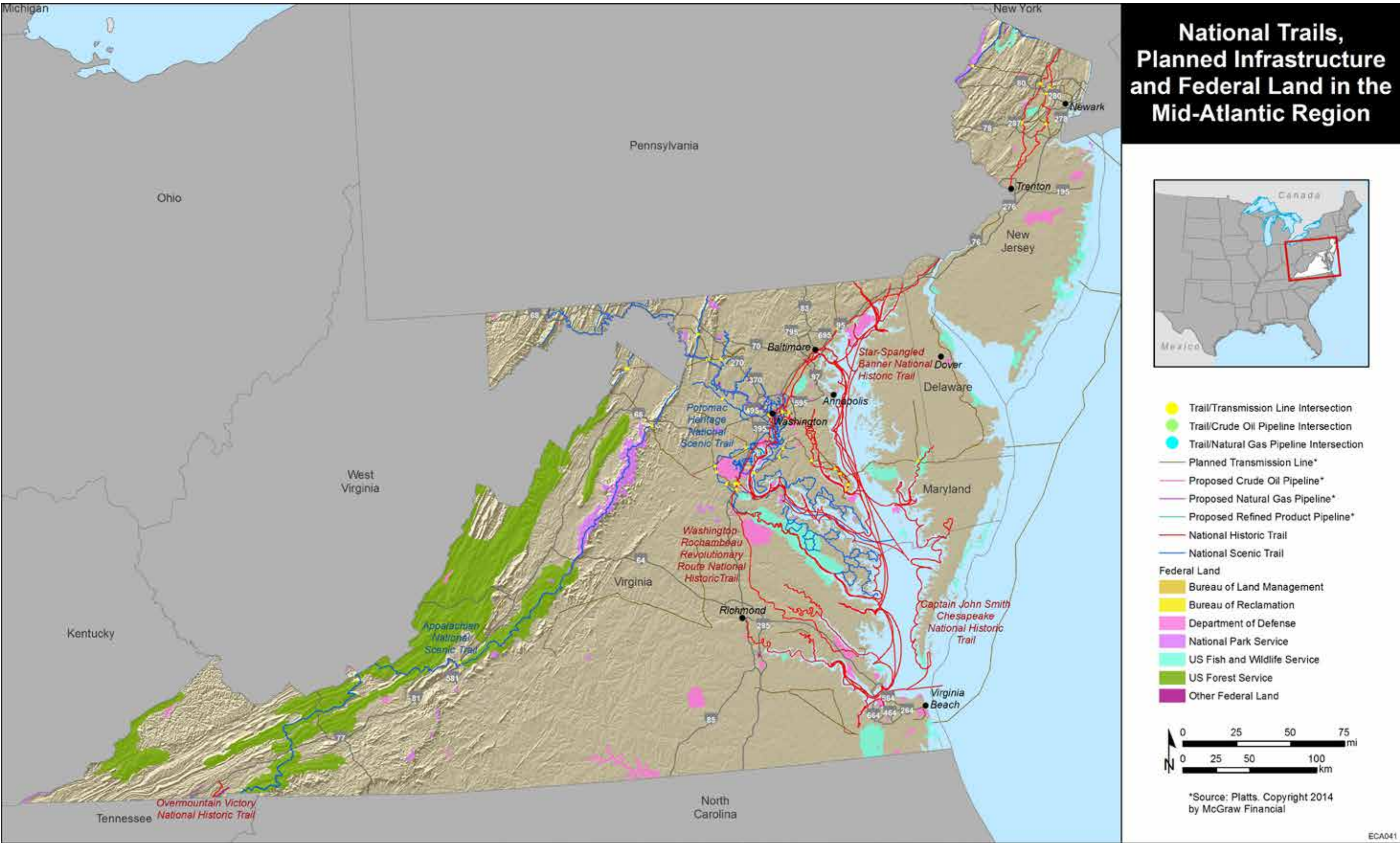


Figure B-1.8 Planned High-voltage Electrical Transmission Lines and Pipelines, National Trails, and Federal Land in the Mid-Atlantic Region

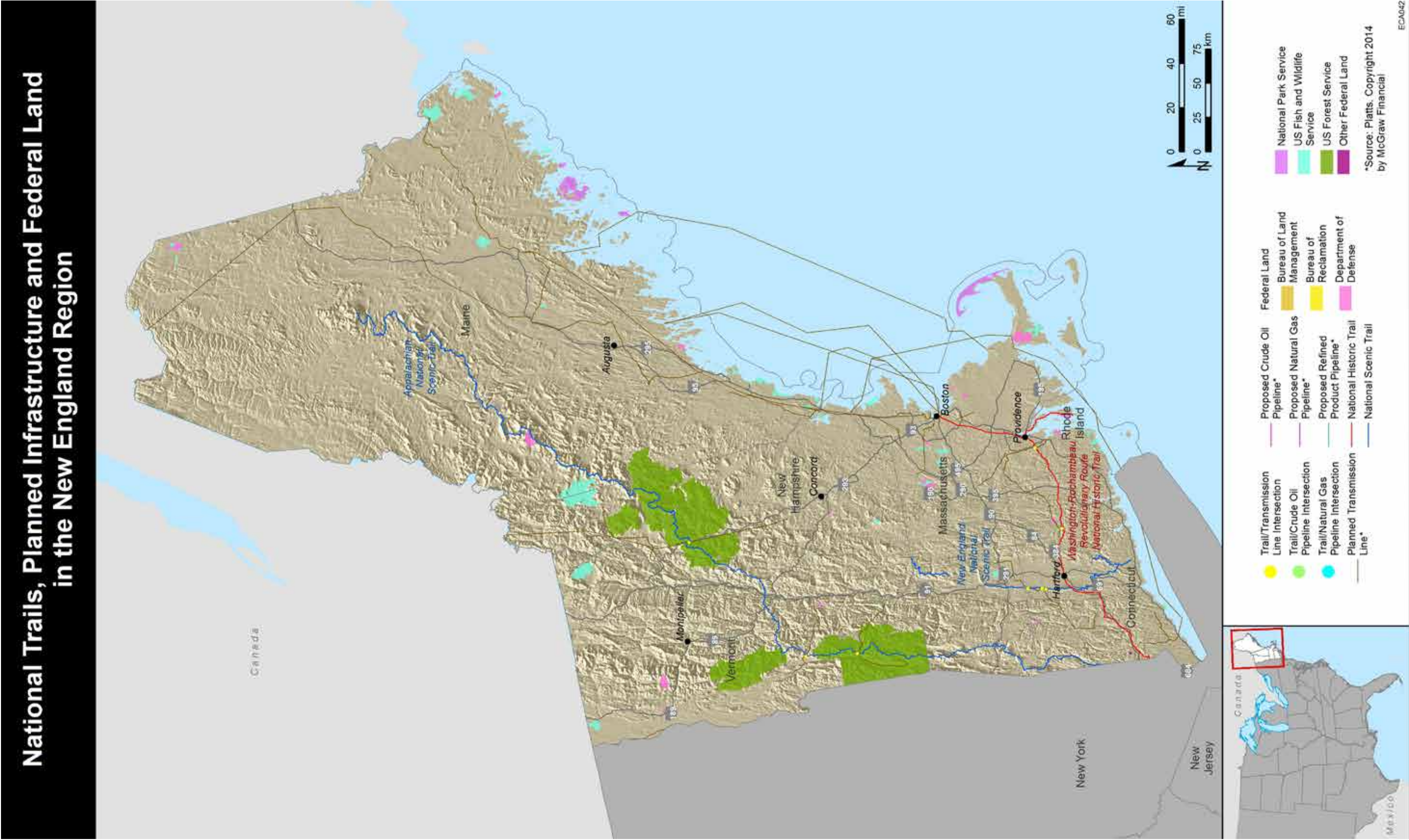


Figure B-1.9 Planned High-voltage Electrical Transmission Lines and Pipelines, National Trails, and Federal Land in the New-England Region

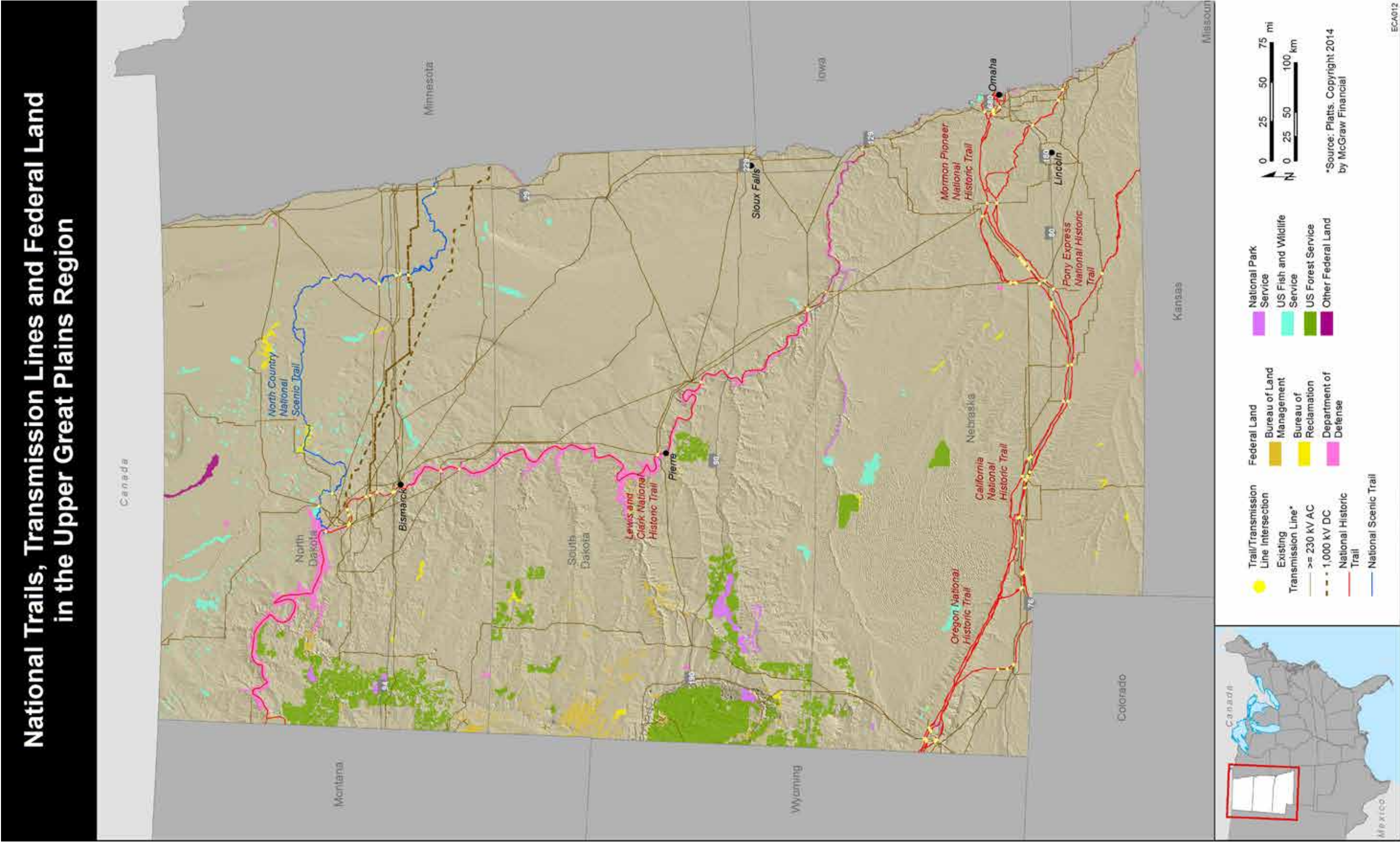


Figure B-2.1 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the Upper Great Plains Region

