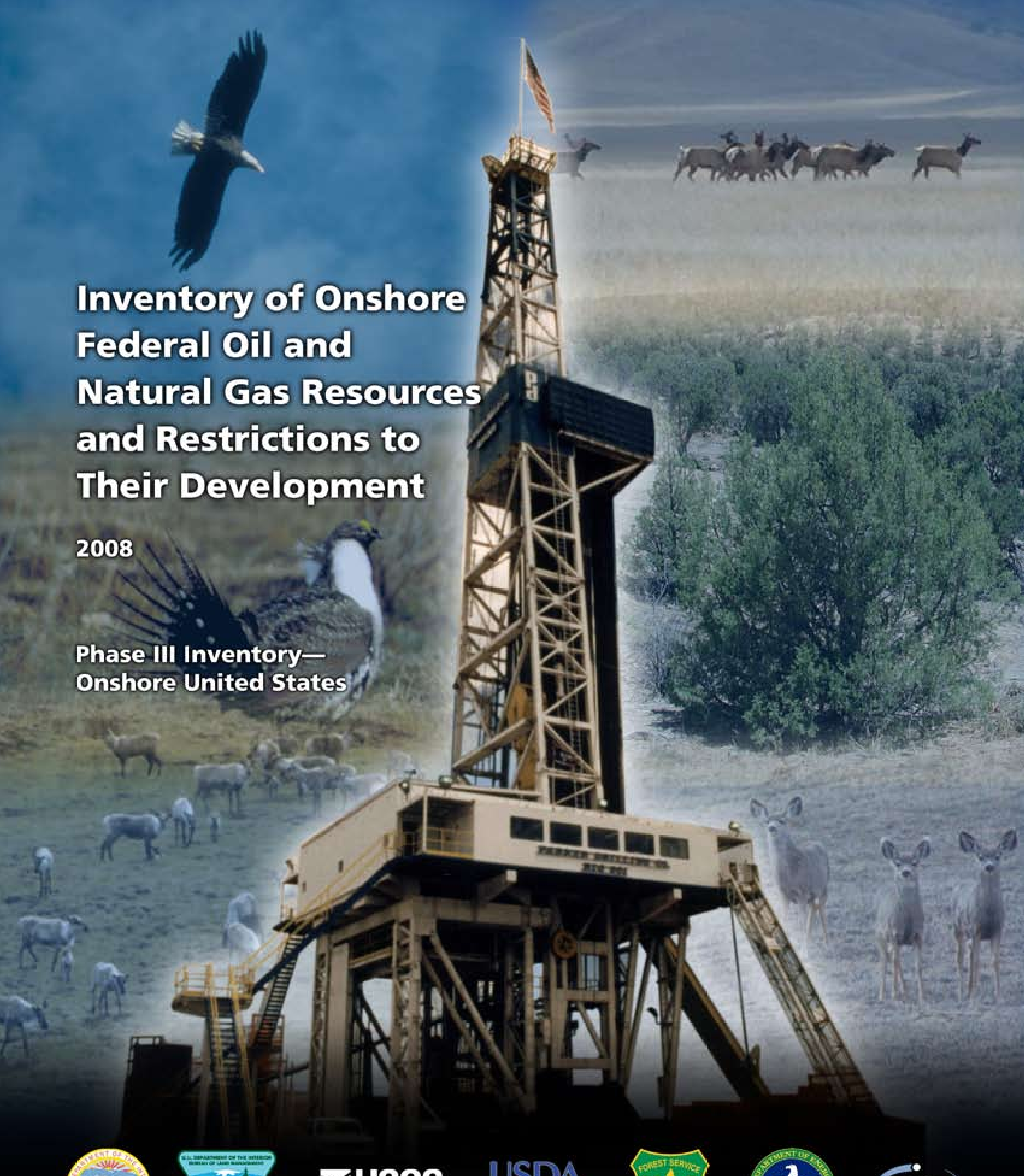

Inventory of Onshore Federal Oil and Natural Gas Resources and Restrictions to Their Development

2008

Phase III Inventory—Onshore United States

In Compliance with the Energy Act of 2000, P. L. 106-469 § 604 as Amended by the Energy Policy Act of 2005, P. L. 109-58 § 364

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Phase III Inventory – Onshore United States

Prepared by the
U.S. Departments of the Interior,
Agriculture, and Energy

In Compliance with the Energy Act of 2000, P.L. 106-469 §604,
as Amended by the Energy Policy Act of 2005, P.L. 109-58 §364

BLM/WO/GI-03/002+3100/REV08

2008

www.blm.gov/epca

DVD-ROMs are available from the Bureau of Land Managment

Design and layout by the BLM National Operations Center, Information and Publishing Services Section.

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Executive Summary

The Mandate From Congress

In November 2000, Congress enacted the Energy Act of 2000, as amended (also referred to as the Energy Policy and Conservation Act [EPCA]). The Act directed the Secretary of the Interior, in consultation with the Secretaries of Agriculture and Energy, to conduct an inventory of oil and natural gas resources beneath onshore Federal lands:[1]

The inventory shall identify:

> 1) the United States Geological Survey estimates of oil and gas resources underlying these lands;
>
> 2) the extent and nature of any restrictions or impediments to the development of the resources, including:
>
> > (A) impediments to the timely granting of leases;
> >
> > (B) post-lease restrictions, impediments, or delays on development for conditions of approval, applications for permits to drill, or processing of environmental permits . . . .

The EPCA marked the first time that Congress asked the Department of the Interior to conduct a study of restrictions.

On October 11, 2001, Congress provided its sense of priority for this study:
. . . in light of recent attacks on the United States that have underscored the potential for disruptions to America's energy supply, the managers believe this project should be considered a top priority for the Department.

In August 2005, Congress enacted the Energy Policy Act of 2005 (EPAct 2005). Section 364 of this Act amends the inventory requirements of EPCA.[2]

This EPCA Phase III Inventory (Inventory) includes, for the first time, the entire onshore United States. This release is composed of a detailed review of Federal oil and gas resources and constraints on their development within 18 geological provinces. In addition, the rest of the country was extrapolated from the results of these provinces studied in detail (Figure ES-1).

For the Federal agencies that manage public land (principally the Department of the Interior's Bureau of Land Management [BLM] and the United States Department of Agriculture-Forest Service [FS]) and the citizens they serve, this Inventory will serve primarily as a planning tool. It provides public land managers with additional information to help them develop management plans for the lands under their jurisdiction. It enables them to identify areas of high oil and natural gas potential and to evaluate the effectiveness of mitigating stipulations and conditions of approval (COAs) while balancing the development with the protection of other valuable resources in the area. The Inventory offers additional information for

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1 Federal lands are defined as not including Indian lands.

2 EPAct 2005 amends the inventory requirements at 42 USC 6217. The updates have been reflected in the text of this document.

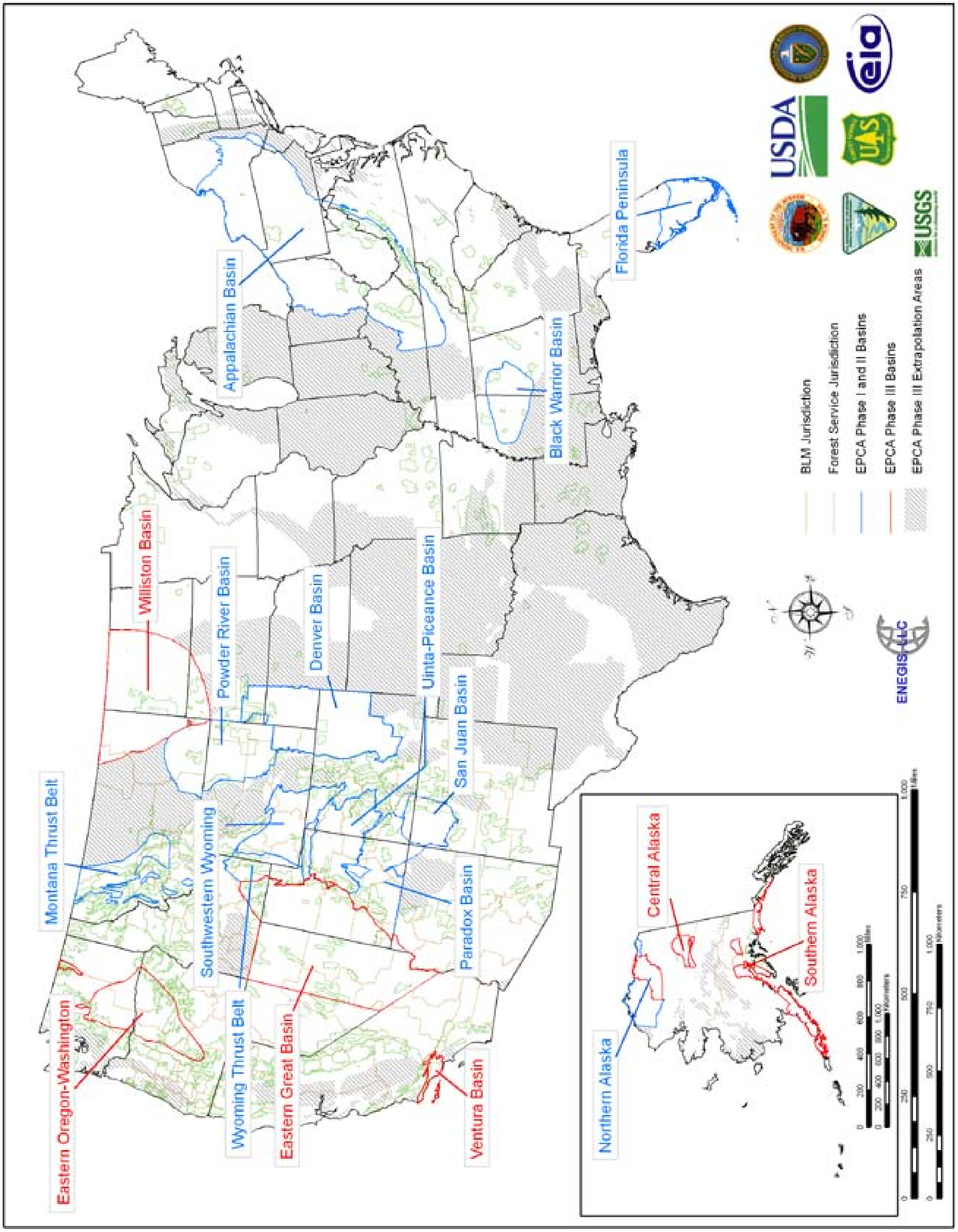

Figure ES-1. Study Area Locations

resource managers to identify areas of low oil and gas potential, but high potential for other resource (e.g., wildlife habitat) values or uses (e.g., recreation). In these situations, resource managers and oil and gas operators can consider applying land management strategies that promote increased protection of other valuable resources or uses that might ordinarily conflict with oil or gas development. This report is a critical step in evaluating whether the documented impediments and restrictions are appropriate, and to what extent they constrain oil and gas development.

This Inventory provides information regarding the geographical relationship between oil and gas resources and the constraints that govern their development. It is not a reassessment of any stipulations or COAs on the development of oil and gas resources. The public's opportunity to participate in any change of restrictions on oil and gas activities will occur during the land use planning or legislative process. This Inventory provides basic information. Additional information may be available from monitoring and scientific studies incorporated into adaptive management processes.

This Inventory was prepared under the lead of the BLM. Senior professionals from the Department of the Interior's BLM and United States Geological Survey (USGS), the FS; the Department of Energy (DOE)-Office of Fossil Energy, and the Energy Information Administration (EIA) were the major contributors. The USGS provided the assessment of undiscovered technically recoverable oil and natural gas resources for Federal lands. The EIA contributed the estimate of reserves growth and proved reserves for Federal lands. The DOE provided technical expertise to guide the design and analysis process for the Inventory. Field offices of the BLM and the FS contributed their land use planning information regarding oil and natural gas availability and leasing stipulations for the lands under their respective jurisdictions.

Methodology

This Inventory is based on information that was previously developed through the scientific and land use planning processes of the contributing Federal agencies. This information, in large part, was provided to the public for its review and use and is the best that is commercially and scientifically available. It was compiled and analyzed by experts from the contributing agencies. The analytical methods and protocols used in the supporting studies were subjected to rigorous review. The present study necessarily incorporates the assumptions, conditions, and limitations of the supporting scientific information, as discussed in this report. This Inventory is significant because it builds upon the process established in the EPCA Phase I and II Inventories, and now covers Federal lands throughout the United States. It examines oil and natural gas (undiscovered technically recoverable resources and reserves growth) in context with information about constraints on the resource's development.

The Inventory examines in detail six geological provinces in addition to the twelve included in the Phase II of EPCA. These six provinces are Central Alaska (Yukon Flats portion); Southern Alaska; Eastern Oregon-Washington; the Ventura Basin in California; the Eastern Great Basin in Idaho, Nevada, Utah and Arizona; and the Williston Basin in Montana, North Dakota and South Dakota.

The Inventory encompasses the 1.2 billion acres of land that the USGS inventoried as a part of its National Oil and Gas Assessment (NOGA), of which about 279 million are under Federal management. This acreage includes split-estate lands where lands with non-Federal surface are underlain by Federal mineral rights.

This analysis of constraints to development centers on two factors that affect access to oil and gas resources on Federal lands. These factors are: (1) whether the lands are "open" or "closed" to leasing (i.e., accessible or inaccessible), and (2) the degree of access afforded by lease stipulations and other conditions on "open" lands (some leasable lands may in effect be "closed" if no drilling can occur). All oil and gas leases are subject to a baseline level of constraint governed by statutory and regulatory requirements (standard lease terms [3]). These stipulations serve many purposes, ranging from the protection of environmental, social, historical, or cultural resources or values to the payment of rentals and royalties.

The Inventory finds that approximately 3,125 individual lease stipulations are being applied, in addition to the aforementioned standard lease terms, by the land managing agencies in the areas analyzed in detail. To focus the analysis of constraints on oil and gas development, the Inventory evaluates the onshore Federal lands: (1) where leasing is permitted under standard lease terms; (2) where leasing is permitted with varying limitations on access, principally seasonal occupancy restrictions; and (3) where oil and gas leasing is precluded or prohibited.

[3] See the "LEASE TERMS" section of the BLM form 3100-11 at http://www.blm.gov/style/medialib/blm/wy/minerals/og/ogforms.Par.9931.File.dat/Form_3100-11.pdf

The Inventory also considers exceptions to stipulations that may be granted after a review of on-the-ground conditions and the use of modern technologies such as directional drilling. The impact of COAs attached to Federal drilling permits is also analyzed, which gives a more complete assessment of access constraints. A total of 157 unique COAs were identified and their effects on development evaluated. The nine categories of constraints analyzed in this report include the complete range of access restrictions associated with oil and gas leasing.

Results

The results of this Inventory are unique for each of the eighteen comprehensively studied areas examined. The aggregate results for all of the study areas and extrapolated areas (Table ES-1, Figure ES-2, and Figure ES-3) are summarized below.

- Federal lands with potential for oil or natural gas resources, including split-estate minerals, total 279.0 million acres.
- Undeveloped oil resources under these Federal lands total 30.5 billion barrels, comprising 24.2 billion barrels of undiscovered technically recoverable resources and 6.3 billion barrels of reserves growth.
- Undeveloped gas resources under these Federal lands total 231.0 trillion cubic feet, comprising 214.1 trillion cubic feet of undiscovered technically recoverable resources and 16.9 trillion cubic feet of reserves growth.
- Total proved reserves under these Federal lands total 5.3 billion barrels of oil and 68.8 trillion cubic feet of natural gas.
- Approximately 60 percent (165.9 million acres) of the Federal land

is inaccessible. Based on resource estimates, these lands contain about 62 percent of the oil (19.0 billion barrels) and 41 percent of the natural gas (94.5 trillion cubic feet).

- Approximately 23 percent (65.2 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard stipulations. Based on resource estimates, these lands contain 30 percent of the oil (9.3 billion barrels) and 49 percent of the gas (112.9 trillion cubic feet).
- Approximately 17 percent of the Federal land in these areas (48.0 million acres) is accessible under standard lease terms. Based on resource estimates, these lands contain 8 percent of the oil (2.3 billion barrels) and 10 percent of the gas (23.6 trillion cubic feet).

Overall the study shows that oil and gas resources are most concentrated in Northern Alaska and the Interior West. Figure ES-4 summarizes the accessibility of these resources on a quadrillion British thermal unit (quad) basis[4].

Compliance With The Law

All oil and gas leases on Federal lands, including those issued with only the standard lease terms, are subject to full compliance with all environmental laws and regulations. These laws include, but are not limited to, the National Environmental Policy Act, Clean Water Act, Clean Air Act, Endangered Species Act, and National Historic Preservation Act. While compliance with these laws may delay, modify, or prohibit oil and gas activities, these laws represent the values and bounds Congress believes appropriate to manage Federal lands. The present study was requested by Congress to provide information to deliberate on the role of Federal lands in contributing to the U.S. energy supply.

It is important to emphasize that this Inventory was prepared at the direction of Congress. It is not a decision-making document. The Inventory identifies Federal land areas of varying oil and natural gas potential and the nature of constraints to the development of those resources across the U.S. Any reassessment of restrictions on oil and gas activities will occur as part of the public land use planning or legislative processes, both of which are fully open to public participation and debate about the appropriate balance between resource protection and resource development.

[4] One quad BTU is equivalent to 0.9756 TCF or 172.4 MMBO.

Table ES-1. Onshore United States—Total Federal Land and Oil and Natural Gas Resources by Access Category

		Access Category	Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)[d]	Percent of Federal	(BCF)[e]	Percent of Federal
More Constrained ↑	1.	No Leasing (Statutory/ Executive Order) (NLS)	39,945	14.3%	9,054	29.7%	19,449	8.4%
	2.	No Leasing (Administrative) (NLA)	50,414	18.1%	2,461	8.1%	16,618	7.2%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	55,278	19.8%	6,684	21.9%	49,814	21.6%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	20,245	7.3%	777	2.5%	8,621	3.7%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	283	0.1%	32	0.1%	430	0.2%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	11,883	4.3%	5,198	17.0%	40,021	17.3%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	18,389	6.6%	1,799	5.9%	35,751	15.5%
	8.	Leasing, Controlled Surface Use (CSU)[f]	34,631	12.4%	2,231	7.3%	36,716	15.9%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	47,972	17.2%	2,268	7.5%	23,554	10.2%
Total, Federal Lands including Split Estate			**279,039**	100%	**30,503**	100%	**230,975**	100%
Total Non-Federal			**936,414**		**58,056**		**423,282**	
Total Inventory Area			**1,215,453**		**88,560**		**654,256**	

Summary						
Inaccessible (Categories 1-4)	165,882	60%	18,976	62%	94,502	41%
Accessible with Restrictions (Categories 5-8)	65,186	23%	9,260	30%	112,919	49%
Accessible under Standard Lease Terms (Category 9)	47,972	17%	2,268	8%	23,554	10%
Total, Federal Lands Including Split Estate	**279,039**	**100%**	**30,503**	**100%**	**230,975**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Million barrels [e] Billion cubic feet [f] Includes Cumulative Timing Limitations of ≤3 months

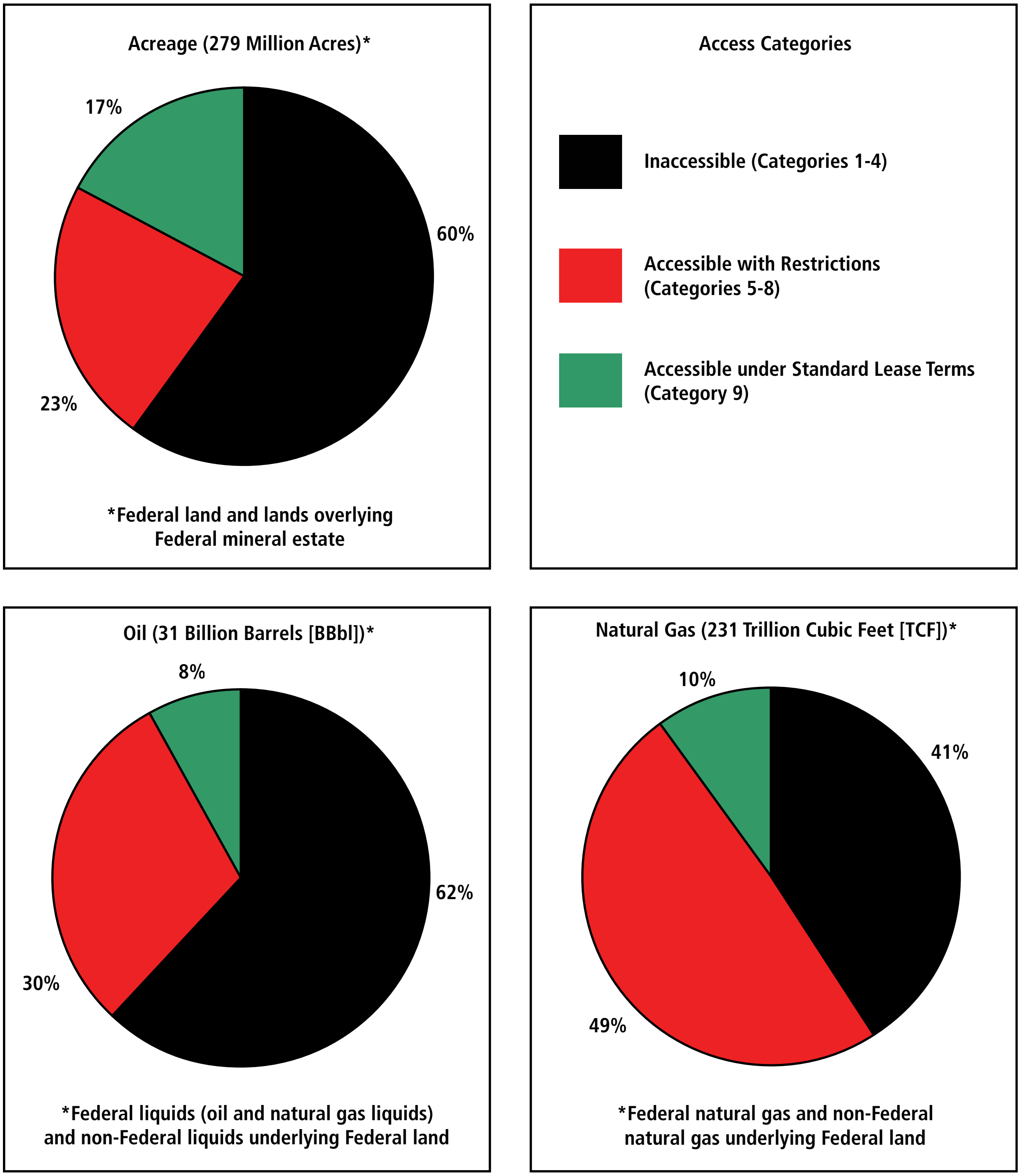

Figure ES-2. Simplified Chart of Results; Onshore United States—Total Federal Land and Oil and Natural Gas Resources* by Accessibility

* Undiscovered technically recoverable resources and reserves growth.

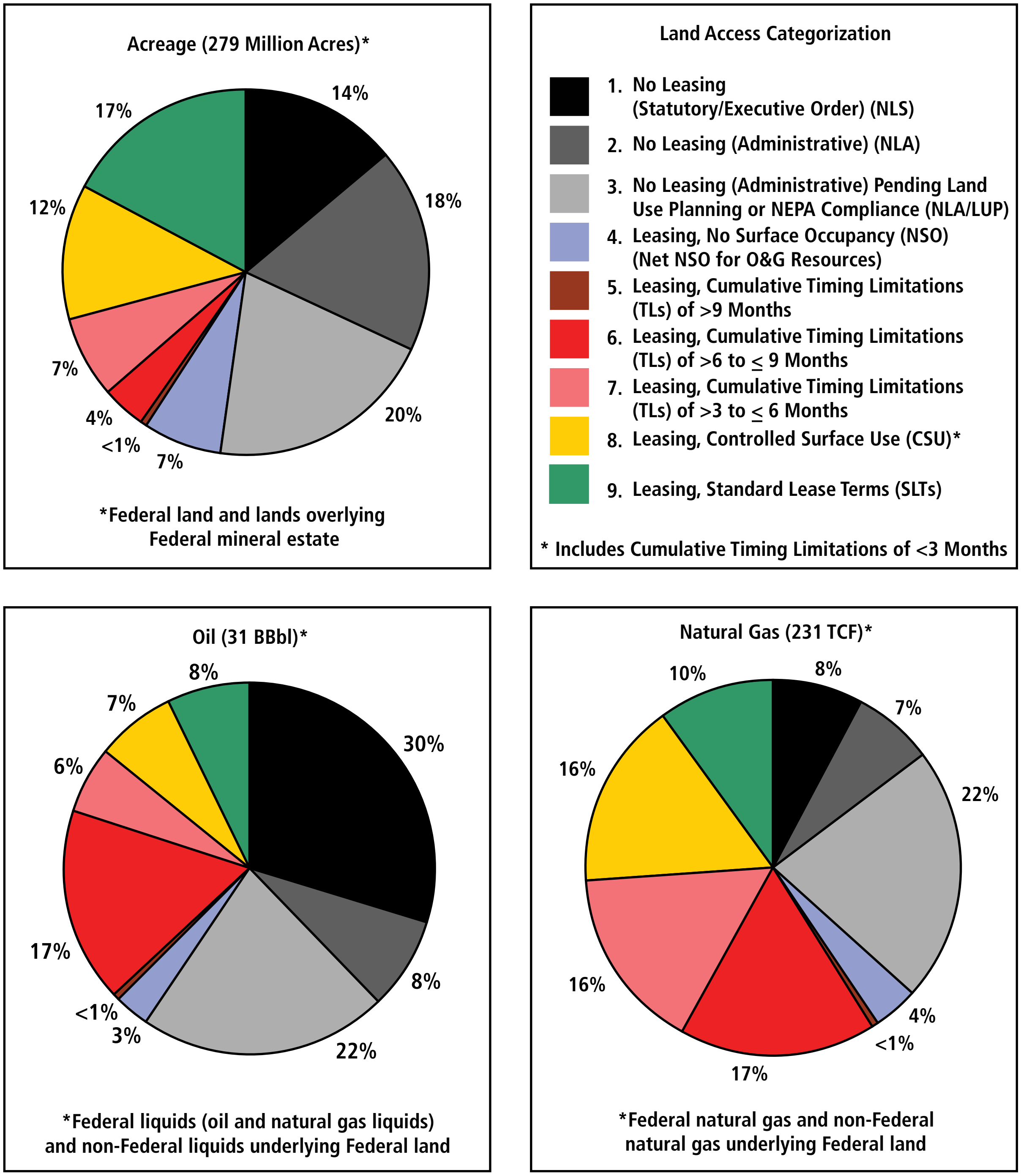

Figure ES-3. Chart of Results; Onshore United States—Total Federal Land and Oil and Natural Gas Resources* by Access Category

* Undiscovered technically recoverable resources and reserves growth.

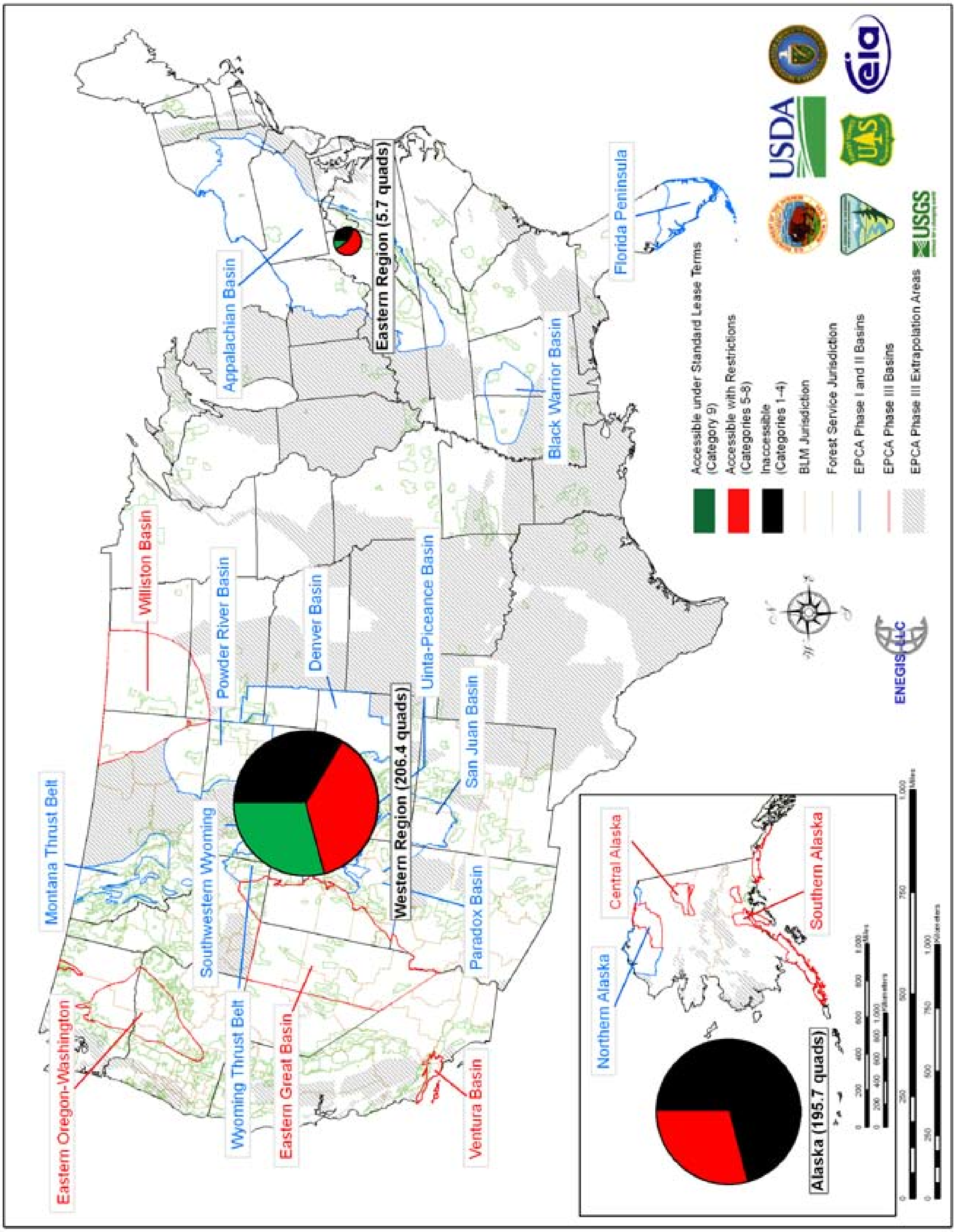

Figure ES-4. Regional Charts

1.0 Introduction

As the energy needs of the nation continue to grow, the onshore sedimentary basins of the United States become increasingly significant oil and natural gas sources to help meet these needs, especially for natural gas. In 2006, the U.S. consumed about 22 trillion cubic feet (TCF) of natural gas, produced domestically approximately 19 TCF, and imported the remaining 3 TCF. Onshore Federal lands produced about 11 percent of the 2006 domestic natural gas consumption. The Energy Information Administration (EIA) in its *Annual Energy Outlook 2008* Reference Case predicts that the demand for natural gas will rise to 23 TCF by 2030 of which about 3 TCF will be imported.[5]

Based on recent U.S. Geological Survey (USGS)[6] and Minerals Management Service (MMS)[7] assessments, the nation's undiscovered natural gas resources total approximately 1,056 TCF.[8] The second largest potential source for domestic natural gas production is the Outer Continental Shelf (OCS) which contains approximately 40 percent of the nation's undiscovered natural gas resources. All resources in the OCS are Federally owned and managed. The EIA data indicate that lower 48 offshore production of natural gas will peak at 4.5 TCF in 2019, driven by activity in the Gulf of Mexico. However, after 2015, lower 48 offshore production is estimated by EIA to decline to 3.5 TCF in 2030.

The nation's largest natural gas source is the nonfederal onshore lands and state waters, also containing about 40 percent of the total.[9] Onshore Federal lands contain the remaining 20 percent of the nation's domestic natural gas resources. This Inventory analyzes onshore Federal natural gas resources, totaling 214 TCF. This 214 TCF would be sufficient to meet the nation's residential consumption for about 49 years at current rates.

Similarly, the U.S. consumed about 7.5 billion barrels (Bbbls) of oil in 2006. About 60 percent of this oil was imported. Onshore Federal lands produced about 5 percent of the 2006 domestic consumption. The EIA predicts that the nation will consume 9.1 Bbbls in 2030.

The nation's undiscovered oil resources total about 139 Bbbls. Of that total, the MMS estimates that 86 Bbbls are offshore under the OCS, comprising 62 percent of the nation's resources. State waters and nonfederal onshore resources are the second largest potential source of production (21 percent) followed by Federal onshore oil resources (17 percent).

This Inventory estimates that, of the 24 Bbbls of undiscovered oil resources on Federal onshore lands, 17 Bbbls occur within Northern Alaska.

5 Available on the EIA website: http://www.eia.doe.gov/oiaf/aeo/pdf/earlyrelease.pdf.

6 Available on the USGS website: http://certmapper.cr.usgs.gov/data/noga00/natl/tabular/2007/summary_07.pdf.; data as of January 2007

7 Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation's Outer Continental Shelf, 2006 Update, available on the MMS website: http://www.mms.gov/revaldiv/PDFs/2006NationalAssessmentBrochure.pdf

8 See the "Undiscovered Petroleum Resources" definition in Appendix 2.

9 Enegis, LLC, estimate based on USGS resource data (revised since the Phase II inventory) and MMS data.

It is clear that Federal lands will be an important future domestic energy supply source. According to EIA data, the Rocky Mountain region surpassed the Gulf of Mexico in 2005 as the single largest supplier of natural gas to the nation.[10] The sedimentary basins in the Interior West are particularly significant future sources of natural gas, and the Alaska North Slope is similarly noteworthy with respect to both oil and gas. Considerable natural gas supply would become available to the lower 48 states with the building of an Alaskan natural gas pipeline, anticipated for completion in 2020.[11]

Congress directed the Secretary of the Interior to inventory the nation's Federal onshore oil and gas resources in relation to Federal actions that inhibit access to these resources. The purpose of this Inventory is to add clarity to the debate and assist energy policymakers and Federal land managers in making decisions concerning oil and gas development.

The total area of the United States is 2.4 billion acres.[12] The EPCA Phase III Inventory examines the oil and gas resource areas of the onshore U.S. which total 1.2 billion acres (Figure 1-1). These resource areas include 279 million acres of Federal land of which 184 million acres were analyzed in detail. The data on the remaining 96 million acres was extrapolated. Of the 700 million acres of Federal mineral estate (including split-estate minerals)[13] administered by the Federal government, 421 million acres are outside of those areas believed to contain oil and natural gas resources.

A full set of acronyms and abbreviations used in this report, as well as a glossary, can be found in Appendices 1 and 2, respectively.

1.1 Background

Access to Federal lands is probably the most often-cited issue affecting onshore domestic oil and gas exploration and production. The restrictions and impediments that constrain access to Federal lands are frequently a complex set of requirements that can preclude drilling or increase costs and delay activity. These restrictions include areas unavailable for leasing and areas where the minerals can be leased but the surface of the land may not be occupied thereby affecting recovery of the resources. There are also limitations on drilling activities due to a variety of environmental and socioeconomic considerations, typically manifested as lease stipulations and drilling permit conditions of approval (COAs).

Recent attempts to understand the impacts of Federal land management decisions on access to oil and gas resources began with a 1999 National Petroleum Council (NPC) study.[14] One of the objectives of the NPC study was to collect and analyze data on land use and natural gas resources for

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[10] The effects of Hurricane Katrina in 2005 impacted production in the Gulf of Mexico.

[11] Annual Energy Outlook, 2008. Energy Information Administration. http://www.eia.doe.gov/oiaf/aeo/production.html.

[12] http://www.nationalatlas.gov/articles/mapping/a_general.html#one

[13] Public Lands, On-Shore Federal and Indian Minerals in Lands of the U.S. Bureau of Land Management. December 1, 2000

[14] Meeting the Challenges of the Nation's Growing Natural Gas Demand, December 1999, available on the NPC website: http://www.npc.org/reports/ng.html.

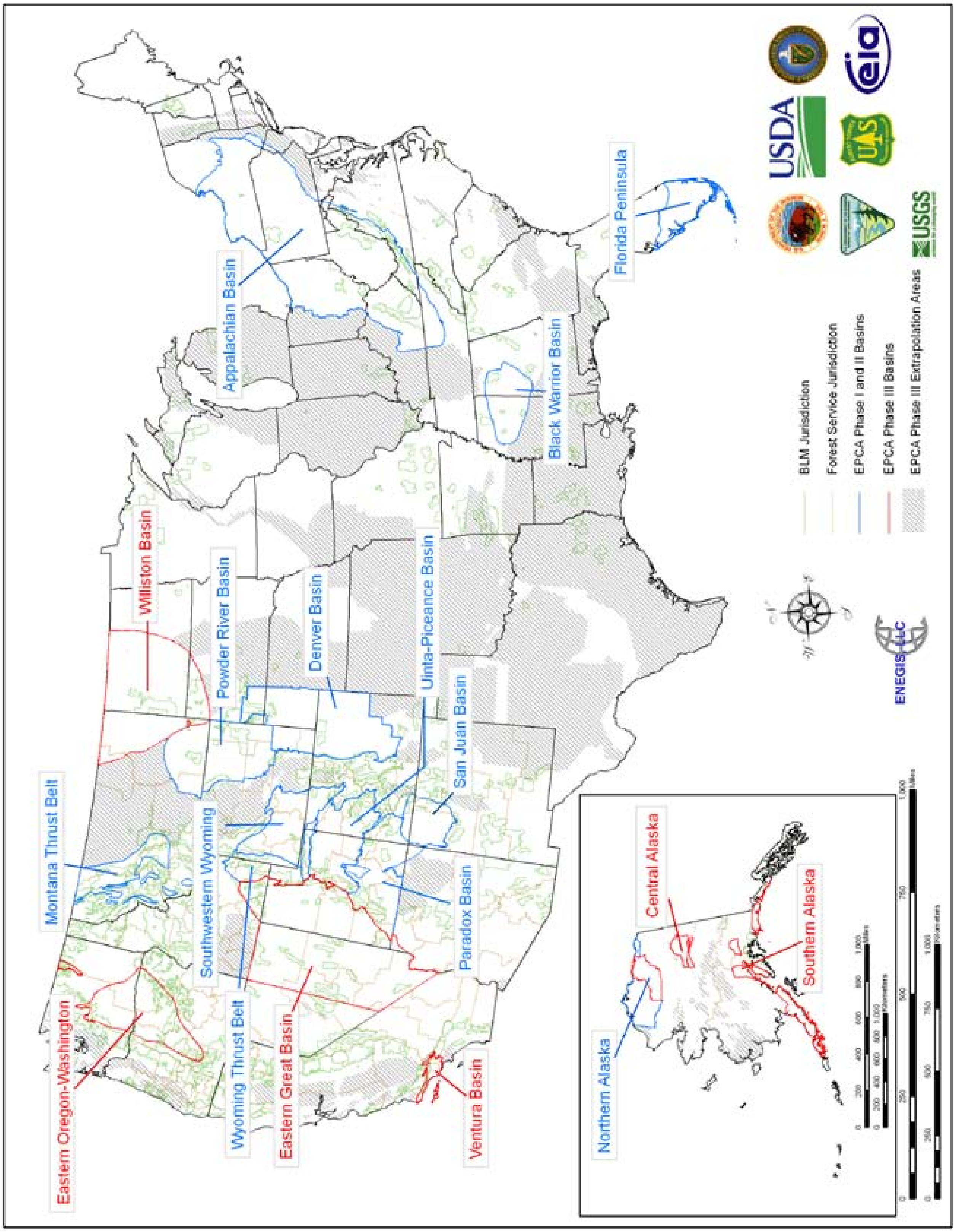

Figure 1-1. Study Area Locations

Federal lands to identify opportunities for increasing natural gas supply from this area.

In response to the NPC report, the Department of Energy (DOE), with the cooperation of the Department of the Interior (DOI) and the U.S. Department of Agriculture (USDA), embarked on an effort to assess the relationship between gas resources and land use restrictions on Federal lands. The first area studied was the Greater Green River Basin (GGRB) of Wyoming and Colorado.[15]

Both the NPC and DOE studies were substantially less comprehensive than the present Inventory. In 2000, while the DOE study was being conducted, EPCA was signed into law. Section 604 of this Act required a similar study, to be led by DOI in cooperation with the USDA and DOE, which was to include an analysis of undiscovered oil and natural gas resources and proved oil and gas reserves for all onshore Federal lands in the United States. The text of Section 604 and the related conference report are given below.

1.2 The EPCA as Amended by the Epact 2005

Sec. 604. Scientific Inventory of Oil and Gas Resources[16]

(a) In General—

The Secretary of the Interior, in consultation with the Secretaries of Agriculture and Energy, shall conduct an inventory of all onshore Federal lands. The inventory shall identify—

(1) the United States Geological Survey estimates of the oil and gas resources underlying these lands;

(2) the extent and nature of any restrictions or impediments to the development of the resources, including—

(A) impediments to the timely granting of leases;

(B) post-lease restrictions, impediments, or delays on development for conditions of approval, applications for permits to drill, or processing of environmental permits; and

(C) permits or restrictions associated with transporting the resources for entry into commerce; and

(3) the quantity of resources not produced or introduced into commerce because of the restrictions.

(b) Regular Update—

Once completed, the USGS resource estimates and the surface availability data as provided in subsection (a)(2) shall be regularly updated and made publicly available.

(c) Inventory—

The inventory shall be provided to the Committee on Resources of the House of Representatives and to the Committee on Energy and Natural Resources of the Senate within two years after the date of enactment of this section.

15 "Federal Lands Analysis, Natural Gas Assessment, Southern Wyoming and Northwestern Colorado, Study Methodology and Results," May 2001, available on the DOE website: http://fossil.energy.gov/programs/oilgas/publications/fla/Federal_Lands_Assessment_Report.html

16 Section 604 of EPCA was amended by Section 364 of EPAct 2005 (42 USC 6217).

(d) Assessments—
Using the inventory, the Secretary of Energy shall make periodic assessments of economically recoverable resources accounting for a range of parameters such as current costs, commodity prices, technology, and regulations.

1.3 The EPCA Phase I and II Inventories

Released in January 2003, the EPCA Phase I Inventory focused on basins of the Interior West, where most Federal onshore oil and gas resources in the lower 48 states are located.[17] The Phase I Inventory covered the Uinta-Piceance, Paradox/San Juan, Powder River, and Greater Green River Basins and the Montana Thrust Belt.

The EPCA Phase II Inventory was released in November 2006 and superseded the Phase I Inventory.[18] It includes all the Rocky Mountain basins covered by the Phase I Inventory as well as six additional basins – Northern Alaska (NPR-A and ANWR 1002), the Wyoming Thrust Belt, Denver Basin, Florida Peninsula, Black Warrior Basin and the Appalachian Basin. In addition, the Phase II Inventory adds the effect of COAs on land access.

17 Scientific Inventory of Onshore Federal Lands' Oil and Gas Resources and Reserves and the Extent and Nature of Restrictions or Impediments to Their Development, January 2003, available on the BLM website: http://www.blm.gov/epca/epcaI.htm.

18 Scientific Inventory of Onshore Federal Lands' Oil and Gas Resources and Reserves and the Extent and Nature of Restrictions or Impediments to Their Development, November 2006, available on the BLM website: http://www.blm.gov/epca/epcaI.htm.

1.4 The National Petroleum Council Report, 2003

In 2003, the NPC provided an update to its 1999 natural gas study.[19] With respect to Federal land access, the NPC examined COAs in addition to lease stipulations. The study found that the COAs are more of an impediment to development than leasing stipulations. For example, in the Green River Basin, the 2003 NPC study determined that 9 percent of the resource was unavailable for leasing with an additional 31 percent "effectively" off-limits to development due to prohibitive COAs. The NPC study noted that, in addition to making leasable areas unavailable, the COAs added significant costs and delays to development. Further, it estimated that of the 238 TCF undiscovered, technically recoverable natural gas resources in the Rocky Mountain region, 69 TCF are unavailable for development while the remaining 56 TCF are affected by access-related regulatory requirements.

1.5 Approach

Similar to the Phase II Inventory, a Steering Committee, composed of representatives from the participating agencies, was responsible for overseeing the completion of the Phase III Inventory. Subsequent to the Phase II Inventory, the Steering Committee identified the next six major oil and gas geological provinces to be examined:

- Central Alaska (Yukon Flats) (YKF)
- Southern Alaska (SAK)
- Eastern Oregon-Washington (EOW)

19 Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy, National Petroleum Council, September 2003, available on the NPC website: http://www.npc.org/reports/ng.html.

- Ventura Basin (VEN)
- Eastern Great Basin (EGB)
- Williston Basin (WIL).

As with the Phase II Inventory, each of these study areas is defined by the aggregation of the USGS oil and gas resource plays for each area. The energy resource, Federal land status, and oil and gas constraints data for these areas were incorporated into a Geographic Information System (GIS) that allows derivative mapping and statistical analysis. The results presented in this report are inclusive as the Phase III Inventory incorporates and supersedes the Phase II Inventory.

1.6 Roles of the Agencies

Section 604 of EPCA designated responsibility for preparing the Inventory to the DOI, in consultation with the USDA and DOE. The Interagency Steering Committee is responsible for providing guidance for conducting the studies, recommending direction to the company contracted to support the Inventory, making decisions concerning critical parameters, reviewing the methodologies and results, and publishing the report.

The Secretary of the Interior designated the Bureau of Land Management (BLM) as the lead agency for the Inventory. The BLM maintains the oil and gas lease stipulation information and well files containing COAs for lands under its jurisdiction, and land status data for all Federally owned lands within the United States.

The USGS, also a bureau of the DOI, conducts assessments of undiscovered technically recoverable oil and natural gas. The primary source of the oil and gas resource information used in this study is the USGS National Assessment of United States Oil and Gas Resources.

The Secretary of Agriculture designated the USDA-Forest Service (FS), its primary land management agency, to contribute its information regarding oil and gas lease availability and leasing stipulations for lands within the National Forest System.

The DOE contributes its expertise and experience in guiding the design and analysis process for the Inventory. DOE's EIA contributes its analysis of proved reserves estimates and reserves growth for Federal lands.

During the course of this study (including earlier Inventory phases), members of the Steering Committee and contract personnel visited field offices within the various basins. The BLM, FS and other Federal agency personnel from more than 110 offices (Table 1-1) participated in these visits. The purpose of these visits was to inform Federal land managers about the studies and to solicit input concerning lease stipulations, COAs, and other issues of concern regarding oil and gas development. As described in Section 2, information obtained from these officials was critical to the study. Data were collected during and following the field visits.

[20] The contractor is Enegis, LLC of Fairfax, VA. They have engaged Premier Data Services of Englewood, CO as a subcontractor.

Table 1-1. Federal Land Management Offices Participating in the Inventory

Jurisdiction	Study Area*
National Forests in Alabama	BWB
Albuquerque, NM, BLM Field Office	SJB
Allegheny NF	APB
Anchorage, AK, BLM Field Office	SAK
Angeles NF	VEN
Arapaho and Roosevelt NF and Pawnee NG	DEN
Arizona Strip, AZ, BLM Field Office	EGB
Ashley NF	UPB, SWW
Bakersfield, CA, BLM Field Office	VEN
Battle Mountain, NV, BLM Field Office	EGB
Beaverhead-Deerlodge NF	MTB
Big Cypress National Preserve	FLP
Bighorn NF	PDR
Billings, MT, BLM Field Office	PDR
Bitterroot NF	MTB
Black Hills NF	PDR, DEN
Bridger-Teton NF	WTB, SWW
Buffalo, WY, BLM Field Office	PDR
Burley, ID, BLM Field Office	EGB
Butte, MT, BLM Field Office	MTB
Caribou-Targhee NF	EGB, WTB
Carson NF	SJB
Casper, WY, BLM Field Office	PDR, DEN
Cedar City, UT, BLM Field Office	EGB, PDX
Chugach NF	SAK
Cibola NF	SJB
Custer NF	PDR
Dakota Prairie NG	WIL
Daniel Boone NF	APB
Deschutes NF	EOW
Desert Range Experiment Station	EGB
Dillon, MT, BLM Field Office	MTB
Dixie NF	PDX
Elko, NV, BLM Field Office	EGB
Ely, NV, BLM Field Office	EGB
Fairbanks, AK, BLM Field Office	NAK

Jurisdiction	Study Area*
Farmington, NM, BLM Field Office	SJB
Fillmore, UT, BLM Field Office	EGB, UPB
Finger Lakes NF	APB
Fishlake NF	PDX, UPB
Flathead NF	MTB
Gallatin NF	MTB
George Washinton NF	APB
Glennallen, AK, BLM Field Office	SAK
Glenwood Springs, CO, BLM Field Office	UP, SWW
Grand Junction, CO, BLM Field Office	UPB, PDX
Grand Mesa Uncompahgre/Gunnison NF	UPB, PDX
Gunnison, CO, BLM Field Office	UPB
Helena NF	MTB
Humboldt NF	EGB
Idaho Falls, ID, BLM Field Office	WTB, EGB
Jackson, MS, BLM Field Office	FLP, BWB, APB
Jefferson NF	APB
Chugach NF	SAK
Jurisdiction	Study Area*
Kemmerer, WY, BLM Field Office	SWW, WTB
Kootenai NF	MTB
Lakeview, OR, BLM Field Office	EOW
Lander, WY, BLM Field Office	SWW
Las Vegas, NV, BLM Field Office	EGB
Lewis and Clark NF	MTB
Lewistown, MT, BLM Field Office	MTB
Little Snake, CO, BLM Field Office	UPB, SWW
Lolo NF	MTB
Los Padres NF	VEN
Malta, MT, BLM Field Office	WIL
Manti La Sal NF	UPB, EGB, PDX
Medicine Bow-Routt NF and Thunder Basin NG	UPB, PDR, SWW
Miles City, MT, BLM Field Office	PDR, WIL

Table 1-1. Federal Land Management Offices Participating in the Inventory (continued)

Jurisdiction	Study Area*
Milwaukee, WI, BLM Field Office	APB
National Forests in Mississippi	BWB
Missoula, MT, BLM Field Office	MTB
Moab, UT, BLM Field Office	UPB, PDX
Monongahela NF	APB
Monticello, UT, BLM Field Office	PDX
Nebraska NF and Oglala & Buffalo Gap NG	PDR, DEN
Newcastle, WY, BLM Field Office	PDR, DEN
North Dakota, BLM Field Office	WIL
Northern, AK, BLM Field Office	YKF, NAK
Ochoco NF	EOW
Palm Springs/South Coast, CA BLM Field Office	VEN
Pike-San Isabel NF	DEN
Pinedale, WY, BLM Field Office	SWW, WTB
Pocatello, ID, BLM Field Office	EGB, WTB
Price, UT, BLM Field Office	UPB, PDX
Prineville, OR, BLM Field Office	EOW
Rawlins, WY, BLM Field Office	SWW, DEN
Richfield, UT, BLM Field Office	UPB, EGB, PDX
Rock Springs, WY, BLM Field Office	SWW
Royal Gorge, CO, BLM Field Office	DEN
Salt Lake, UT, BLM Field Office	UPB, EGB, WTB
San Juan, CO, BLM Field Office	SJB, PDX
San Juan NF	SJB, PDX
Santa Fe NF	SJB
Sawtooth NF	EGB
South Dakota BLM Field Office	PDR, DEN, WIL
Spokane, WA, BLM Field Office	EOW
St. George, UT, BLM Field Office	PDX, EGB
Taos, NM, BLM Field Office	SJB
Tennessee Valley Authority	BWB, APB
Tongass NF	SAK
Uinta NF	UP, EGB
Umatilla NF	EOW
Uncompahgre, CO, BLM Field Office	UPB, PDX
Vale, OR, BLM Field Office	EOW
Vernal, UT, BLM Field Office	UPB
Wasatch-Cache NF	WTB, EGB, SWW
Wayne NF	APB
White River, CO, BLM Field Office	UPB, SWW
White River NF	UPB, SWW

1.7 Intended Use

This Inventory is designed to be useful to a wide range of interests. In a broad sense, it gives a picture of where oil and natural gas is estimated to occur and a quantification of what statutory and administrative constraints limit exploration and development. Agencies can use this Inventory data to identify areas of high resource potential and to examine Federal land management decisions affecting access to energy resources. This Inventory provides both the public and Federal land managers with information about the potential magnitude of oil and natural gas resources unavailable for development due to access limitations. This information can be used in conjunction with information about other resource values and the environment.

The highly detailed Federal land access data along with the oil and gas resource data are available for additional analyses by Congress, industry, environmental organizations, and other interested parties. Land withdrawals, oil and gas lease stipulations, and COAs mitigate or prevent adverse impacts to other valuable land resources. Land management agencies can analyze this information together with existing policies and procedures to identify opportunities for improving and enhancing decisions in their land use planning, leasing, and permitting processes. Agencies can use this information to prioritize the need for additional data and analyses, and to identify opportunities for improving access to oil and gas resources. Overall, this Inventory provides fundamental information to help resolve development issues.

A fundamental product of this Inventory is the GIS database containing numerous layers of geographic data referenced by longitude and latitude. An important caution applies to the use and interpretation of the undiscovered energy resources data: the exact locations of recoverable accumulations of undiscovered oil and natural gas resources on Federal lands are unknown. For the purpose of this Inventory, it is assumed that there is a uniform distribution of the resources across the geographic extent of a given play or assessment unit.

Over the last several decades, the USGS methodology has been the government's standard for oil and gas resource estimation. The USGS assessment process estimates the volume of undiscovered oil, natural gas, and natural gas liquids that have the potential to be added to reserves during a 30-year forecast period. Assessment results are based on known or estimated geological input parameters provided by knowledgeable geologists—parameters such as trapping mechanism, source rock, reservoir quality and size of known accumulations. Because of the uncertainty about the input parameters, the assessment result is expressed as a probability distribution of potential resources in the assessment unit or geologic play. For these reasons this Inventory does not imply that the locations of accumulations of undiscovered oil and gas resources are known to occur under specific land parcels.

1.8 Products/Future Direction

The tables, data, maps (GIS products), and this summary report, describing the methodology, applied standards, results, and land access issues, are available on DVD and on the BLM (http://www.blm.gov/epca) website.

Section 604 of EPCA requires that all Federal lands of the onshore United States be inventoried. With the completion of this Phase III report, an estimated 87 percent of the onshore Federal oil and gas resources, including reserves growth, were inventoried in detail, and the results for the remaining 13 percent were extrapolated. For subsequent releases, the information and analysis for previously studied areas will be updated as the availability of new data and developments in technology warrant.

2.0 Methodology

The Inventory examines the following geological provinces in detail:[20]

- Northern Alaska (NAK)
- Central Alaska – Yukon Flats (YKF)
- Southern Alaska (SAK)
- Eastern Oregon-Washington (EOW)
- Ventura Basin (VEN)
- Eastern Great Basin (EGB)
- Uinta-Piceance Basin (UPB)
- Paradox Basin (PDX)
- San Juan Basin (SJB)
- Montana Thrust Belt (MTB)
- Williston Basin (WIL)
- Powder River Basin (PDR)
- Wyoming Thrust Belt (WTB)
- Southwestern Wyoming (SWW)[21]
- Denver Basin (DEN)
- Florida Peninsula (FLP)
- Black Warrior Basin (BWB)
- Appalachian Basin (APB).

The study areas were delineated by aggregating oil and/or natural gas resource plays[22] within the provinces as defined by the USGS National Assessment of Oil and Gas Resources. Resource play boundaries and oil and gas resource estimates within the plays were obtained in GIS format from the USGS. These plays were then aggregated in a GIS to create a resource density map layer for each study area.

Where play boundaries span more than a single geologic province, one province was selected over the other in order to preserve geographic uniqueness for the purposes of this Inventory. For example, at the boundary of the PDX and UPB study areas, the UPB was defined by the outline of Uinta plays even though these plays overlap plays from the Paradox Basin. The Uinta-Piceance study area thus contains some Paradox Basin resources and reserves. Likewise, the WTB and SWW study areas were defined by the SWW USGS boundaries and the DEN and PDR study areas by the PDR USGS province boundaries.

Federal land status was generated using the "Status" dataset from the BLM's Legacy Rehost 2000 (LR-2000) system to create GIS maps. Oil and gas leasing stipulation and COA data were obtained for each jurisdiction from BLM field offices and FS offices in the study areas. Most of the stipulation data were available in GIS format; some existed only as hardcopy and had to be digitized to create GIS map files.

Stipulations[23] and COAs are additional requirements that are attached to Federal oil and gas leases and drilling permits for environmental protection and other reasons and are subject to change over time. This Inventory represents a "snapshot" of the conditions within the study areas at the time of data collection. The stipulations used in the Inventory are those applied when new

[20] The study areas in this document are referenced in USGS Oil and Gas province order.

[21] Southwestern Wyoming was referred to as the "Greater Green River Basin" in the Phase I and II releases. The name has been changed to follow USGS nomenclature.

[22] "Plays," more recently referred to as "assessment units," are a set of known or postulated oil and gas accumulations having similar geologic origins. The term plays is used generically in this document (see section 2.2.1 for further explanation).

[23] Different land use planning documents refer to their mitigation/protection restrictions by a number of different names, including Guidelines, Standards, and Required Operating Procedures (ROP). For the purpose of this report, all of these restrictions are referred to as "stipulations."

oil and gas leases are issued and are those contained primarily in National Forest Plans (FPs) and BLM Resource Management Plans (RMPs) in effect as of December 2006. Some stipulations are not maintained in an automated system and may not have been available for use in this Inventory (see Section 2.1.2 for further discussion).[24]

After lease issuance, and prior to approval of any drilling activities, the operator must submit an Application for Permit to Drill (APD). An APD provides operational and geologic information as well as the applicant's proposal for use of the surface. The COAs are post-lease requirements that are attached to an approved APD for environmental protection, safety, and conservation of resource. The COAs were developed over a number of years as mitigation measures for surface disturbing activities and are based upon lease notices and/or administrative policy actions.

To the extent that current leases were issued under, and are stipulated according to, an existing land use plan, the Inventory accurately reflects the access situation. Older leases issued before the effective date of the relevant plans may not be subject to stipulations from the current land use planning document. It is reasonable, however, to consider the plan stipulations as applicable. Environmental conditions that necessitate stipulations often are the driver for COAs that are attached to drilling permits on older leases. The surface managing agency is therefore able to achieve the needed environmental protection.

Additional factors exist that affect oil and gas exploration and development on Federal lands. Many cannot be quantified prior to the receipt of a specific drilling application. The factors include:

- Protection for threatened, endangered, and sensitive species. Surveys are sometimes required to determine whether a lease contains habitat for such species.
- Archaeological surveys are sometimes required under the authority of the National Historic Preservation Act. Related issues involve other cultural resources and consultation with Native American tribes.
- Air quality impacts and resulting restrictions on activities that may affect air quality.
- Visual impacts of oil and gas operations.
- Noise from oil and gas operations.
- Suburban encroachment on oil and gas fields and county government restrictions.

Section 4 of this report presents these issues in greater detail. Many of these requirements manifest themselves as COAs attached to drilling permits following a specific analysis under the National Environmental Policy Act (NEPA). These requirements can delay or modify a planned oil and gas development activity at the permit stage and, in some cases, preclude it altogether. Site-specific COAs have been incorporated into the Inventory and further described in Section 2.1.3.

Analytically, the Inventory entailed the spatial intersection (in a GIS) of oil and gas resource information with data on Federal land ownership and access constraints. The Inventory also takes into account how leasing stipulations are implemented

[24] For quality control purposes, after the stipulation lists were compiled, they were made available to the individual field offices, who were encouraged to review the stipulations and offer any changes to stipulations or their access categorization. All changes suggested by offices were incorporated into the Inventory.

in practice by Federal land managers by considering the effect of directional drilling and the general frequency with which exceptions to the stipulations are granted.[25]

The rest of this section provides a more detailed description of the Inventory methodology.

2.1 Procedures for Collecting and Preparing Land Status and Oil and Gas Access Constraints

2.1.1 Federal Land Status

This section briefly presents the process for determination of land status. See Appendix 3 for a more detailed description.

2.1.1.1 Sources of Land Status Data

The primary source of Federal land status data outside of the Eastern areas was the BLM's LR-2000 Status Dataset, which was supplemented by other records from Federal, state, and county governments. For the Eastern study areas the mapping of Federal lands was completed based upon detailed research of multiple sources of information that describe the nature and extent of Federal surface and mineral interests. In the Alaska study areas, the primary source of land status data was the State of Alaska supplemented by records from other Federal and state government sources.

2.1.1.2 Land Status Data Preparation

Land Status data, which are often stored in alphanumeric format, were converted, as necessary, for this Inventory into a GIS layer by using commercially available software. The software interpolated the legal descriptions contained in the Status Dataset against a public land survey GIS layer derived from either the BLM's Geographic Coordinate Database (GCDB) or other sources such as digitized USGS 7-1/2 minute quadrangle maps.

Maps of the Federal land status for the study areas are presented in Figures 2-1 through 2-18. Maps of the Federal land status for Extrapolation Areas by region are included as Figures 2-19 through 2-21, and use information from the publicly available National Atlas.[26]

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25 Areas within the EPCA inventory with less than 5 BCF (equivalent) of gas were analyzed by extrapolating the land access data from nearby areas with greater resources. This includes areas in Jarbidge, ID BLM; Kremmling, CO BLM; La Jara, CO BLM; Klamath Falls, OR BLM; and Colville, Fremont, Gifford-Pinchot, Mt. Baker-Snoqualmie, Mt. Hood, Wenatchee, and Winema National Forests. These areas were included in the total resource values for their respective basins.