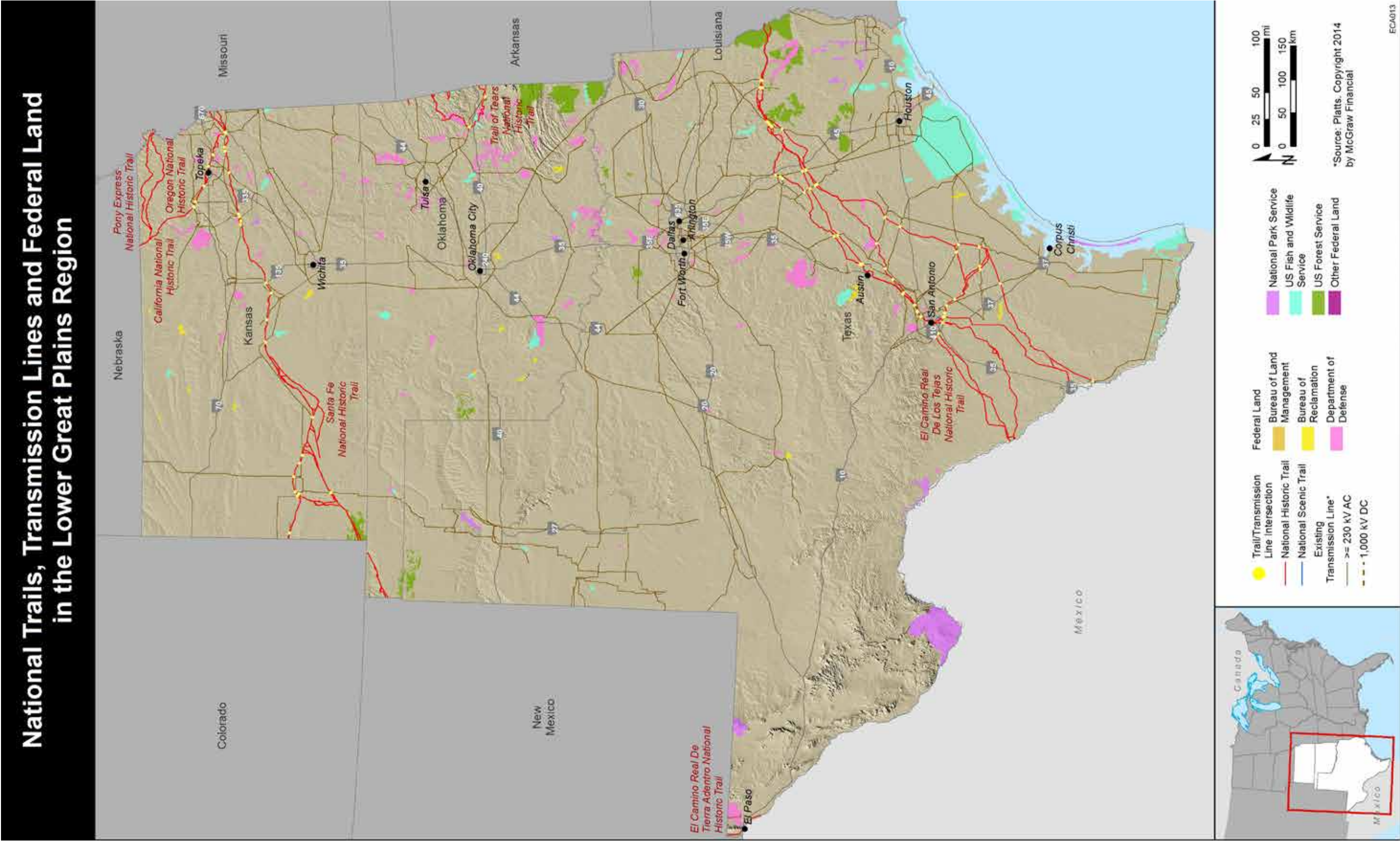


Figure B-2.2 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the Lower Great Plains Region

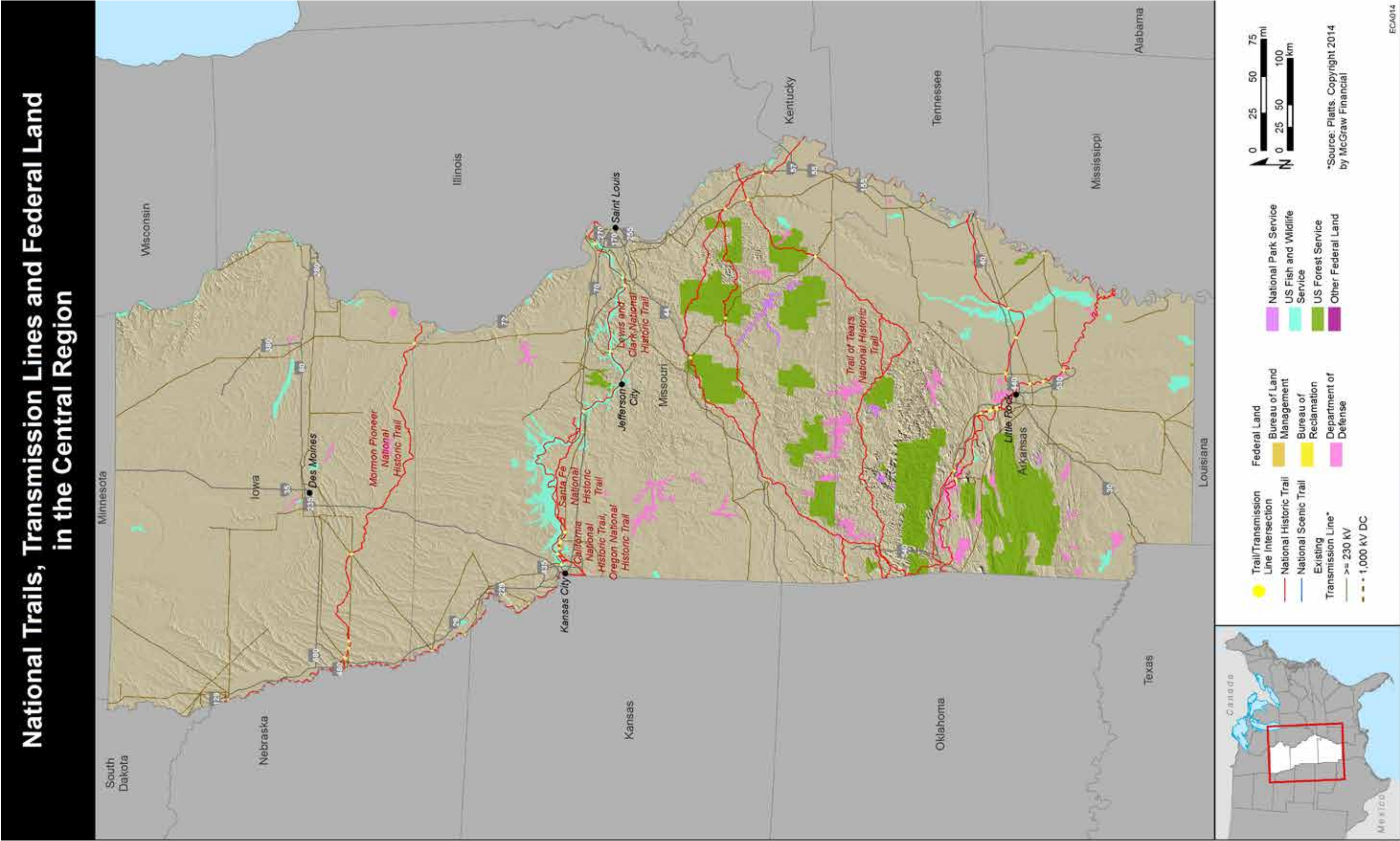


Figure B-2.3 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the Central Region

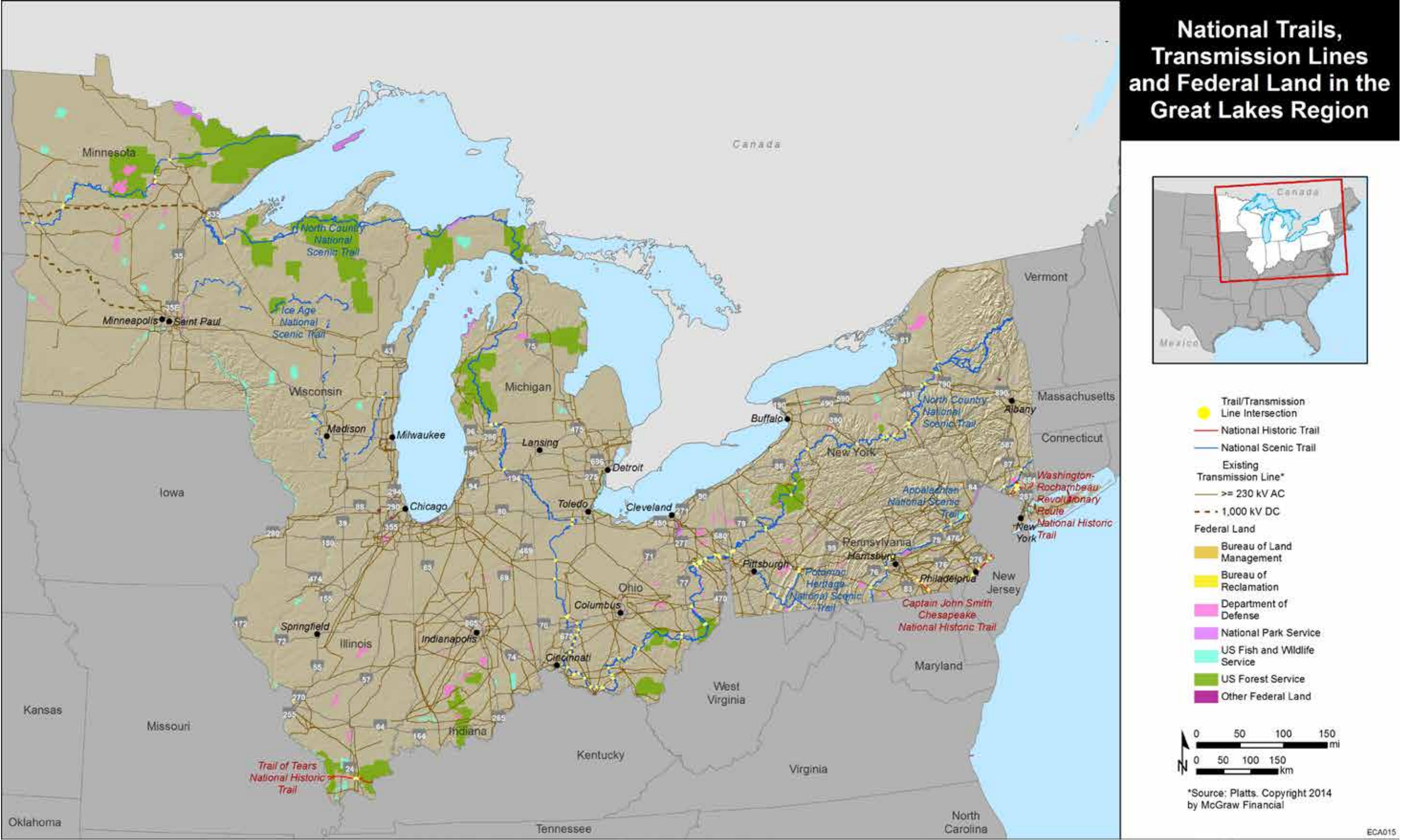


Figure B-2.4 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the Great Lakes Region

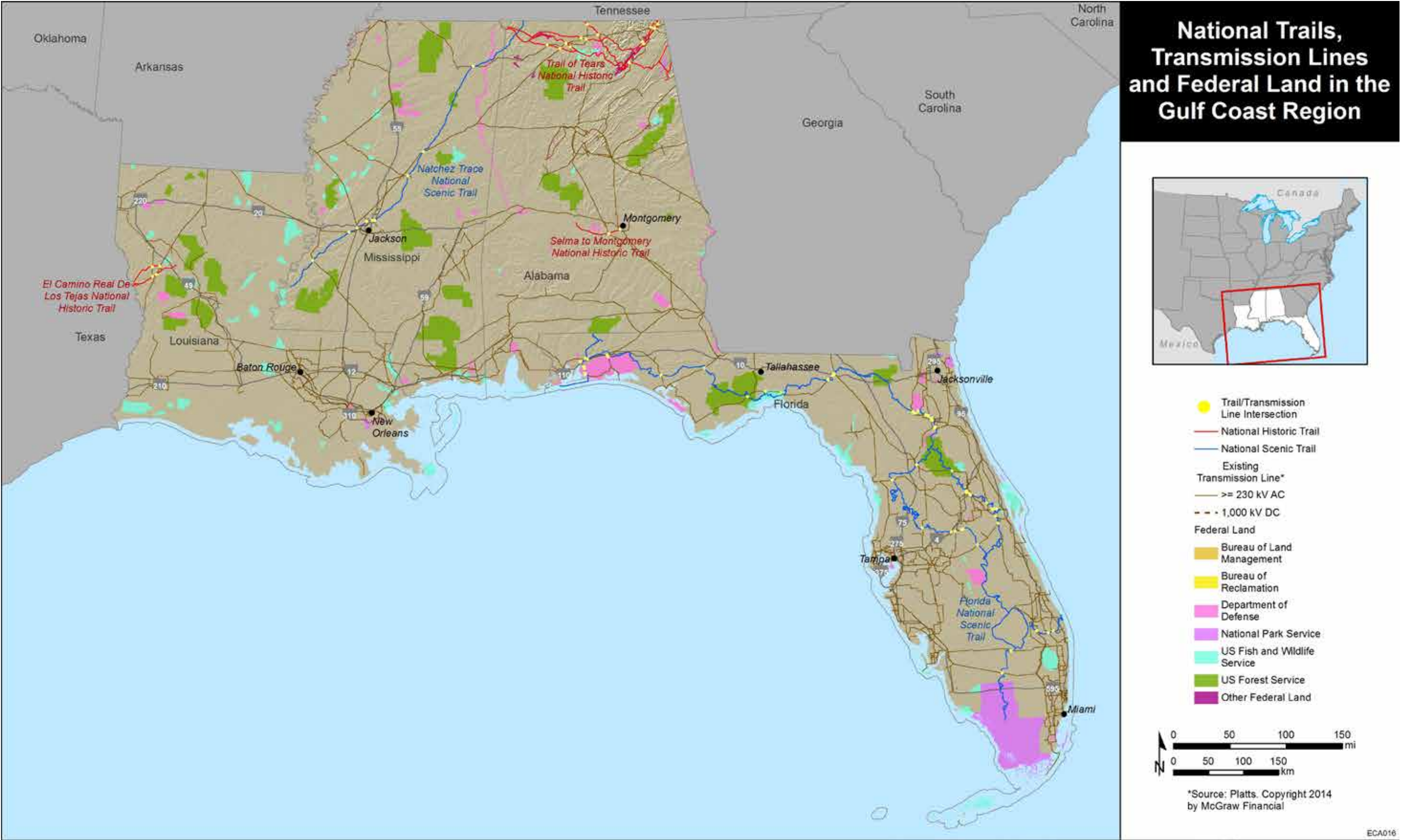


Figure B-2.5 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the Gulf Coast Region

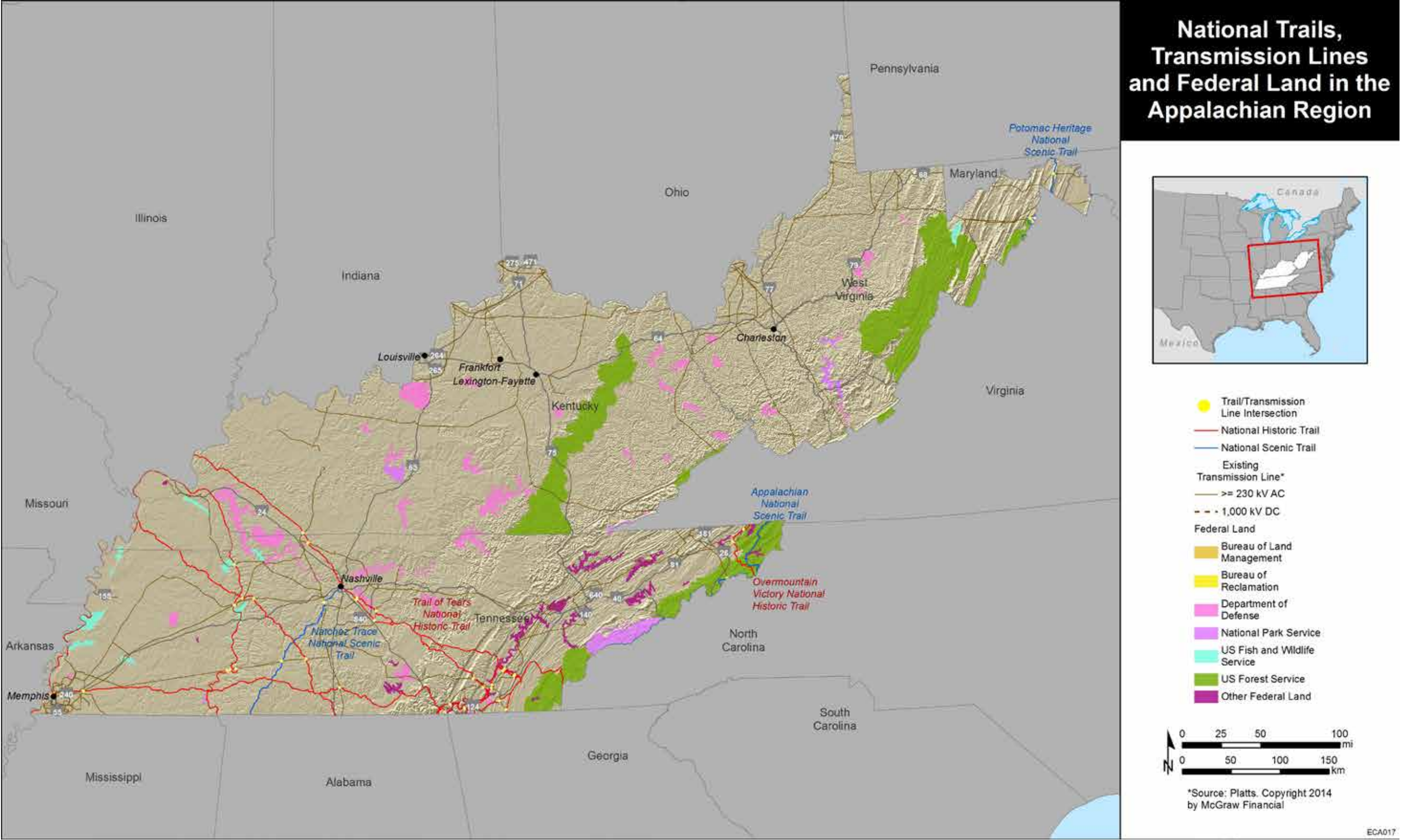


Figure B-2.6 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the Appalachian Region

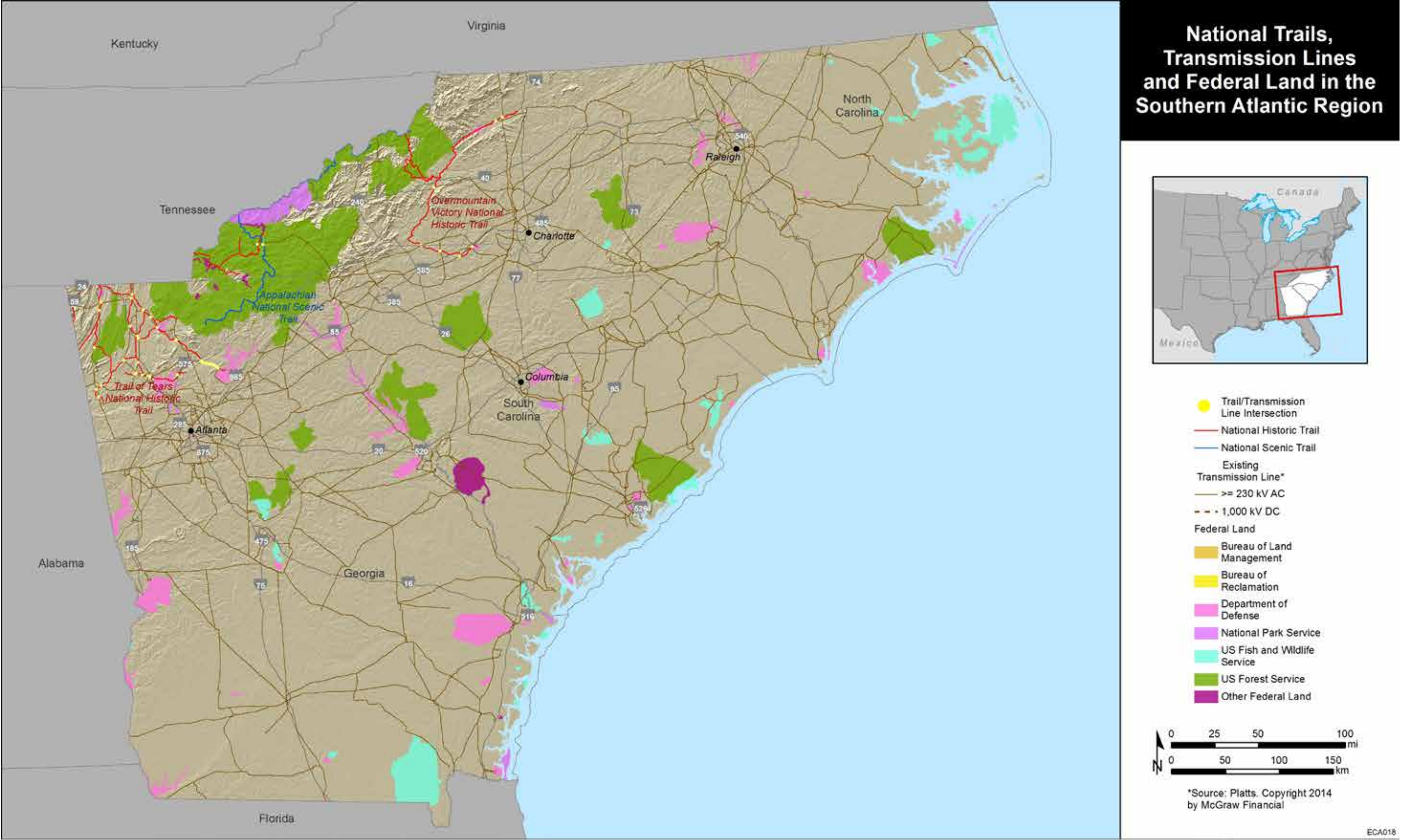


Figure B-2.7 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the Southern Atlantic Region