26 National Atlas, http://www.nationalatlas.gov/mld/fedlanp.html

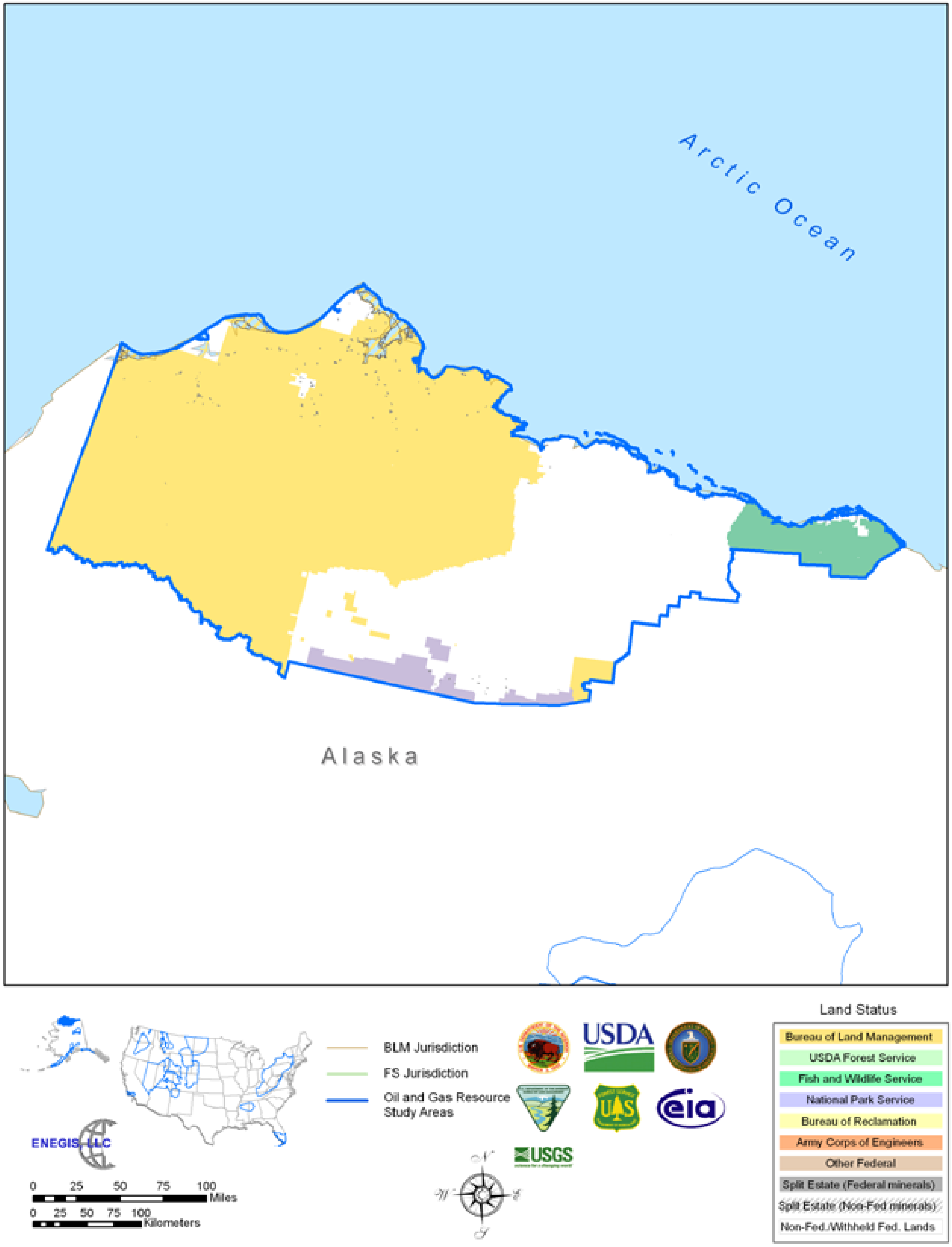

Figure 2-1. Federal Land Status Map, Northern Alaska Study Area

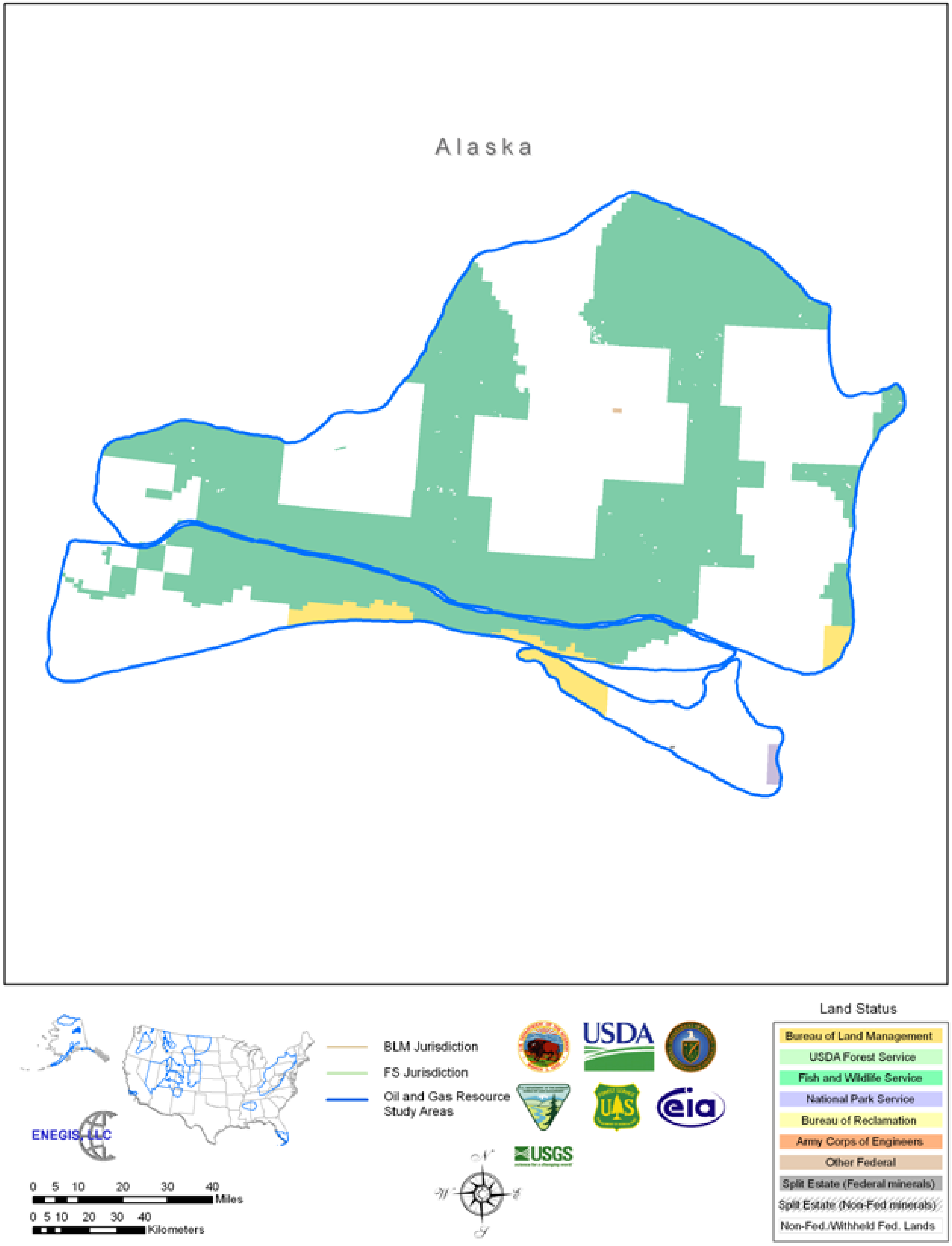

Figure 2-2. Federal Land Status Map, Central Alaska - Yukon Flats Study Area

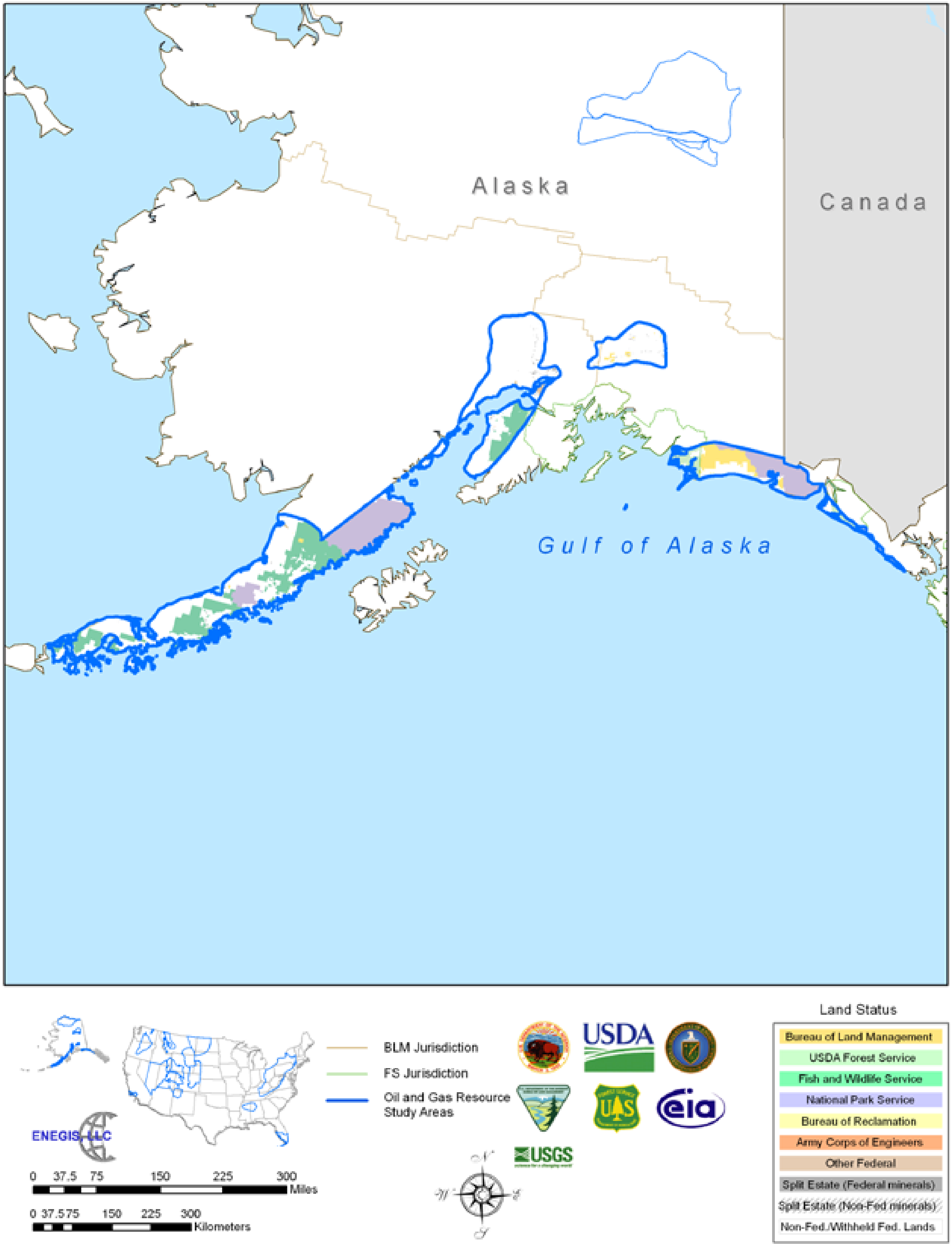

Figure 2-3. Federal Land Status Map, Southern Alaska Study Area

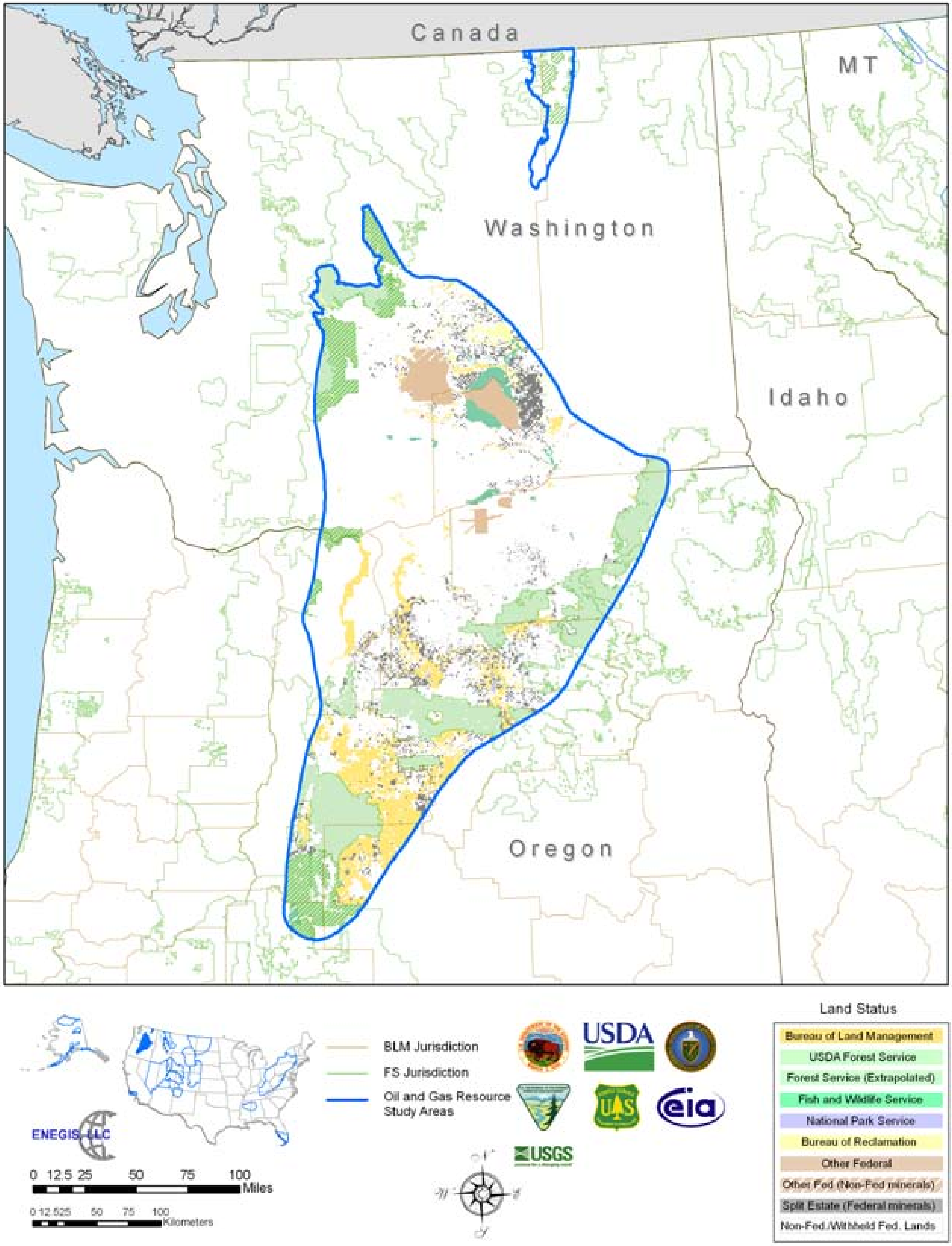

Figure 2-4. Federal Land Status Map, Eastern Oregon-Washington Study Area

Figure 2-5. Federal Land Status Map, Ventura Basin Study Area

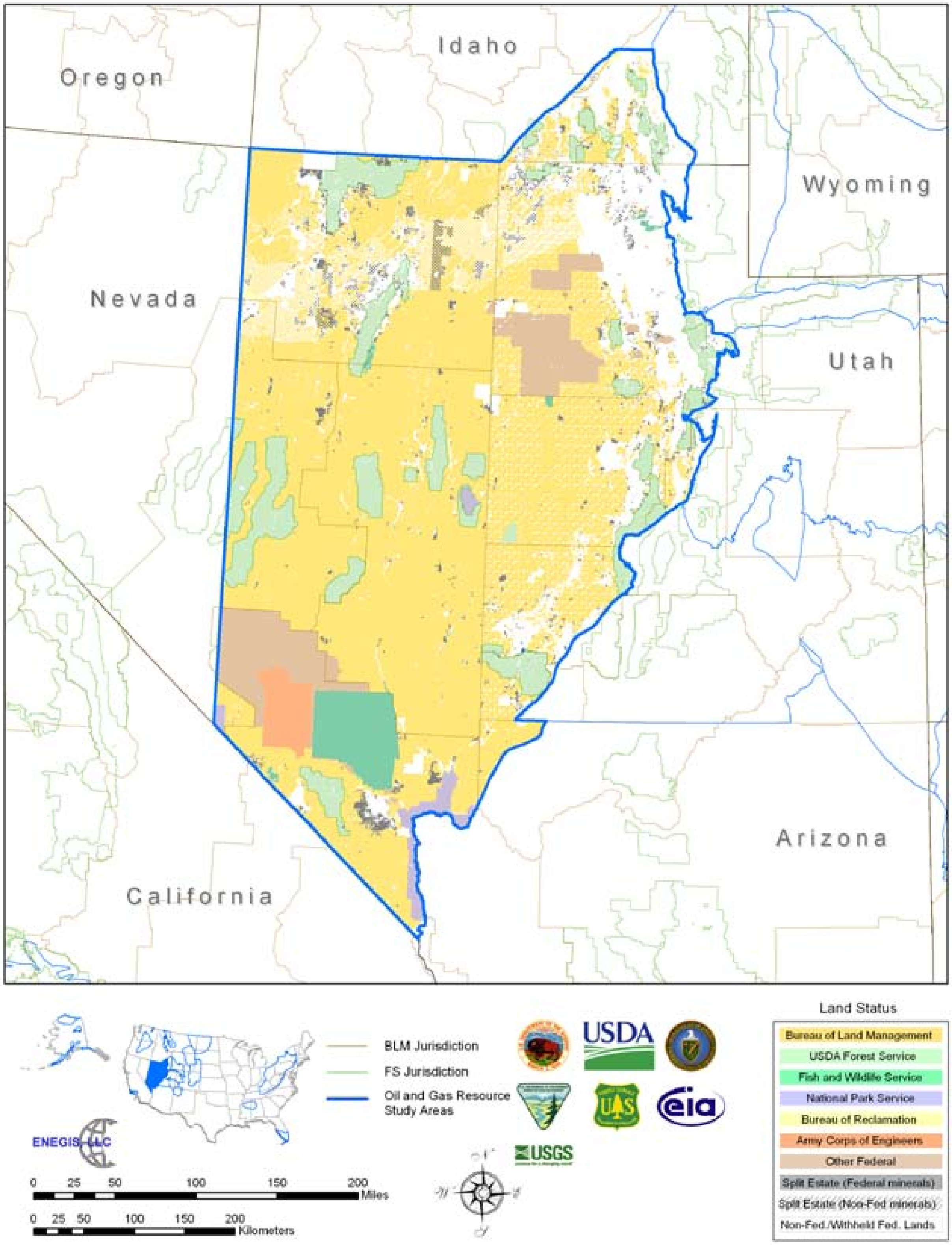

Figure 2-6. Federal Land Status Map, Eastern Great Basin Study Area

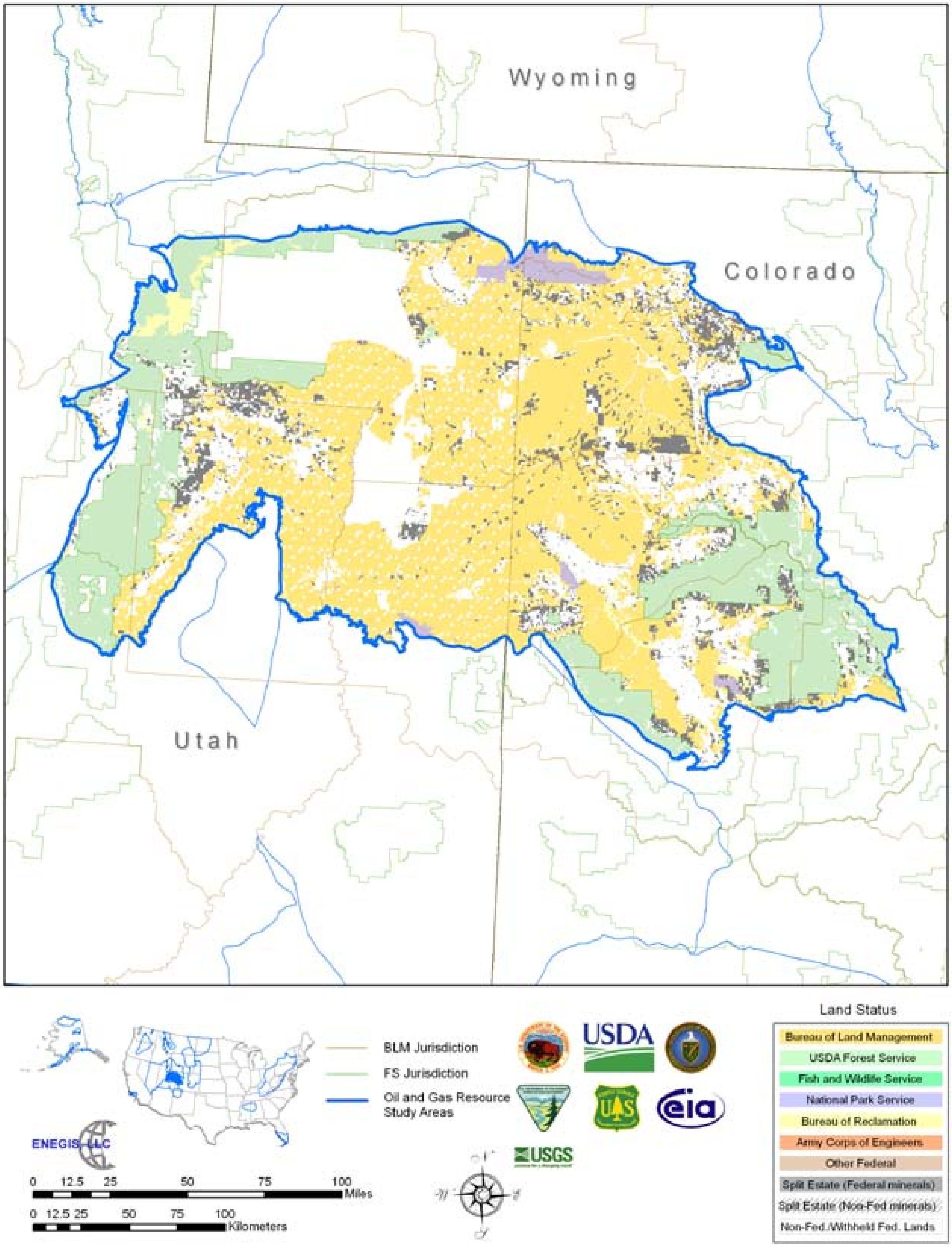

Figure 2-7. Federal Land Status Map, Uinta-Piceance Basin Study Area

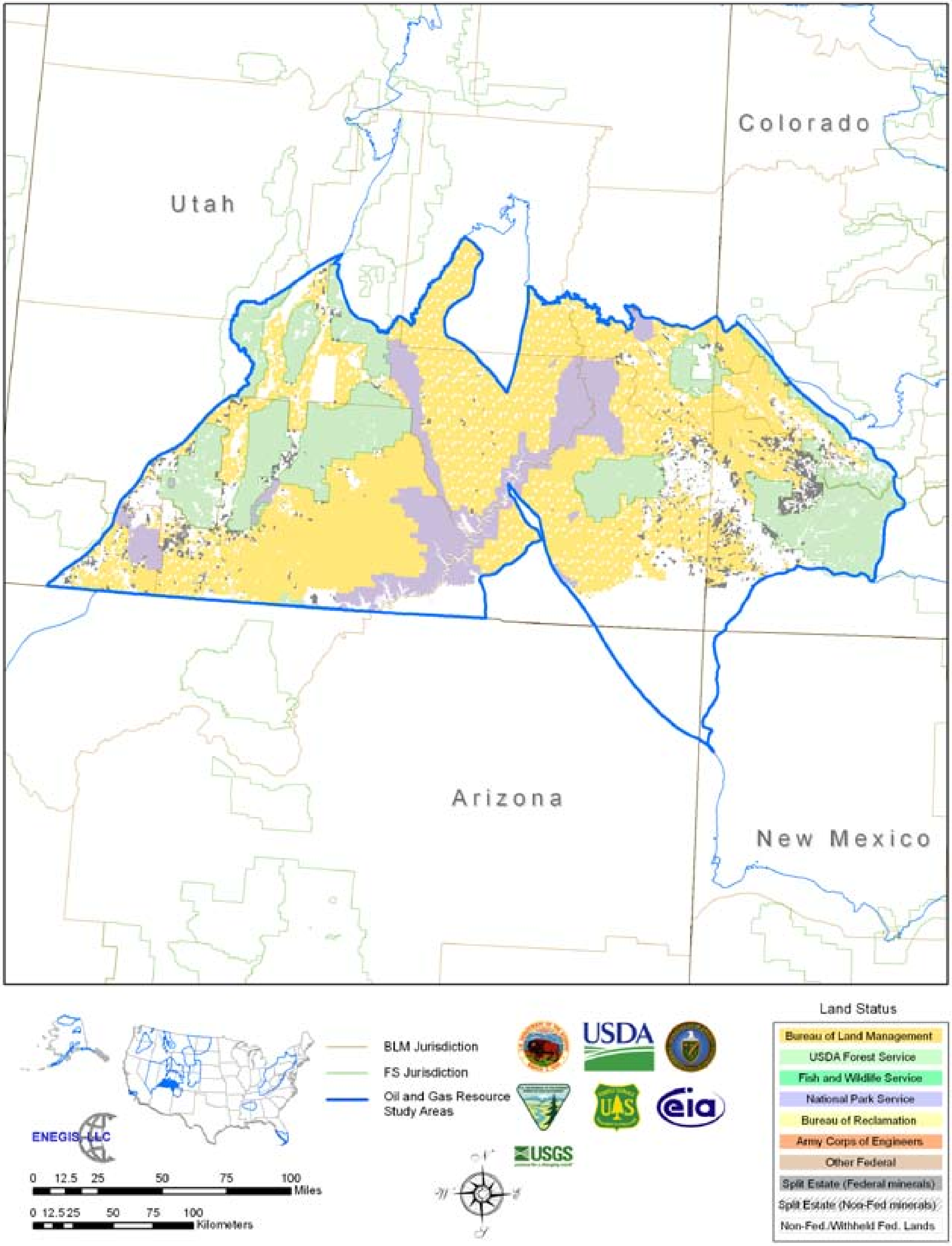

Figure 2-8. Federal Land Status Map, Paradox Basin Study Area

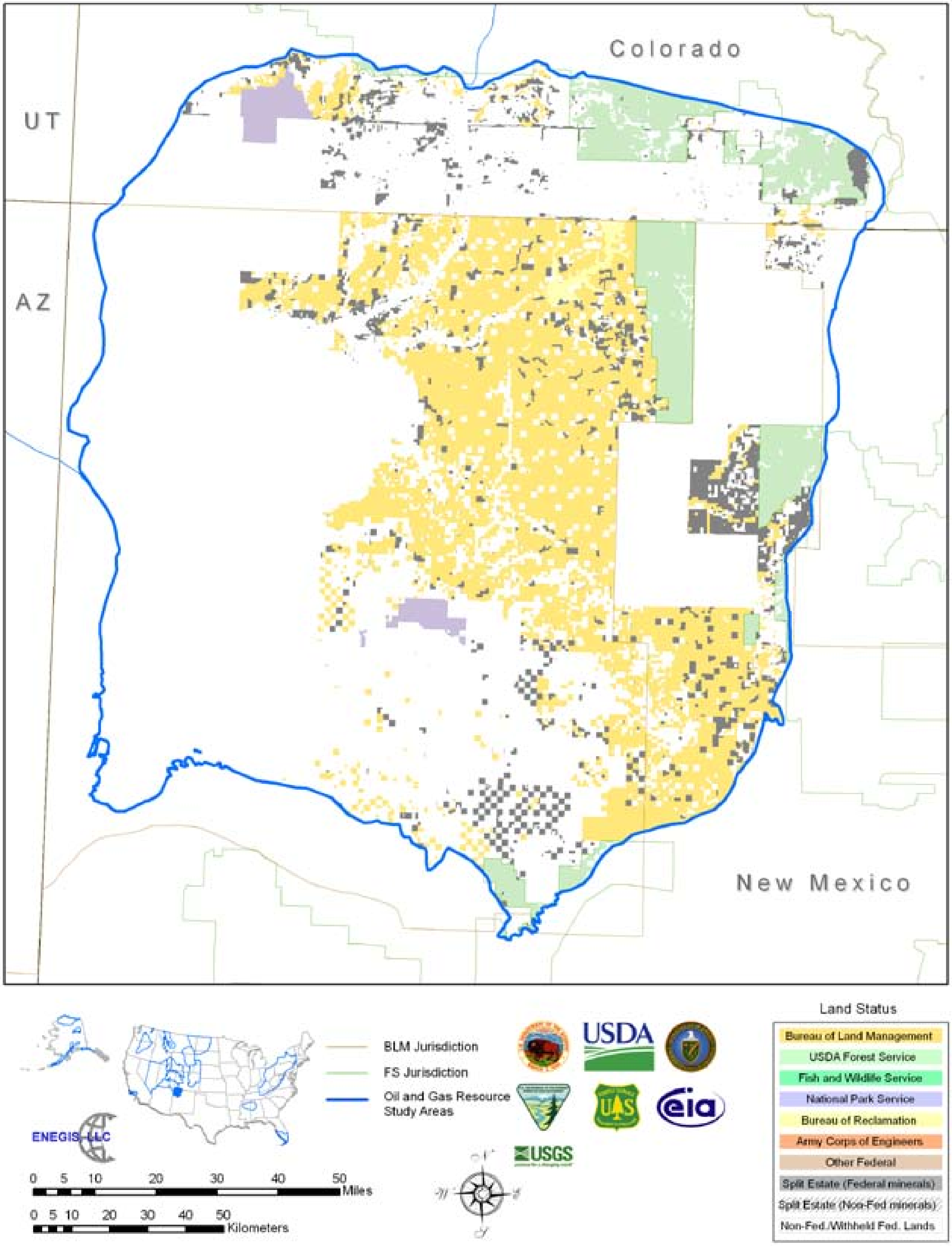

Figure 2-9. Federal Land Status Map, San Juan Basin Study Area

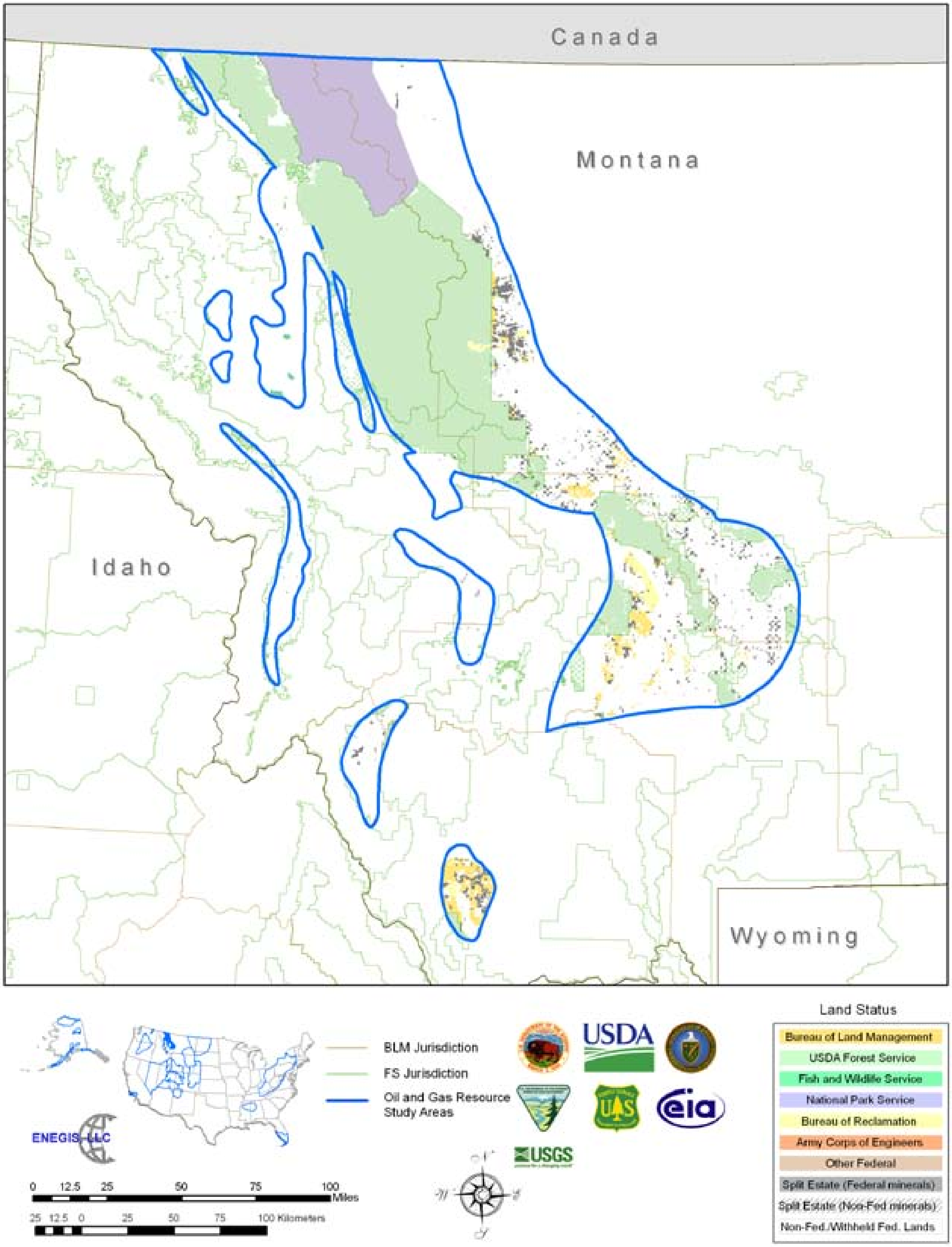

Figure 2-10. Federal Land Status Map, Montana Thrust Belt Study Area

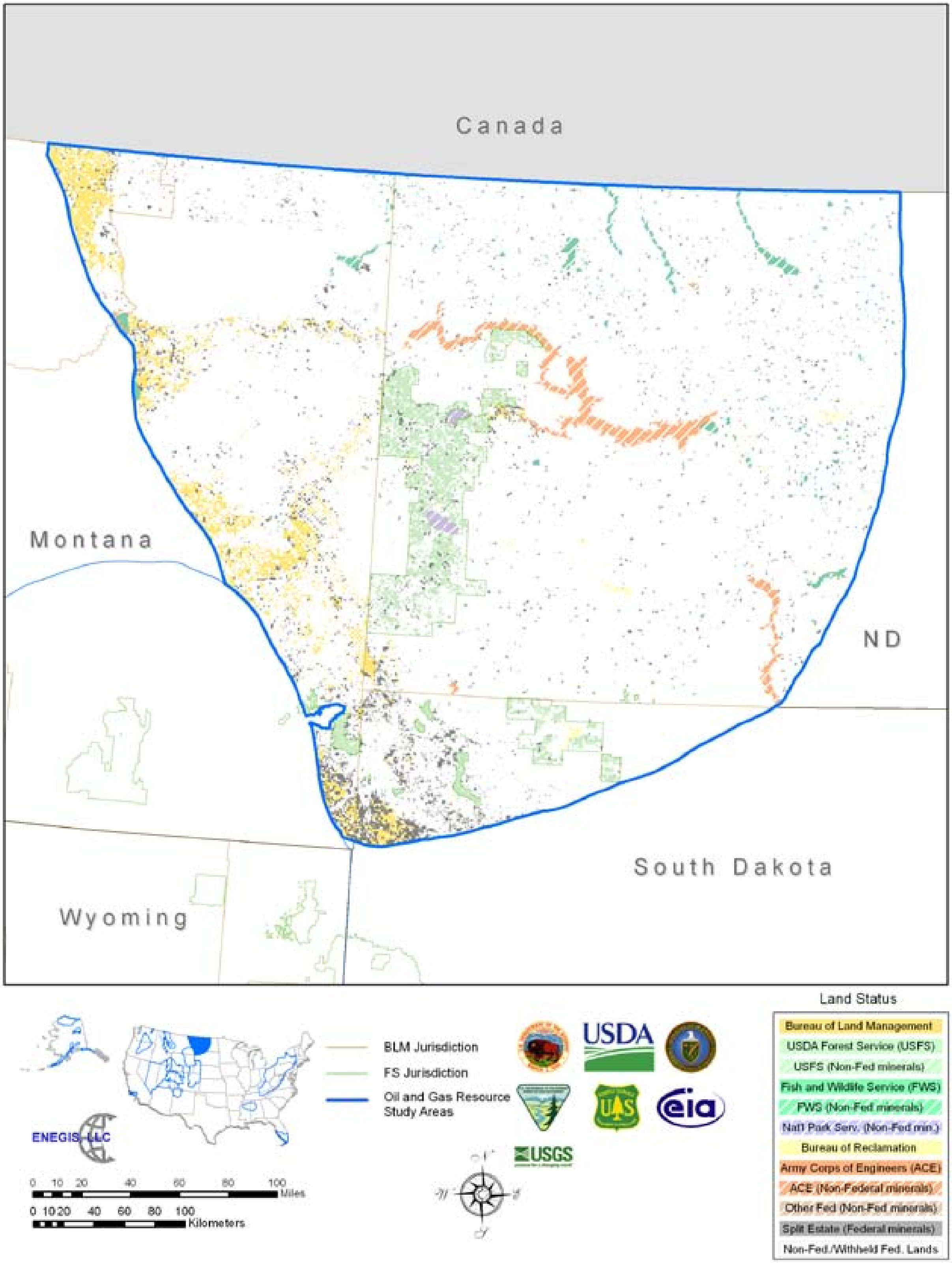

Figure 2-11. Federal Land Status Map, Williston Basin Study Area

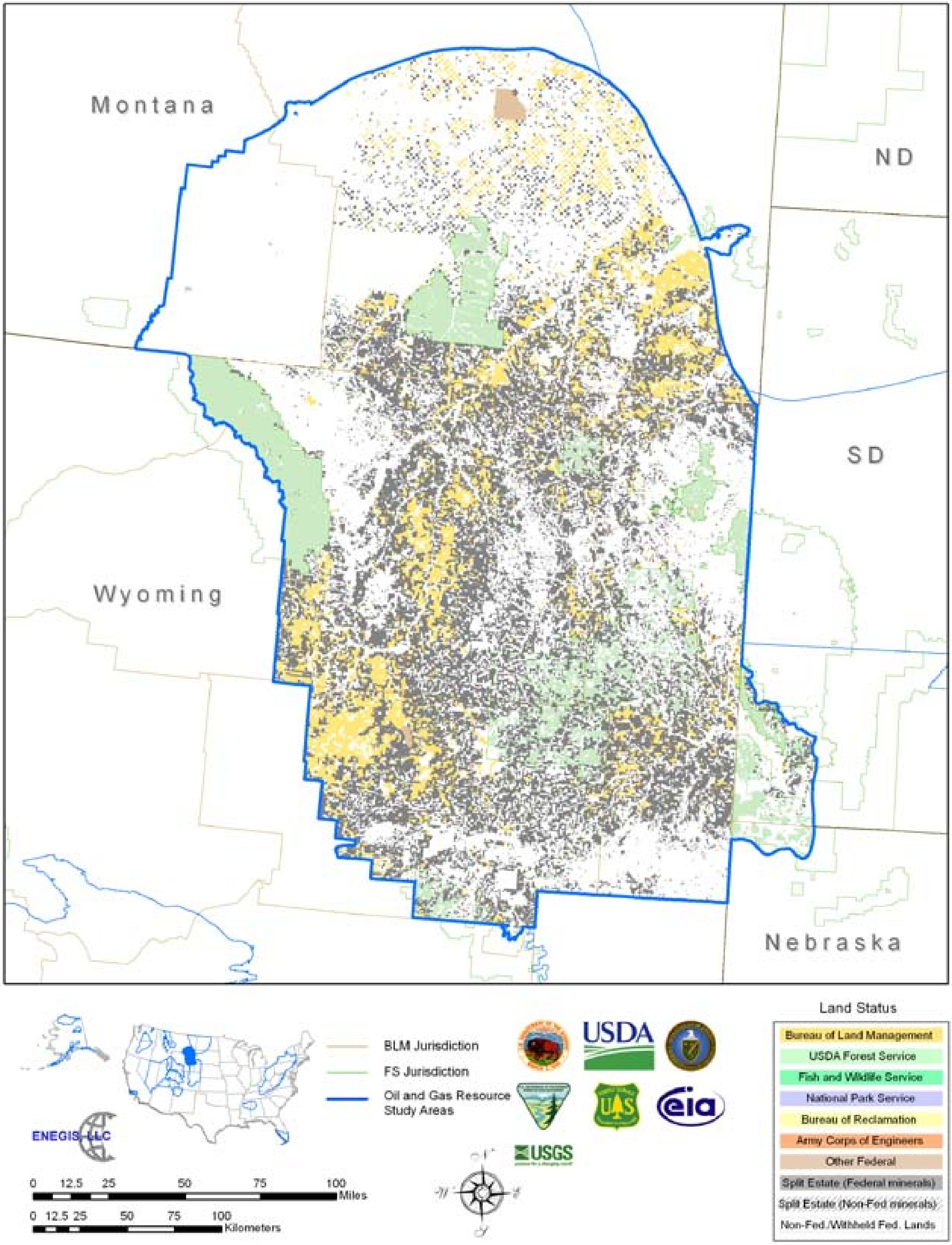

Figure 2-12. Federal Land Status Map, Powder River Basin Study Area

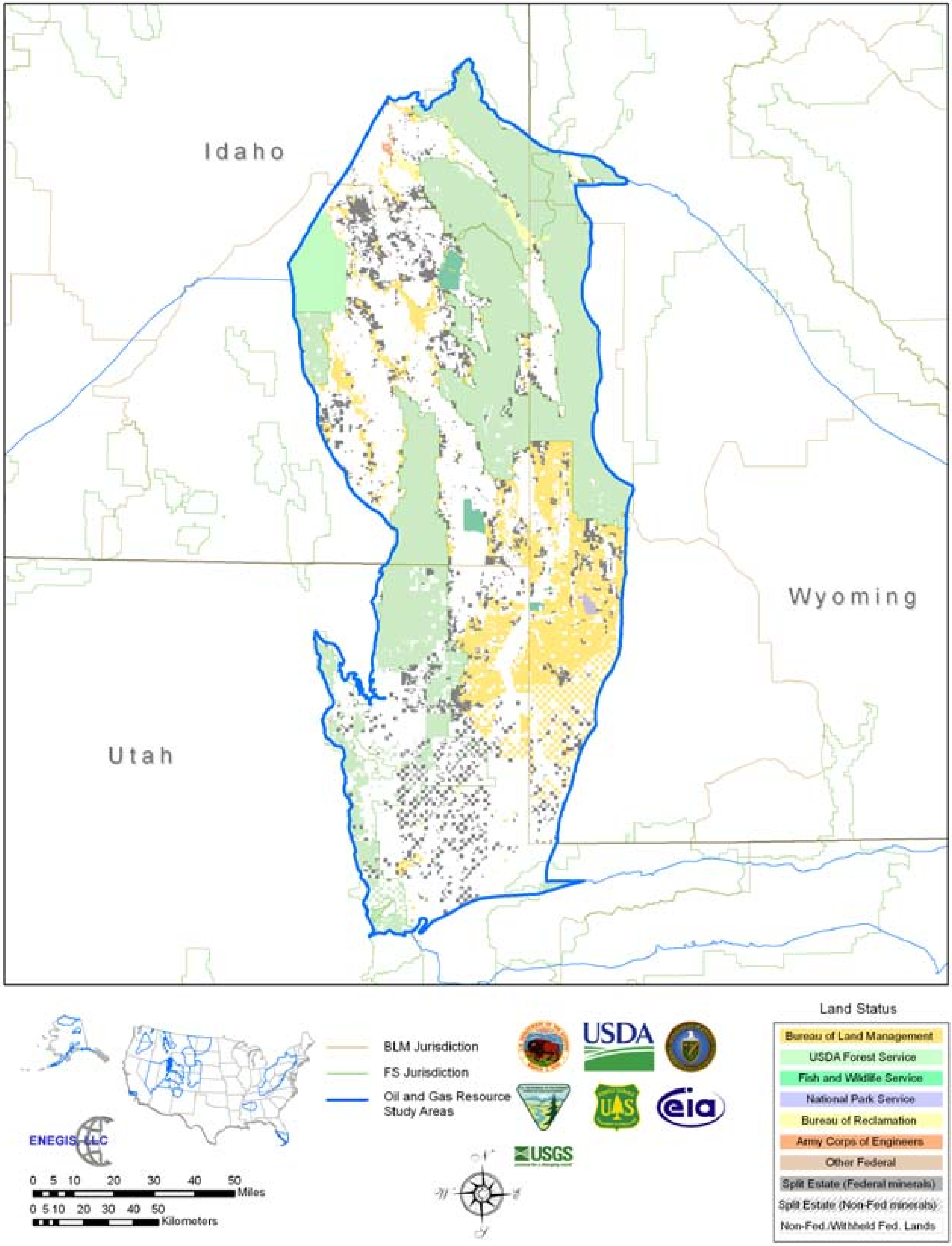

Figure 2-13. Federal Land Status Map, Wyoming Thrust Belt Study Area

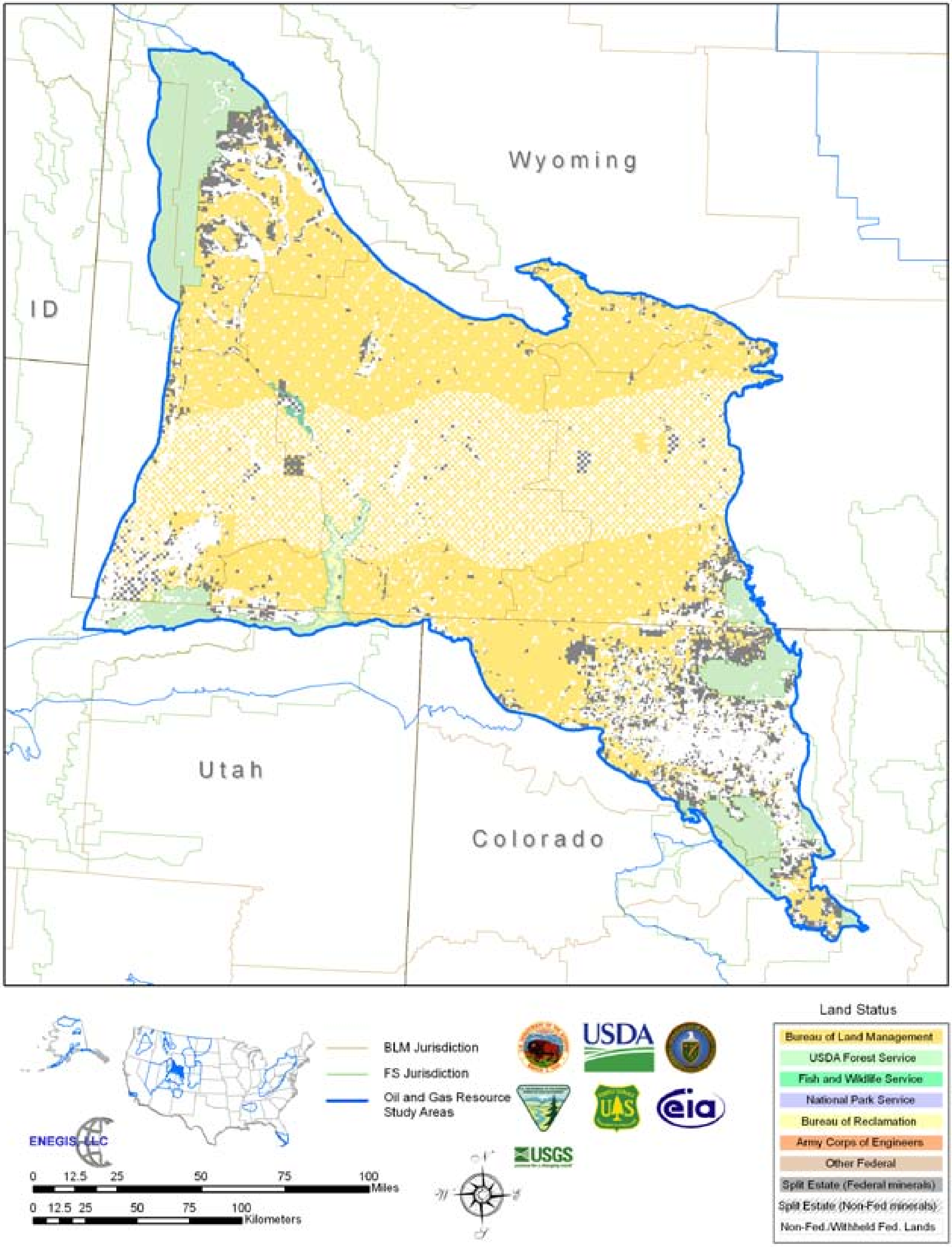

Figure 2-14. Federal Land Status Map, Southwestern Wyoming Study Area

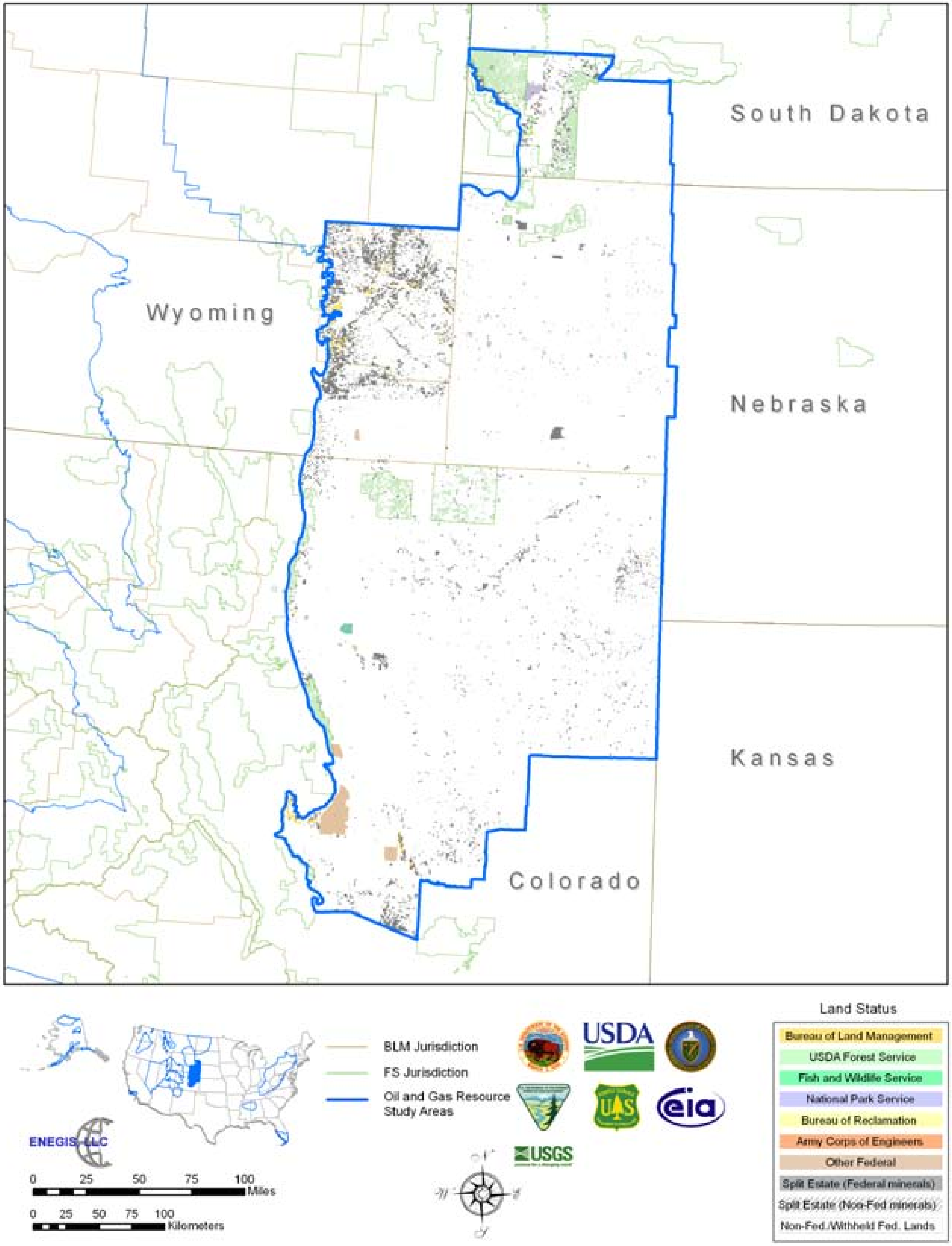

Figure 2-15. Federal Land Status Map, Denver Basin Study Area

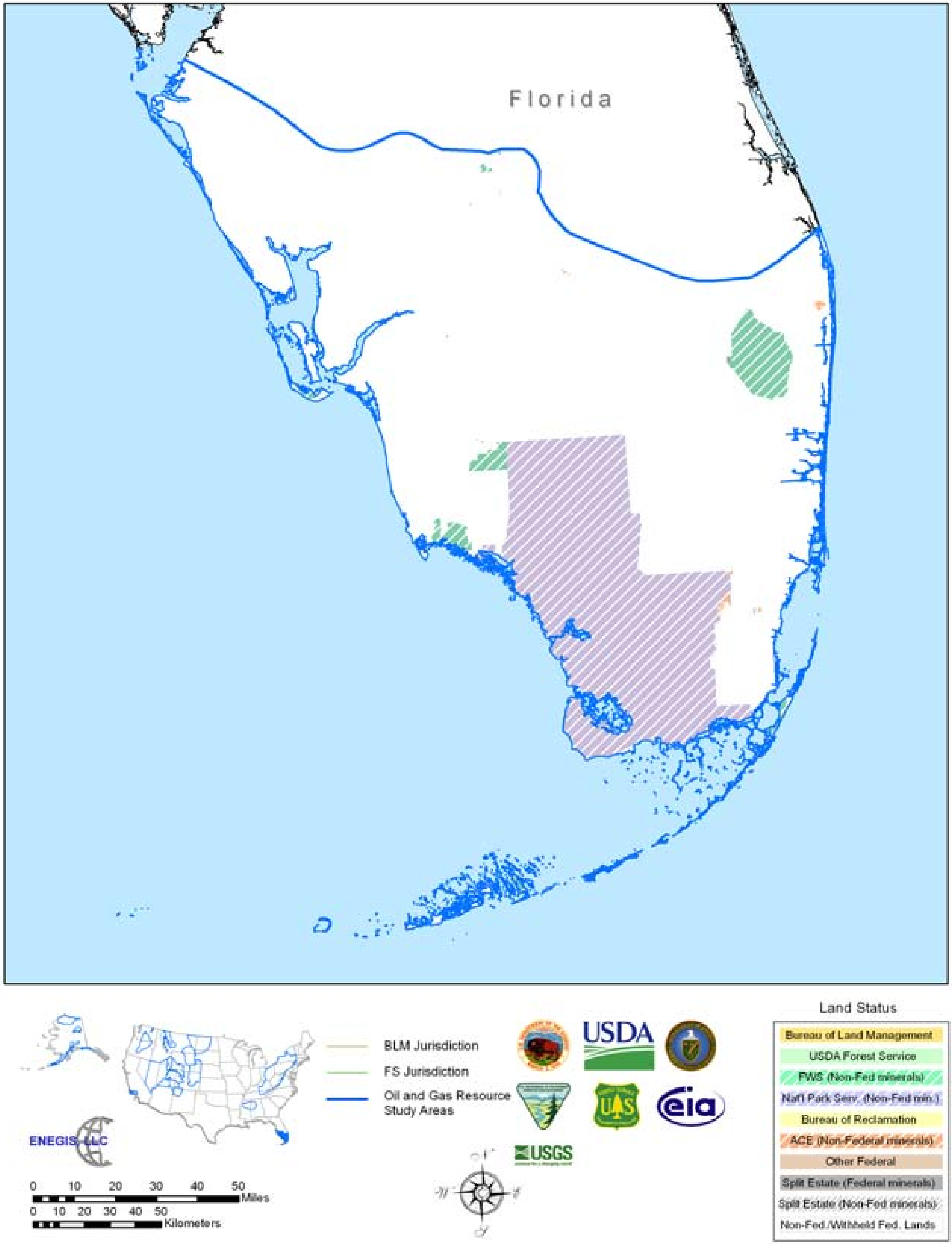

Figure 2-16. Federal Land Status Map, Florida Peninsula Study Area

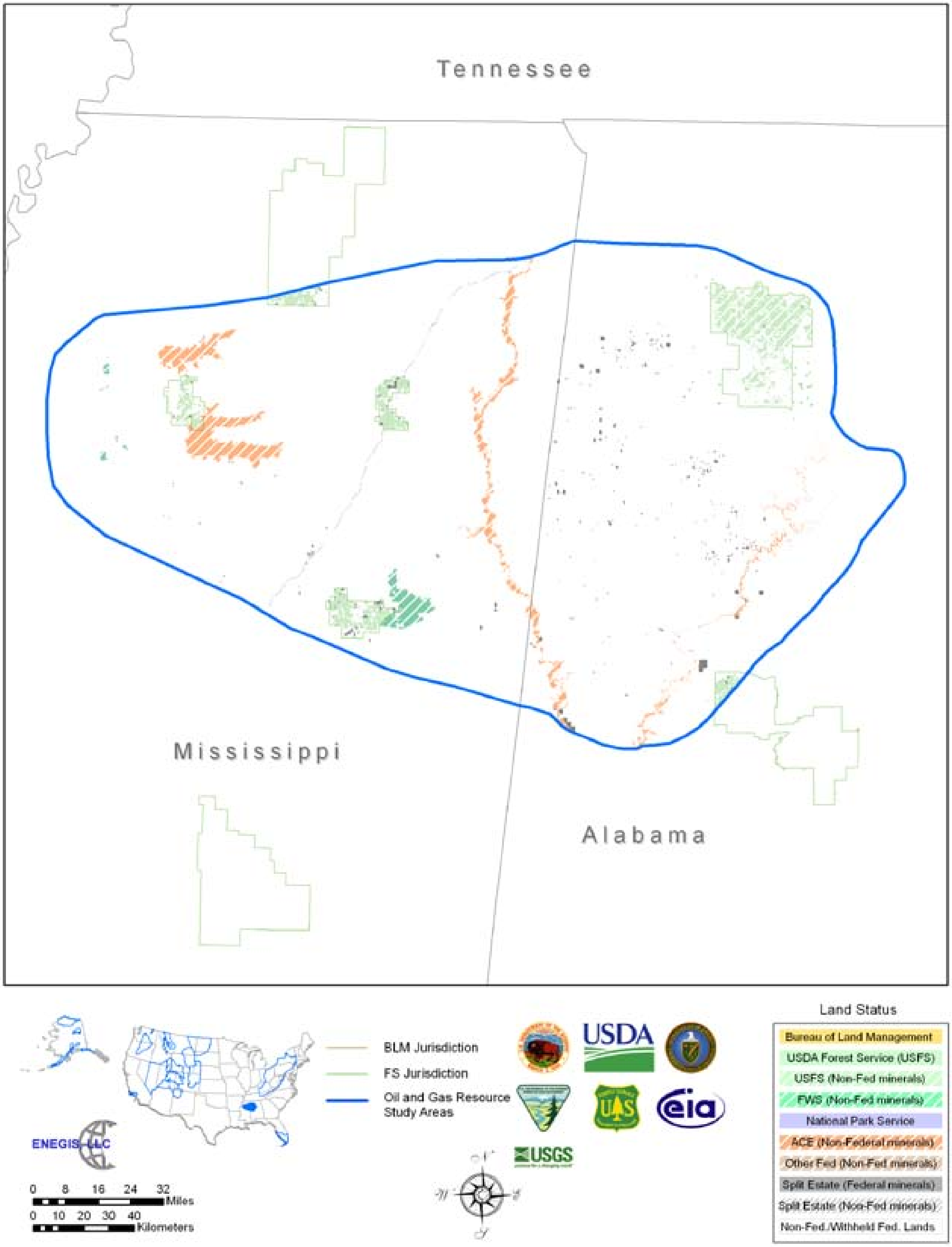

Figure 2-17. Federal Land Status Map, Black Warrior Basin Study Area

Figure 2-18. Federal Land Status Map, Appalachian Basin Study Area

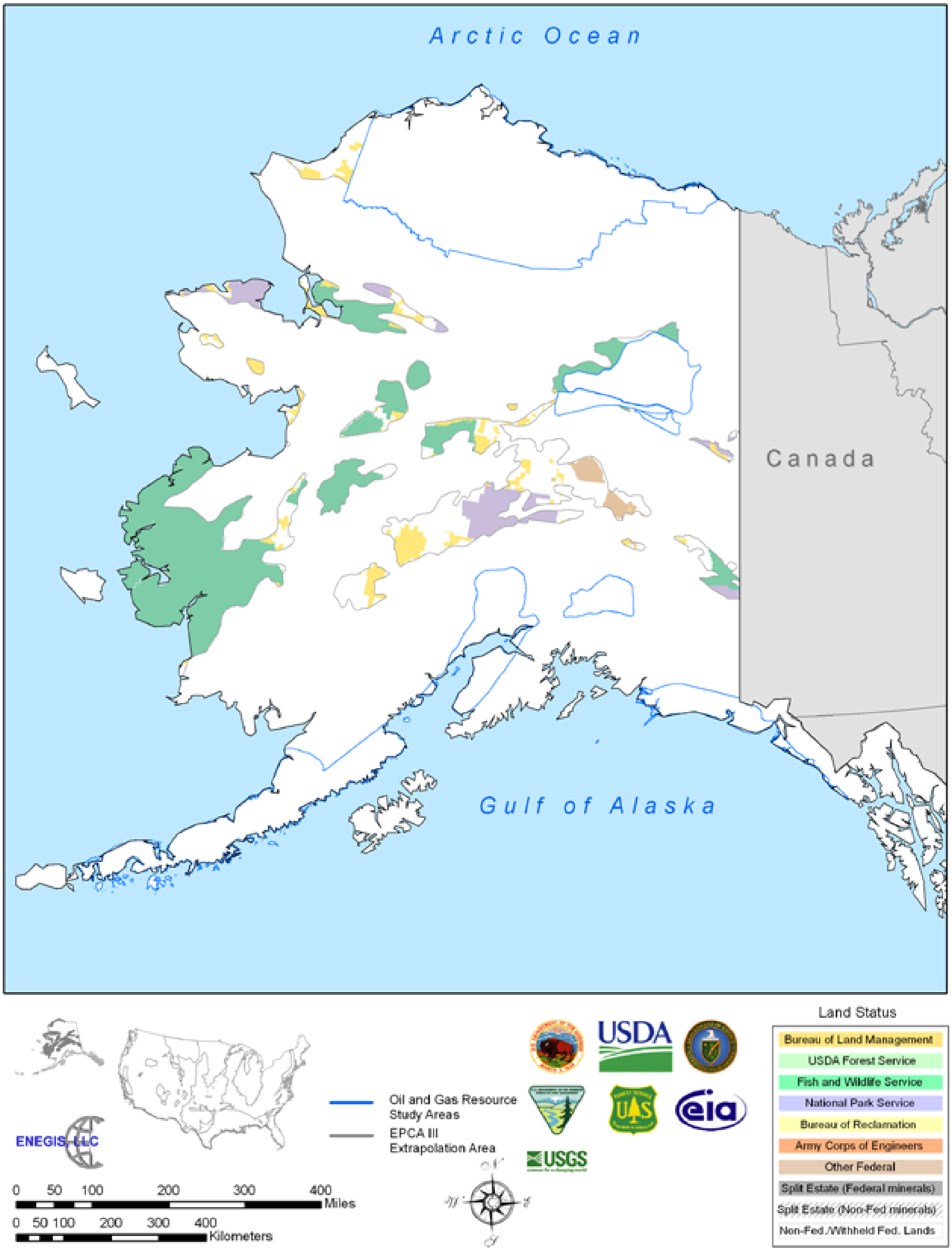

Figure 2-19. Federal Land Status Map, Alaska Extrapolation Area

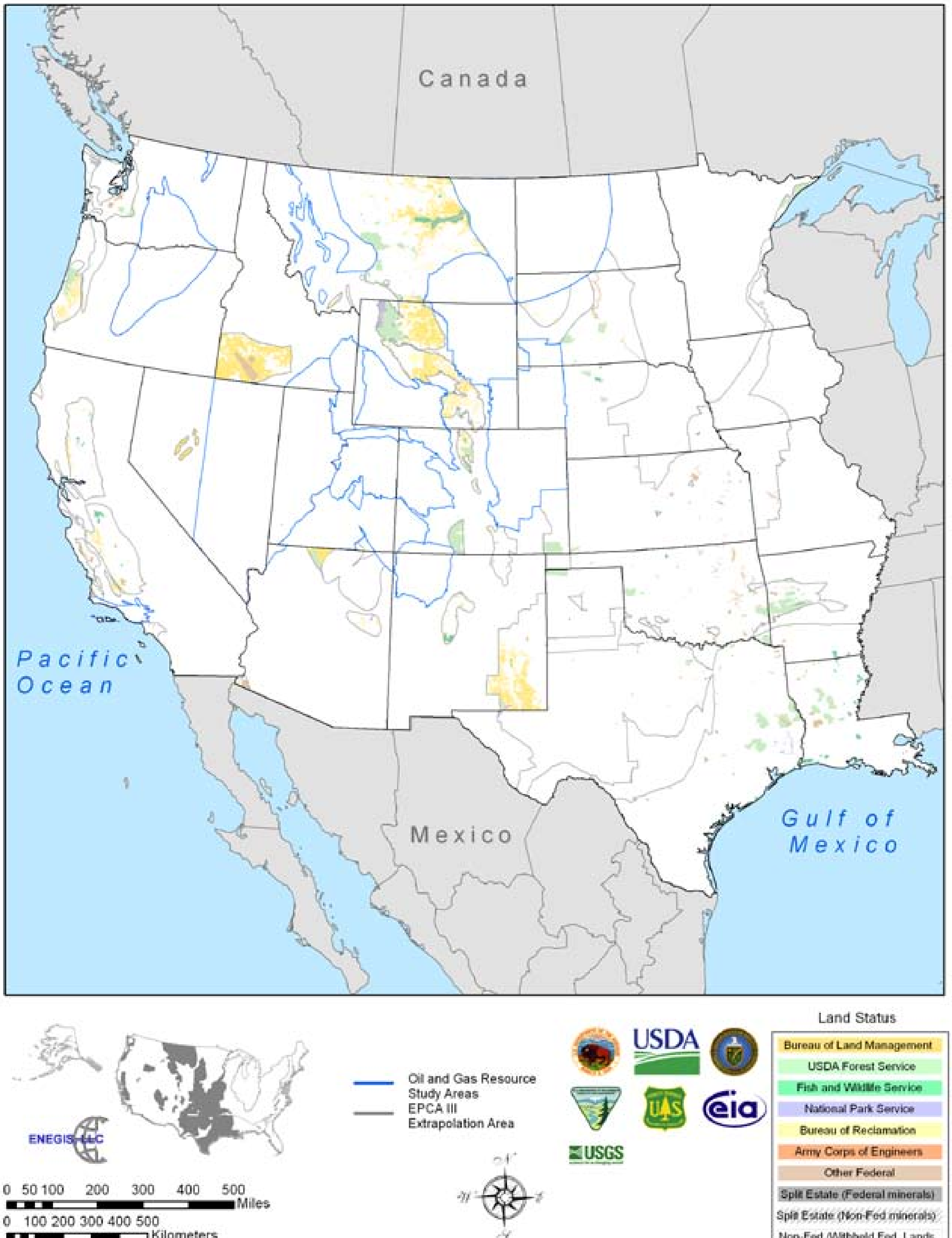

Figure 2-20. Federal Land Status Map, Western Extrapolation Area

Figure 2-21. Federal Land Status Map, Eastern Extrapolation Area

2.1.1.3 Land Status Data-Related Caveats

The following precautions are advised when reviewing this Inventory:

- The land status data are generally spatially accurate down to 40 acres for the lower 48 States. In Alaska, the data are spatially accurate down to 640 acres.
- The GIS files, created using the processes described in detail in Appendix 3, were interpolated from the legal land descriptions contained in the BLM's LR-2000 database. If a legal description referenced a small survey lot or tract by number, a nominal location was mapped through a process that referenced the Legal Land Description dataset. This dataset is limited to a 40-acre description and therefore carries a minor degree of generalization in complex areas. Isolated parcels of less than 40 acres, particularly in the Eastern study areas, were not included in the Inventory.
- This mapping process uses public land survey data derived from various sources. The spatial location of the land status parcels so derived matches the accuracy of the survey data.
- Some land status GIS data are restricted from public release by agency request. Such data were used in the analyses presented in this report, but are not contained in the public datasets.

For purposes of this Inventory, Federal lands include split estate lands. In cases of split estate lands, where the Federal government holds a partial interest in the oil and gas mineral estate, the Federal government was assumed to hold total mineral interest. Table 2-1 depicts Federal lands by surface management agency within the Inventory. Note that the table includes both comprehensively studied areas and extrapolated areas.

Table 2-1. Federal Land Acreage by Surface Management Agency

Federal Surface Management Agency	Detailed Study Areas (acres)	Extrapolated Areas (acres)	Total Phase III Inventory Acreage (acres)	Extrapolated (percent)
Bureau of Land Management (including split estate)	114,438,133	26,994,121	141,432,254	19%
Forest Service, U.S. Department of Agriculture	36,015,422	23,853,805	59,869,227	40%
Fish and Wildlife Service	12,979,860	29,493,919	42,473,779	69%
National Park Service	11,834,570	6,289,748	18,124,318	35%
Department of Defense	4,791,945	7,668,537	12,460,482	62%
Army Corps of Engineers	2,407,574	0	2,407,574	0%
Bureau of Reclamation	776,843	739,111	1,515,954	49%
Tennessee Valley Authority	50,993	332,162	383,155	87%
Other Federal Lands	237,292	135,183	372,475	36%
Total Federal Lands	183,532,631	95,506,586	279,039,217	34%

2.1.2 Federal Oil and Gas Availability for Leasing and Lease Stipulations

All onshore Federal oil and gas leases contain terms and conditions as specified on the standard lease form (BLM Form 3100-11).[27] Some of these terms and conditions govern land use and resource development to a certain extent. Environmental and other considerations, which are identified during the land use planning process, determine the need for additional terms and conditions, also known as lease stipulations. For example, a lease may contain a stipulation that prohibits surface disturbance during certain time periods for wildlife. Such stipulations on land use and timing may constrain exploration and development of oil and natural gas on Federal lands.

Some Federal lands are unavailable for leasing. See Table A9-2 in Appendix 9 for a listing of agencies and Federal designations that generally prohibit oil and gas leasing.

The Federal government does not issue oil and gas leases for areas where it has surface ownership but no mineral rights. In such instances, the Federal government, while allowing access to the subsurface resources owned by another party, typically uses surface occupancy restrictions (SORs) to protect surface resources. From the standpoint of the Inventory, SORs and lease stipulations have similar impacts. Thus, for the purposes of this study, the term "stipulation" is used generically to include SORs.

2.1.2.1 Sources of Lease Stipulation Data

Oil and gas lease stipulations are derived from the Federal surface management agency's land use plans, e.g., RMPs for the BLM and FPs for the FS. These plans are generally produced and maintained by their respective agencies on a field office jurisdictional basis (in the case of the BLM), or on a National Forest/Grassland basis (in the case of the FS). Land use planning documents are revised every 10 to 15 years, or on an as-needed basis, but may be amended to address specific land use issues. Table 2-2 lists the land use planning documents used for this Inventory.

Hardcopy and digital data showing the mapped lease stipulation areas were collected from BLM and FS offices within the study areas (see Table 1-1). During office visits, copies of land use planning documents, such as RMPs and FPs, were also obtained.

Most of the lease stipulation data are maintained by the agencies as GIS data layers (digital map files). Some offices, particularly where the planning effort pre-dated the widespread availability of GIS technology, maintain this information in the form of hardcopy maps. For this Inventory, these maps were digitized, stored, and analyzed as GIS layers. The digitized maps were then returned to the originating field offices for review and future use. For some BLM and FS plans, maps are not available for some stipulations either in GIS or hardcopy form.

Data for this study were collected during the three phases of the Inventory. For the UPB, PDX, SJB, PDR, and MTB study areas, data were initially collected in the winter of 2001-2002. For the SWW study area, data were used from the DOE's Federal

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[27] The form is available at https://www.blm.gov/FormsCentral/show-form.do?nodeId=687#

Table 2-2. Land Use Plans by Study Area

Study Area	Land Use Plan	Year Published
Northern Alaska	Alaska-NE NPRA Final Integrated Activity Plan/EIS -- Amendment	2006
	Alaska-NW NPRA Final Integrated Activity Plan/EIS	2003
	Utility Corridor Proposed RMP and Final EIS	1989
Central Alaska - Yukon Flats	RMP for the Steese National Conservation Area	1986
	RMP for the White Mountains National Recreation Area	2004
Southern Alaska	Revised Land and RMP for Chugach NF	2003
	Revised Land and RMP for Tongass NF	1997
Eastern Oregon-Washington	Lakeview RMP	2003
	Brothers/LaPine RMP	1989
	John Day River Management Plan, Two Rivers, John Day, and Baker RMP Amendments	2001
	Two Rivers RMP	1986
	Upper Deschutes ROD and RMP	2005
	Proposed Spokane RMP and Amended Final EIS	1992
	Baker RMP	1989
	Ochoco NF, Oil & Gas Leasing Analysis Final EIS	1993
	Deschutes NF Plan	1990
	Umatilla and Malheur NFs, O&G Leasing Final EIS	1995
Ventura Basin	Caliente RMP	1997
	South Coast RMP and ROD	1994
	Revised Land Management Plan and Final EIS for Angeles NF	2000
	Revised Land Management Plan and Final EIS for Los Padres NF	2005
Eastern Great Basin	Arizona Strip DO RMP/EIS	1992
	Egan RMP Approved Oil & Gas Leasing Amendment and ROD	1994
	Tonopah RMP and ROD	1997
	Cassia RMP	1985
	Monument RMP	1986
	Cedar Beaver Garfield Antimony RMP	1986
	Pinyon MFP	1983
	Elko RMP and List of Stipulations	1987
	Wells ROD and List of Stipulations	1985
	House Range Resource Area RMP and ROD Rangeland Program Summary	1987
	Warm Springs Resource Area RMP Rangeland Program Summary	1987
	Big Desert Management Plan	1981
	Las Vegas RMP and Final EIS	1998
	Pocatello & Medicine Lodge Resource Areas RMP	1988
	Henry Mtn., Parker Mtn., and Mtn. Valley MFP	1982

Table 2-2. Land Use Plans by Study Area (continued)

Study Area	Land Use Plan	Year Published
Eastern Great Basin (continued)	Bear River EA	1994
	ROD and Rangeland Summary for the Box Elder RMP	1986
	ROD for the Pony Express RMP and Rangeland Program Summary for Utah County	1990
	Revised Forest Plan for the Caribou NF	2003
	Humbolt and Toiyabe Forest Plan and Amendments	2003
	Final EIS for Oil & Gas Leasing on Lands Administered by the Manti-La Sal NF	1992
Uinta/Piceance Basin	Ashley NF Stipulation for Lands of the NF System	1992
	Glenwood Springs Resource Area Final Supplemental EIS	1999
	Grand Mesa, Uncompahgre and Gunnison (GMUG) NFs ROD Oil & Gas Leasing Final EIS	1993
	Grand Junction Resource Area Management Plan and ROD	1987
	Gunnison Resource Area RMP	1993
	Routt NF Land and RMP Revision	1997
	Uncompahgre Basin RMP and ROD	1989
	Thunder Basin Nat. Grassland Land and RMP	2002
	Land and RMP–Manti-La Sal NF	1986
	Book Cliffs RMP ROD and Rangeland Program (combine with Diamond Mtn into Vernal RMP)	1985
	Leasing Stipulations, Craig-Little Snake BLM	1991
	Price River Resource Area MFP	1982
	San Rafael RMP	1991
	Gunnison Gorge NCA Approved RMP and ROD	2004
	Land and RMP Revision–Uinta NF	2003
	San Juan/San Miguel RMP Amendment (San Miguel updated with Uncomphagre RMP)	1991
	San Juan/San Miguel RMP Amendment (San Juan RMP revision)	1991
	Diamond Mountain Recreation Area ARMP/ROD (combine with Book Cliffs into Vernal RMP)	1994
	White River Resource Area RMP	1997
	White River RMP, Oil and Gas Final EIS/ROD	1993
Paradox Basin	Vermillion MFP	1981
	Grand Resource Area RMP	1985
	San Juan ROD & Rangeland Program Summary	1991
	Paria MFP	1981
	Escalante MFP	1981
	Zion MFP	1981

Table 2-2. Land Use Plans by Study Area (continued)

Study Area	Land Use Plan	Year Published
San Juan Basin	Rio Puerco RMP (Now the Albuquerque FO. Update Document 2001. RMP revision TBD)	1992
	New Mexico BOR–Navajo Reservoir (Draft EA Navajo Reservoir Area RMP)	2005
	Carson NF Plan (Valle Vidal amendments in progress)	1986
	Cedar Beaver Garfield Antimony RMP	1986
	Cibola NF Plan (Grasslands RMP under revision)	1985
	Cibola NF Plan (Forests RMP revision to start 2007)	1985
	Farmington Oil and Gas Leasing Amendment	1991
	Taos Field Office Oil & Gas Leasing Stipulations	1985
	St. George FO-ROD and RMP	1999
Montana Thrust Belt	Beaverhead NF EIS	1996
	Headwaters RMP/EIS (South Headwaters update will be part of new Butte FO RMP)	1984
	Dillon RMP	2006
	Headwaters RMP/EIS (North Headwaters RMP revision)	1984
	Helena NF Plan and ROD	1986
	Lewis and Clark NF, Oil and Gas Leasing Final EIS	1997
	Garnet RMP	1986
Powder River Basin	Black Hills NF Plan of Land and RMP	1991
	Buffalo RMP	2001
	Bighorn NF Revised Land and RMP	2005
	South Dakota RMP	1986
	Platte River RMP Revised & Updated Decisions (renamed Casper RMP)	2001
	Billings RMP	2003
	Miles City BLM Oil and Gas Amendment (Miles City RMP Revision 2007)	1994
	Nebraska NF Revised Land and RMP FEIS/RD	2002
	Newcastle FO, ROD & Approved RMP	2000
Williston Basin	Valley MFP	1978
	Big Dry RAMP - Maintenance Version	1996
	Powder River RAMP Maintenance Version	1985
	North Dakota RMP	1988
	Dakota Prairie Grasslands Northern Region Land and RMP FEIS/ROD	2002
Wyoming Thrust Belt	Targhee NF Revised Forest Plan	2000
	Pocatello & Medicine Lodge Resource Areas RMP (Pocatello RMP pending)	1988

Table 2-2. Land Use Plans by Study Area (concluded)

Study Area	Land Use Plan	Year Published
Southwestern Wyoming	Bridger-Teton NF Land and RMP	1990
	Kemmerer RMP/ROD	1986
	Lander RMP	1987
	Medicine Bow NF Revised Land and RMP	2003
	Pinedale Anticline Oil & Gas Exploration and Development Project EIS ROD	2000
	Pinedale RMP amended 2000 for oil & gas	2000
	Lease Stipulations, Rawlins BLM	2001
	ROD and Jack Morrow Hills CAP/Green River RMP Amendment	2006
	ROD and Green River RMP	1997
	Wasatch-Cache NF, Revised Forest Plan	2003
Denver Basin	Arapaho-Roosevelt NFs, Pawnee NG Revision of the Land and Resource Management Plan	1997
	Nebraska RMP	1992
	Pike & San Isabel NF, Cimarron & Comanche NG, O&G Leasing Final EIS (Grasslands)	1992
	Pike & San Isabel NF, Cimarron & Comanche NG, O&G Leasing Final EIS (Forests)	1992
	Royal Gorge RMP and NE Royal Gorge RMP	1991
Florida Peninsula	Florida RMP/ROD	1995
	Big Cypress General Management Plan/ Final EIS	1991
Black Warrior Basin	Alabama NFs–Revised Land and RMP	2004
	Mississippi EA report–O&G leasing on the NFs	1976
Appalachian Basin	Allegheny NF Land and RMP	1986
	Mosquito Creek Lake DR	2000
	Berlin Lake Project DR; Conemaugh River Lake Project EA	1985
	Daniel Boone NF Revised Land and RMP	2004
	Seneca Army Depot and Sampson State Park	1993
	George Washington NF–Final revised Land and RMP	1993
	Jefferson NF–Revised Land and RMP	2004
	Monongahela NF and Amendments Land and RMP	1986
	Wayne NF ROD for the Final EIS Land and RMP	2006

lands analysis[28] collected during the fall and winter of 2000-2001; these data were verified with the local BLM and FS offices and were current as of August 2002. The data for NAK were collected in the fall of 2003. Data for the WTB, DEN, BWB, FLP and APB were collected during 2004. Data for the YKF, SAK, EOW, VEN, EGB, and WIL were collected during 2006. Also during 2006, offices from areas analyzed in the first two phases of the Inventory were canvassed for any updated data, which were collected and incorporated into the Inventory. These data were verified with the local BLM and FS offices and were current as of December 2006.

2.1.2.2 Lease Stipulation Data Preparation

Most of the lease stipulation data preparation consisted of the gathering, digitizing, and compiling of the data in multi-layered digital map files. Federal Geographic Data Committee Standards (FGDC)-compliant supporting documentation (metadata) for the resulting GIS layers was also created.

This Inventory concerns only Federal lands within the aggregate resource play boundaries of the study areas, which are based on geology as defined in the USGS National Assessment of Oil and Gas Resources. Consequently, the land status and stipulation digital map files, which correspond to Federal land management agency jurisdiction boundaries, were clipped using GIS to fit within each of the study area boundaries. Data contained within the compiled digital map files were then queried for unique leasing stipulation values. The results were saved as separate map files. Each digital map file represents a unique stipulation value.

For a description of the specific data preparation steps, see Appendix 4.

2.1.2.3 Lease Stipulation Data-Related Caveats

The following precautions are advised when reviewing this study:

- All stipulations for which GIS data were available from the Federal land management agencies were used in the analysis. Most of the stipulations within the study areas were available in GIS data formats; however, supporting documentation was not generally provided with GIS files. Although this can lead to inaccuracies due to undocumented differences in technical parameters, such errors are minor in terms of the scope of the Inventory.
- The GIS data for areas with steep slopes in the Manti-La Sal National Forest could not be modeled in the form provided by the office, due to the file's extremely large size. All polygons with an area smaller than 1 acre were excluded from the data prior to modeling in order to reduce the file size and allow for geoprocessing. This process is expected to cause the area reported for the forest to be available for leasing with no surface occupancy to be slightly smaller than the actual area.
- Many stipulations not available in GIS format were digitized. Any resulting inaccuracies due to this process are likely to have insignificant impacts upon the analysis.

[28] Federal Lands Analysis, Natural Gas Assessment, Southern Wyoming and Northwestern Colorado, Study Methodology and Results, June 2001, available on the DOE website: http://fossil.energy.gov/programs/oilgas/publications/fla/Federal_Lands_Assessment_Report.html.

- Neither hardcopy nor digital maps were available for some stipulations (see Section 2.3.1.1 for further discussion).
- The lease stipulation data are generally accurate to a minimum of 40 acres in the lower 48 states, and 640 acres in Alaska.

Some lease stipulation GIS data are restricted from public release by agency request. Such data were used in the Inventory's analysis but are not contained in the public datasets.

2.1.3 Federal Drilling Permit Conditions of Approval (COA)

As described in Section 2.1.2, a Federal oil and gas lease conveys the right to develop such resources on the leased land subject to reasonable regulations as determined by the land managing agency. The purpose of the inclusion of COAs in this Inventory is to enhance the land access constraints analysis and thus provide a more complete assessment of the onshore Federal lands' availability for oil and gas exploration and development.

The COAs arise from a variety of controlling authorities, but the most significant and wide-ranging are those governed by four Federal laws; specifically, the Federal Land Policy and Management Act (FLPMA), the NEPA, the Endangered Species Act (ESA) and the National Historic Preservation Act (NHPA). The COAs attached to each APD can be general in nature or site-specific, and thus vary from one BLM Field Office to another.

Some COAs can be identified as "best management practices" while others are included as a standard set by the approving office. In the Inventory study areas, approximately 157 types of COAs provide mitigation for surface-disturbing activities. For example, COAs can address:

- Big game winter range
- Protection of wildlife habitat
- Protection of cultural resources
- Noise reduction
- Road construction and maintenance
- Tanks and pits for fluid storage
- Pipeline and power line construction
- Wildfire suppression
- Management of noxious weeds
- Reclamation
- Erosion control
- Fertilizer application

In order to examine COAs and their effects upon land access, it was necessary for the BLM to review extensively the APD well records in its field offices. The methodology for the assessment of COAs is described in Appendix 5.

2.1.3.1 Sources of Conditions of Approval Data

For the Inventory, a number of APDs for all study areas were sampled. A stratified random sampling protocol was used on a list of all Federal APDs approved during fiscal years 1999-2004. The sample represents approximately 10 percent of the total population. The BLM Field Offices were visited and information on site-specific COAs was abstracted from the hardcopy well files. A summarized version of the COAs and stipulations that affected oil and gas access in each selected APD was noted.

In addition, information was obtained from BLM Field Office personnel to qualitatively assess the extent of negotiations that occur prior to the submission of an APD, including adjustments at the time of well staking and are presented in Appendix 5.

2.1.3.2 Conditions of Approval Data Preparation

The COAs data preparation consisted of compiling the collected information into spreadsheets and spatial GIS displays. The abstracted information was grouped into general classes that were assigned unique codes. Table 2-3 presents a list by BLM office. Appendix 5 contains details on the data preparation task.

Table 2-3. COAs by BLM Field Office

BLM FO	Well Population	Sample Size	Sample Wells w/ COAs
Albuquerque	48	30	4
Bakersfield	11	11	1
Battle Mountain	3	3	1
Buffalo	5,077	200	69
Casper	170	30	25
Elko	3	3	-
Ely	13	13	2
Farmington	2,713	200	74
Glenwood Springs	349	53	16
Grand Junction	40	30	22
Kemmerer	96	30	22
Lander	11	11	7
Little Snake	63	30	23
Miles City	391	66	37
Milwaukee	14	14	2
Moab	23	23	10
Monticello	9	9	3
New Castle	76	30	8
North Dakota	175	25	15
Northern Alaska	39	25	4
Pindale	710	107	72
Rawlins	714	107	50
Rock Springs	173	30	15
Royal Gorge	39	30	23
Salt Lake	1	1	-
San Juan	35	30	22
South Dakota	6	6	1
Uncompahgre	7	7	7
Vernal	861	130	35
White River	320	48	22
Total	**12,190**	**1,332**	**592**

2.1.3.3 Conditions of Approval Data-Related Caveats

The APDs examined were randomly sampled. To the extent that the sample is not representative of the population, extrapolation of sample results could introduce error.

Because of the large number of approved Federal APDs, the sample for the Inventory was restricted to represent a portion of the total number, but has been improved by means of a stratified sampling protocol explained in Appendix 5. This method reduces the impact of potential inaccuracies introduced due to extrapolation of results to general areas. Some field offices had small populations of wells (<30), which can lead to relatively poor samples. In such cases, all wells in an office were sampled.

2.1.4 Extrapolation of Federal Lands and Resources Outside Detailed Study Areas

In order to inventory all Federal onshore oil and gas resources, the analytical model includes an extrapolation of the land and resource categorization to the lands outside the detailed study areas. The areas to be extrapolated were delineated using the USGS 1995 National Oil and Gas Assessment for the United States[29] and new assessments completed[30] since then. The National Atlas Federal lands layer was used for land status within the extrapolated areas.[31] Land area was tallied by Federal surface management agency (see Table 2-1). Additionally, the reserves growth were extrapolated to account for the remaining resources outside the detailed study areas using the proved reserves estimates compiled by the EIA for each state. A detailed explanation of the analytical process for extrapolation can be found in Appendix 9. The results are summarized in Section 3.

2.2 Procedures for Collecting and Preparing Oil and Gas Resource, Reserves Growth, and Reserves Data

2.2.1 Undiscovered Oil and Gas Resources

2.2.1.1 Sources of Oil and Gas Resources Data

In conformance with the EPCA, the volumes of undiscovered technically recoverable oil and gas resources in each oil and gas play are supplied exclusively by the USGS.

Undiscovered technically recoverable resources are those hydrocarbon resources that, on the basis of geologic information and theory, are estimated to exist outside of known producing fields. These resources can be produced using current technology without regard to economic profitability. Technically recoverable resources are a subset of the total resource-in-place that could be expected to be recovered over an exploration and development life cycle measured in decades.

The USGS assesses oil and gas resources in geologic “plays” or “assessment units.” A play is a set of known or postulated oil and gas accumulations defined by common geological conditions (source rock, migration, timing, charge, traps, seals, etc.) that characterize a group of hydrocarbon

[29] USGS National oil and gas assessment. http://energy.cr.usgs.gov/oilgas/noga/1995.html

[30] Completed before February 2007

[31] The National Atlas of the United States. http://www.nationalatlas.gov/

Oil and gas resources occur in four categories:

The *In-place resource* is the total volume of oil and gas thought to exist (both discovered and yet-to-be discovered) without regard to the ability to either access or produce it. Although the in-place resource is primarily a fixed, unchanging volume, the current understanding of that volume is continually changing as geologic knowledge and technology improves.

Technically recoverable resources are a subset of the in-place resource that includes only that oil and gas (both discovered and undiscovered) that is expected to be producible given available technology with no regard to current economics. Technically recoverable resources are therefore dynamic, and change in response to our increased understanding of both the in-place resource as well as the likely nature of future technology.

Economically recoverable resources are a subset of the technically recoverable that includes only that oil and gas that is expected to be producible at a profit. This is a very dynamic category, changing not only with the increasing knowledge and technology but also with the rapid and sometimes unpredictable changes in economic conditions, prices, markets, and regulation.

Reserves are oil and gas that has been proven by drilling and is available for profitable production. Reserves are also subject to economic conditions.

accumulations in the subsurface. An assessment unit is defined as a mappable volume of rock within a total petroleum system that encompasses accumulations (discovered and undiscovered) that share similar geologic traits and socio-economic factors. Accumulations within an assessment unit should constitute a sufficiently homogeneous population such that the chosen methodology of resource assessment is applicable. A total petroleum system might equate to a single assessment unit. If necessary, a total petroleum system can be subdivided into two or more assessment units so that each unit is sufficiently homogeneous to assess individually.

The USGS assesses two resource play types: conventional and continuous. Conventional plays contain discrete hydrocarbon accumulations often associated with hydrocarbon/water contacts. Continuous plays are pervasive hydrocarbon accumulations that can cross rock unit boundaries, lack discrete structural boundaries, and exhibit other atypical reservoir properties (Figure 2-22). They include tight gas sands, gas shales, and coalbed natural gas (also referred to as coal gas, coalbed gas or coalbed methane). Compared to conventional plays, continuous accumulations typically are more geographically extensive. Most of the resources in the study areas in the lower-48 states are of the continuous type.

There are 208 discrete oil and natural gas resource plays in the Inventory detailed study areas. The probabilistic mean estimate of hydrocarbon resource volumes for each USGS-defined play was utilized for

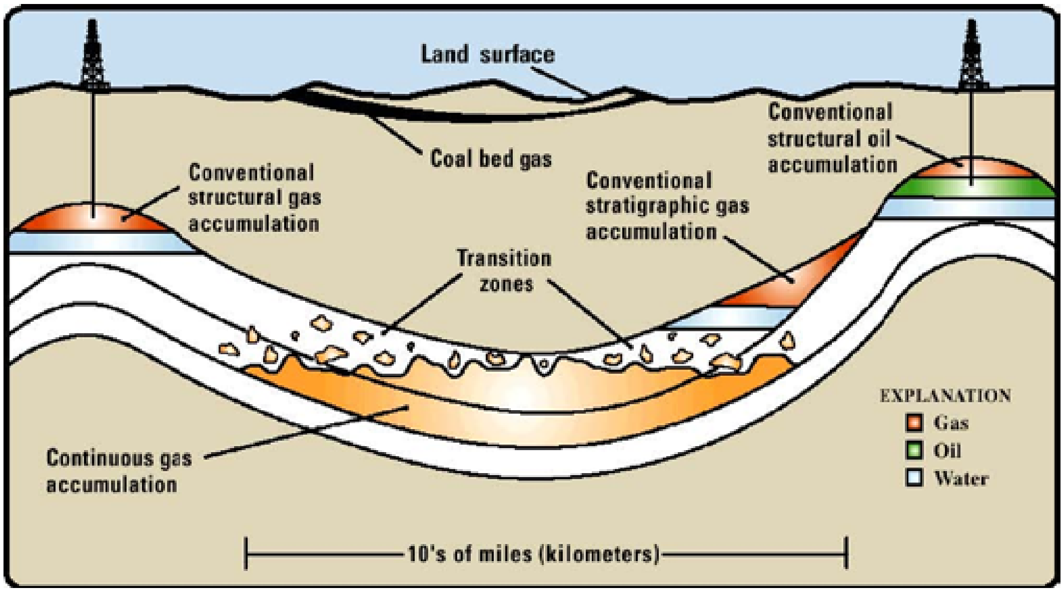

Figure 2-22. Conventional vs. Continuous Accumulations

this Inventory (Table 2-4). The assessed resources include oil, natural gas liquids (NGLs), associated dissolved (AD) natural gas, non-associated natural gas (NAG) and liquids in gas reservoirs. Oil is a natural liquid of mostly hydrocarbon molecules. The NGLs are liquid when produced to the surface but exist in the gas phase in the subsurface. Natural gas is a mixture of hydrocarbon gases consisting primarily of methane. Associated dissolved natural gas is that produced from oil fields, whereas non-associated natural gas is that produced from gas fields. The USGS assesses technically recoverable resources for each of these resource types, and estimates their volumes. While modeled discretely in this analysis, for purposes of presentation in this Inventory, undiscovered oil, NGLs, and liquids associated with natural gas reservoirs were subsequently aggregated into a single "Total Oil" resource category. Similarly, AD and non-associated natural gases were combined as "Total Natural Gas."

2.2.1.2 Oil and Gas Resource Data Preparation

The geometry of an oil and gas play is defined by its geology and extends horizontally and vertically in the subsurface. Figure 2-23 is an idealized block diagram showing how three different plays can occur in a single area. Plays are commonly "stacked" in the subsurface so that a given surface land parcel can overlie numerous plays.

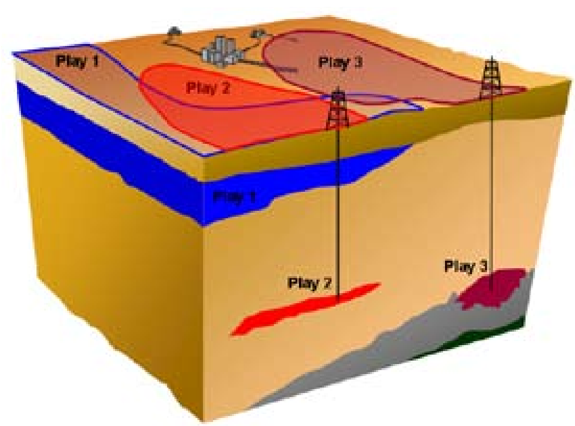

Figure 2-23. Conceptual Block Diagram of Oil and Gas Plays

Table 2-4. Undiscovered Technically Recoverable Resources by Play

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(01) Northern Alaska	anwr001	Wedge	Conventional	509	259
(01) Northern Alaska	anwr002	Undeformed Franklin	Conventional	134	353
(01) Northern Alaska	anwr003	Turbidite	Conventional	1680	1400
(01) Northern Alaska	anwr004	Topset	Conventional	6196	1704
(01) Northern Alaska	anwr005	Thompson	Conventional	420	691
(01) Northern Alaska	anwr006	Thin-Skinned Thrust Belt	Conventional	1172	1787
(01) Northern Alaska	anwr007	Niguanak-Aurora	Conventional	411	532
(01) Northern Alaska	anwr008	Kermik	Conventional	63	129
(01) Northern Alaska	anwr009	Ellesmerian Thrust Belt	Conventional	18	876
(01) Northern Alaska	anwr010	Deformed Franklin	Conventional	92	860
(01) Northern Alaska	NAK025	Brookian Topset	Conventional	452	919
(01) Northern Alaska	NAK026	Brookian Clinoform	Conventional	1740	8260
(01) Northern Alaska	NAK027	Kemik-Thomson	Conventional	303	2762
(01) Northern Alaska	NAK028	Beaufortian Kuparac Topset	Conventional	184	672
(01) Northern Alaska	NAK029	Beaufortian Createaceous Shelf Margin	Conventional	8	598
(01) Northern Alaska	NAK030	Beaufortian Upper Jurassic Topset East	Conventional	7	146
(01) Northern Alaska	NAK031	Beaufortian Upper Jurassic Topset West	Conventional	151	432
(01) Northern Alaska	NAK032	Beaufortian Clinoform	Conventional	130	1124
(01) Northern Alaska	NAK033	Brookian Topset Structural North	Conventional	265	395
(01) Northern Alaska	NAK034	Brookian Topset Structural South	Conventional	38	2392
(01) Northern Alaska	NAK035	Brookian Clinoform Structural North	Conventional	149	397
(01) Northern Alaska	NAK036	Brookian Clinoform Structural South	Conventional	43	2558
(01) Northern Alaska	NAK037	Beaufortian Structural	Conventional	36	2137
(01) Northern Alaska	NAK038	Ellesmerian Structural	Conventional	20	1502
(01) Northern Alaska	NAK039	Basement Involved Structural	Conventional	62	3030
(01) Northern Alaska	NAK040	Thrust Belt Triangle Zone	Conventional	91	3874
(01) Northern Alaska	NAK041	Thrust Belt Lisburne	Conventional	121	3663
(01) Northern Alaska	NAK042	Triassic Barrow Arch	Conventional	411	496
(01) Northern Alaska	NAK043	Ivishak Barrow Flank	Conventional	5	387
(01) Northern Alaska	NAK044	Lisburne Barrow Arch	Conventional	134	129
(01) Northern Alaska	NAK045	Lisburne Barrow Flank	Conventional	13	1035
(01) Northern Alaska	NAK046	Endicott Truncation	Conventional	80	85
(01) Northern Alaska	NAK047	Endicott	Conventional	6	500

Table 2-4. Undiscovered Technically Recoverable Resources by Play (continued)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(01) Northern Alaska	NAK048	Franklinian	Conventional	13	17
(01) Northern Alaska	NAK049	Nanushuk Formation Coalbed Gas	Coalbed Gas	35	15047
(01) Northern Alaska	NAK050	Prince Creek-Tuluvak Formation	Coalbed Gas	-	778
(01) Northern Alaska	NAK051	Sagavanirtok Formation Coalbed Gas	Coalbed Gas	5	2231
(01) Northern Alaska	npra001	Torok Structural	Conventional	35	17905
(01) Northern Alaska	npra002	Thrust Belt	Conventional	6	1521
(01) Northern Alaska	npra003	Ellesmerian Ivishak	Conventional	84	106
(01) Northern Alaska	npra004	Ellesmerian Structural	Conventional	-	1990
(01) Northern Alaska	npra005	Ellesmerian Lisburne Total	Conventional	29	668
(01) Northern Alaska	npra006	Ellesmerian Endicott Total	Conventional	3	1073
(01) Northern Alaska	npra007	Ellesmerian Echooka Total	Conventional	7	512
(01) Northern Alaska	npra008	Brookian Topset Structural	Conventional	137	10606
(01) Northern Alaska	npra009	Brookian Topset	Conventional	239	192
(01) Northern Alaska	npra010	Brookian Clinoform	Conventional	2787	12272
(01) Northern Alaska	npra011	Beaufortian Upper Jurassic Topset	Conventional	7035	10357
(01) Northern Alaska	npra012	Beaufortian Lower Jurassic Topset	Conventional	83	793
(01) Northern Alaska	npra013	Beaufortian Cretaceous Topset Total	Conventional	103	2534
(01) Northern Alaska	npra014	Beaufortian Clinoform	Conventional	12	822
(02) Central Alaska - Yukon Flats	YKF001	Tertiary Sandstone	Conventional	288	5283
(02) Central Alaska - Yukon Flats	YKF002	Subthrust	Conventional	1	17
(02) Central Alaska - Yukon Flats	YKF003	Crooked Creek	Conventional	10	163
(02) Central Alaska - Yukon Flats	YKF004	Coalbed Gas	Coalbed Gas	-	-
(03) Southern Alaska	301	Alaska Peninsula Mesozoic	Conventional	52	52
(03) Southern Alaska	302	Alaska Peninsula Tertiary	Conventional	9	188
(03) Southern Alaska	303	Cook Inlet Beluga-Sterling Gas	Conventional	-	738
(03) Southern Alaska	304	Cook Inlet Hemlock-Tyonek Oil	Conventional	647	647
(03) Southern Alaska	305	Cook Inlet Late Mesozoic Oil	Conventional - Not quantitatively assessed	-	-
(03) Southern Alaska	306	Copper River Upper Cretaceous - Tertiary Biogenic Gas	Conventional - Not quantitatively assessed	-	-

Table 2-4. Undiscovered Technically Recoverable Resources by Play (continued)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(03) Southern Alaska	307	Copper River Mesozoic Oil	Conventional - Not quantitatively assessed	-	-
(03) Southern Alaska	308	Gulf of Alaska Yakataga Fold Belt	Conventional	173	173
(03) Southern Alaska	309	Gulf of Alaska Yakutat Foreland	Conventional	57	57
(05) Eastern Oregon-Washington	pr501g	Northwestern Columbia Plateau Gas	Conventional	1	235
(05) Eastern Oregon-Washington	pr502g	Central and Northeastern Oregon Paleogene Gas	Conventional	0	78
(05) Eastern Oregon-Washington	pr503g	Columbia Basin - Basin-Centered Gas	Continuous-type gas	122	12200
(13) Ventura Basin	pr1301g	Paleogene - Onshore	Conventional	140	338
(13) Ventura Basin	pr1302g	Neogene - Onshore	Conventional	257	251
(13) Ventura Basin	pr1303g	Pliocene Stratigraphic	Conventional - Not quantitatively assessed	-	-
(13) Ventura Basin	pr1304g	Cretaceous	Conventional - Not quantitatively assessed	-	-
(13) Ventura Basin	pr1311g	Paleogene - Offshore State Waters	Conventional	327	784
(13) Ventura Basin	pr1312g	Neogene - Offshore State Waters	Conventional	256	250
(19) Eastern Great Basin	EGB001	Neogene Basins	Conventional	833	108
(19) Eastern Great Basin	EGB002	Ranges and Other Structures	Conventional	524	61
(19) Eastern Great Basin	EGB003	Sevier Thrust System	Conventional	326	100
(20) Uinta-Piceance Basins	50200101	Conventional Ferron Sandstone Gas	Conventional	<.5	40
(20) Uinta-Piceance Basins	50200161	Deep (6,000 feet plus) Coal and Sandstone Gas	Continuous Gas	-	59
(20) Uinta-Piceance Basins	50200181	Northern Coal Fairway/Drunkards Wash	Coalbed Gas	-	752
(20) Uinta-Piceance Basins	50200182	Central Coal Fairway/Buzzards Bench	Coalbed Gas	-	537
(20) Uinta-Piceance Basins	50200183	Southern Coal Fairway	Coalbed Gas	-	153

Table 2-4. Undiscovered Technically Recoverable Resources by Play (continued)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(20) Uinta-Piceance Basins	50200184	Joes Valley and Messina Grabens	Coalbed Gas–Not quantitatively assessed	-	-
(20) Uinta-Piceance Basins	50200185	Southern Coal Outcrop	Coalbed Gas	-	11
(20) Uinta-Piceance Basins	50200201	Uinta-Piceance Basin Conventional Gas	Conventional	1	66
(20) Uinta-Piceance Basins	50200261	Uinta Basin Continuous Gas Mesaverde TPS	Continuous Gas	11	7391
(20) Uinta-Piceance Basins	50200262	Uinta Basin Transitional Gas	Continuous Gas	2	1493
(20) Uinta-Piceance Basins	50200263	Piceance Basin Continuous Gas Mesaverde TPS	Continuous Gas	9	3064
(20) Uinta-Piceance Basins	50200264	Piceance Basin Transitional Gas	Continuous Gas	1	302
(20) Uinta-Piceance Basins	50200281	Uinta Basin Blackhawk Coalbed Gas	Coalbed Gas	-	499
(20) Uinta-Piceance Basins	50200282	Mesaverde Group Coalbed Gas	Coalbed Gas	-	368
(20) Uinta-Piceance Basins	50200361	Piceance Basin Continuous Gas Mancos/Mowry TPS	Continuous Gas	2	1653
(20) Uinta-Piceance Basins	50200362	Uinta Basin Continuous Gas Mancos/Mowry TPS	Continuous Gas	6	3111
(20) Uinta-Piceance Basins	50200363	Uinta-Piceance Transitional and Migrated Gas	Continuous Gas	2	1755
(20) Uinta-Piceance Basins	50200401	Hanging Wall	Conventional	5	28
(20) Uinta-Piceance Basins	50200402	Paleozoic/Mesozoic	Conventional	8	50
(20) Uinta-Piceance Basins	50200501	Uinta Green River Conventional Oil and Gas	Conventional	11	29
(20) Uinta-Piceance Basins	50200502	Piceance Green River Conventional Oil	Conventional–Not quantitatively assessed	-	-
(20) Uinta-Piceance Basins	50200561	Deep Uinta Overpressured Continuous Oil	Continuous Oil	43	64
(21) Paradox Basin	2101	Buried Fault Blocks, Older Paleozoic	Conventional	62	292
(21) Paradox Basin	2102	Porous Carbonate Buildup	Conventional	192	482
(21) Paradox Basin	2103	Fractured Interbed	Continuous	242	194

Table 2-4. Undiscovered Technically Recoverable Resources by Play (continued)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(21) Paradox Basin	2104	Permian-Pennsylvanian Marginal Clastics	Conventional	3	56
(21) Paradox Basin	2105	Salt Anticline Flank	Conventional	20	396
(21) Paradox Basin	2106	Permo-Triassic Unconformity	Conventional	21	2
(21) Paradox Basin	2107	Cretaceous Sandstone	Conventional	1	58
(22) San Juan Basin	50220101	Tertiary Conventional Gas	Conventional	1	80
(22) San Juan Basin	50220161	Pictured Cliffs Continuous Gas	Continuous Gas	17	5640
(22) San Juan Basin	50220181	Fruitland Fairway Coalbed Gas	Coalbed Gas	-	3981
(22) San Juan Basin	50220182	Basin Fruitland Coalbed Gas	Coalbed Gas	-	19595
(22) San Juan Basin	50220261	Lewis Continuous Gas	Continuous Gas	31	10177
(22) San Juan Basin	50220302	Gallup Sandstone Conventional Oil and Gas	Conventional	2	<.5
(22) San Juan Basin	50220303	Mancos Sandstones Conventional Oil	Conventional	14	58
(22) San Juan Basin	50220304	Dakota-Greenhorn Conventional Oil and Gas	Conventional	3	22
(22) San Juan Basin	50220361	Mesaverde Central-Basin Continuous Gas	Continuous Gas	5	1317
(22) San Juan Basin	50220362	Mancos Sandstones Continuous Gas	Continuous Gas	76	5116
(22) San Juan Basin	50220363	Dakota-Greenhorn Continuous Gas	Continuous Gas	16	3929
(22) San Juan Basin	50220381	Menefee Coalbed Gas	Coalbed Gas	-	664
(22) San Juan Basin	50220401	Entrada Sandstone Conventional Oil	Conventional	3	6
(27) Montana Thrust Belt	50270101	Thrust Belt Conventional Gas and Oil	Conventional	134	5,761
(27) Montana Thrust Belt	50270102	Sawtooth Range Structure Conventional Oil and Gas	Conventional	18	795
(27) Montana Thrust Belt	50270103	Frontal Structures Conventional Oil and Gas	Conventional	68	1,192
(27) Montana Thrust Belt	50270201	Helena Salient Conventional Oil and Gas	Conventional	15	639
(27) Montana Thrust Belt	50270401	Blacktail Salient Conventional Oil and Gas	Conventional	6	16
(27) Montana Thrust Belt	50270561	Marias River Shale Continuous Oil	Continuous Oil	33	111
(27) Montana Thrust Belt	50270701	Tertiary Basins Oil and Gas	Conventional	73	124

Table 2-4. Undiscovered Technically Recoverable Resources by Play (continued)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(31) Williston Basin	pr3101g	Madison (Mississippian)	Conventional	183	169
(31) Williston Basin	pr3102g	Red River (Ordovician)	Conventional	106	372
(31) Williston Basin	pr3103g	Middle and Upper Devonian (Pre-Bakken - Post-Prairie Salt)	Conventional	60	126
(31) Williston Basin	pr3105g	Pre-Prairie Middle Devonian and Silurian	Conventional	78	203
(31) Williston Basin	pr3106g	Post-Madison to Triassic Clastics	Conventional	18	6
(31) Williston Basin	pr3107g	Pre-Red River Gas	Conventional	2	95
(31) Williston Basin	pr3110g	Bakken Fairway	Continuous-type oil	73	65
(31) Williston Basin	pr3111g	Bakken Intermediate	Continuous-type oil	70	56
(31) Williston Basin	pr3112g	Bakken Outlying	Continuous-type oil	8	7
(31) Williston Basin	pr3113g	Southern Williston Basin Margin - Niobrara Shallow Biogenic	Continuous-type gas	-	1,894
(33) Powder River Basin	3301	Basin Margin Subthrust	Conventional	21	20
(33) Powder River Basin	3302	Basin Margin Anticline	Conventional	7	4
(33) Powder River Basin	3303	Leo Sandstone	Conventional	81	5
(33) Powder River Basin	3304	Upper Minnelusa Sandstone	Conventional	522	31
(33) Powder River Basin	3305	Lakota Sandstone	Conventional	55	22
(33) Powder River Basin	3306	Fall River Sandstone	Conventional	200	115
(33) Powder River Basin	3307	Muddy Sandstone	Conventional	104	389
(33) Powder River Basin	3309	Deep Frontier Sandstone	Conventional	58	193
(33) Powder River Basin	3310	Turner Sandstone	Conventional	25	32
(33) Powder River Basin	3312	Sussex-Shannon Sandstone	Conventional	72	54
(33) Powder River Basin	3313	Mesaverde-Lewis	Conventional	62	58
(33) Powder River Basin	50330101	Eastern Basin Margin Upper Fort Union Sandstone	Conventional	-	27

Table 2-4. Undiscovered Technically Recoverable Resources by Play (continued)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(33) Powder River Basin	50330181	Wasatch Formation	Coalbed Gas	-	1,934
(33) Powder River Basin	50330182	Upper Fort Union Formation	Coalbed Gas	-	12,132
(33) Powder River Basin	50330183	Lower Fort Union-Lance Formations	Coalbed Gas	-	198
(33) Powder River Basin	50330261	Mowry Continuous Oil Assessment Unit	Continuous Oil	395	12
(33) Powder River Basin	50330461	Shallow Continuous Biogenic Gas Assessment Unit	Continuous Gas	-	3,368
(36) Wyoming Thrust Belt	au360101	Thrust Belt Conventional	Conventional	96	557
(36) Wyoming Thrust Belt	au360281	Frontier-Adaville-Evanstone Coalbed Gas	Continuous	-	361
(37) Southwestern Wyoming	50370101	Sub-Cretaceous Conventional Oil and Gas	Conventional	58	1,383
(37) Southwestern Wyoming	50370201	Mowry Conventional Oil and Gas	Conventional	12	206
(37) Southwestern Wyoming	50370261	Mowry Continuous Gas	Continuous Gas	171	8,543
(37) Southwestern Wyoming	50370361	Niobrara Continuous Oil	Continuous Oil	107	62
(37) Southwestern Wyoming	50370401	Hilliard-Baxter-Mancos Conventional Oil and Gas	Conventional	1	15
(37) Southwestern Wyoming	50370461	Hilliard-Baxter-Mancos Continuous Gas	Continuous Gas	752	11,753
(37) Southwestern Wyoming	50370501	Mesaverde Conventional Oil and Gas	Conventional	3	56
(37) Southwestern Wyoming	50370561	Almond Continuous Gas	Continuous Gas	200	13,350
(37) Southwestern Wyoming	50370562	Rock Springs-Ericson Continuous Gas	Continuous Gas	146	12,178
(37) Southwestern Wyoming	50370581	Mesaverde Coalbed Gas	Coalbed Gas	-	249
(37) Southwestern Wyoming	50370601	Mesaverde-Lance-Fort Union Conventional Oil and Gas	Conventional	17	320
(37) Southwestern Wyoming	50370661	Mesaverde-Lance-Fort Union Continuous Gas	Continuous Gas	614	13,635
(37) Southwestern Wyoming	50370681	Mesaverde Coalbed Gas	Coalbed Gas	-	27
(37) Southwestern Wyoming	50370682	Fort Union Coalbed Gas	Coalbed Gas	-	81

Table 2-4. Undiscovered Technically Recoverable Resources by Play (continued)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(37) Southwestern Wyoming	50370701	Lewis Conventional Oil and Gas	Conventional	8	195
(37) Southwestern Wyoming	50370761	Lewis Continuous Gas	Continuous Gas	541	13,536
(37) Southwestern Wyoming	50370801	Lance-Fort Union Conventional Oil and Gas	Conventional	2	246
(37) Southwestern Wyoming	50370861	Lance-Fort Union Continuous Gas	Continuous Gas	76	7,583
(37) Southwestern Wyoming	50370881	Lance Coalbed Gas	Coalbed Gas	-	165
(37) Southwestern Wyoming	50370882	Fort Union Coalbed Gas	Coalbed Gas	-	943
(37) Southwestern Wyoming	50370981	Wasatch-Green River Coalbed Gas	Coalbed Gas	-	65
(39) Denver Basin	au390181g	Denver Formation Coals	Coalbed Gas–Not quantitatively assessed	-	-
(39) Denver Basin	au390182g	Laramie Formation Coals	Coalbed Gas–Not quantitatively assessed	-	-
(39) Denver Basin	au390201g	Fractured Niobrara Limestone Transitional	Conventional	1	1
(39) Denver Basin	au390261g	Fractured Niobrara Limestone (Silo Field Area)	Continuous Oil	8	8
(39) Denver Basin	au390361g	Fractured Pierre Shale	Continuous Oil–Not quantitatively assessed	-	-
(39) Denver Basin	au390401g	Dakota Group and D Sandstone	Conventional	39	45
(39) Denver Basin	au390402g	Subthrust Structural	Conventional	17	41
(39) Denver Basin	au390501g	Permian-Pennsylvanian Reservoirs	Conventional	11	5
(39) Denver Basin	au390601g	Pierre Shale Sandstones	Conventional	3	18
(39) Denver Basin	au390661g	Niobrara-Codell (Wattenberg Area)	Continuous Oil	64	322
(39) Denver Basin	au390662g	Dakota Group Basin-Center Gas	Continuous Gas	11	1,095
(39) Denver Basin	au390761g	Niobrara Chalk	Continuous Gas	-	984
(50) Florida Penninsula	au500101g	Lower Cretaceous Shoal-Reef Oil	Conventional	274	29

Table 2-4. Undiscovered Technically Recoverable Resources by Play (continued)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(50) Florida Penninsula	au500201g	Pre-Punta Gorda Dolomite Gas and Oil	Conventional	152	1,629
(65) Black Warrior Basin	au650101g	Pre-Mississippian Carbonates AU	Conventional	6	1,087
(65) Black Warrior Basin	au650102g	Carboniferous Sandstones AU	Conventional	8	368
(65) Black Warrior Basin	au650281g	Black Warrior Basin AU	Continuous	-	7,056
(67) Appalachian Basin	au670101g	Rome Trough	Conventional	4	616
(67) Appalachian Basin	au670301g	Lower Paleozoic Carbonates in Thrust Belt	Conventional	3	302
(67) Appalachian Basin	au670302g	Knox Unconformity	Conventional	36	574
(67) Appalachian Basin	au670303g	Black River-Trenton Hydrothermal Dolomite	Conventional	35	1,919
(67) Appalachian Basin	au670304g	Lockport Dolomite	Conventional	2	207
(67) Appalachian Basin	au670361g	Clinton-Medina Basin Center	Continuous	108	10,833
(67) Appalachian Basin	au670362g	Clinton-Medina Transitional Northeast	Continuous	16	1,619
(67) Appalachian Basin	au670363g	Clinton-Medina Transitional	Continuous	141	11,771
(67) Appalachian Basin	au670364g	Tuscarora Basin Center	Continuous	10	2,620
(67) Appalachian Basin	au670401g	Oriskany Sandstone-Structural	Conventional	2	386
(67) Appalachian Basin	au670402g	Oriskany Sandstone-Stratigraphic	Conventional	1	65
(67) Appalachian Basin	au670403g	Greenbrier Limestone	Conventional	4	128
(67) Appalachian Basin	au670404g	Mississippian Sandstones	Conventional	6	113
(67) Appalachian Basin	au670461g	Greater Big Sandy	Continuous	63	6,323
(67) Appalachian Basin	au670462g	Northwestern Ohio Shale	Continuous	53	2,654
(67) Appalachian Basin	au670463g	Devonian Siltstone and Shale	Continuous	31	1,294
(67) Appalachian Basin	au670464g	Marcellus Shale	Continuous	12	1,925

Table 2-4. Undiscovered Technically Recoverable Resources by Play (concluded)

USGS Province Name	USGS Code	USGS Play or Assessment Unit Name	Play Type	Total Liquids[a] (MMbbl)	Total Natural Gas[b] (Bcf)
(67) Appalachian Basin	au670465g	Catskill Sandstones and Siltstones	Continuous	235	11,741
(67) Appalachian Basin	au670466g	Berea Sandstone	Continuous	163	6,800
(67) Appalachian Basin	au670581g	Pocahontas Basin	Continuous	-	3,577
(67) Appalachian Basin	au670582g	Eastern Dunkard Basin	Continuous	-	4,823
			Total Resources	**37,467**	**419,429**

All values are mean resource values from the USGS National Assessment of Oil and Gas Resources. Note that the resource values presented here include some offshore areas (state waters) that are not analyzed in the inventory.

[a] Comprising oil, NGLs, and liquids associated with natural gas reservoirs.

[b] Comprising associated dissolved and nonassociated natural gas

For this Inventory, a homogeneous distribution of resource within a play boundary is assumed because of the lack of more geographically specific information. In fact, the USGS indicates that resources are generally not homogeneously distributed within a play. This is particularly true for conventional accumulations, and less so for continuous accumulations. Despite the assumption of homogeneous distribution of resources in the plays, various oil and gas densities can be mapped as a result of play stacking.

2.2.1.3 Oil and Gas Resource Data-Related Caveats

The estimation of undiscovered technically recoverable resources is inherently uncertain, as reflected by the fact that the USGS develops cumulative probability distributions of the estimated resources for each play. These distributions are used to derive 95 percent probable resource (a 19-in-20 chance of that volume or more), 5 percent probable resource (a 1-in-20 chance of that much or more), and mean resource volumes. The mean volume, used in this Inventory, represents the arithmetic average of all possible resource outcomes weighted by their probability of occurrence. The analytical results in the Inventory use the mean and therefore do not explicitly reflect the range of uncertainty in the resource assessments.

Not all of the resource plays recognized by the USGS within the boundaries of this Inventory were evaluated. The USGS has identified hypothetical plays that lack sufficient data to estimate undiscovered resources. To the extent that hypothetical plays contain significant resources, the results presented here would be an underestimate.

It should be understood that all resource assessments change over time. Not only is it difficult to assess accurately the resource at any one point in time, but the recoverable portion of the resource changes in response to advances in technology, and changes in other conditions under which extraction occurs. Nonetheless, accurate and up-to-date assessments of the potential resources must be continually provided to ensure that public policy decisions are conducted with the best information possible.

For this Inventory, the assumption is made that the estimated oil and gas volumes are evenly distributed under the surface area of each play. A resource density map for each basin was created in the GIS by using a spatial summation of the oil and gas volumes contributed by each play. The densities are expressed as millions of cubic feet (MMCF) of gas per square mile and thousands of barrels (Mbbls) of oil per square mile.

2.2.2 Proved Ultimate Recovery Growth ("Reserves Growth")

The EIA's role in this Inventory is to provide data and analysis relevant to proved reserves and reserves growth of crude oil, natural gas, and natural gas liquids that are associated with already discovered fields underlying Federal onshore lands. This responsibility involves:

- Providing estimates of proved reserves for these fields at the highest possible level of detail consistent with a legal requirement to protect the confidentiality of field operators' proprietary data.
- Estimating future ultimate recovery appreciation for currently producing fields.
- Providing inputs to estimate additional land access constraints that may result from expected ultimate recovery appreciation.

The estimation of proved reserves is necessary for developing reserves growth estimates.

The proved ultimate recovery (PUR) of an oil or gas field is the estimated volume of oil or gas that will ultimately be produced from the field. At any point in time, the PUR is the sum of a field's estimated proved reserves and its cumulative production. The estimated PUR for a new oil or gas field generally increases with time, as a result of new geologic and engineering knowledge gained during operation of the field.

This phenomenon is variously termed "reserves growth," "reserves appreciation," "ultimate recovery appreciation" or "proved ultimate recovery growth." Proved ultimate recovery growth (PURG), the term preferred by the EIA, has been recognized since 1960 and currently accounts for the majority of annual additions to domestic proved reserves. Owing to its importance to present and future domestic oil and gas supply, EIA has been highlighting PURG in the overview section of its annual reserves reports since 1992. Since 1976 PURG has grown in all but one year for both oil plus lease condensate and natural gas. From 1976 through 1994 only 12 percent of proved reserves additions of crude oil and lease condensate and 11 percent of proved reserve additions of wet natural gas were booked as new field discoveries. The rest came from the proved reserves categories related to the proved ultimate recovery appreciation process.[32]

[32] Energy Information Administration, U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2004 Annual Report, November 2005, available online at http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/crude_oil_natural_gas_reserves/cr.html.

The proved ultimate recovery for an individual field or group of fields in a basin "grows" with time due to such factors as:

- Delineation and development drilling that extends the area of known reservoirs
- Discovery of new producing zones (deeper or shallower)
- Application of improved reservoir management and well completion practices and technologies
- Economic factors that increase wellhead prices or reduce operating costs thus extending the economic life of producing fields.

Initial estimates of PUR are usually conservative owing to the small knowledge base available at that time regarding a field's performance. Annual estimates of a field's PUR normally increase significantly in the early post-discovery years as the field is delineated. In later years, PUR continues to grow due to such factors as installation of improved recovery technology, increased knowledge of field performance, and infill drilling, although generally the annual rate of growth slows. Consequently, the growth factors are large during the early years of field development and then often decline as PUR asymptotically approaches a maximum value, i.e., reserves growth usually slows as field development matures.

For the Inventory's study areas, the EIA estimated remaining proved ultimate recovery growth (RPURG), the future reserves growth resource. The resources attributed to future reserves growth for the detailed study areas are 10.2 billion barrels of oil and 37.8 TCF of gas. See Appendix 7 for a detailed explanation of the estimation methodology.

The EIA's selected reserves growth estimates covering Federal and non-Federal lands in the detailed study areas are provided in Table 2-5. The reserves growth estimates for Federal lands, including the extrapolated areas, are provided in Table 2-7.[33] Not all of the Inventory's study areas could be evaluated owing to insufficient data.

Table 2-5. Remaining Proved Ultimate Recovery Growth ("Reserves Growth") by Study Area (Federal and non-Federal)

Study Area	Remaining Ultimate Recovery Growth (Reserves Growth)	
	Oil (MMbbls)	Gas (BCF)
Northern Alaska	5,724	14,285
Central Alaska - Yukon Flats	-	-
Southern Alaska	-	-
Eastern Oregon-Washington	-	-
Ventura Basin	999	1,156
Eastern Great Basin	14	-
Uinta/Piceance Basin	434	3,354
Paradox Basin	25	485
San Juan Basin	93	1,793
Montana Thrust Belt	-	-
Williston Basin	1,641	2,801
Powder River Basin*	794	548
Wyoming Thrust Belt	7	1,106
Southwestern Wyoming	202	10,260
Denver Basin	170	839
Florida Peninsula	-	-
Black Warrior Basin	3	1,149
Appalachian Basin	-	-
Total	10,106	37,776

Note: A dash (-) means there is insufficient data for analysis

[33] Note that Table 2-7 does not include reserves growth associated with state waters, which are significant in Alaska.

2.2.2.1 Sources of Remaining Proved Ultimate Recovery Data

The EIA compiled the historical increase in estimates of PUR for oil and gas fields in each study area and projected these data to estimate the PUR of the fields at abandonment. RPURG is the estimated future portion of the growth in PUR from 2003, for Phase I and II basins and from 2004 for Phase III basins, to the time of field abandonment.

For each study area, the EIA created a database containing field names, field discovery dates, annual oil and gas production for each field, estimated cumulative production, and annual estimates of oil and gas proved reserves for each field.[34] Each field in a study area was assigned to a vintage year according to its date of first production or its date of discovery. The annual proved reserves estimates were usually available only from 1977 to present. The resulting files contained vintage year, number of fields in each vintage (in barrels of oil equivalent), PUR for each field vintage, annual natural gas PUR for each vintage, and annual liquid PUR for each vintage.

Many field names and codes had to be altered, corrected, and matched across the multiple data sources in order to accumulate properly the field data. Obvious major errors were corrected, but many apparent data discontinuities and variations within vintages were mostly accepted "as-is." Reserves data were used as reported by the field operators unless very obvious errors were found. Specific vintages that did not fit the trend of most of the data for a basin were excluded. Attempts to divide the data within a basin into conventional reservoirs, tight formation, and coal gas resources were largely unsuccessful because of the limited number of vintages, the short histories available for some of the fields, and frequent inability to separate the data by reservoir type within a field.

The EIA used a hyperbolic incremental growth factor model to estimate RPURG for each study area and resource type. The hyperbolic model depends on incremental growth factors by vintage, or age of the fields in the basin. Both are asymptotic functions that use time as the sole driver. Although other potential drivers such as drilling rates or wellhead prices are not directly used, these factors have affected the historical data that feed into the models. The application for estimating PURG for a basin over time is described in Appendix 7.

There were insufficient data geographically and temporally from the APB and MTB for a PURG analysis. Separate estimates for tight reservoirs were not made for the DEN, BWB and the WTB owing to a combination of data anomalies and data interpretation concerns. In all study areas, the available coalbed natural gas data were deemed to be insufficiently dependable for development of separate conventional natural gas and coalbed natural gas PURG estimates.

2.2.2.2 Remaining Proved Ultimate Recovery Data Preparation

The estimated remaining proved ultimate recovery or "reserves growth" resources for each study area were incorporated into the Inventory by adding a reserves growth resource layer to the USGS undiscovered technically recoverable resources. As

[34] Data sources included the EIA Reserves and Production Division's Oil and Gas Integrated Field File (RPD OGIFF), the EIA Field Code Master List (FCML), the EIA-23 Reserves Survey, various state web sites, and commercial sources (mainly IHS Energy Group).

with the undiscovered resource layer, the Inventory assumes that the reserves growth resources are homogeneously distributed within the geographic boundaries of the reserves growth resource layer. This is a simplifying assumption, which may be modified in the future as new reserves growth methodologies and findings become available.

The geographic boundary of the reserves growth resource layer was created for each study area from a union of the field boundaries of all the producing oil and gas fields identified by the EIA within the study area. Within the resource plays, individual field boundaries were extended an additional mile in all directions prior to the union, so the geographic boundary of the reserves growth resource layer extends a mile beyond the 2003 boundaries of the actual fields incorporated into the layer. This was done to approximate future extensions to the proved area of producing fields, which contributes to reserves growth. Next, the total reserves growth resource estimated for each study area was homogenously distributed within the geographic boundary of the reserves growth resource layer for the study area. Lastly, the two resource layers, the USGS undiscovered technically recoverable resource layer and the EIA RPURG resource layer, were combined to create the oil and natural gas resource maps shown in Section 2.2.3.

2.2.2.3 Remaining Proved Ultimate Recovery Estimate Data-Related Caveats

The estimated reserves growth resources for the Phase III study areas are lower than generally would be expected, especially compared to previously published reserves growth estimates including the USGS 1995 National Assessment[35], the NPC[36], the Potential Gas Committee (PGC),[37] as well as some operators' not necessarily representative anecdotal reports of estimated reserves growth for fields in some study areas.[38] Reserves growth in most of the study areas ranged from 3 percent to 25 percent of current proved reserves. However, the BWB reserves growth was estimated to be over 200 percent of proved reserves.

It is unlikely that there is a single cause of the differences with other studies. Certainly there are some significant differences in methodology and input data. For example, the PGC uses a non-statistical, reservoir-specific approach that relies on expert judgment to estimate the probable resources associated with the additional development of an already discovered reservoir. Historically, the most successful estimates of reserves growth have relied on the use of reservoir level data, rather than the more aggregate field level data on which this Inventory's estimates are based. This is not particularly surprising since most factors that affect the reserves growth phenomenon

[35] Root, D.H. and others, 1995, Estimates of inferred reserves for the 1995 USGS national oil and gas resource assessment, U.S. Geological Survey Open-File Report 95-75L.

[36] National Petroleum Council, 2003, *Balancing Natural Gas Policy-Fueling Demands of a Growing Economy*, September 2003. The Supply Task Group estimated reserves growth for natural gas.

[37] Potential Gas Committee, 2005, *Potential Supply of Natural Gas in the United States as of December 31, 2004*, September 2005. The PGC estimates "Probable Resources" for natural gas. PGC defines Probable Resources as resources associated with known fields including supply from future extensions of existing pools in known productive reservoirs, infill drilling, and future new pool discoveries within existing fields.