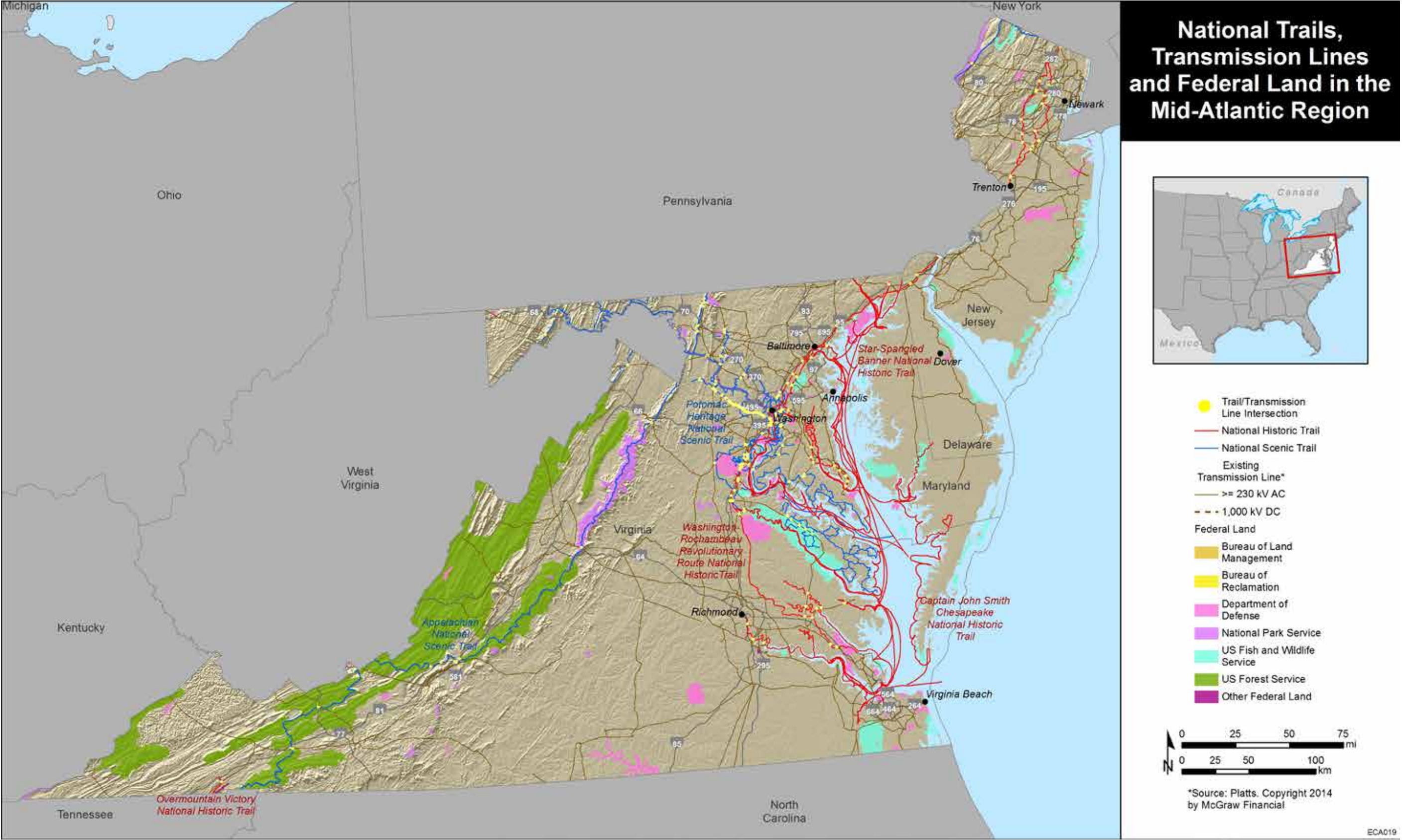


Figure B-2.8 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the Mid-Atlantic Region

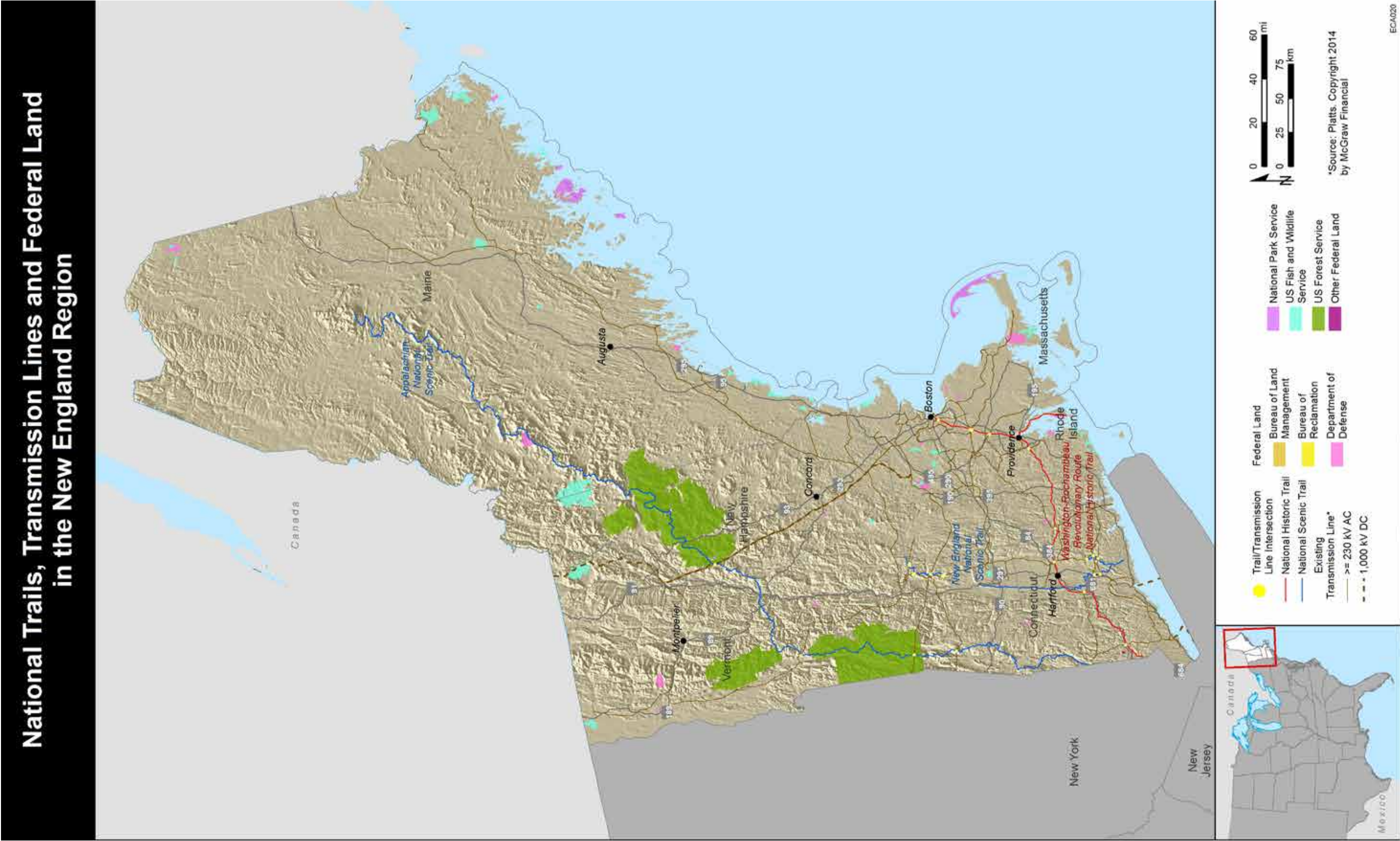


Figure B-2.9 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in the New-England Region