[38] For example, EnCana reports significant reserves growth in Jonah and Mamm Creek fields.

are reservoir-specific and will not necessarily apply to an entire field when it consists of multiple reservoirs as many fields do.[39] Unfortunately, reservoir level proved reserves data are only rarely available for onshore United States fields and the RPURG estimation must therefore be done using the field level data that are available. It should also be noted that this is, insofar as we know, the first time that field level RPURG analysis has been attempted on a scale comparable to that of this Inventory.

The EIA methodology used for the Inventory's study areas and the methodology used by the USGS to estimate reserves growth for the most recent National Assessment are both statistical extrapolations of historical reserves growth and are subject to the same inherent limitations,[40] although the methodologies differ in detail. These limitations introduce substantial uncertainty into the final results, which the USGS is currently addressing in an ongoing review of their reserves growth estimation methodology (see below). In a recent test, the USGS found that two different statistical extrapolation methodologies produce reserves growth estimates that differed by approximately 25 percent and were as much as 60 percent higher than actual volumetric data.[41] The results shown in Tables A7-1 through A7-3 should be interpreted with these limitations in mind:

- Inherent uncertainty in the underlying data (for example, 'reserves' are defined differently by different operators and different commercial/private databases; fields and reservoirs are inconsistently defined).
- Current statistical methodologies rely on field age (since field discovery) as a surrogate for field development effort. Other factors such as reserves recognition practices, differential application of new technology and production monitoring practices, different operating environments, and access to markets may not be adequately represented by field age alone.
- Large fields have more weight in the analysis, which may bias the results toward the development histories of the largest fields in a basin or study area. Large fields may be more likely than smaller fields to receive consistently applied development efforts and new technology applications, and be less sensitive to economic factors.
- Uncertainties are not addressed directly, such as variance of the input data and uncertainties in the underlying assumed field development scenarios.

A phenomenon observed in the 1995 USGS National Assessment may also be operating, in which the estimated reserves growth based on a dataset for the lower-48 states as a whole produced greater reserves growth estimates than the sum of reserves growth estimated independently for individual regions. In October 2006, the USGS commenced a scoping project to evaluate possible improvements to existing reserves growth methodology, identify alternative methodologies, and recommend a robust reserves growth methodology that

39 *The Intricate Puzzle of Oil and Gas "Reserves Growth,"* available online at http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/1997/intricate_puzzle_reserves_growth/m07fa.pdf

40 From Klett, Timothy, *One-Year Reserve-Growth Scoping Project, Fiscal Year 2006*, presentation to American Association of Petroleum Geologists, Committee on Resource Evaluation, February 9, 2006.

41 Ibid; slide titled "Test of Modified Arrington and USGS Least Squares/Monotonic Methods".

can be universally applied.[42] The EIA is investigating whether it might be possible to develop improved, less labor-intensive means of cleansing the field level data of its apparent anomalies and errors and whether the estimates can be improved by moving to a multi-parameter estimation methodology. The findings and recommendations of the USGS reserves growth scoping project will be incorporated into the reserves growth assessment for any subsequent phases of this Inventory. Consequently, the reserves growth volumes estimated for this report may be re-evaluated and are subject to change.

2.2.3 Oil and Natural Gas Resource Maps

The products of the oil and gas resource data preparation work are maps of hydrocarbon volumes, projected to the surface. These maps depict areas of varying potential resource richness based on often vertically stacked play resource volumes. The distributions of undiscovered technically recoverable resources and reserves growth are shown by study area for oil in Figures 2-24 through 2-44 and for natural gas in Figures 2-45 through 2-65. Note that the resources maps of the extrapolated areas include resources for the comprehensively studied areas.

[42] Brenda S. Pierce, USGS, personal communication to Jeffrey Eppink, Advanced Resources International,, regarding USGS Energy Resources Team Reserves Growth Scoping Project, project number 8930C1K.