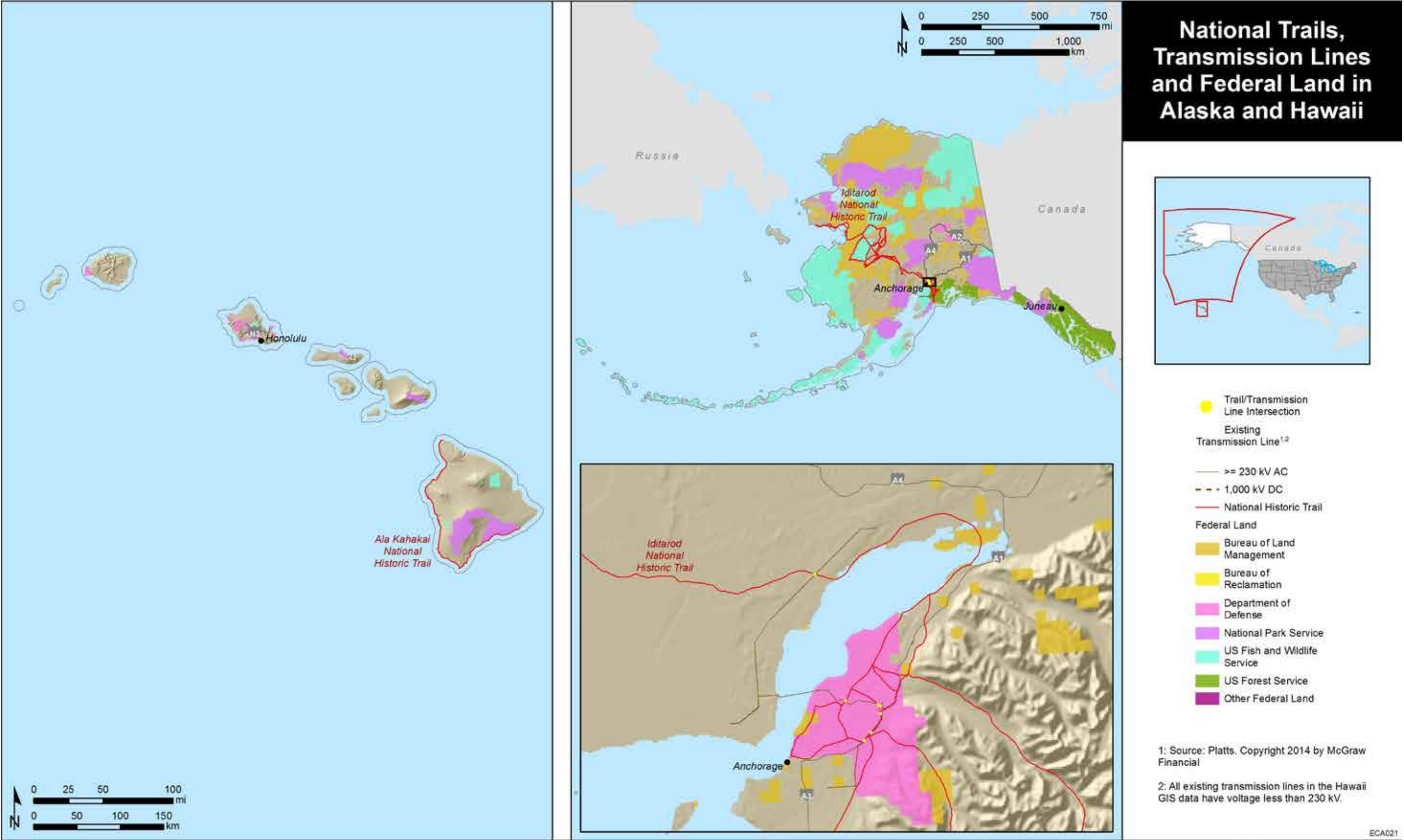


Figure B-2.10 Existing High-voltage Electrical Transmission Lines, National Trails, and Federal Land in Alaska and Hawaii

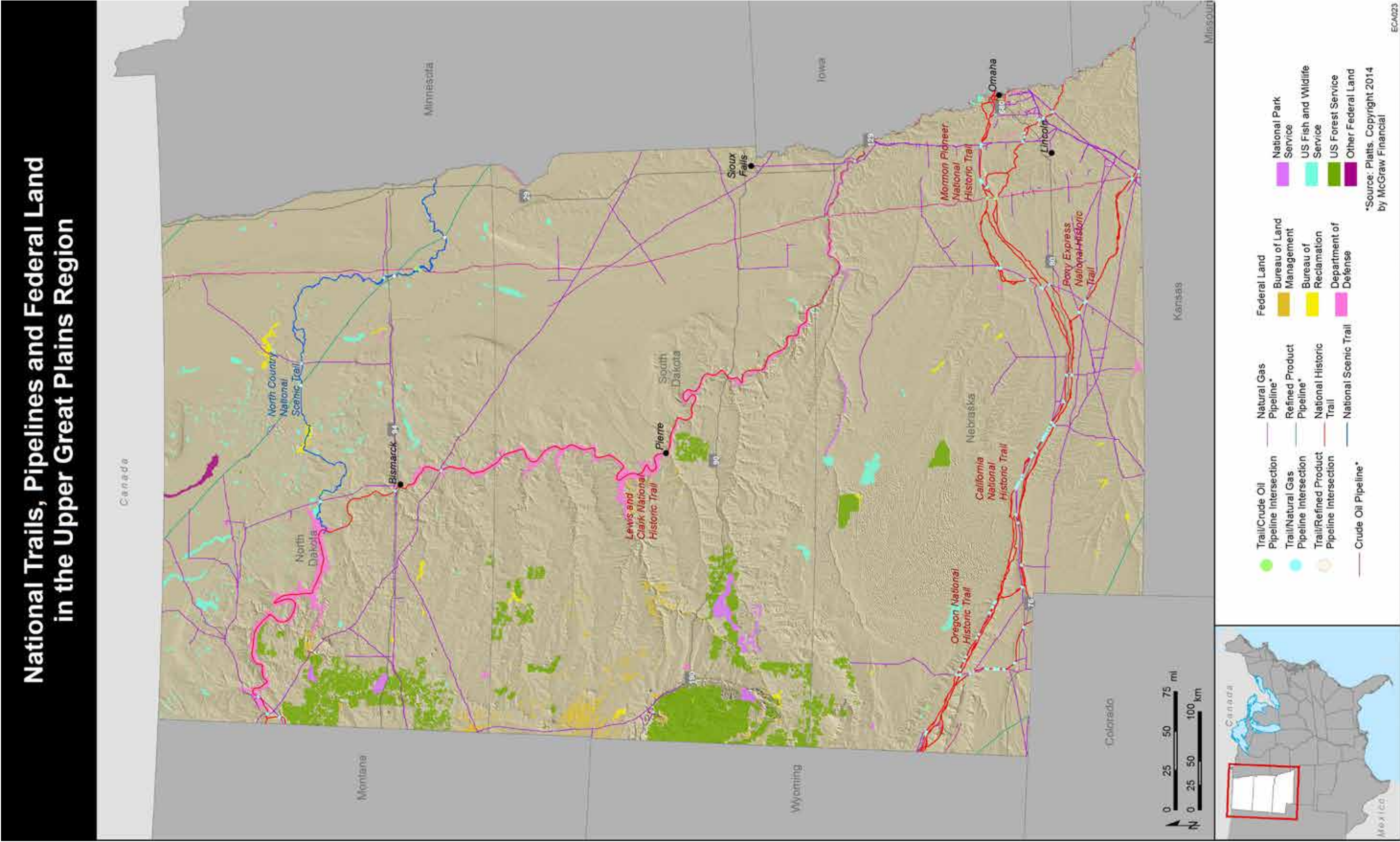


Figure B-3.1 Existing Pipelines, National Trails, and Federal Land in the Upper Great Plains Region

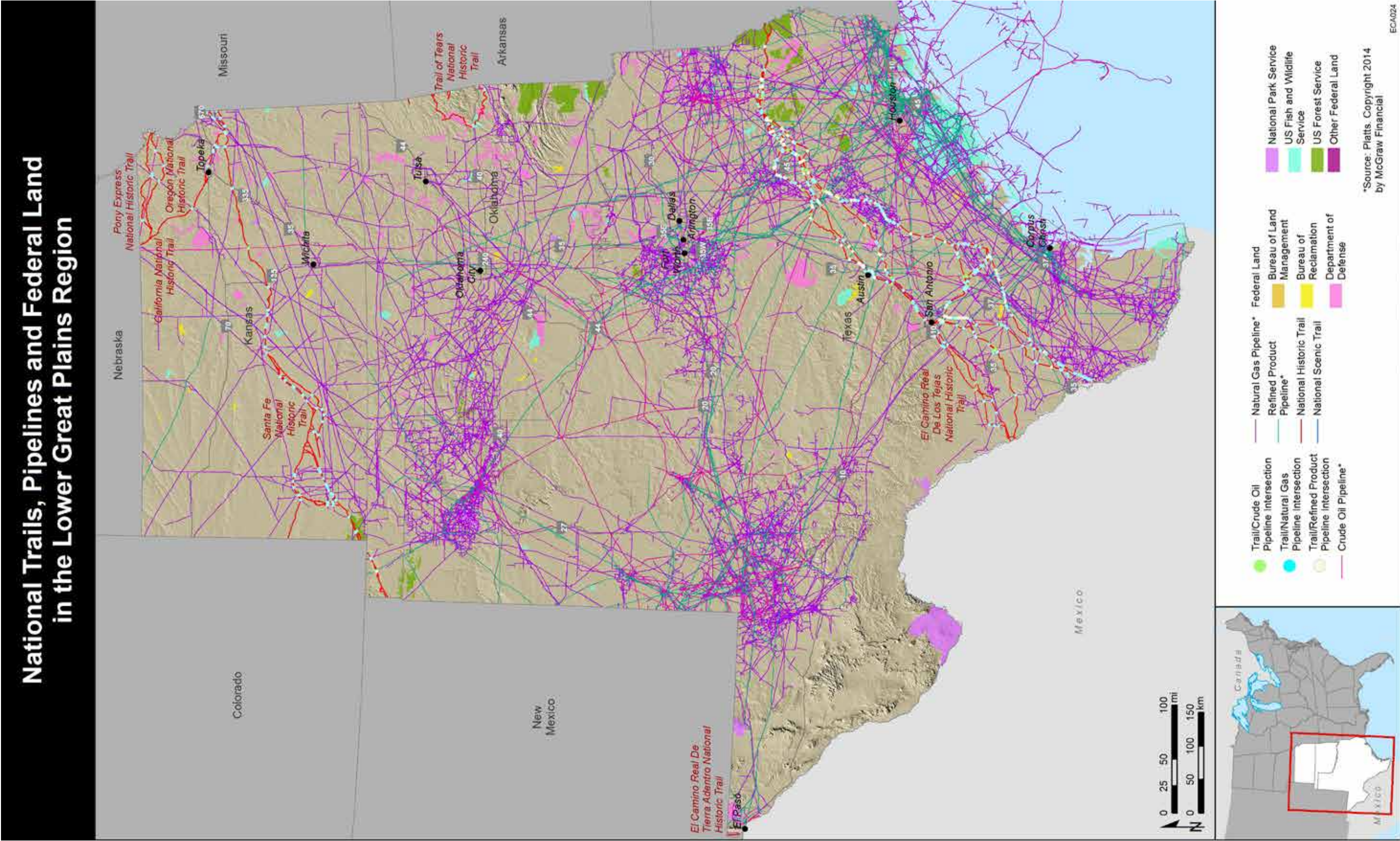


Figure B-3.2 Existing Pipelines, National Trails, and Federal Land in the Lower Great Plains Region