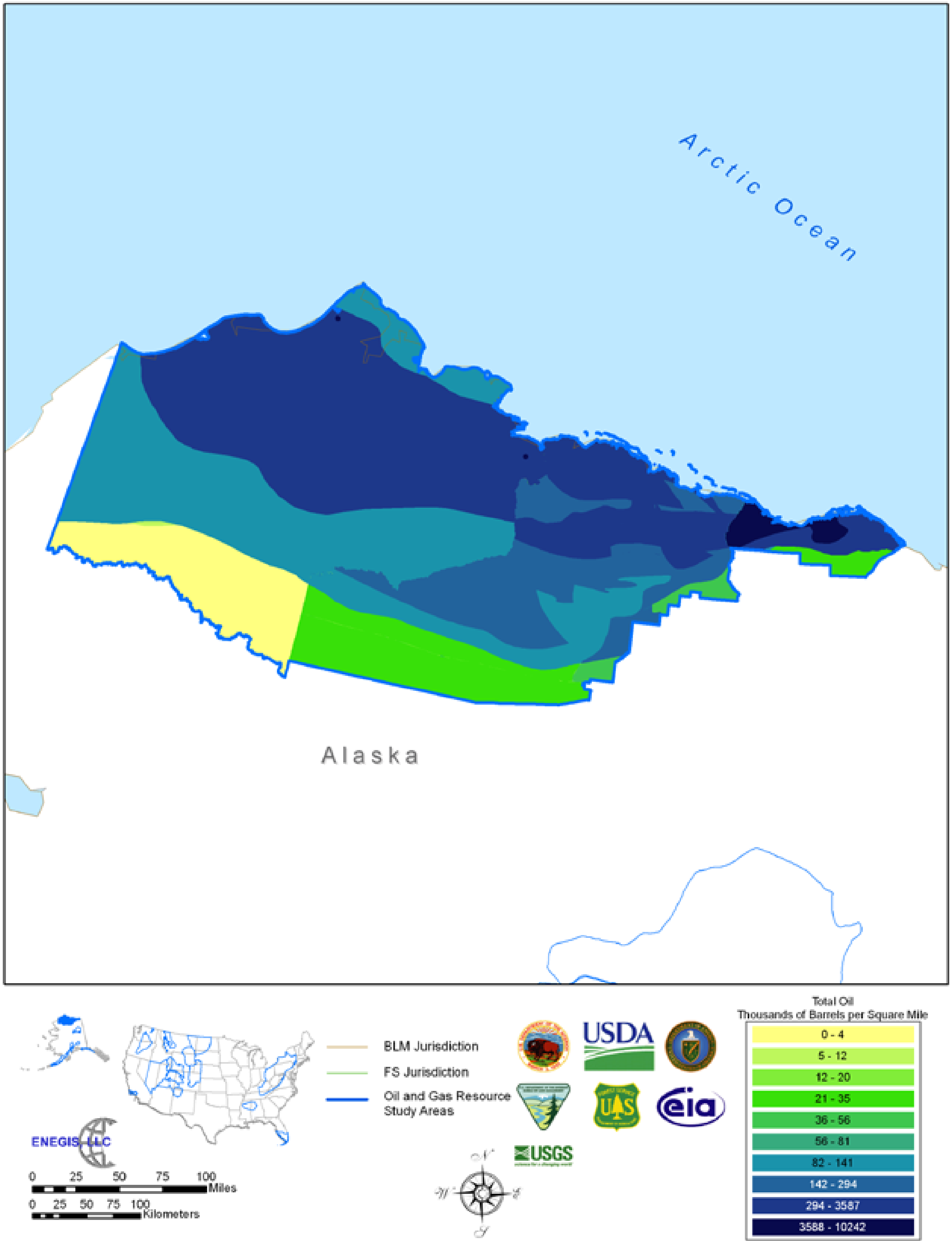

Figure 2-24. Total Oil Map, Northern Alaska Study Area

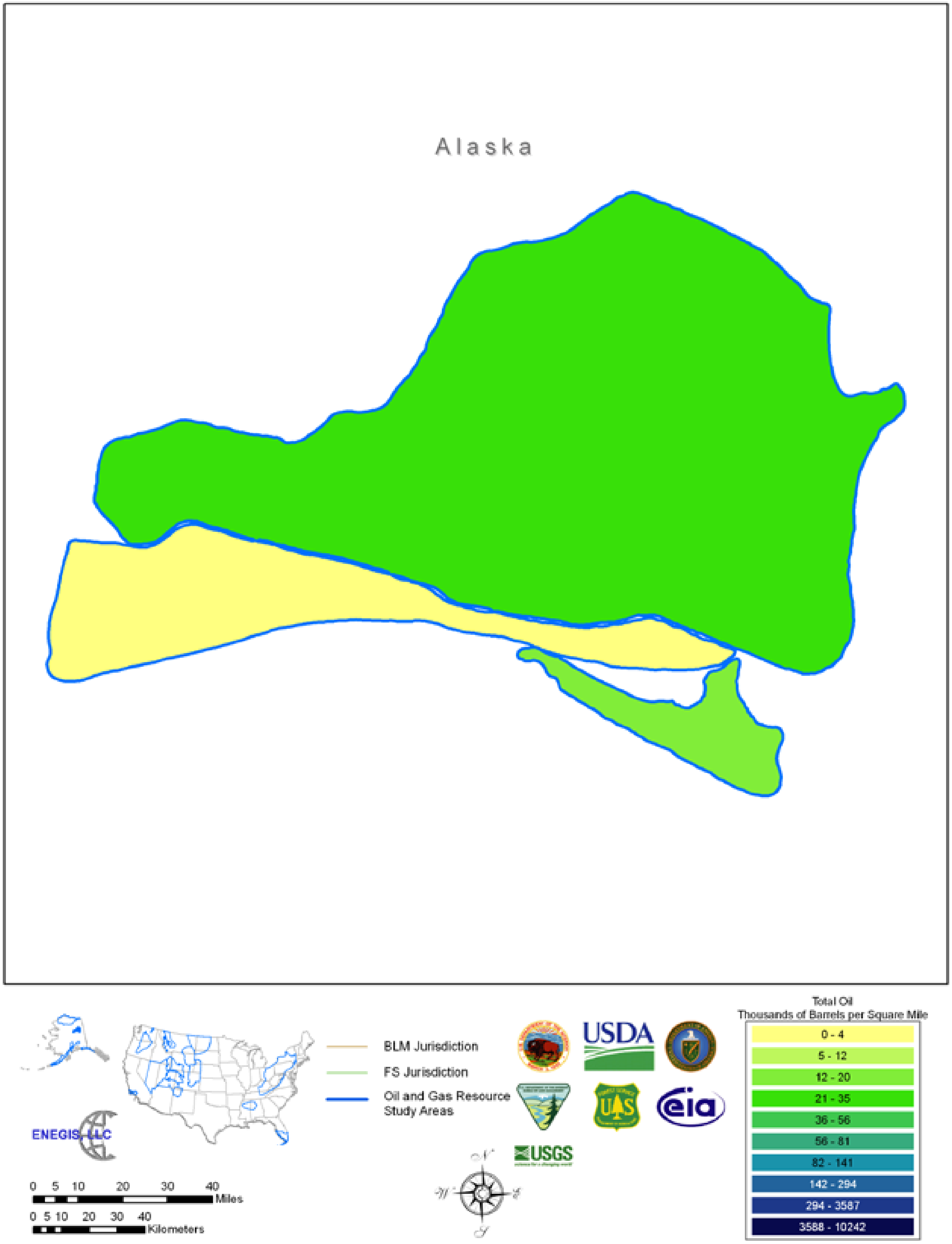

Figure 2-25. Total Oil Map, Central Alaska - Yukon Flats Study Area

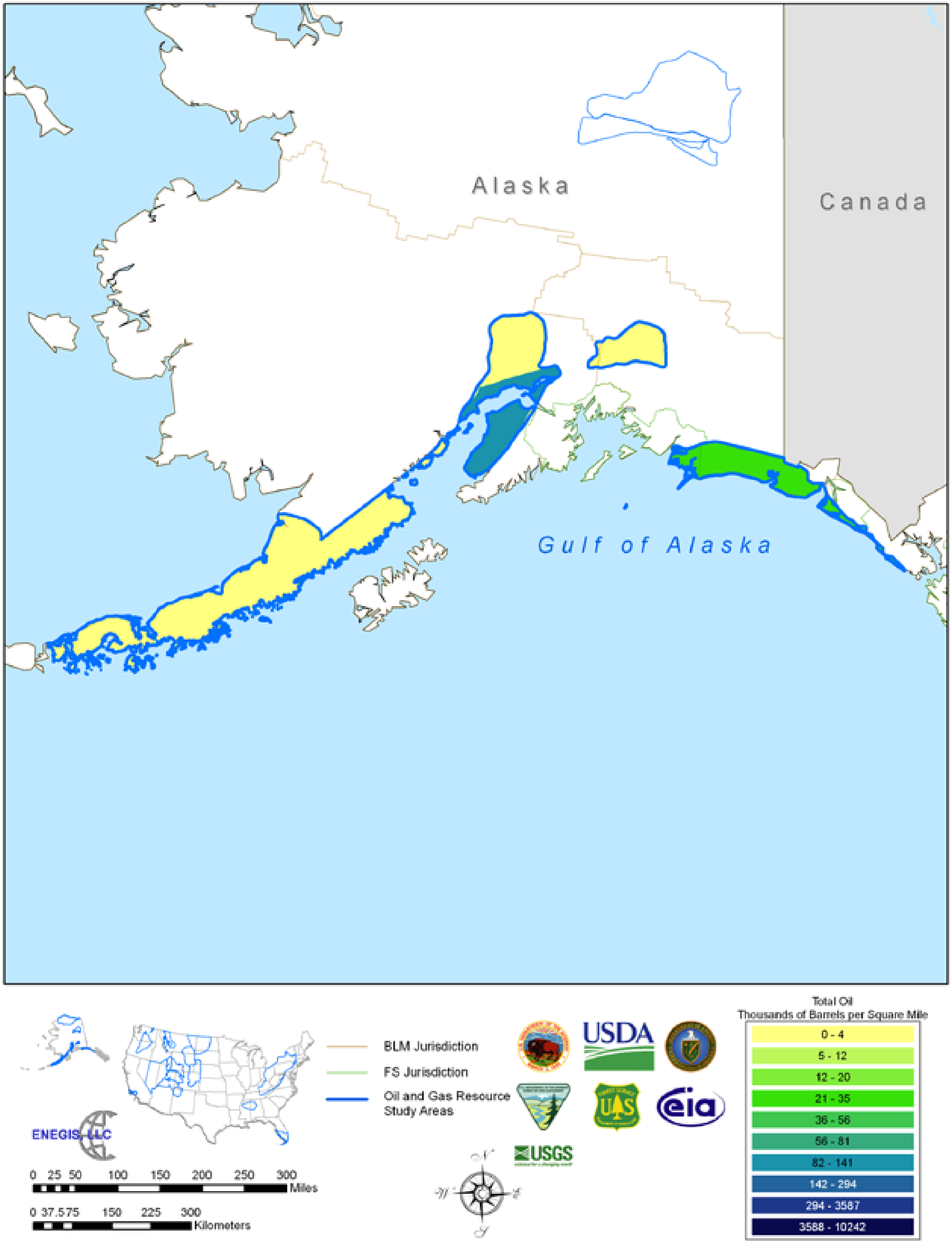

Figure 2-26. Total Oil Map, Southern Alaska Study Area

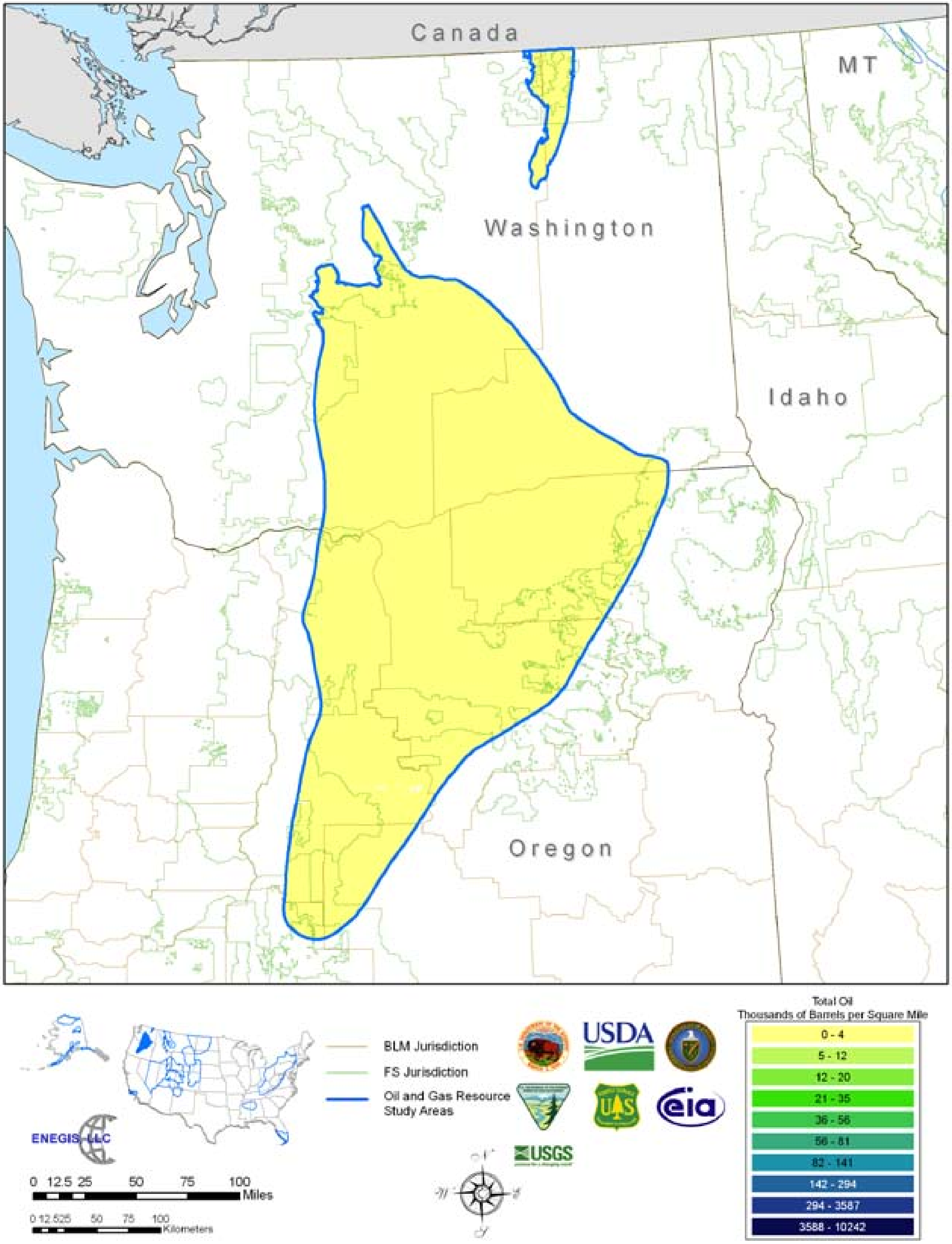

Figure 2-27. Total Oil Map, Eastern Oregon-Washington Study Area

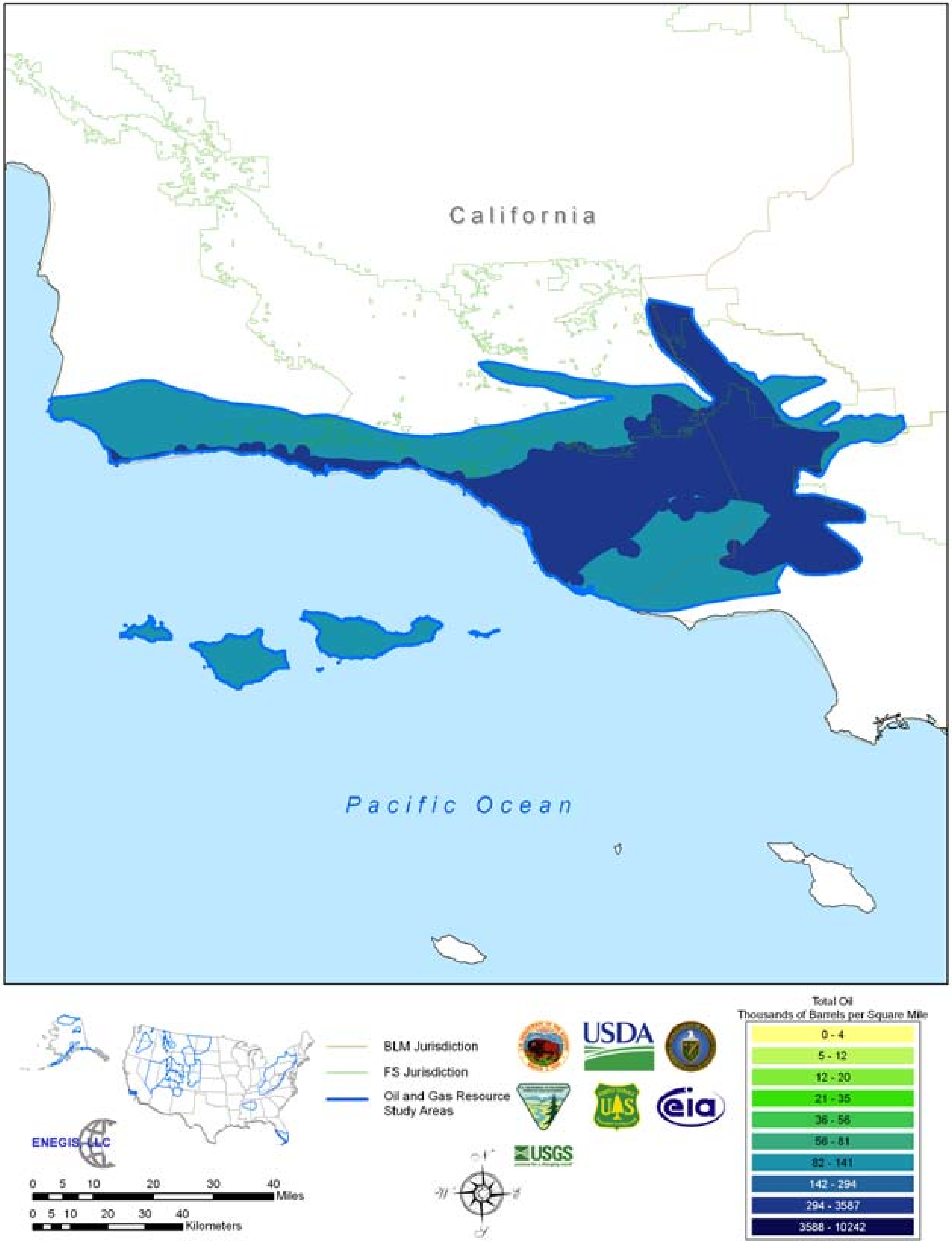

Figure 2-28. Total Oil Map, Ventura Basin Study Area

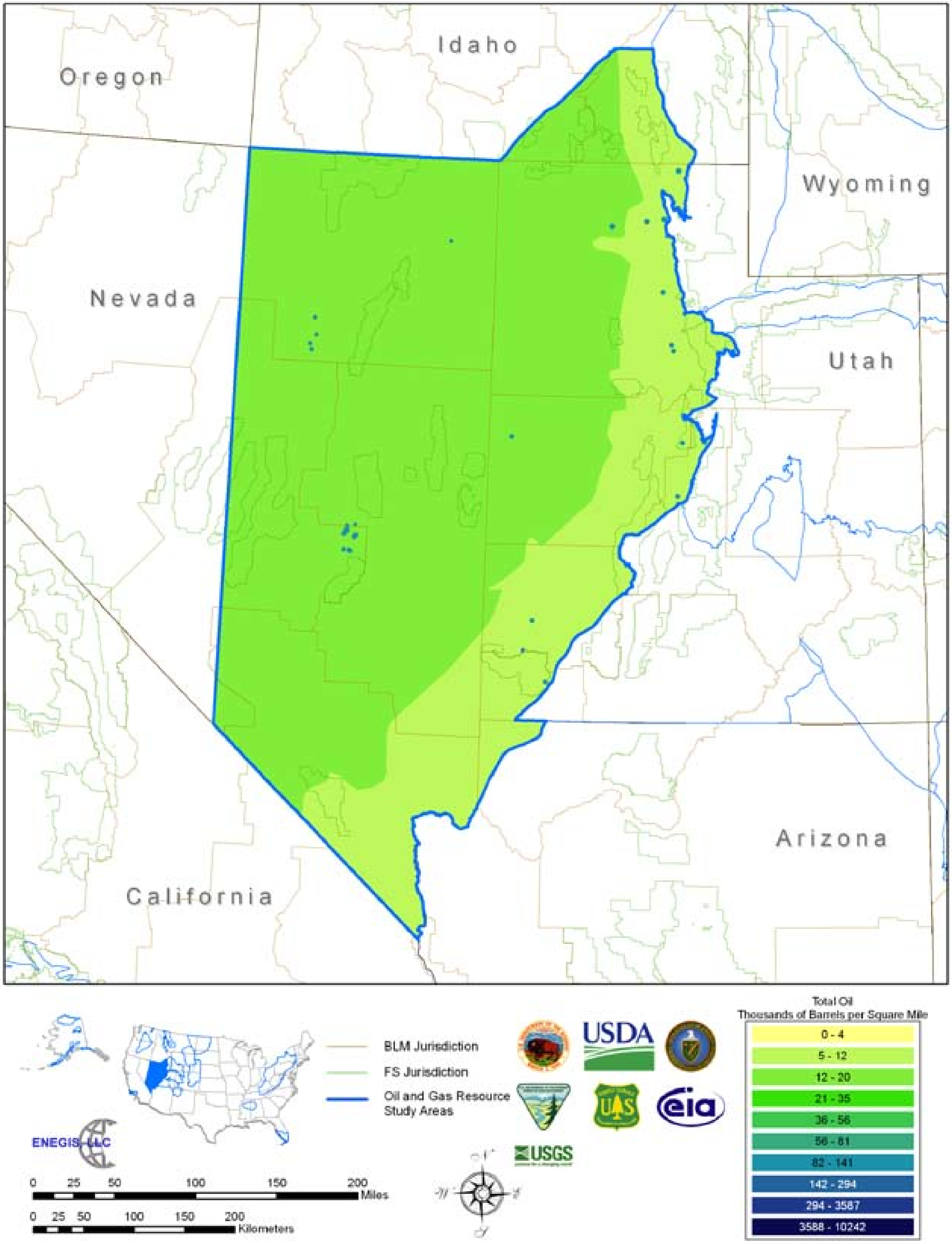

Figure 2-29. Total Oil Map, Eastern Great Basin Study Area

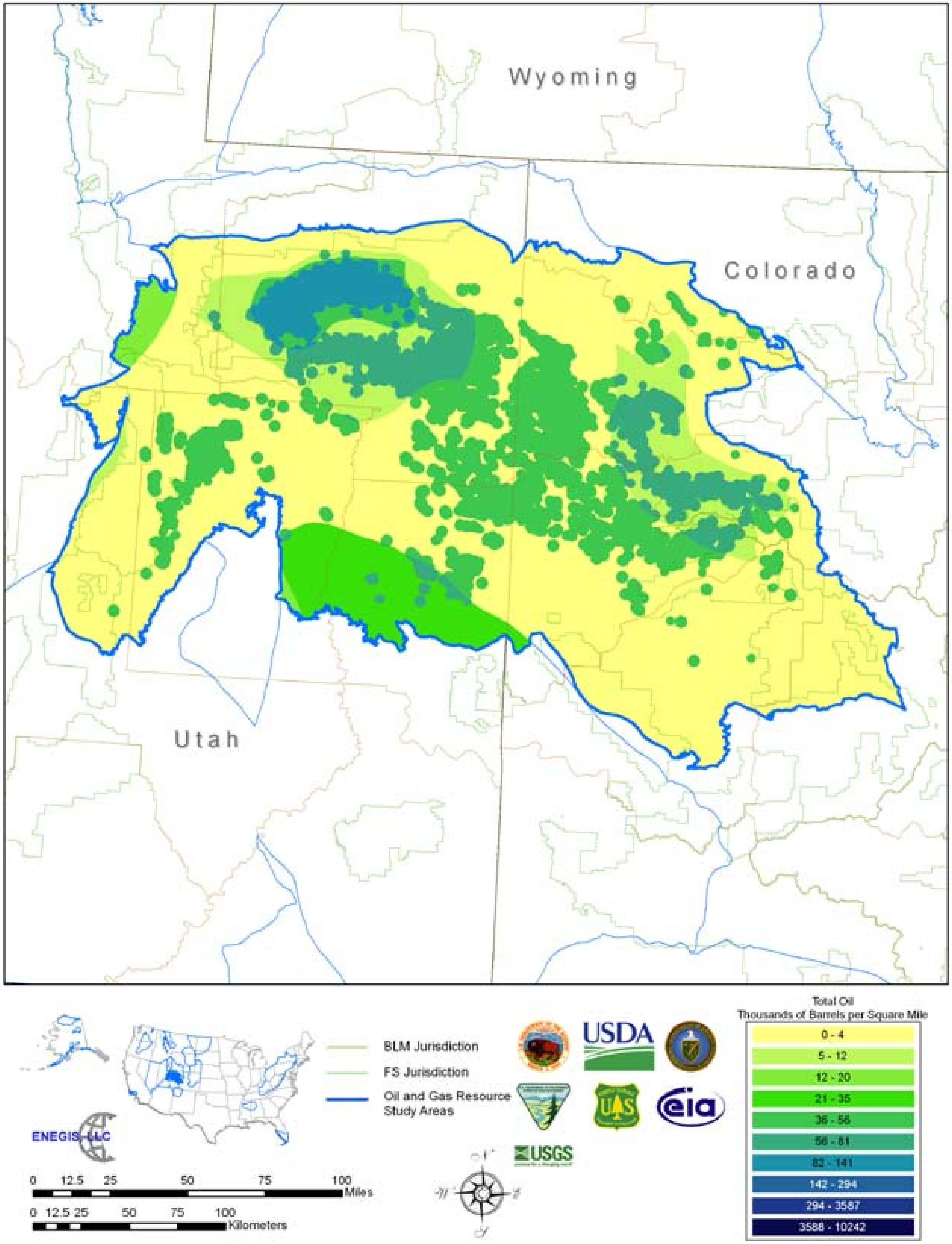

Figure 2-30. Total Oil Map, Uinta-Piceance Basin Study Area

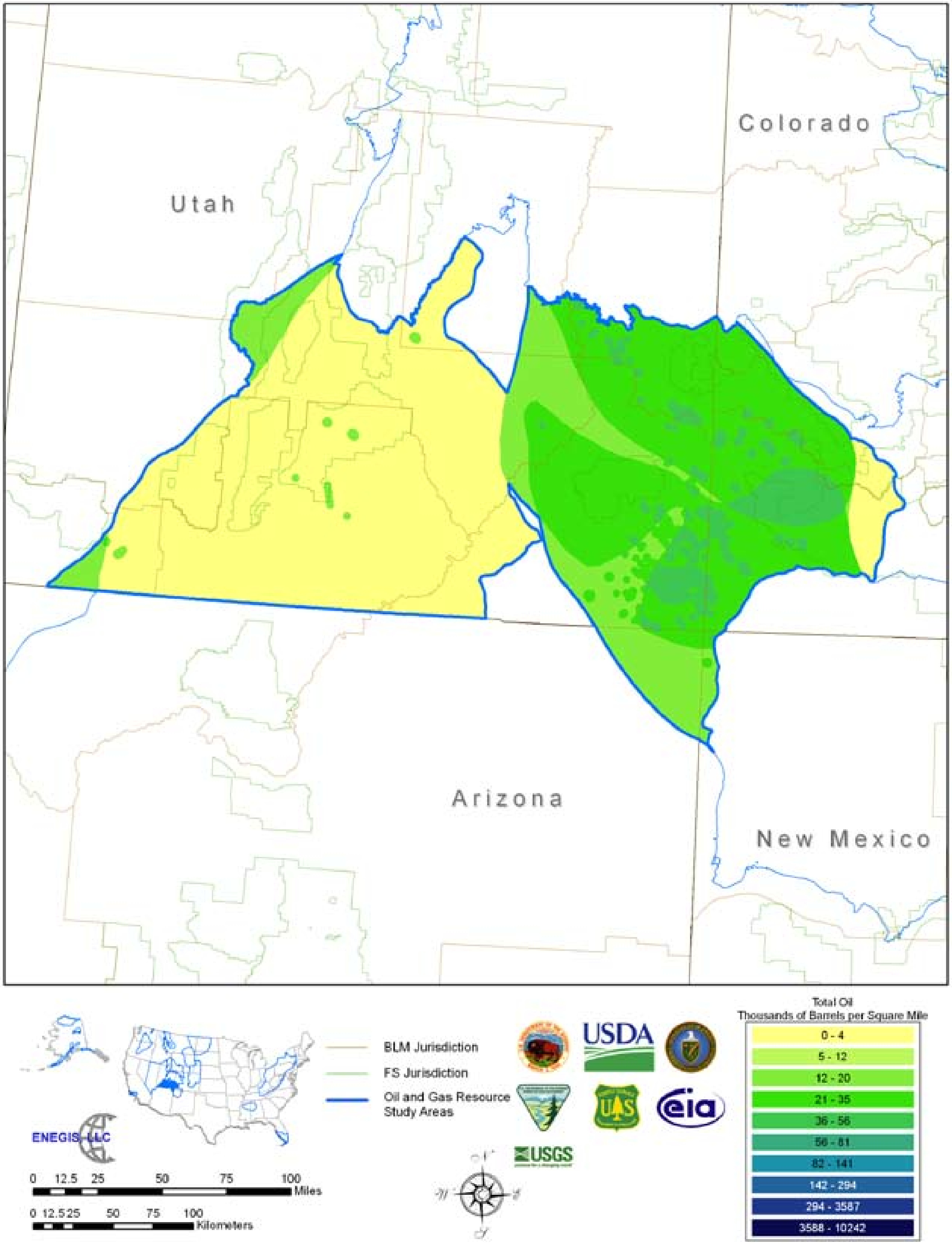

Figure 2-31. Total Oil Map, Paradox Basin Study Area

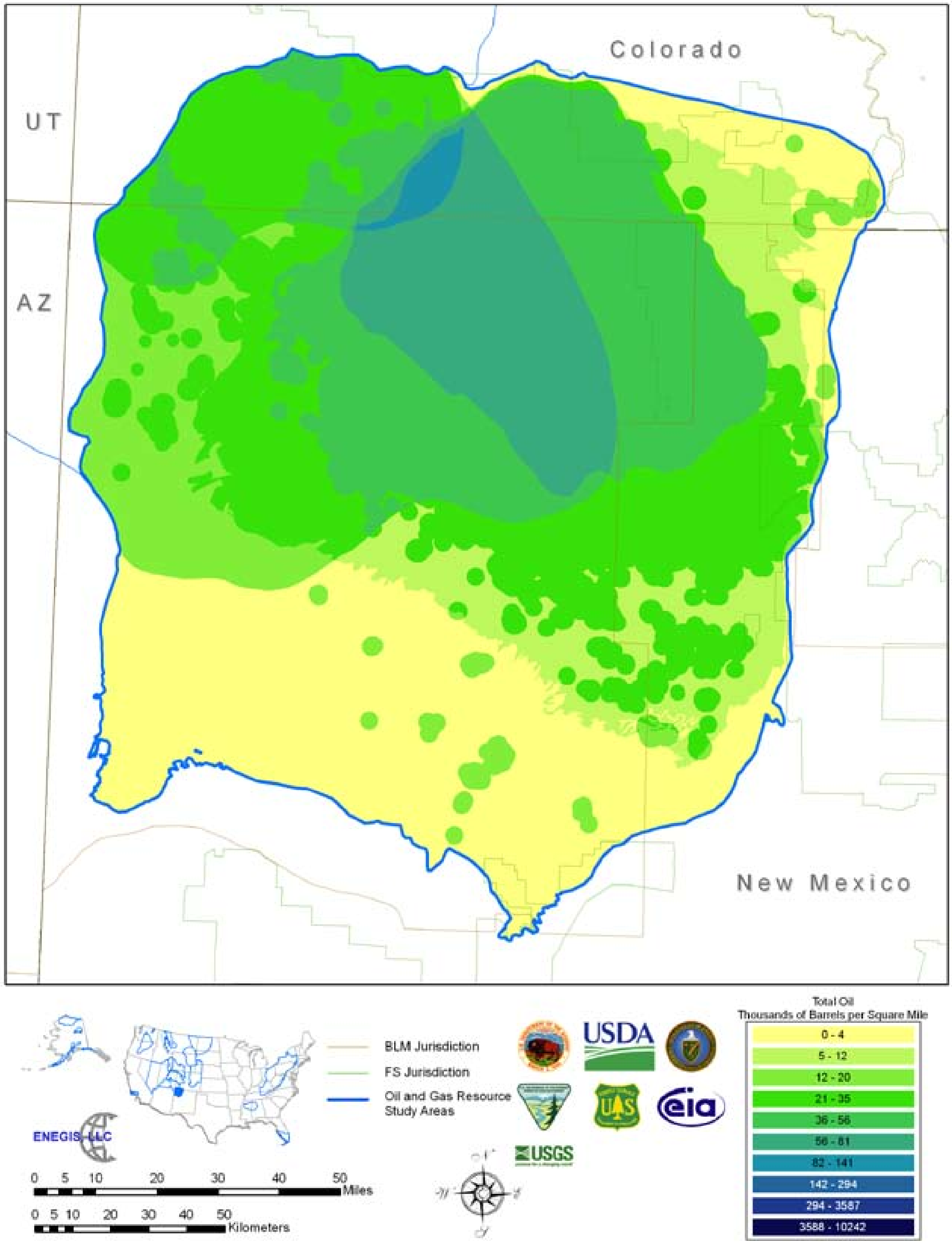

Figure 2-32. Total Oil Map, San Juan Basin Study Area

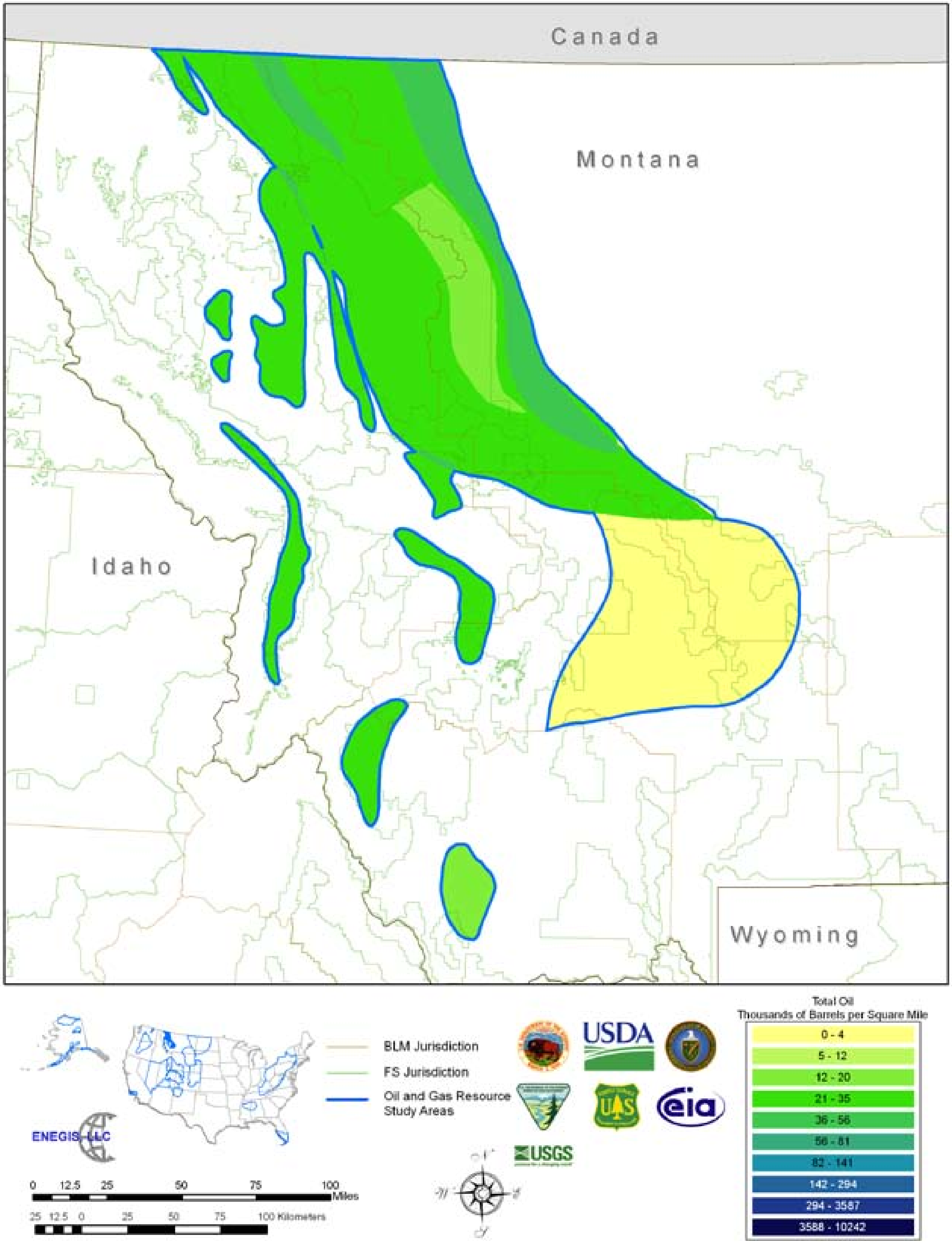

Figure 2-33. Total Oil Map, Montana Thrust Belt Study Area

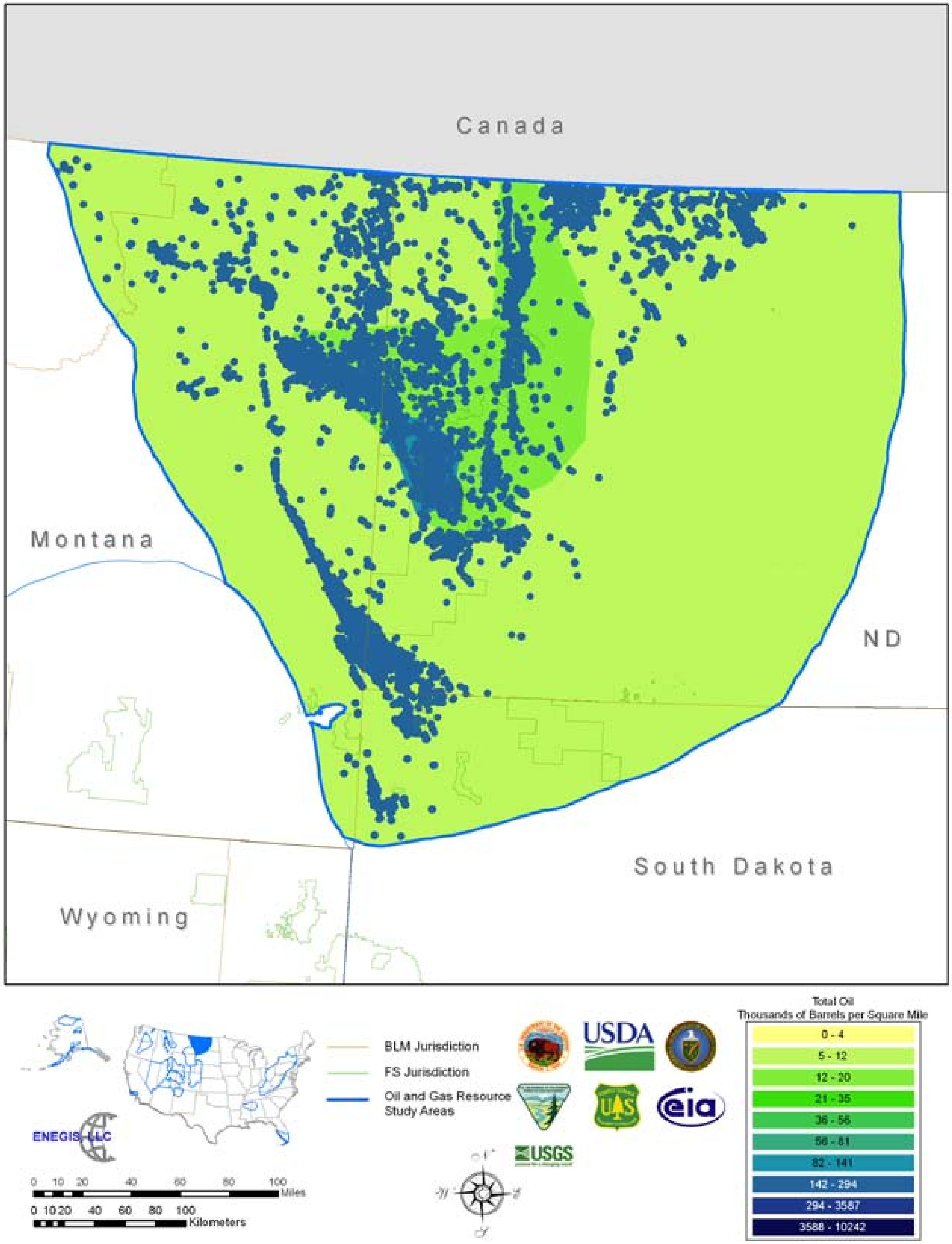

Figure 2-34. Total Oil Map, Williston Basin Study Area

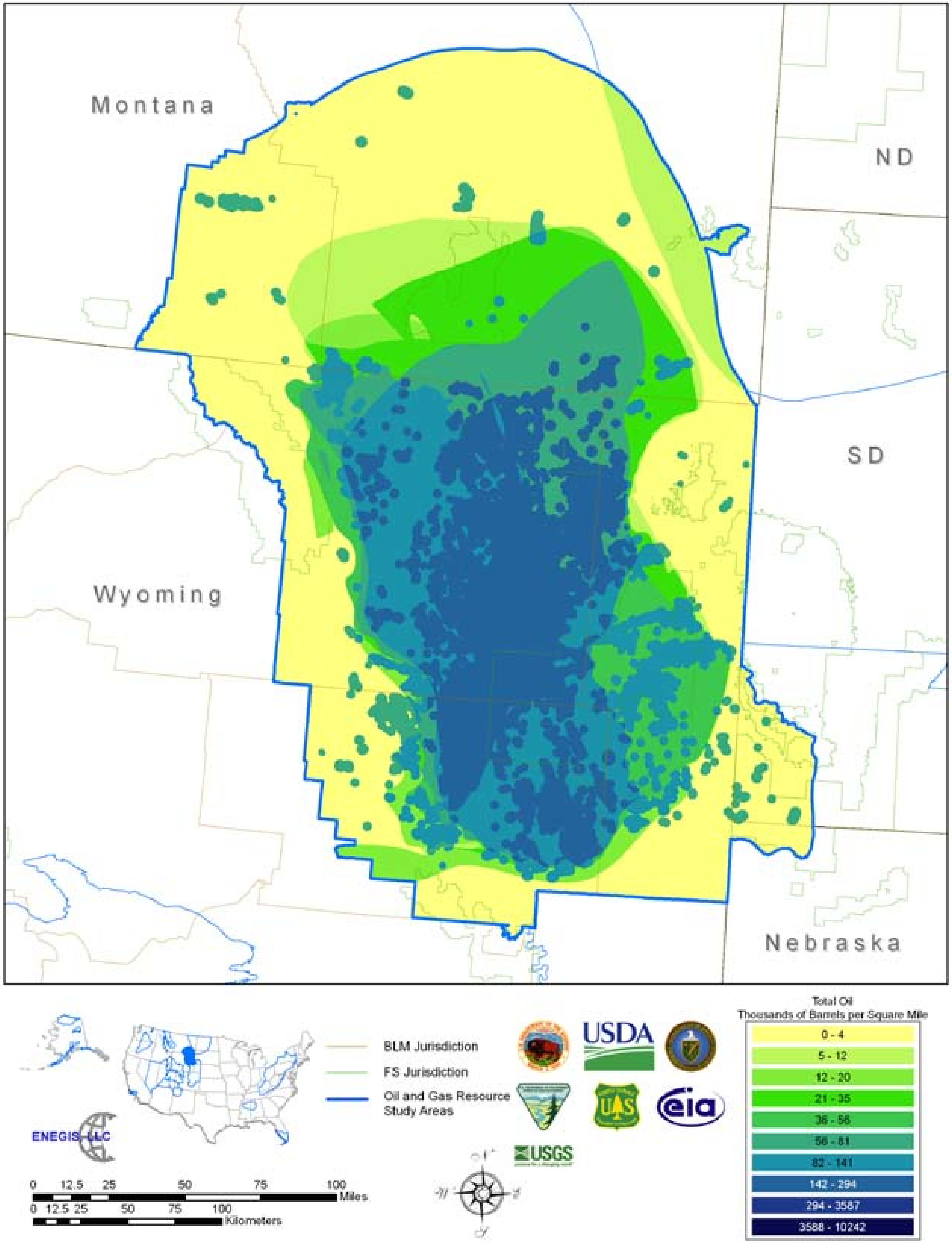

Figure 2-35. Total Oil Map, Powder River Basin Study Area

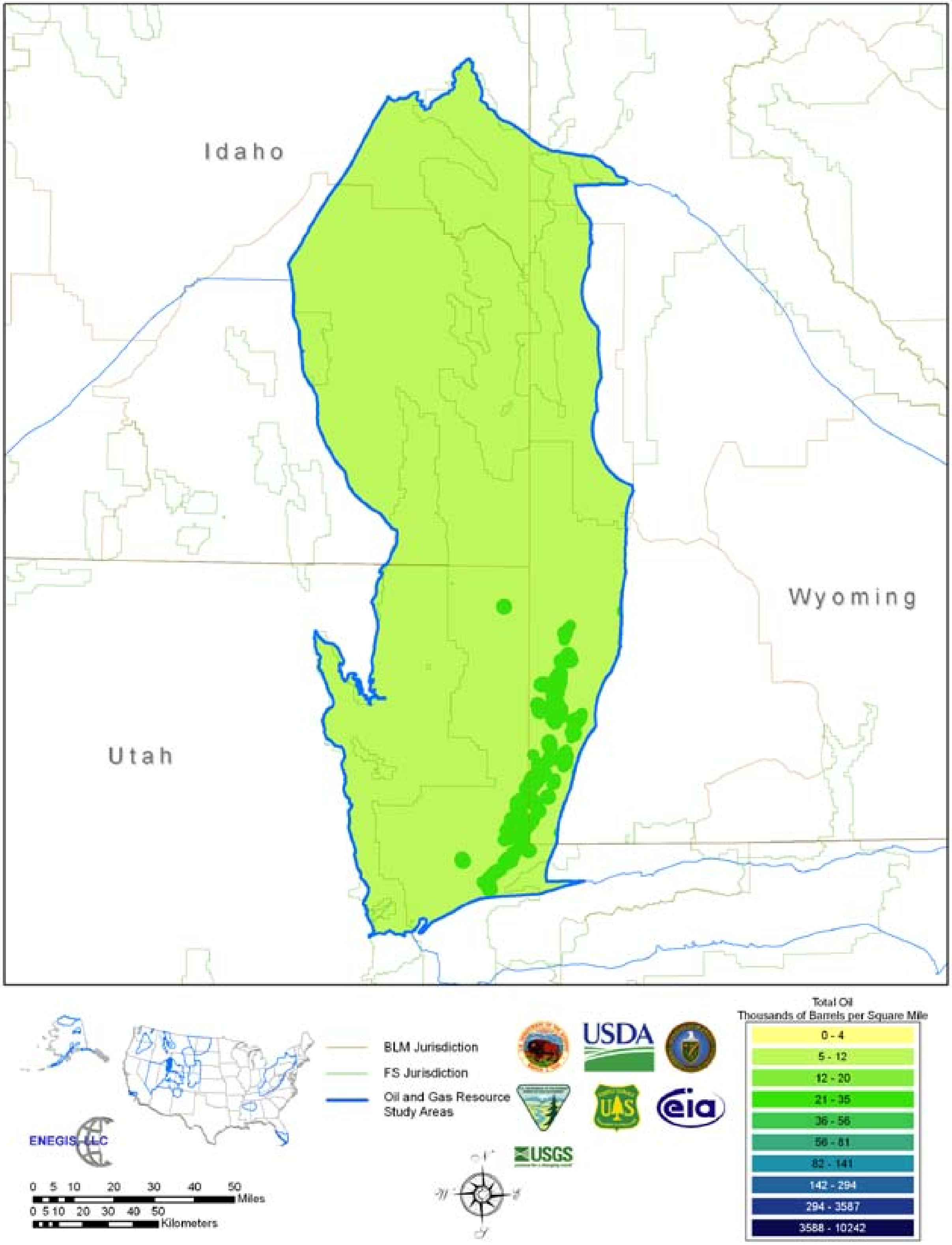

Figure 2-36. Total Oil Map, Wyoming Thrust Belt Study Area

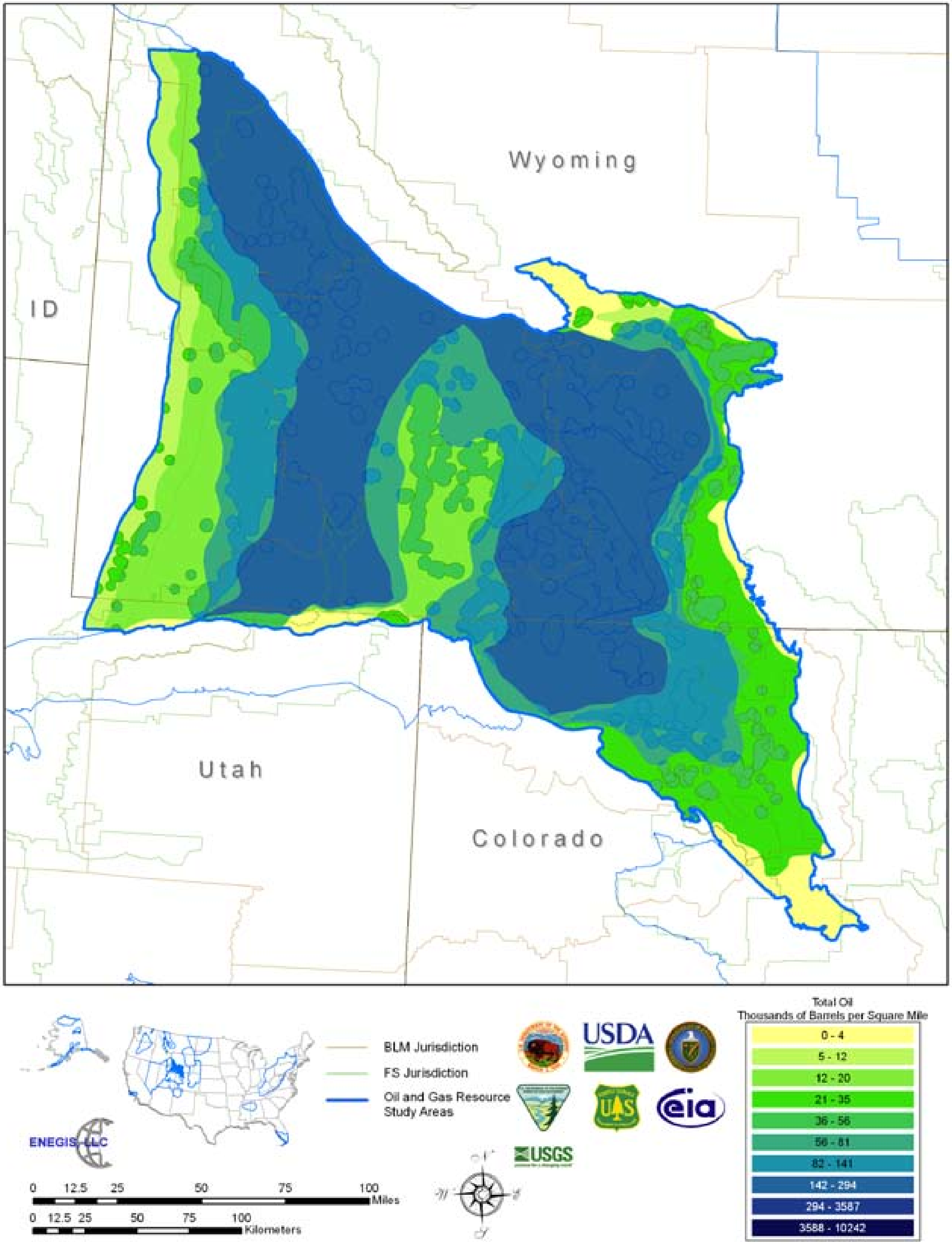

Figure 2-37. Total Oil Map, Southwestern Wyoming Study Area

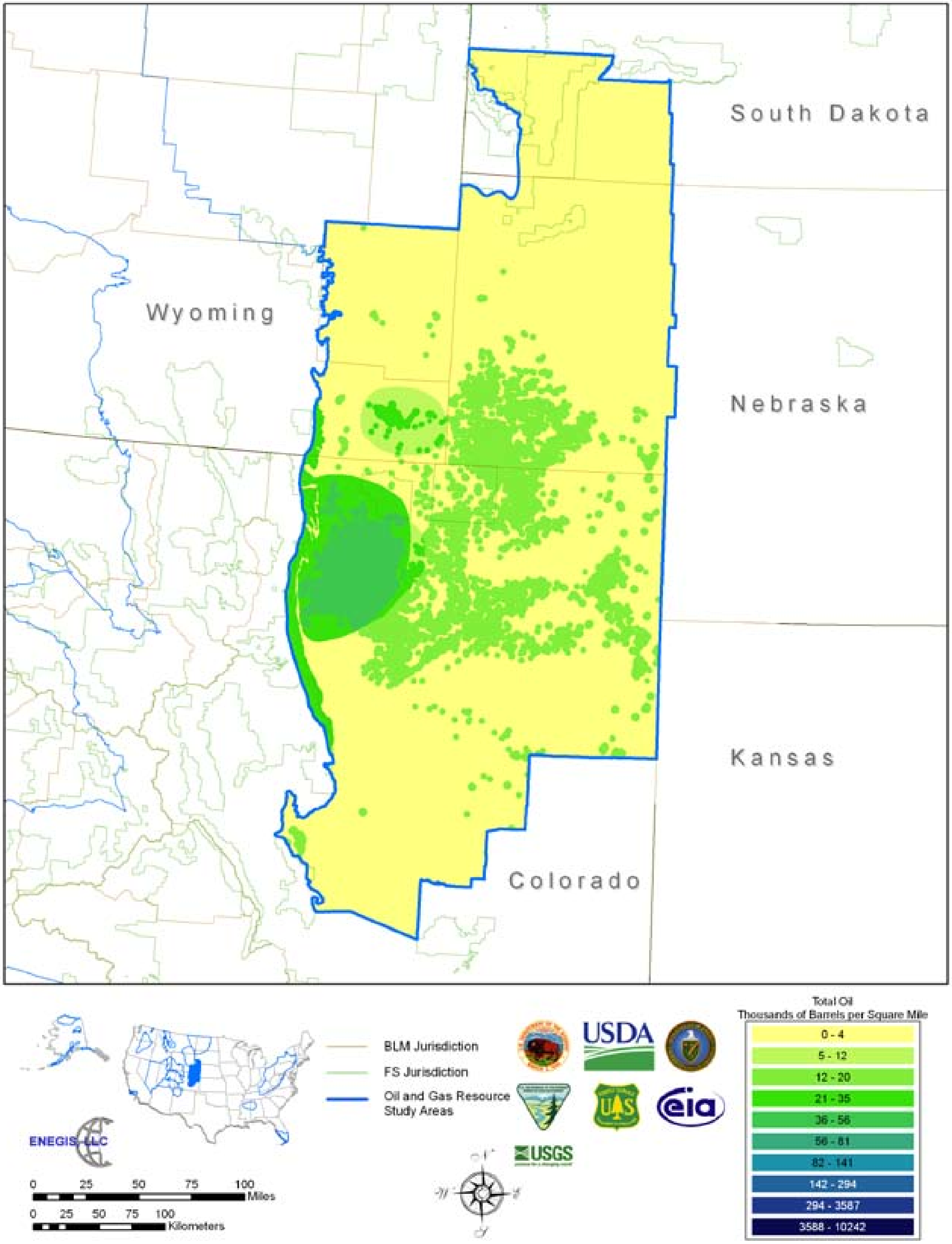

Figure 2-38. Total Oil Map, Denver Basin Study Area

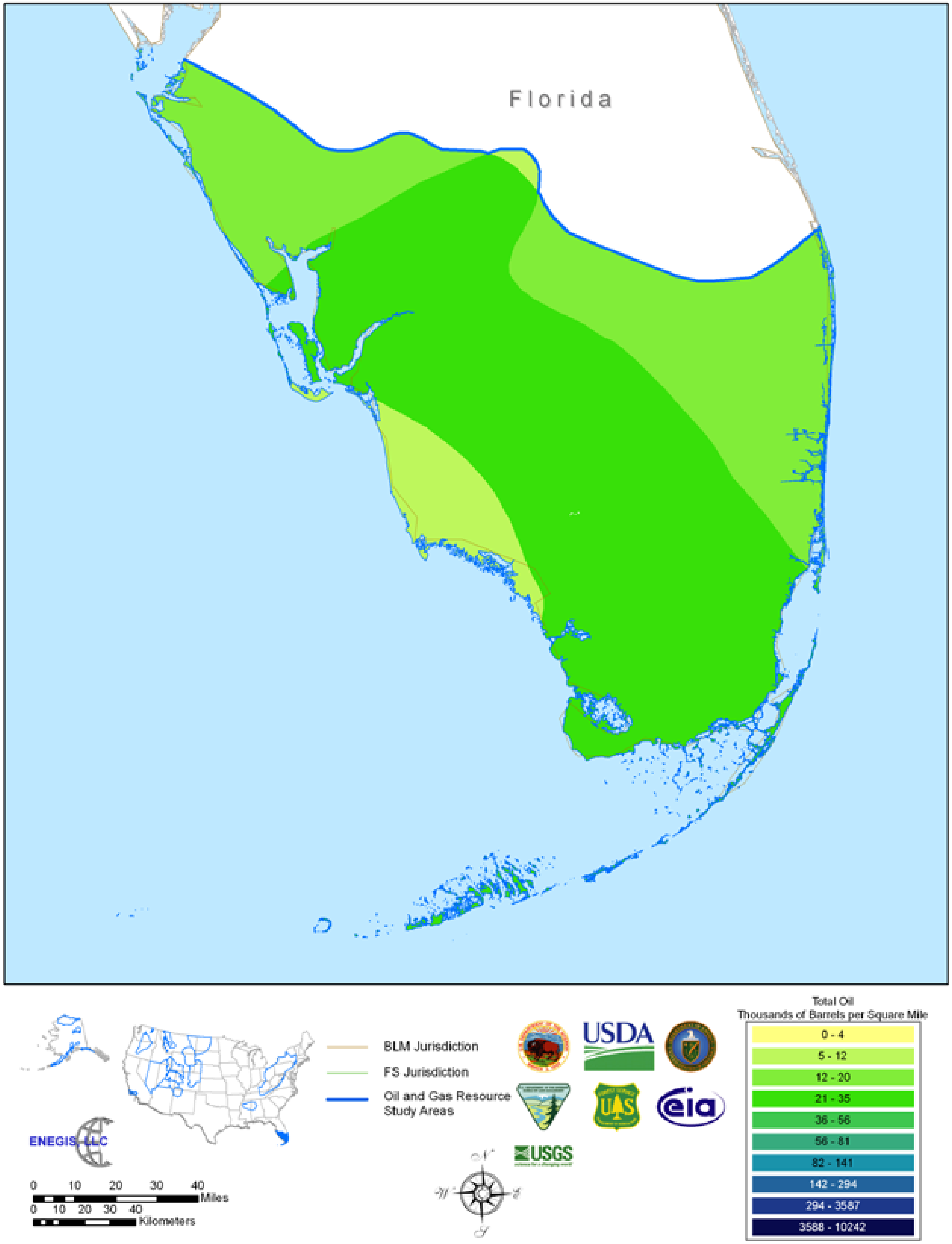

Figure 2-39. Total Oil Map, Florida Peninsula Study Area

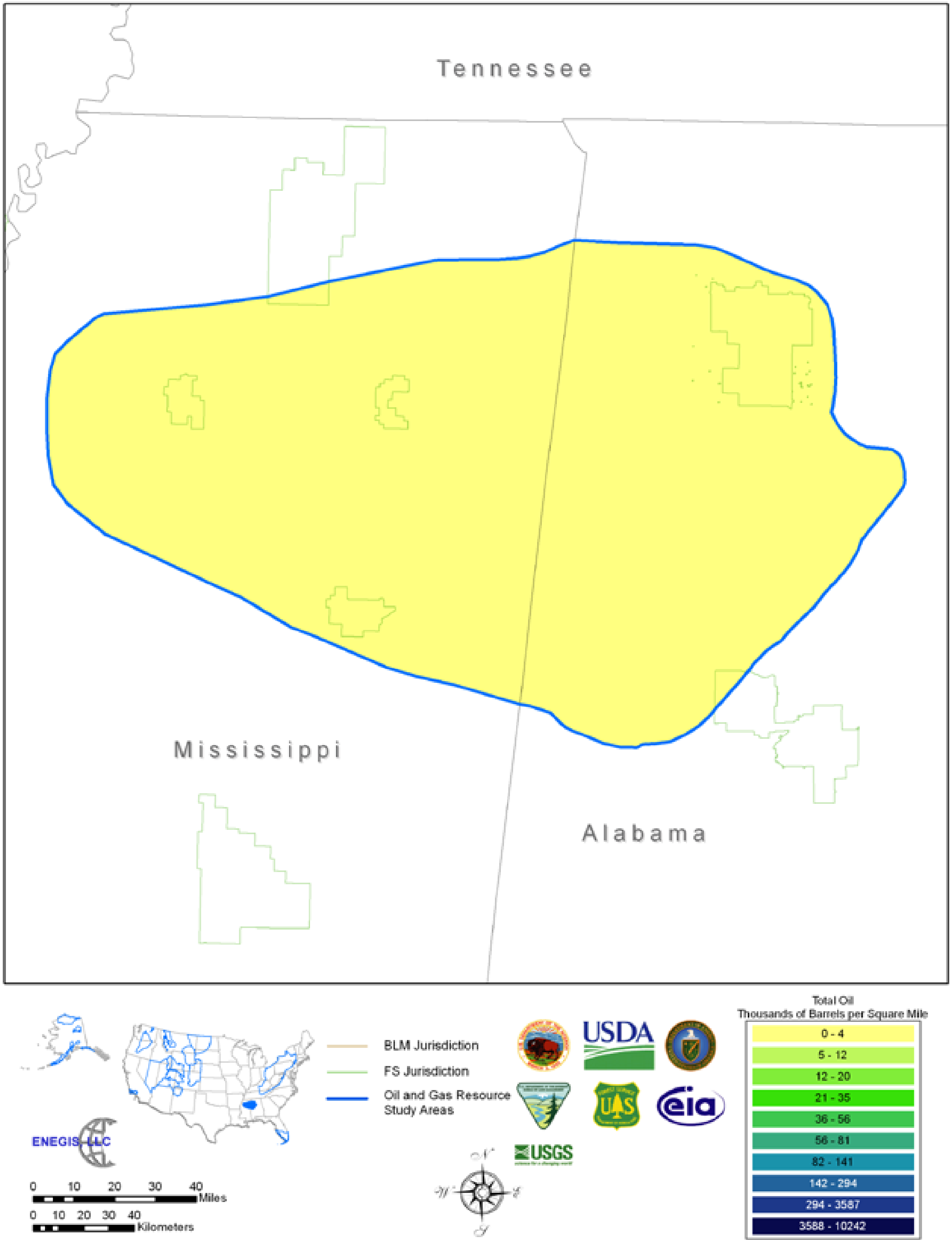

Figure 2-40. Total Oil Map, Black Warrior Basin Study Area

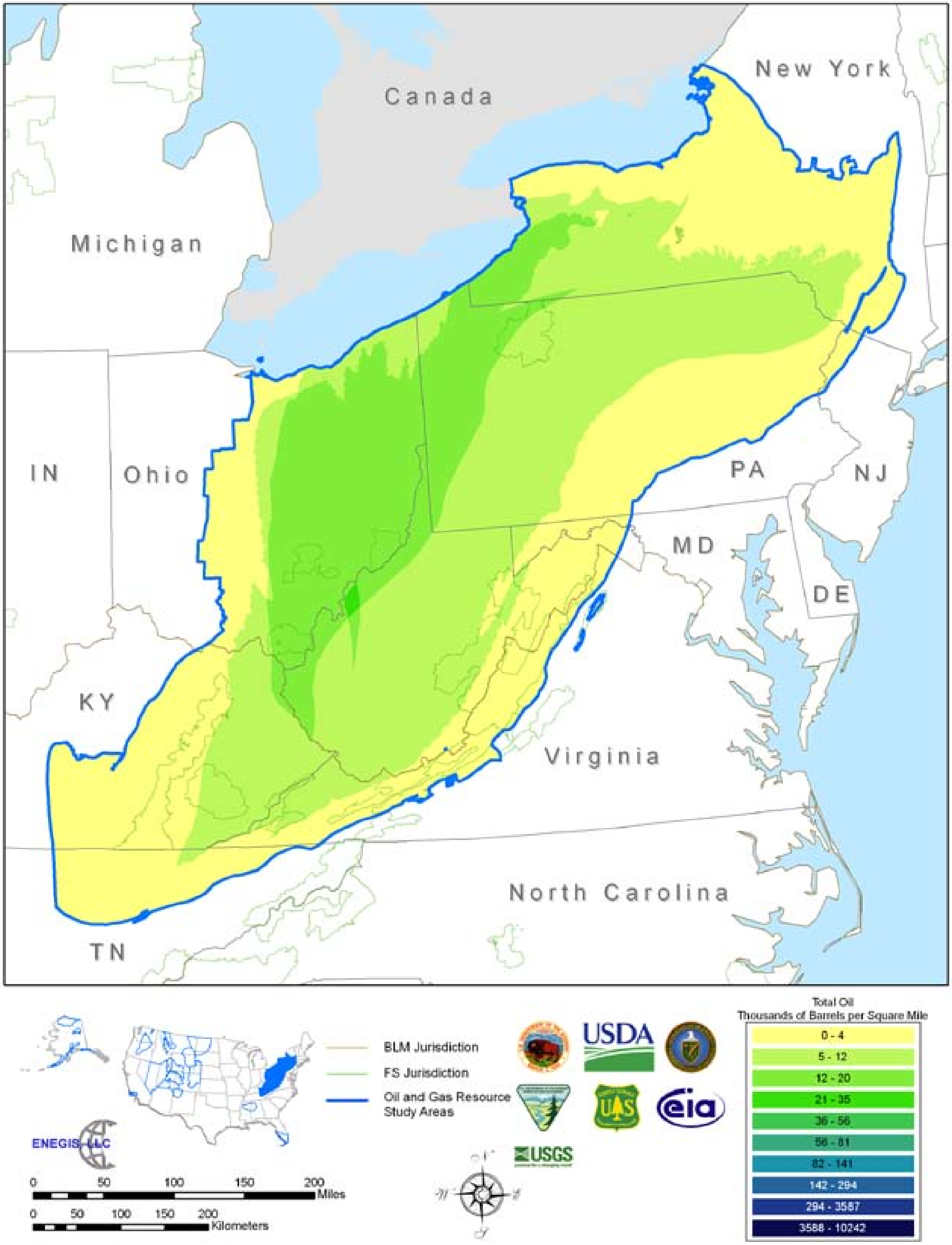

Figure 2-41. Total Oil Map, Appalachian Basin Study Area

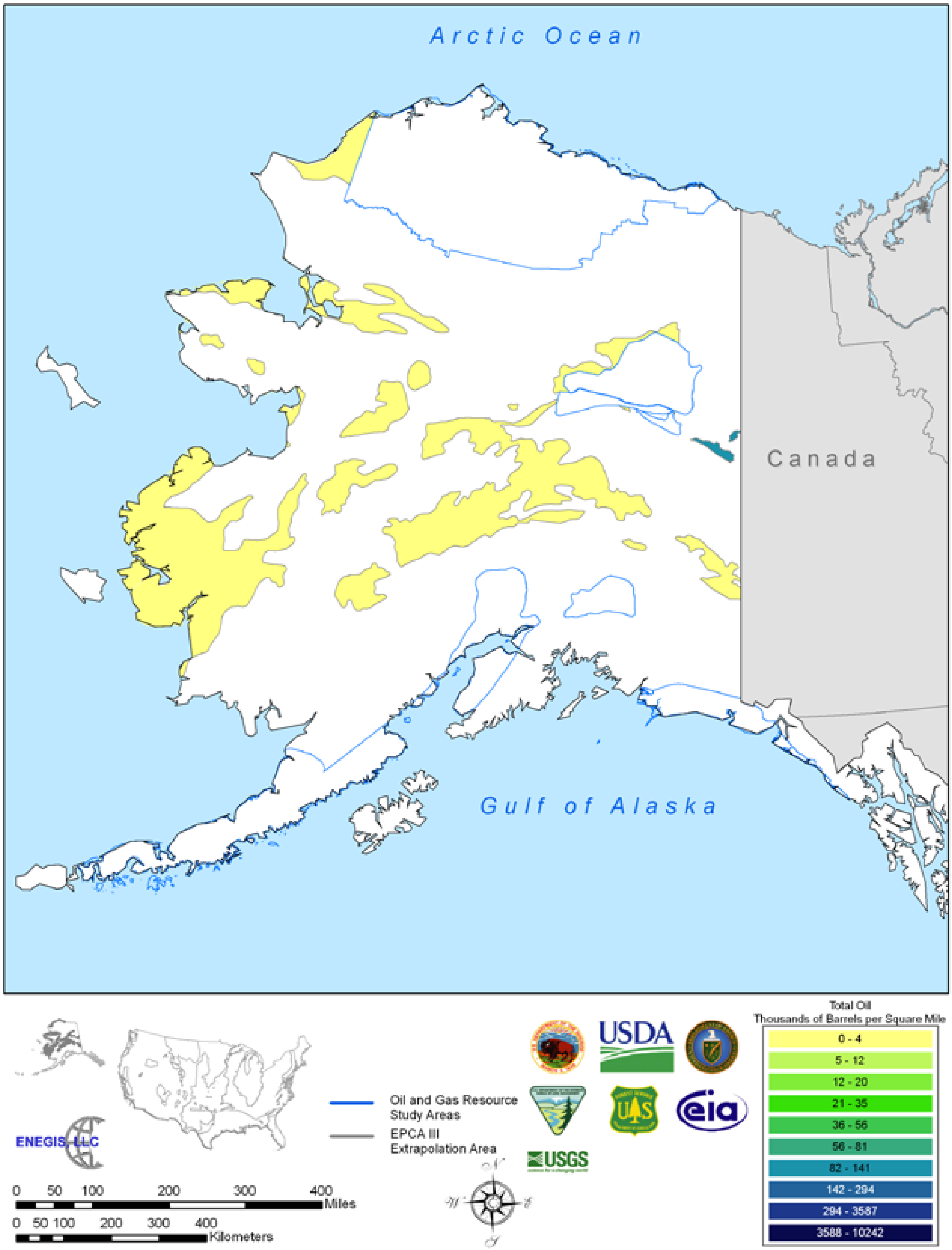

Figure 2-42. Total Oil Map, Alaska Extrapolation Area

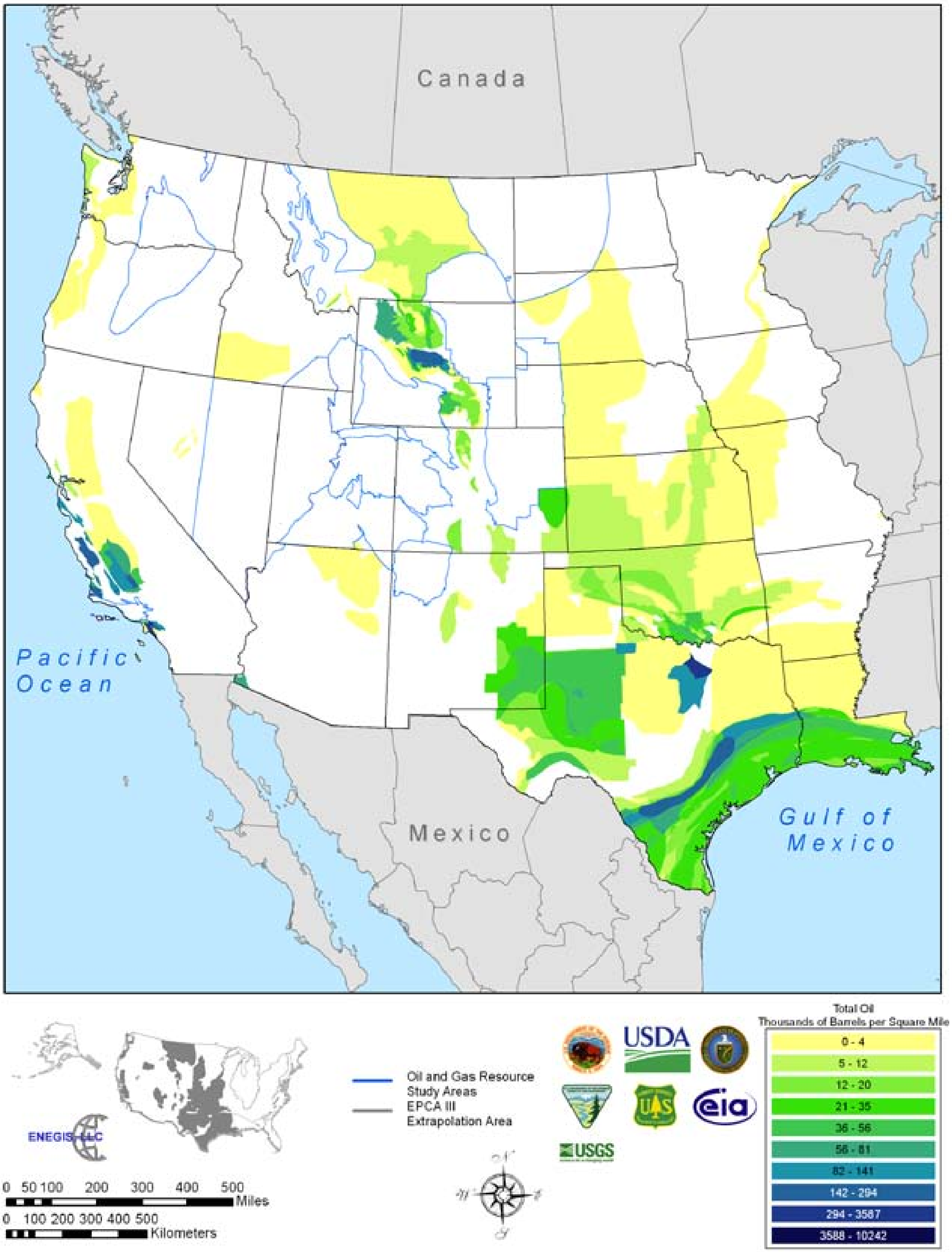

Figure 2-43. Total Oil Map, Western Extrapolation Area

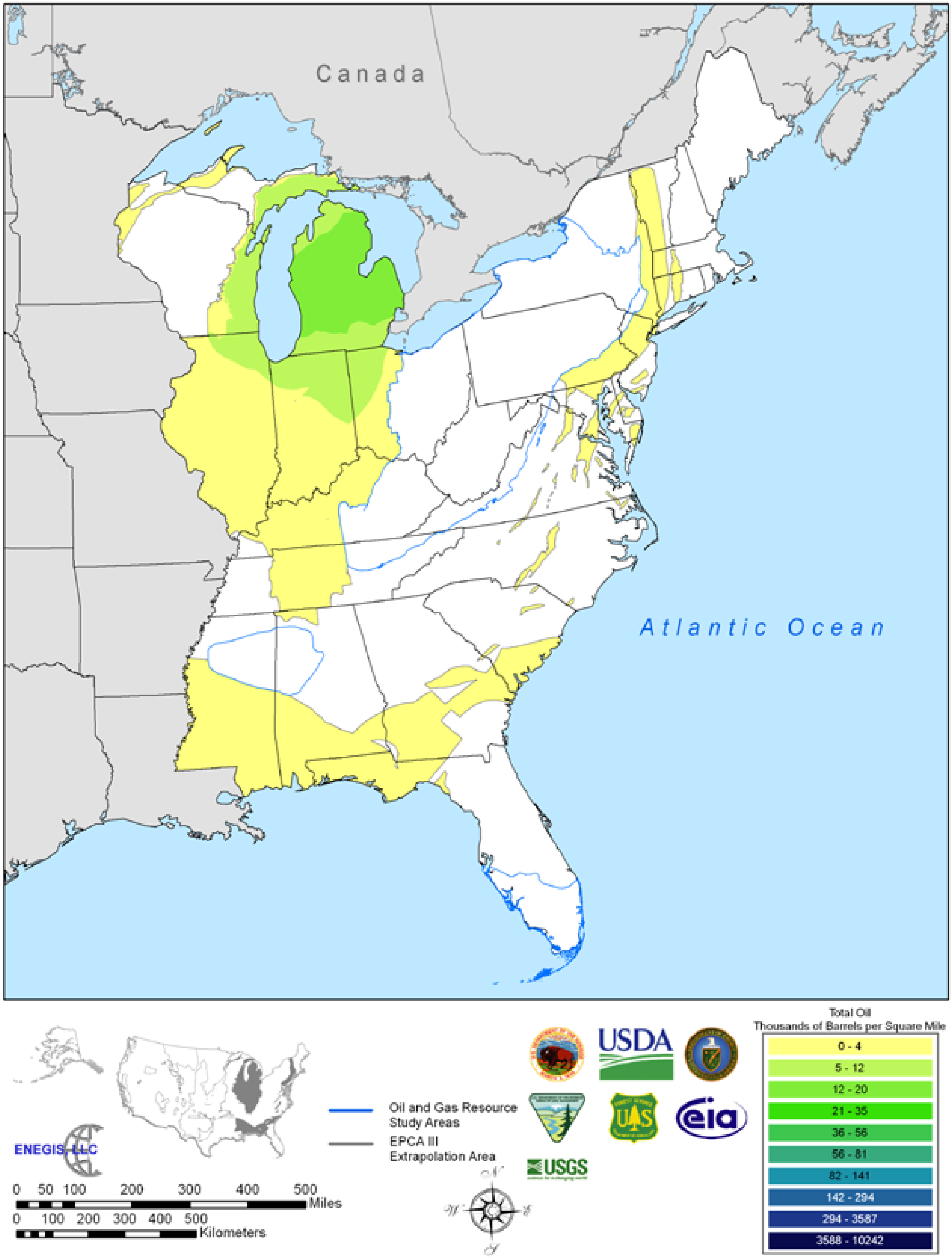

Figure 2-44. Total Oil Map, Eastern Extrapolation Area

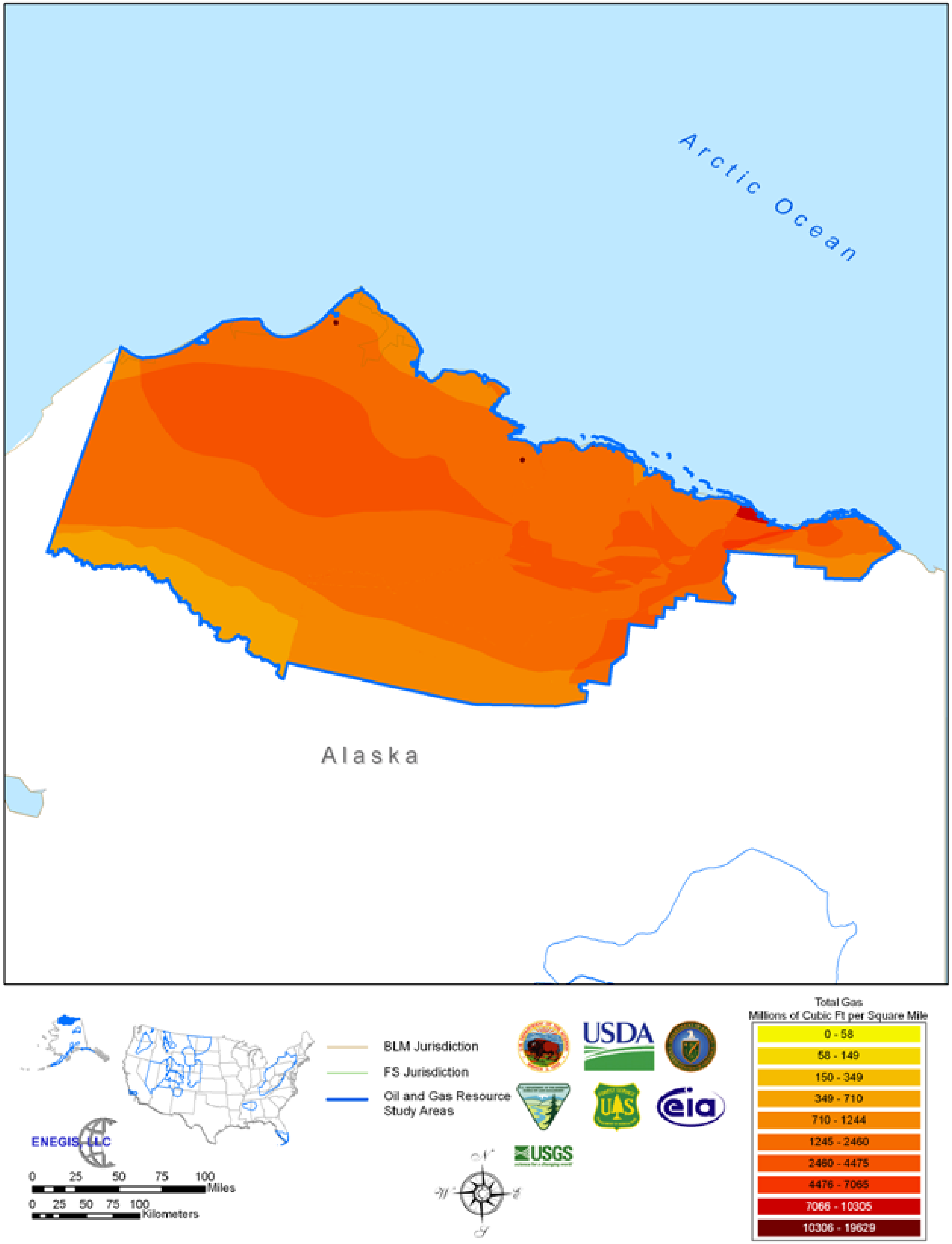

Figure 2-45. Total Natural Gas Map, Northern Alaska Study Area

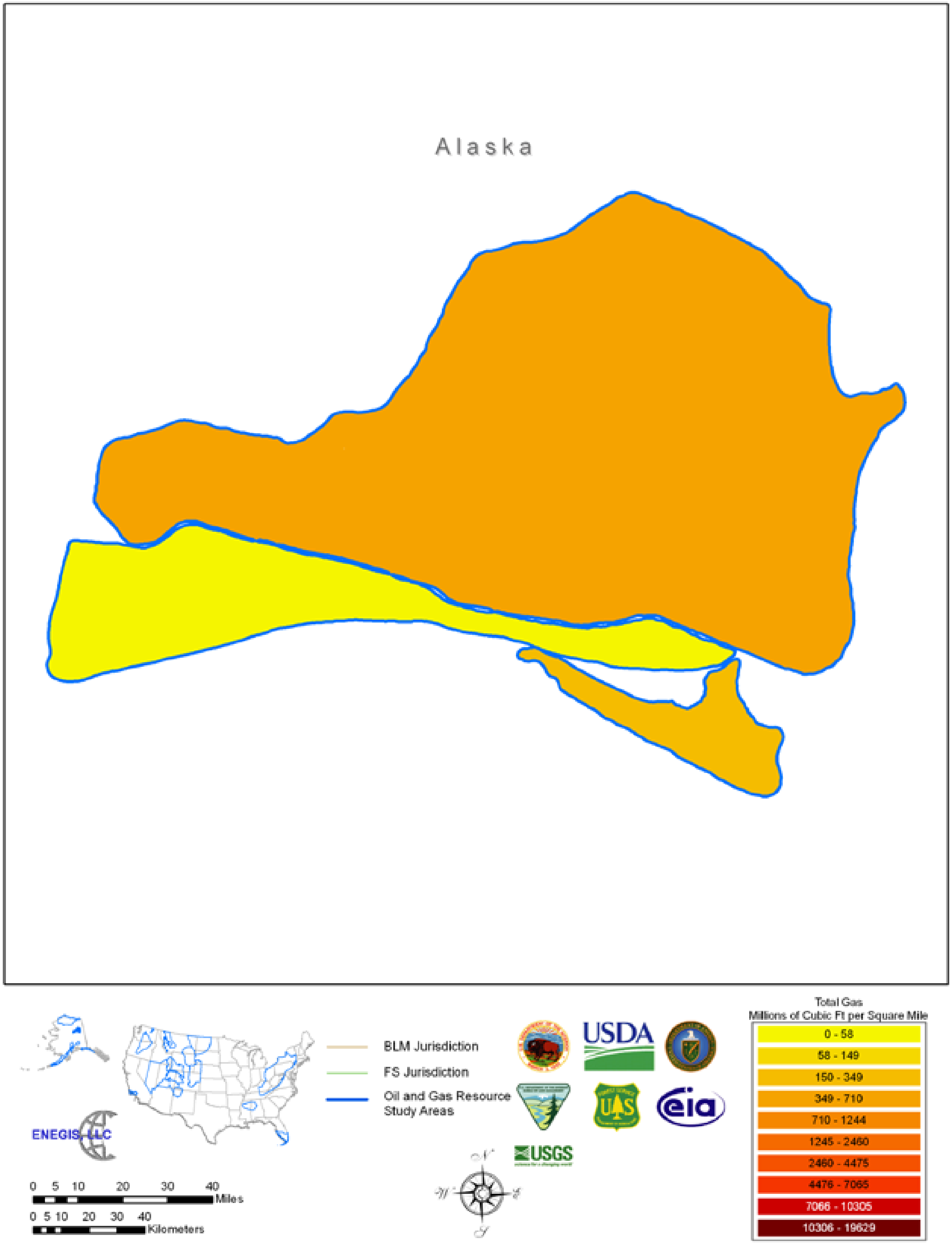

Figure 2-46. Total Natural Gas Map, Central Alaska - Yukon Flats Study Area

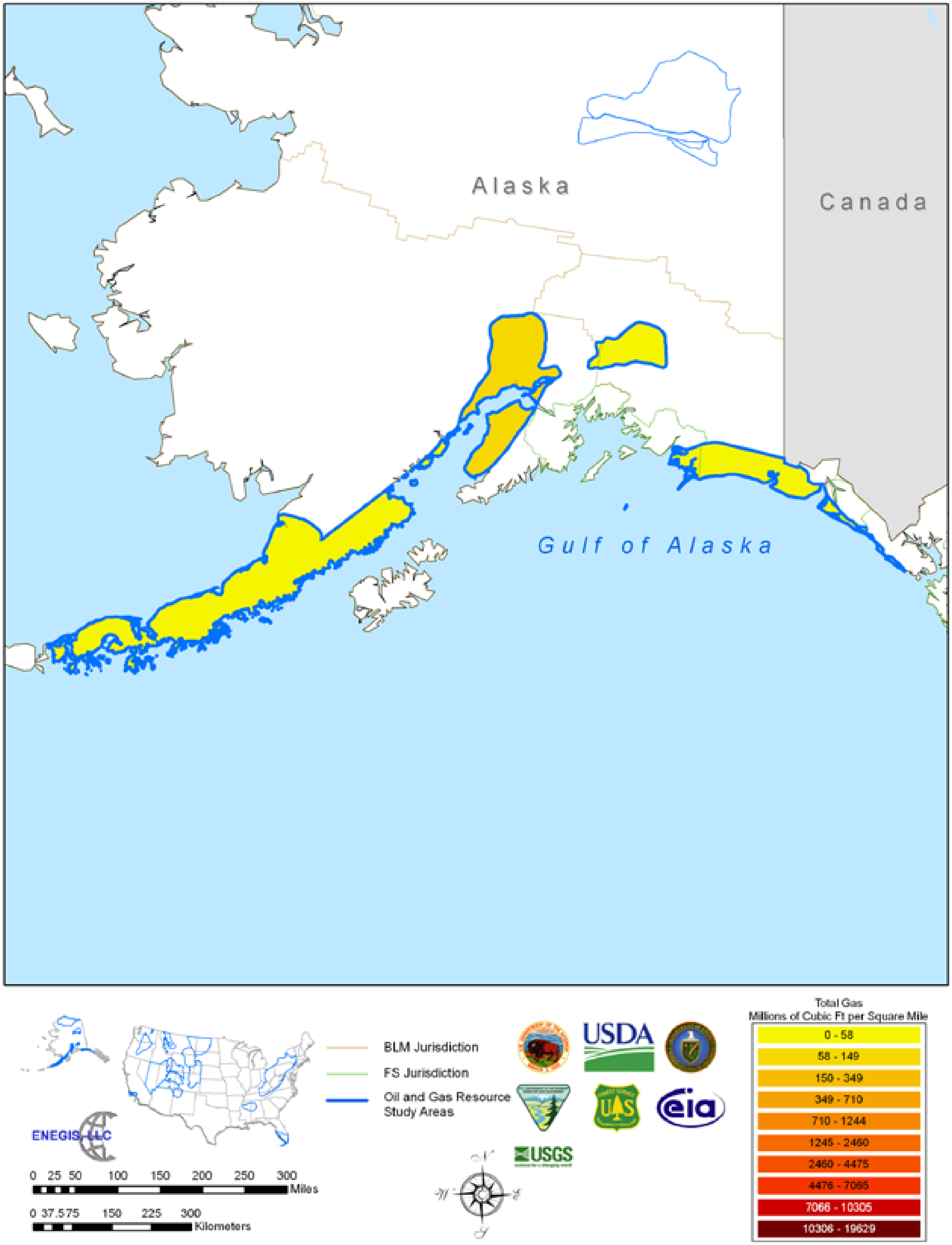

Figure 2-47. Total Natural Gas Map, Southern Alaska Study Area

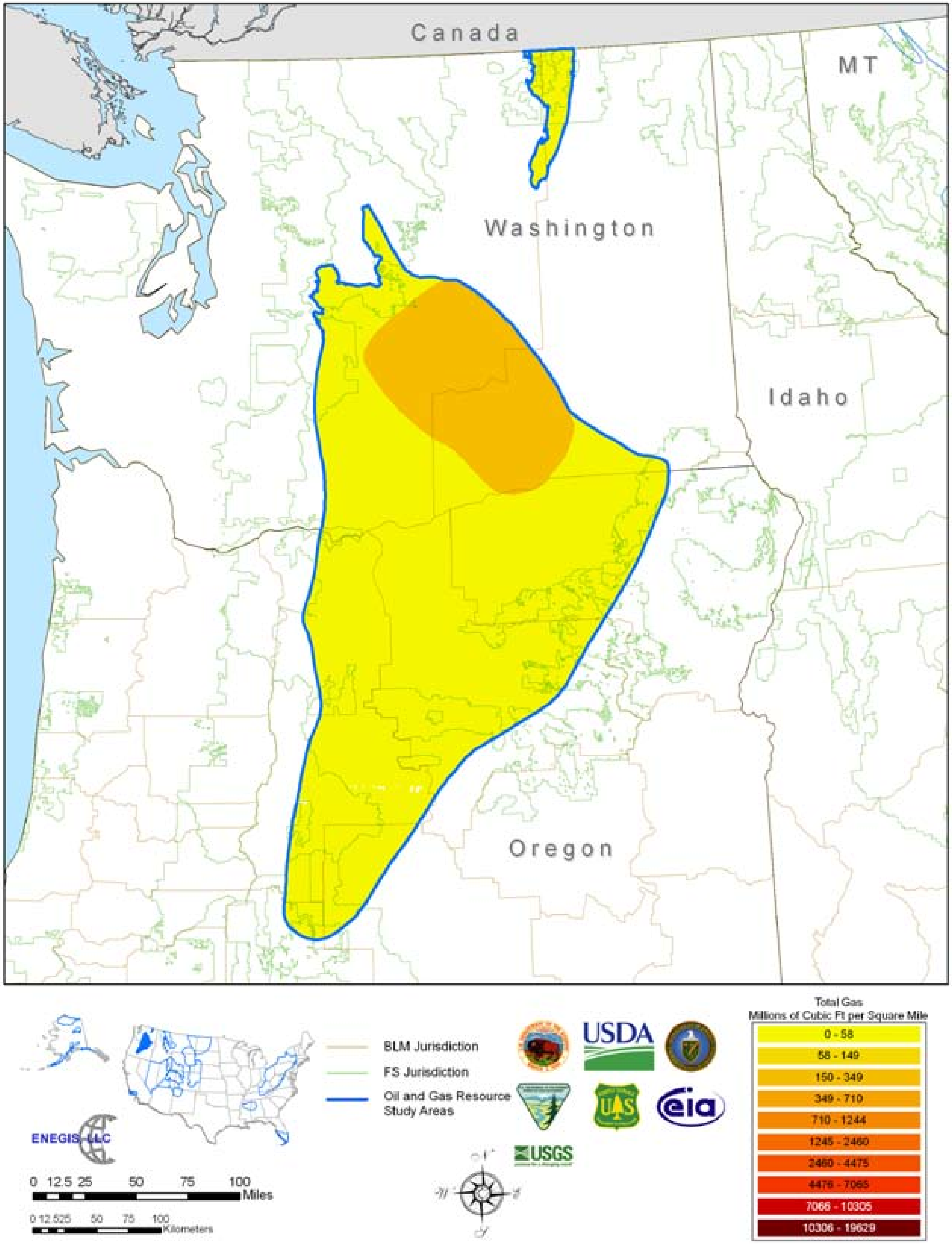

Figure 2-48. Total Natural Gas Map, Eastern Oregon-Washington Study Area

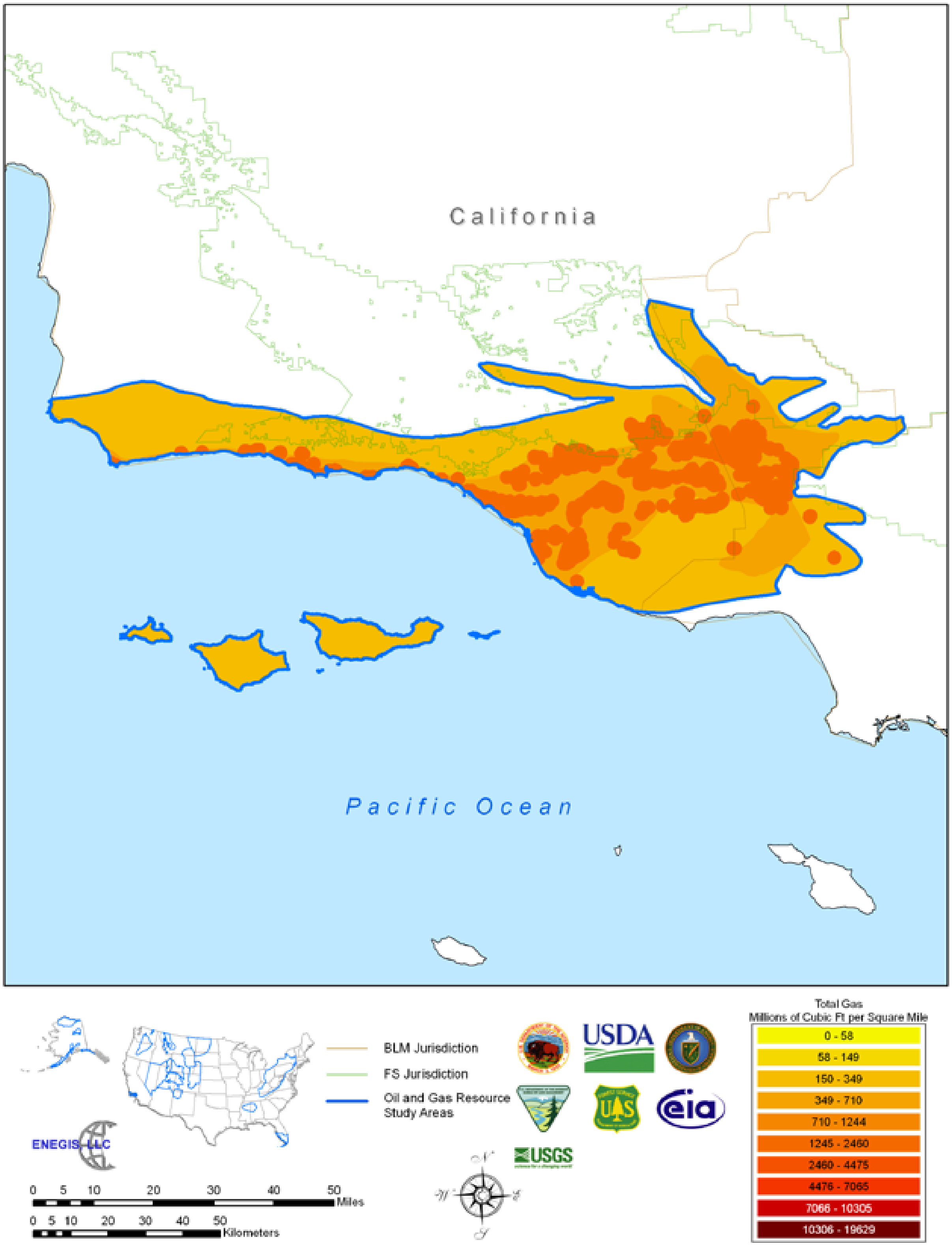

Figure 2-49. Total Natural Gas Map, Ventura Basin Study Area

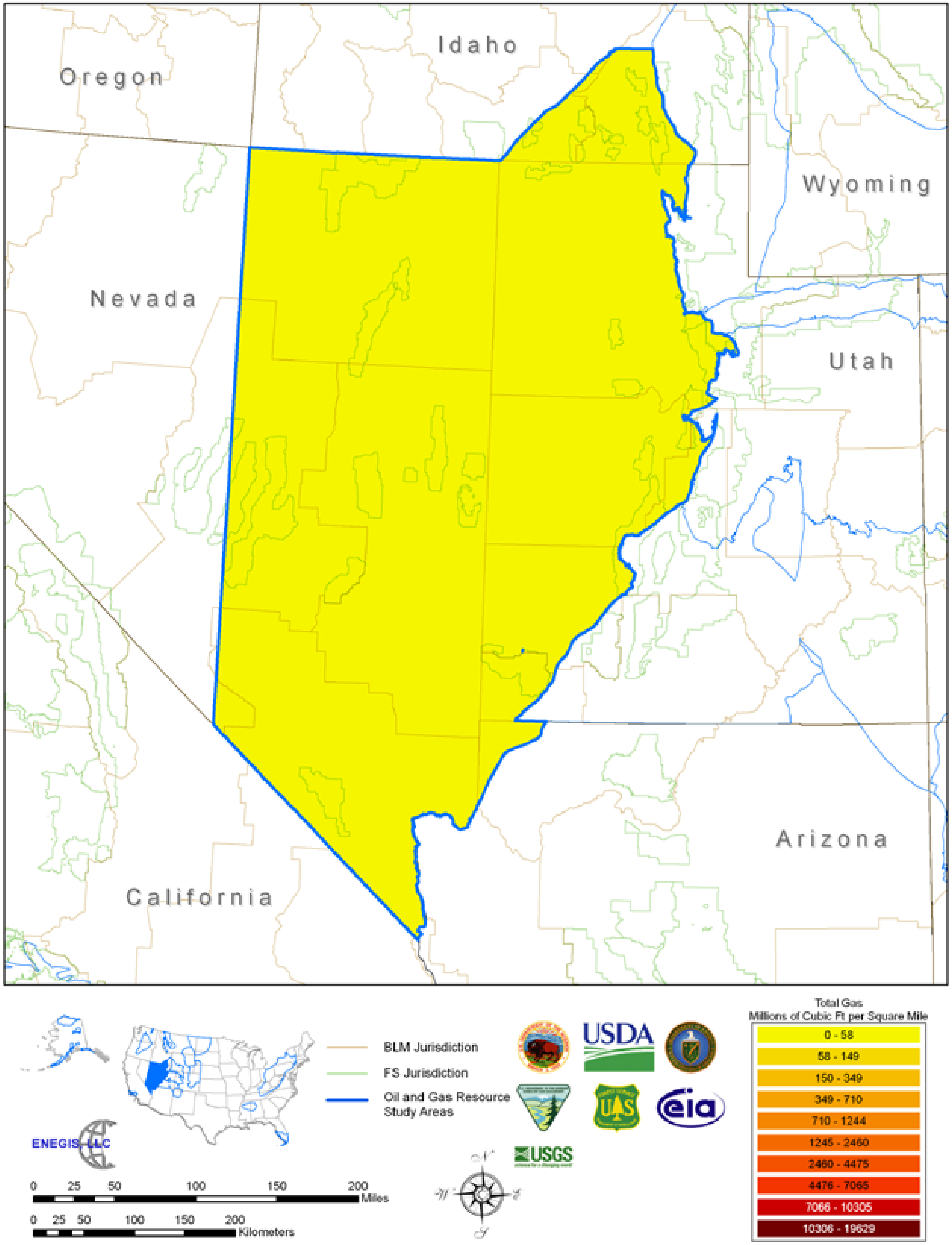

Figure 2-50. Total Natural Gas Map, Eastern Great Basin Study Area

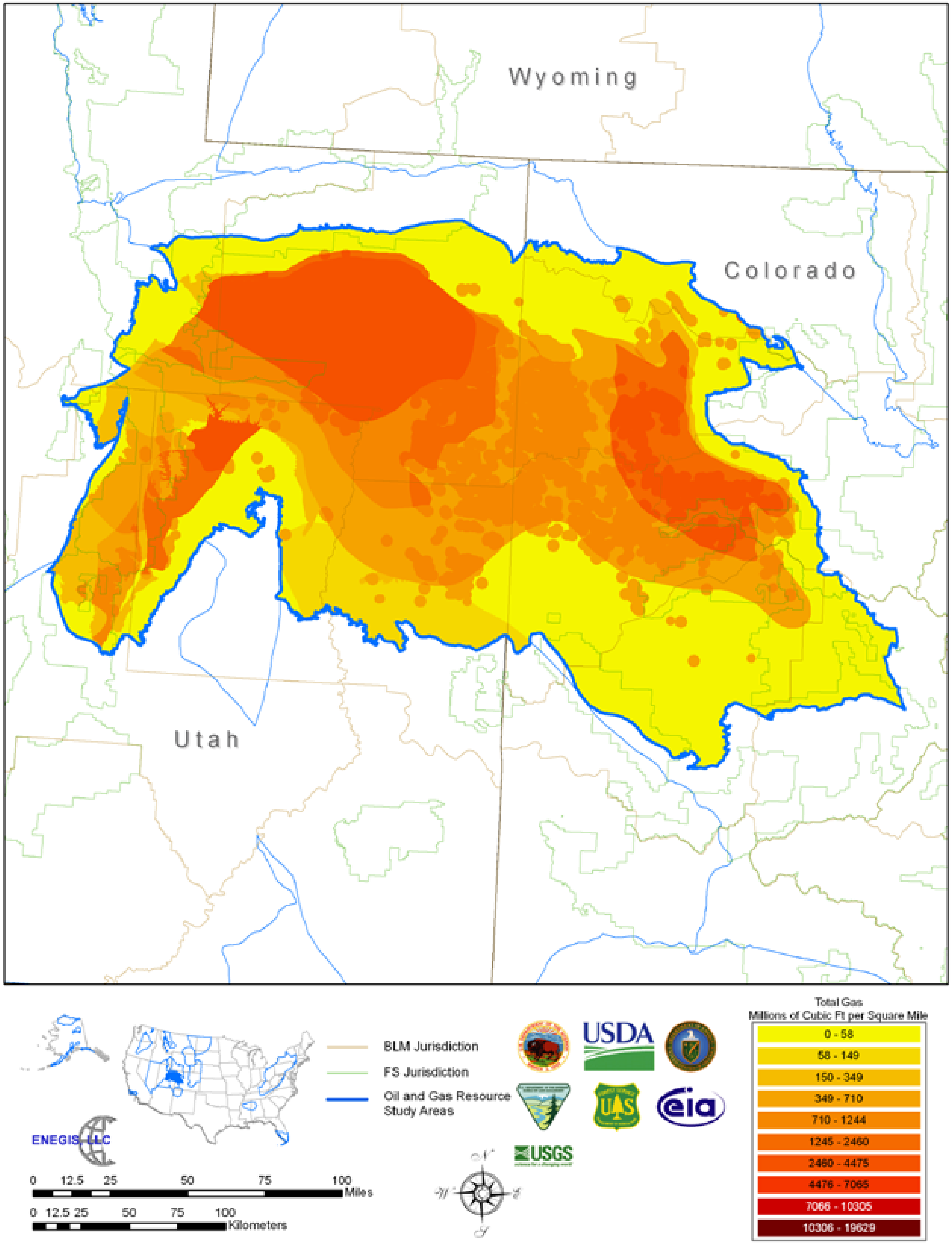

Figure 2-51. Total Natural Gas Map, Uinta-Piceance Basin Study Area

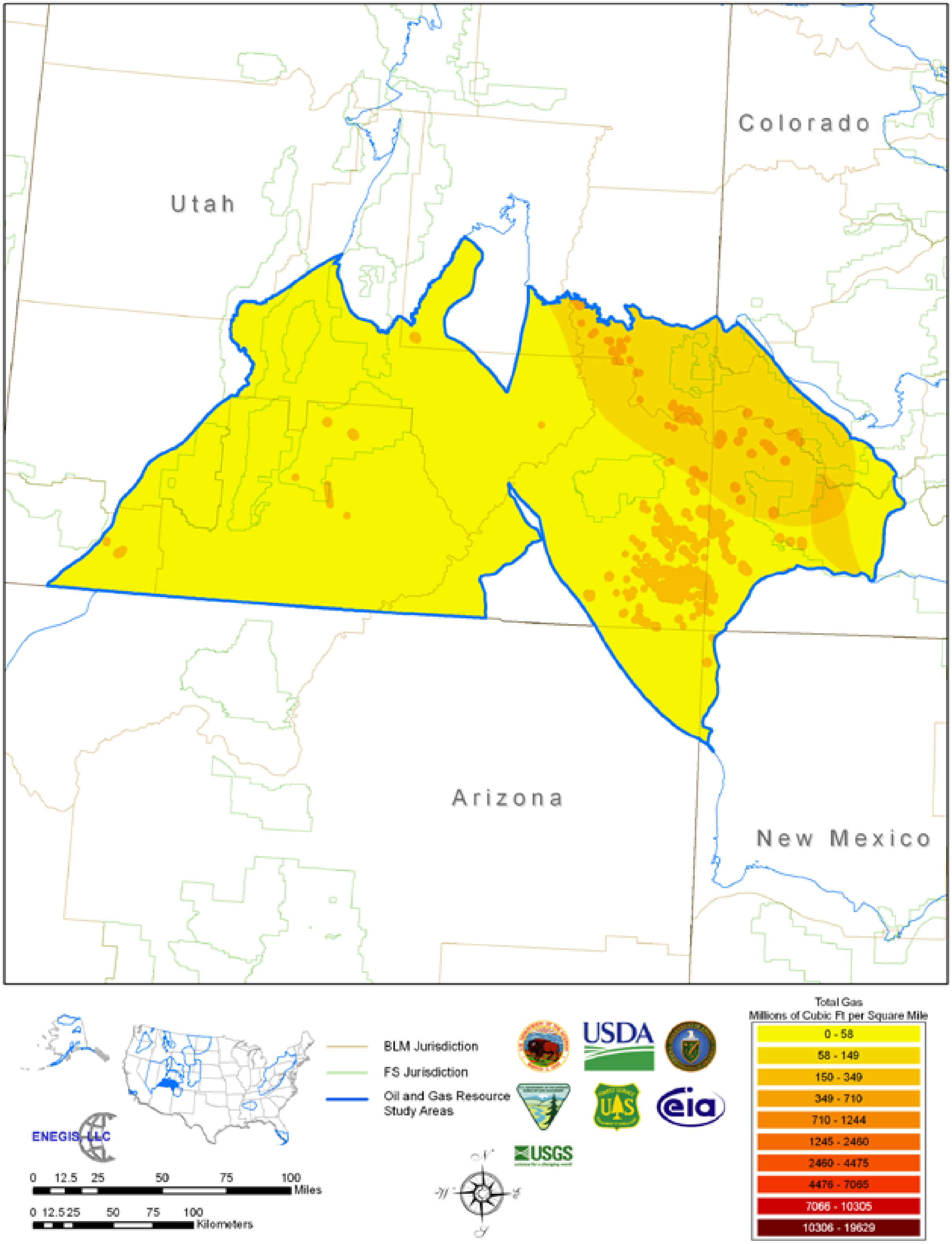

Figure 2-52. Total Natural Gas Map, Paradox Basin Study Area

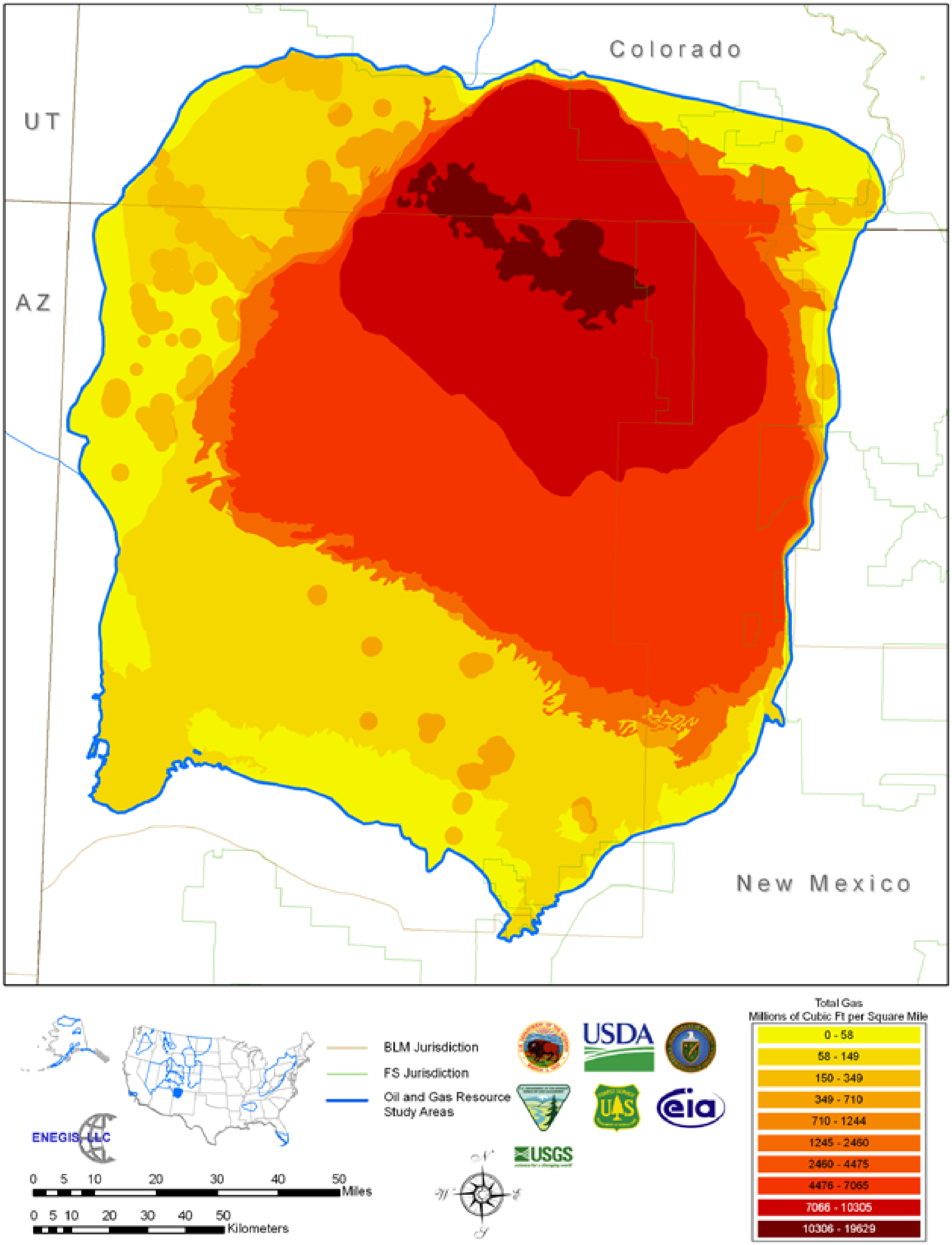

Figure 2-53. Total Natural Gas Map, San Juan Basin Study Area

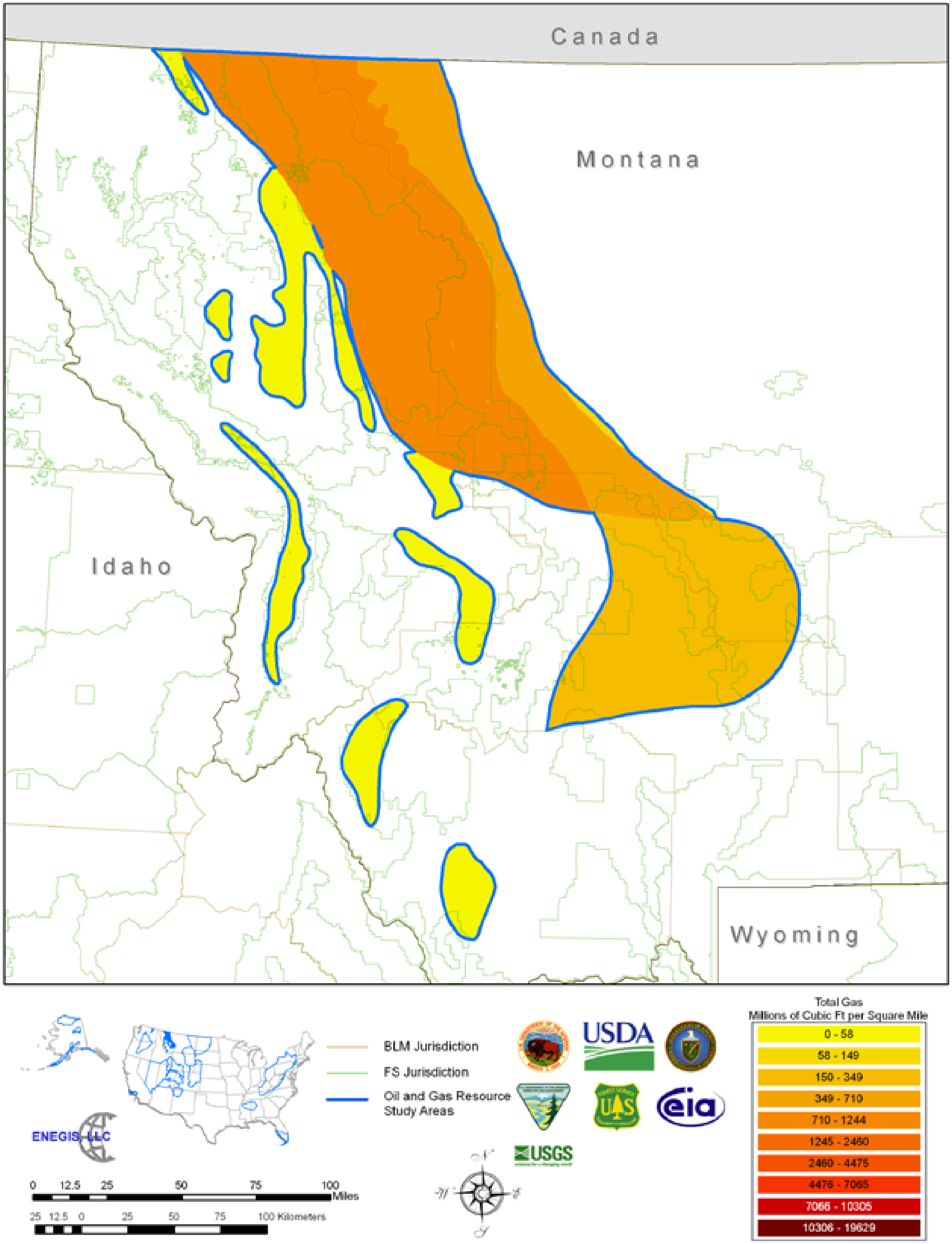

Figure 2-54. Total Natural Gas Map, Montana Thrust Belt Study Area

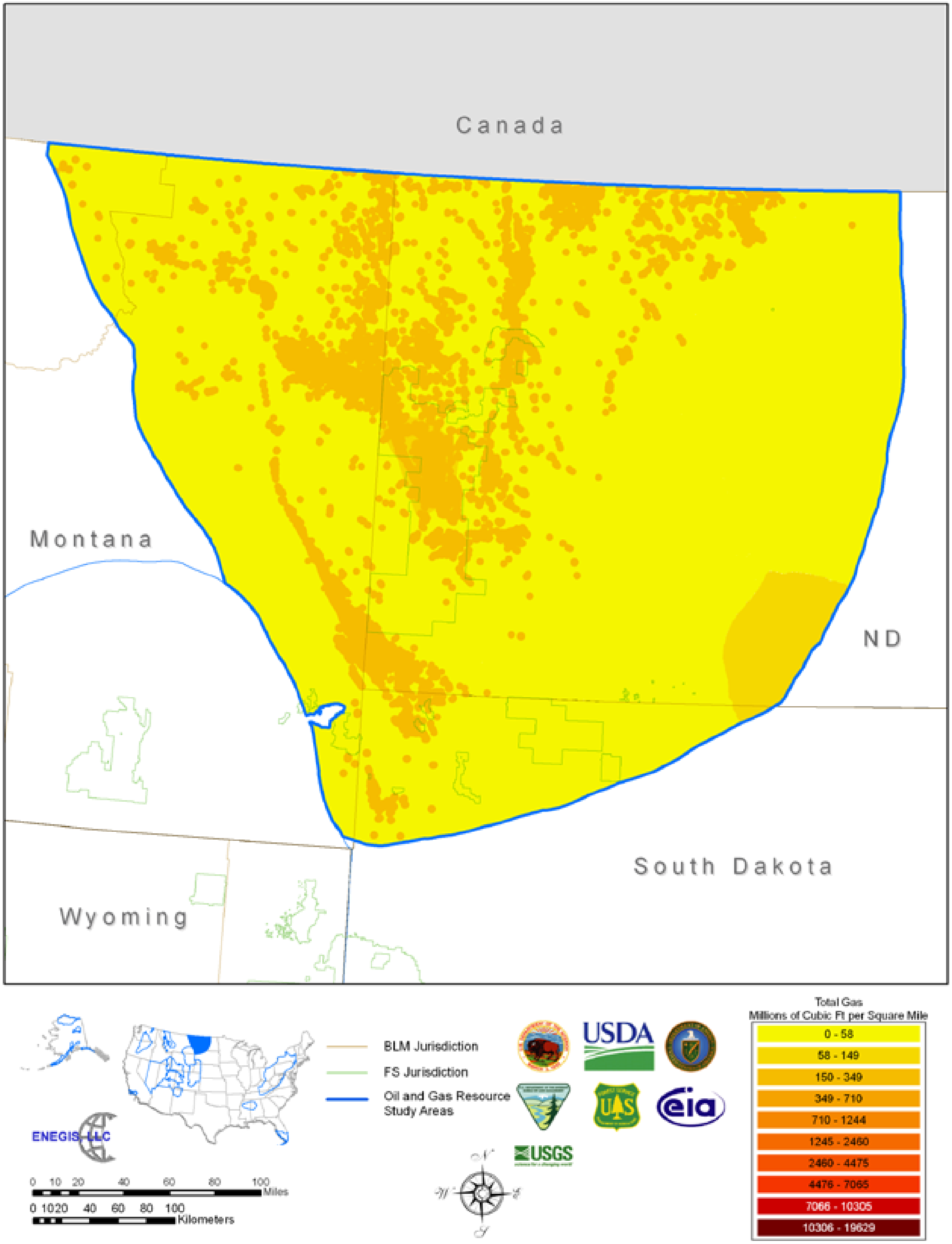

Figure 2-55. Total Natural Gas Map, Williston Basin Study Area

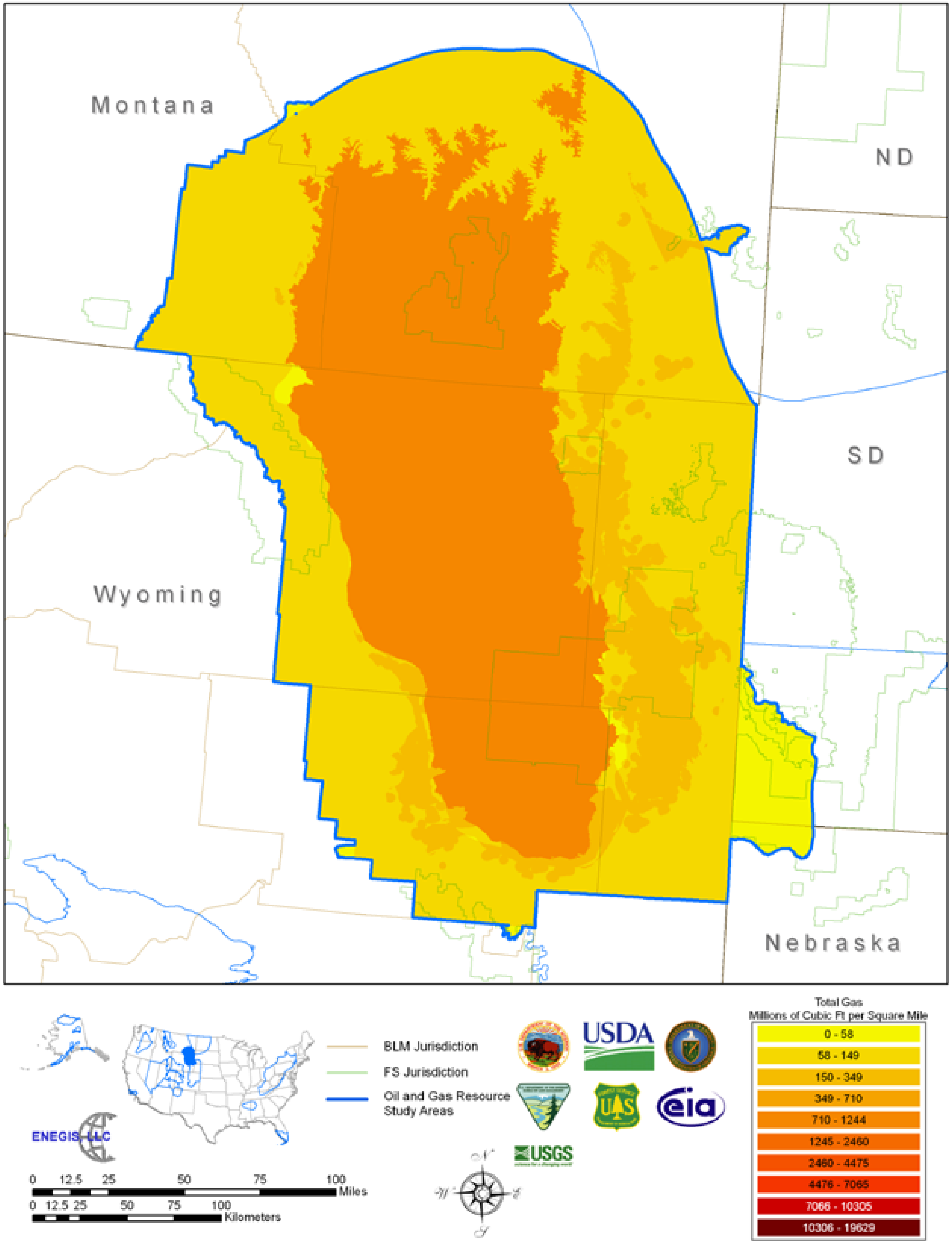

Figure 2-56. Total Natural Gas Map, Powder River Basin Study Area

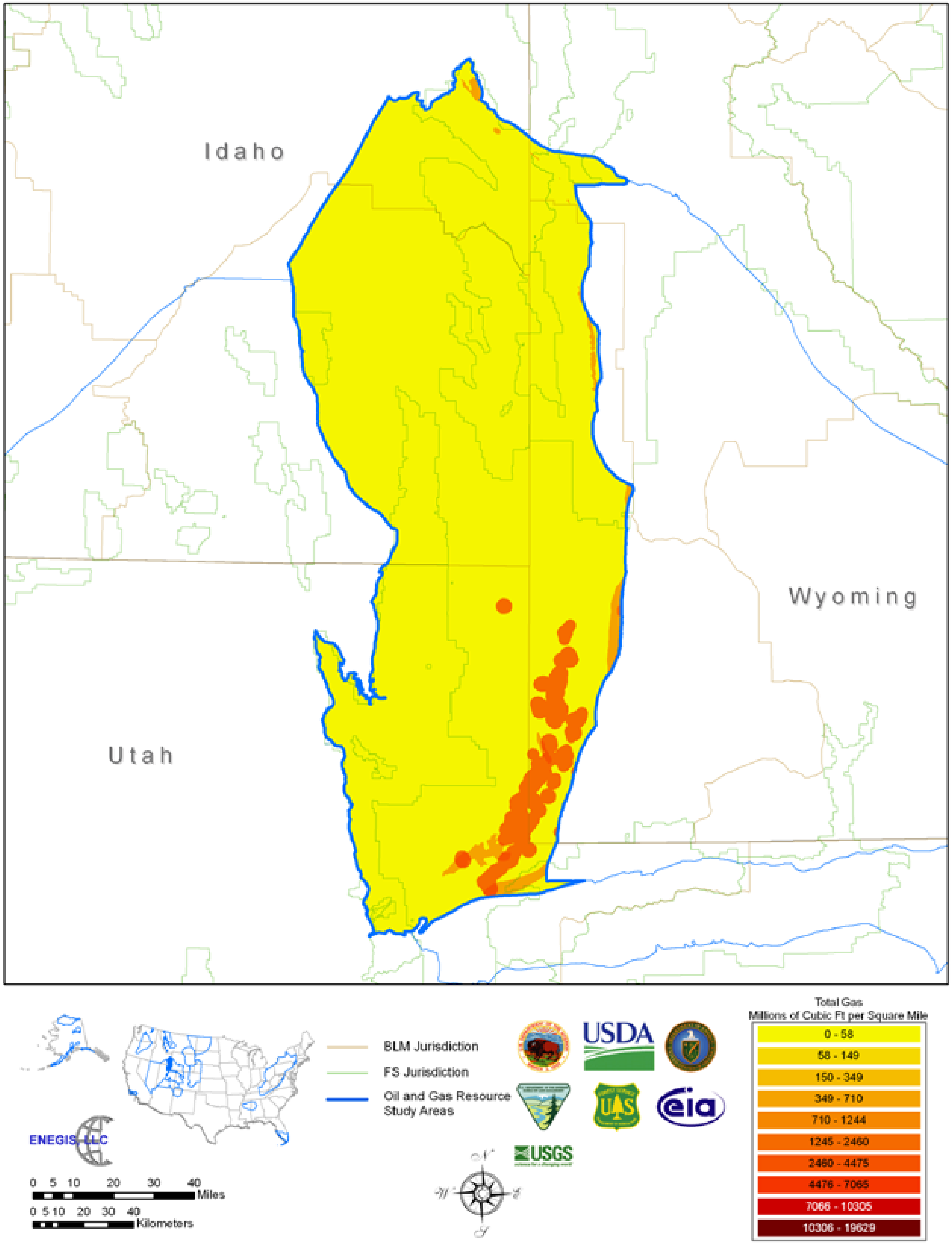

Figure 2-57. Total Natural Gas Map, Wyoming Thrust Belt Study Area

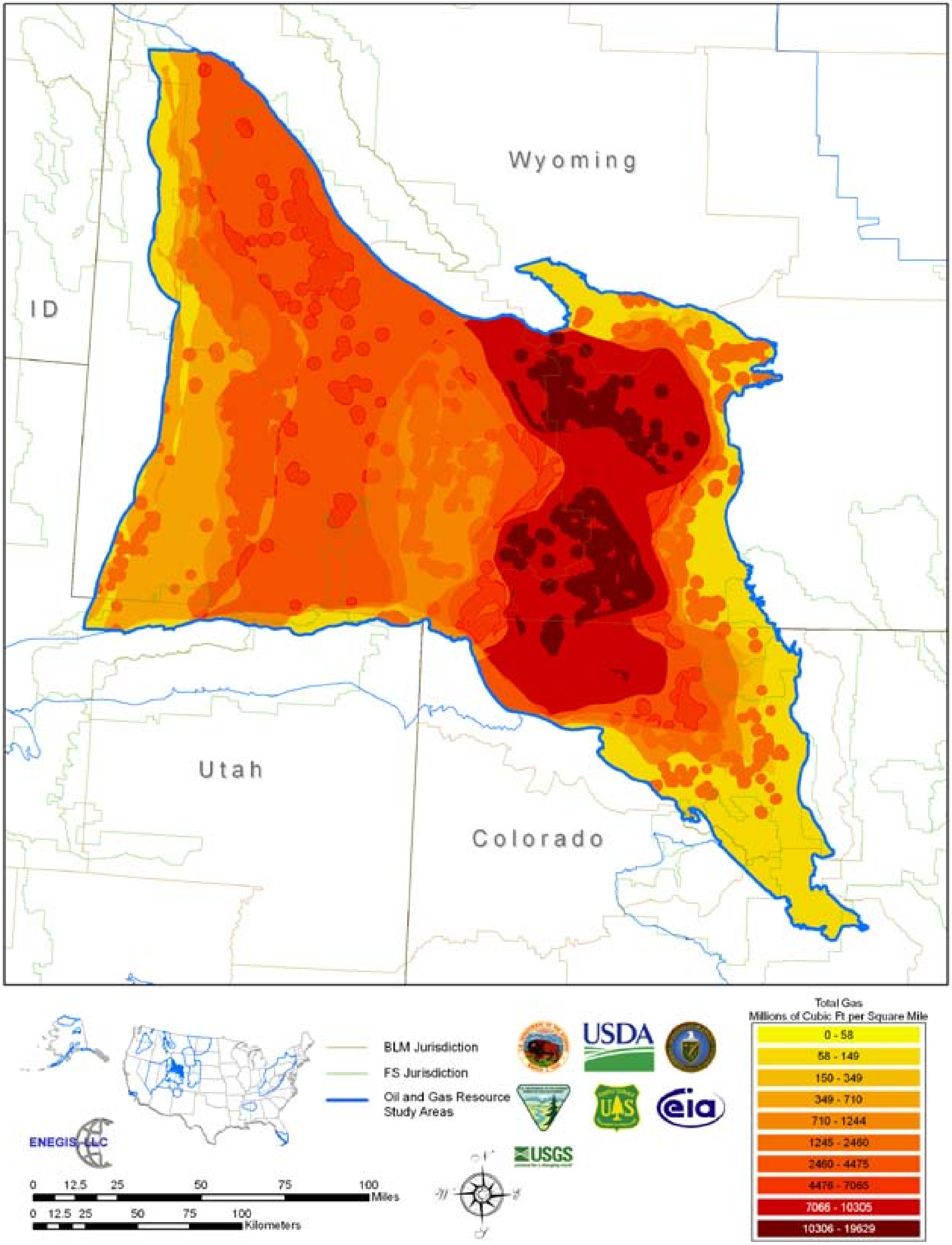

Figure 2-58. Total Natural Gas Map, Southwestern Wyoming Study Area

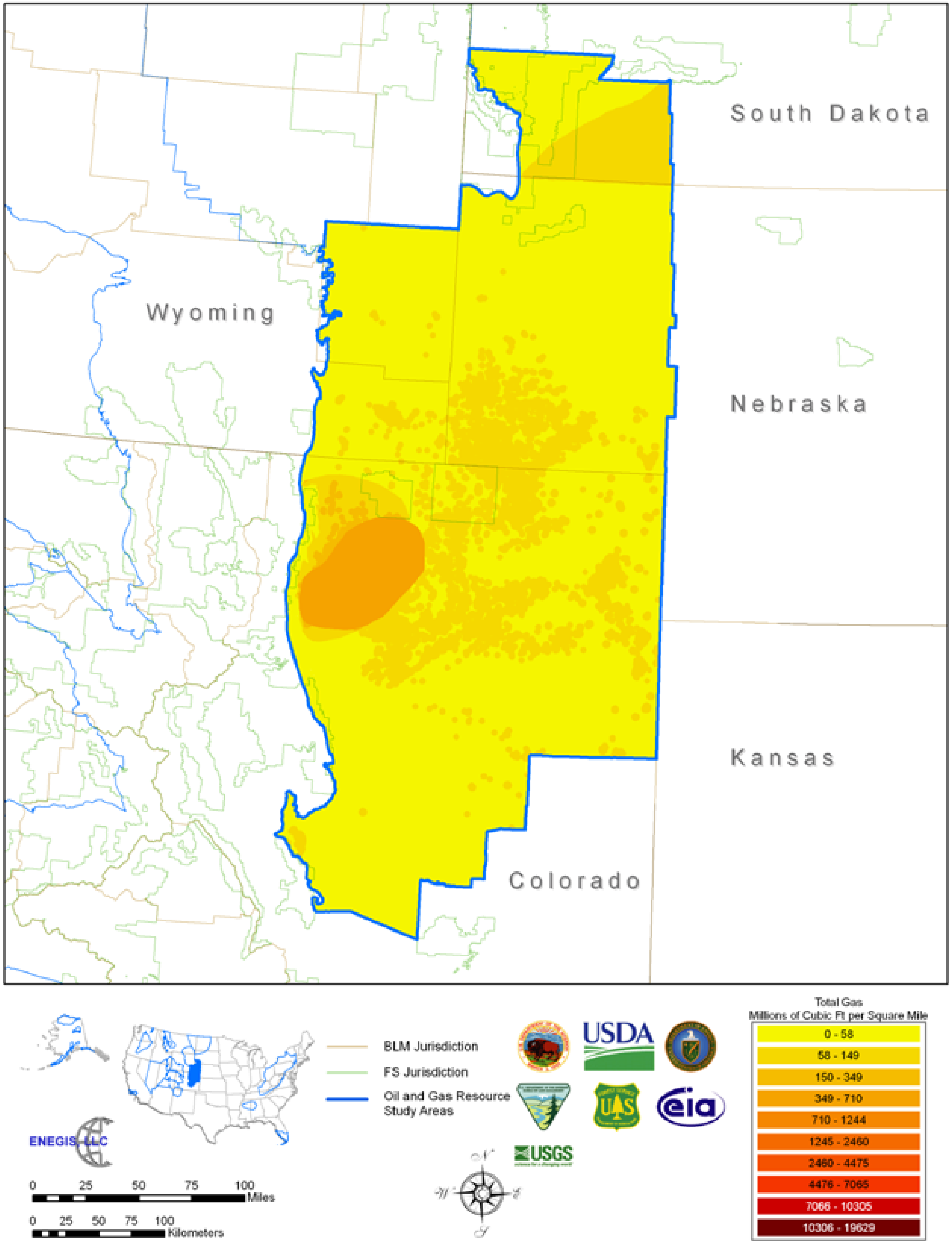

Figure 2-59. Total Natural Gas Map, Denver Basin Study Area

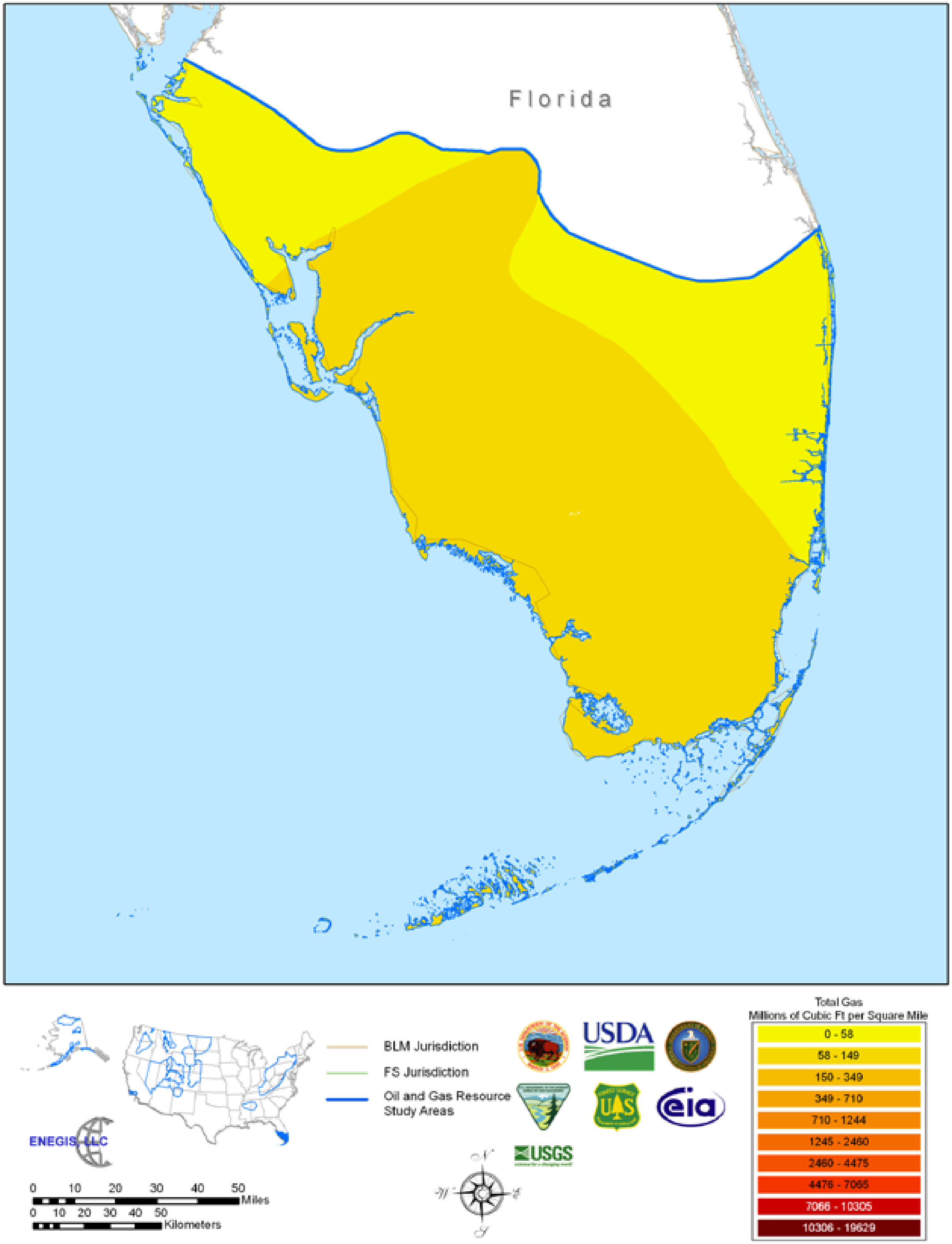

Figure 2-60. Total Natural Gas Map, Florida Peninsula Study Area

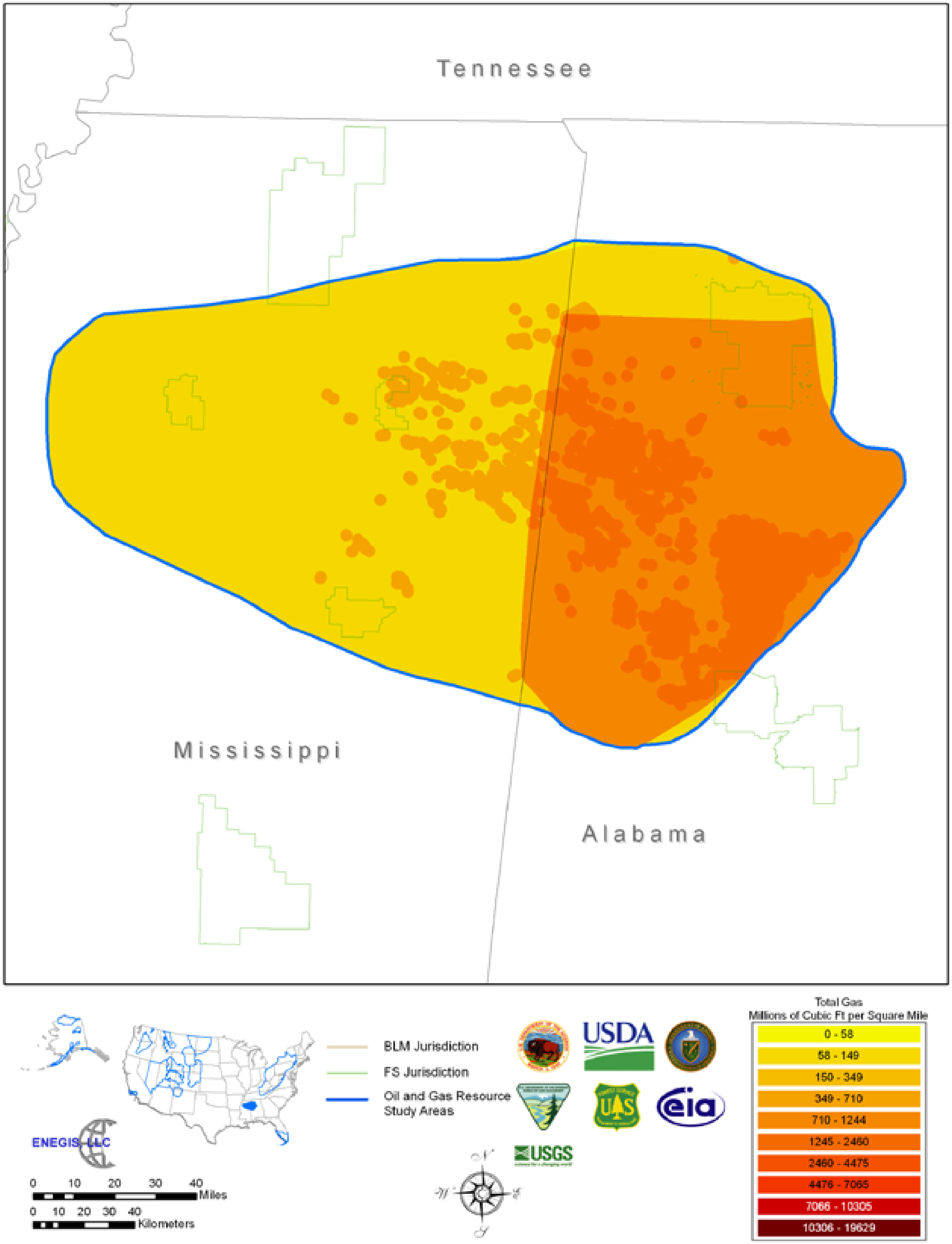

Figure 2-61. Total Natural Gas Map, Black Warrior Basin Study Area

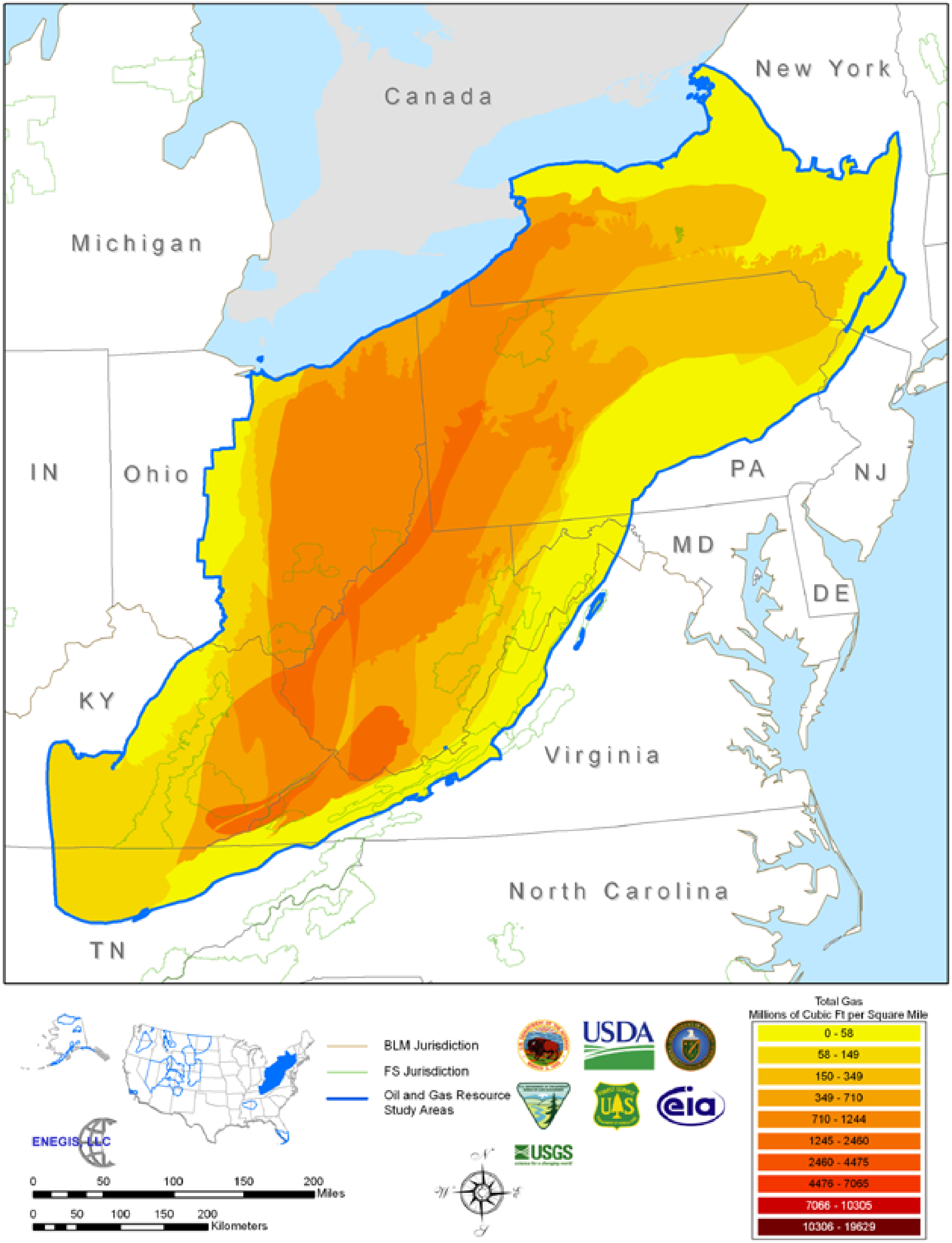

Figure 2-62. Total Natural Gas Map, Appalachian Basin Study Area

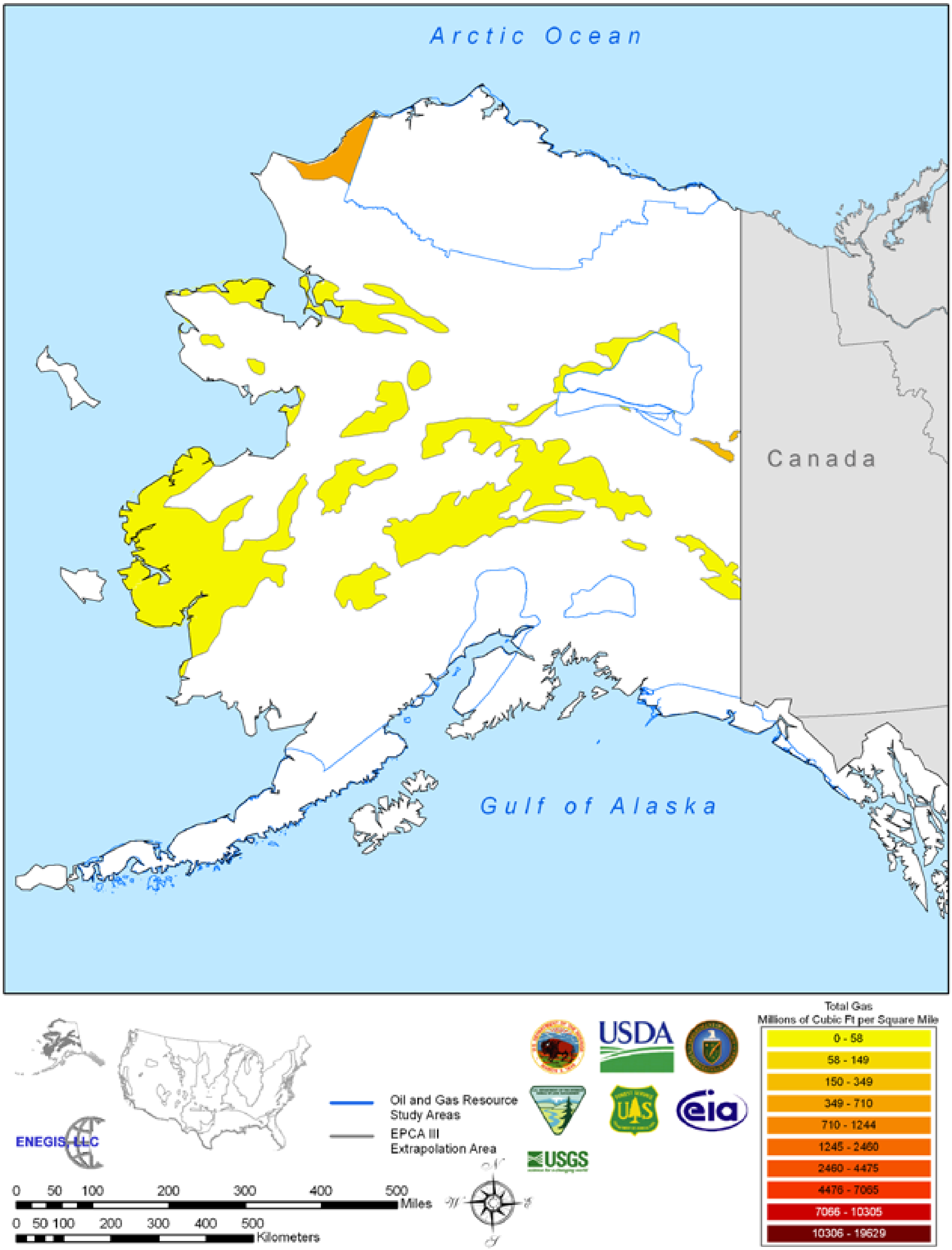

Figure 2-63. Total Natural Gas Map, Alaska Extrapolation Area

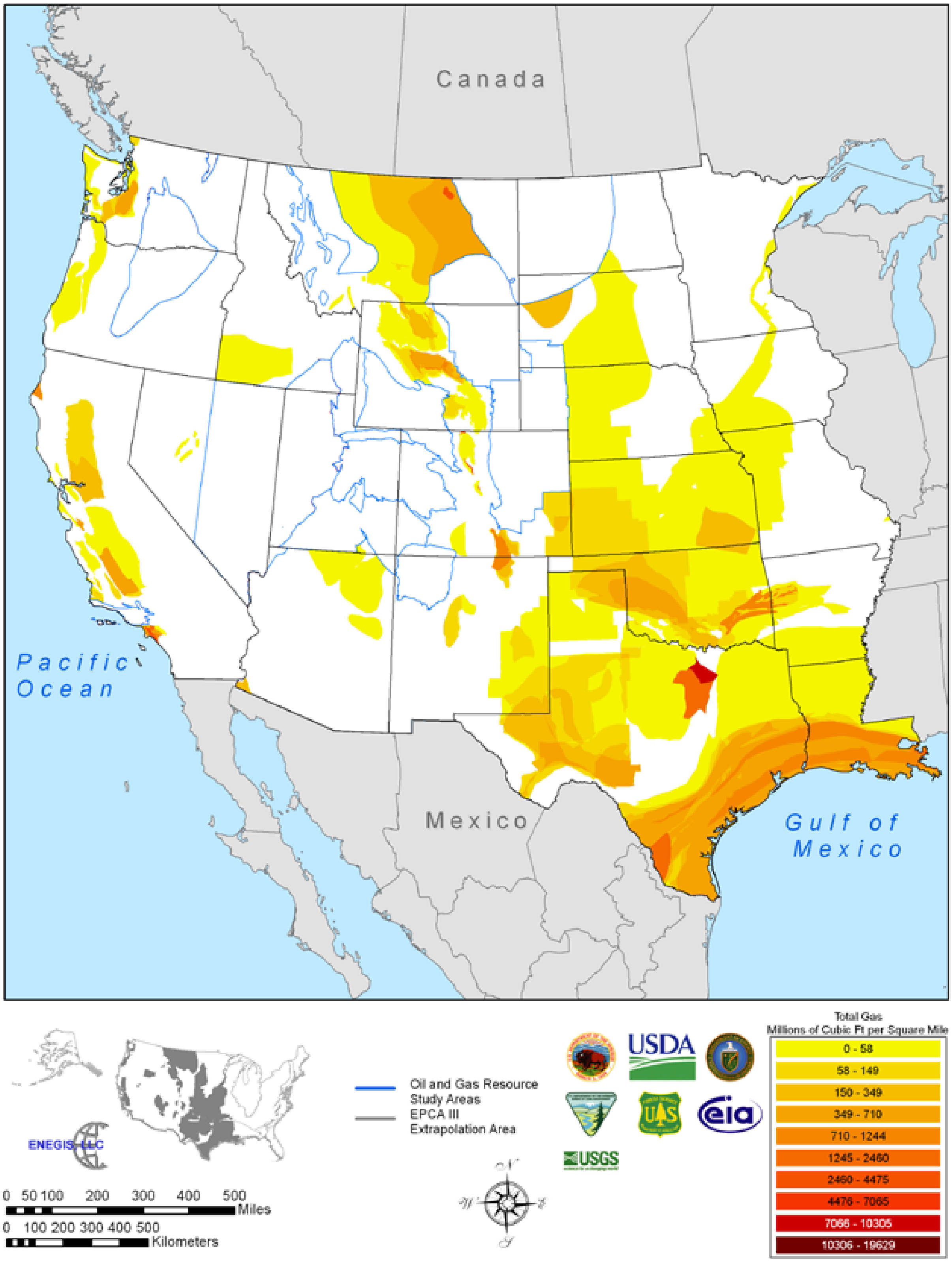

Figure 2-64. Total Natural Gas Map, Western Extrapolation Area

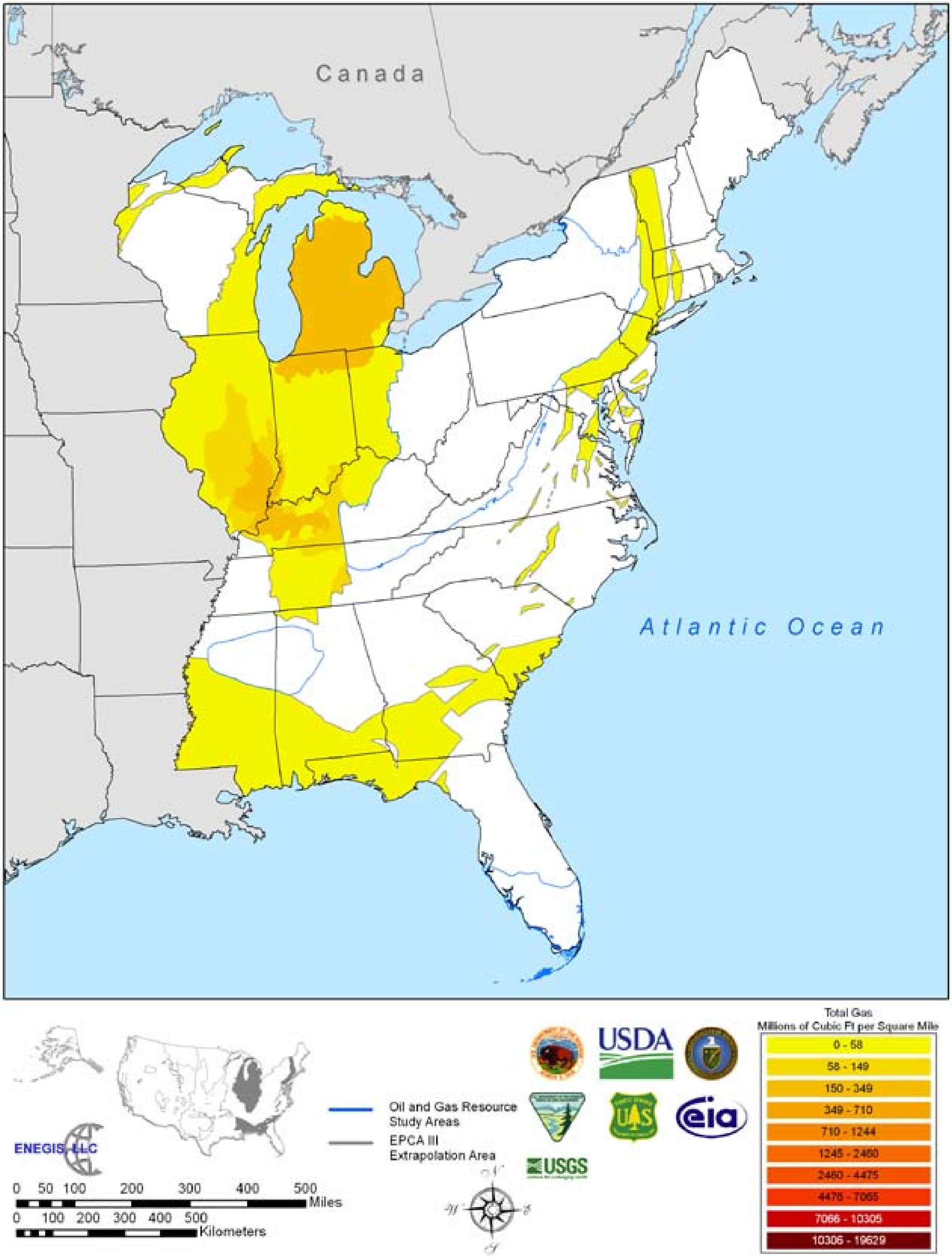

Figure 2-65. Total Natural Gas Map, Eastern Extrapolation Area

2.2.4 Proved Reserves

Proved reserves are defined as quantities of crude oil, natural gas, or natural gas liquids that geological and engineering data demonstrate with reasonable certainty (defined as greater than 90 percent probability) to be recoverable from known reservoirs under existing economic and operating conditions. Proved reserves are, in effect, the current "inventory on-the-shelf" portion of total resource endowment.[43]

2.2.4.1 Sources of Proved Oil and Gas Reserves Data

Comprehensive estimates of the domestic proved reserves of crude oil, natural gas, and natural gas liquids are prepared annually by the EIA. These estimates are a combination of reported and statistically imputed volumes based on:

- Thousands of individual proved reserves and production estimates reported to EIA annually,[44] either at the field level or at the state level by a representative sample of the operators of domestic oil and gas wells. Of the 20,670 operators in the 2004 survey, 1,341 were included in the sample.
- All operators of active domestic natural gas processing plants who annually report their operations on Form EIA-64A "Annual Report of the Origin of Natural Gas Liquids Production." For the 2004 survey, 488 active gas processing plants responded to the survey. The response rate was 100 percent.

Only the largest oil and gas well operators (those producing 1.5 MMbbl or more of crude oil, or 15 billion cubic feet (BCF) or more of natural gas per year) are required to submit to EIA proved reserves and production estimates by field for all of their operated properties. There were 164 large operators in the 2004 survey, all of which were included in the sample. The response rate was 100 percent.

Intermediate size operators (those producing less than the largest operators but at least 400,000 barrels of crude oil, or at least 2 BCF of natural gas per year) are required to submit production estimates by field for all of their operated properties, but are only required to submit proved reserves estimates by field when they maintain them in their records. There were 532 mid-sized operators in the 2004 survey. All were included in the sample and their response rate was also 100 percent.

Small operators are those with production less than 400,000 barrels of crude oil or 2 BCF of natural gas per year. There were 19,994 small operators in the 2004 survey. Of these, 275 were sampled with certainty at an associated response rate of 93.8 percent and an additional 370 were randomly sampled at an associated response rate of 94.6 percent.

2.2.4.2 Proved Oil and Gas Reserves Data Preparation

The procedures used to prepare the proved oil and gas reserves data are described in Appendix 8.

2.2.4.3 Proved Reserves Data-Related Caveats

Because the EIA's proved reserves survey is expressly designed to minimize the respondents' reporting burden and yet

[43] The full technical definition of proved reserves is at the Society of Petroleum Engineers website at http://www.spe.org/spe/jsp/basic/0,,1104_12169,00.html

[44] Form EIA-23 "Annual Survey of Domestic Oil and Gas Reserves."

provide reliable estimates at the state and national level of data aggregation, the EIA does not have operator-submitted, field-specific proved reserves information covering every oil or gas field in the country. However, the EIA has data reported for about 90 percent of all estimated domestic proved reserves. The EIA may have only partial reported estimates for a field that has two or more operators if one is not required to report proved reserves by field.

These deficiencies in the EIA's field-specific proved reserves information were remedied for this Inventory by use of additional procedures based on either publicly available production data or reserve-to-production ratio analogs.

In addition to gaps and omissions in operator-reported estimates of proved reserves, the proved reserves data are subject to two further caveats:

1. For the EIA survey, field location is reported at the county level. The precise field locations needed for this Inventory's GIS-based methodology required correlation of the EIA's reserves data files with commercial sources of field and/or well information that provide more precise location data. This process involved detailed, often well-by-well, effort owing to the existence of non-standard field names and codes, or the occasional lack of a field name, in the commercial or State data sources.

2. The EIA is obliged by law to ensure the confidentiality of the data submitted by each reserves survey respondent. Within the Inventory's study areas, there are situations where a field is operated by a single operator, or where a single operator is dominant. In such cases, the EIA cannot disclose the proved reserves estimates for the field without a written agreement from the operator waiving the right to confidentiality. Such agreements are rare and time-consuming to obtain. To avoid the release of confidential information while still adequately supporting this Inventory, the EIA elected not to present field-specific proved reserves estimates even where doing so would not have compromised a respondent's identity. Instead, the fields have been grouped into a range of proved reserves categories that are broad enough to prevent extraction of the estimates for any specific field.

Table 2-6 provides a summary of proved reserves on Federal and non-Federal lands. Note that proved oil and gas reserves are not presented on Figures 2-24 through 2-65. See Appendix 8 for a more detailed explanation of proved reserves estimation and field boundary construction.

This Inventory is designed to portray the constraints on future access to the potential oil and gas resource base. Consequently, undiscovered technically recoverable resources and reserves growth resources are included in the categorization, but not proved reserves.[45] Table 2-7 and Figure 2-66 summarize the oil and gas resource types on Federal lands for the study areas and extrapolation areas. Table 2-8 summarizes the total acreage and oil and gas resource types for the onshore United States. Note that the total resource values listed in

[45] Proved reserves were incorporated into the EPCA Phase I inventory. Due to the revision of inventory requirements by the Energy Policy Act of 2005, proved reserves volumes are reported in this Phase III inventory but are excluded from the access categorization.

Table 2-6. Proved Reserves Summary Statistics

Study Area	Number of Fields	Total Liquid Reserves (MMbbl)	Federal Land Liquid Reserves (MMbbl)	Federal Portion of Total Liquid Reserves	Total Gas Reserves (Bcf)	Federal Land Gas Reserves (Bcf)	Federal Portion of Total Gas Reserves
Northern Alaska	23	4,034	3	0.08%	6,334	5	0.08%
Central Alaska - Yukon Flats	-	-	-	-	-	-	-
Southern Alaska	27	3	0	7.98%	1,335	48	3.58%
Eastern Oregon-Washington	-	-	-	-	-	-	-
Ventura Basin	86	215	12	5.6%	254	19	7.6%
Eastern Great Basin	29	4	4	99.5%	0	0	94.7%
Uinta-Piceance Basin	180	254	143	56.2%	7,182	3,794	52.8%
Paradox Basin	171	119	36	30.4%	14,156	7,497	53.0%
San Juan Basin	79	55	17	30.4%	6,498	3,441	53.0%
Montana Thrust Belt	-	-	-	-	-	-	-
Williston Basin	955	769	173	22.5%	841	173	20.6%
Powder River Basin	543	193	109	56.3%	2,399	936	39.0%
Wyoming Thrust Belt	28	35	14	39.8%	1,141	475	41.6%
Southwestern Wyoming	281	177	122	69.0%	12,703	10,064	79.2%
Denver Basin	1,638	148	3	1.7%	2,737	30	1.1%
Florida Peninsula	21	20	-	0.0%	0	-	0.0%
Black Warrior Basin	235	1	0	0.4%	1,248	18	1.4%
Appalachian Basin	3,354	79	0	0.2%	9,550	28	0.3%
Alaskan Extraoplation Area	-	493	0	0.1%	508	3	0.7%
Western Extrapolation Area	-	14,649	4,701	32.1%	76,217	42,046	55.2%
Eastern Extrapolation Area	-	3,496	6	0.2%	43,452	184	0.4%
Total	7,650	24,745	5,344	21.6%	186,553	68,760	36.9%

Note: The smallest reserves amounts round to zero. A dash (-) indicates there are no fields reporting proved reserves in the study area.

** Number of fields was not extrapolated for these areas.*

Table 2-7. Summary of All Federal Oil and Gas Resources by Study Area and Resource Type

Study Area	Undiscovered Resources		Reserves Growth		Proved Reserves	
	Oil (MMbbls)	Gas (BCF)	Oil (MMbbls)	Gas (BCF)	Oil (MMbbls)	Gas (BCF)
Northern Alaska	16,991	77,723	766	1,912	3	5
Central Alaska - Yukon Flats	149	2,721	-	-	-	-
Southern Alaska	268	394	-	-	0	48
Eastern Oregon-Washington	4	856	-	-	-	-
Ventura Basin	185	342	96	111	12	19
Eastern Great Basin	1,347	204	8	-	4	0
Uinta-Piceance Basin	79	11,881	288	2,230	143	3,794
Paradox Basin	298	778	14	270	36	7,497
San Juan Basin	108	24,282	42	818	17	3,441
Montana Thrust Belt	171	6,308	-	-	-	-
Williston Basin	113	184	254	434	173	173
Powder River Basin	892	8,848	397	289	109	936
Wyoming Thrust Belt	42	286	2	347	14	475
Southwestern Wyoming	1,949	61,290	133	6,743	122	10,064
Denver Basin	13	66	4	22	3	30
Florida Peninsula	74	323	-	-	-	-
Black Warrior Basin	1	354	0	37	0	18
Appalachian Basin	33	2,423	-	-	0	28
Alaskan Extrapolation Area	53	1,816	571	519	0	3
Western Extrapolation Area	1,326	11,995	3,738	2,736	4,701	42,046
Eastern Extrapolation Area	75	1,016	19	419	6	184
Total	24,169	214,088	6,333	16,887	5,344	68,760

Note: Federal lands include split estate, A dash (-) means there is insufficient data for analysis. Onshore resources only

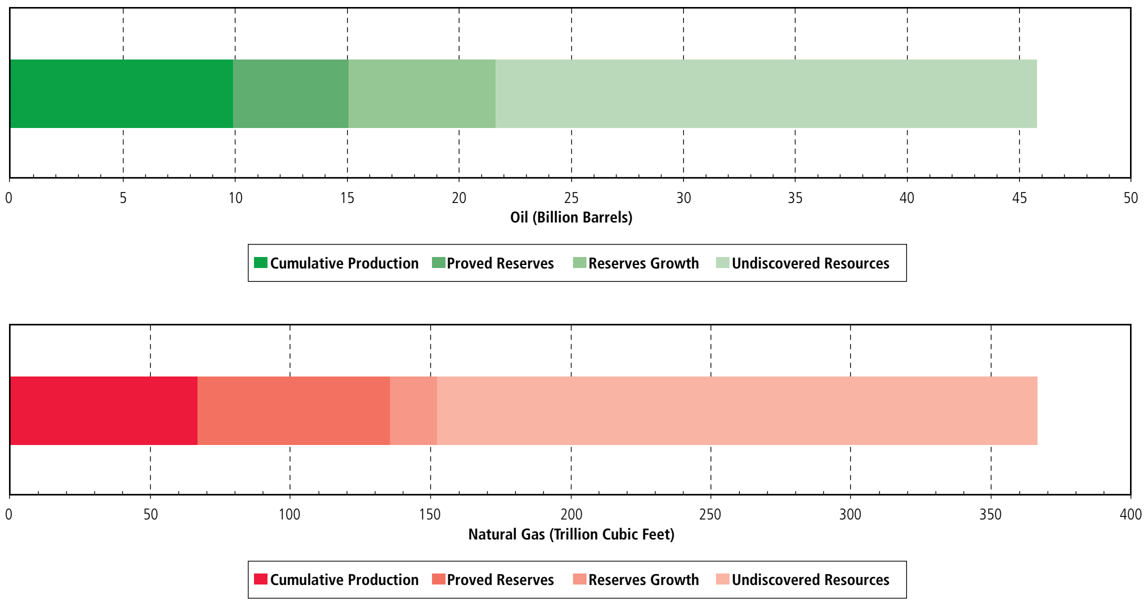

Figure 2-66. Distribution of Total Federal Onshore Hydrocarbon Endowment by Type and Resource Category

the table will be larger than for the Inventory primarily due to the exclusion of resources under state waters.

2.3 Data Integration and Spatial Analysis

2.3.1 Categorization of Oil and Gas Access Constraints

The main factors that affect access to oil and gas resources on Federal lands are land availability (Section 2.1.1) and leasing and drilling restrictions (Sections 2.1.2 and 2.1.3). To simplify the analysis and present meaningful results, these factors were categorized into a hierarchy that represents varying levels of access as shown in Table 2-9. This categorization was necessary to enable a reasonable quantitative analysis, given the fact that approximately 3,125 individual stipulations from 128 Federal land use plans (LUPs) exist for the study areas within the Inventory.

The hierarchy of categories was formulated to ensure that the constraints on oil and gas development could be appropriately assessed (especially for areas of multiple, overlapping stipulations), and to ensure that the cumulative impacts on access would be examined. In addition, the hierarchy was formulated based upon the accessibility of the lands for leasing, and for areas where leasing is permitted, the impacts relative to the difficulty for conducting drilling operations.

The Federal lands categorization hierarchy is ordered from "No Leasing" (most constrained) to "Leasing with Standard Lease Terms" (least constrained) as follows:

1. **No Leasing (Statutory/Executive Order) (NLS)** are lands that cannot be leased due to Congressional or Presidential action. Examples include national parks, national monuments, and wilderness areas.

Table 2-8. Summary of All Oil and Gas Resources by Type

	Area	Undiscovered Resources		Reserves Growth		Proved Reserves		Total Resources	
	(Acres)	Oil (MMbbls)	Natural Gas (Bcf)	Oil (MMbbls)	Natural Gas (Bcf)	Oil (MMbbls)	Natural Gas (Bcf)	Oil (MMbbls)	Natural Gas (Bcf)
Detailed Study Areas	477,277,102	33,056	395,554	7,661	31,811	6,105	66,377	46,822	493,742
Alaskan Extrapolation Area	51,849,954	64	3,303	697	945	493	508	1,254	4,756
Western Extrapolation Area	475,461,923	12,013	164,344	33,867	37,485	14,649	76,217	60,529	278,046
Eastern Extrapolated Area	210,863,789	962	14,736	240	6,078	3,496	43,452	4,698	64,266
Non-Resource areas	1,164,511,392	0	0	0	0	0	0	0	0
Total U.S.	2,379,964,160	46,095	577,937	42,465	76,319	24,745	186,553	113,303	840,810

Note: Onshore resources only. Includes non-Federal lands.

Table 2-9. Federal Land Access Categorization Hierarchy

Level	Access Category	Comments
1	No Leasing (Statutory/Executive Order), (NLS)	Accessibility determined by Law or Executive Order; drilling prohibited
2	No Leasing (Administrative), general category (NLA)	Accessibility determined by Federal surface management agency; drilling prohibited
3	No Leasing (Administrative), Pending Land Use Planning or NEPA Compliance (NLA/LUP)	Status set by Federal surface management agency; drilling prohibited pending planning or NEPA compliance
4	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	Not accessible for drilling except for resources within an extended drilling zone
5	Leasing, Cumulative Timing Limitations (TLs) on Drilling >9 Months	Categorized by the cumulative effect of seasonal leasing stipulations during which drilling is prohibited, generally for protection of wildlife
6	Leasing, Cumulative Timing Limitations (TLs) on Drilling >6 - ≤9 Months	
7	Leasing, Cumulative Timing Limitations (TLs) on Drilling >3 - ≤6 Months	
8	Leasing, Controlled Surface Use (CSU)	Drilling permitted, specialized mitigation plan required (this category includes Cumulative Timing Limitations (TLs) on Drilling ≤3 Months, which are minimal)
9	Leasing, Standard Lease Terms (SLTs)	Drilling permitted, mitigation plan required

2. **No Leasing (Administrative) (NLA)** are lands that are withheld from leasing based on discretionary decisions made by the Federal land management agency. The NLA areas can include endangered species habitat and historical sites.

3. **No Leasing (Administrative), Pending Land Use Planning or NEPA Compliance (NLA/LUP)** are lands that have not yet undergone or are currently undergoing land use planning or NEPA analysis, and that are generally not available for leasing. In the cases where there is no land use plan in effect, non-Federal mineral estate underlying Federal land is categorized as NLA/LUP to reflect the fact that access to mineral estate can be allowed through the NEPA process.

4. **Leasing, No Surface Occupancy (NSO) (Net NSO for Oil & Gas Resources)** are lands that can be leased but ground-disturbing oil and natural gas exploration and development activities are prohibited. These stipulations protect identified resources such as special status plant species habitat. Their surface areas are mapped as described by the LUPs. However, at least some of the resources can be accessed by directional drilling from nearby lands where surface occupancy is allowed. This is accounted for by creating an extended drilling zone (EDZ, as described in Appendix 9) that reduces the size of the NSO area. The area removed is then placed in the next most restrictive resource access category (5 through 9, below) that would otherwise apply in the absence of the NSO stipulation. Within the EDZ area the underlying resource is considered accessible even though the surface above it cannot be occupied by drilling equipment. After the EDZ is removed, the NSO area that remains is referred to as "Net NSO" (NNSO) and the resources under it are therefore considered inaccessible.

5. **Leasing, Cumulative Timing Limitations (TLs)** on drilling of >9 Months are lands that can be leased, but stipulations and/or COAs limit the time of the year when oil and gas exploration and drilling can take place to less than 3 months. Timing limitations prohibit surface use during specified time intervals to protect identified resources such as sage grouse habitat or elk calving areas.

6. **Leasing, Cumulative Timing Limitations (TLs)** on drilling of >6 to ≤9 Months are lands that can be leased, but stipulations and/or COAs limit the time of the year when oil and gas exploration and drilling can take place from 3 to 6 months.

7. **Leasing, Cumulative Timing Limitations (TLs)** on drilling of >3 to ≤6 Months are lands that can be leased, but stipulations and/or COAs limit the time of the year when oil and gas exploration and drilling can take place from 6 to 9 months.

8. **Leasing, Controlled Surface Use (CSU)** are lands where stipulations and/or COAs control the surface location of natural gas and oil exploration and development activities by excluding them from portions of the lease. For example, a CSU stipulation could require an operator to develop a specialized mitigation plan based on the presence of moderately steep slopes. This category also includes the minimal

areas that have timing limitations of less than three months.

9. **Leasing, Standard Lease Terms (SLTs)** areas are lands that can be leased and where no additional stipulations are added to the standard lease form. Standard lease terms, however, still dictate that the lessee must comply with many environmental standards and other requirements (see Section 2.1.2, above).

Categorizations were made on the basis of LUPs and discussions with Federal land management agencies. In most cases categorization is relatively straightforward; in other cases judgments were made based upon experience with stipulation datasets. For the FS, FPs standards and guidelines are both included in the definition of "Management Direction" at 36 CFR 219.3 (Forest Planning), and were used synonymously without distinction in evaluating FS stipulations.

All categorizations were made available to field offices for review and comment.

2.3.1.1 Data Integration and Spatial Analysis-Related Caveats

The following precautions are advised when reviewing this study:

- A total of 3,125 stipulations in 128 LUPs were analyzed in the Inventory. Substantial efforts were made to assess stipulations where no GIS data were available, either by digitizing or obtaining data from other sources. Despite these efforts, not all stipulations have corresponding GIS data. While it is impossible to assess the absolute magnitude of this issue, it is nevertheless believed to be significant. By item count, approximately 49 percent of total stipulations in the Inventory do not have GIS associated with them. To the extent that this issue exists, the Inventory overestimates access to lands and resources. The induced error is likely to be less than 49 percent as many of the missing stipulations are not likely to have large geographic coverage or may be outside a given study area. This issue points to a data gap to be addressed by the surface managing agencies.
- In NSO areas that abut non-Federal lands, no assumption was made about the availability of adjacent non-Federal lands as a base from which to drill under Federal lands. It is estimated that this situation has a minimal effect, affecting less than one half of one percent of the resources in the study areas. Therefore, an EDZ was not applied to NSO lands adjacent to non-Federal lands.

2.3.2 Analytical Modeling of Federal Lands and Resources

See Appendix 9 for a detailed description of the GIS methodology used to categorize the Federal lands and resources for the Inventory.

3.0 Results

The results of the Inventory are presented below, summarized by access category for land area and resources and grouped by study area. Table 3-1 shows the combined results for all 18 study areas and extrapolated areas, while Tables 3-2 through 3-19 show the results for individual study areas. Also depicted on the bottom of each table is a simplified summary showing accessibility of oil and gas resources. The tables show the results for Federal land access categorization by land area, total oil (used generically to include oil, NGLs, and liquids associated with gas reservoirs), and total natural gas (associated and non-associated with oil reservoirs). Oil and natural gas totals include undiscovered technically recoverable and reserves growth resources. Figures 3-1 through 3-92 show the corresponding pie charts depicting the simplified three-category and the detailed nine-category access hierarchies, the Federal land access categorization maps for each study area, and the corresponding maps showing undiscovered oil and natural gas resources on Federal lands. Tables 3-20 through 3-22 show the results for the areas that were extrapolated by region. The corresponding charts are in Figures 3-93 through 3-98.

3.1 Study Area Features

Each of the study areas is unique in terms of its Federal land and resources accessibility. Noteworthy features are presented below.

3.1.1 Northern Alaska

- Approximately 70 percent (17.8 million acres) of the Federal land is not accessible (Figures 3-3 and 3-4, Categories 1 through 4). Based on resource estimates, these lands contain 75 percent (13,255 MMbbls) of the technically recoverable Federal oil and 66 percent (52,459 BCF) of the technically recoverable Federal natural gas.
- Approximately 30 percent (7.5 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-3 and 3-4, Categories 5 through 8). Based on resource estimates, these lands contain 25 percent (4,502 MMbbls) of the technically recoverable Federal oil and 34 percent (27,173 BCF) of the technically recoverable Federal natural gas.
- Almost no Federal land in this study area is accessible under standard lease terms (Figures 3-3 and 3-4, Category 9). These lands contain no significant oil or natural gas.
- Coalbed natural gas was assessed by the USGS in early 2007 and is included in this Inventory along with the previously assessed conventional resources.

Table 3-1. Onshore United States—Total Federal Land and Oil and Natural Gas Resources by Access Category

	Access Category		Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)[d]	Percent of Federal	(BCF)[e]	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	39,945	14.3%	9,054	29.7%	19,449	8.4%
	2.	No Leasing (Administrative) (NLA)	50,414	18.1%	2,461	8.1%	16,618	7.2%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	55,278	19.8%	6,684	21.9%	49,814	21.6%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	20,245	7.3%	777	2.5%	8,621	3.7%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	283	0.1%	32	0.1%	430	0.2%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	11,883	4.3%	5,198	17.0%	40,021	17.3%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	18,389	6.6%	1,799	5.9%	35,751	15.5%
	8.	Leasing, Controlled Surface Use (CSU)[f]	34,631	12.4%	2,231	7.3%	36,716	15.9%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	47,972	17.2%	2,268	7.5%	23,554	10.2%
Total, Federal Lands including Split Estate			**279,039**	100%	**30,503**	100%	**230,975**	100%
Total Non-Federal			**936,414**		**58,056**		**423,282**	
Total Inventory Area			**1,215,453**		**88,560**		**654,256**	

Summary						
Inaccessible (Categories 1-4)	165,882	60%	18,976	62%	94,502	41%
Accessible with Restrictions (Categories 5-8)	65,186	23%	9,260	30%	112,919	49%
Accessible under Standard Lease Terms (Category 9)	47,972	17%	2,268	8%	23,554	10%
Total, Federal Lands Including Split Estate	**279,039**	**100%**	**30,503**	**100%**	**230,975**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Million barrels [e] Billion cubic feet [f] Includes Cumulative Timing Limitations of ≤3 months

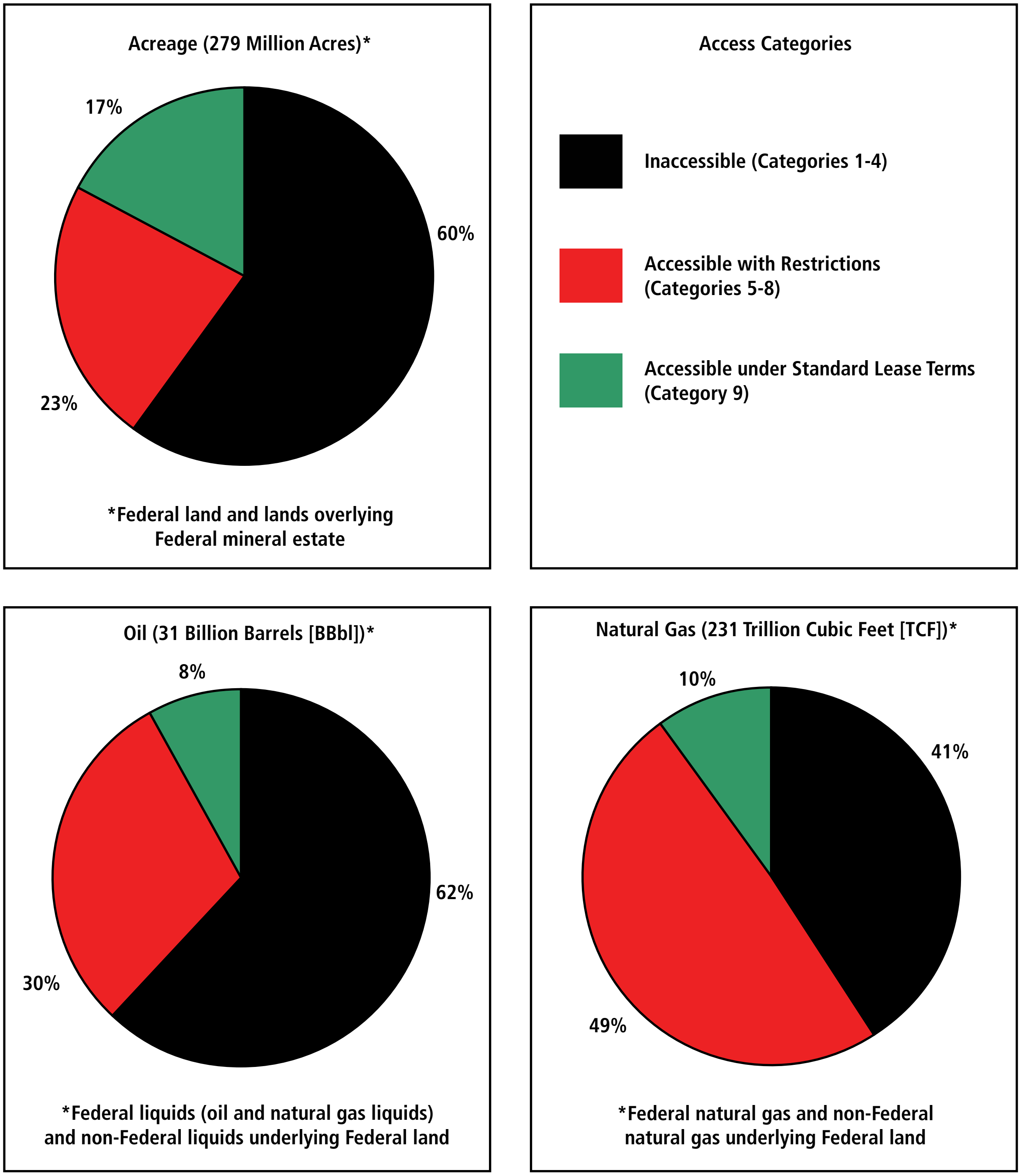

Figure 3-1. Simplified Chart of Results; Onshore United States—Total Federal Land and Oil and Natural Gas Resources* by Accessibility

* Undiscovered technically recoverable resources and reserves growth.

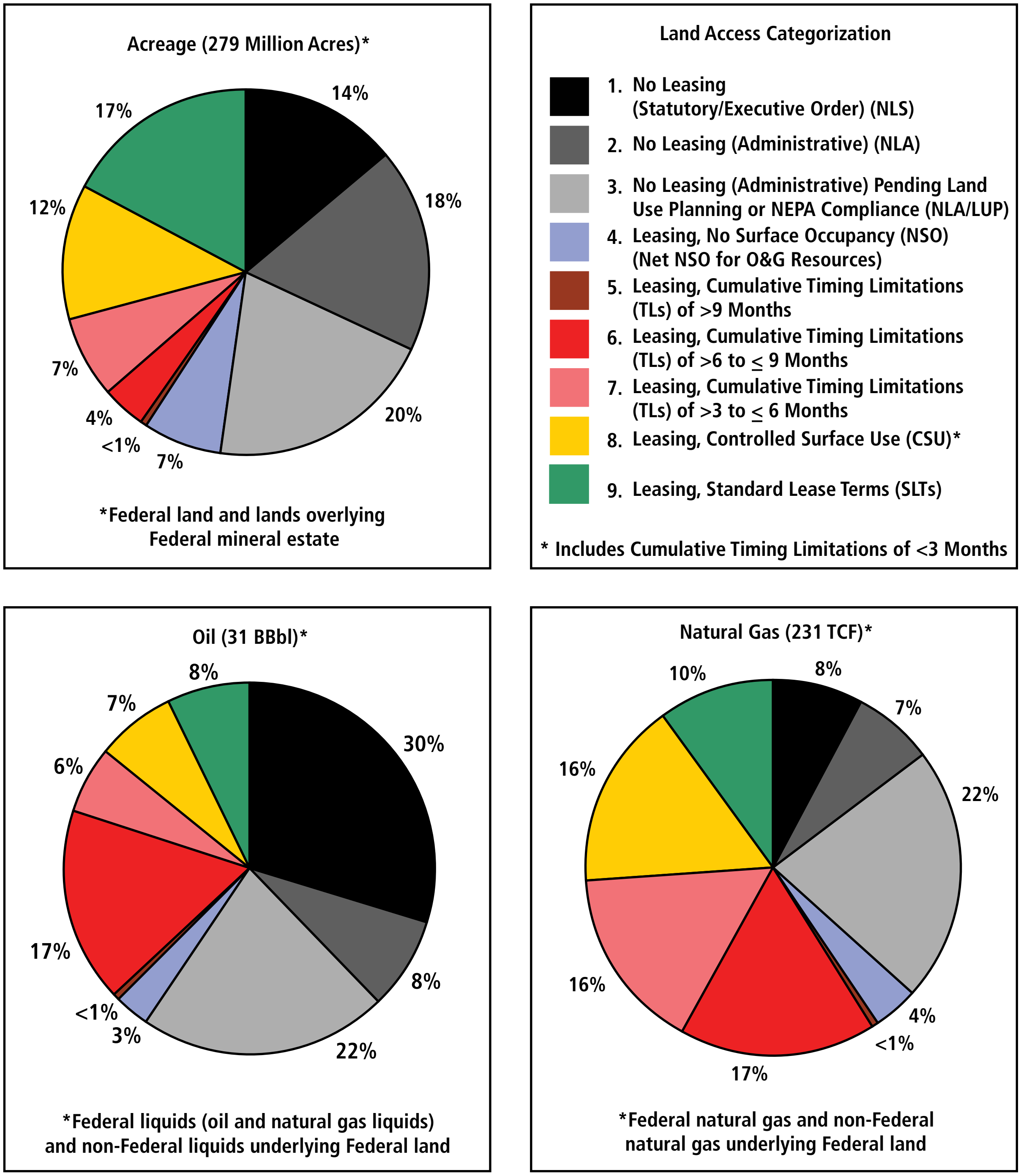

Figure 3-2. Chart of Results; Onshore United States—Total Federal Land and Oil and Natural Gas Resources* by Access Category

* Undiscovered technically recoverable resources and reserves growth.

Table 3-2. Northern Alaska Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

	Access Category		Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	2,526	10.0%	7,248	40.8%	8,028	10.1%
↑	2.	No Leasing (Administrative) (NLA)	1,359	5.4%	1,077	6.1%	4,952	6.2%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	13,667	53.9%	4,923	27.7%	39,235	49.3%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	276	1.1%	8	0.0%	244	0.3%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	7,038	27.8%	4,402	24.8%	26,048	32.7%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	256	1.0%	78	0.4%	420	0.5%
	8.	Leasing, Controlled Surface Use (CSU)[d]	227	0.9%	22	0.1%	705	0.9%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	2	0.0%	0	0.0%	3	0.0%
Total, Federal Lands including Split Estate			**25,352**	100.0%	**17,758**	100.0%	**79,635**	100.0%
Total Non-Federal			**13,665**		**7,782**		**47,280**	
Total Inventory Area			**39,017**		**25,540**		**126,916**	

Summary						
Inaccessible (Categories 1-4)	17,828	70%	13,255	75%	52,459	66%
Accessible with Restrictions (Categories 5-8)	7,521	30%	4,502	25%	27,173	34%
Accessible under Standard Lease Terms (Category 9)	2	0%	0	0%	3	0%
Total, Federal Lands Including Split Estate	**25,352**	**100%**	**17,758**	**100%**	**79,635**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

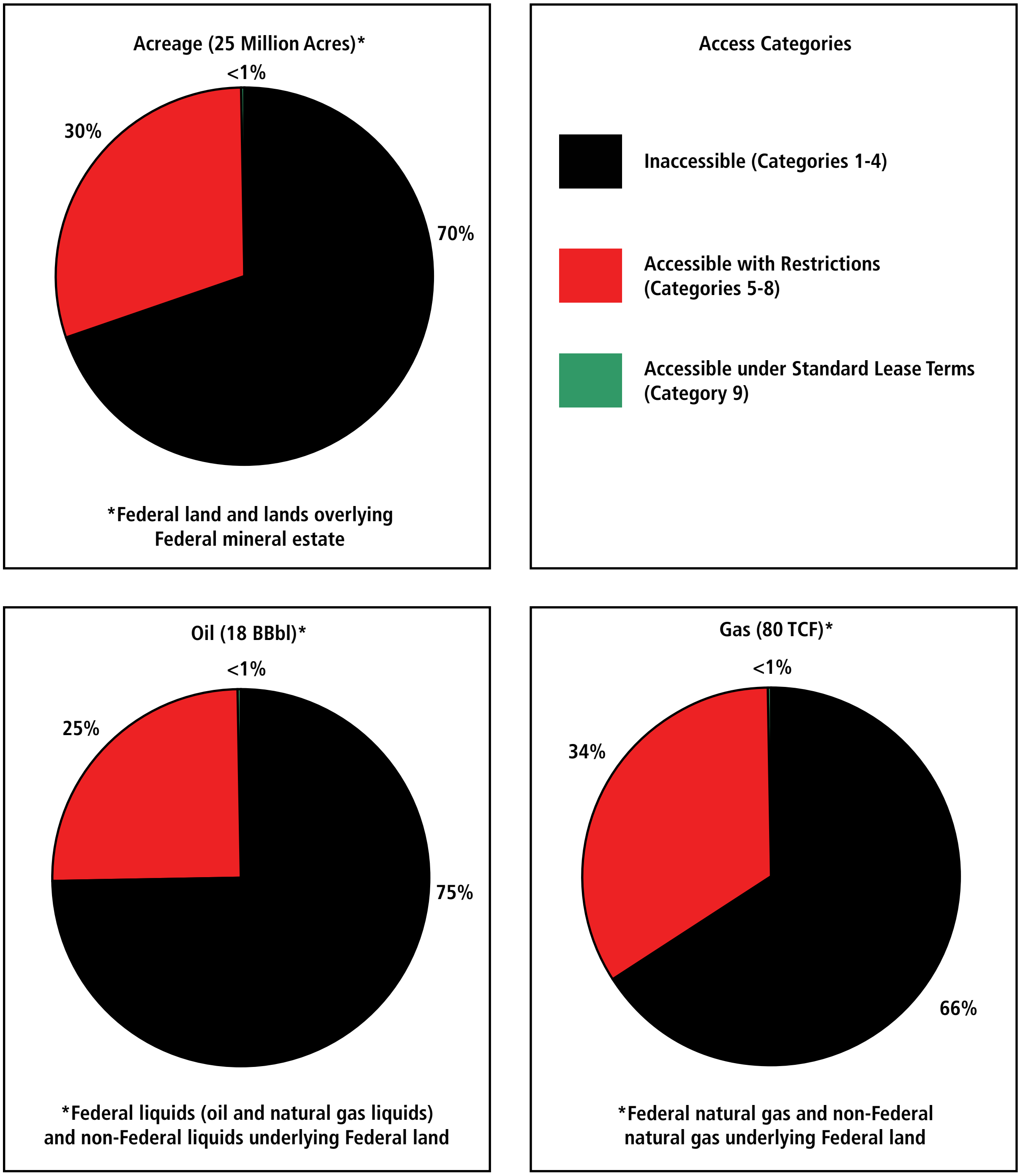

Figure 3-3. Simplified Chart of Results, Northern Alaska Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

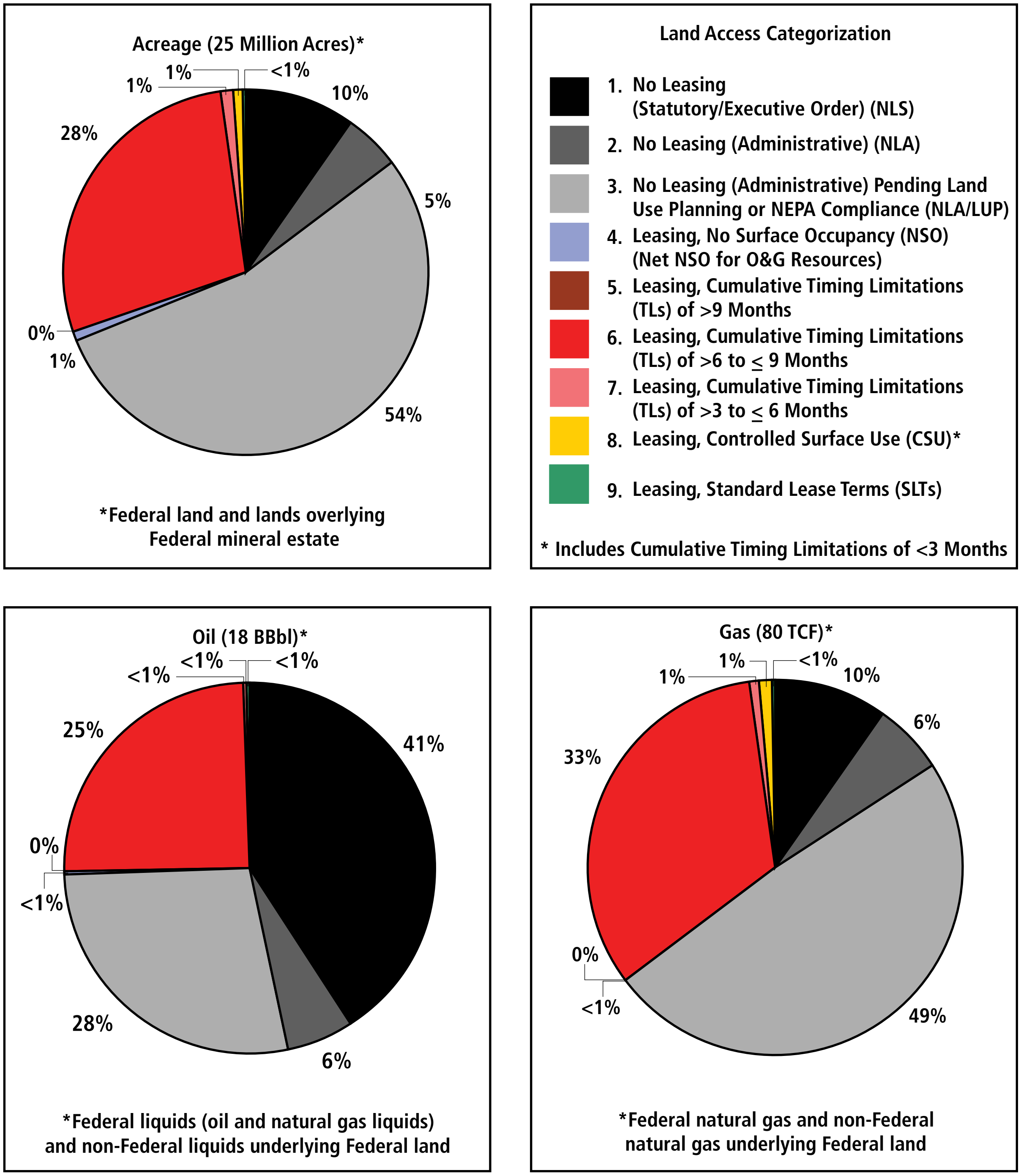

Figure 3-4. Chart of Results, Northern Alaska Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

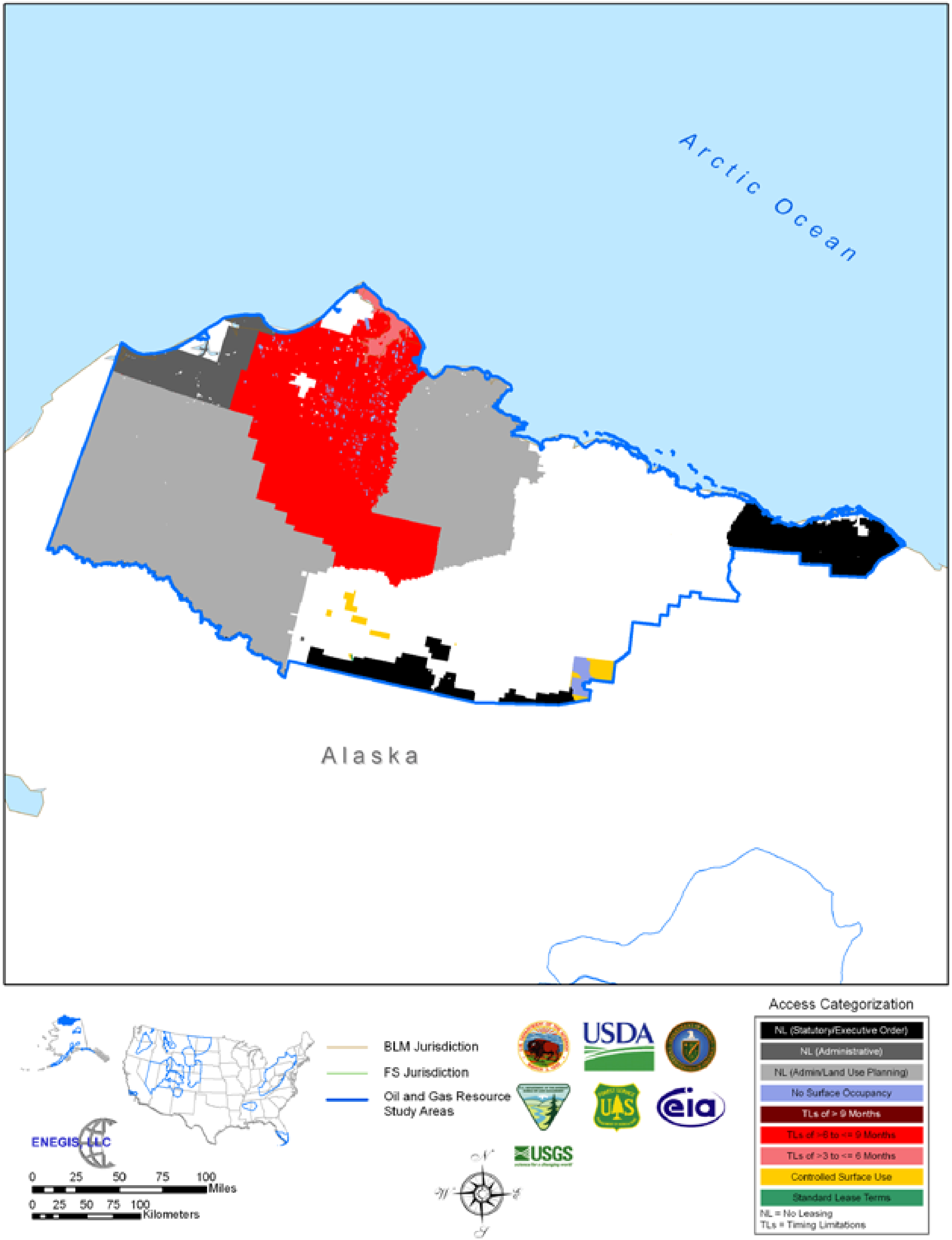

Figure 3-5. Federal Land Access Categorization Map, Northern Alaska Study Area

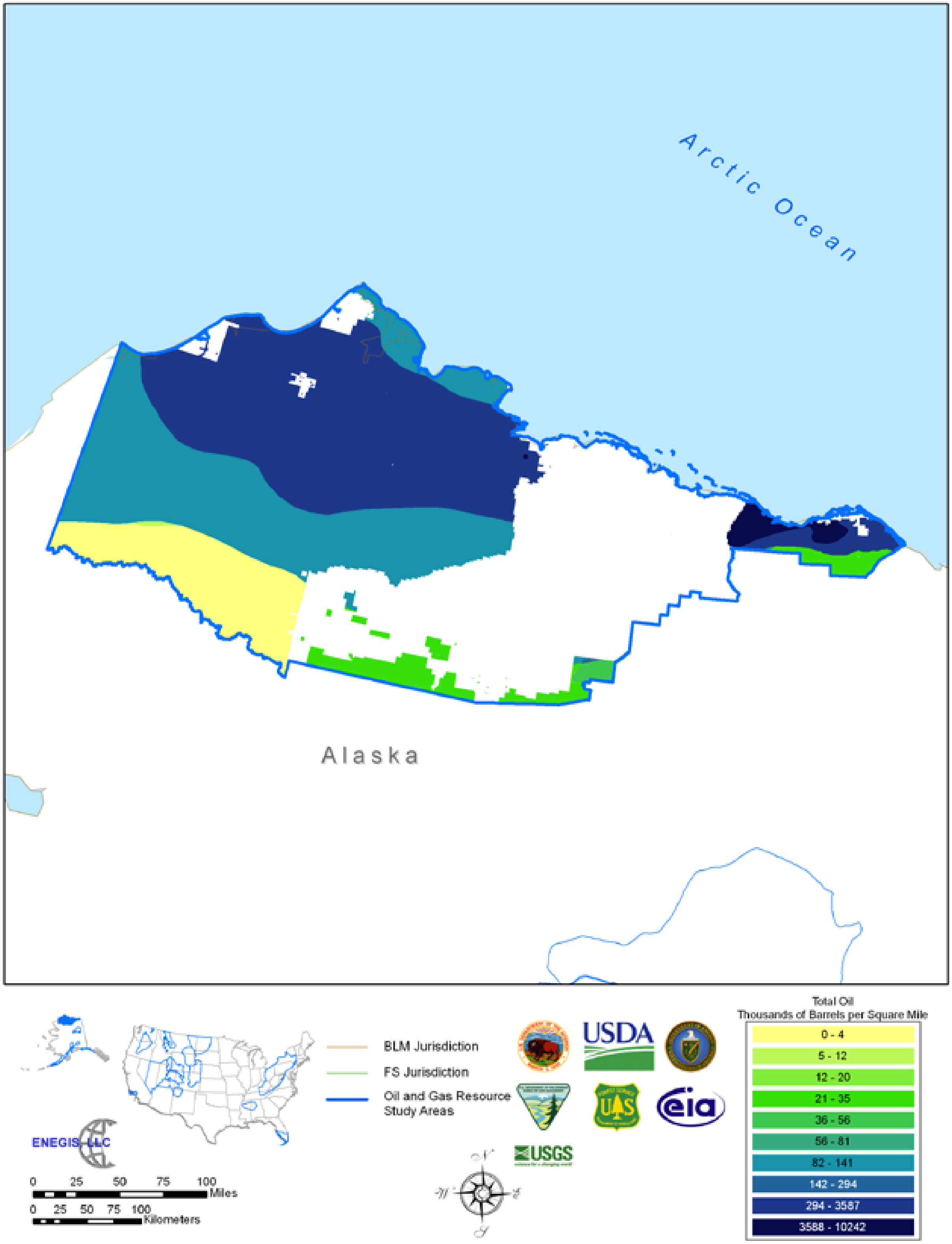

Figure 3-6. Map of Total Federal Oil, Northern Alaska Study Area

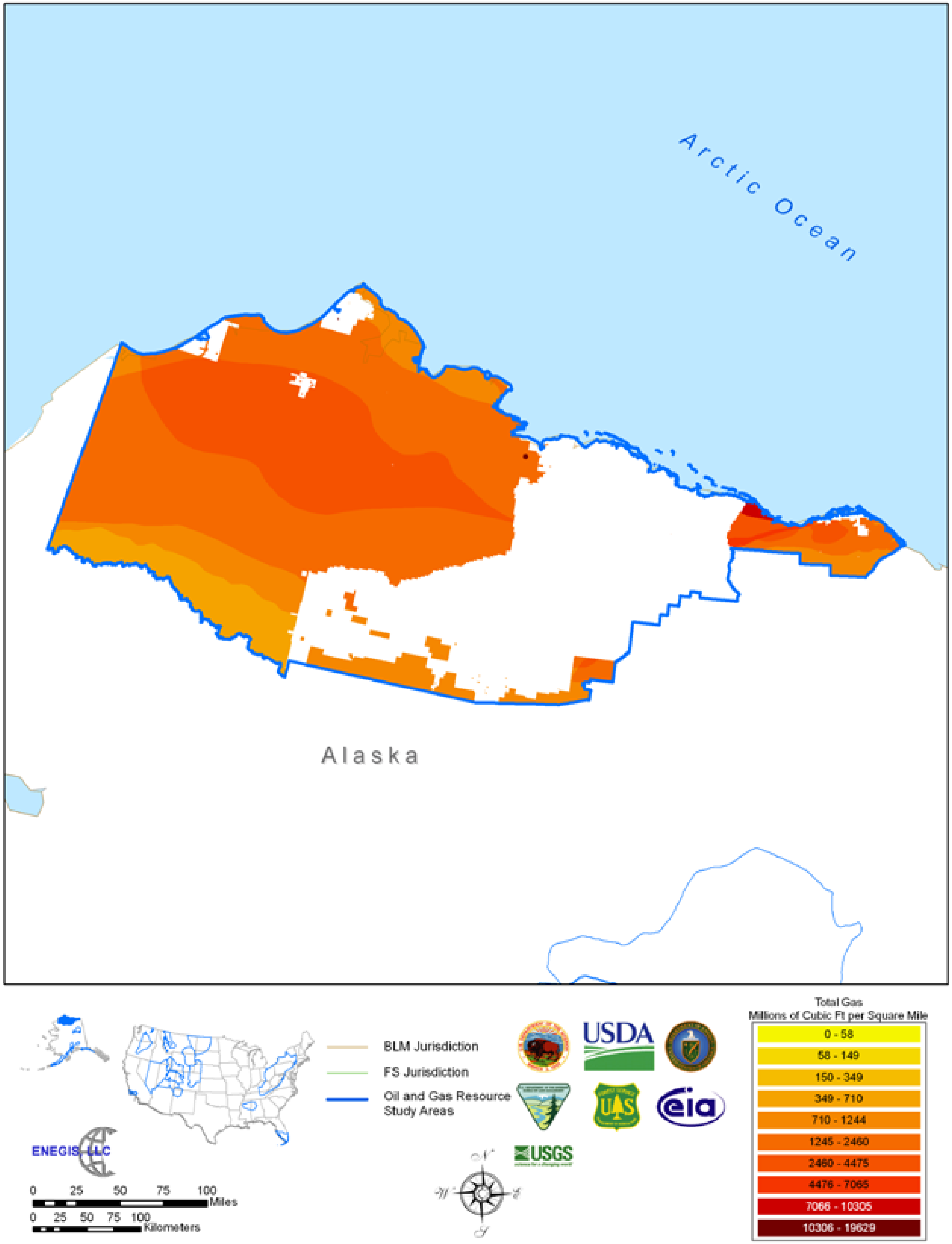

Figure 3-7. Map of Total Federal Natural Gas, Northern Alaska Study Area

3.1.2 Central Alaska – Yukon Flats

- Approximately 99 percent (4.1 million acres) of the Federal land is not accessible (Figures 3-8 and 3-9, Categories 1 through 4). Based on resource estimates, these lands contain almost all of the Federal oil (148.7 MMbbls) and Federal natural gas (2,720 BCF).
- Approximately 1 percent (28 thousand acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-8 and 3-9, Categories 5 through 8). These lands contain virtually no Federal oil or natural gas.
- Less than 1 percent (1 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-8 and 3-9, Category 9). These lands contain virtually no oil or natural gas.
- The majority of the Federal land and resources are within the Yukon Flats National Wildlife Refuge and therefore categorized as NLA.

3.1.3 Southern Alaska

- Approximately 98 percent (10.5 million acres) of the Federal land is not accessible (Figures 3-13 and 3-14, Categories 1 through 4). Based on resource estimates, these lands contain 93 percent (251.1 MMbbls) of the Federal oil and 93 percent (370.6 BCF) of the Federal natural gas.
- Approximately 1 percent (151.5 thousand acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-13 and 3-14, Categories 5 through 8). Based on resource estimates, these lands contain 6 percent (16.4 MMbbls) of the Federal oil and 4 percent (16.4 BCF) of the Federal natural gas in the basin.
- Less than 1 percent (57.5 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-13 and 3-14, Category 9). Based on resource estimates, these lands contain 1 percent (2.2 MMbbls) of the Federal oil and 2 percent (6.8 BCF) of the Federal natural gas.
- The dominant surface management agencies are the Fish and Wildlife Service (FWS), National Park Service (NPS) and BLM.

3.1.4 Eastern Oregon-Washington

- Approximately 33 percent (2.8 million acres) of the Federal land is not accessible (Figures 3-18 and 3-19, Categories 1 through 4). Based on resource estimates, these lands contain 53 percent (1.9 MMbbls) of the Federal oil and 52 percent (443.6 BCF) of the Federal natural gas.
- Approximately 36 percent (3.0 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-18 and 3-19, Categories 5 through 8). Based on resource estimates, these lands contain 16 percent (0.6 MMbbls) of the Federal oil and 18 percent (151.2 BCF) of the Federal natural gas in the basin.
- Approximately 31 percent (2.6 million acres) of the Federal land is accessible under standard lease terms (Figures 3-18 and 3-19, Category 9). Based on resource estimates, these lands contain 30 percent (1.1 MMbbl) of the Federal oil and 30 percent (261.3 BCF) of the Federal natural gas.

Table 3-3. Central Alaska – Yukon Flats Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

		Access Category	Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained ↑	1.	No Leasing (Statutory/ Executive Order) (NLS)	318	7.6%	6	3.7%	96	3.5%
	2.	No Leasing (Administrative) (NLA)	3,793	91.0%	142	95.4%	2,601	95.6%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	30	0.7%	1	0.9%	24	0.9%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	-	0.0%	-	0.0%	-	0.0%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	-	0.0%	-	0.0%	-	0.0%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	-	0.0%	-	0.0%	-	0.0%
	8.	Leasing, Controlled Surface Use (CSU)[d]	28	0.7%	0	0.0%	0	0.0%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	1	0.0%	0	0.0%	0	0.0%
Total, Federal Lands including Split Estate			**4,169**	100.0%	**149**	100.0%	**2,721**	100.0%
Total Non-Federal			**4,260**		**151**		**2,742**	
Total Inventory Area			**8,429**		**299**		**5,463**	

Summary						
Inaccessible (Categories 1-4)	4,141	99%	149	100%	2,720	100%
Accessible with Restrictions (Categories 5-8)	28	1%	0	0%	0	0%
Accessible under Standard Lease Terms (Category 9)	1	0%	0	0%	0	0%
Total, Federal Lands Including Split Estate	**4,169**	**100%**	**149**	**100%**	**2,721**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

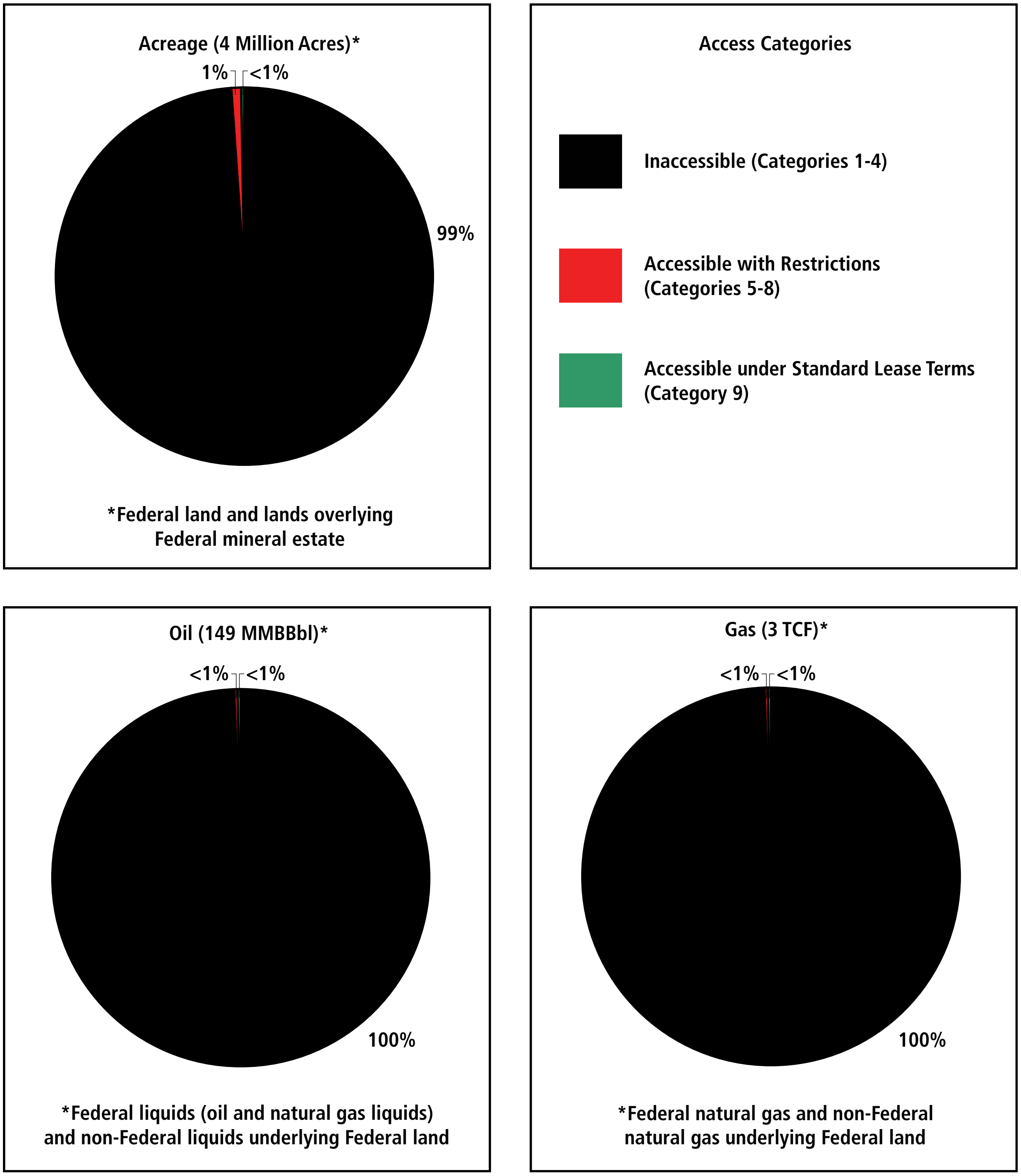

Figure 3-8. Simplified Chart of Results, Central Alaska – Yukon Flats Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

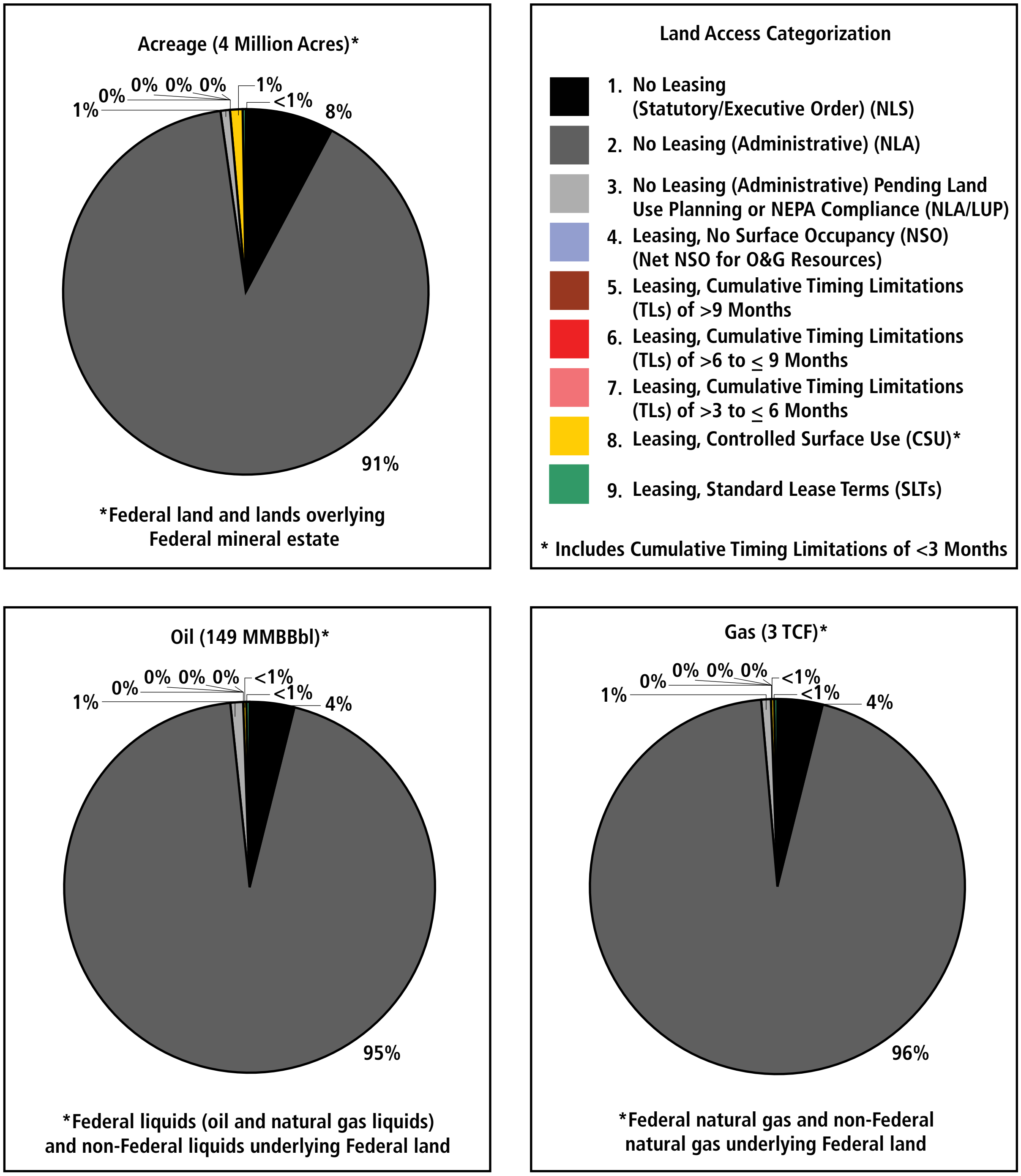

Figure 3-9. Chart of Results, Central Alaska – Yukon Flats Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

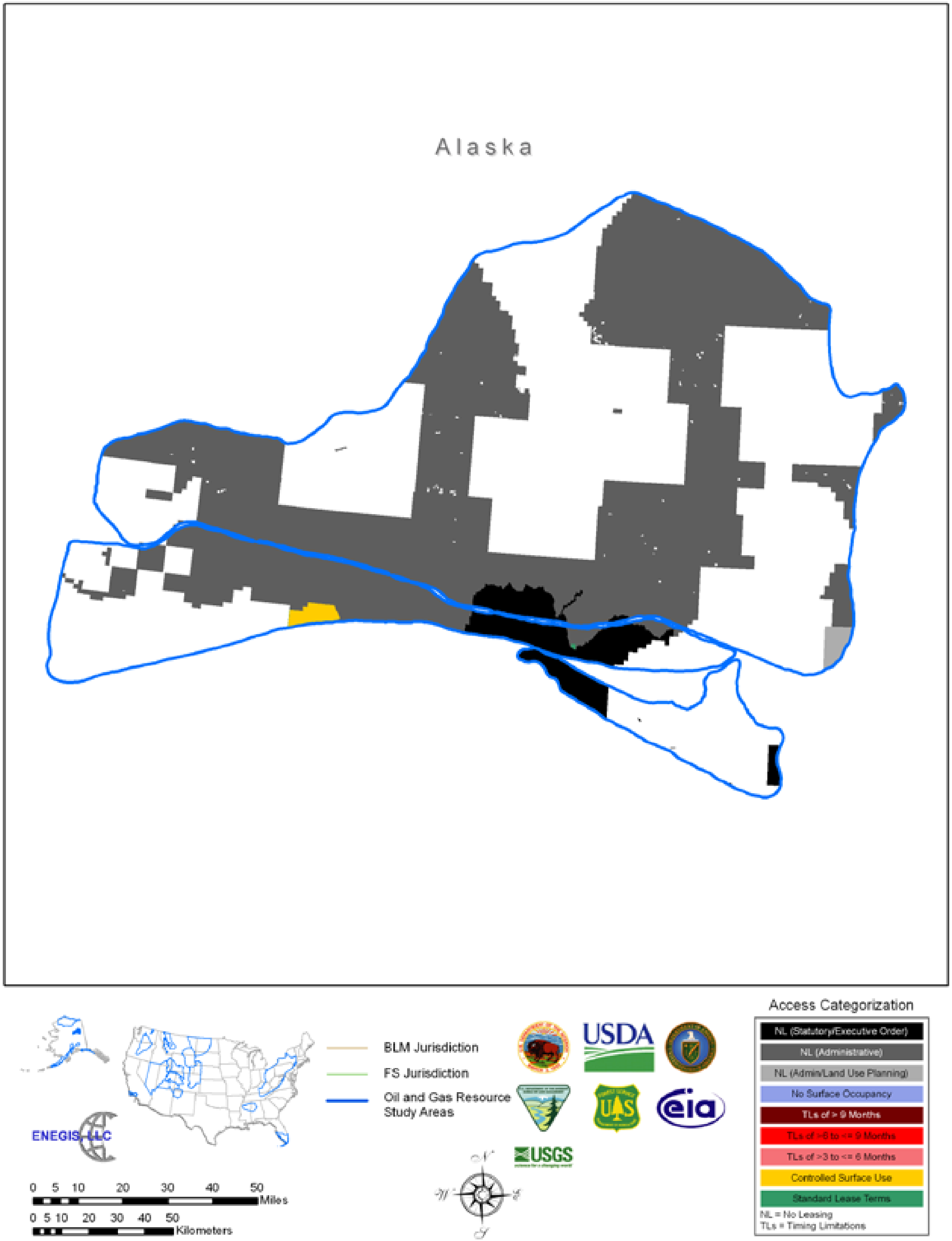

Figure 3-10. Federal Land Access Categorization Map, Central Alaska – Yukon Flats Study Area

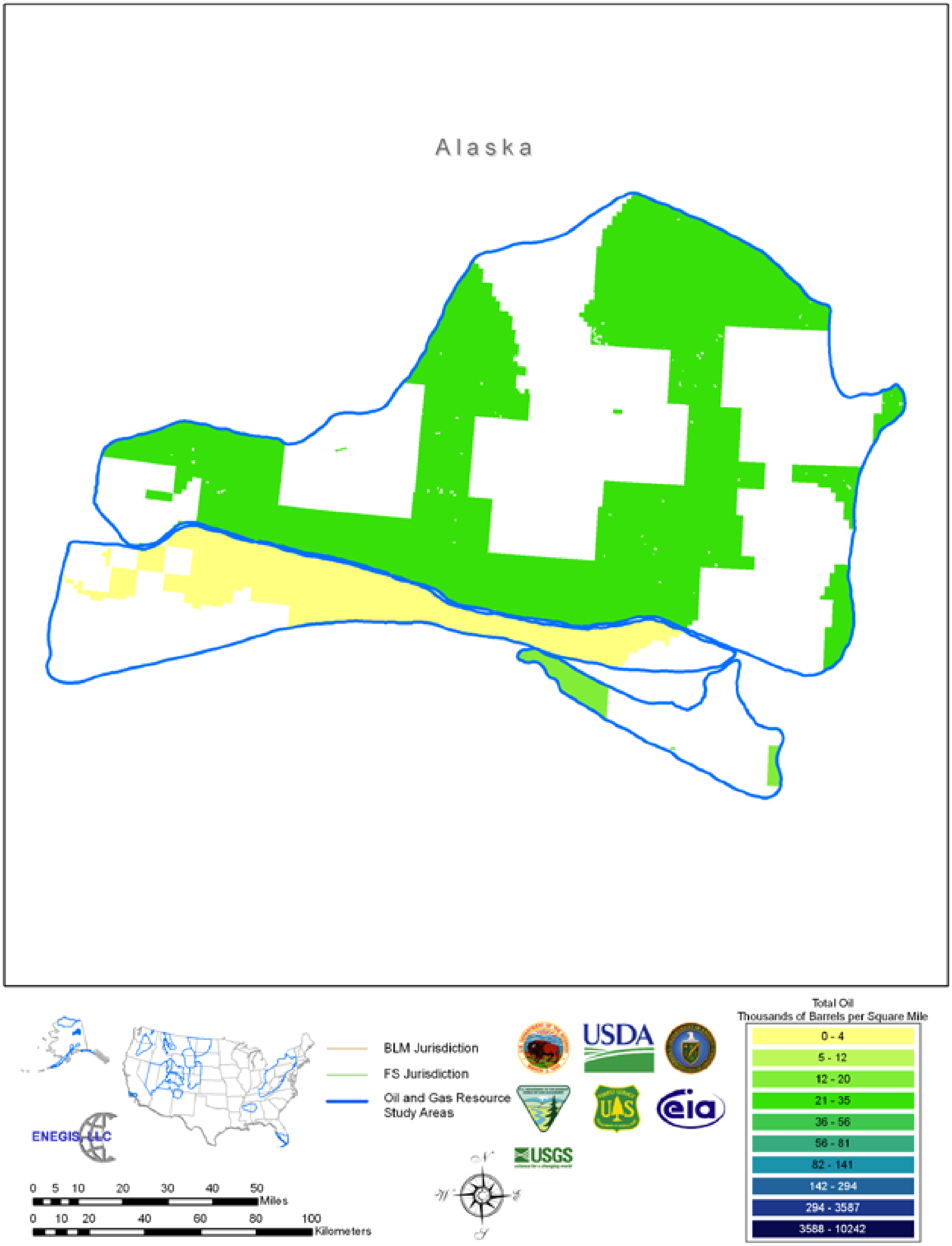

Figure 3-11. Map of Total Federal Oil, Central Alaska – Yukon Flats Study Area

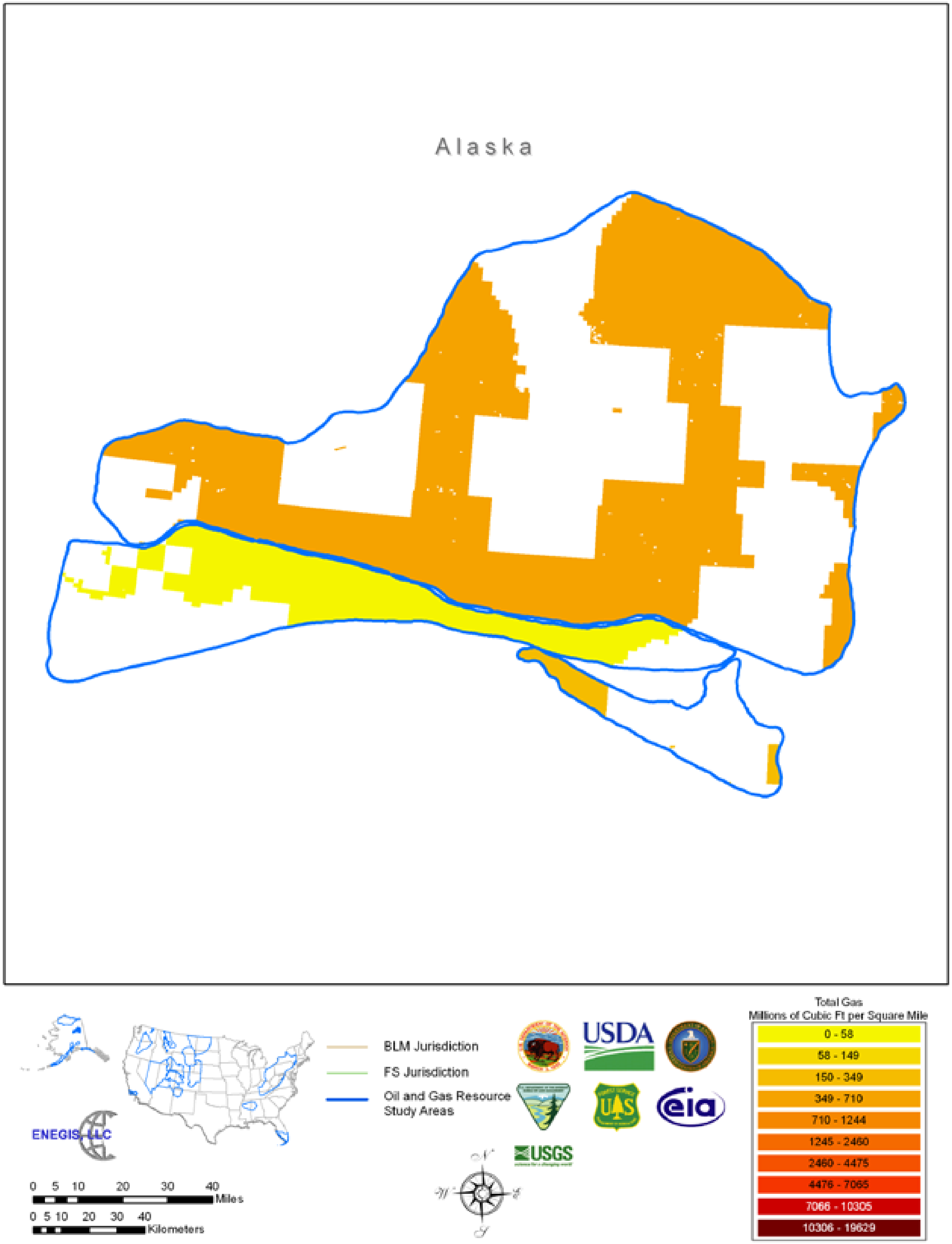

Figure 3-12. Map of Total Federal Natural Gas, Central Alaska – Yukon Flats Study Area

Table 3-4. Southern Alaska Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

Access Category			Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	4,546	42.2%	82	30.2%	83	21.1%
↑	2.	No Leasing (Administrative) (NLA)	4,666	43.3%	119	44.2%	233	59.2%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	948	8.8%	42	15.5%	46	11.7%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	396	3.7%	8	3.1%	8	2.2%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	19	0.2%	6	2.2%	6	1.5%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	5	0.0%	5	1.7%	5	1.2%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	2	0.0%	-	0.1%	-	0.1%
	8.	Leasing, Controlled Surface Use (CSU)[d]	126	1.2%	6	2.1%	6	1.4%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	57	0.5%	2	0.8%	7	1.7%
Total, Federal Lands including Split Estate			**10,765**	100.0%	**270**	100.0%	**394**	100.0%
Total Non-Federal			**14,695**		**354**		**943**	
Total Inventory Area			**25,460**		**624**		**1,336**	

Summary						
Inaccessible (Categories 1-4)	10,556	98%	251	93%	371	94%
Accessible with Restrictions (Categories 5-8)	152	1%	16	6%	16	4%
Accessible under Standard Lease Terms (Category 9)	57	1%	2	1%	7	2%
Total, Federal Lands Including Split Estate	**10,765**	**100%**	**270**	**100%**	**394**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

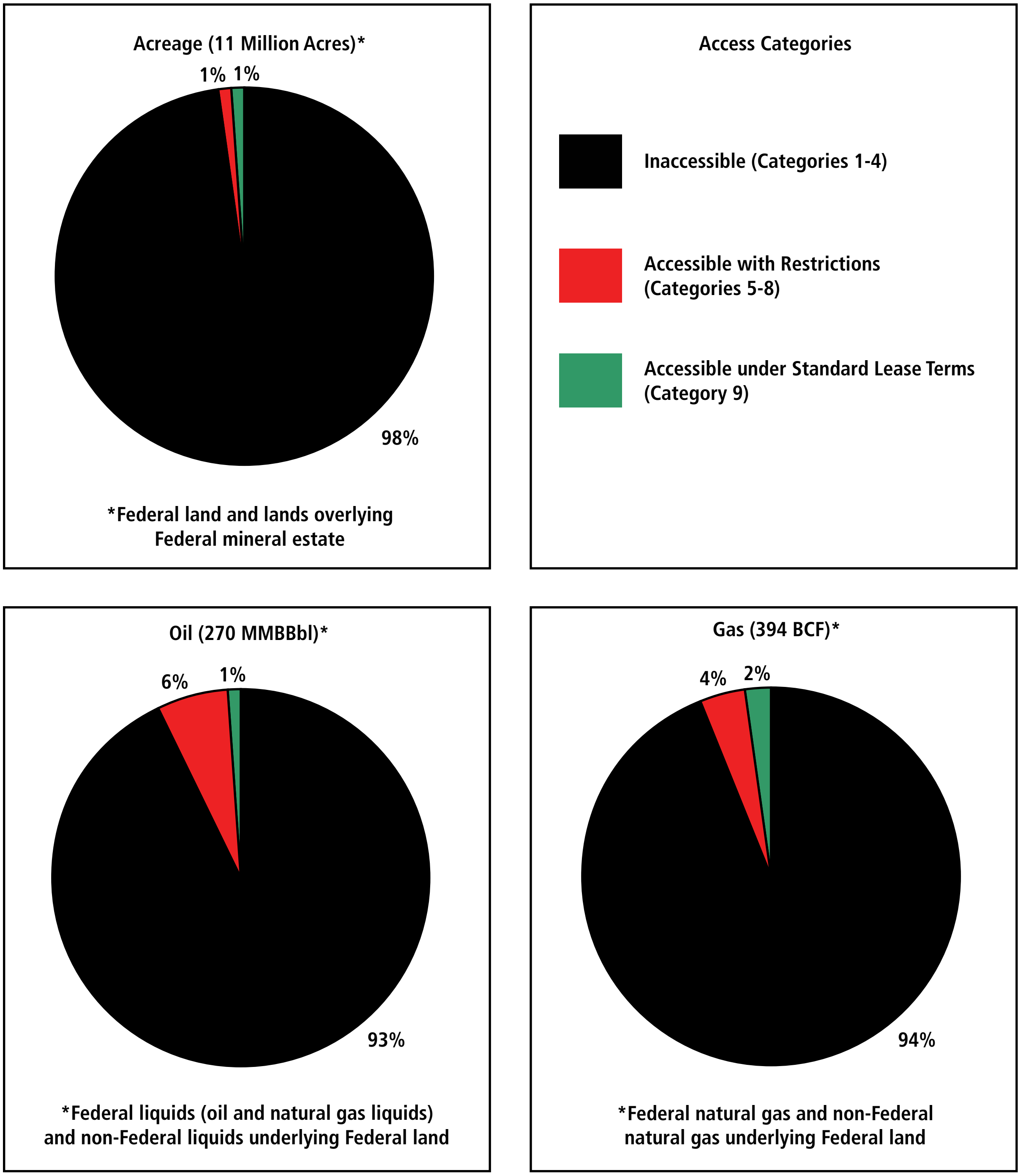

Figure 3-13. Simplified Chart of Results, Southern Alaska Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

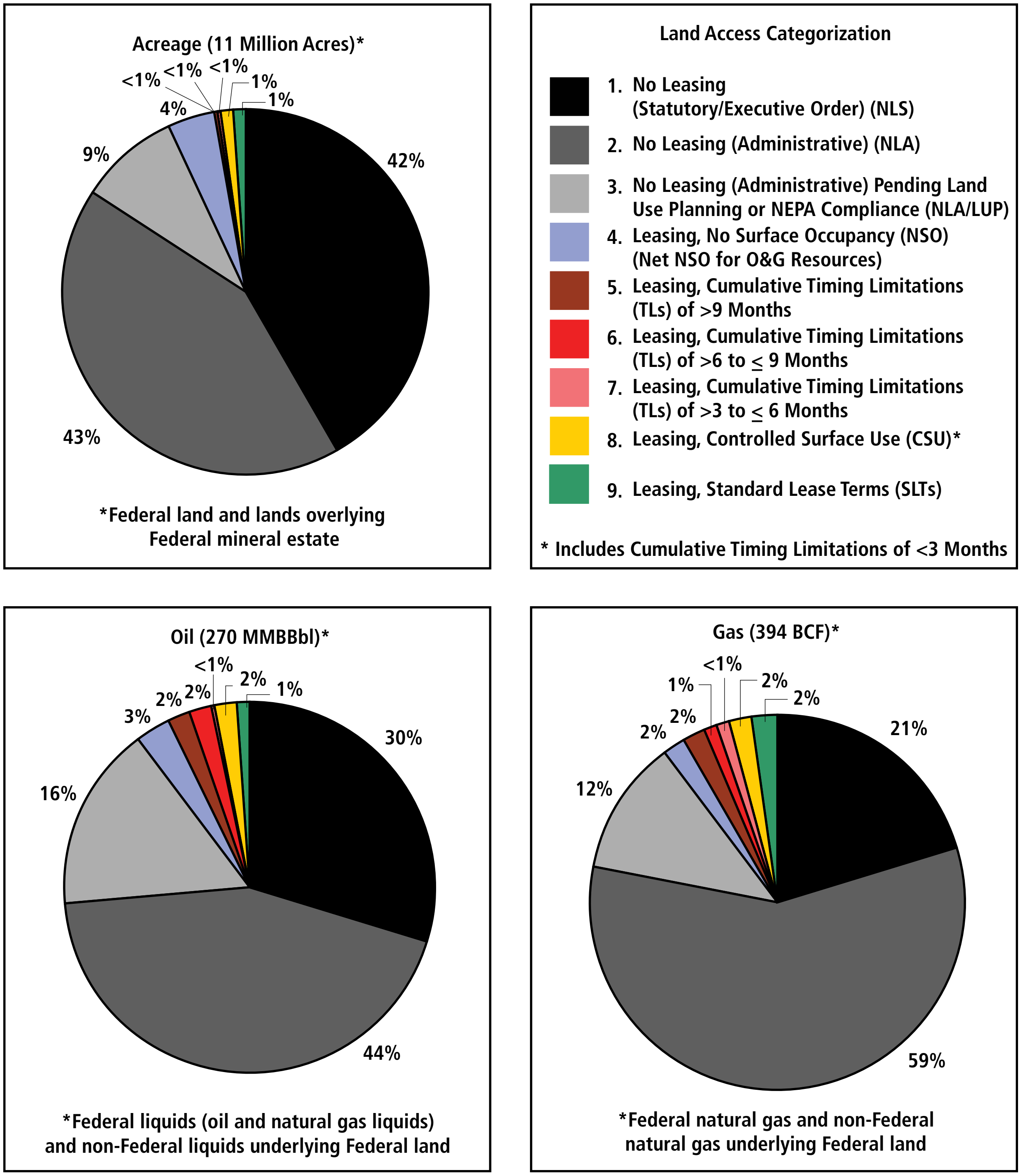

Figure 3-14. Chart of Results, Southern Alaska Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

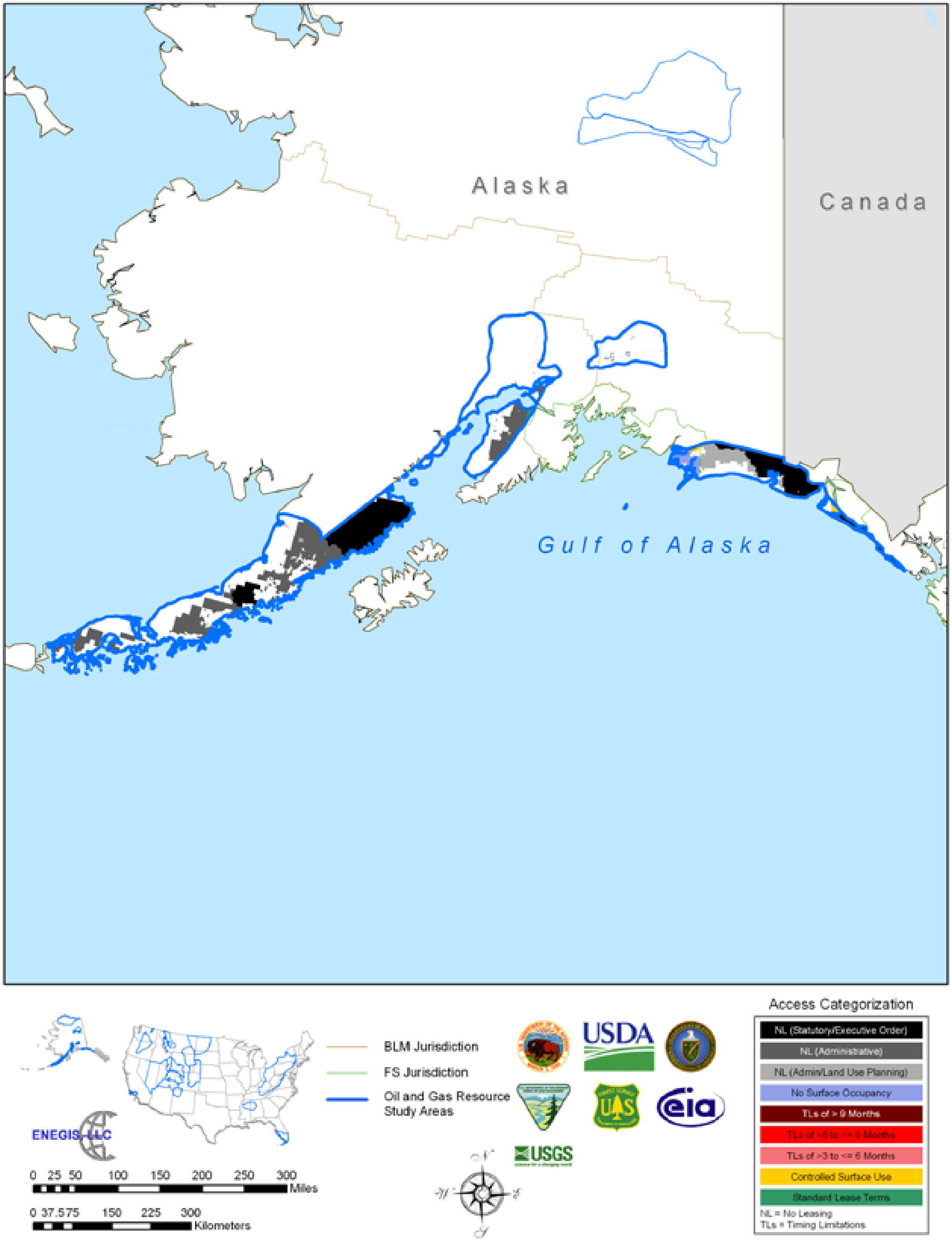

Figure 3-15. Federal Land Access Categorization Map, Southern Alaska Study Area

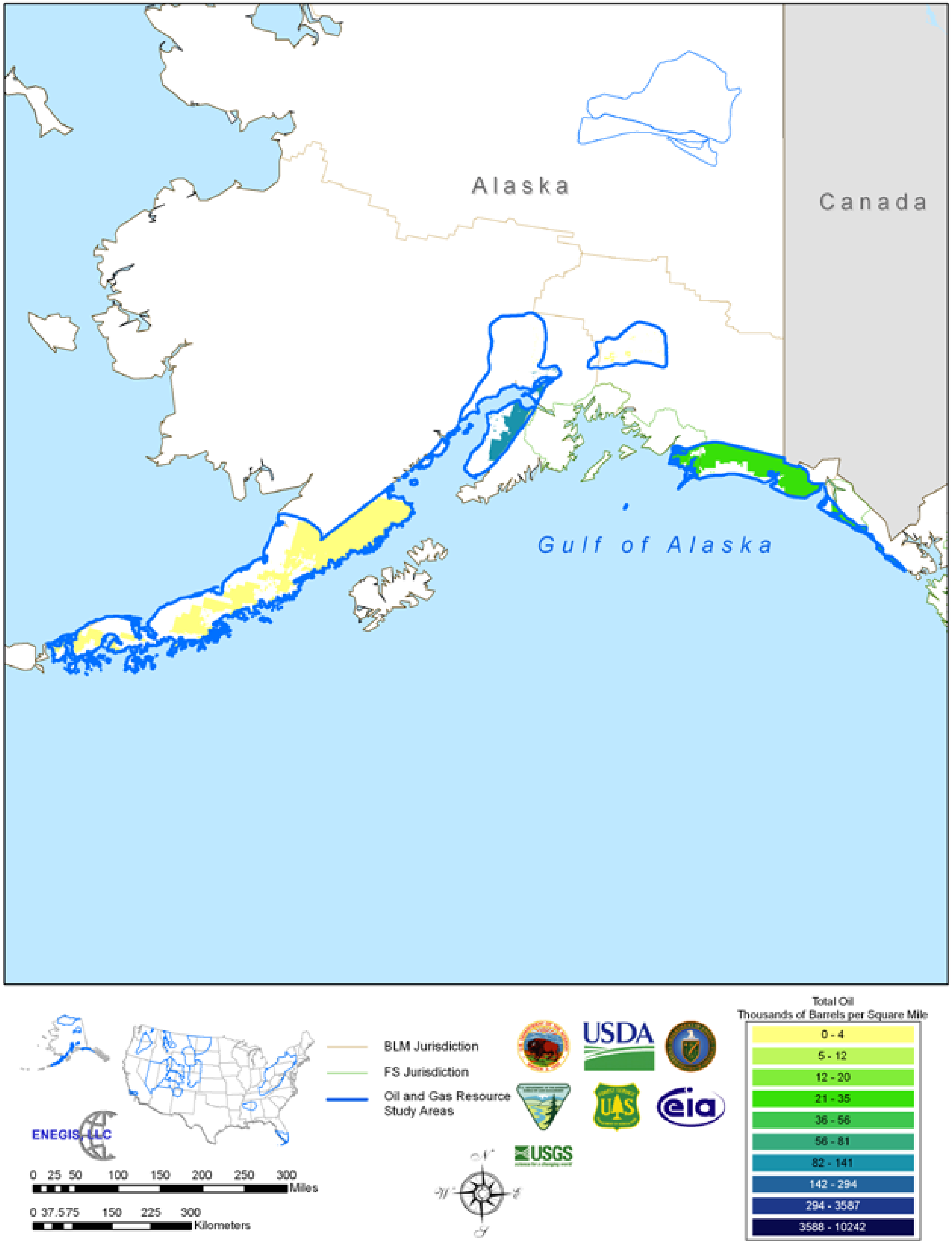

Figure 3-16. Map of Total Federal Oil, Southern Alaska Study Area

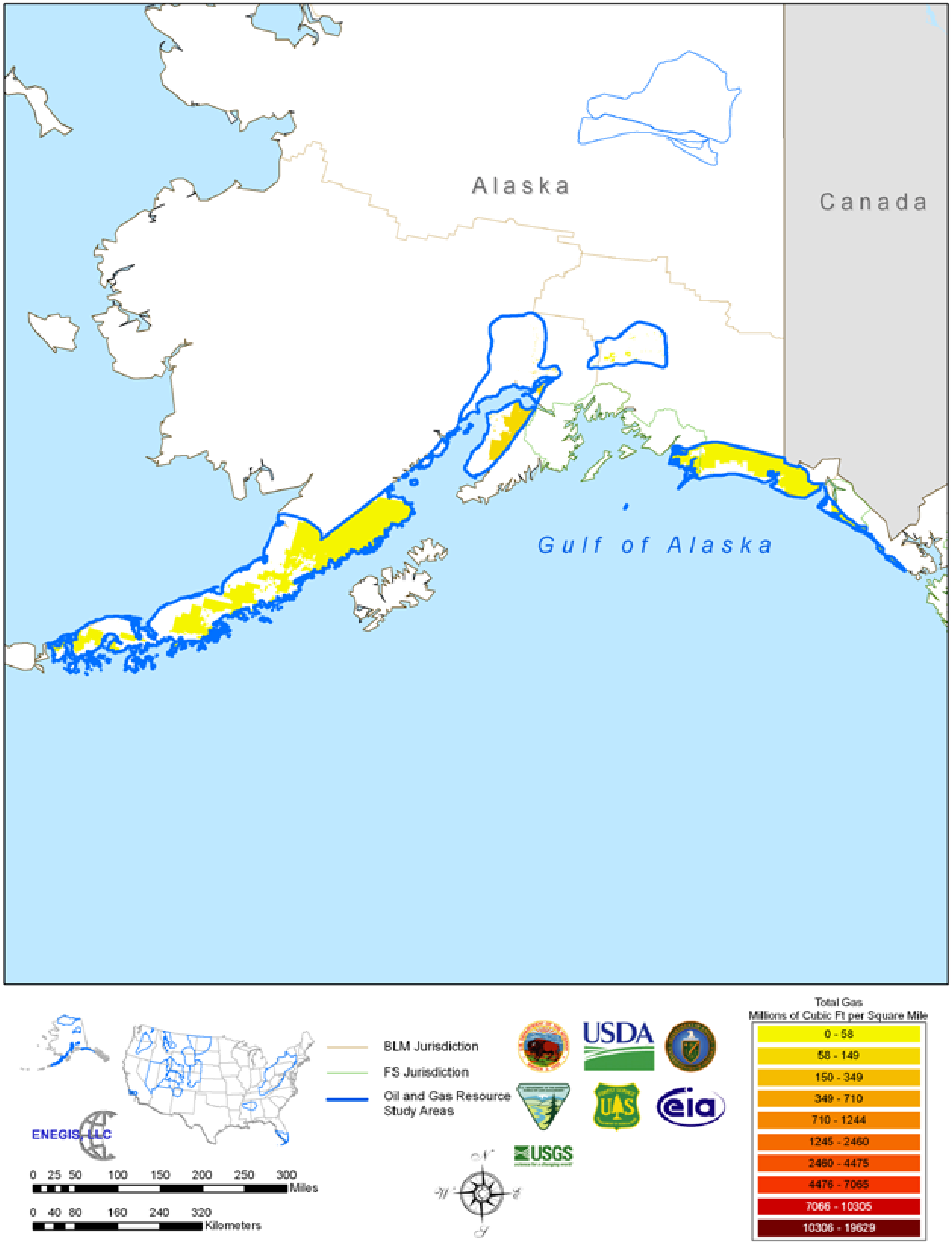

Figure 3-17. Map of Total Federal Natural Gas, Southern Alaska Study Area

- There has been little exploration in this basin due to the relative ineffectiveness of geophysical surveys caused by the extensive presence of volcanic rock.

3.1.5 Ventura Basin

- Approximately 92 percent (563.2 thousand acres) of the Federal land is not accessible (Figures 3-23 and 3-24, Categories 1 through 4). Based on resource estimates, these lands contain 48 percent (134.2 MMbbls) of the Federal oil and 55 percent (249.0 BCF) of the Federal natural gas.
- Approximately 5 percent (32.3 thousand acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-23 and 3-24, Categories 5 through 8). Based on resource estimates, these lands contain 48 percent (134.4 MMbbls) of the Federal oil and 41 percent (185.9 BCF) of the Federal natural gas in the basin.
- Approximately 3 percent (16.0 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-23 and 3-24, Category 9). Based on resource estimates, these lands contain 4 percent (11.9 MMbbls) of the Federal oil and 4 percent (17.7 BCF) of the Federal natural gas.
- The FS and the NPS are the dominant Federal land managers in the Ventura Basin.

3.1.6 Eastern Great Basin

- Approximately 51 percent (27.9 million acres) of the Federal land is not accessible (Figures 3-28 and 3-29, Categories 1 through 4). Based on resource estimates, these lands contain 49 percent (667.6 MMbbls) of the Federal oil and 49 percent (99.3 BCF) of the Federal natural gas.
- Approximately 21 percent (11.3 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-28 and 3-29, Categories 5 through 8). Based on resource estimates, these lands contain 23 percent (310.4 MMbbls) of the Federal oil and 23 percent (46.3 BCF) of the Federal natural gas in the basin.
- Approximately 28 percent (15.4 million acres) of the Federal land is accessible under standard lease terms (Figures 3-28 and 3-29, Category 9). Based on resource estimates, these lands contain 28 percent (377.6 MMbbls) of the Federal oil and 29 percent (58.6 BCF) of the Federal natural gas.
- Federal land comprises nearly 80 percent of the study area with the BLM as the dominant land manager.

3.1.7 Uinta-Piceance Basin

- Approximately 40 percent (5.3 million acres) of the Federal land is not accessible (Figures 3-33 and 3-34, Categories 1 through 4). Based on resource estimates, these lands contain 14 percent (52.8 MMbbls) of the Federal oil and 16 percent (2,243 BCF) of the Federal natural gas.
- Approximately 32 percent (4.3 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-33 and 3-34, Categories 5 through 8). Based on resource estimates, these lands contain 59 percent (217.8 MMbbls) of the Federal oil and 62 percent (8,780 BCF) of the Federal natural gas in the basin.

Table 3-5. Eastern Oregon-Washington Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

	Access Category		Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	1,096	13.1%	-	1.2%	16	1.8%
	2.	No Leasing (Administrative) (NLA)	812	9.7%	2	43.5%	355	41.5%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	153	1.8%	-	6.7%	55	6.5%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	740	8.8%	-	1.8%	17	2.0%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	64	0.8%	-	2.0%	17	1.9%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	1,125	13.4%	-	1.9%	22	2.6%
	8.	Leasing, Controlled Surface Use (CSU)[d]	1,802	21.5%	-	12.6%	112	13.1%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	2,577	30.8%	1	30.4%	261	30.5%
Total, Federal Lands including Split Estate			**8,369**	100.0%	**3**	100.0%	**856**	100.0%
Total Non-Federal			**14,577**		**6**		**1,555**	
Total Inventory Area			**22,946**		**10**		**2,411**	

Summary						
Inaccessible (Categories 1-4)	2,801	33%	2	53%	444	52%
Accessible with Restrictions (Categories 5-8)	2,991	36%	1	16%	151	18%
Accessible under Standard Lease Terms (Category 9)	2,577	31%	1	30%	261	31%
Total, Federal Lands Including Split Estate	**8,369**	**100%**	**3**	**100%**	**856**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

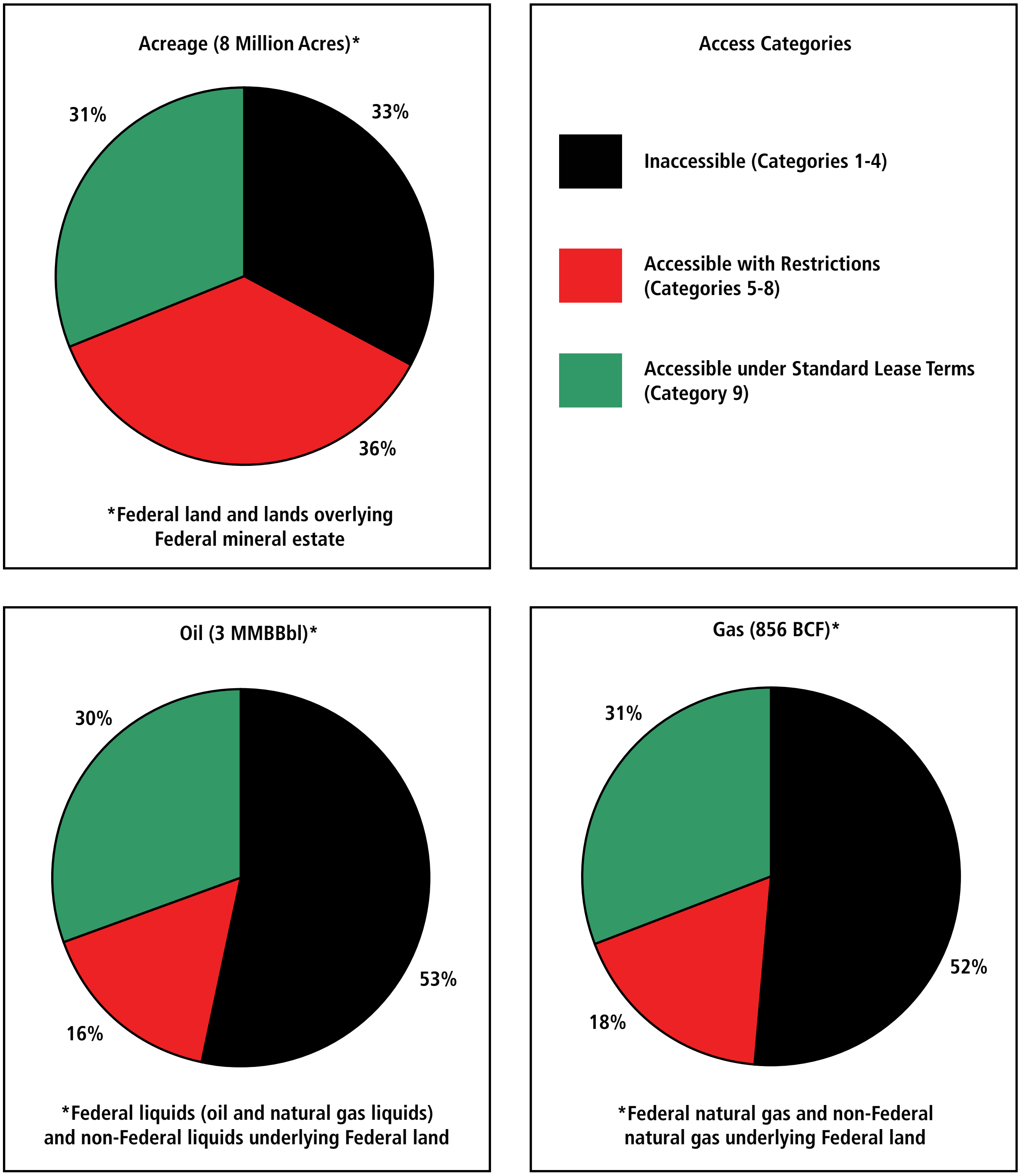

Figure 3-18. Simplified Chart of Results, Eastern Oregon-Washington Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

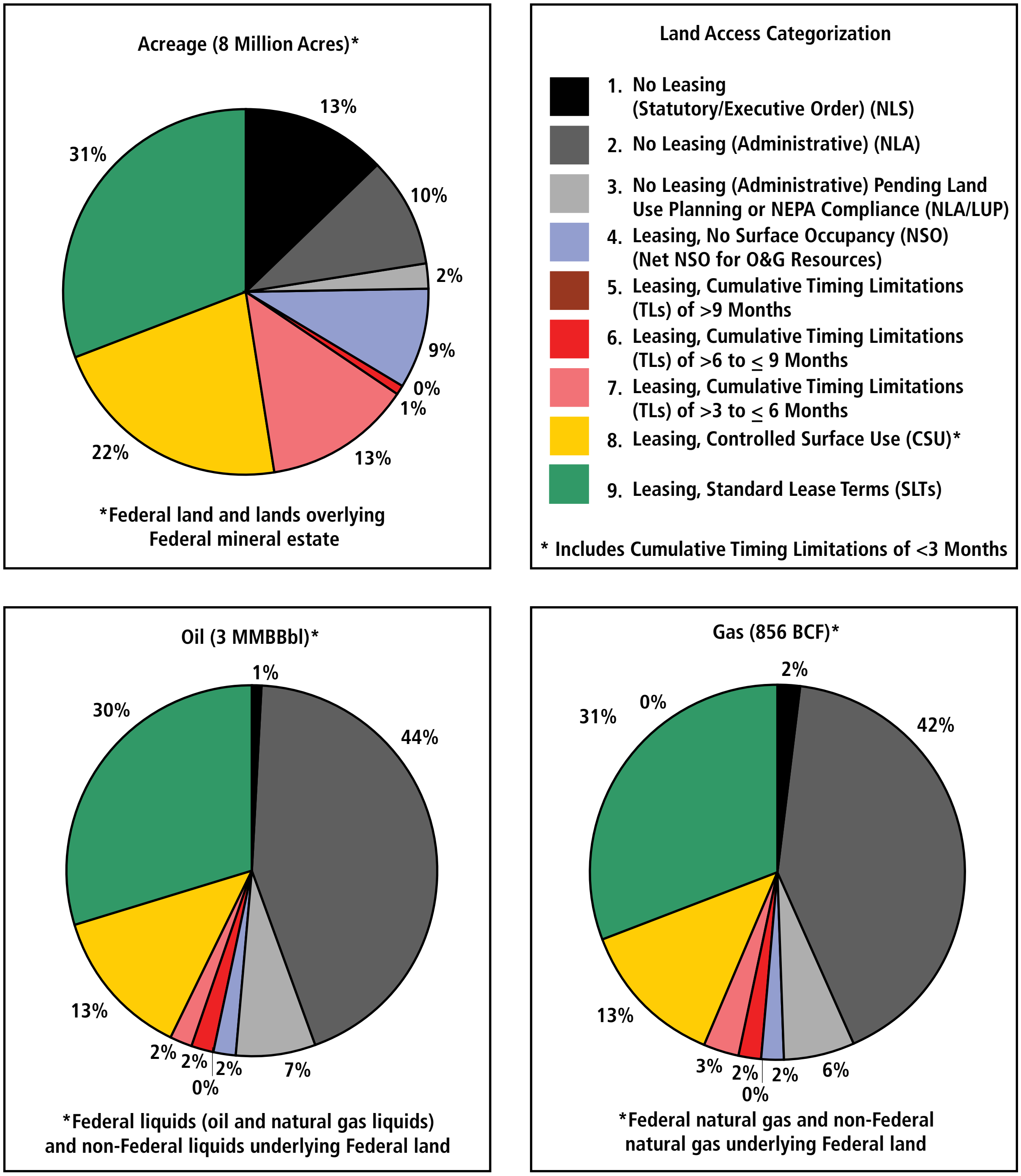

Figure 3-19. Chart of Results, Eastern Oregon-Washington Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

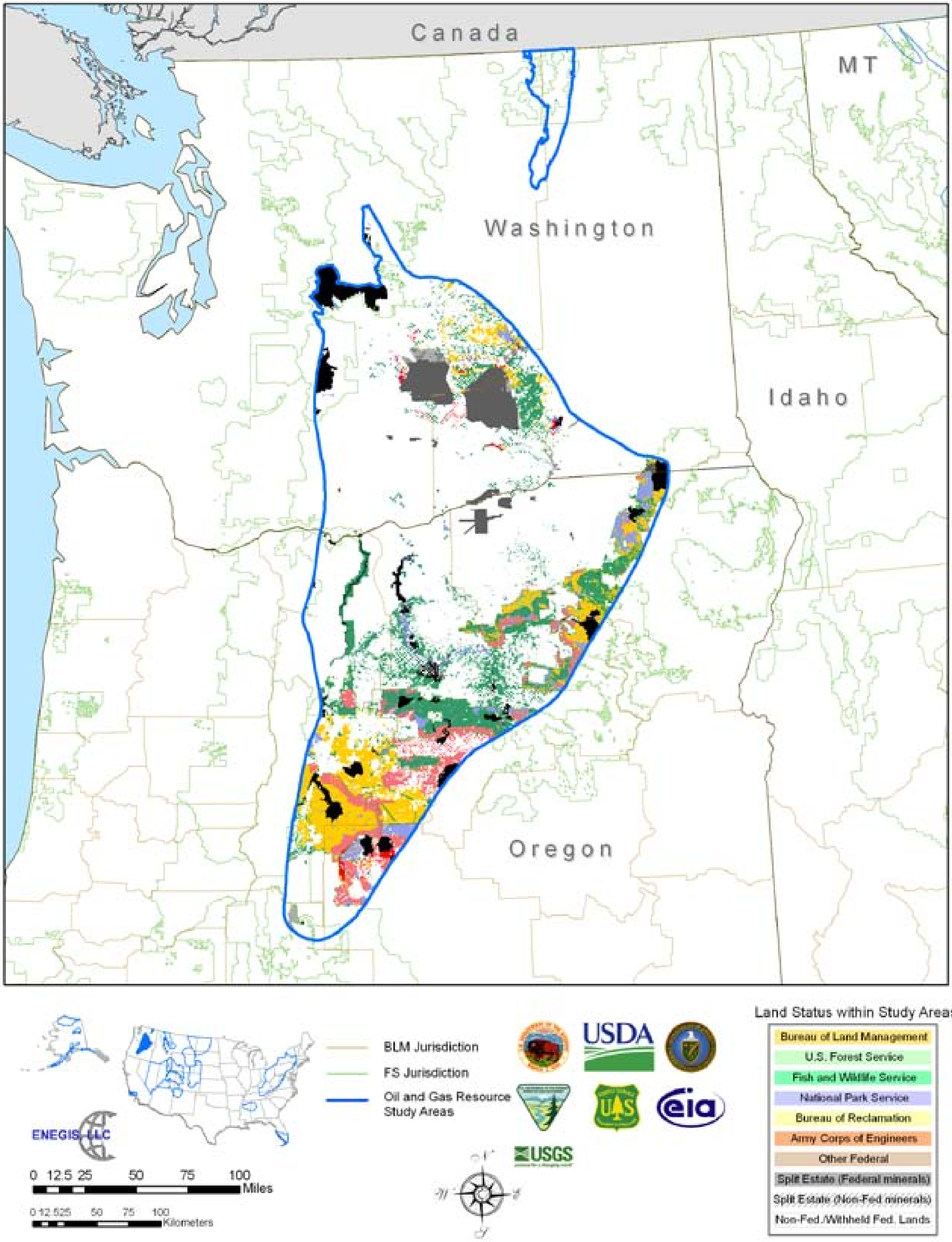

Figure 3-20. Federal Land Access Categorization Map, Eastern Oregon-Washington Study Area

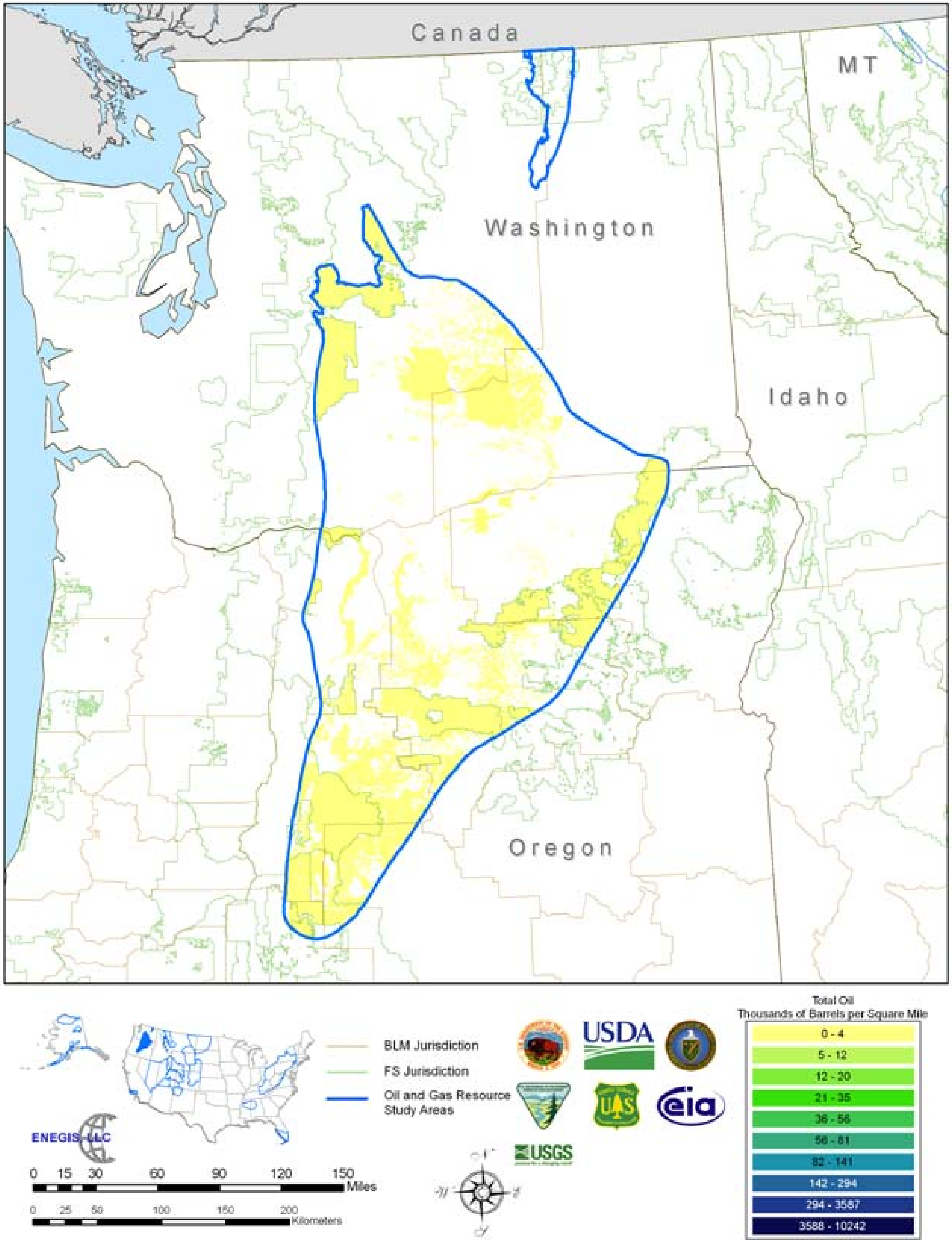

Figure 3-21. Map of Total Federal Oil, Eastern Oregon-Washington Study Area

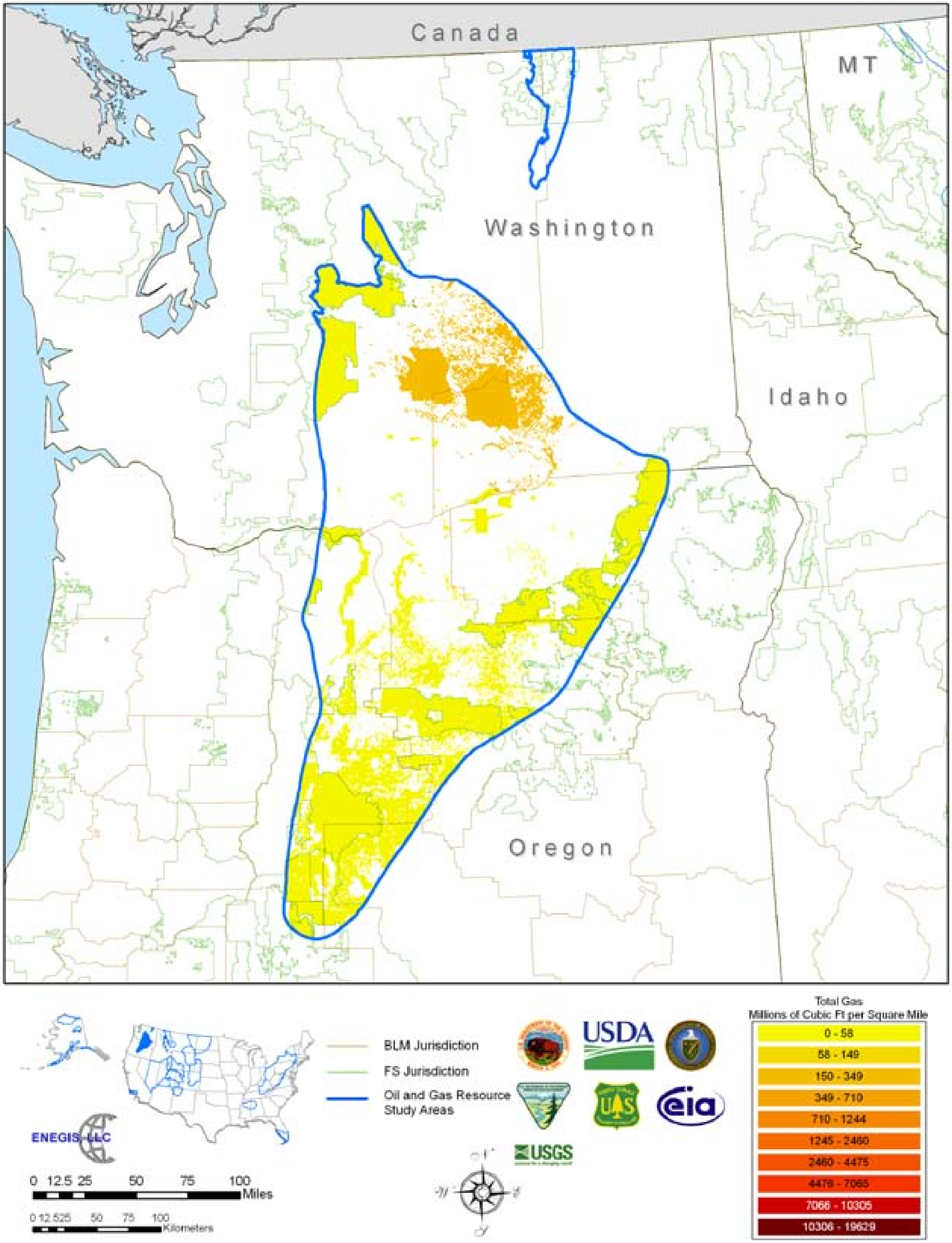

Figure 3-22. Map of Total Federal Natural Gas, Eastern Oregon-Washington Study Area

Table 3-6. Ventura Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

	Access Category	Area		Resources[a]			
				Total Oil[b]		Total Gas[c]	
		(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained ↑	1. No Leasing (Statutory/ Executive Order) (NLS)	280	45.7%	89	31.7%	169	37.3%
	2. No Leasing (Administrative) (NLA)	28	4.6%	9	3.2%	17	3.8%
	3. No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	21	3.4%	8	2.9%	14	3.1%
	4. Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	235	38.4%	28	10.1%	49	10.8%
	5. Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6. Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	-	0.0%	-	0.0%	-	0.0%
	7. Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	4	0.7%	34	12.1%	44	9.8%
	8. Leasing, Controlled Surface Use (CSU)[d]	28	4.6%	100	35.8%	141	31.3%
Less Constrained	9. Leasing, Standard Lease Terms (SLTs)	16	2.6%	12	4.2%	18	3.9%
Total, Federal Lands including Split Estate		**612**	100.0%	**281**	100.0%	**453**	100.0%
Total Non-Federal		**1,195**		**1,394**		**1,824**	
Total Inventory Area		**1,807**		**1,674**		**2,277**	

Summary						
Inaccessible (Categories 1-4)	563	92%	134	48%	249	55%
Accessible with Restrictions (Categories 5-8)	32	5%	134	48%	186	41%
Accessible under Standard Lease Terms (Category 9)	16	3%	12	4%	18	4%
Total, Federal Lands Including Split Estate	**612**	**100%**	**281**	**100%**	**453**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

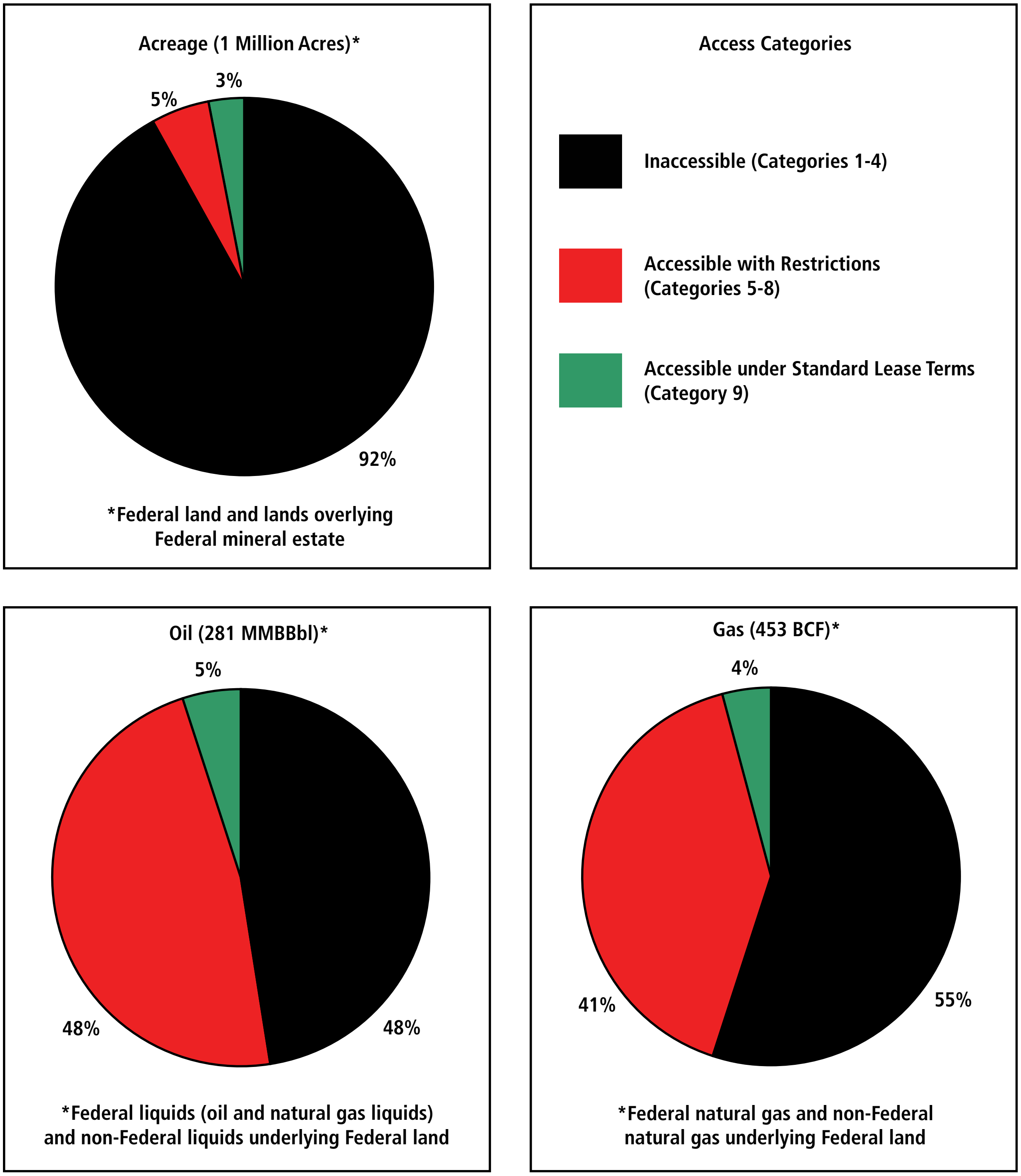

Figure 3-23. Simplified Chart of Results, Ventura Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

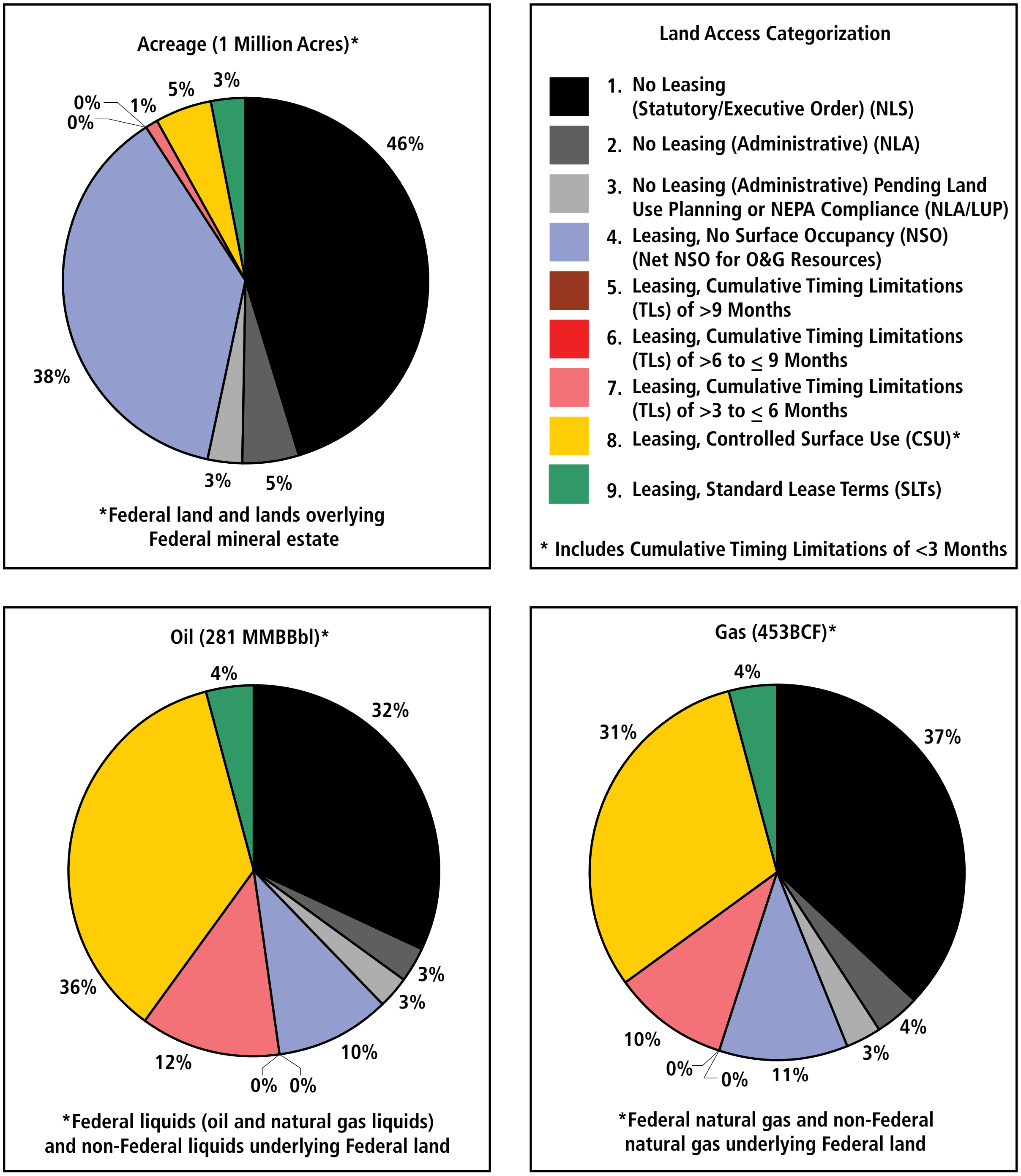

Figure 3-24. Chart of Results, Ventura Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