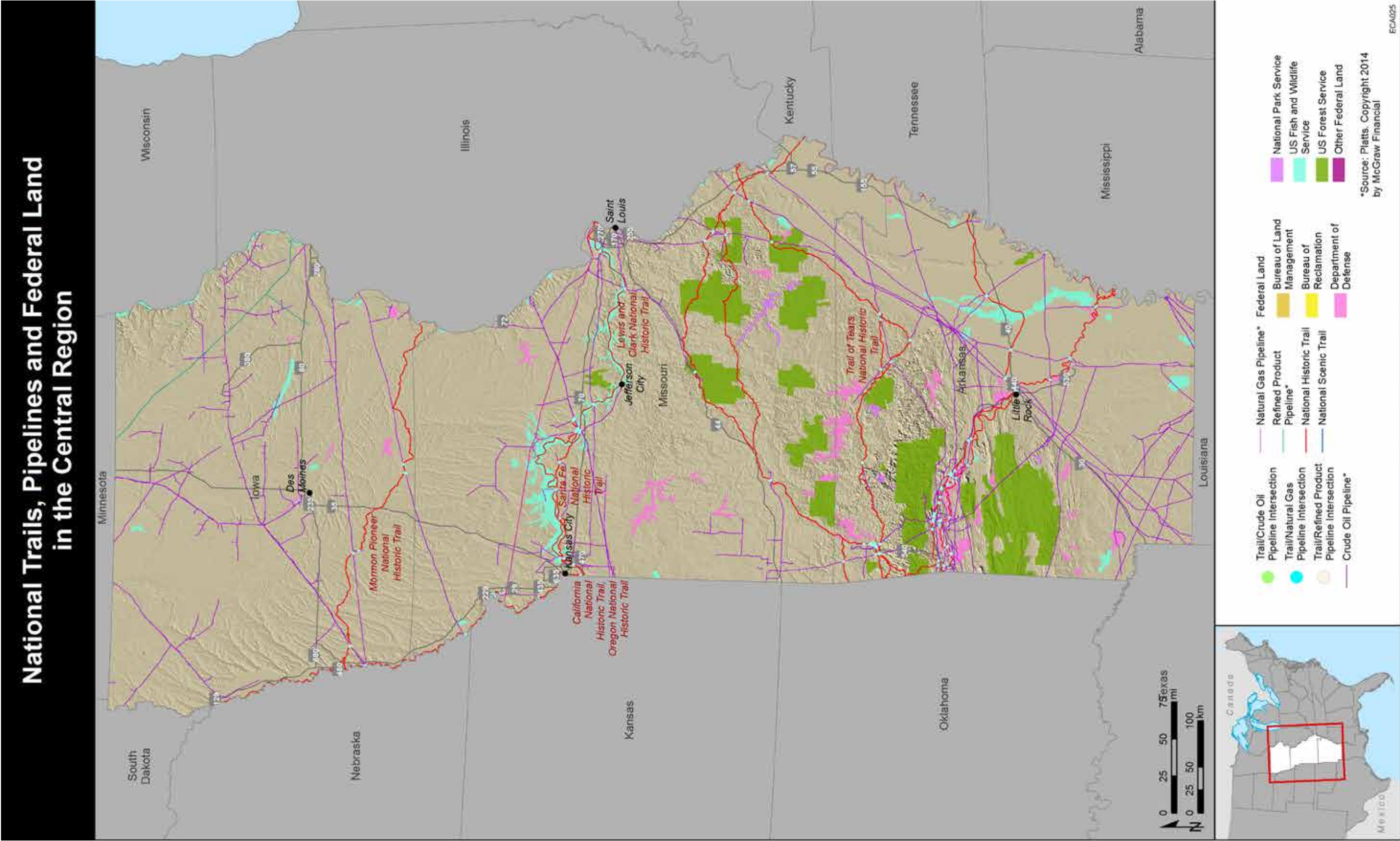


Figure B-3.3 Existing Pipelines, National Trails, and Federal Land in the Central Region

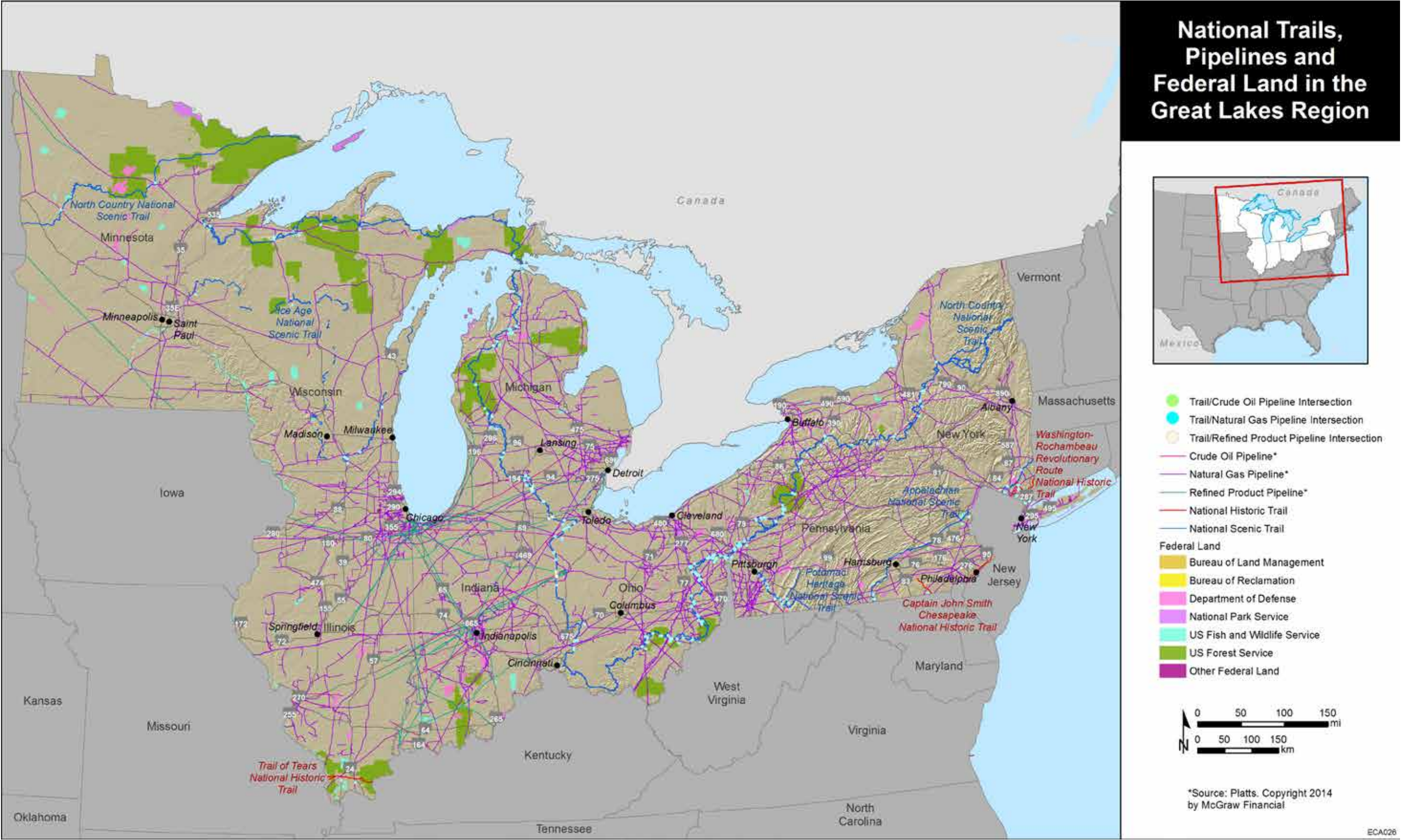


Figure B-3.4 Existing Pipelines, National Trails, and Federal Land in the Great Lakes Region

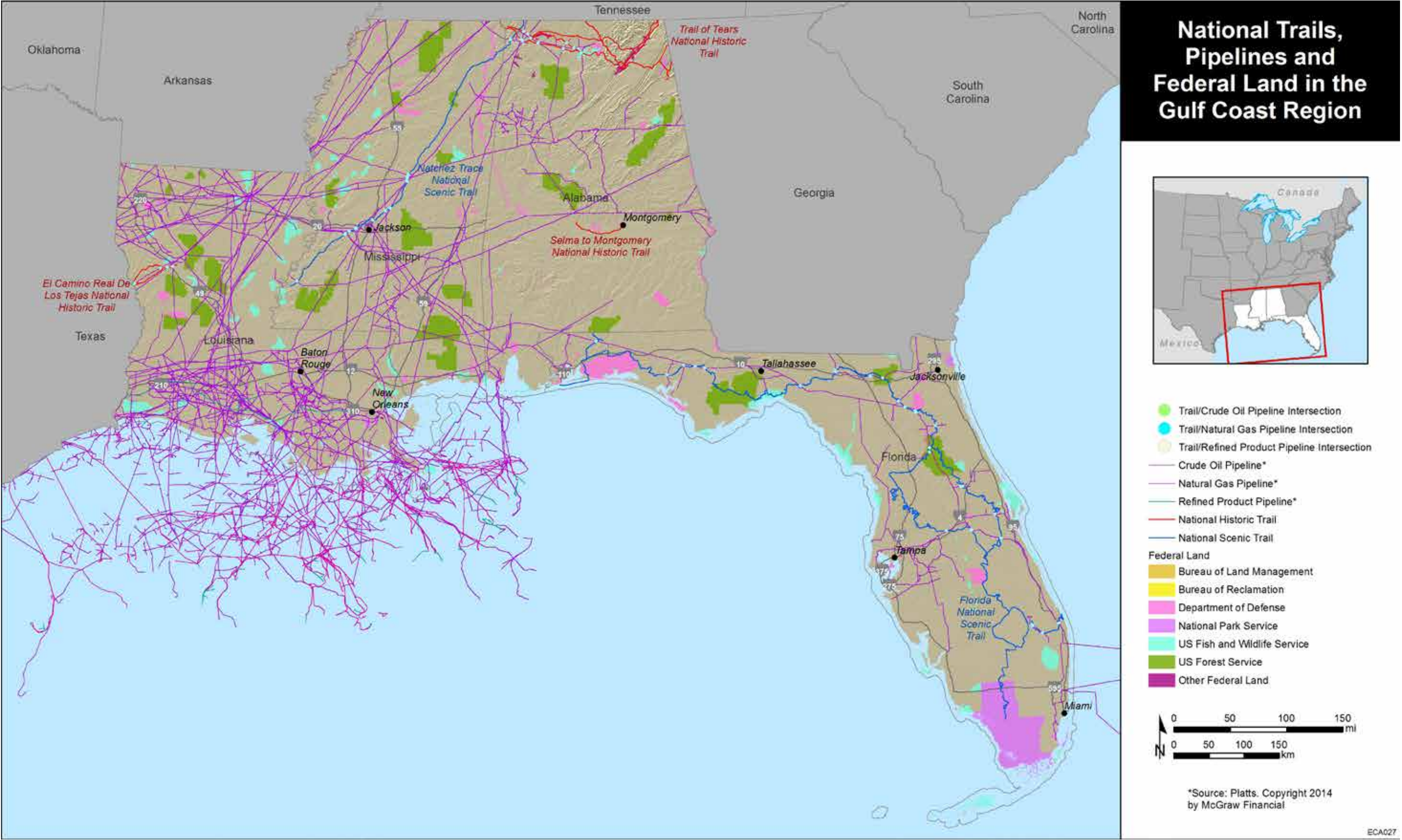


Figure B-3.5 Existing Pipelines, National Trails, and Federal Land in the Gulf Coast Region