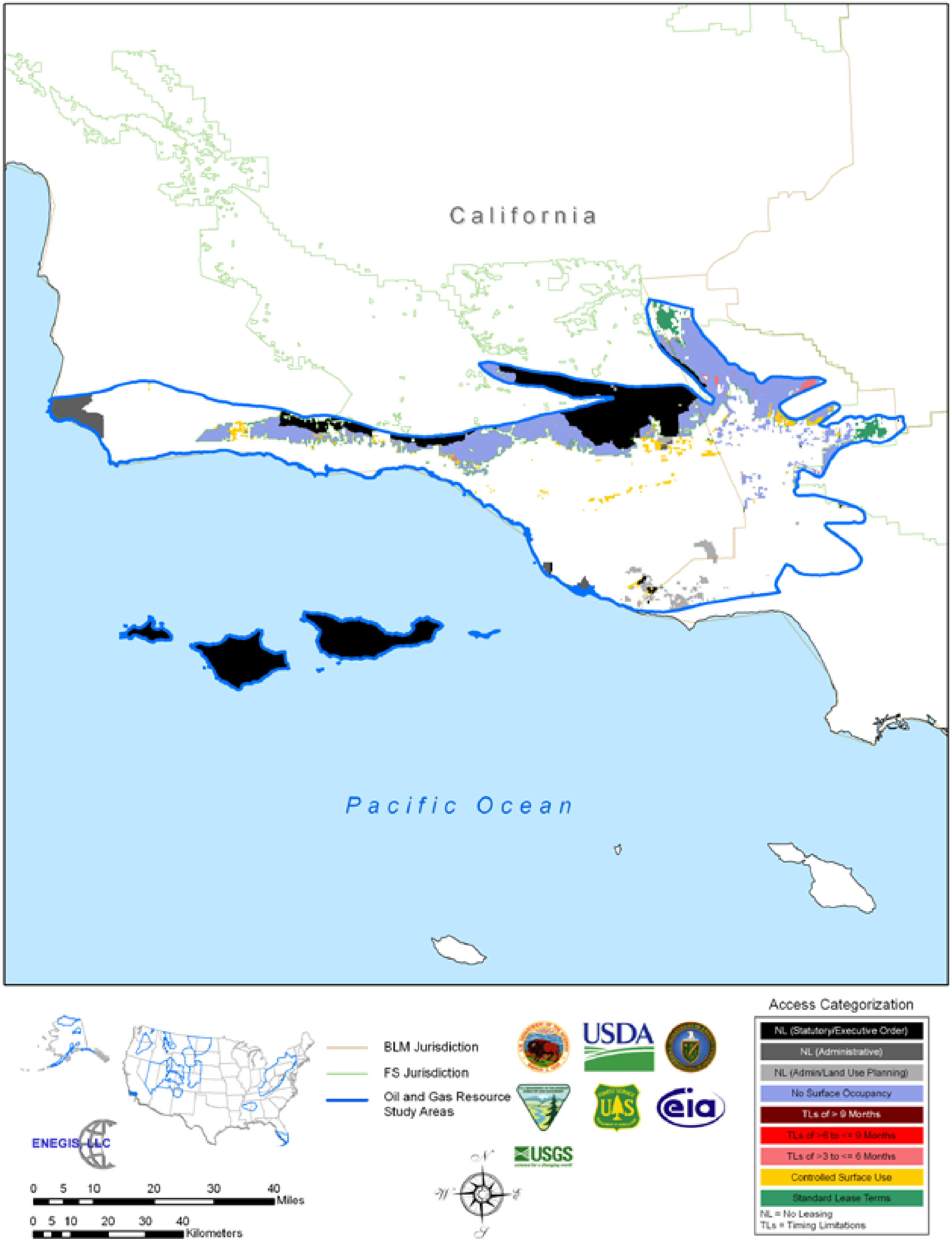

Figure 3-25. Federal Land Access Categorization Map, Ventura Basin Study Area

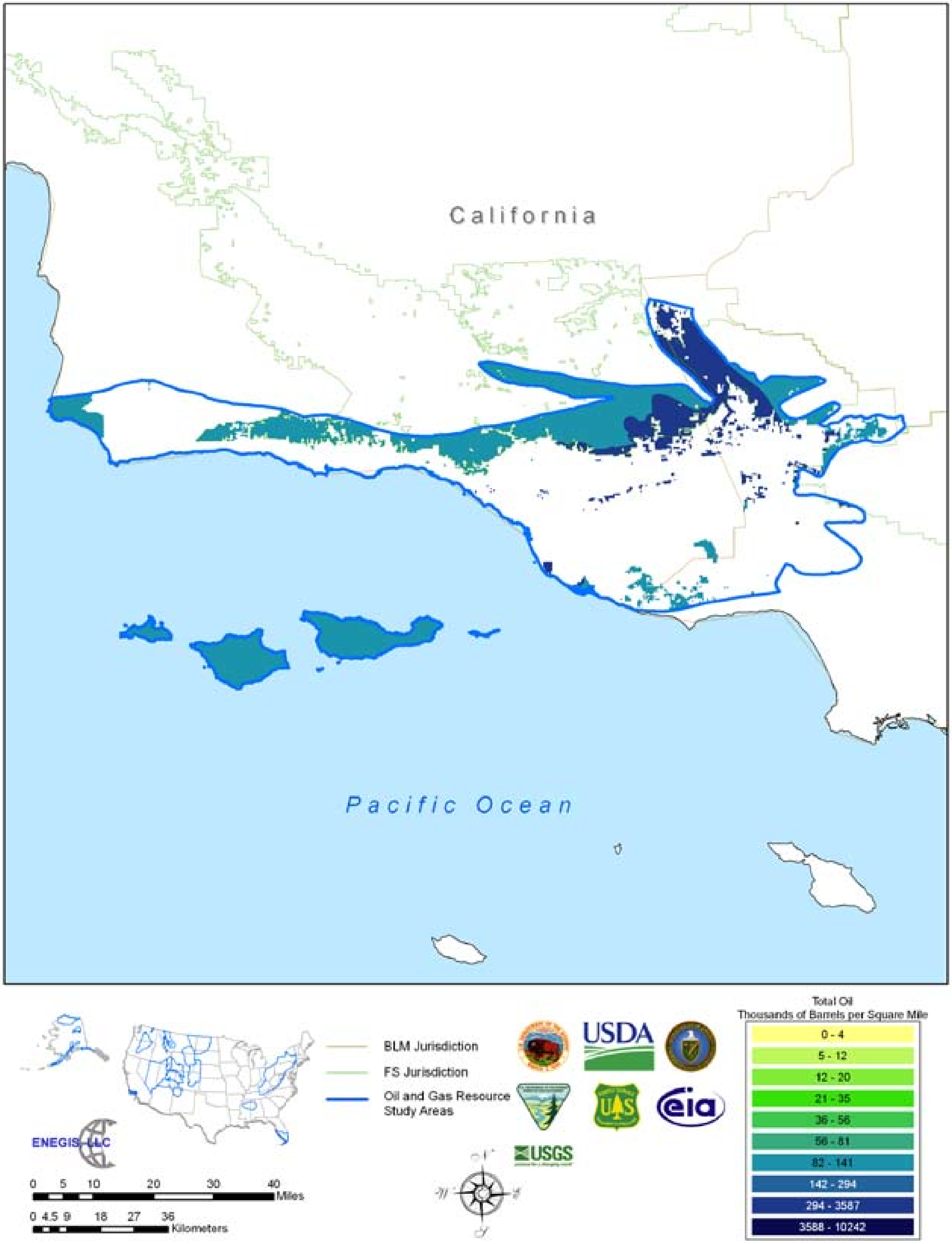

Figure 3-26. Map of Total Federal Oil, Ventura Basin Study Area

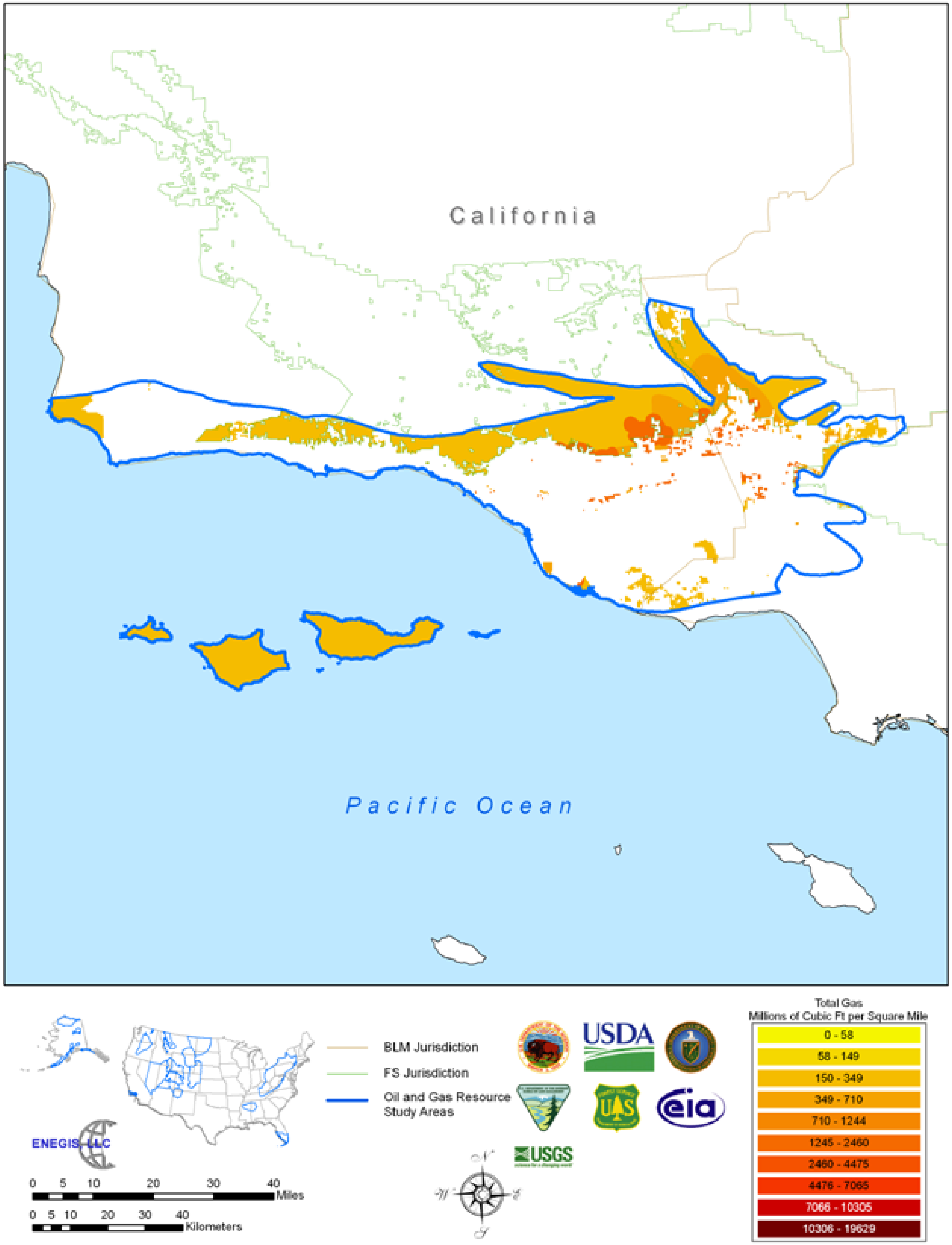

Figure 3-27. Map of Total Federal Natural Gas, Ventura Basin Study Area

Table 3-7. Eastern Great Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

Constraint	No.	Access Category	Area (acres x 1000)	Area Percent of Federal	Total Oil[b] (MMbbls)	Total Oil[b] Percent of Federal	Total Gas[c] (BCF)	Total Gas[c] Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	4,281	7.8%	98	7.2%	17	8.6%
	2.	No Leasing (Administrative) (NLA)	6,577	12.1%	174	12.8%	23	11.1%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	15,052	27.6%	379	28.0%	55	27.0%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	2,029	3.7%	16	1.2%	4	2.0%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	28	0.1%	0	0.0%	0	0.1%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	150	0.3%	4	0.3%	1	0.3%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	2,331	4.3%	64	4.7%	9	4.5%
	8.	Leasing, Controlled Surface Use (CSU)[d]	8,751	16.0%	242	17.9%	36	17.7%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	15,354	28.1%	378	27.9%	59	28.7%
Total, Federal Lands including Split Estate			**54,553**	100.0%	**1,356**	100.0%	**204**	100.0%
Total Non-Federal			**14,331**		**325**		**60**	
Total Inventory Area			**68,884**		**1,681**		**264**	

Summary	Area (acres x 1000)	Percent of Federal	Total Oil (MMbbls)	Percent of Federal	Total Gas (BCF)	Percent of Federal
Inaccessible (Categories 1-4)	27,940	51%	668	49%	99	49%
Accessible with Restrictions (Categories 5-8)	11,259	21%	310	23%	46	23%
Accessible under Standard Lease Terms (Category 9)	15,354	28%	378	28%	59	29%
Total, Federal Lands Including Split Estate	**54,553**	**100%**	**1,356**	**100%**	**204**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

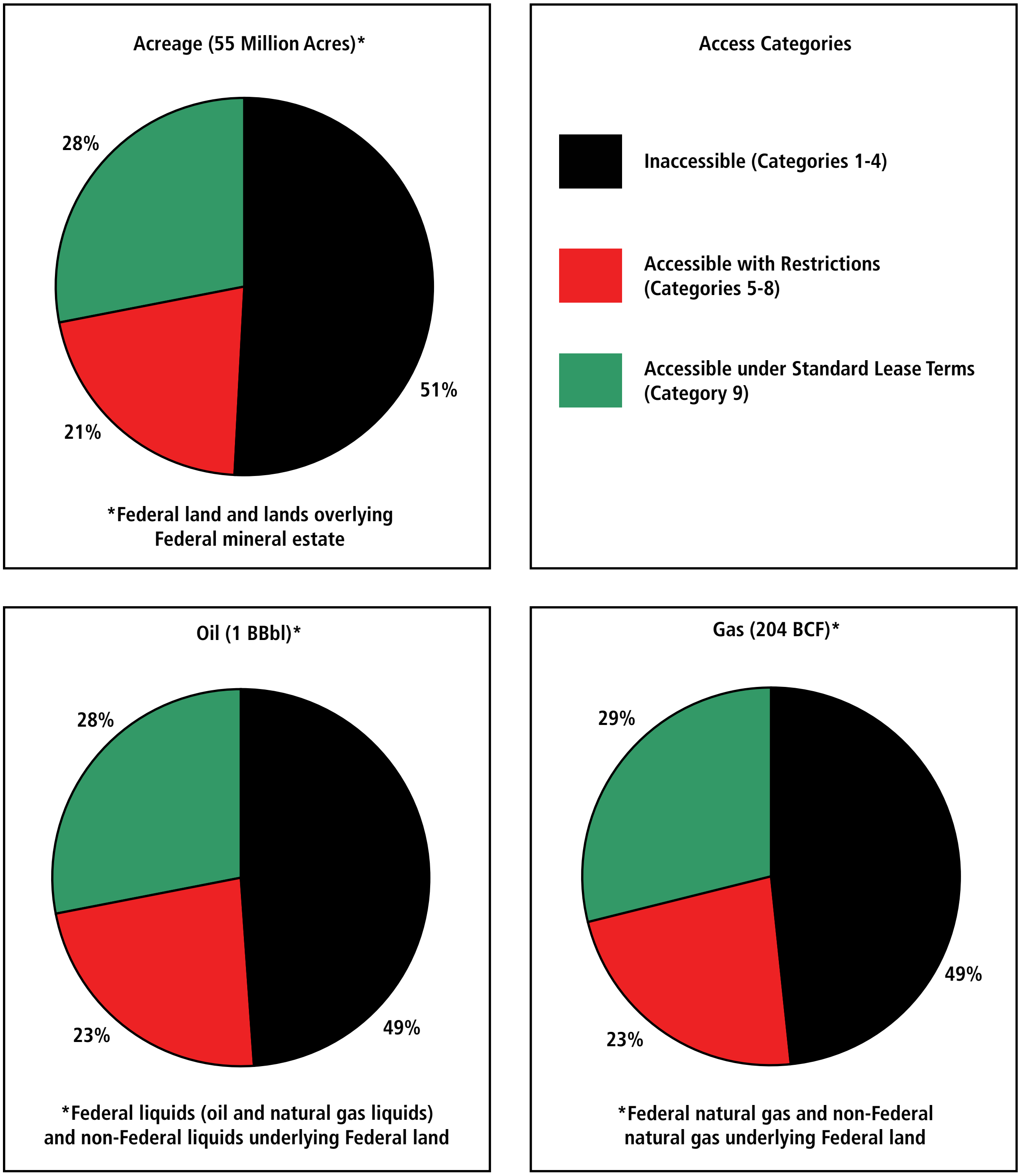

Figure 3-28. Simplified Chart of Results, Eastern Great Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

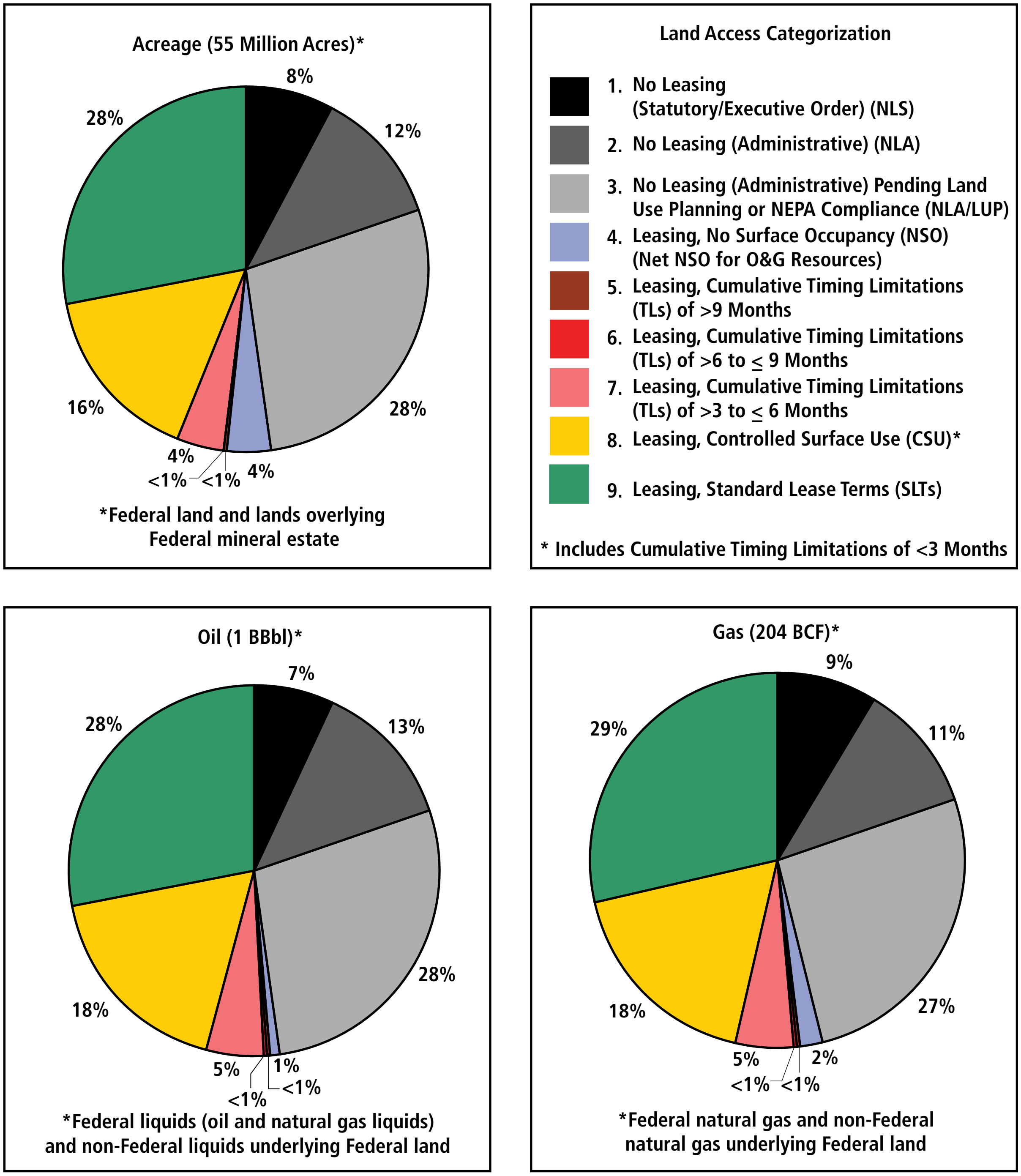

Figure 3-29. Chart of Results, Eastern Great Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

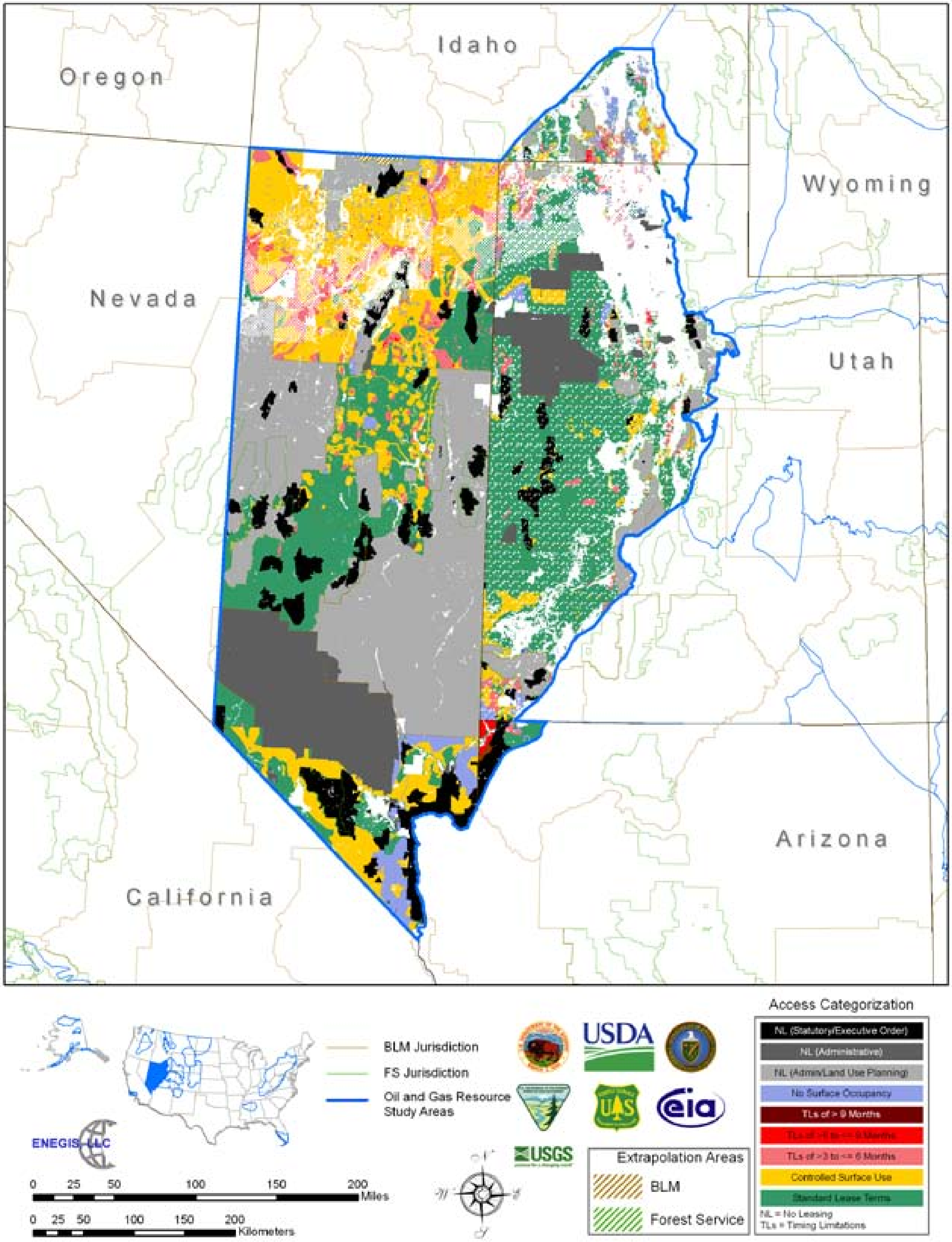

Figure 3-30. Federal Land Access Categorization Map, Eastern Great Basin Study Area

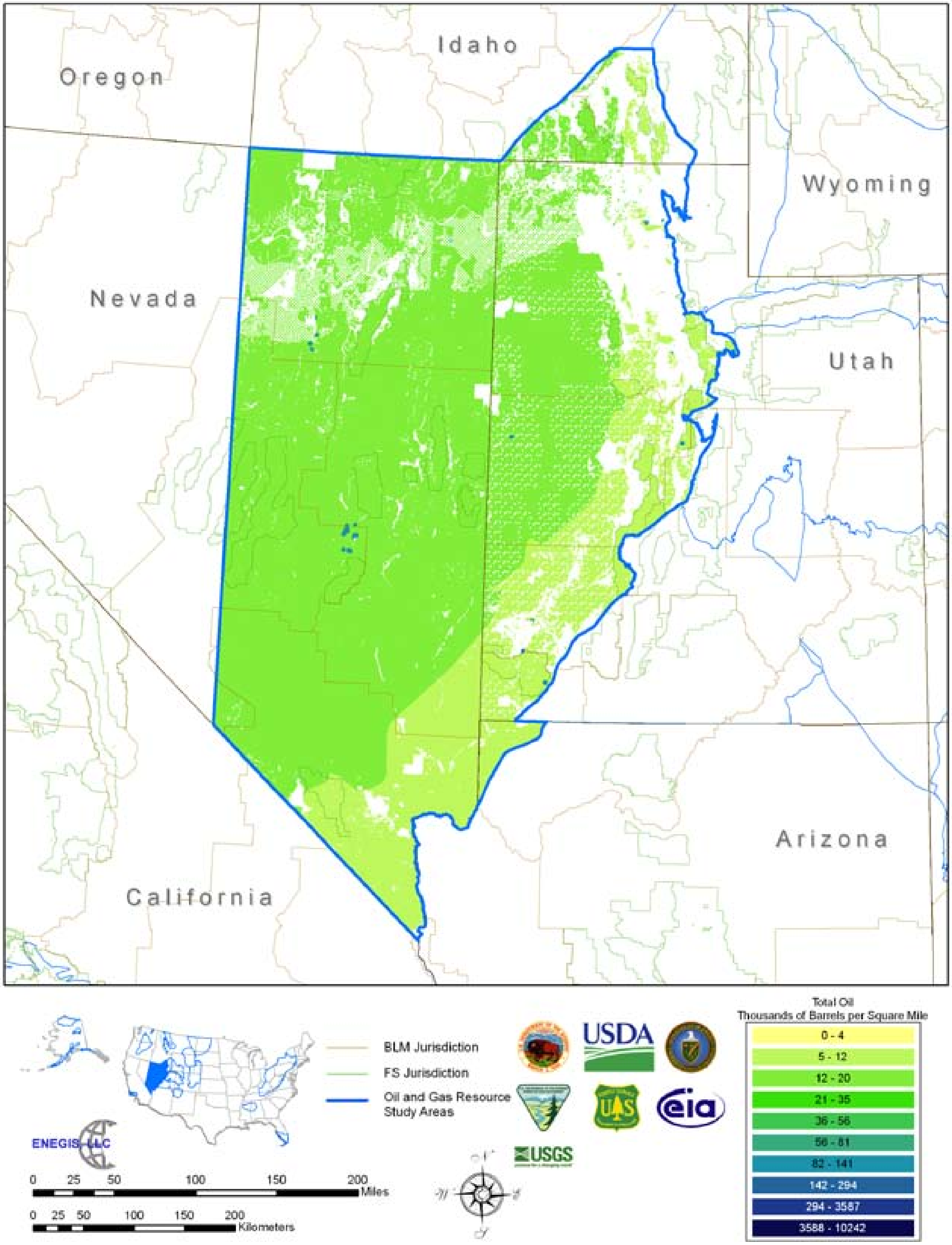

Figure 3-31. Map of Total Federal Oil, Eastern Great Basin Study Area

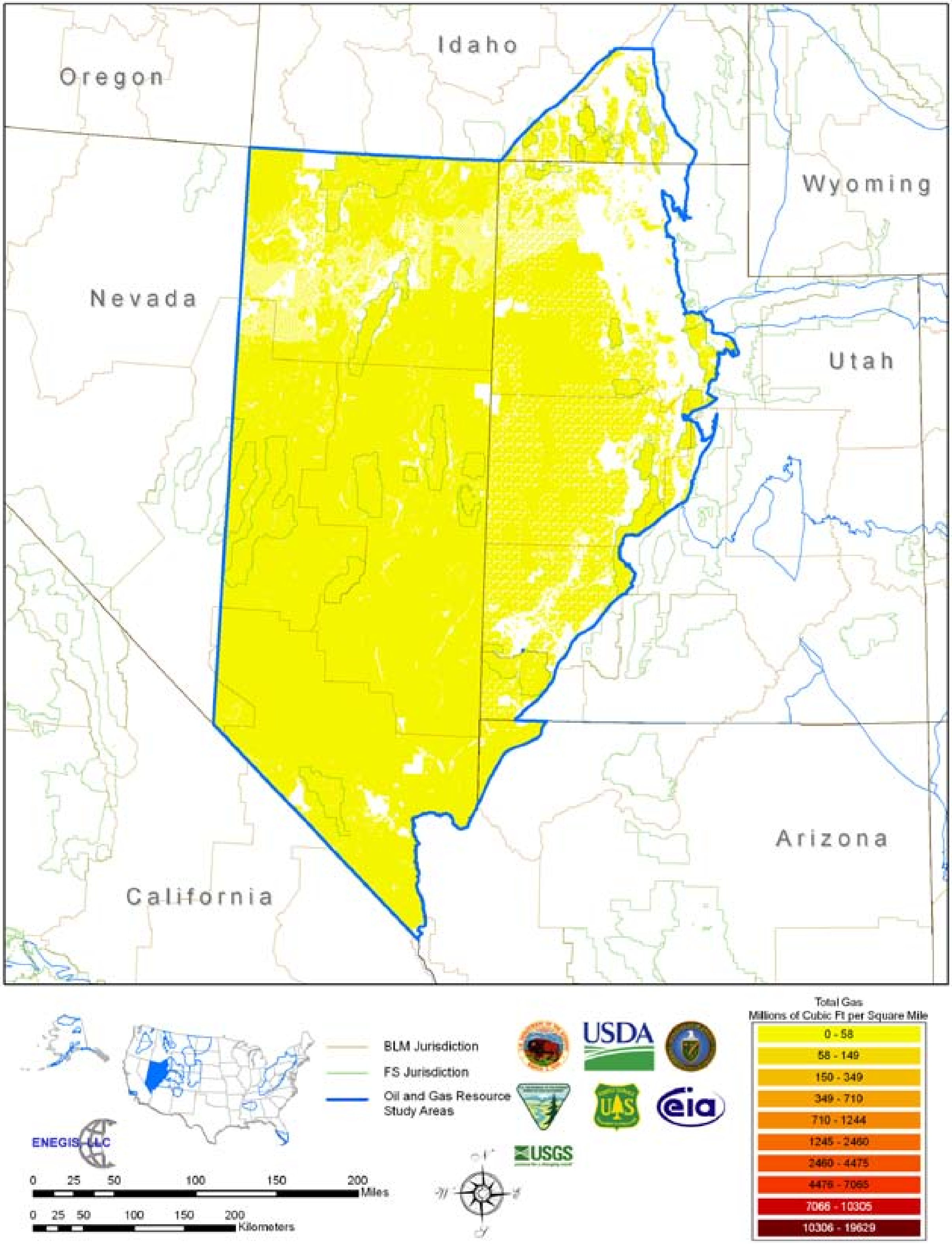

Figure 3-32. Map of Total Federal Natural Gas, Eastern Great Basin Study Area

- Approximately 27 percent (3.5 million acres) of the Federal land is accessible under standard lease terms (Figures 3-33 and 3-34, Category 9). Based on resource estimates, these lands contain 26 percent (96.2 MMbbls) of the Federal oil and 22 percent (3, 088 BCF) of the Federal natural gas.
- Most of the undiscovered natural gas (greater than 95 percent) is interpreted to be continuous (unconventional) resources.

3.1.8 Paradox Basin

- Approximately 60 percent (8.7 million acres) of the Federal land is not accessible (Figures 3-38 and 3-39, Categories 1 through 4). Based on resource estimates, these lands contain 46 percent (143.1 MMbbls) of the Federal oil and 38 percent (397.9 BCF) of the Federal natural gas.
- Approximately 14 percent (2.0 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-38 and 3-39, Categories 5 through 8). Based on resource estimates, these lands contain 31 percent (95.7 MMbbls) of the Federal oil and 38 percent (377.4 BCF) of the Federal natural gas.
- Approximately 27 percent (3.9 million acres) of the Federal land is accessible under standard lease terms (Figures 3-38 and 3-39, Category 9). Based on resource estimates, these lands contain 23 percent (72.9 MMbbls) of the Federal oil and 26 percent (273.2 BCF) of the Federal natural gas.
- National Forests in the western part of the basin do not have current land use planning documents.

3.1.9 San Juan Basin

- Approximately 24 percent (686.2 thousand acres) of the Federal land is not accessible (Figures 3-43 and 3-44, Categories 1 through 4). Based on resource estimates, these lands contain 15 percent (22.2 MMbbls) of the Federal oil and 13 percent (3,199 BCF) of the Federal natural gas.
- Approximately 23 percent (664.2 thousand acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-43 and 3-44, Categories 5 through 8). Based on resource estimates, these lands contain 61 percent (91.3 MMbbls) of the Federal oil and 61 percent (15,267 BCF) of the Federal natural gas.
- Approximately 53 percent (1.5 million acres) of the Federal land is accessible under standard lease terms (Figures 3-43 and 3-44, Category 9). Based on resource estimates, these lands contain 25 percent (37.1 MMbbls) of the Federal oil and 26 percent (6,634 BCF) of the Federal natural gas.
- Most of the undiscovered natural gas (approximately 95 percent) is interpreted to be continuous resources.

3.1.10 Montana Thrust Belt

- Approximately 96 percent (5.4 million acres) of the Federal land is not accessible (Figures 3-48 and 3-49, Categories 1 through 4). Based on resource estimates, these lands contain 97 percent (165.3 MMbbls) of the Federal oil and 99 percent (6.2 TCF) of the Federal natural gas.

Table 3-8. Uinta-Piceance Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

		Access Category	Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	1,631	12.4%	26	7.1%	759	5.4%
↑	2.	No Leasing (Administrative) (NLA)	655	5.0%	7	2.0%	482	3.4%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	889	6.8%	7	2.0%	543	3.8%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	2,126	16.2%	12	3.3%	459	3.3%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	110	0.8%	4	1.1%	111	0.8%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	371	2.8%	19	5.1%	775	5.5%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	1,216	9.3%	69	18.8%	3,156	22.4%
	8.	Leasing, Controlled Surface Use (CSU)[d]	2,560	19.5%	126	34.4%	4,738	33.6%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	3,549	27.1%	96	26.2%	3,088	21.9%
Total, Federal Lands including Split Estate			**13,106**	100.0%	**367**	100.0%	**14,111**	100.0%
Total Non-Federal			**5,859**		**221**		**10,903**	
Total Inventory Area			**18,965**		**588**		**25,013**	

Summary						
Inaccessible (Categories 1-4)	5,301	40%	53	14%	2,243	16%
Accessible with Restrictions (Categories 5-8)	4,256	32%	218	59%	8,780	62%
Accessible under Standard Lease Terms (Category 9)	3,549	27%	96	26%	3,088	22%
Total, Federal Lands Including Split Estate	**13,106**	**100%**	**367**	**100%**	**14,111**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

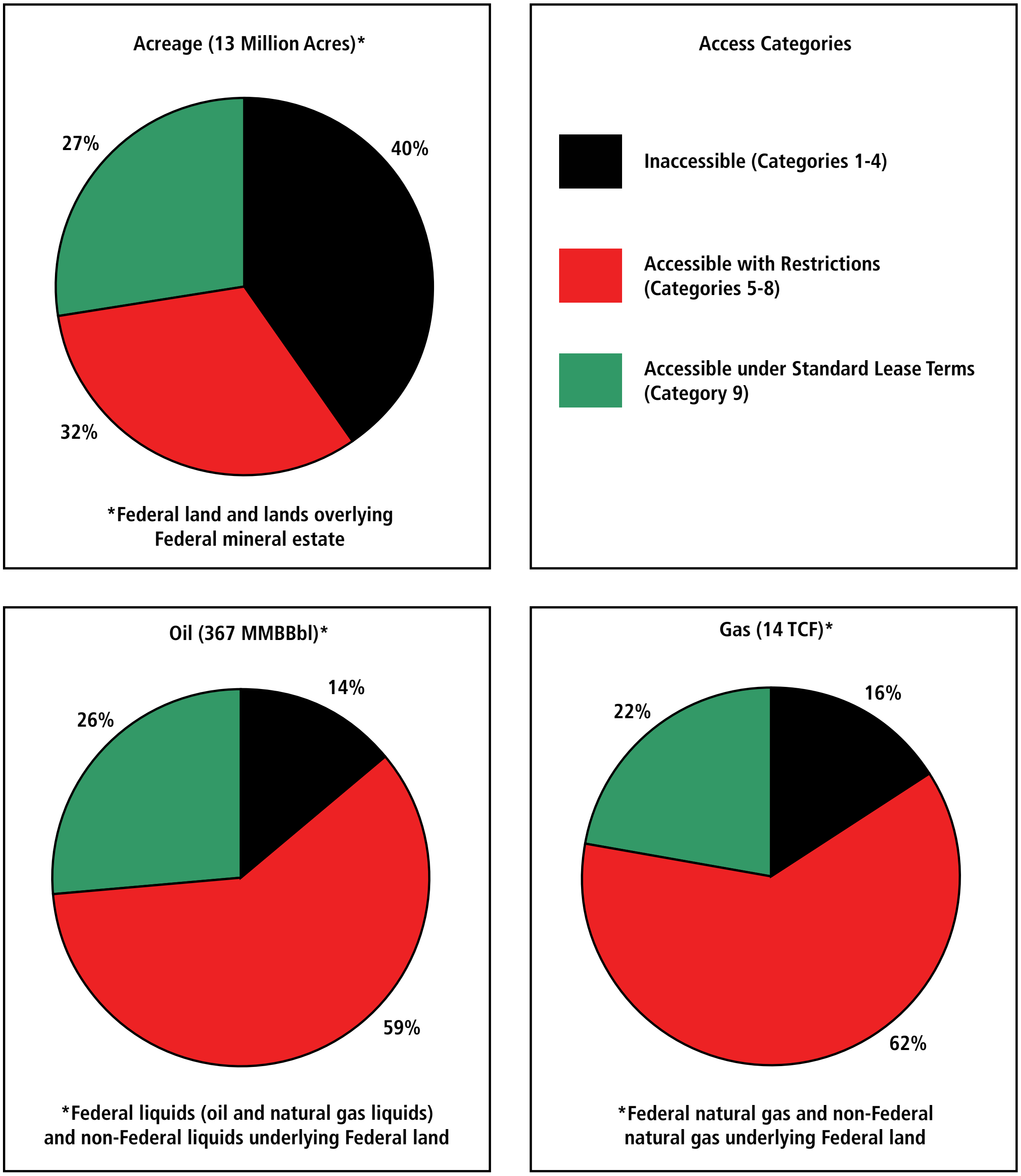

Figure 3-33. Simplified Chart of Results, Uinta-Piceance Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

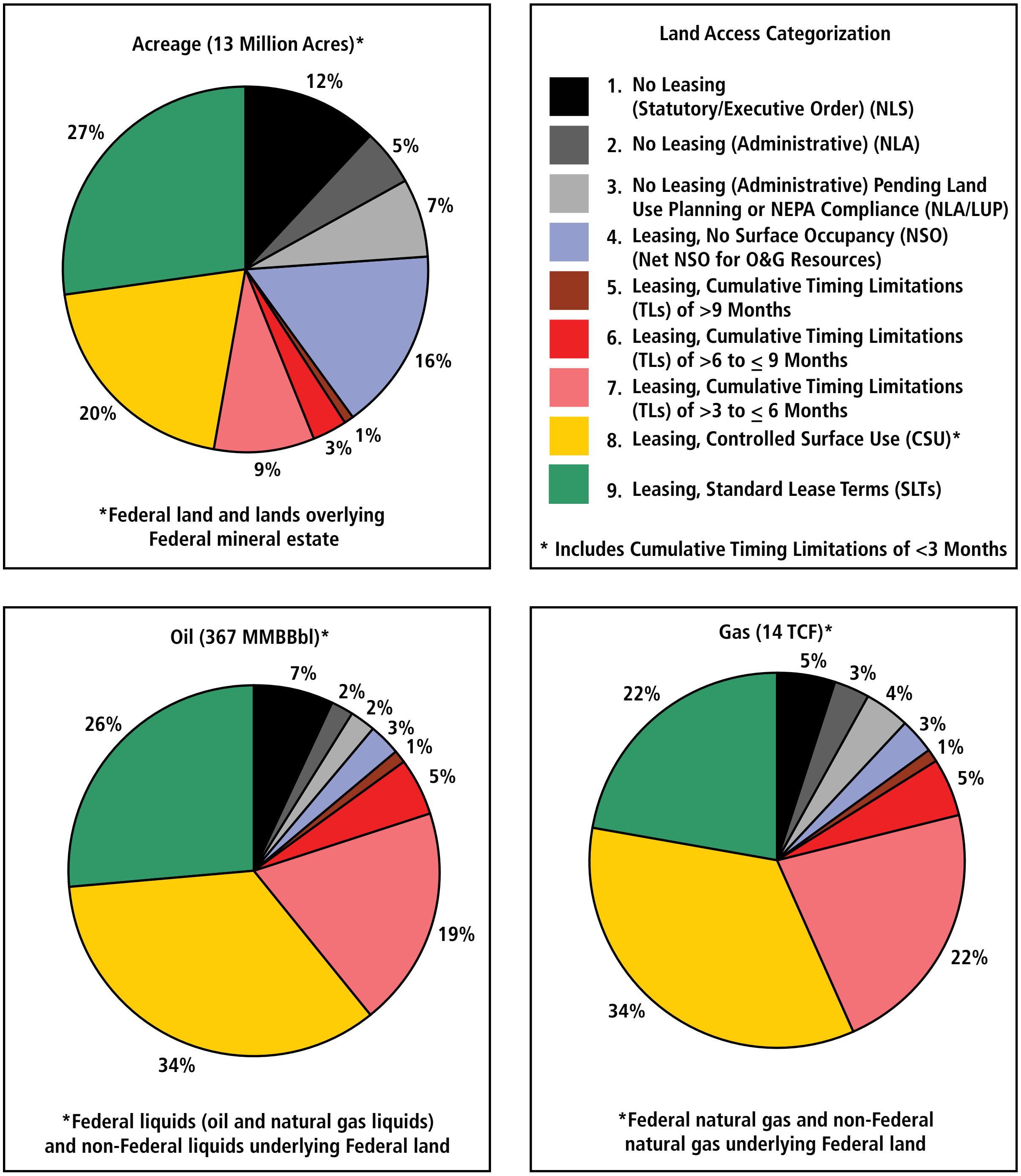

Figure 3-34. Chart of Results, Uinta-Piceance Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

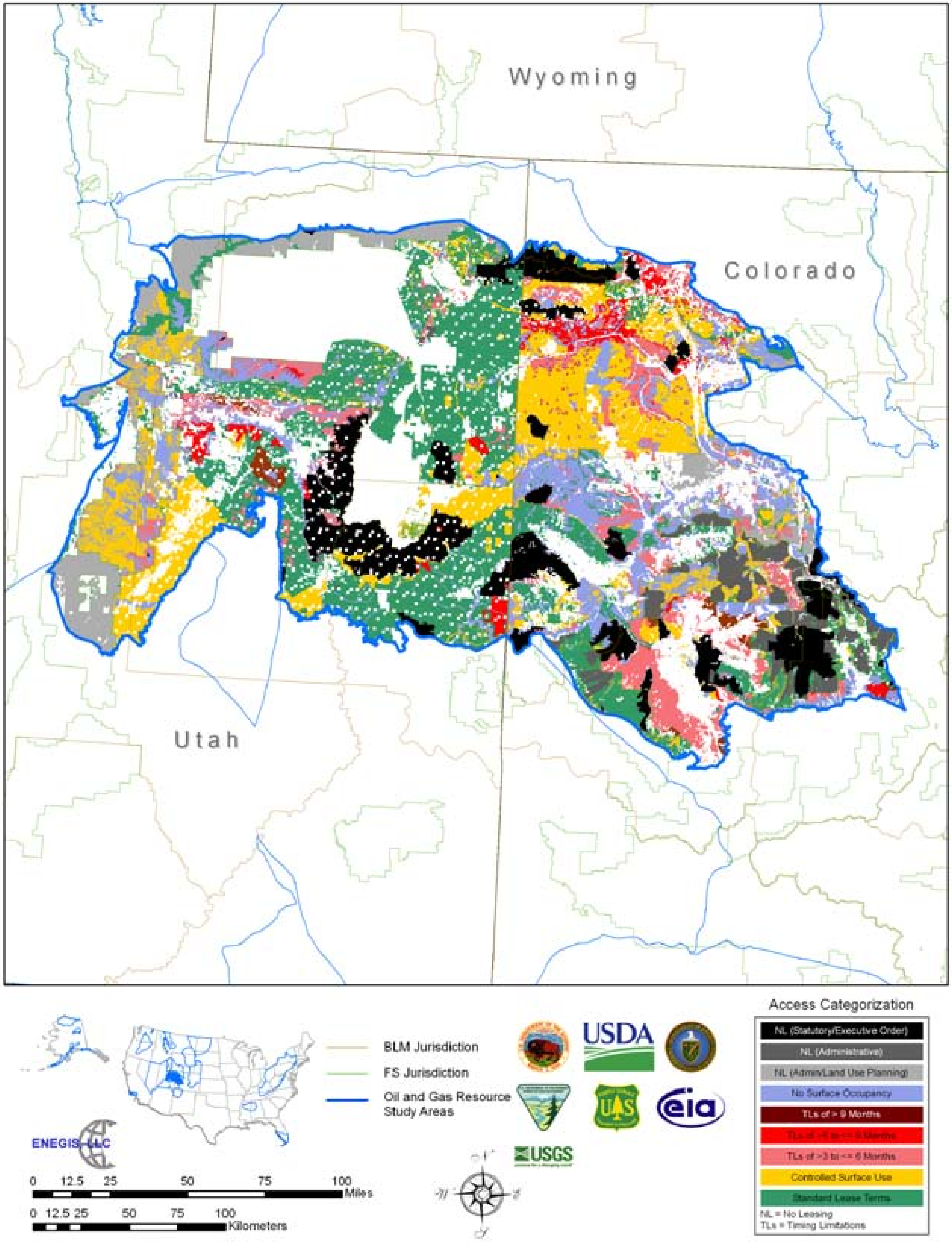

Figure 3-35. Federal Land Access Categorization Map, Uinta-Piceance Basin Study Area

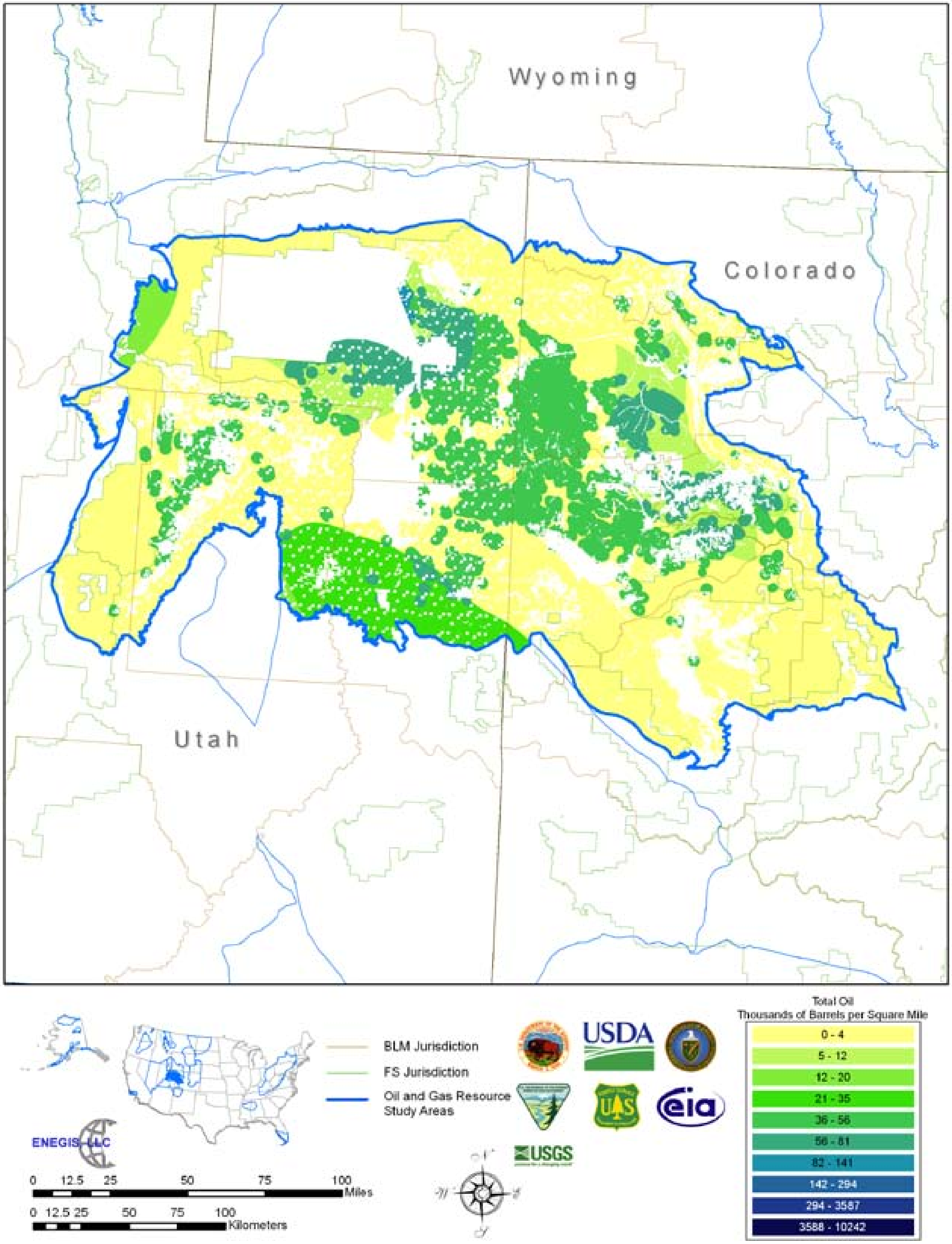

Figure 3-36. Map of Total Federal Oil, Uinta-Piceance Basin Study Area

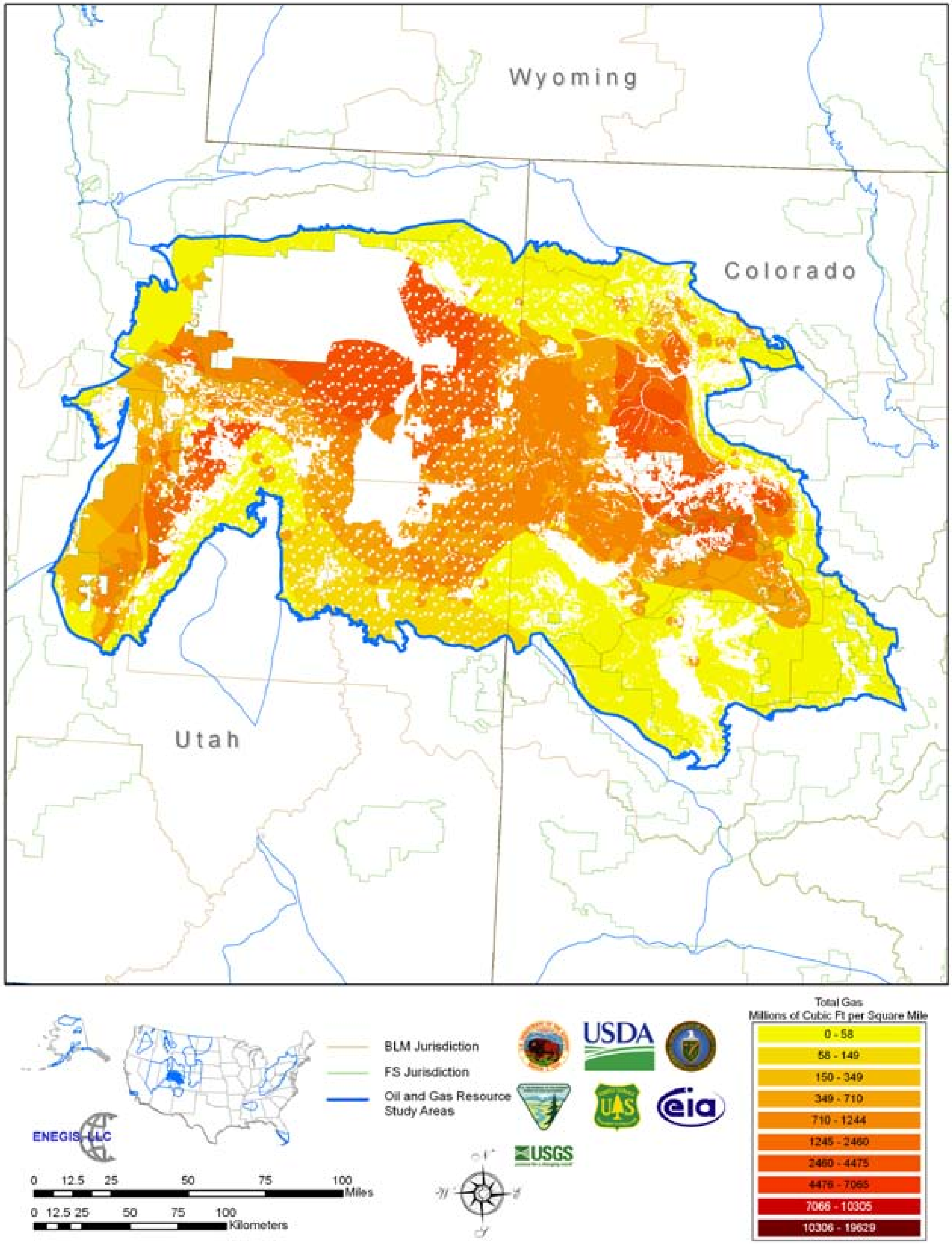

Figure 3-37. Map of Total Federal Natural Gas, Uinta-Piceance Basin Study Area

Table 3-9. Paradox Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

Access Category			Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained ↑	1.	No Leasing (Statutory/ Executive Order) (NLS)	5,194	35.5%	82	26.2%	198	18.8%
	2.	No Leasing (Administrative) (NLA)	196	1.3%	7	2.3%	21	2.0%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	2,851	19.5%	45	14.5%	153	14.6%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	457	3.1%	9	2.9%	26	2.5%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	28	0.2%	4	1.4%	20	1.9%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	776	5.3%	39	12.6%	173	16.5%
	8.	Leasing, Controlled Surface Use (CSU)[d]	1,235	8.5%	52	16.7%	185	17.6%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	3,878	26.5%	73	23.4%	273	26.1%
Total, Federal Lands including Split Estate			**14,616**	100.0%	**312**	100.0%	**1,048**	100.0%
Total Non-Federal			**4,897**		**138**		**515**	
Total Inventory Area			**19,513**		**450**		**1,563**	

Summary						
Inaccessible (Categories 1-4)	8,698	60%	143	46%	398	38%
Accessible with Restrictions (Categories 5-8)	2,040	14%	96	31%	377	36%
Accessible under Standard Lease Terms (Category 9)	3,878	27%	73	23%	273	26%
Total, Federal Lands Including Split Estate	**14,616**	**100%**	**312**	**100%**	**1,048**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

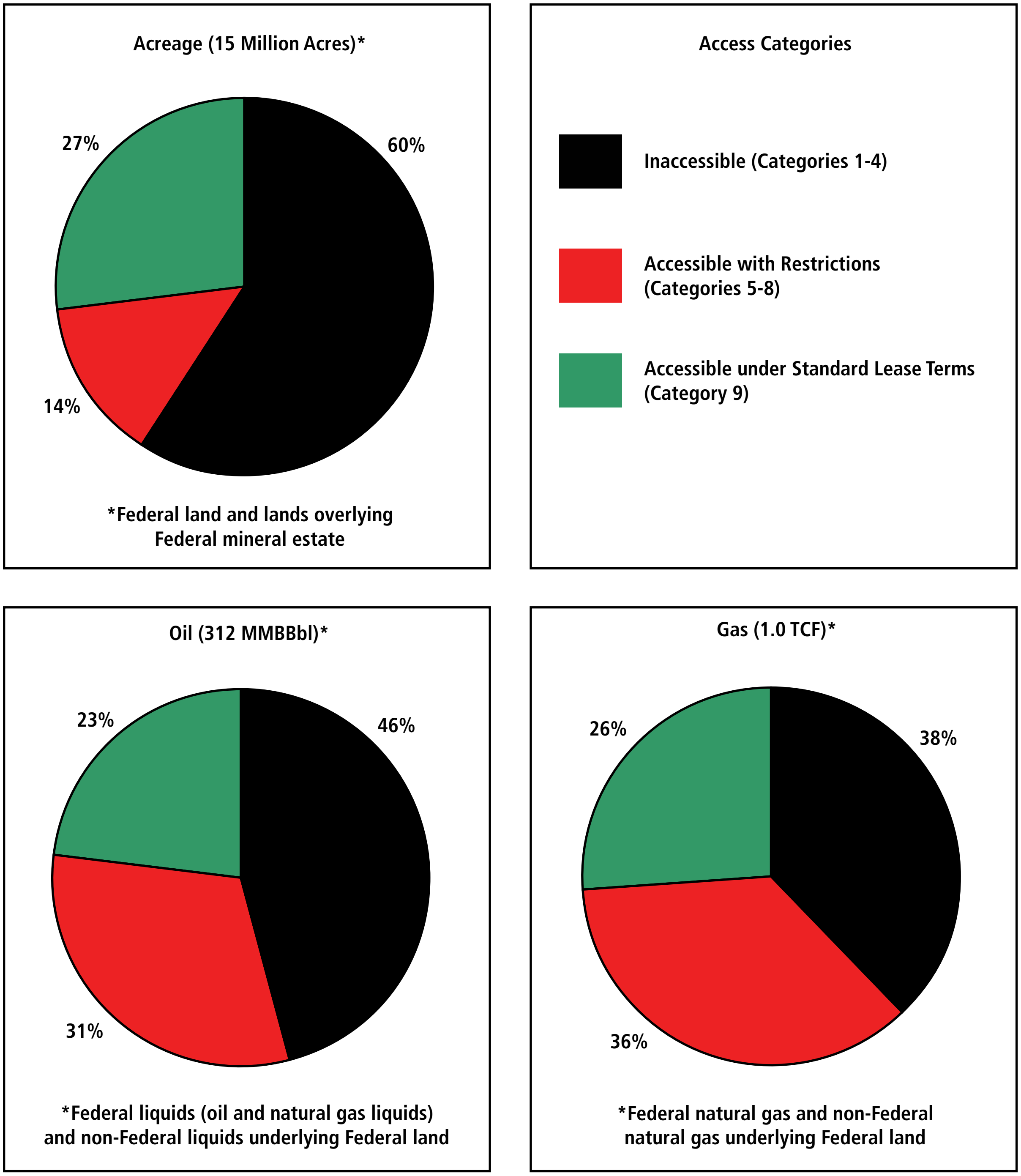

Figure 3-38. Simplified Chart of Results, Paradox Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

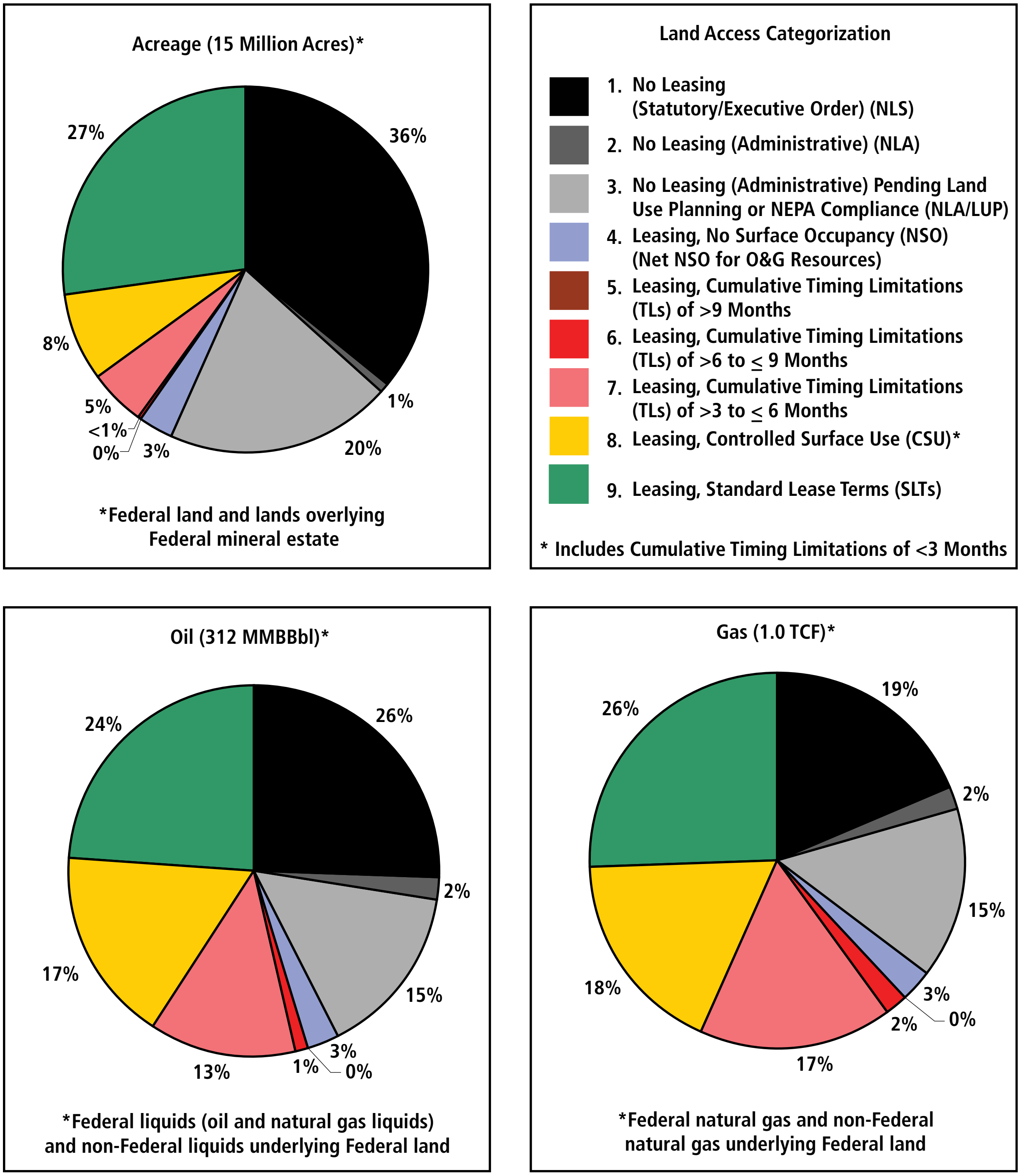

Figure 3-39. Chart of Results, Paradox Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

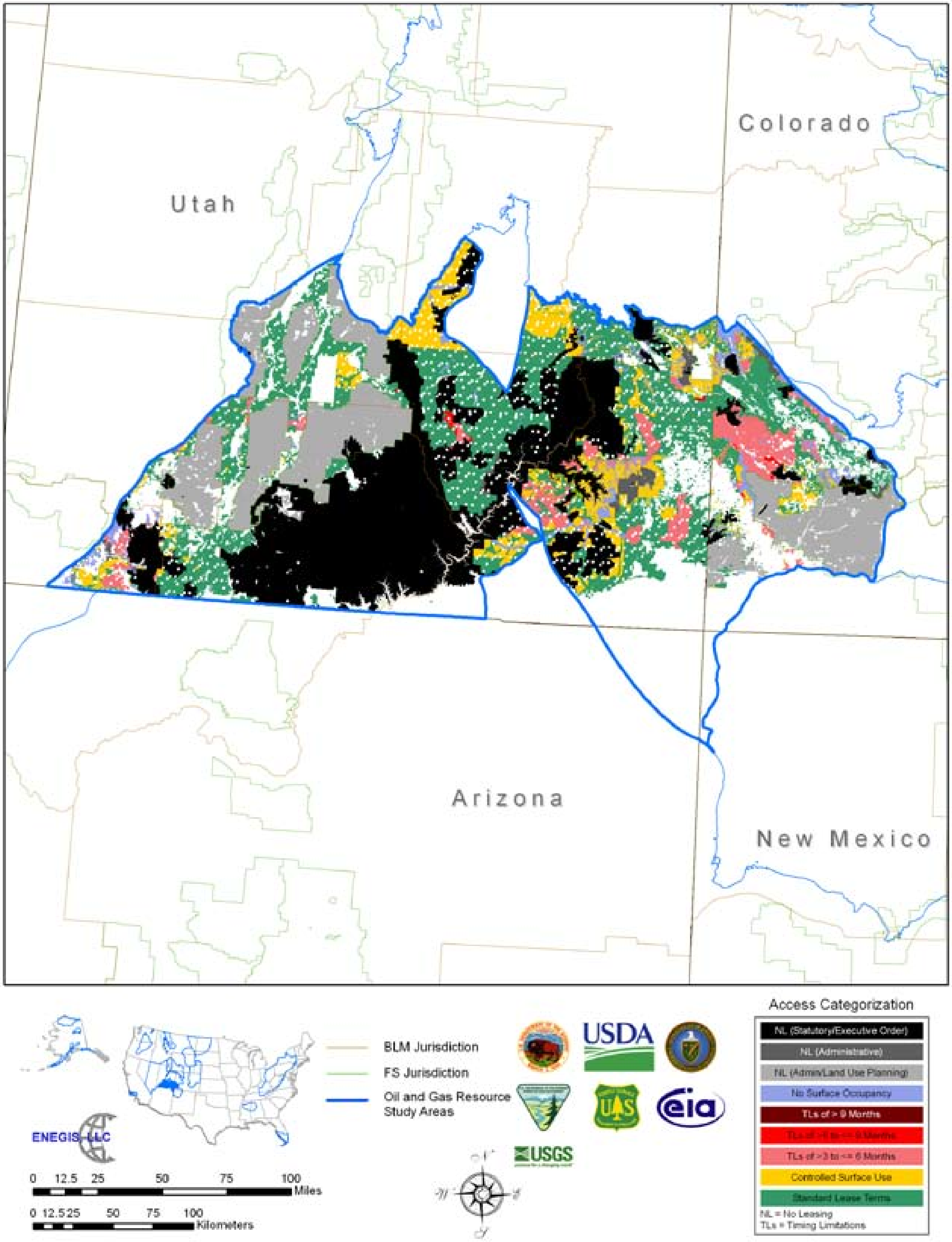

Figure 3-40. Federal Land Access Categorization Map, Paradox Basin Study Area

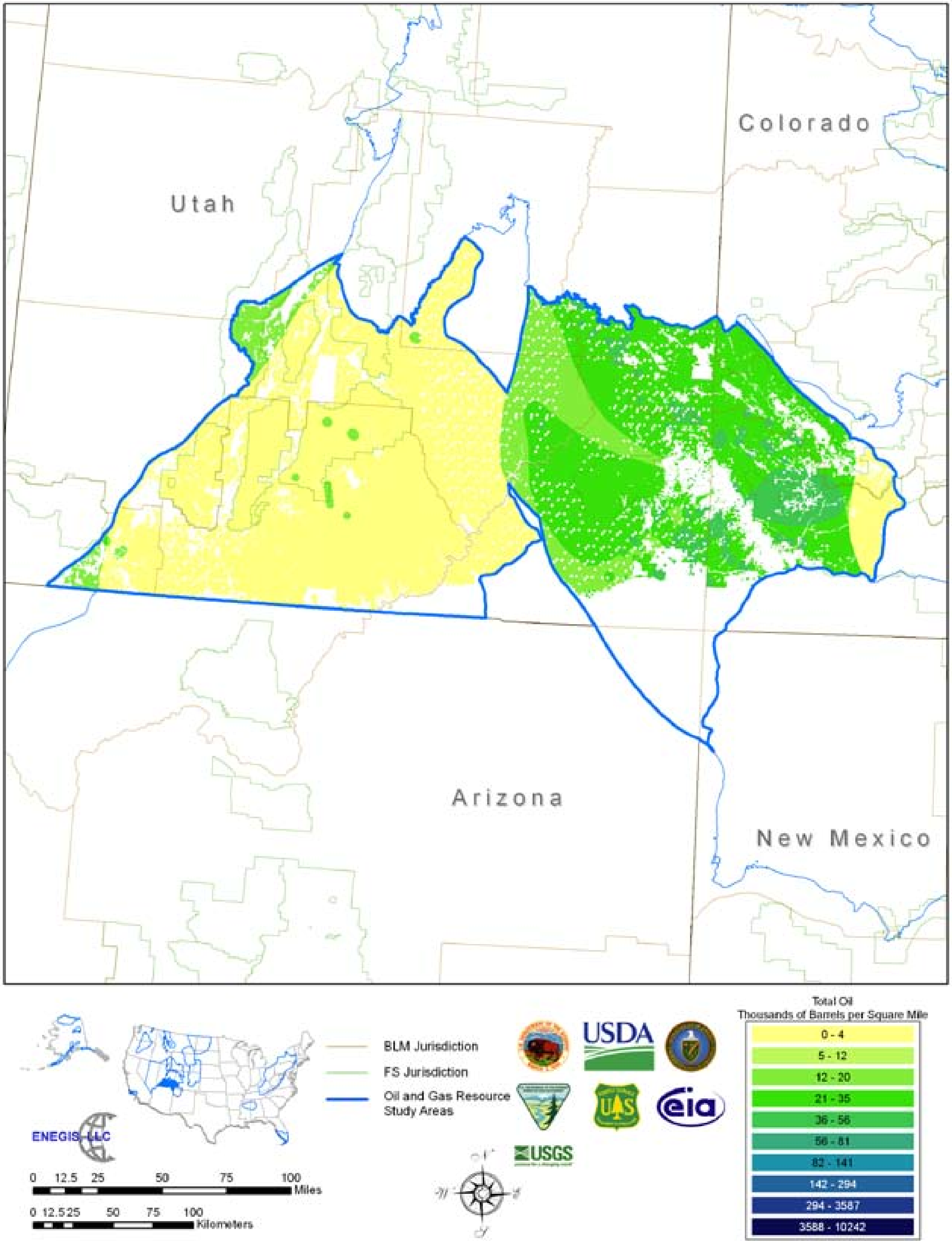

Figure 3-41. Map of Total Federal Oil, Paradox Basin Study Area

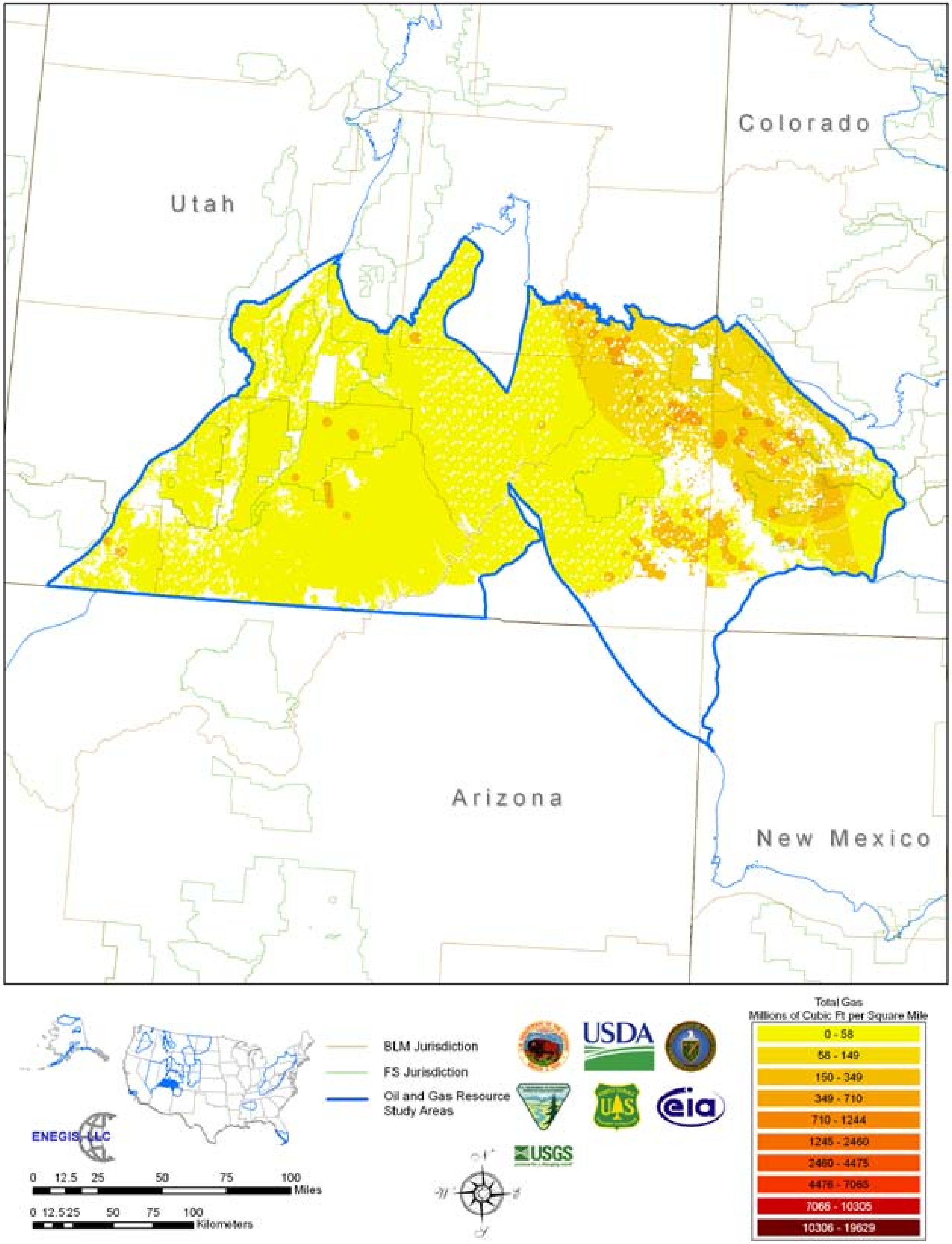

Figure 3-42. Map of Total Federal Natural Gas, Paradox Basin Study Area

Table 3-10. San Juan Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

		Access Category	Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	213	7.5%	6	3.8%	425	1.7%
	2.	No Leasing (Administrative) (NLA)	60	2.1%	4	2.4%	488	1.9%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	325	11.4%	9	5.8%	1,630	6.5%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	88	3.1%	4	2.7%	656	2.6%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	11	0.4%	1	0.9%	202	0.8%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	269	9.4%	31	20.8%	5,844	23.3%
	8.	Leasing, Controlled Surface Use (CSU)[d]	385	13.5%	59	39.0%	9,221	36.7%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	1,509	52.8%	37	24.6%	6,634	26.4%
Total, Federal Lands including Split Estate			**2,860**	100.0%	**151**	100.0%	**25,100**	100.0%
Total Non-Federal			**6,152**		**214**		**27,501**	
Total Inventory Area			**9,012**		**365**		**52,601**	

Summary						
Inaccessible (Categories 1-4)	686	24%	22	15%	3,199	13%
Accessible with Restrictions (Categories 5-8)	664	23%	91	61%	15,267	61%
Accessible under Standard Lease Terms (Category 9)	1,509	53%	37	25%	6,634	26%
Total, Federal Lands Including Split Estate	**2,860**	**100%**	**151**	**100%**	**25,100**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

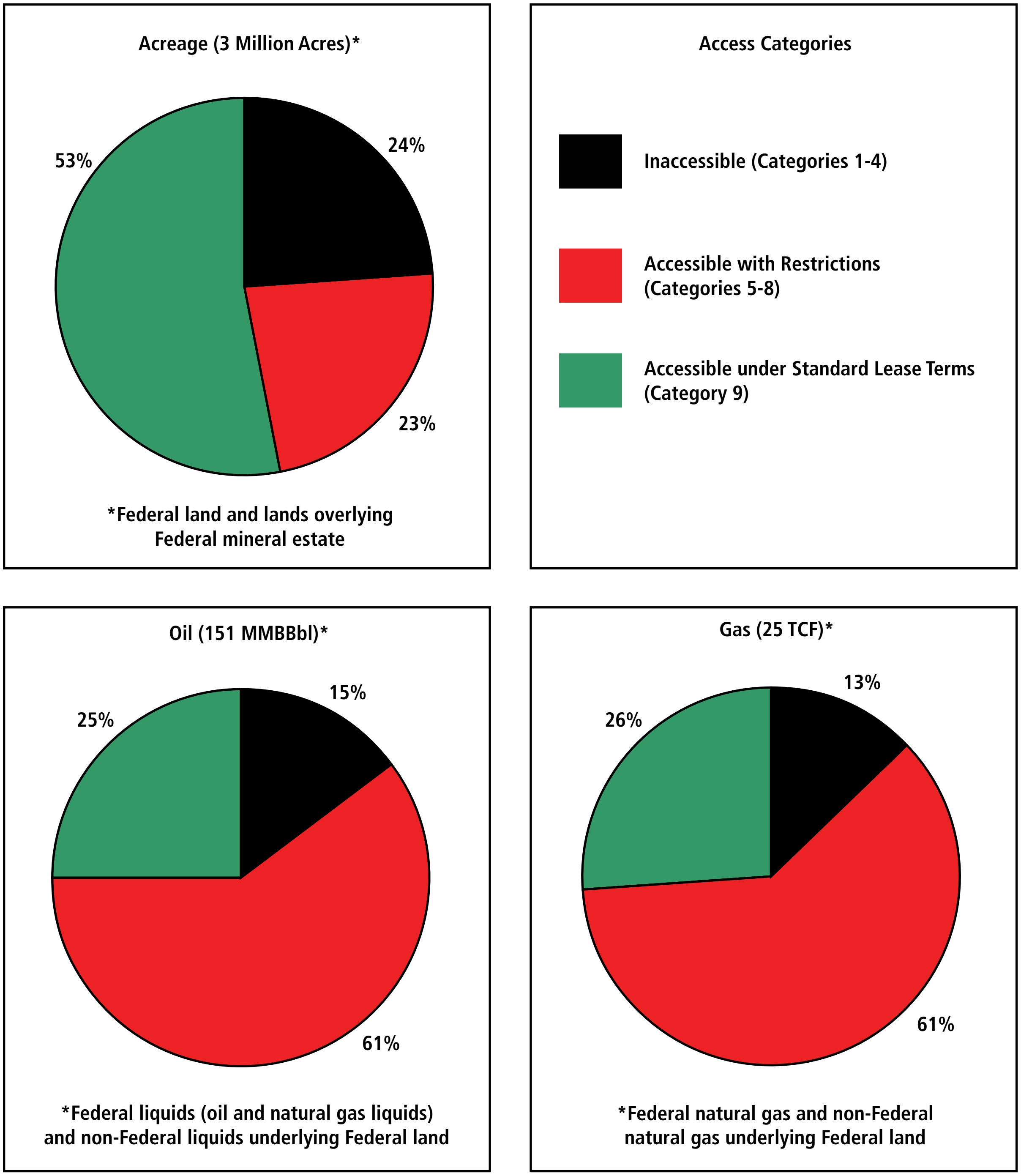

Figure 3-43. Simplified Chart of Results, San Juan Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

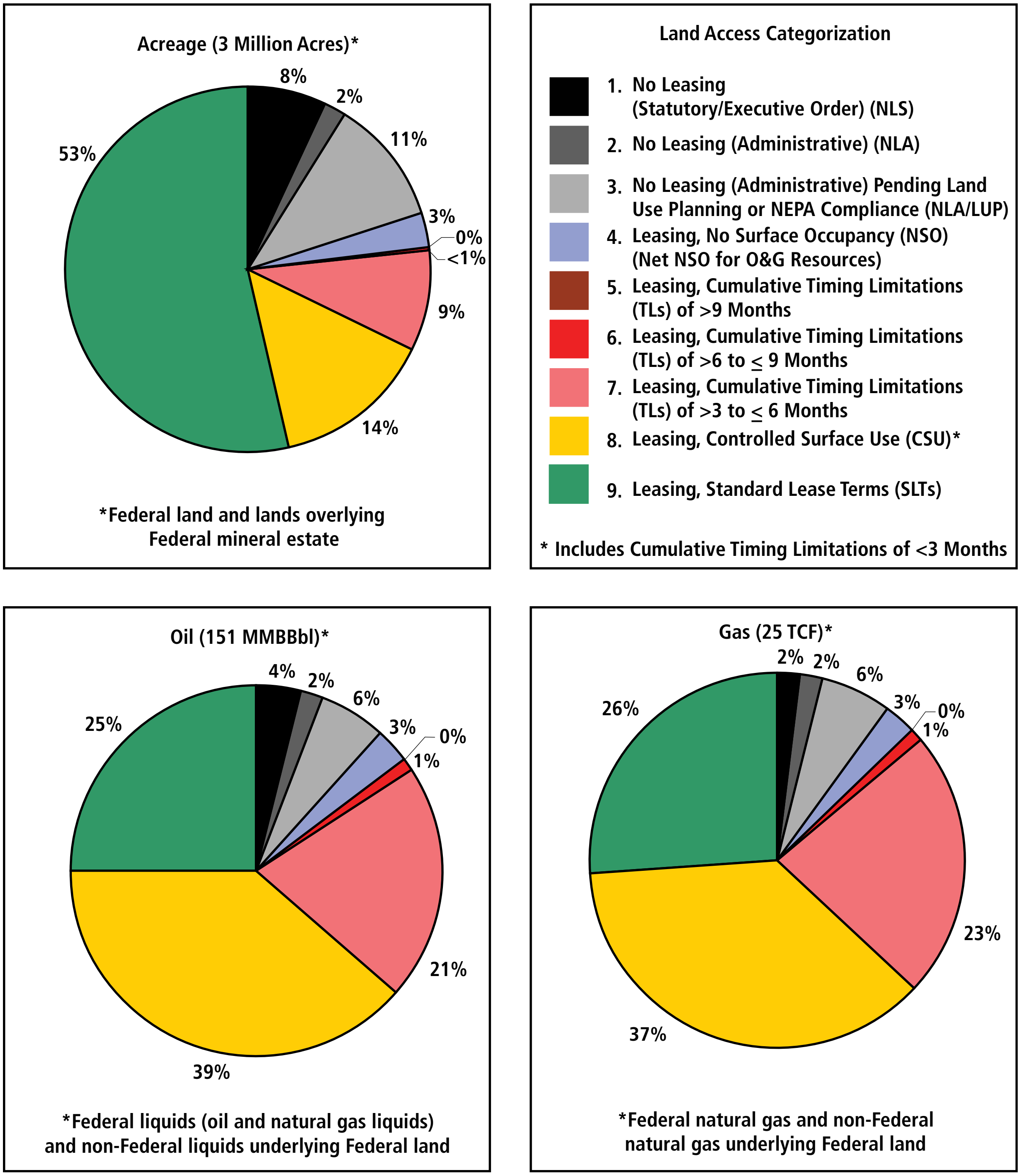

Figure 3-44. Chart of Results, San Juan Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

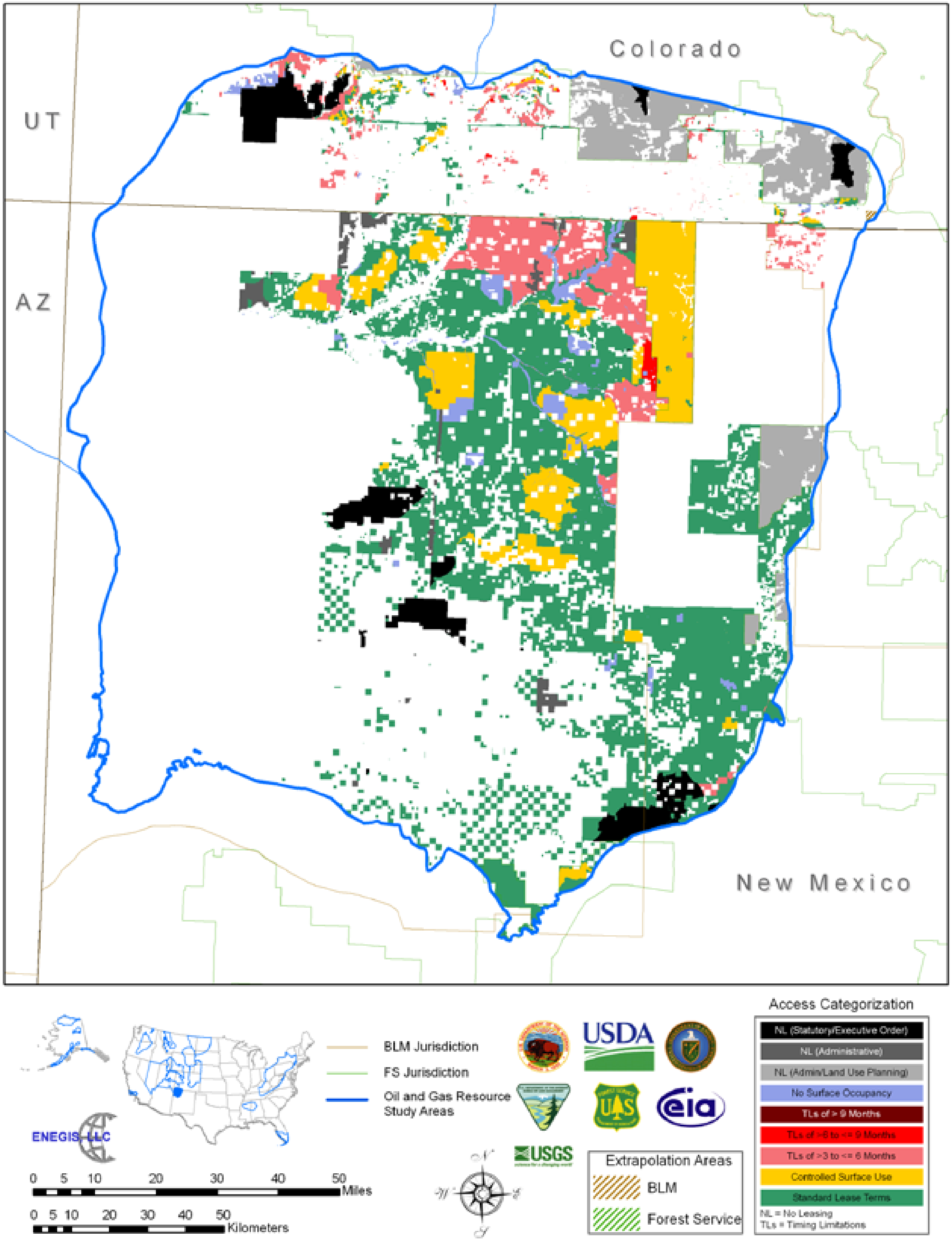

Figure 3-45. Federal Land Access Categorization Map, San Juan Basin Study Area

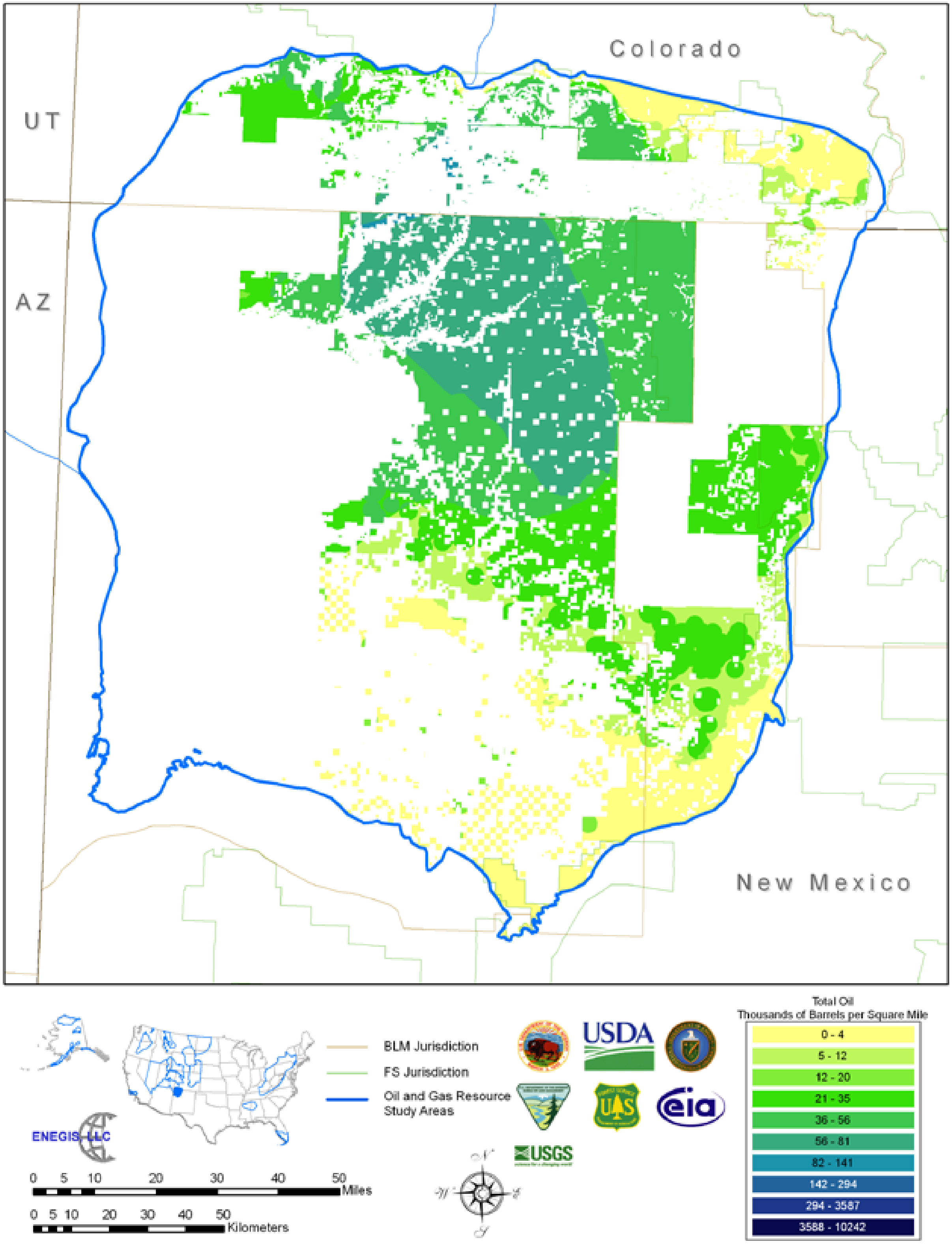

Figure 3-46. Map of Total Federal Oil, San Juan Basin Study Area

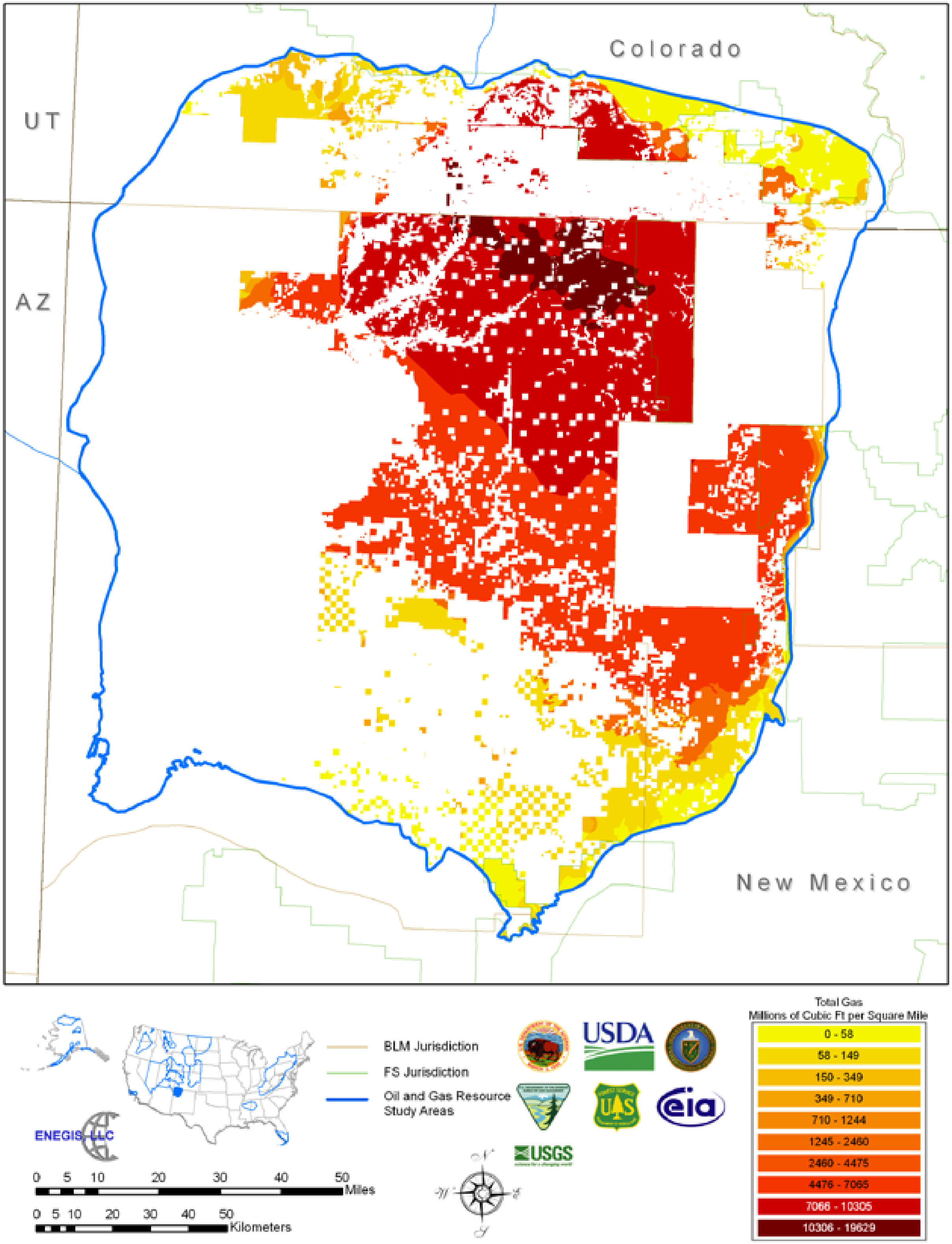

Figure 3-47. Map of Total Federal Natural Gas, San Juan Basin Study Area

- Approximately 3 percent (152.1 thousand acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-48 and 3-49, Categories 5 through 8). Based on resource estimates, these lands contain 3 percent (4.3 MMbbls) of the Federal oil and 1 percent (43.0 BCF) of the Federal natural gas.
- Approximately 1 percent (75.6 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-48 and 3-49, Category 9). Based on resource estimates, these lands contain 1 percent (0.9 MMbbls) of the Federal oil and less than 1 percent (22.2 BCF) of the Federal natural gas.
- The USDA-Forest Service is the primary land management agency in the Montana Thrust Belt, with 71 percent of the Federal lands. Almost half of the land that is currently not being leased is undergoing new land use planning.

3.1.11 Williston Basin

- Approximately 26 percent (1.4 million acres) of the Federal land is not accessible (Figures 3-53 and 3-54, Categories 1 through 4). Based on resource estimates, these lands contain 34 percent (124.1 MMbbls) of the Federal oil and 34 percent (212.7 BCF) of the Federal natural gas.
- Approximately 41 percent (2.1 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-53 and 3-54, Categories 5 through 8). Based on resource estimates, these lands contain 38 percent (140.6 MMbbls) of the Federal oil and 27 percent (165.0 BCF) of the Federal natural gas.
- Approximately 32 percent (1.7 million acres) of the Federal land is accessible under standard lease terms (Figures 3-53 and 3-54, Category 9). Based on resource estimates, these lands contain 28 percent (102.3 MMbbls) of the Federal oil and 27 percent (165.3 BCF) of the Federal natural gas.
- The majority of the natural gas is continuous-type resource, and the basin contains an active continuous-type oil play.

3.1.12 Powder River Basin

- Approximately 26 percent (3.1 million acres) of the Federal land is not accessible (Figures 3-58 and 3-59, Categories 1 through 4). Based on resource estimates, these lands contain 4 percent (51 MMbbls) of the Federal oil and 10 percent (874 BCF) of the Federal natural gas.
- Approximately 47 percent (5.7 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-58 and 3-59, Categories 5 through 8). Based on resource estimates, these lands contain 79 percent (1,022 MMbbls) of the Federal oil and 77 percent (7,035 BCF) of the Federal natural gas in the basin.
- Approximately 27 percent (3.2 million acres) of the Federal land is accessible under standard lease terms (Figures 3-58 and 3-59, Category 9). Based on resource estimates, these lands contain 17 percent (216 MMbbls) of the Federal oil and 13 percent (1,228 BCF) of the Federal natural gas.
- Almost all of the undiscovered natural gas is expected to be found in coal beds (98 percent).

Table 3-11. Montana Thrust Belt Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

		Access Category	Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained ↑	1.	No Leasing (Statutory/ Executive Order) (NLS)	2,689	47.6%	94	55.0%	3,687	58.5%
	2.	No Leasing (Administrative) (NLA)	77	1.4%	2	0.9%	48	0.8%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	2,092	37.0%	58	33.9%	2,042	32.4%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	564	10.0%	12	7.1%	466	7.4%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	1	0.0%	0	0.0%	0	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	30	0.5%	1	0.7%	11	0.2%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	115	2.0%	3	1.7%	28	0.4%
	8.	Leasing, Controlled Surface Use (CSU)[d]	6	0.1%	0	0.1%	4	0.1%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	76	1.3%	1	0.5%	22	0.4%
Total, Federal Lands including Split Estate			**5,650**	100.0%	**171**	100.0%	**6,308**	100.0%
Total Non-Federal			**5,933**		**178**		**2,330**	
Total Inventory Area			**11,583**		**348**		**8,638**	

Summary						
Inaccessible (Categories 1-4)	5,423	96%	165	97%	6,243	99%
Accessible with Restrictions (Categories 5-8)	152	3%	4	3%	43	1%
Accessible under Standard Lease Terms (Category 9)	76	1%	1	1%	22	0%
Total, Federal Lands Including Split Estate	**5,650**	**100%**	**171**	**100%**	**6,308**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth *Small rounding errors may be present.*

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

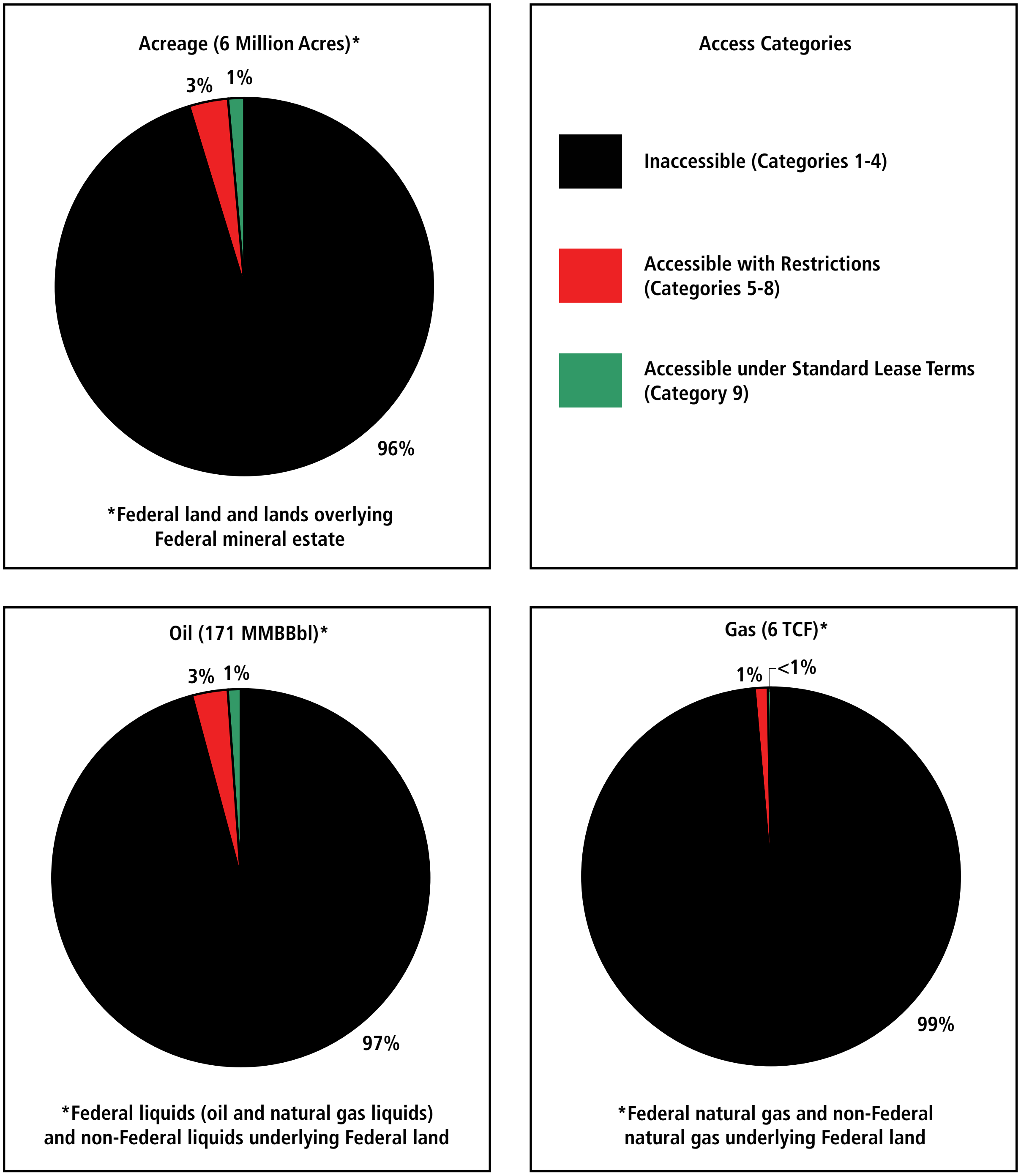

Figure 3-48. Simplified Chart of Results, Montana Thrust Belt Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

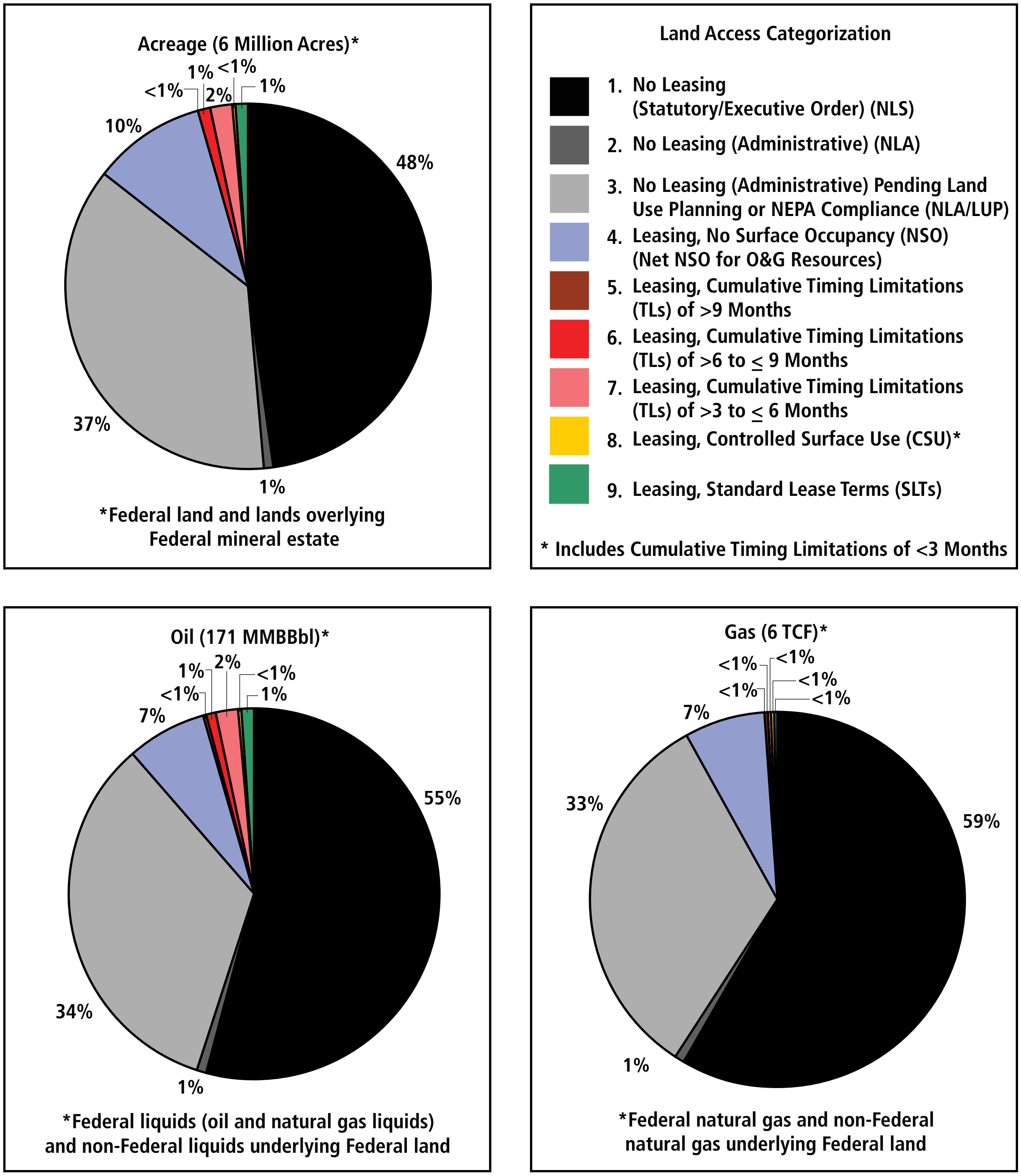

Figure 3-49. Chart of Results, Montana Thrust Belt Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

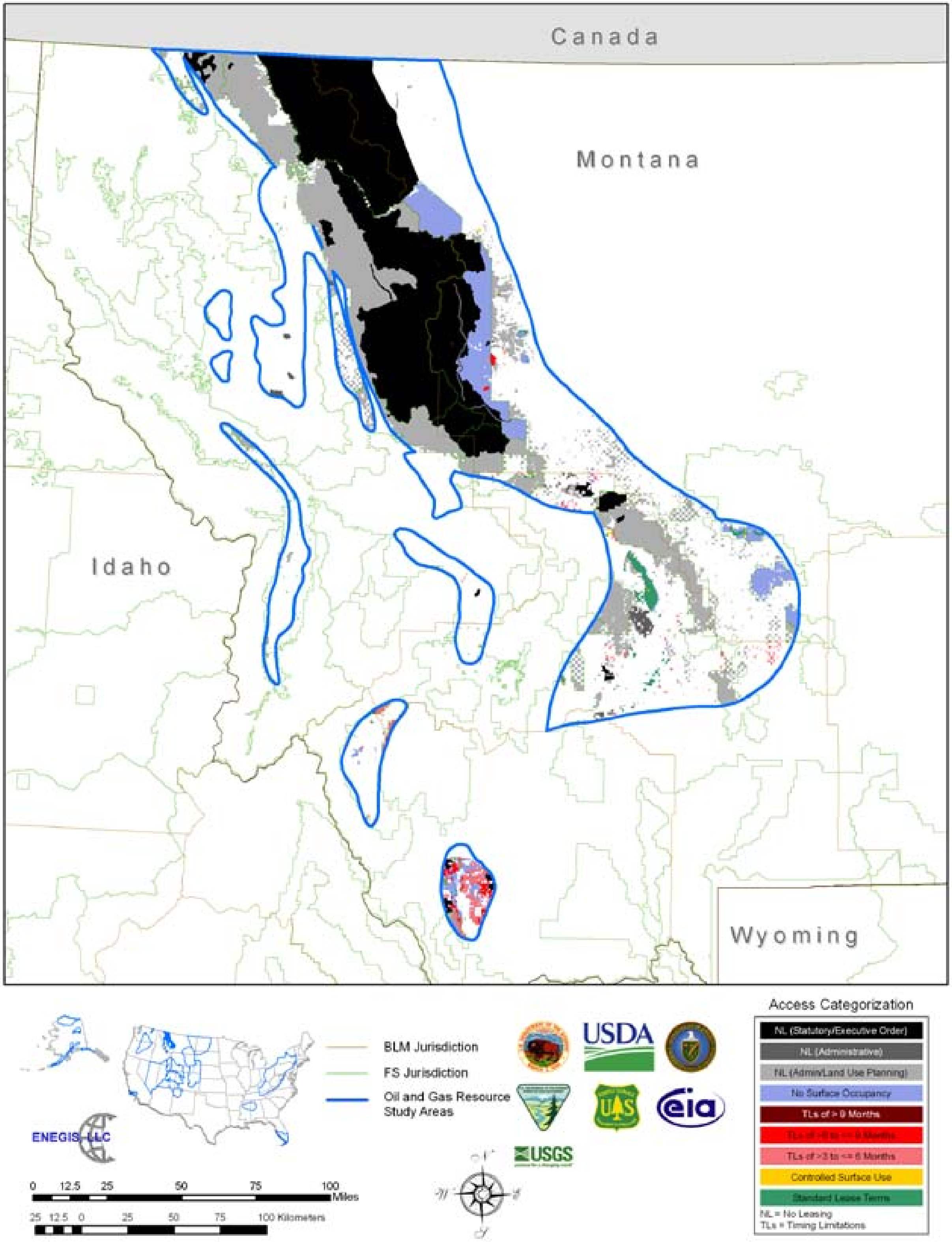

Figure 3-50. Federal Land Access Categorization Map, Montana Thrust Belt Study Area

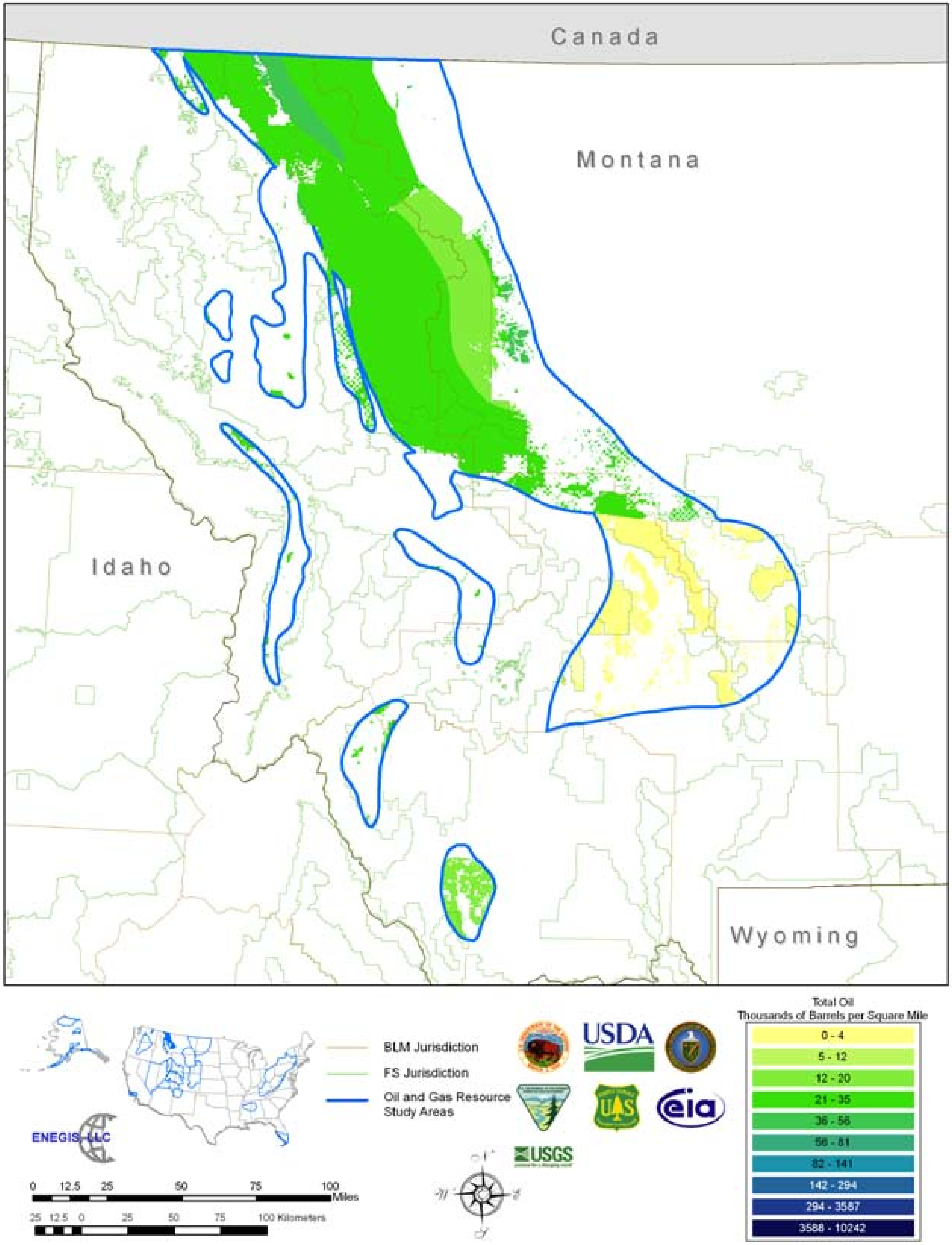

Figure 3-51. Map of Total Federal Oil, Montana Thrust Belt Study Area

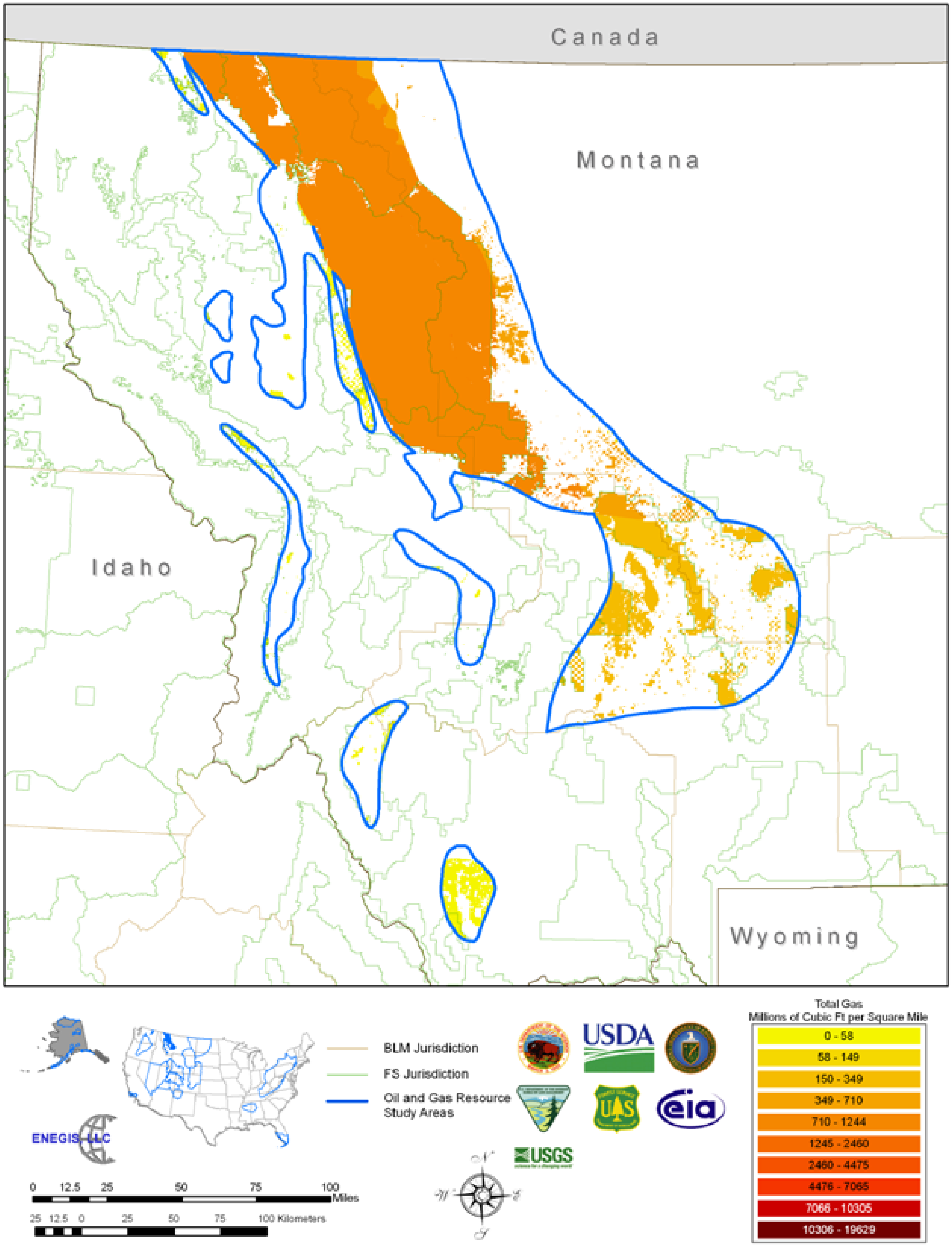

Figure 3-52. Map of Total Federal Natural Gas, Montana Thrust Belt Study Area

Table 3-12. Williston Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

Access Category			Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	94	1.8%	3	0.9%	6	0.9%
	2.	No Leasing (Administrative) (NLA)	105	2.0%	4	1.1%	7	1.2%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	611	11.8%	26	7.2%	48	7.8%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	550	10.6%	90	24.5%	151	24.5%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	74	1.4%	8	2.3%	15	2.4%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	783	15.1%	41	11.2%	68	10.9%
	8.	Leasing, Controlled Surface Use (CSU)[d]	1,288	24.8%	91	24.8%	158	25.5%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	1,679	32.4%	102	27.9%	165	26.8%
Total, Federal Lands including Split Estate			**5,183**	100.0%	**367**	100.0%	**618**	100.0%
Total Non-Federal			**39,516**		**1,858**		**3,394**	
Total Inventory Area			**44,699**		**2,225**		**4,012**	

Summary						
Inaccessible (Categories 1-4)	1,360	26%	124	34%	213	34%
Accessible with Restrictions (Categories 5-8)	2,144	41%	141	38%	240	39%
Accessible under Standard Lease Terms (Category 9)	1,679	32%	102	28%	165	27%
Total, Federal Lands Including Split Estate	**5,183**	**100%**	**367**	**100%**	**618**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

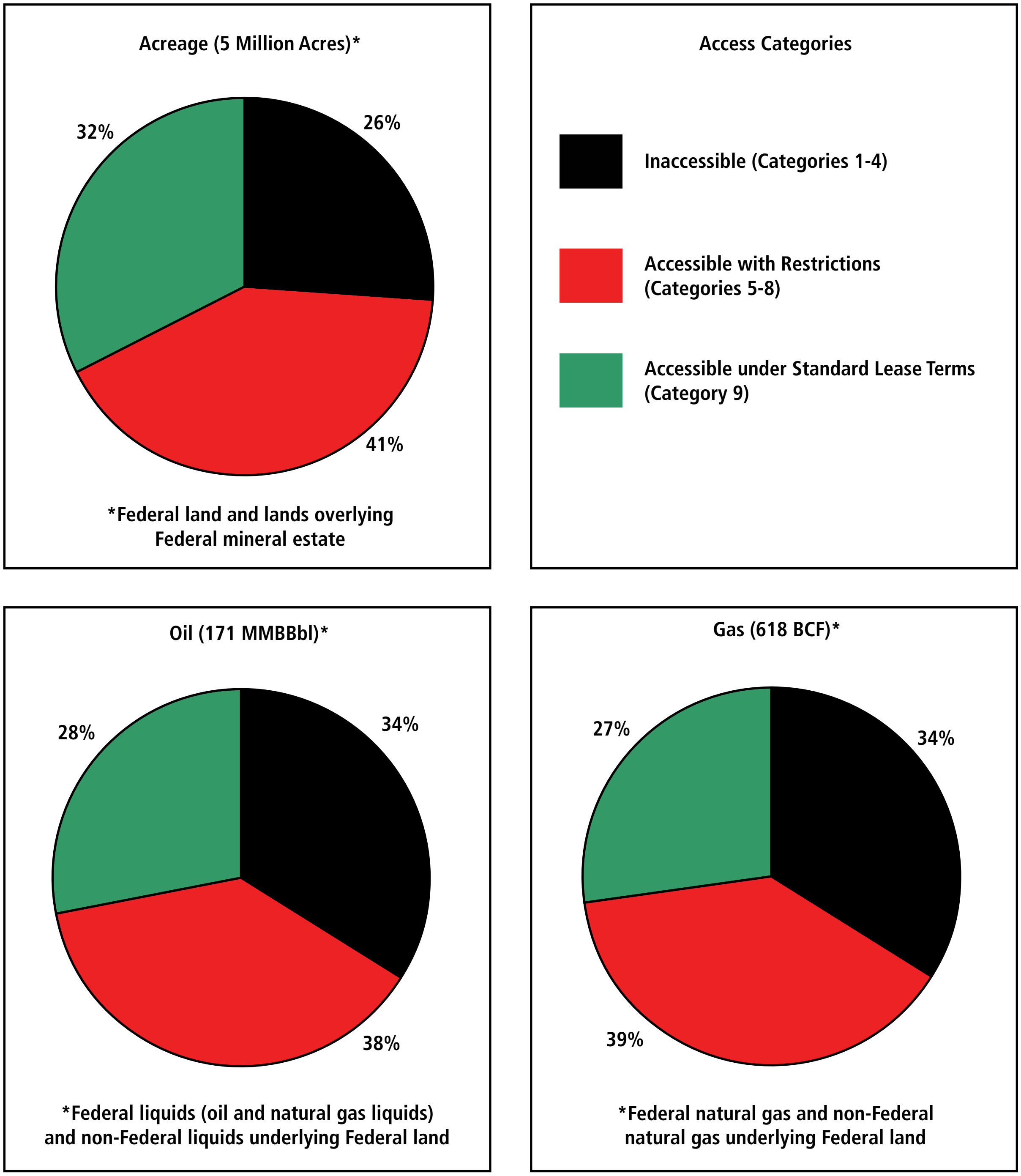

Figure 3-53. Simplified Chart of Results, Williston Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

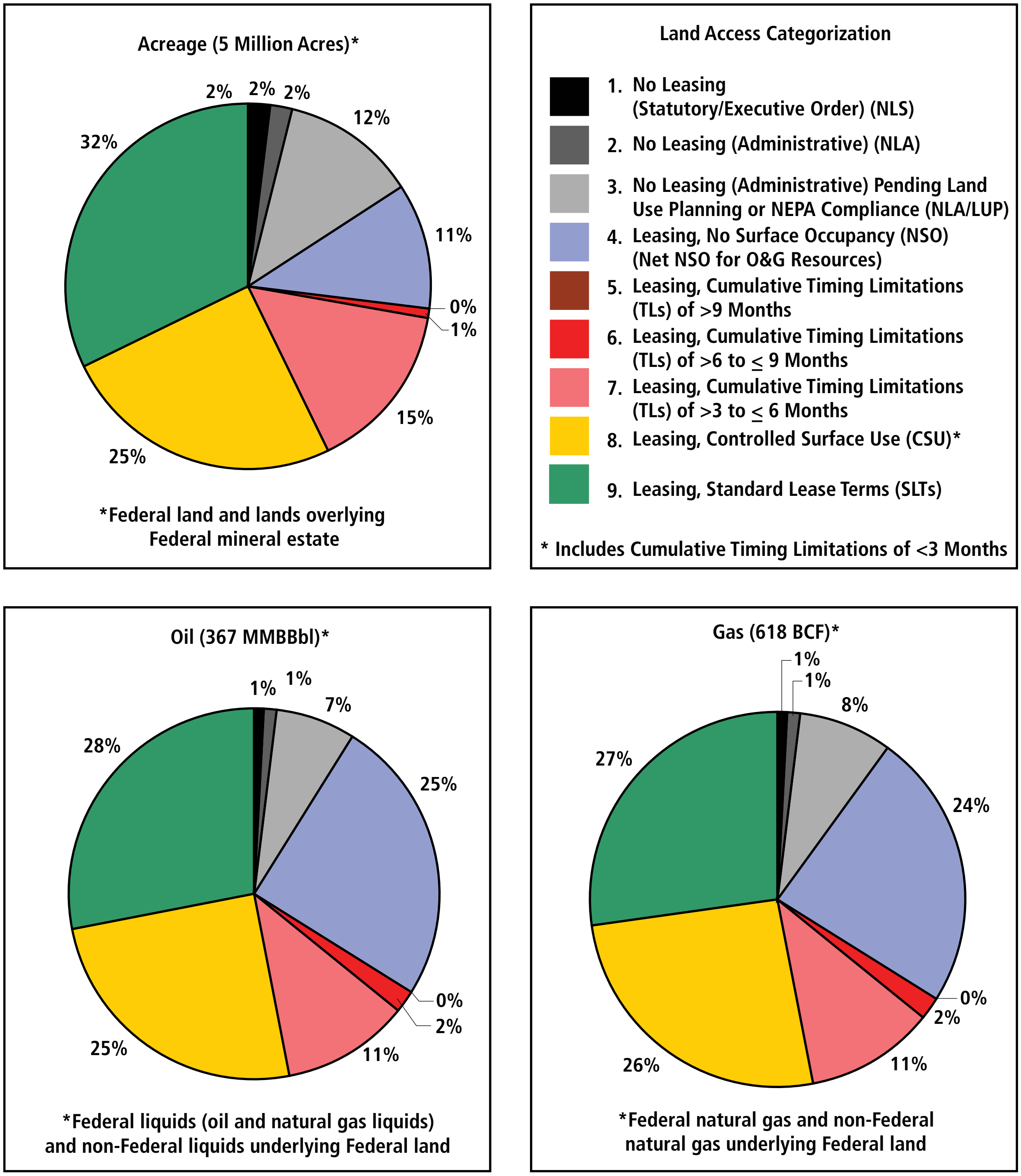

Figure 3-54. Chart of Results, Williston Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

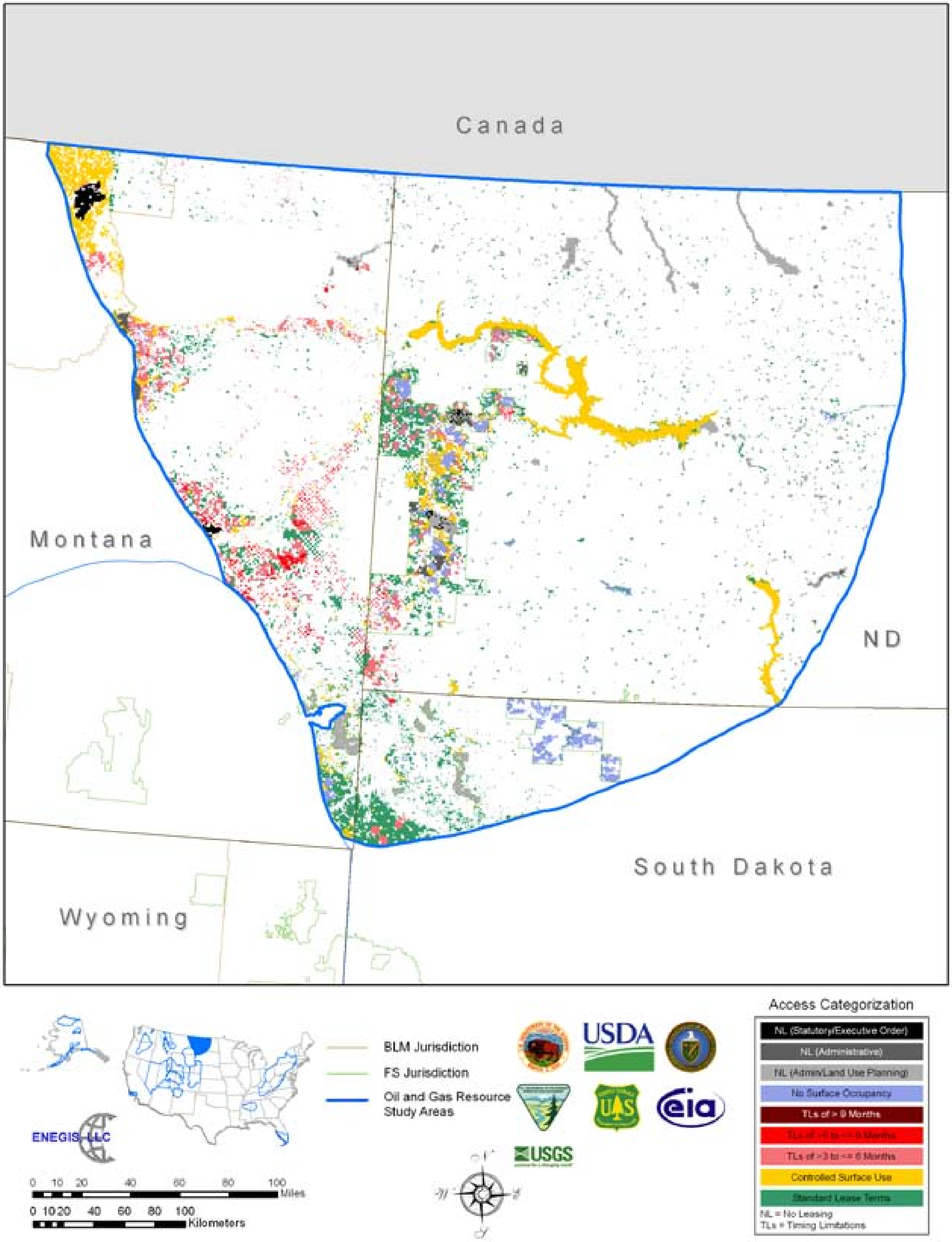

Figure 3-55. Federal Land Access Categorization Map, Williston Basin Study Area

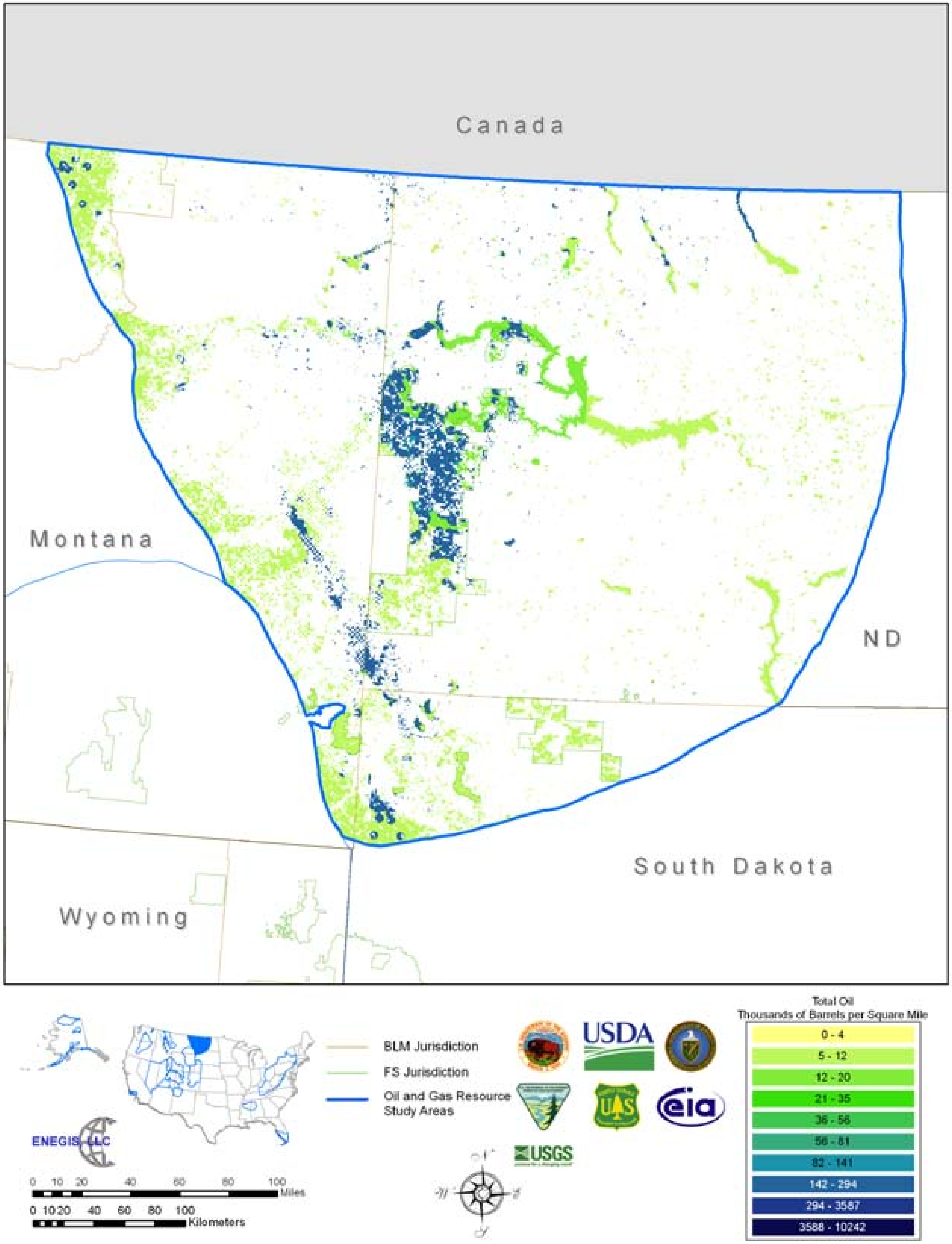

Figure 3-56. Map of Total Federal Oil, Williston Basin Study Area

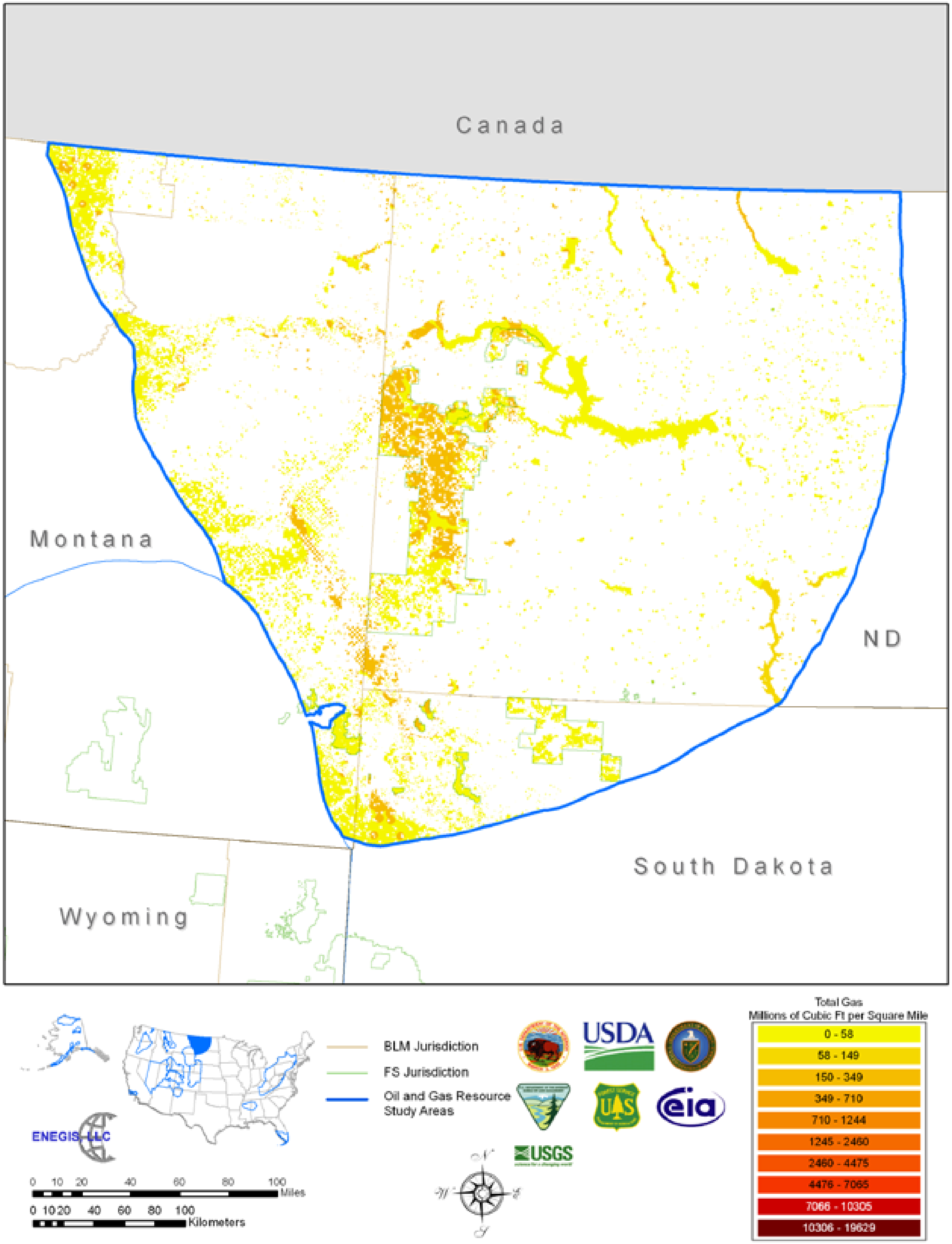

Figure 3-57. Map of Total Federal Natural Gas, Williston Basin Study Area

- Among the study areas, this area has the highest proportion of split estate lands (59 percent of the Federal oil and gas ownership is on split-estate lands).

3.1.13 Wyoming Thrust Belt

- Approximately 57 percent (2.4 million acres) of the Federal land is not accessible (Figures 3-63 and 3-64, Categories 1 through 4). Based on resource estimates, these lands contain 33 percent (14.7 MMbbls) of the Federal oil and 31 percent (87.5 BCF) of the Federal natural gas.
- Approximately 30 percent (1.3 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-63 and 3-64, Categories 5 through 8). Based on resource estimates, these lands contain 51 percent (22.7 MMbbls) of the Federal oil and 76 percent (479.7 BCF) of the Federal natural gas.
- Approximately 13 percent (553.9 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-63 and 3-64, Category 9). Based on resource estimates, these lands contain 16 percent (7.0 MMbbls) of the Federal oil and 10 percent (65.4 BCF) of the Federal natural gas.
- This study area contains only two plays; one is coalbed natural gas and the other is conventional.

3.1.14 Southwestern Wyoming

- Approximately 28 percent (3.2 million acres) of the Federal land in the basin is not accessible (Figures 3-68 and 3-69, Categories 1 through 4). Based on resource estimates, these lands contain 19 percent (393 MMbbls) of the Federal oil and 18 percent (12,311 BCF) of the Federal natural gas.
- Approximately 53 percent (6.0 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-68 and 3-69, Categories 5 through 8). Based on resource estimates, these lands contain 71 percent (1,472 MMbbls) of the Federal oil and 70 percent (47,715 BCF) of the Federal natural gas.
- Approximately 19 percent (2.2 million acres) of the Federal land is accessible under standard lease terms (Figures 3-63 and 3-64, Category 9). Based on resource estimates, these lands contain 10 percent (216.4 MMbbls) of the Federal oil and 12 percent (8,007 BCF) of the Federal natural gas.
- Almost all of the undiscovered natural gas (97 percent) is interpreted to be in continuous (unconventional) accumulations.
- The geography of the Federal land is highly complex due a checkerboard pattern of ownership resulting from railroad land grants.

3.1.15 Denver Basin

- Approximately 39 percent (1.0 million acres) of the Federal land is not accessible (Figures 3-73 and 3-74, Categories 1 through 4). Based on resource estimates, these lands contain 19 percent (3.3 MMbbls) of the Federal oil and 36 percent (31.9 BCF) of the Federal natural gas.

Table 3-13. Powder River Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

		Access Category	Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	161	1.3%	4	0.3%	59	0.6%
	2.	No Leasing (Administrative) (NLA)	132	1.1%	0	0.0%	18	0.2%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	460	3.8%	14	1.1%	588	6.4%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	2,360	19.6%	33	2.6%	209	2.3%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	0	0.0%	8	0.6%	51	0.6%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	521	4.3%	283	21.9%	2,344	25.7%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	2,942	24.4%	421	32.7%	2,933	32.1%
	8.	Leasing, Controlled Surface Use (CSU)[d]	2,247	18.7%	310	24.0%	1,707	18.7%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	3,224	26.8%	216	16.8%	1,228	13.4%
Total, Federal Lands including Split Estate			**12,047**	100.0%	**1,290**	100.0%	**9,137**	100.0%
Total Non-Federal			**15,943**		**1,091**		**10,157**	
Total Inventory Area			**27,991**		**2,380**		**19,294**	

Summary						
Inaccessible (Categories 1-4)	3,113	26%	51	4%	874	10%
Accessible with Restrictions (Categories 5-8)	5,710	47%	1,022	79%	7,035	77%
Accessible under Standard Lease Terms (Category 9)	3,224	27%	216	17%	1,228	13%
Total, Federal Lands Including Split Estate	**12,047**	**100%**	**1,290**	**100%**	**9,137**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

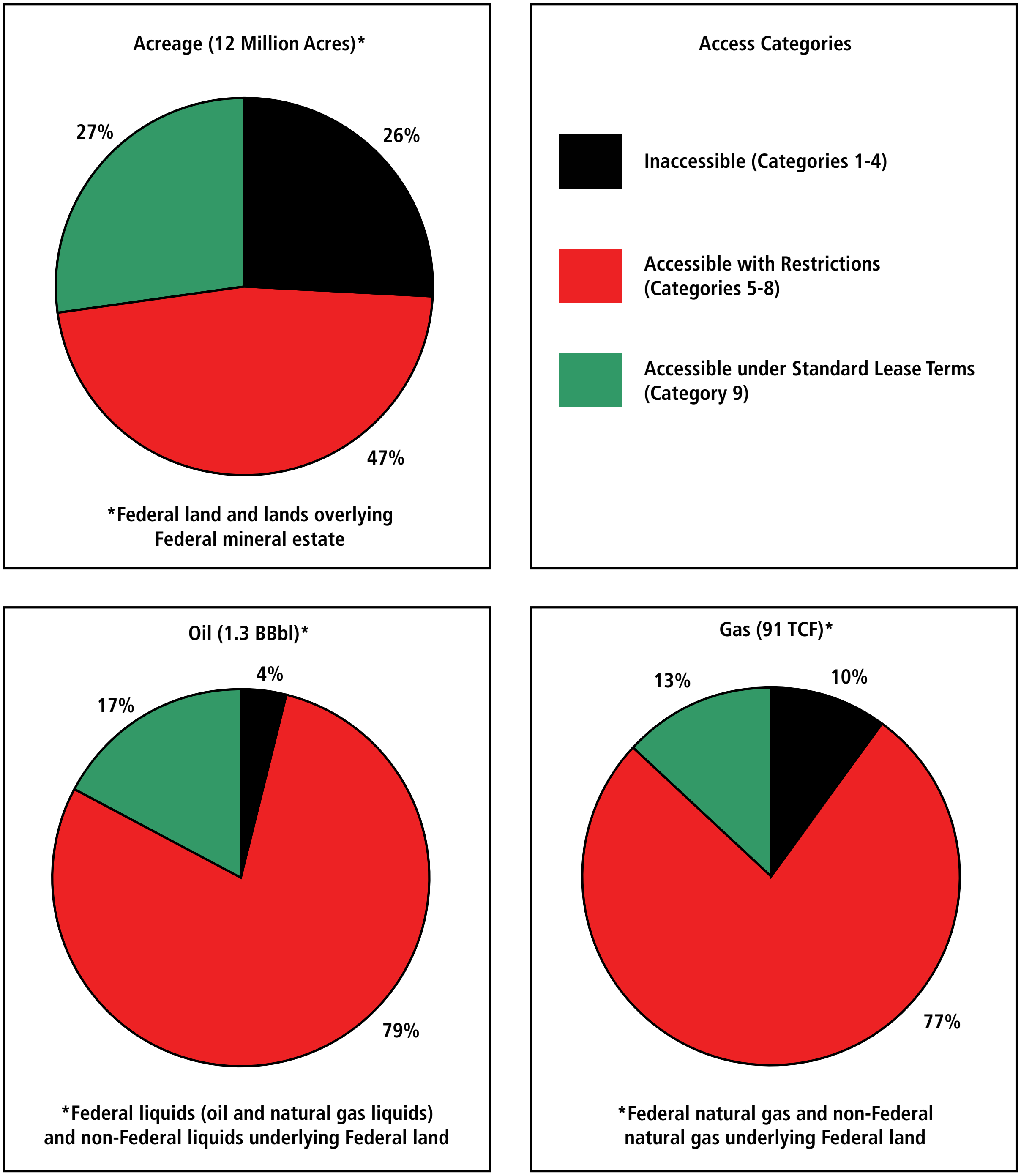

Figure 3-58. Simplified Chart of Results, Powder River Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

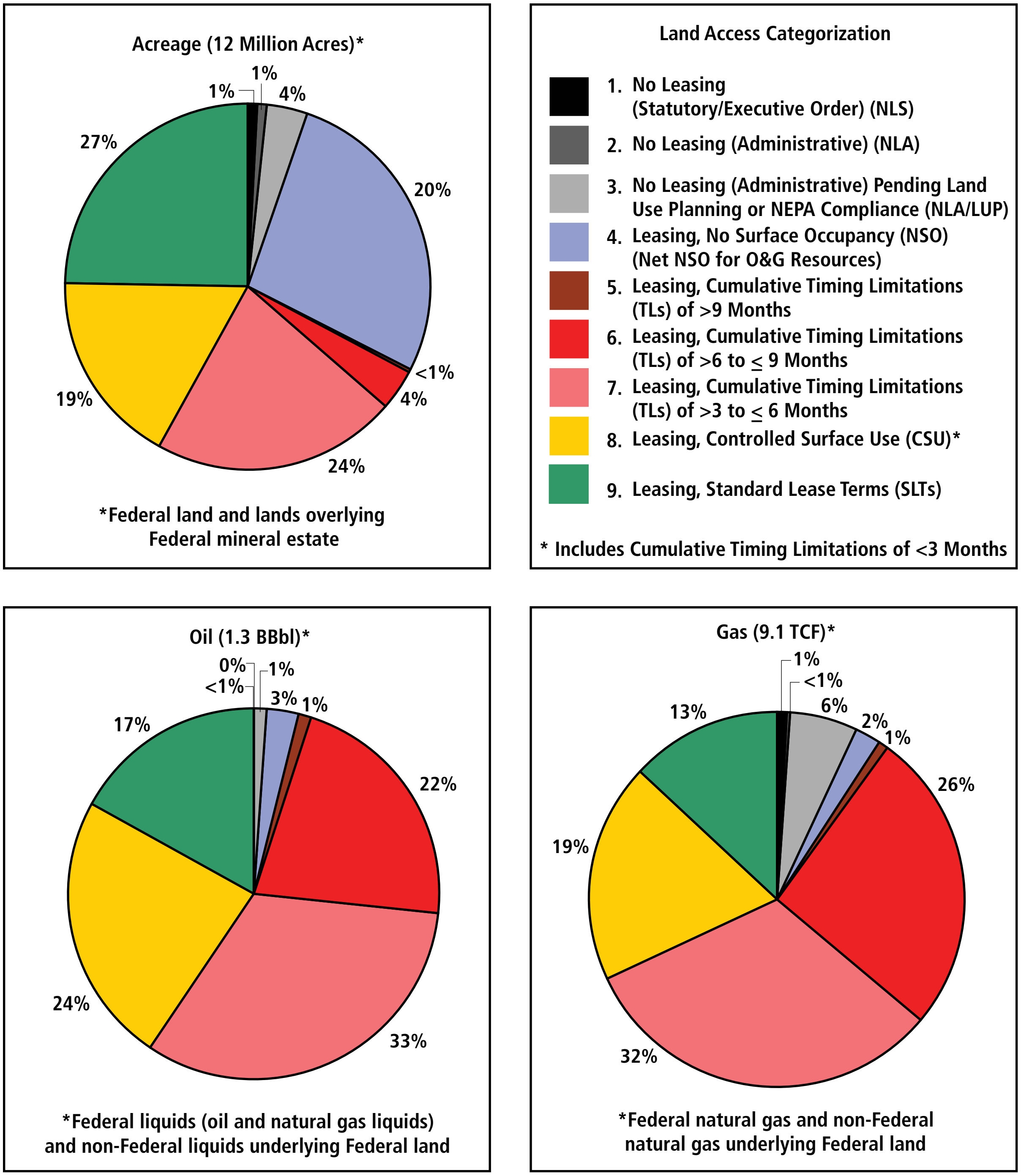

Figure 3-59. Chart of Results, Powder River Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

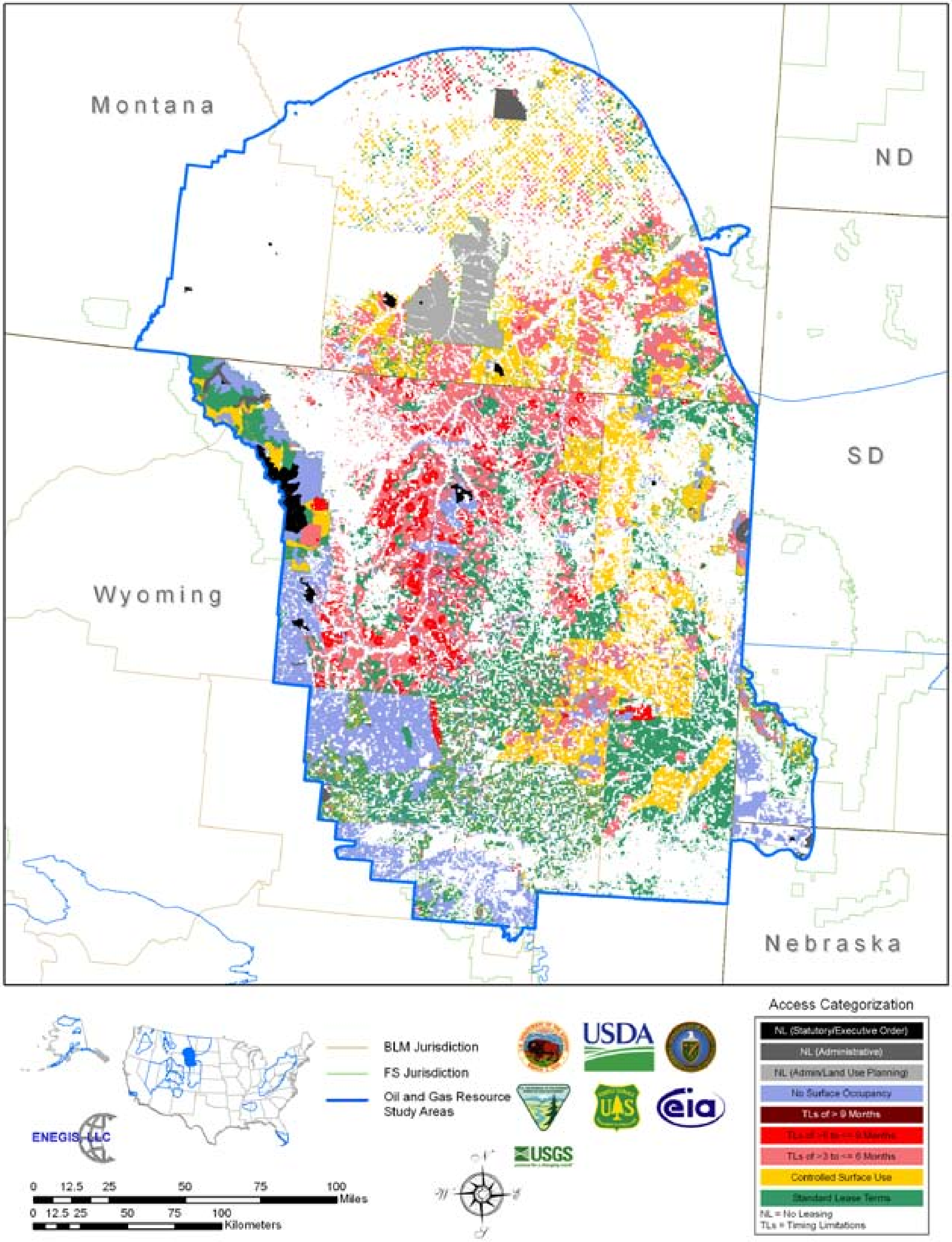

Figure 3-60. Federal Land Access Categorization Map, Powder River Basin Study Area

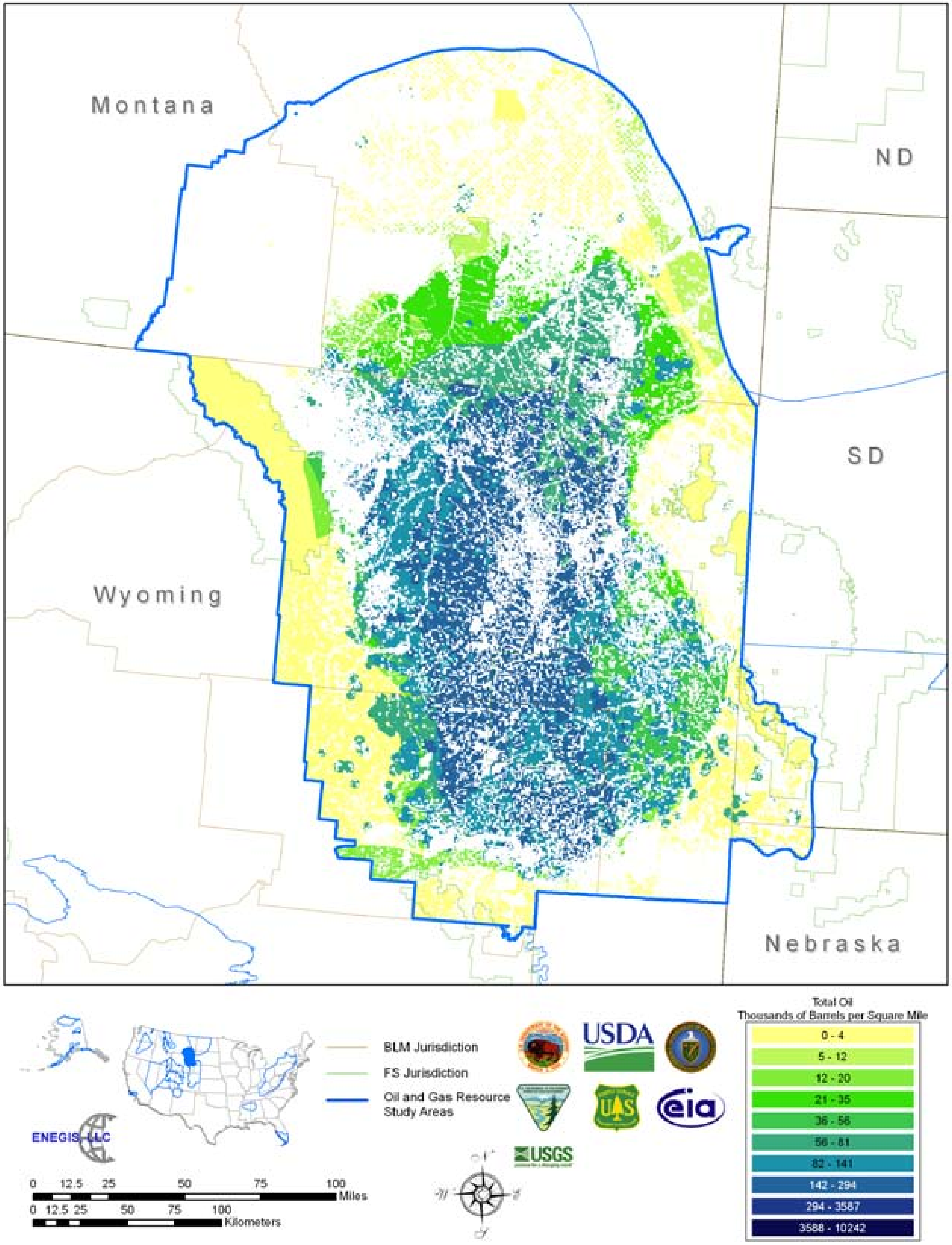

Figure 3-61. Map of Total Federal Oil, Powder River Basin Study Area

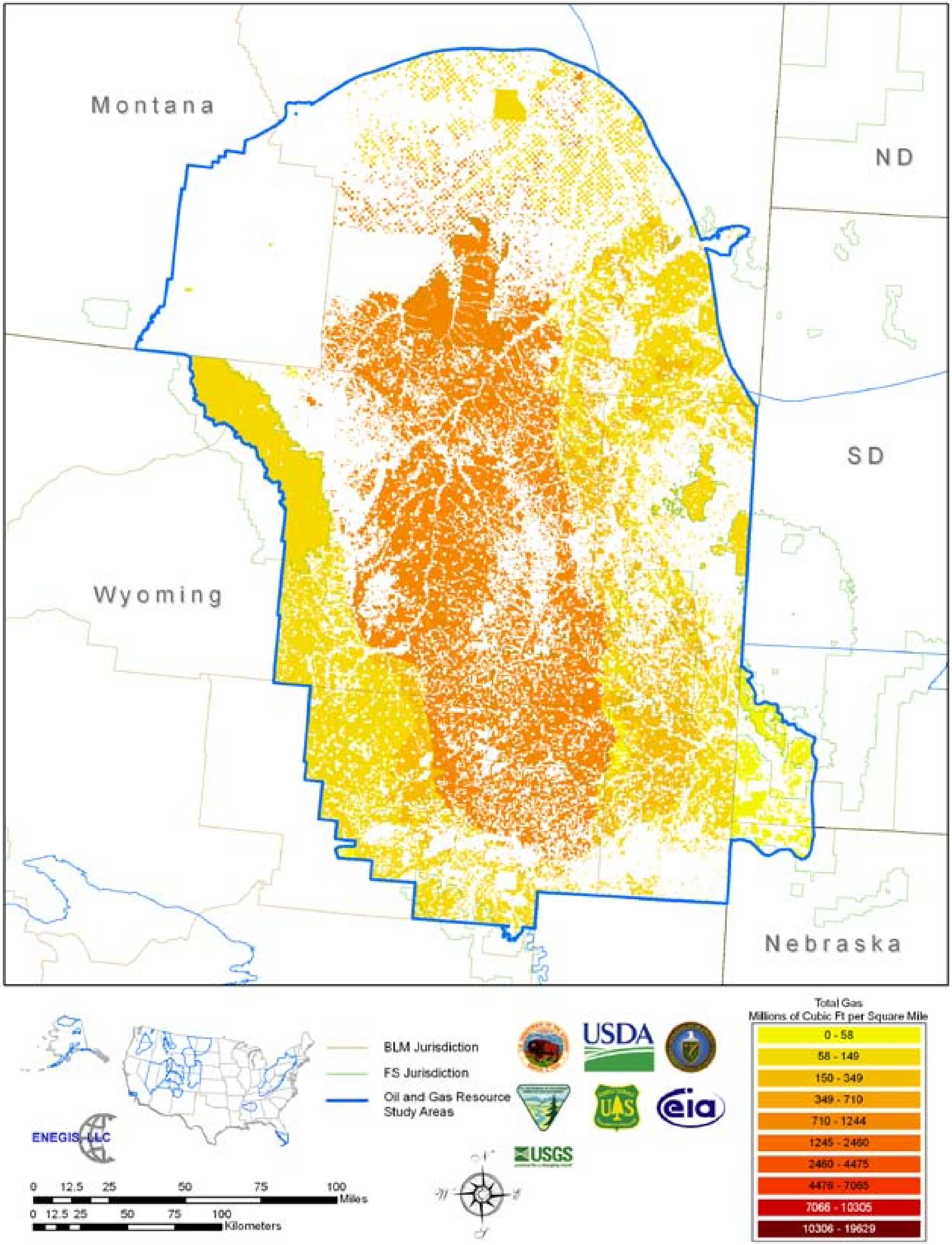

Figure 3-62. Map of Total Federal Natural Gas, Powder River Basin Study Area

Table 3-14. Wyoming Thrust Belt Study Area—Federal Land and Oil and Natural Gas Resources Affected by Access Category

	Access Category	Area		Resources[a]			
				Total Oil[b]		Total Gas[c]	
		(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1. No Leasing (Statutory/ Executive Order) (NLS)	269	6.4%	3	6.1%	16	2.6%
↑	2. No Leasing (Administrative) (NLA)	305	7.3%	3	6.9%	18	2.8%
	3. No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	520	12.5%	5	11.9%	31	4.9%
	4. Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	1,266	30.4%	4	8.3%	22	3.5%
	5. Leasing, Cumulative Timing Limitations (TLs) of >9 Months	41	1.0%	1	2.2%	10	1.6%
	6. Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	181	4.3%	6	12.7%	155	24.5%
	7. Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	494	11.8%	8	18.2%	177	27.9%
	8. Leasing, Controlled Surface Use (CSU)[d]	540	13.0%	8	18.0%	138	21.8%
Less Constrained	9. Leasing, Standard Lease Terms (SLTs)	554	13.3%	7	15.7%	65	10.3%
Total, Federal Lands including Split Estate		**4,171**	100.0%	**44**	100.0%	**633**	100.0%
Total Non-Federal		**3,889**		**44**		**1,057**	
Total Inventory Area		**8,060**		**89**		**1,690**	

Summary						
Inaccessible (Categories 1-4)	2,360	57%	15	33%	87	14%
Accessible with Restrictions (Categories 5-8)	1,257	30%	23	51%	480	76%
Accessible under Standard Lease Terms (Category 9)	554	13%	7	16%	65	10%
Total, Federal Lands Including Split Estate	**4,171**	**100%**	**44**	**100%**	**633**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

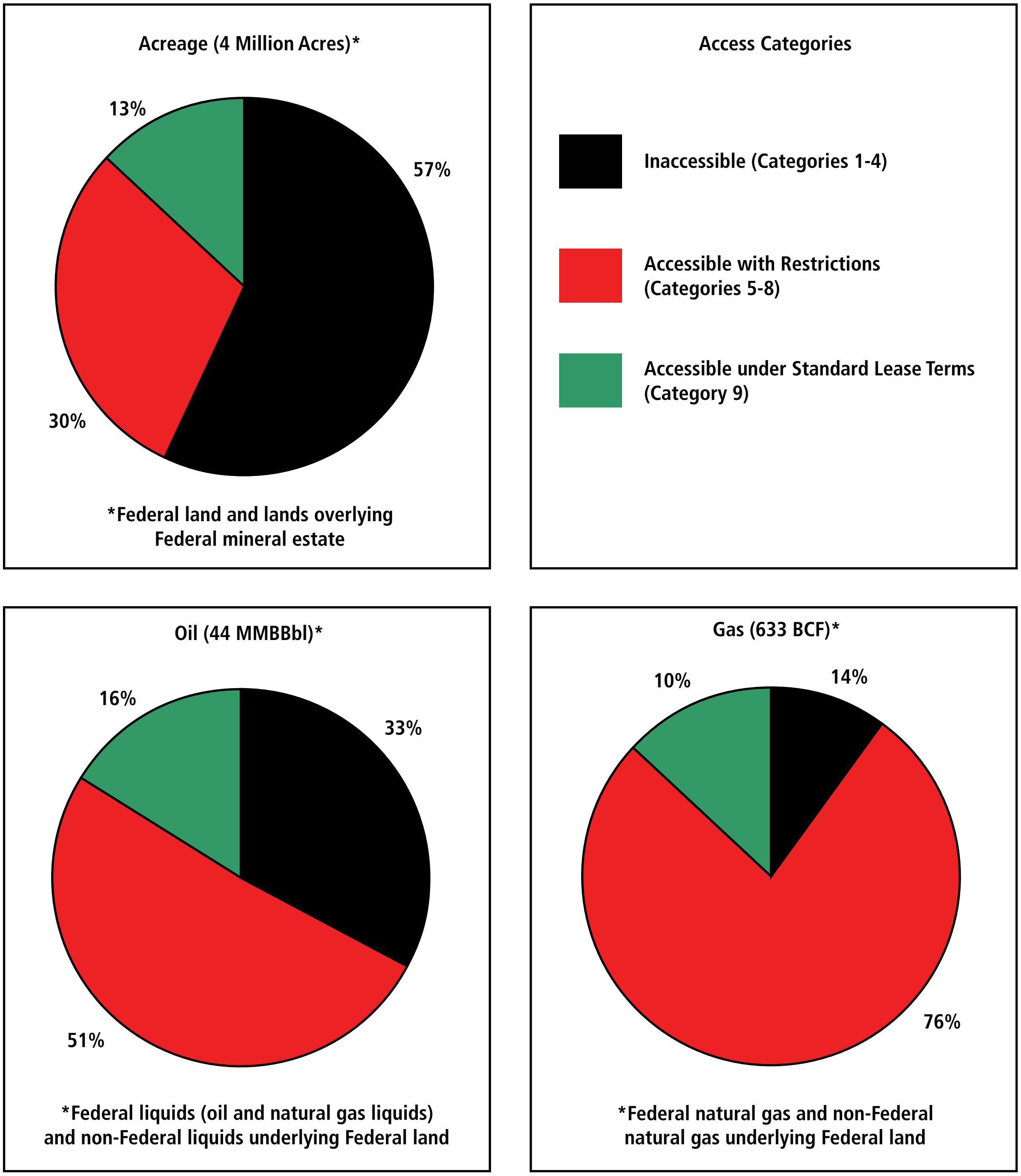

Figure 3-63. Simplified Chart of Results, Wyoming Thrust Belt Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

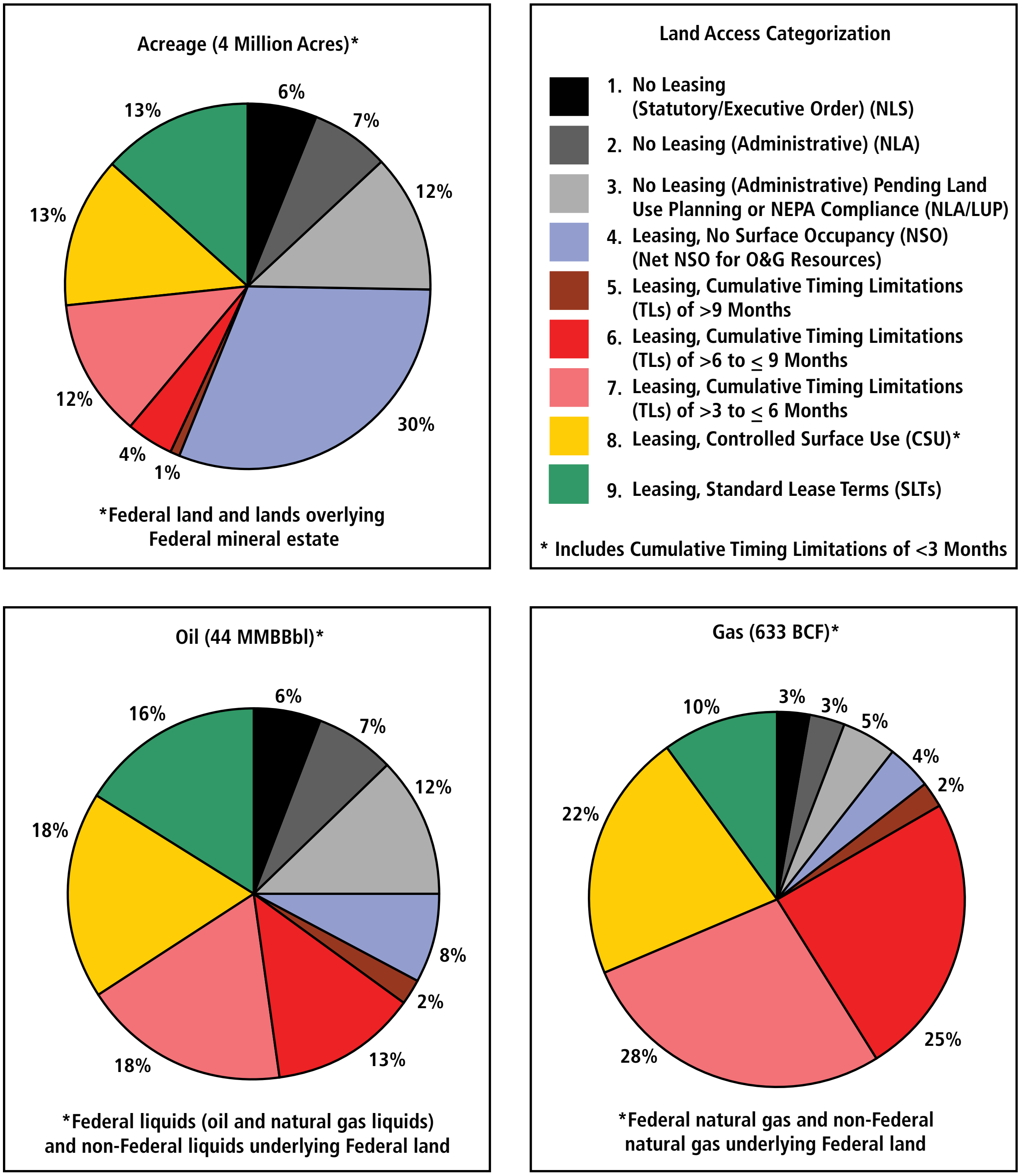

Figure 3-64. Chart of Results, Wyoming Thrust Belt Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

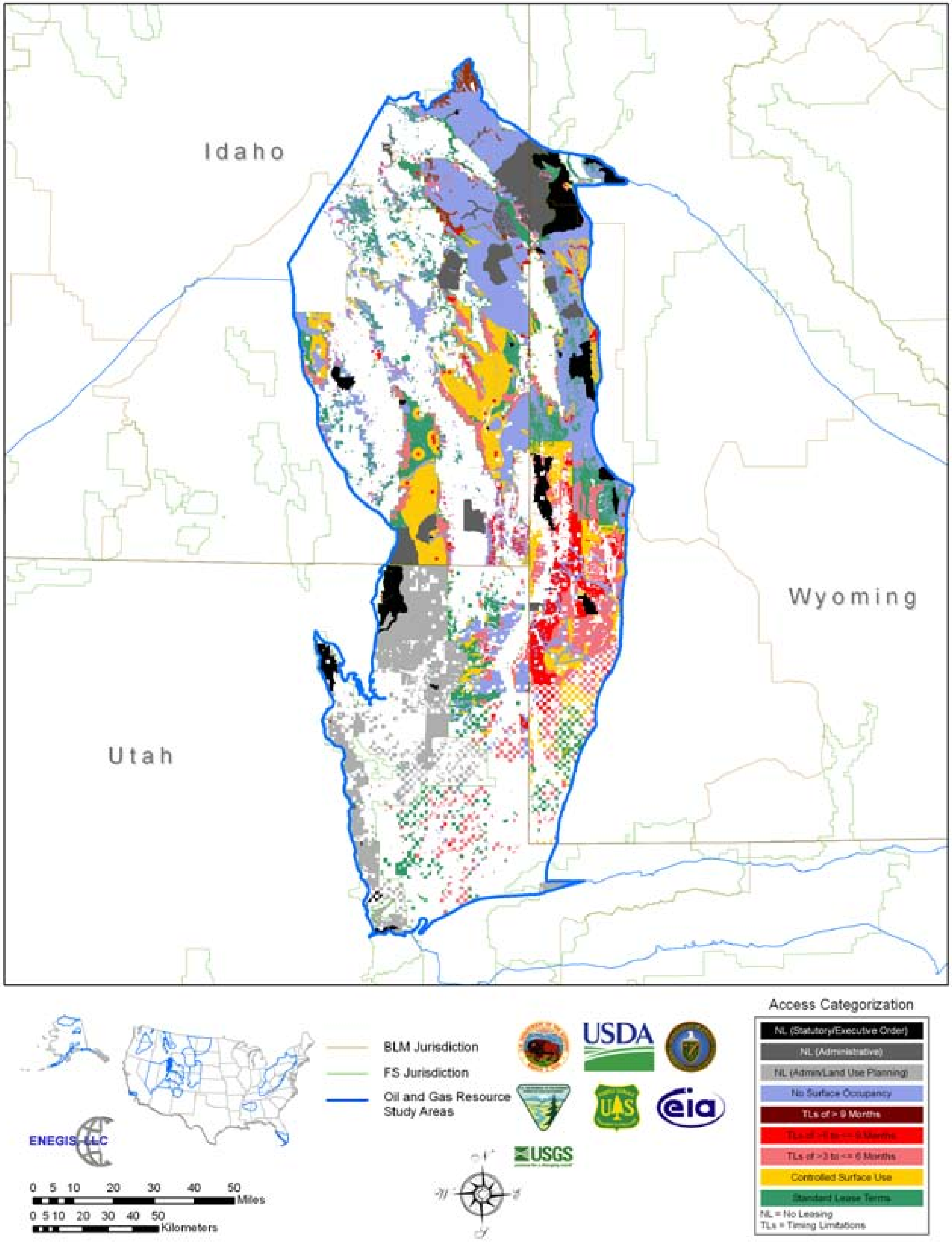

Figure 3-65. Federal Land Access Categorization Map, Wyoming Thrust Belt Study Area

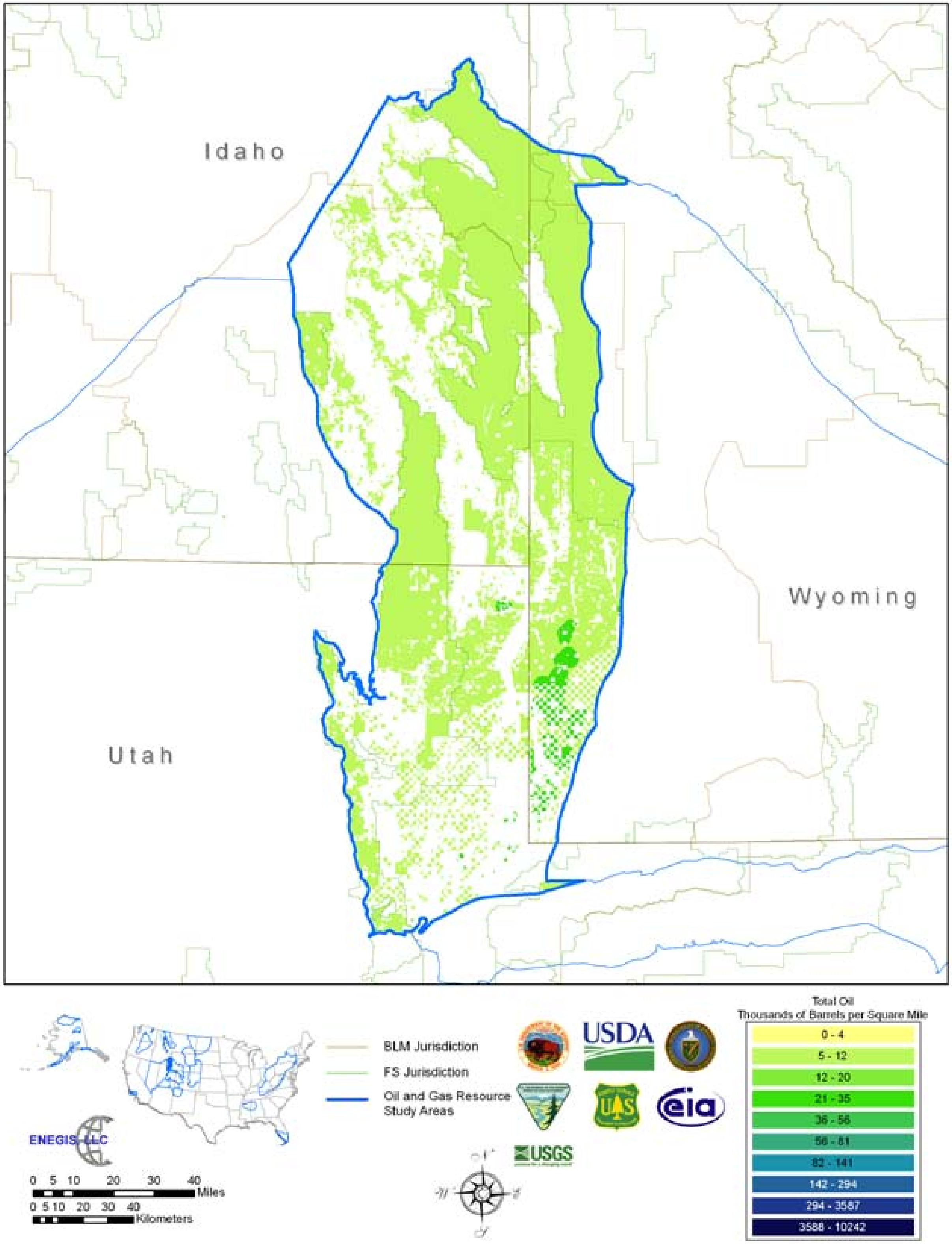

Figure 3-66. Map of Total Federal Oil, Wyoming Thrust Belt Study Area

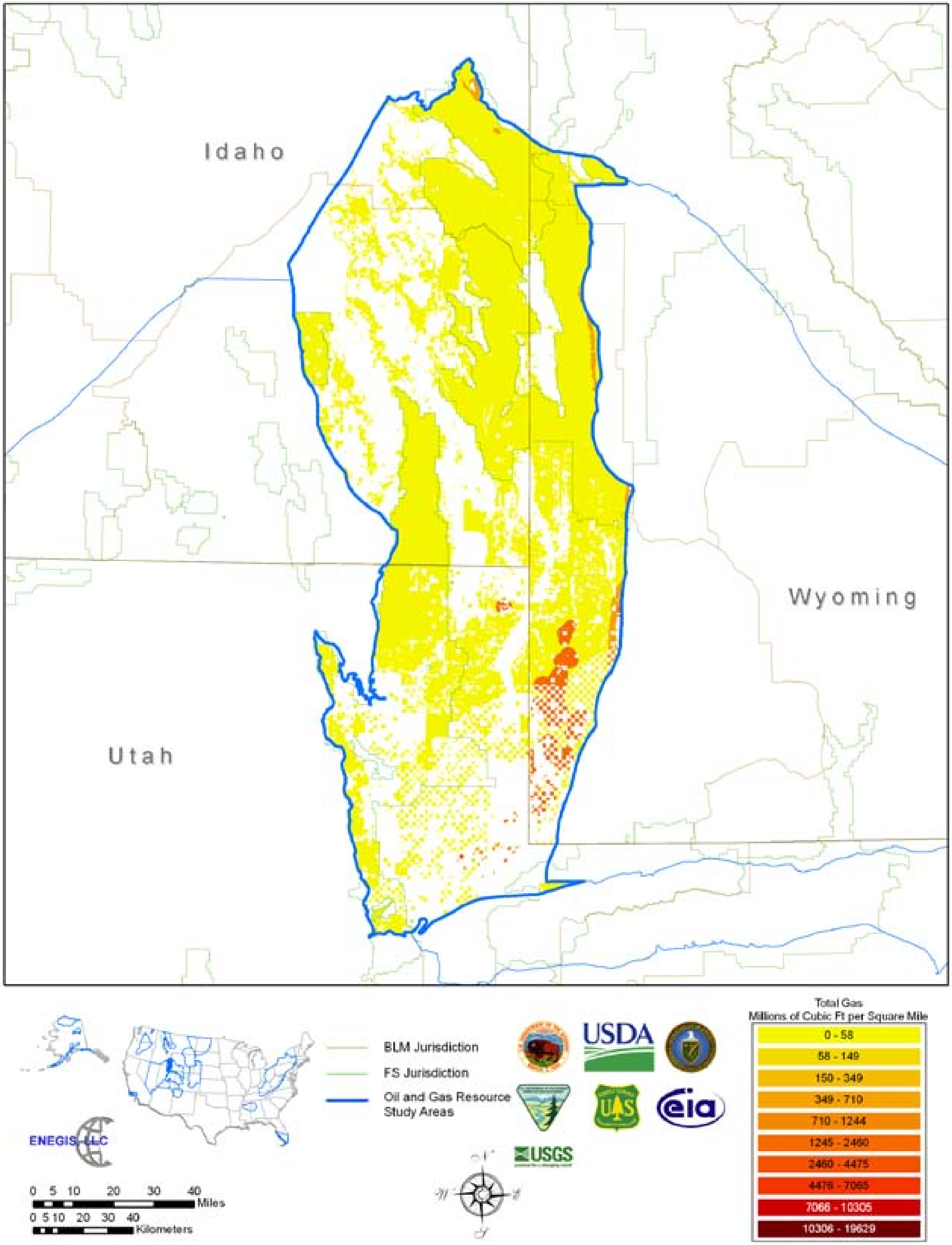

Figure 3-67. Map of Total Federal Natural Gas, Wyoming Thrust Belt Study Area

Table 3-15. Southwestern Wyoming Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

	Access Category	Area		Resources[a]			
				Total Oil[b]		Total Gas[c]	
		(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1. No Leasing (Statutory/ Executive Order) (NLS)	580	5.1%	110	5.3%	3,637	5.3%
↑	2. No Leasing (Administrative) (NLA)	493	4.3%	95	4.6%	2,744	4.0%
	3. No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	182	1.6%	35	1.7%	1,046	1.5%
	4. Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	1,938	17.0%	153	7.4%	4,883	7.2%
	5. Leasing, Cumulative Timing Limitations (TLs) of >9 Months	12	0.1%	6	0.3%	230	0.3%
	6. Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	797	7.0%	330	15.8%	9,862	14.5%
	7. Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	2,497	22.0%	635	30.5%	21,481	31.6%
	8. Leasing, Controlled Surface Use (CSU)[d]	2,686	23.6%	502	24.1%	16,142	23.7%
Less Constrained	9. Leasing, Standard Lease Terms (SLTs)	2,187	19.2%	216	10.4%	8,007	11.8%
Total, Federal Lands including Split Estate		**11,371**	100.0%	**2,082**	100.0%	**68,033**	100.0%
Total Non-Federal		**5,212**		**844**		**27,101**	
Total Inventory Area		**16,583**		**2,925**		**95,134**	

Summary						
Inaccessible (Categories 1-4)	3,192	28%	393	19%	12,311	18%
Accessible with Restrictions (Categories 5-8)	5,992	53%	1,472	71%	47,715	70%
Accessible under Standard Lease Terms (Category 9)	2,187	19%	216	10%	8,007	12%
Total, Federal Lands Including Split Estate	**11,371**	**100%**	**216**	**10%**	**8,007**	**12%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

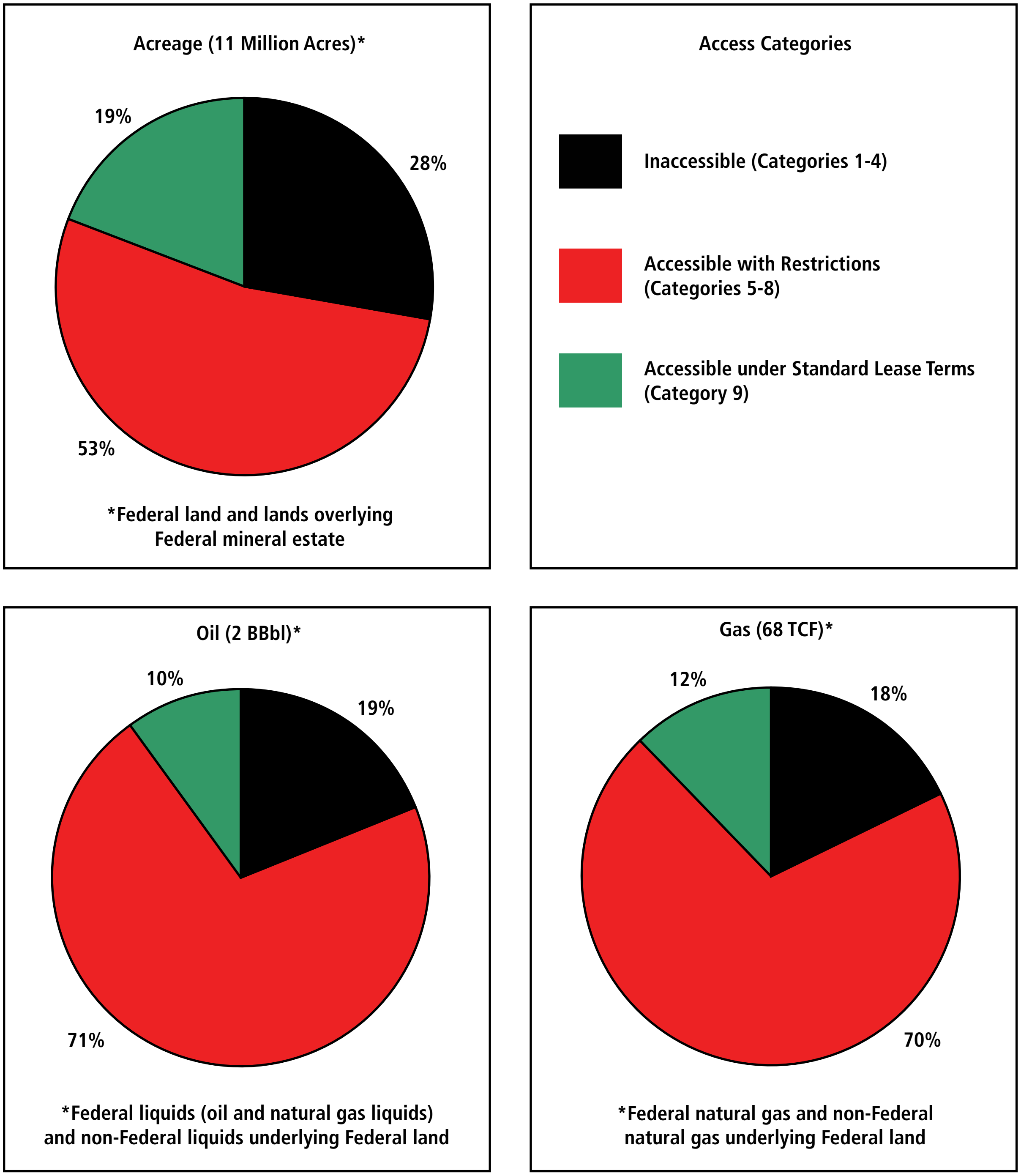

Figure 3-68. Simplified Chart of Results, Southwestern Wyoming Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

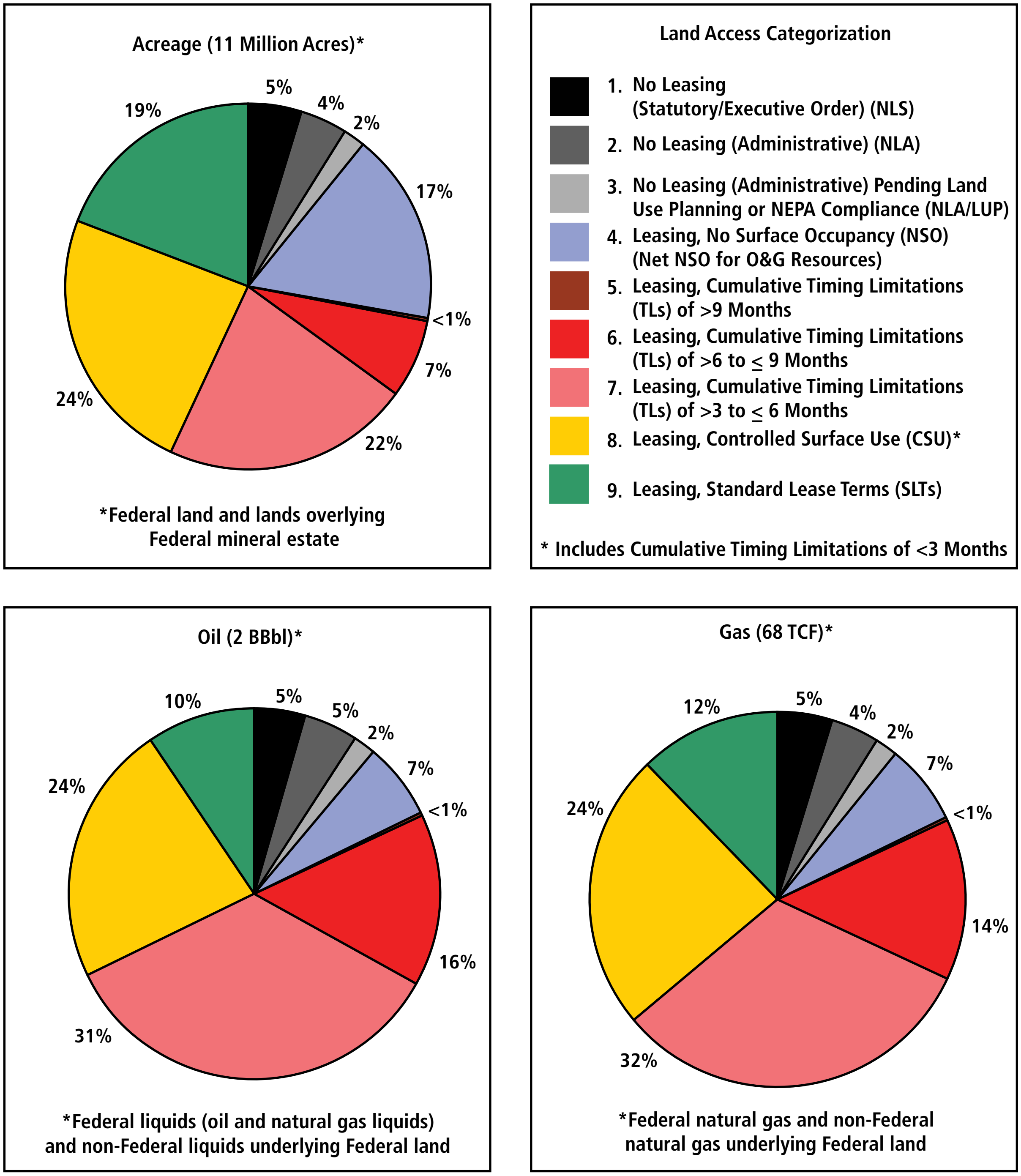

Figure 3-69. Chart of Results, Southwestern Wyoming Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

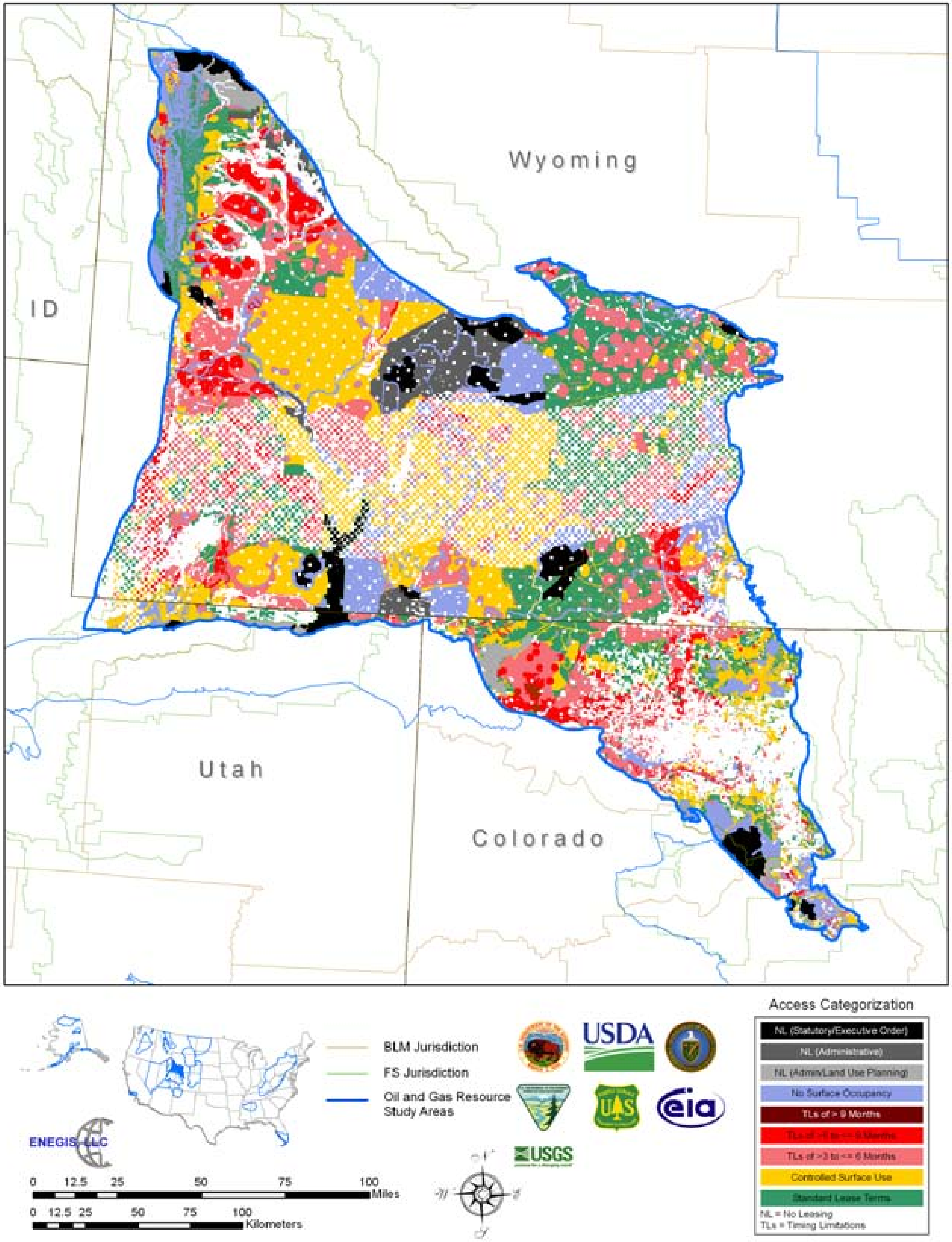

Figure 3-70. Federal Land Access Categorization Map, Southwestern Wyoming Study Area

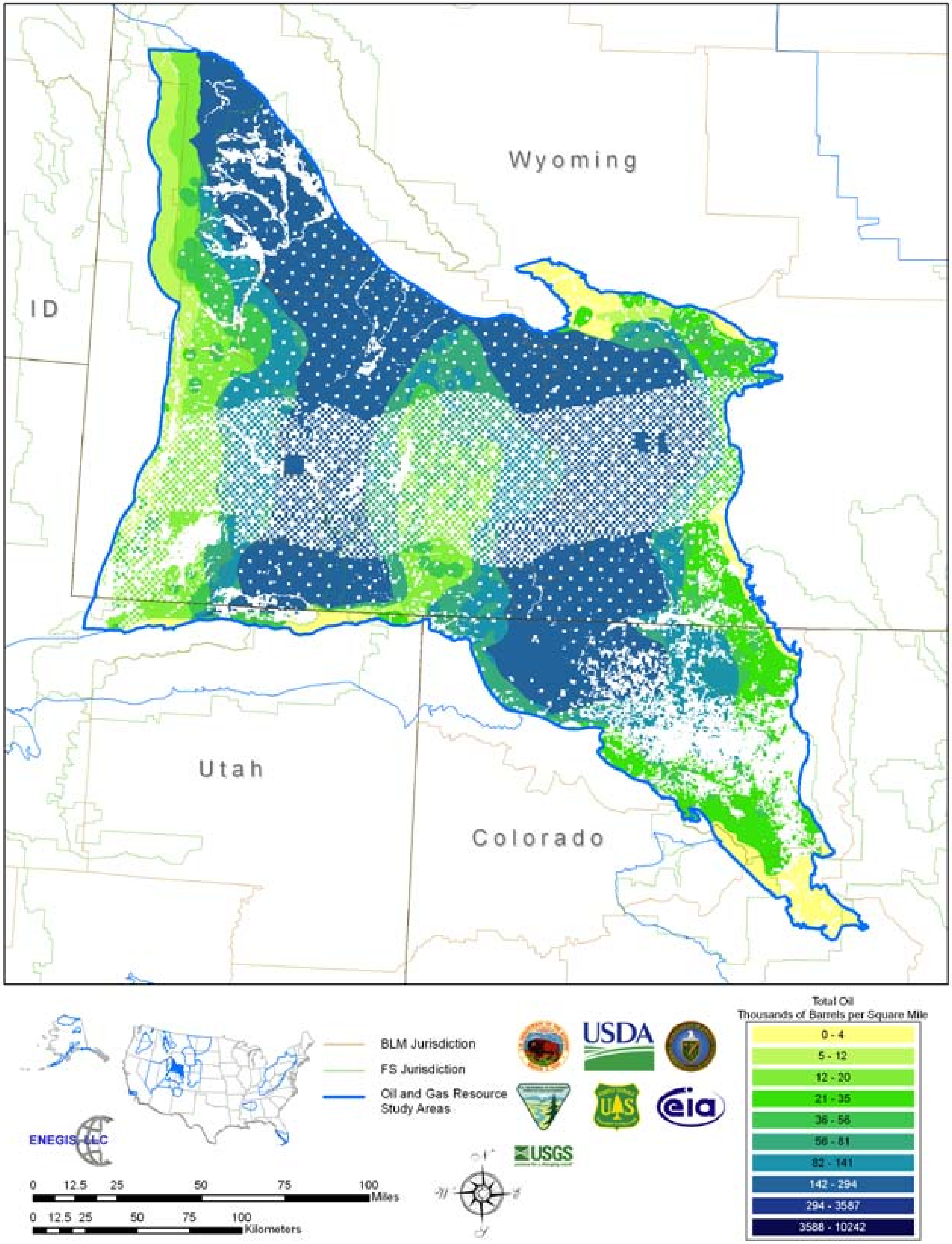

Figure 3-71. Map of Total Federal Oil, Southwestern Wyoming Study Area

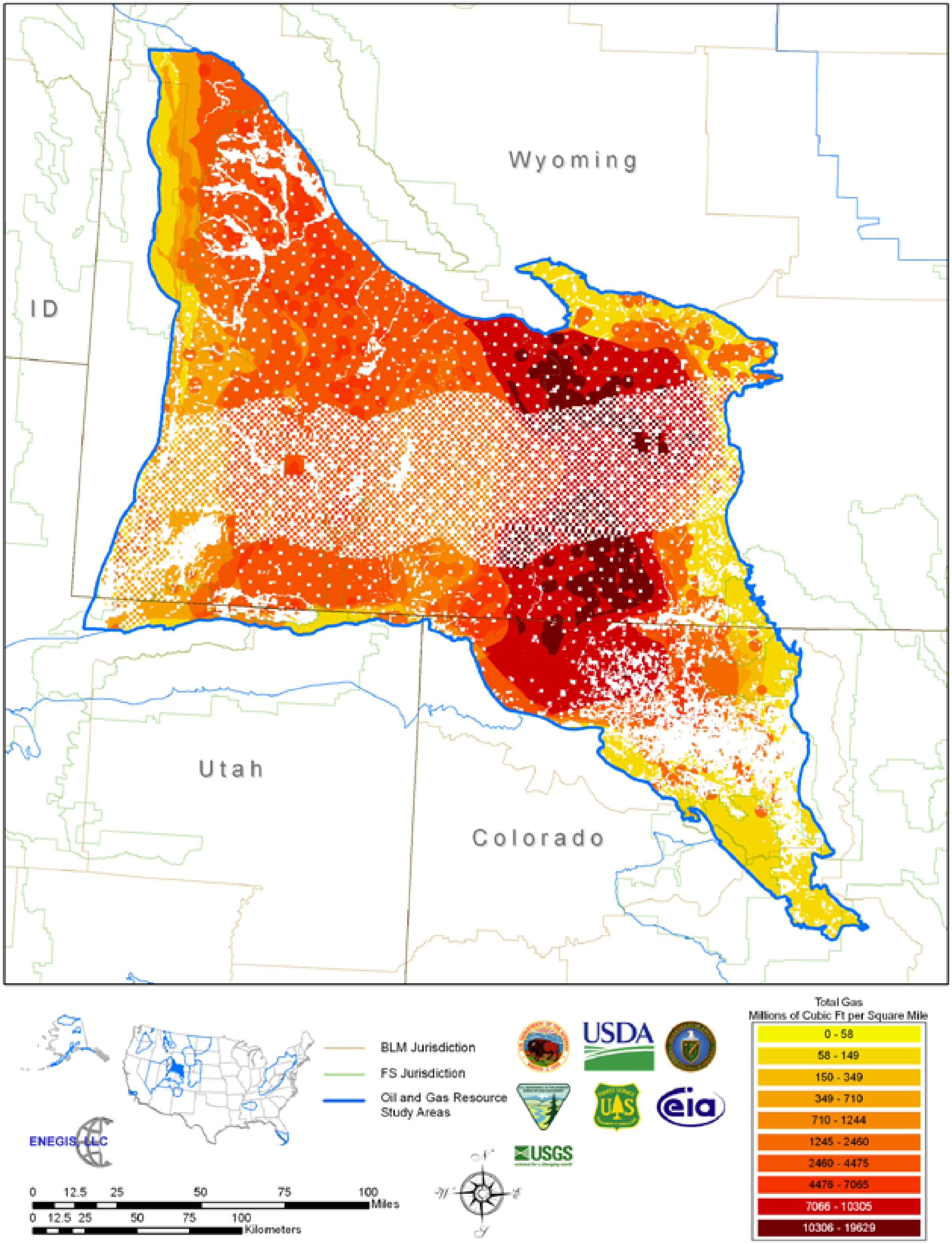

Figure 3-72. Map of Total Federal Natural Gas, Southwestern Wyoming Study Area

- Approximately 28 percent (741.9 thousand acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-73 and 3-74, Categories 5 through 8). Based on resource estimates, these lands contain 69 percent (11.8 MMbbls) of the Federal oil and 52 percent (45.5 BCF) of the Federal natural gas.
- Approximately 33 percent (870.2 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-73 and 3-74, Category 9). Based on resource estimates, these lands contain 12 percent (2.0 MMbbls) of the Federal oil and 12 percent (10.3 BCF) of the Federal natural gas.
- Outside of FS lands, this study area contains limited Federal lands, which are widely dispersed.