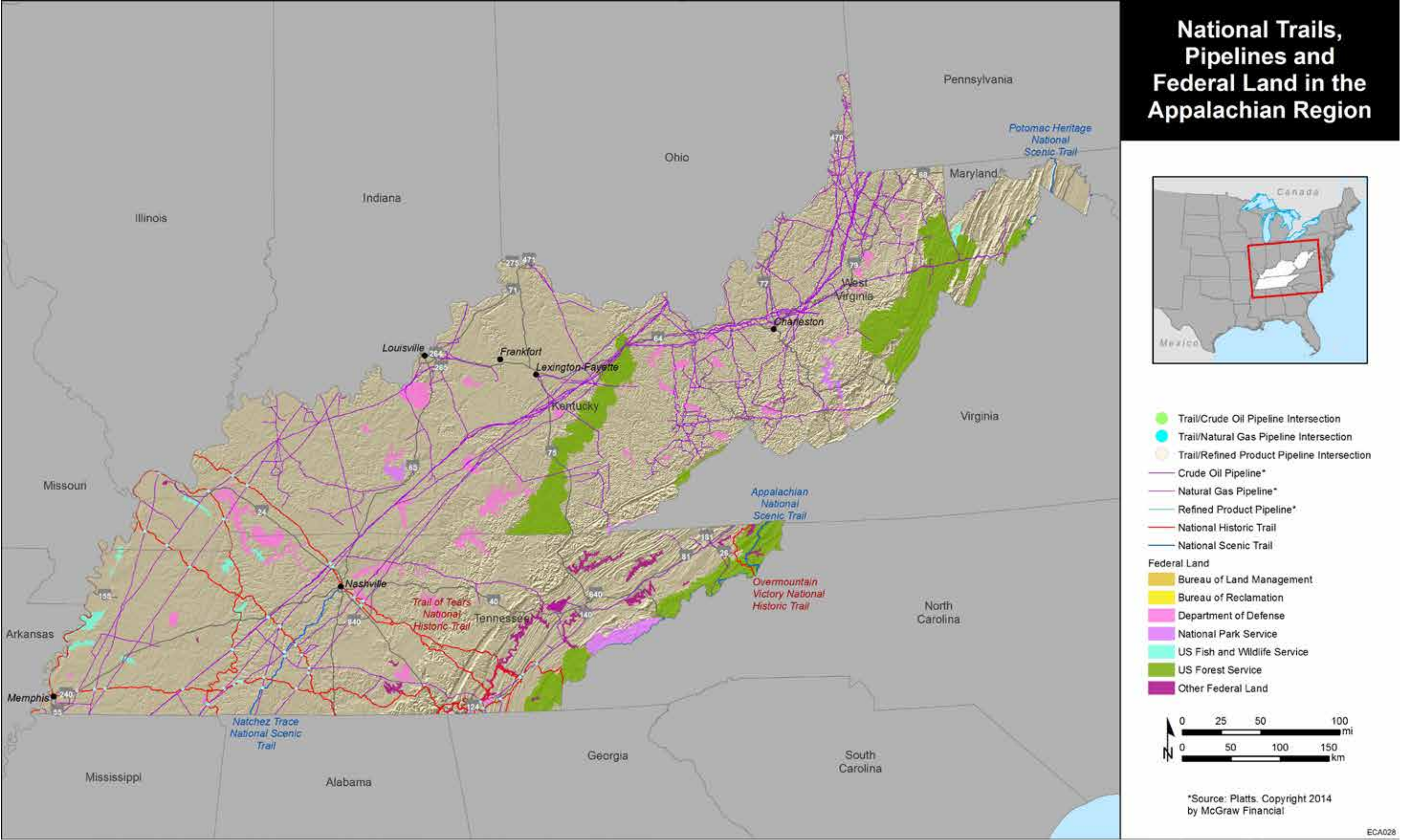


Figure B-3.6 Existing Pipelines, National Trails, and Federal Land in the Appalachian Region

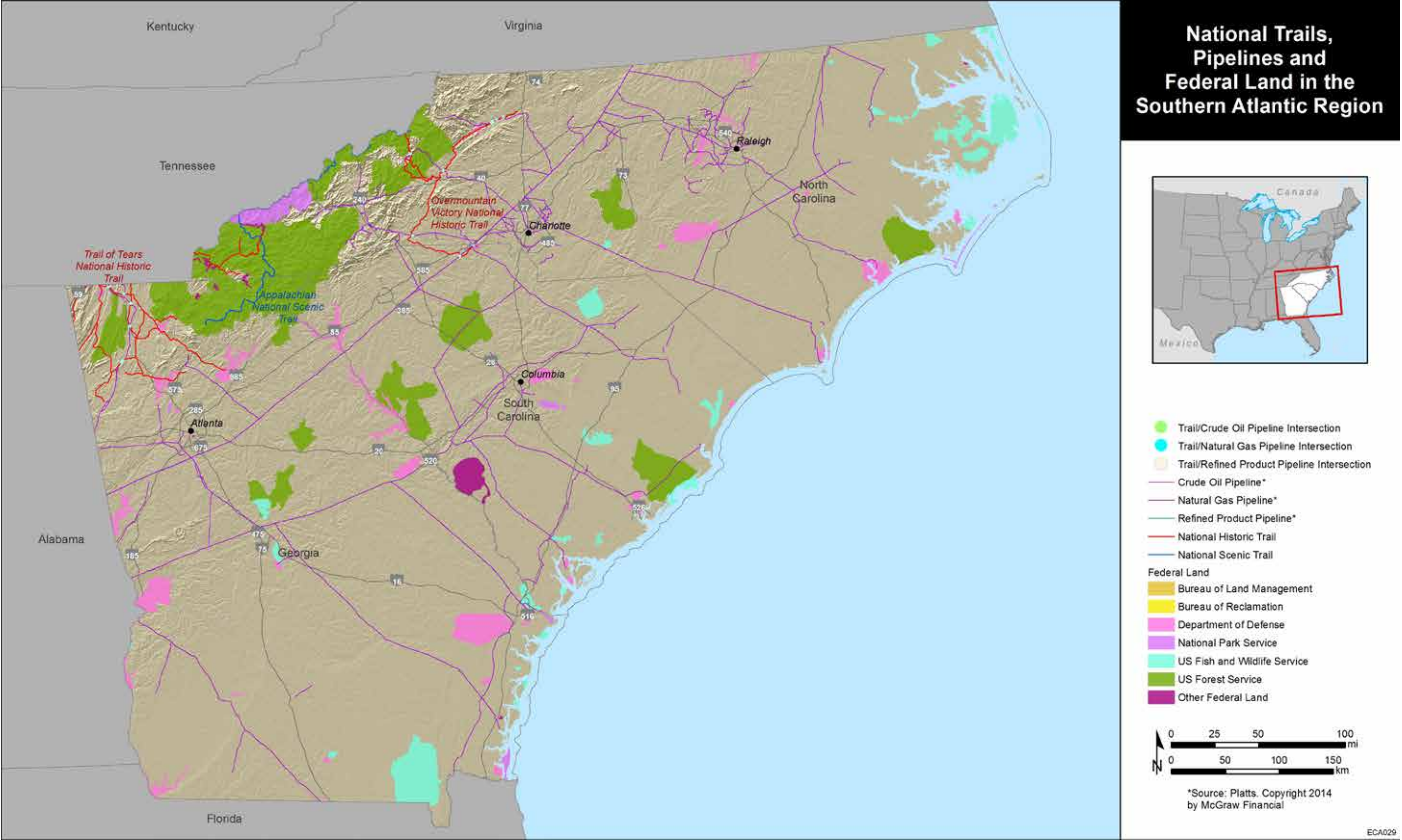


Figure B-3.7 Existing Pipelines, National Trails, and Federal Land in the Southern Atlantic Region

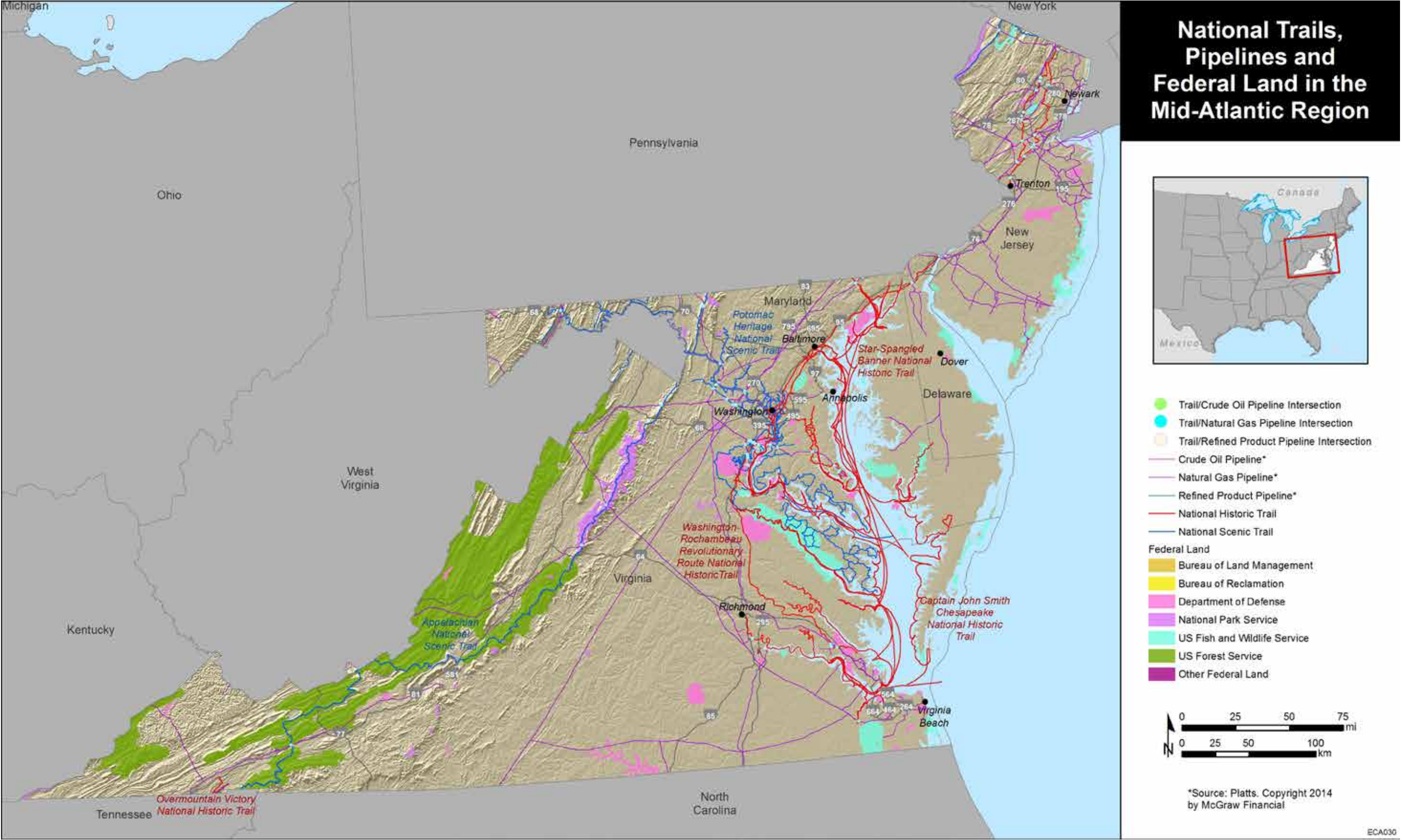


Figure B-3.8 Existing Pipelines, National Trails, and Federal Land in the Mid-Atlantic Region

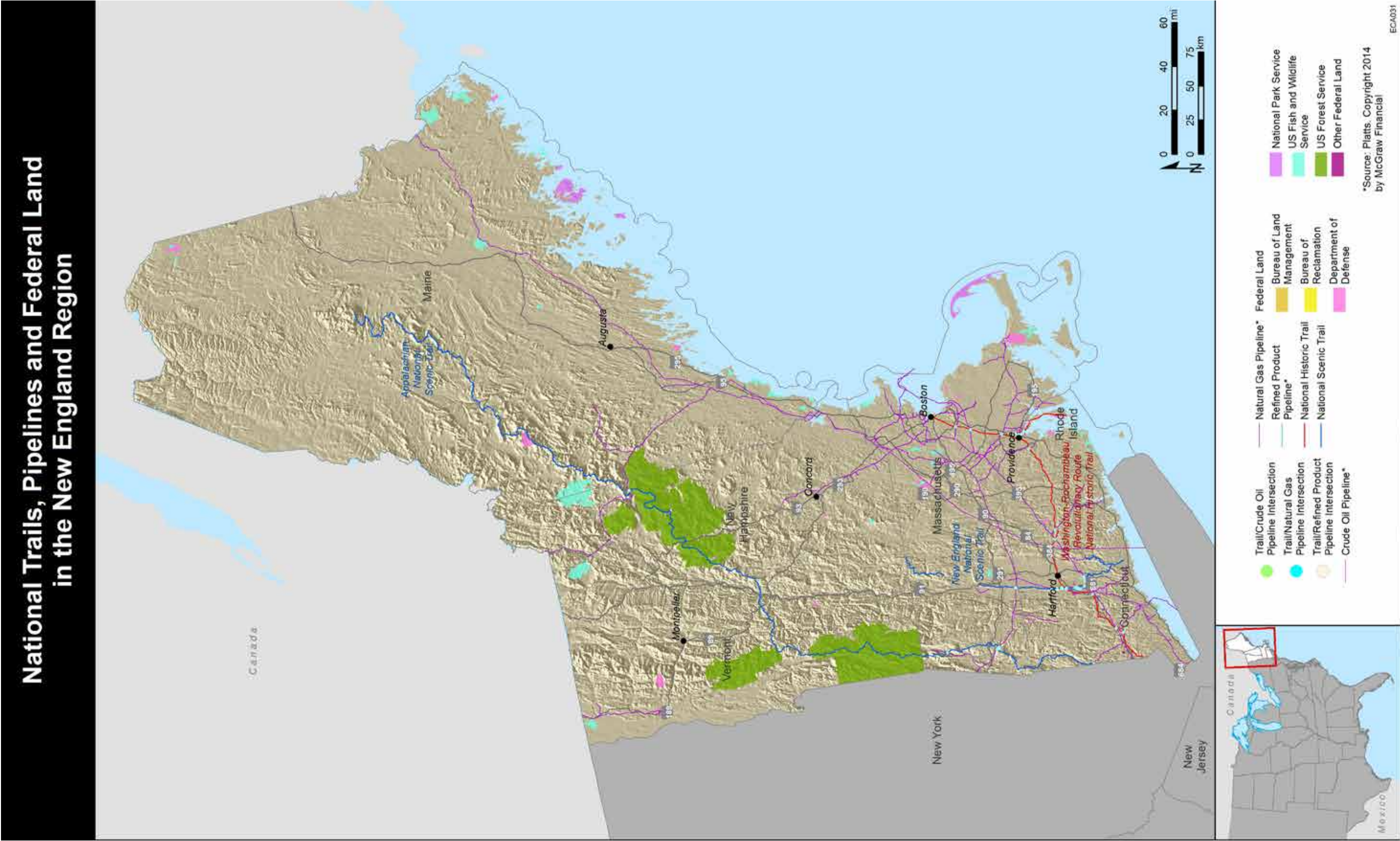


Figure B-3.9 Existing Pipelines, National Trails, and Federal Land in the New-England Region

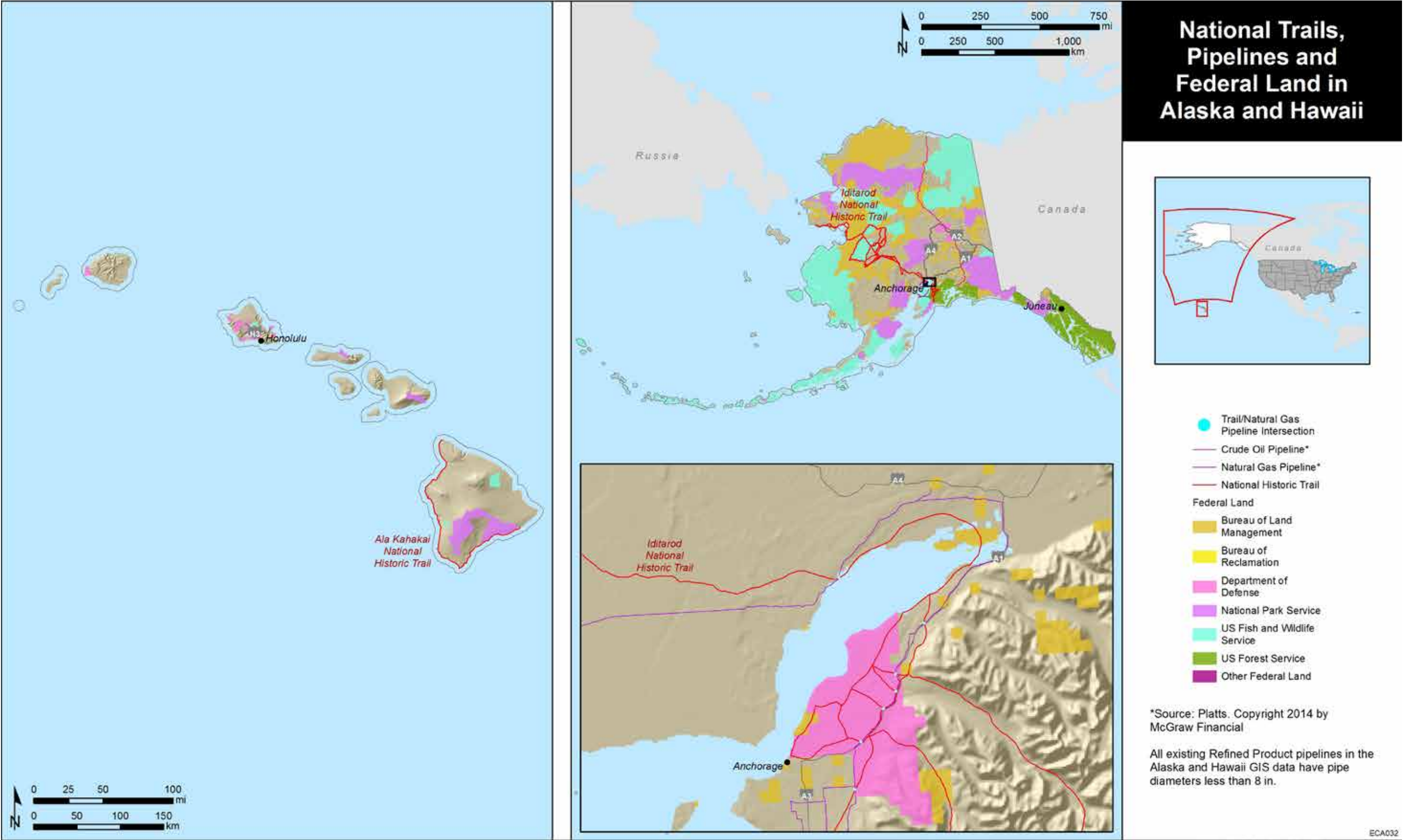


Figure B-3.10 Existing Pipelines, National Trails, and Federal Land in Alaska and Hawaii

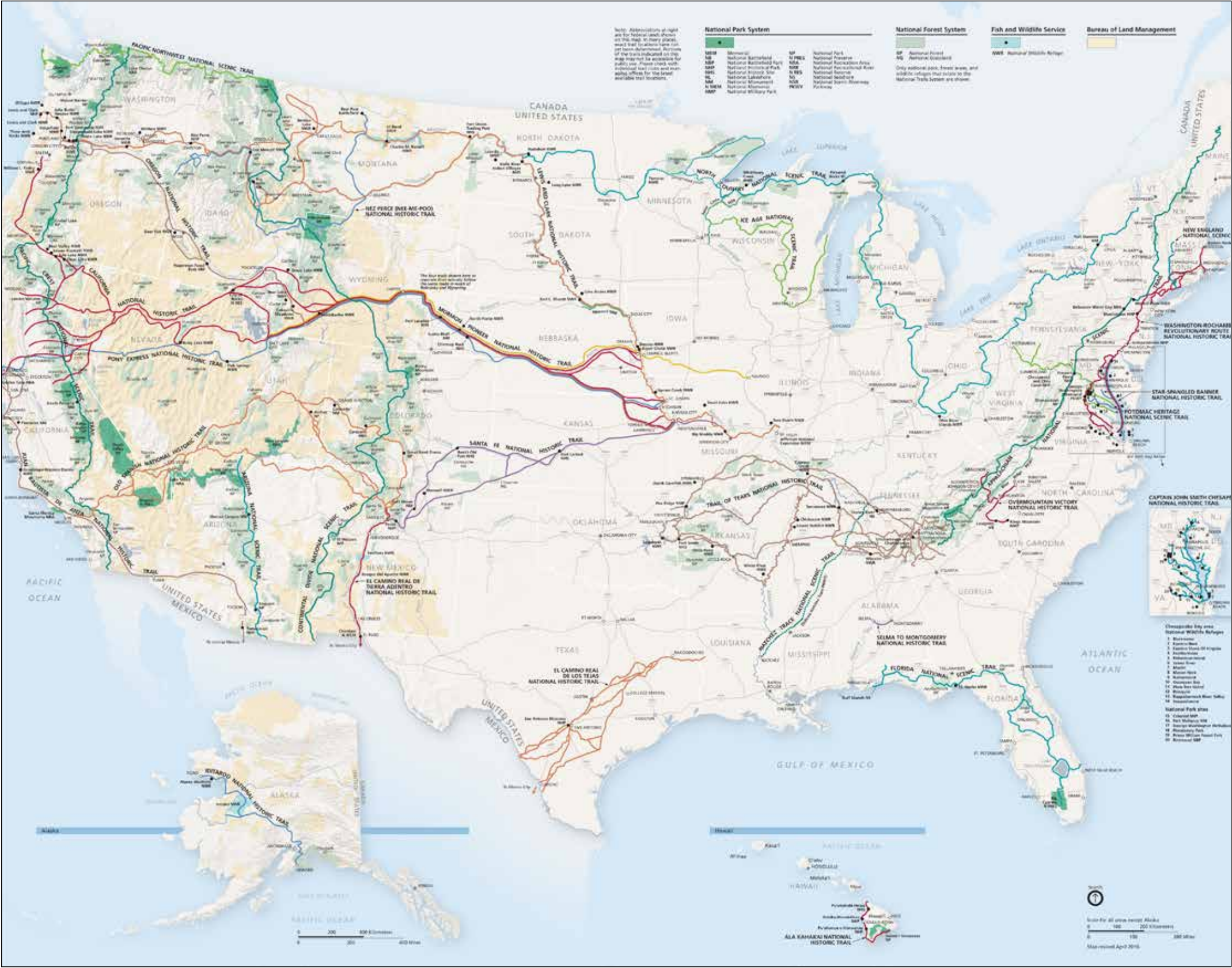


Figure B-4.1 National Trails System (Source: National Park Service)



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