3.1.16 Florida Peninsula

- Approximately 94 percent (1.9 million acres) of the Federal land is not accessible (Figures 3-78 and 3-79, Categories 1 through 4). Based on resource estimates, these lands contain 81 percent (59.8 MMbbls) of the Federal oil and 81 percent (260.7 BCF) of the Federal natural gas.
- Approximately 6 percent (114.4 thousand acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-78 and 3-79, Categories 5 through 8). Based on resource estimates, these lands contain 19 percent (14.0 MMbbls) of the Federal oil and 19 percent (62.3 BCF) of the Federal natural gas.
- Less than 1 percent (1.1 thousand acres) of the Federal land in the study area is accessible under standard lease terms (Figures 3-78 and 3-79, Category 9). These lands contain virtually no Federal oil or natural gas.
- The Department of the Interior has agreed in principle to acquire the mineral rights under Big Cypress National Preserve, Florida Panther National Wildlife Refuge, and Ten Thousand Islands National Wildlife Refuge from Collier Resources Company, virtually ensuring no new oil and gas development in the three areas.[46]

3.1.17 Black Warrior Basin

- Approximately 83 percent (574.4 thousand acres) of the Federal land is not accessible (Figures 3-83 and 3-84, Categories 1 through 4). Based on resource estimates, these lands contain 65 percent of the Federal oil (0.6 MMbbls) and 58 percent (227.2 BCF) of the Federal natural gas.
- Approximately 14 percent (97.5 thousand acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-83 and 3-84, Categories 5 through 8). Based on resource estimates, these lands contain 29 percent of the Federal oil (0.3 MMbbls) and 32 percent (126.2 BCF) of the Federal natural gas.
- Approximately 3 percent (21.8 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-83 and 3-84, Category 9). Based on resource estimates, these lands contain 5 percent of the Federal oil (0.05 MMbbls) and 10 percent (37.5 BCF) of the Federal natural gas.

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[46] Interior Reaches Agreement to Acquire Mineral Rights in Everglades, Settles Litigation on Offshore Oil and Gas Leases in Destin Dome. See the website: http://www.fws.gov/southeast/news/2002/n02-002.html

Table 3-16. Denver Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

		Access Category	Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	68	2.6%	0	0.7%	0	0.3%
	2.	No Leasing (Administrative) (NLA)	305	11.5%	1	8.3%	14	16.3%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	81	3.1%	1	3.3%	1	1.4%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	586	22.1%	1	7.2%	16	18.4%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	2	0.1%	0	0.6%	1	0.8%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	28	1.1%	1	8.5%	5	5.7%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	222	8.4%	3	16.5%	8	9.3%
	8.	Leasing, Controlled Surface Use (CSU)[d]	489	18.4%	7	43.2%	32	36.1%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	870	32.8%	2	11.8%	10	11.7%
Total, Federal Lands including Split Estate			**2,652**	100.0%	**17**	100.0%	**88**	100.0%
Total Non-Federal			**32,842**		**307**		**2,635**	
Total Inventory Area			**35,494**		**324**		**2,723**	

Summary						
Inaccessible (Categories 1-4)	1,040	39%	3	19%	32	36%
Accessible with Restrictions (Categories 5-8)	742	28%	12	69%	46	52%
Accessible under Standard Lease Terms (Category 9)	870	33%	2	12%	10	12%
Total, Federal Lands Including Split Estate	**2,652**	**100%**	**17**	**100%**	**88**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

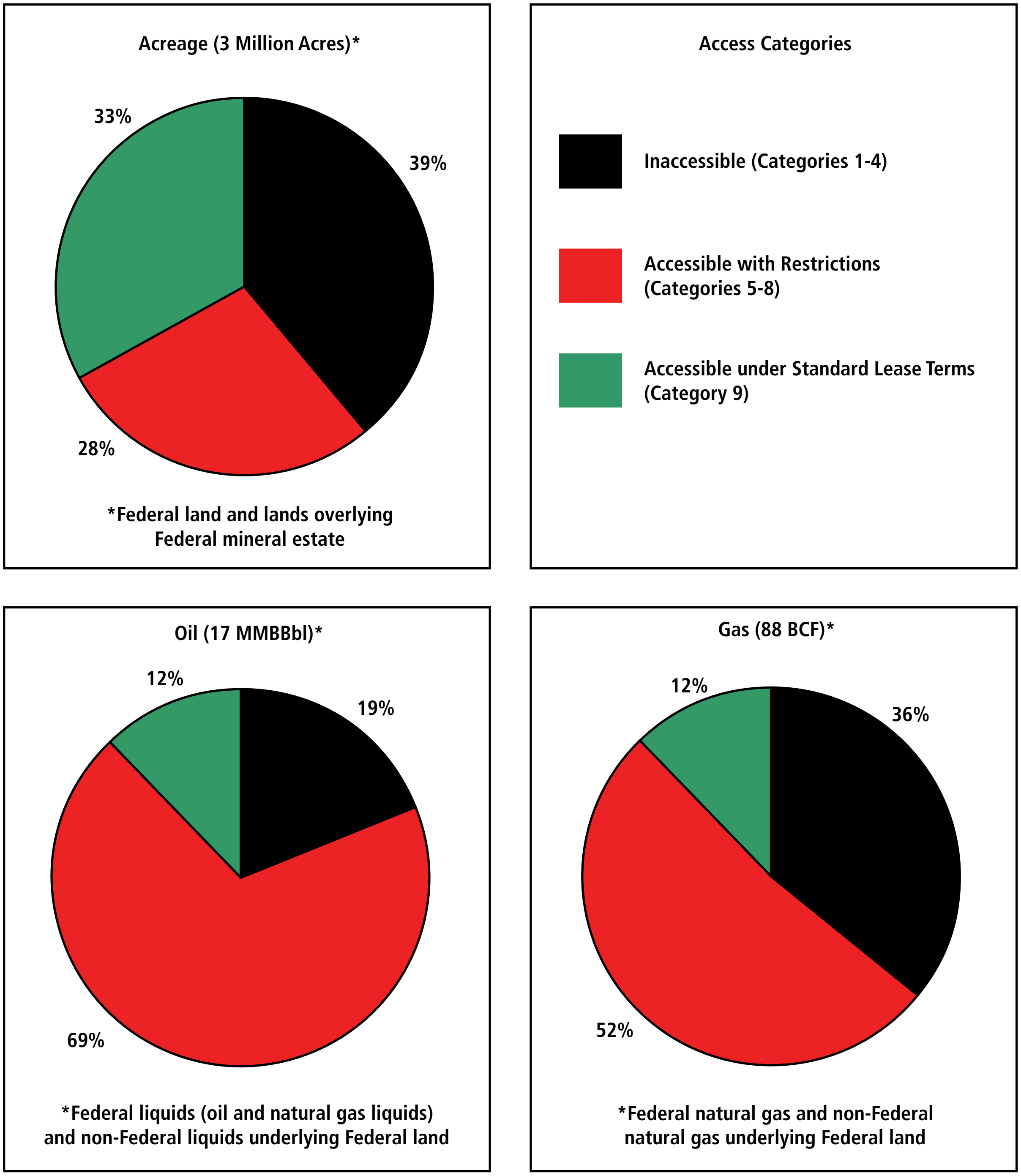

Figure 3-73. Simplified Chart of Results, Denver Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

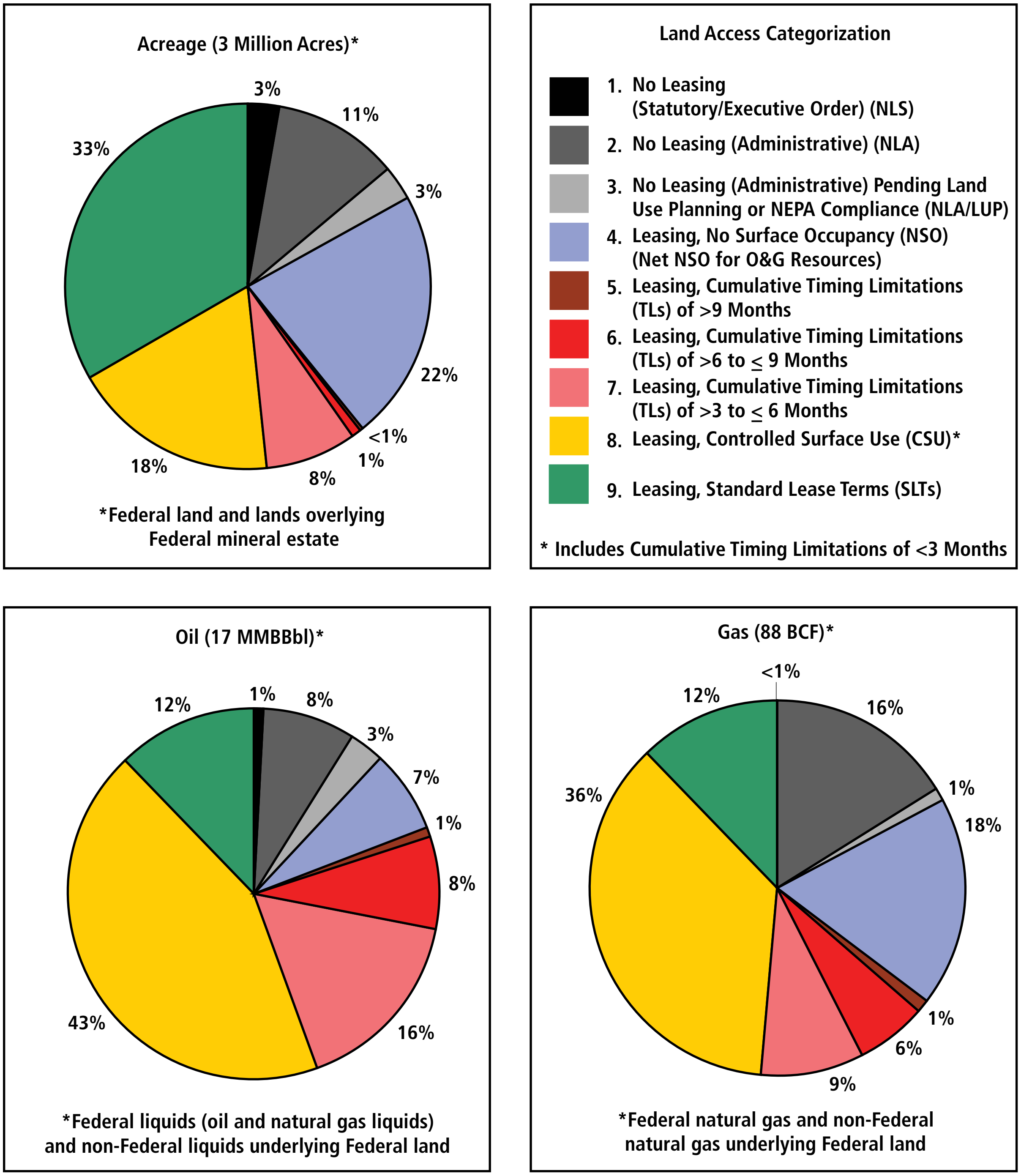

Figure 3-74. Chart of Results, Denver Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

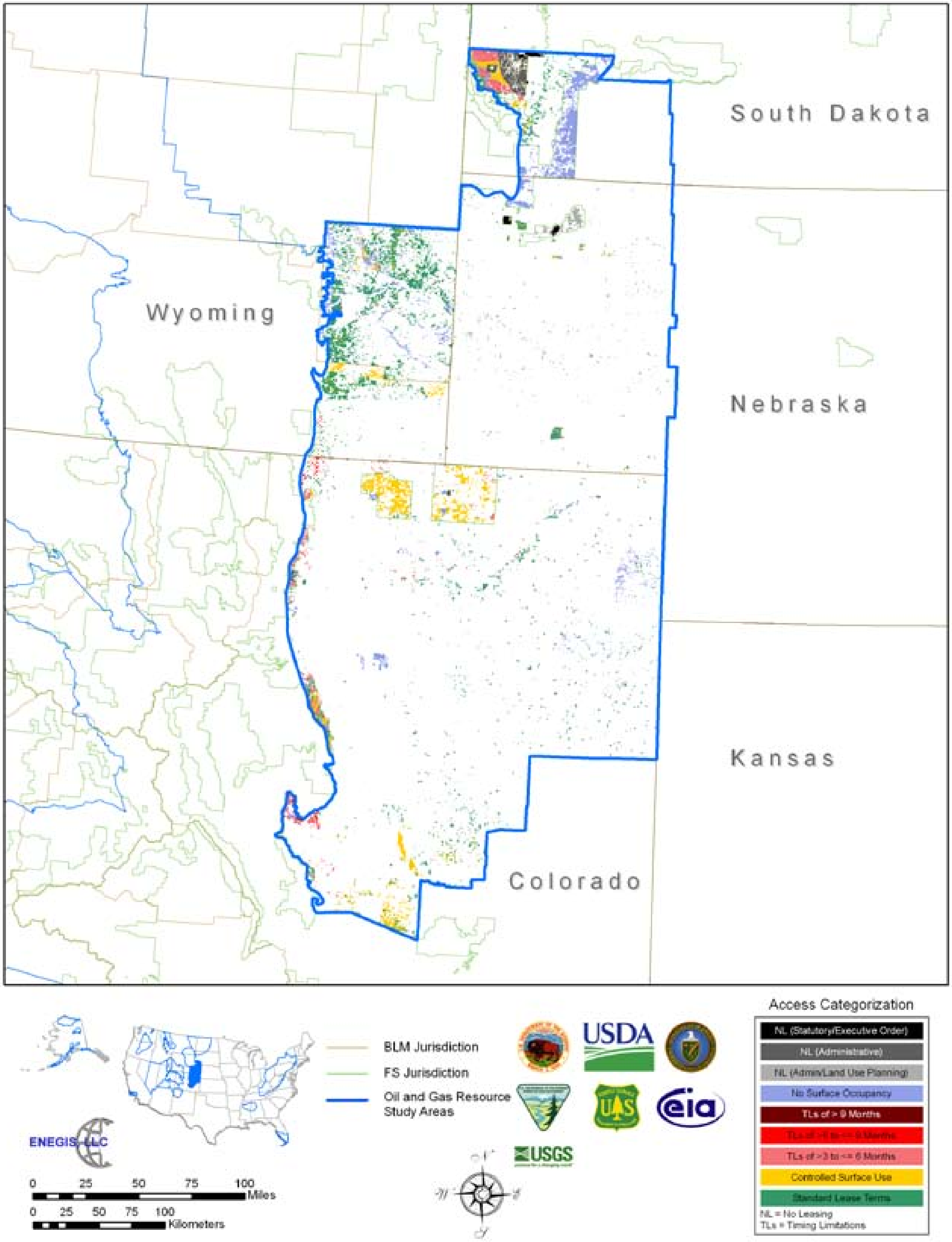

Figure 3-75. Federal Land Access Categorization Map, Denver Basin Study Area

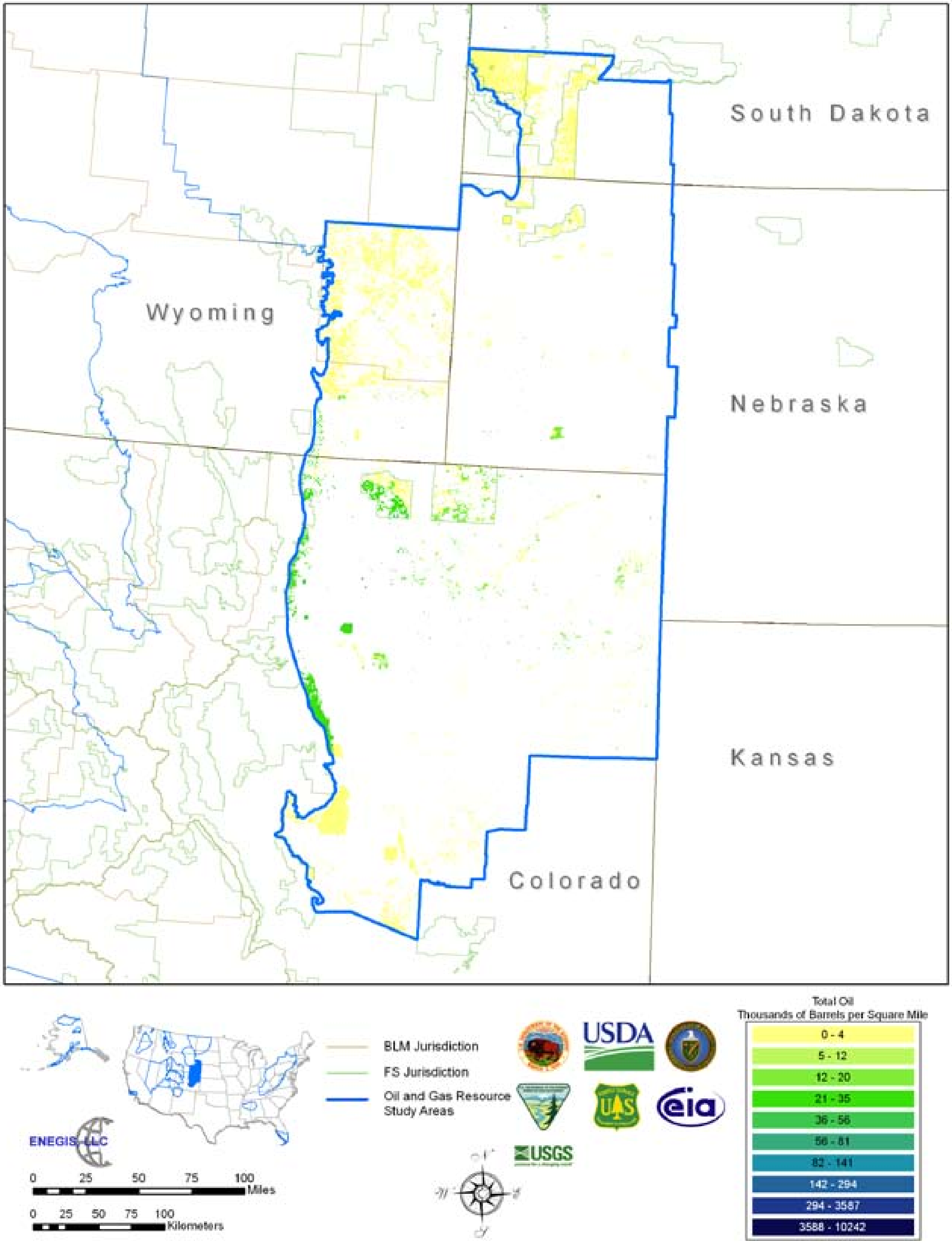

Figure 3-76. Map of Total Federal Oil, Denver Basin Study Area

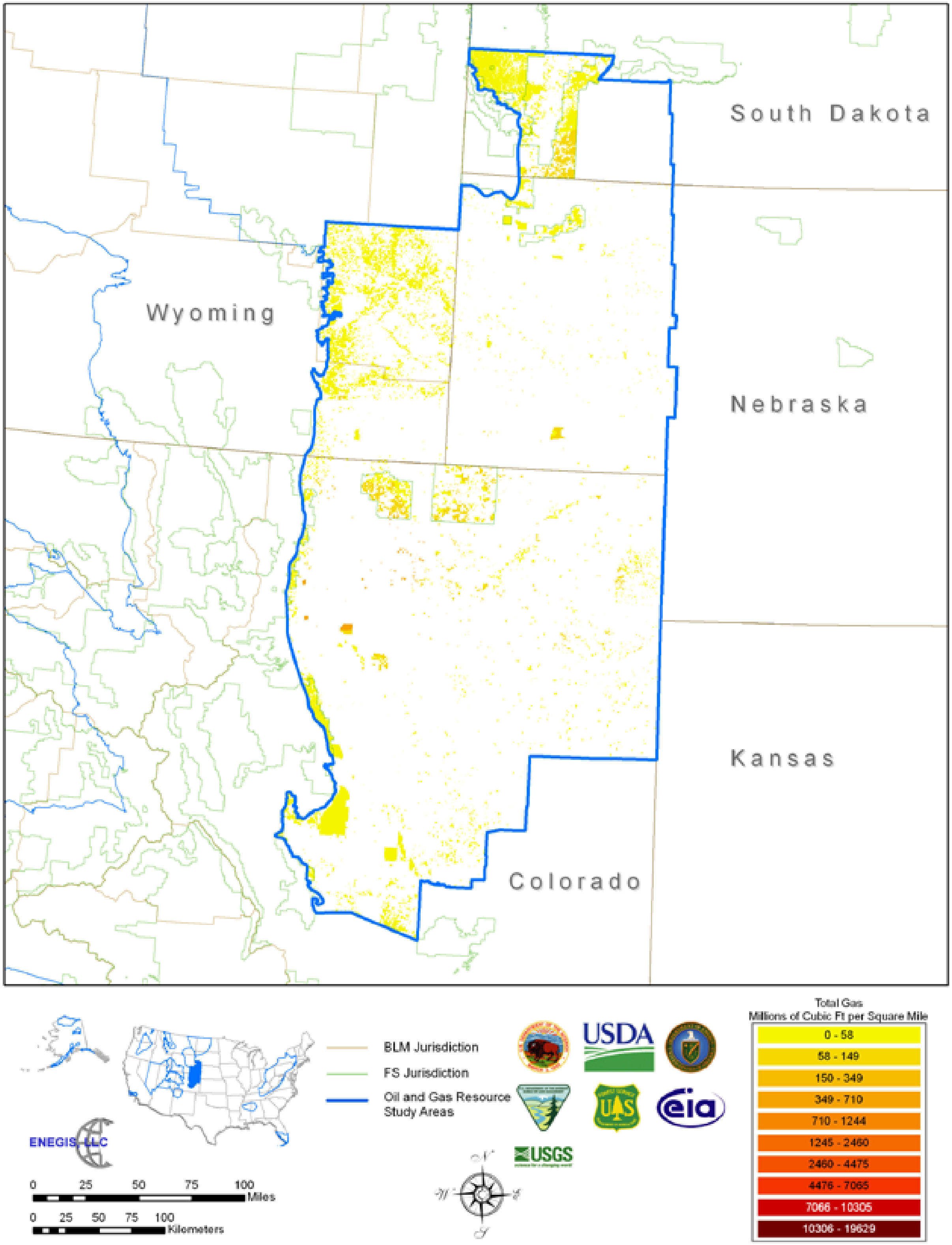

Figure 3-77. Map of Total Federal Natural Gas, Denver Basin Study Area

Table 3-17. Florida Peninsula Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

	Access Category		Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained ↑	1.	No Leasing (Statutory/ Executive Order) (NLS)	4	0.2%	0	0.1%	0	0.0%
	2.	No Leasing (Administrative) (NLA)	3	0.1%	0	0.1%	0	0.1%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	1,376	69.3%	50	67.7%	217	67.2%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	487	24.5%	10	13.0%	43	13.4%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	114	5.7%	14	19.0%	62	19.3%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	-	0.0%	-	0.0%	-	0.0%
	8.	Leasing, Controlled Surface Use (CSU)[d]	1	0.0%	0	0.0%	0	0.0%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	1	0.1%	0	0.1%	0	0.1%
Total, Federal Lands including Split Estate			**1,985**	100.0%	**74**	100.0%	**323**	100.0%
Total Non-Federal			**6,751**		**212**		**701**	
Total Inventory Area			**8,736**		**286**		**1,024**	

Summary						
Inaccessible (Categories 1-4)	1,869	94%	60	81%	261	81%
Accessible with Restrictions (Categories 5-8)	114	6%	14	19%	62	19%
Accessible under Standard Lease Terms (Category 9)	1	0%	0	0%	0	0%
Total, Federal Lands Including Split Estate	**1,985**	**100%**	**74**	**100%**	**323**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

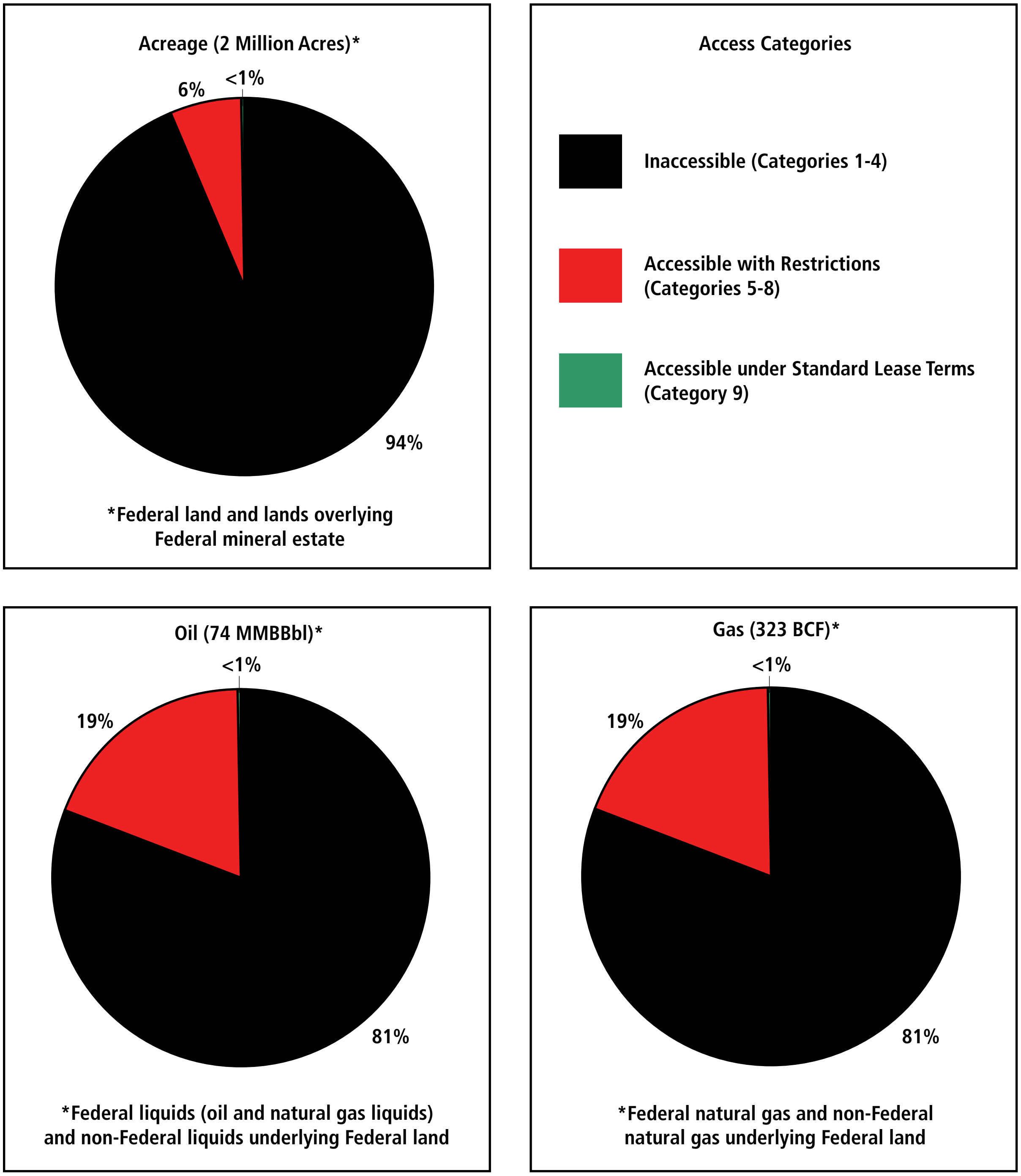

Figure 3-78. Simplified Chart of Results, Florida Peninsula Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

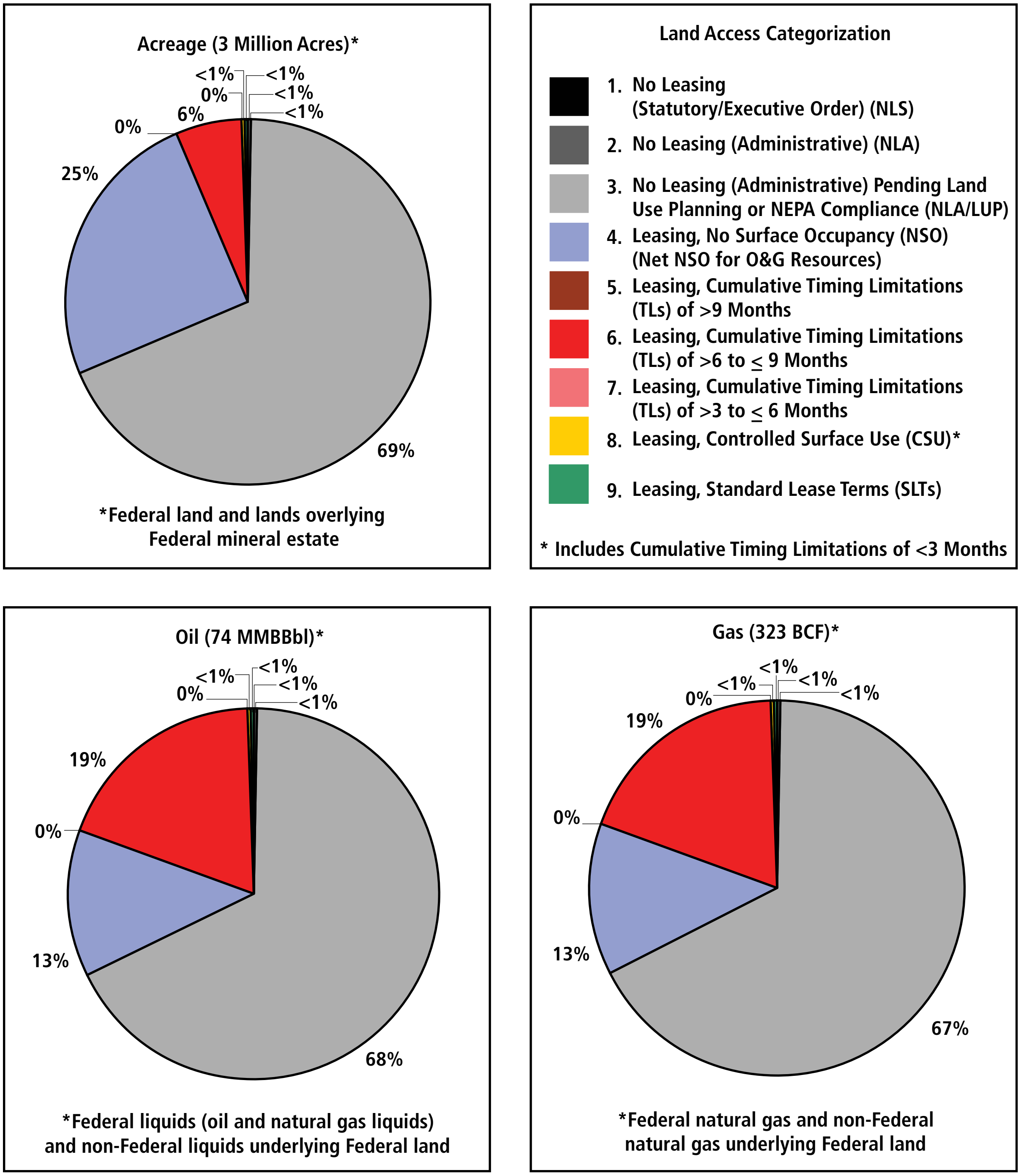

Figure 3-79. Chart of Results, Florida Peninsula Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

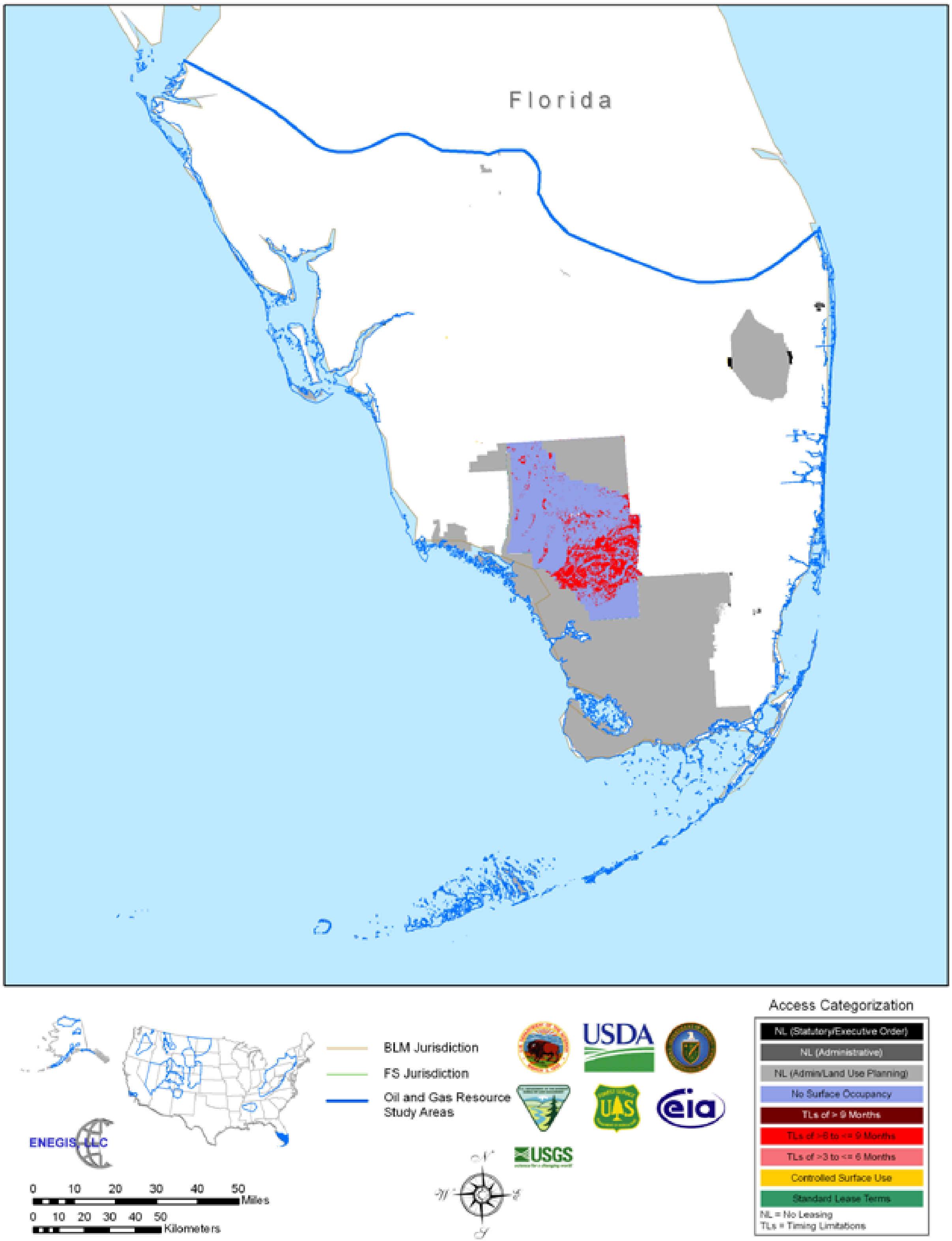

Figure 3-80. Federal Land Access Categorization Map, Florida Peninsula Study Area

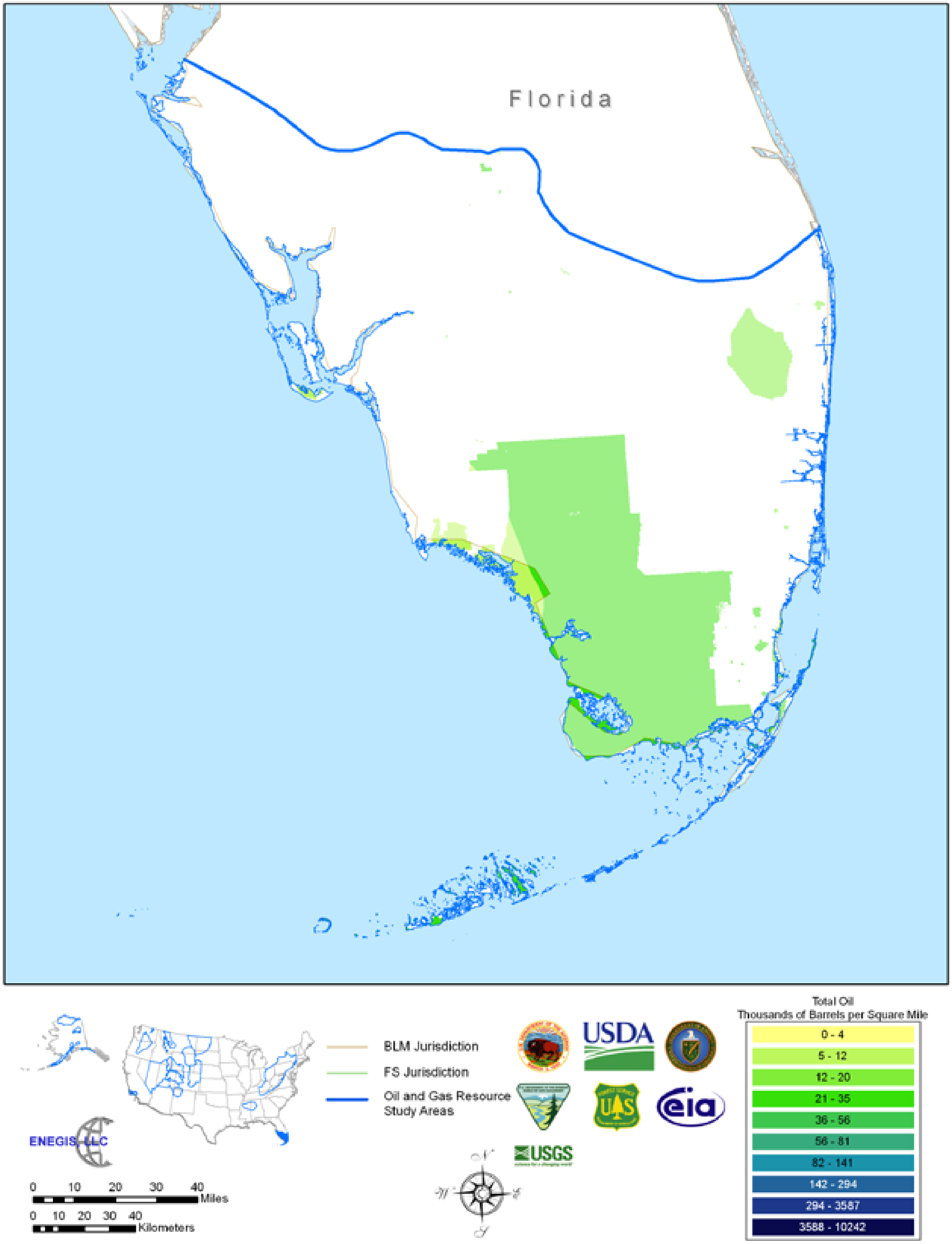

Figure 3-81. Map of Total Federal Oil, Florida Peninsula Study Area

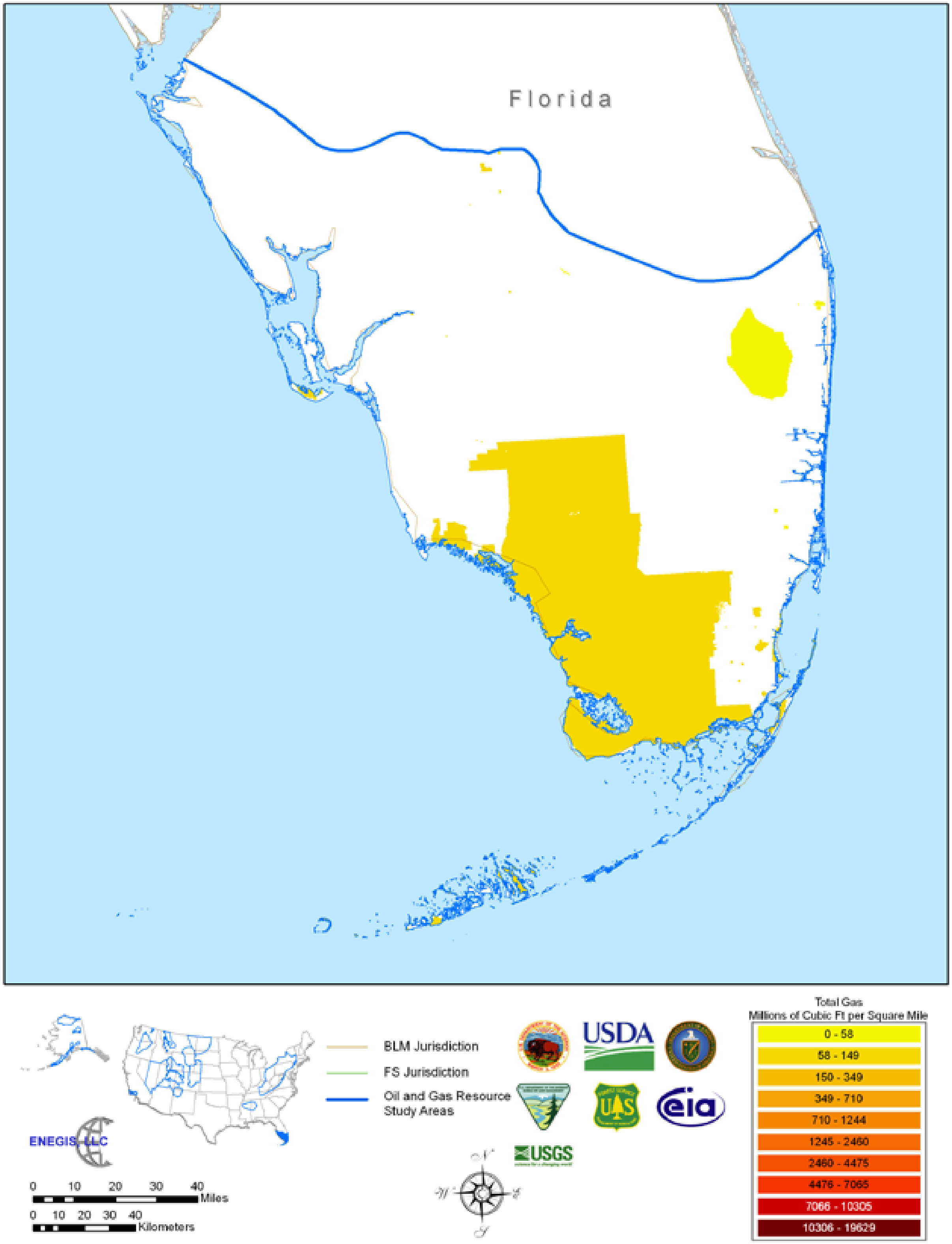

Figure 3-82. Map of Total Federal Natural Gas, Florida Peninsula Study Area

Table 3-18. Black Warrior Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

	Access Category		Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	1	0.1%	0	0.1%	0	0.0%
	2.	No Leasing (Administrative) (NLA)	3	0.4%	0	0.6%	5	1.2%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	382	55.0%	0	51.6%	163	41.7%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	189	27.2%	0	13.0%	59	15.2%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	3	0.4%	0	0.5%	0	0.1%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	-	0.0%	-	0.0%	-	0.0%
	8.	Leasing, Controlled Surface Use (CSU)[d]	95	13.6%	0	28.8%	126	32.2%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	22	3.1%	0	5.3%	37	9.6%
Total, Federal Lands including Split Estate			**694**	100.0%	**1**	100.0%	**391**	100.0%
Total Non-Federal			**10,853**		**16**		**8,922**	
Total Inventory Area			**11,547**		**16**		**9,313**	

Summary						
Inaccessible (Categories 1-4)	574	83%	1	65%	227	58%
Accessible with Restrictions (Categories 5-8)	98	14%	0	29%	126	32%
Accessible under Standard Lease Terms (Category 9)	22	3%	0	5%	37	10%
Total, Federal Lands Including Split Estate	**694**	**100%**	**1**	**100%**	**391**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

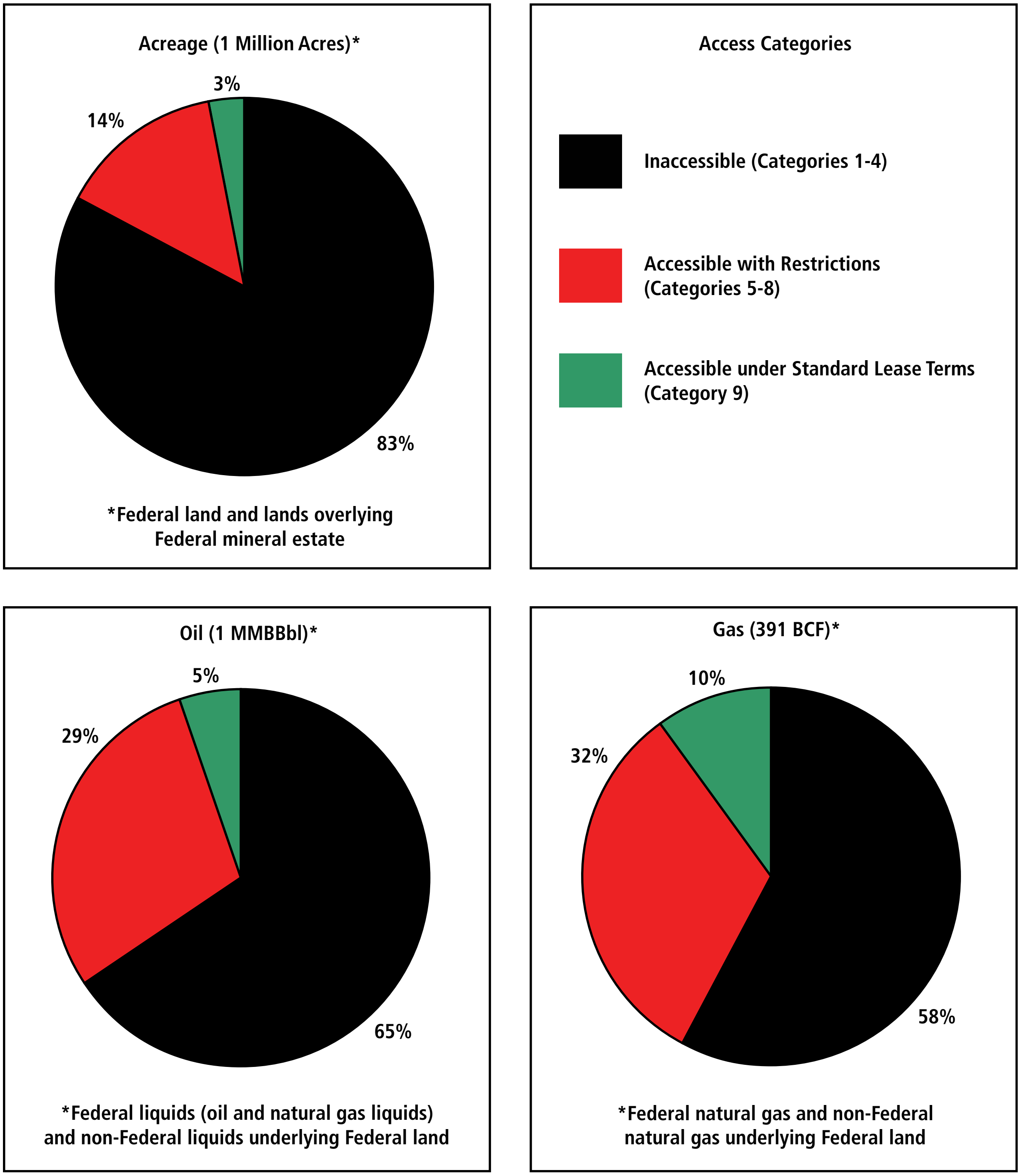

Figure 3-83. Simplified Chart of Results, Black Warrior Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

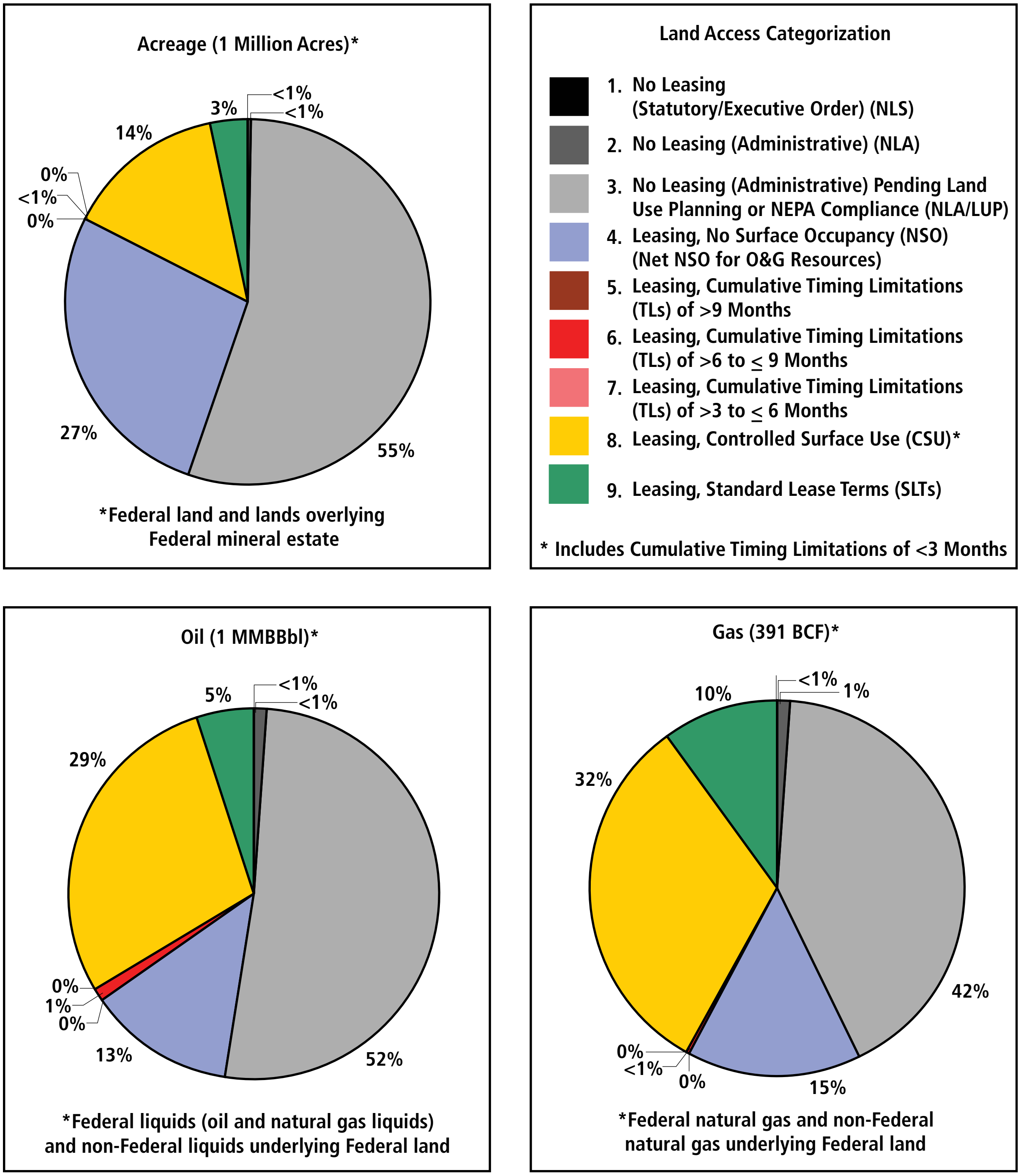

Figure 3-84. Chart of Results, Black Warrior Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

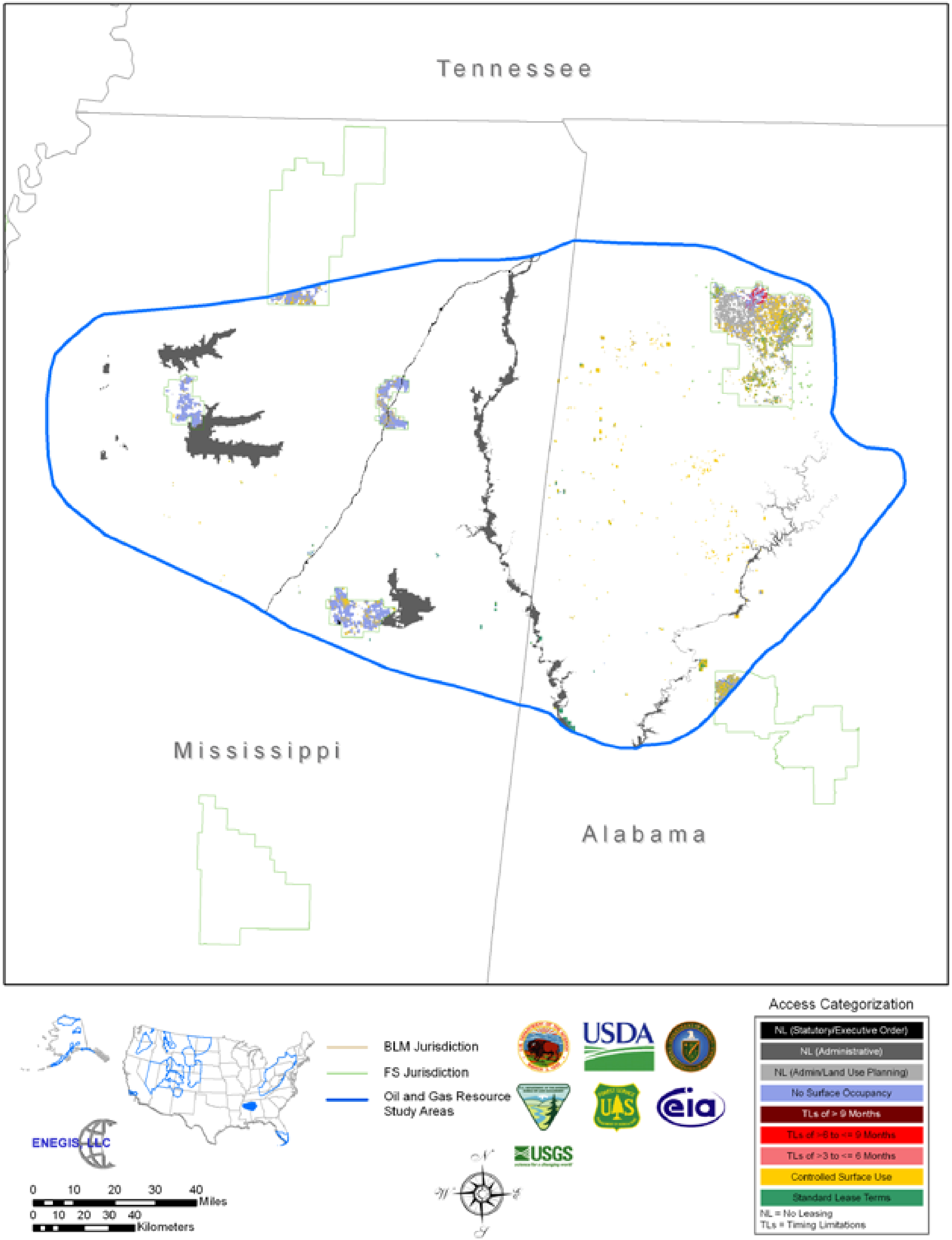

Figure 3-85. Federal Land Access Categorization Map, Black Warrior Basin Study Area

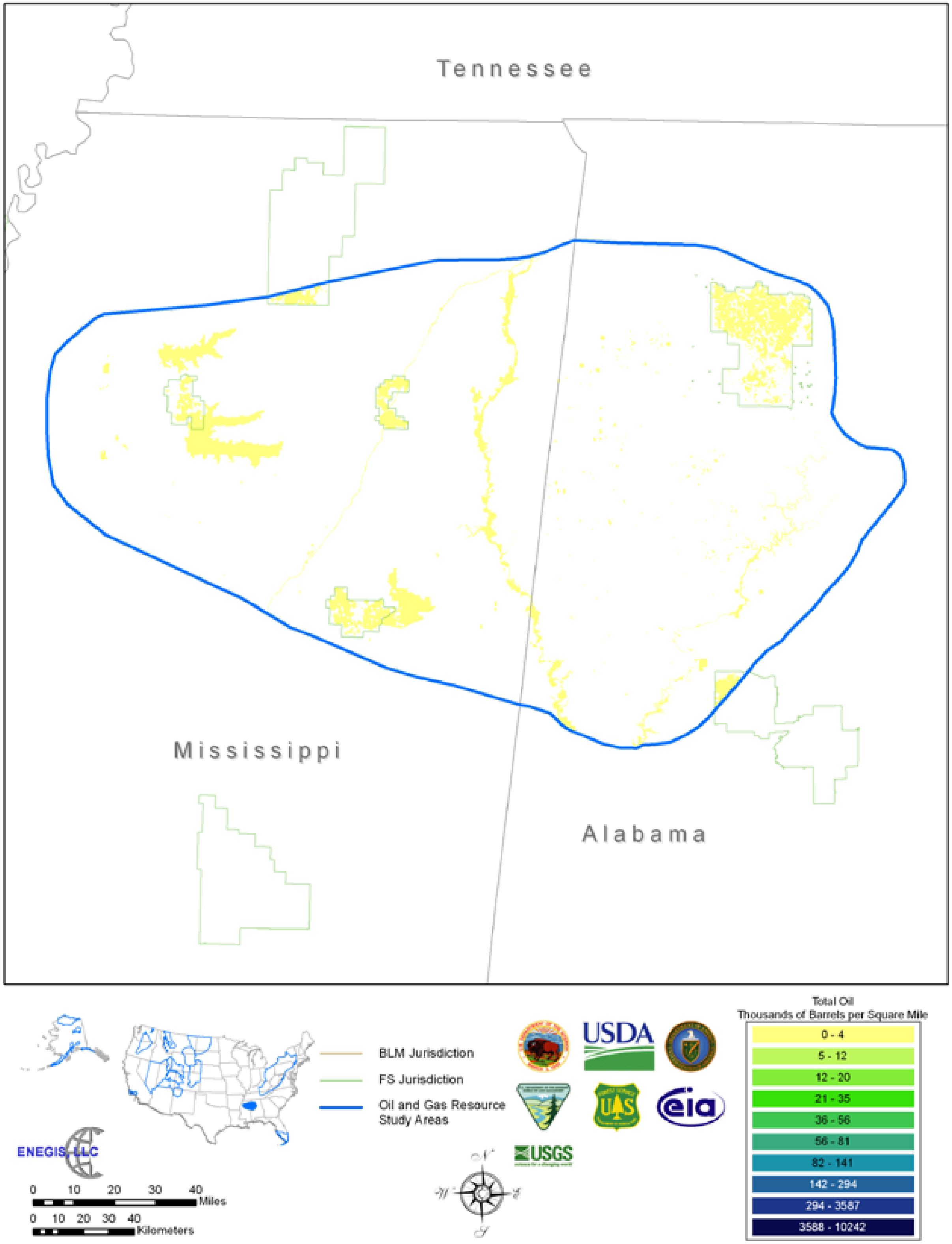

Figure 3-86. Map of Total Federal Oil, Black Warrior Basin Study Area

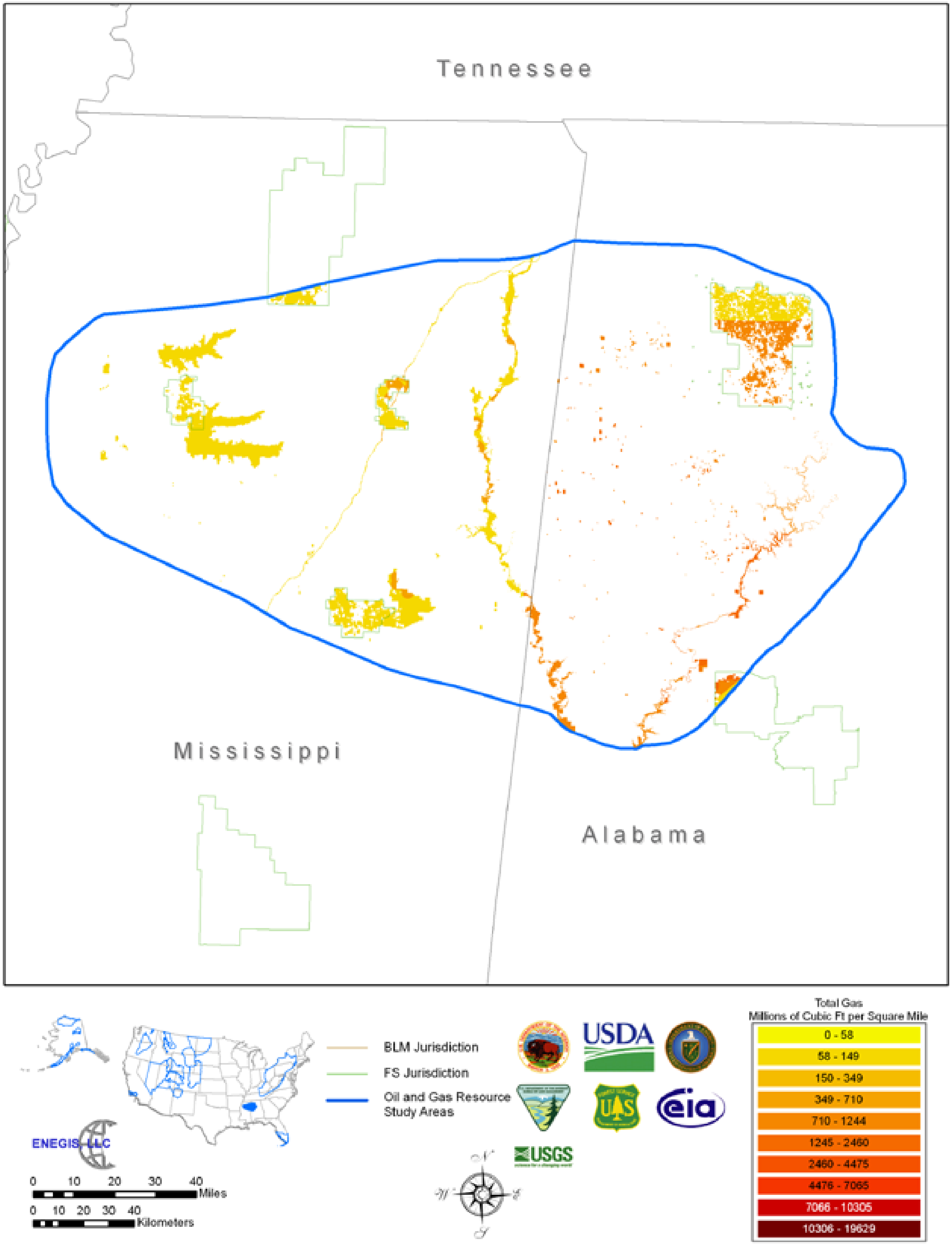

Figure 3-87. Map of Total Federal Natural Gas, Black Warrior Basin Study Area

- The Federal lands in this study area contain only about 1 MMbbls of oil out of a total of 13 MMbbls for all lands in the study area.
- This study area has significant split-estate lands comprising Federal surface and non-Federal mineral estate.

3.1.18 Appalachian Basin

- Approximately 46 percent (2.5 million acres) of the Federal land is not accessible (Figures 3-88 and 3-89, Categories 1 through 4). Based on resource estimates, these lands contain 40 percent (13.4 MMbbls) of the Federal oil and 41 percent (984.7 BCF) of the Federal natural gas.
- Approximately 42 percent (2.2 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-88 and 3-89, Categories 5 through 8). Based on resource estimates, these lands contain 48 percent (16.0 MMbbls) of the Federal oil and 45 percent (1.1 TCF) of the Federal natural gas.
- Approximately 13 percent (691.7 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-88 and 3-89, Category 9). Based on resource estimates, these lands contain 12 percent (3.9 MMbbls) of the Federal oil and 14 percent (346.7 BCF) of the Federal natural gas.
- Most of the undiscovered gas resource (94 percent) is expected to occur in continuous accumulations.
- Coalbed natural gas accounts for about 13 percent of the total undiscovered continuous gas.

3.1.19 Extrapolated Results for Alaska

- Approximately 96 percent (35.7 million acres) of the Federal land is not accessible (Figures 3-93 and 3-94, Categories 1 through 4). Based on resource estimates, these lands contain 89 percent (557 MMbbls) of the Federal oil and 90 percent (2,108 BCF) of the Federal natural gas.
- Approximately 4 percent (1.7 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-93 and 3-94, Categories 5 through 8). Based on resource estimates, these lands contain 11 percent (66 MMbbls) of the Federal oil and 10 percent (227 BCF) of the Federal natural gas.
- Less than 1 percent (70 thousand acres) of the Federal land is accessible under standard lease terms (Figures 3-93 and 3-94, Category 9). Based on resource estimates, these lands contain no significant Federal oil or natural gas resources.

3.1.20 Extrapolated Results for the Western Region

- Approximately 55 percent (25.2 million acres) of the Federal land is not accessible (Figures 3-95 and 3-96, Categories 1 through 4). Based on resource estimates, these lands contain 57 percent (2,890 MMbbls) of the Federal oil and 58 percent (8,529 BCF) of the Federal natural gas.

Table 3-19. Appalachian Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

Access Category			Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	130	2.4%	0	1.4%	33	1.4%
	2.	No Leasing (Administrative) (NLA)	108	2.0%	1	2.9%	93	3.8%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	1,543	28.7%	11	31.7%	774	32.0%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	673	12.5%	1	4.1%	85	3.5%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	0	0.0%	0	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	95	1.8%	1	3.3%	72	3.0%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	340	6.3%	2	6.5%	145	6.0%
	8.	Leasing, Controlled Surface Use (CSU)[d]	1,796	33.4%	13	38.3%	875	36.1%
Less Constrained	9.	Leasing, Standard Lease Terms (SLTs)	691	12.9%	4	11.8%	347	14.3%
Total, Federal Lands including Split Estate			**5,377**	100.0%	**33**	100.0%	**2,423**	100.0%
Total Non-Federal			**93,175**		**858**		**65,271**	
Total Inventory Area			**98,551**		**891**		**67,694**	

Summary						
Inaccessible (Categories 1-4)	2,454	46%	13	40%	985	41%
Accessible with Restrictions (Categories 5-8)	2,232	42%	16	48%	1,091	45%
Accessible under Standard Lease Terms (Category 9)	691	13%	4	12%	347	14%
Total, Federal Lands Including Split Estate	**5,377**	**100%**	**33**	**100%**	**2,423**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

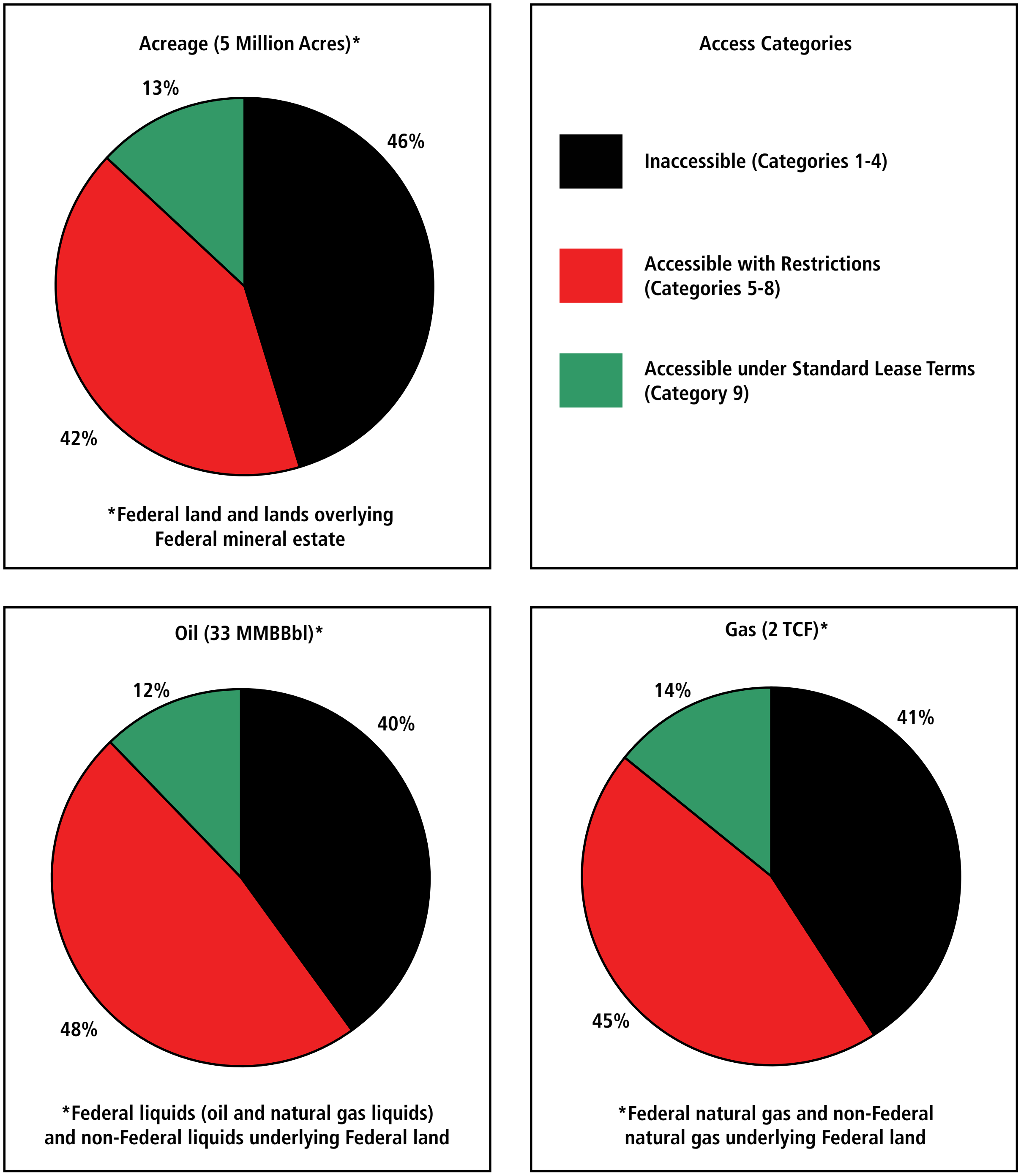

Figure 3-88. Simplified Chart of Results, Appalachian Basin Study Area—Federal Land and Oil and Natural Gas Resources by Accessibility

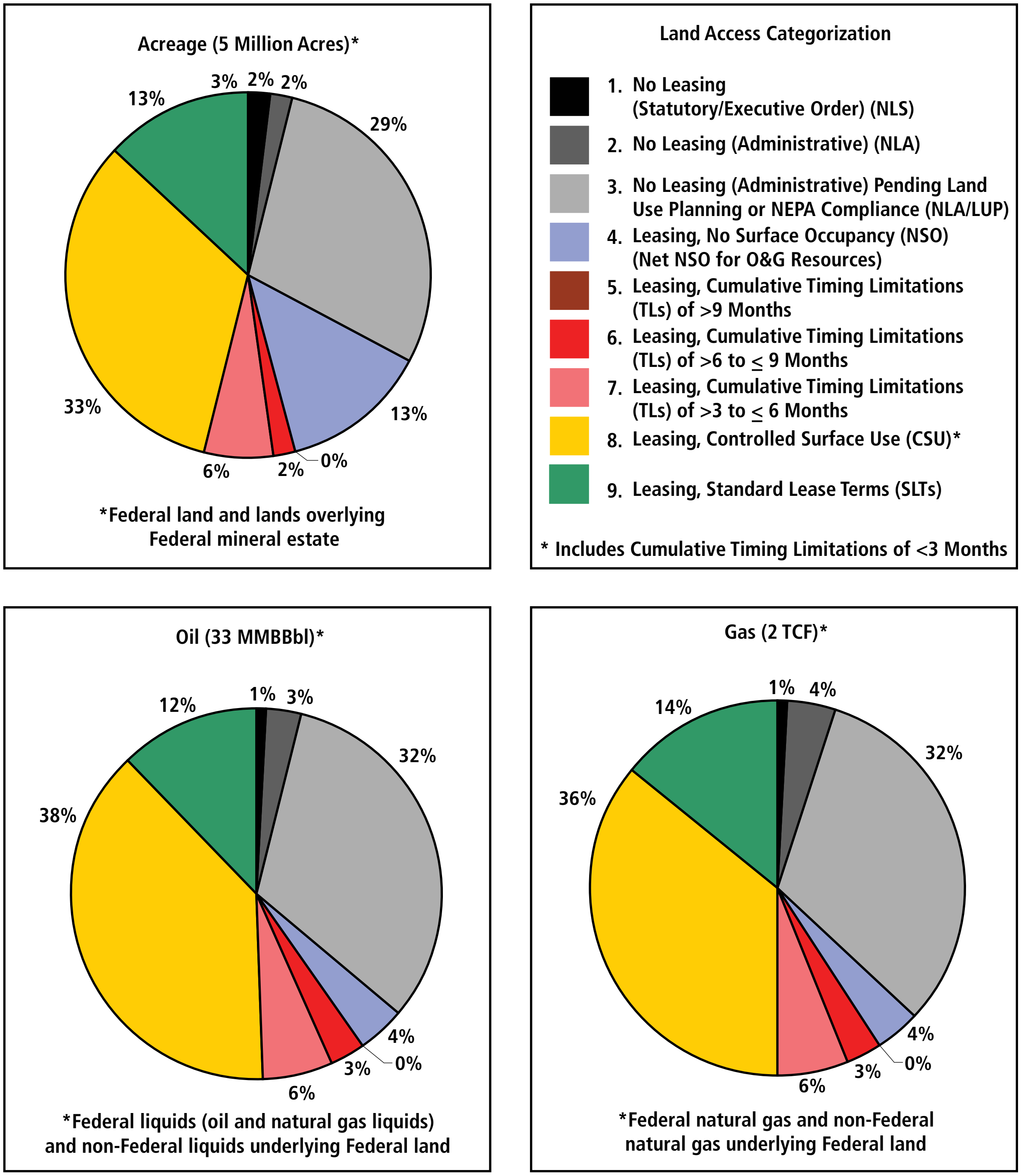

Figure 3-89. Chart of Results, Appalachian Basin Study Area—Federal Land and Oil and Natural Gas Resources by Access Category

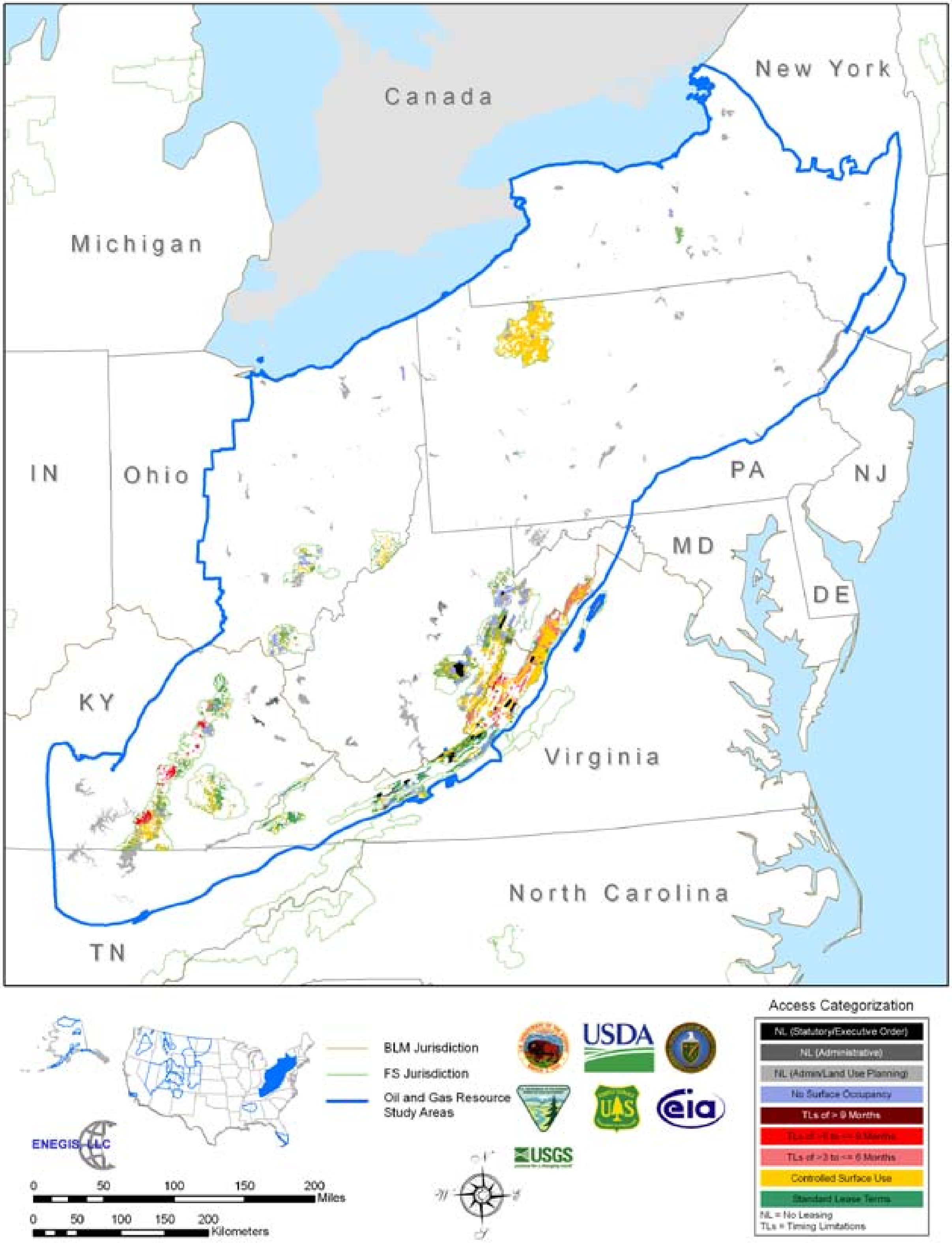

Figure 3-90. Federal Land Access Categorization Map, Appalachian Basin Study Area

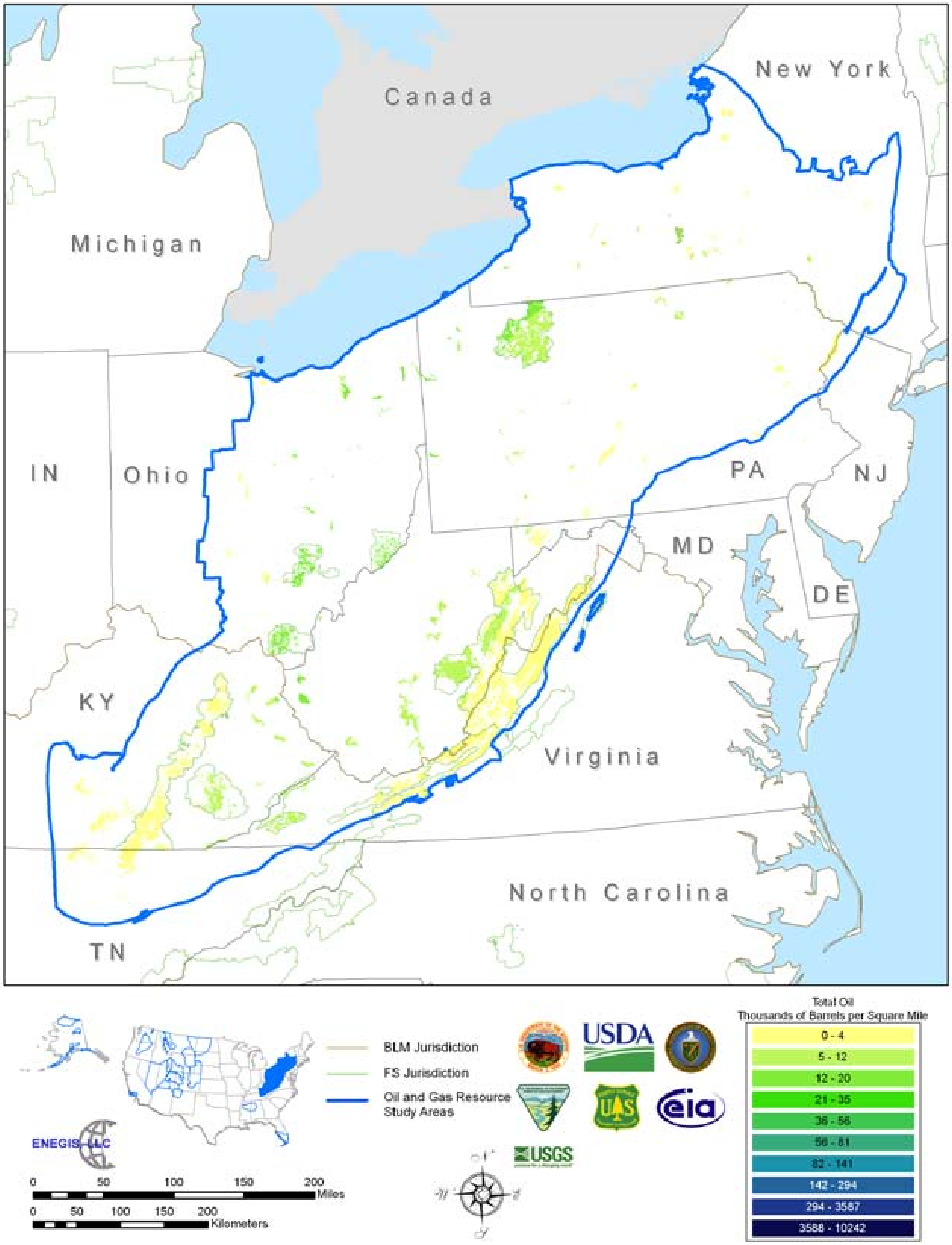

Figure 3-91. Map of Total Federal Oil, Appalachian Basin Study Area

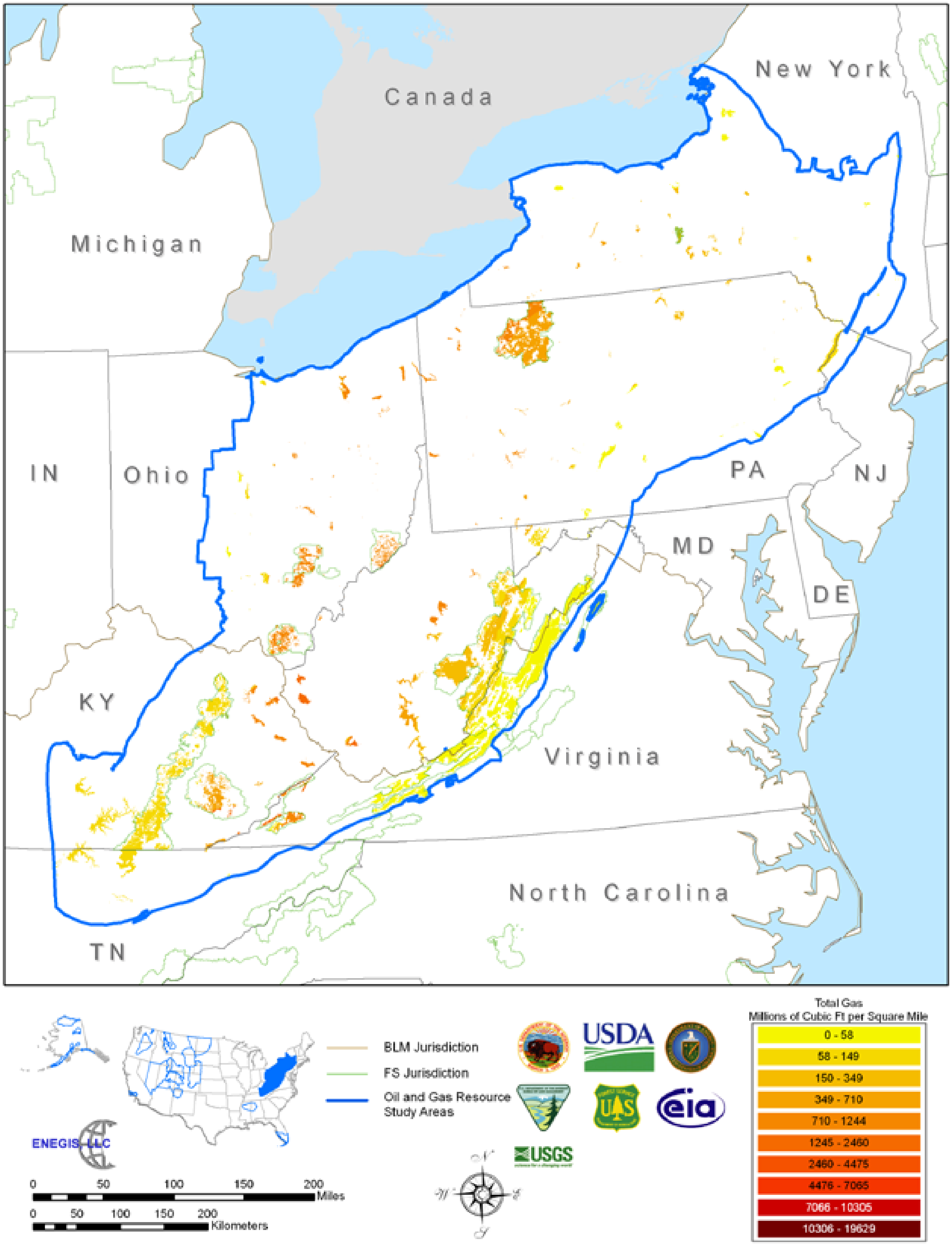

Figure 3-92. Map of Total Federal Natural Gas, Appalachian Basin Study Area

Table 3-20. Extrapolated Results for Alaska —Federal Land and Oil and Natural Gas Resources by Access Category

		Access Category	Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained ↑ Less Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	9,036	24.2%	414	66.4%	542	23.2%
	2.	No Leasing (Administrative) (NLA)	23,380	62.5%	12	1.9%	1,117	47.8%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	3,241	8.7%	128	20.6%	441	18.9%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	61	0.2%	2	0.4%	8	0.4%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	1,556	4.2%	62	9.9%	212	9.1%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	57	0.2%	2	0.4%	8	0.3%
	8.	Leasing, Controlled Surface Use (CSU)[d]	56	0.2%	2	0.4%	8	0.3%
	9.	Leasing, Standard Lease Terms (SLTs)	1	0.0%	0	0.0%	0	0.0%
Total, Federal Lands including Split Estate			**37,388**	100.0%	**623**	100.0%	**2,335**	100.0%
Total Non-Federal			**14,462**		**138**		**1,913**	
Total Inventory Area			**51,850**		**761**		**4,248**	

Summary						
Inaccessible (Categories 1-4)	35,718	96%	557	89%	2,108	90%
Accessible with Restrictions (Categories 5-8)	1,669	4%	66	11%	227	10%
Accessible under Standard Lease Terms (Category 9)	1	0%	0	0%	0	0%
Total, Federal Lands Including Split Estate	**37,388**	**100%**	**623**	**100%**	**2,335**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

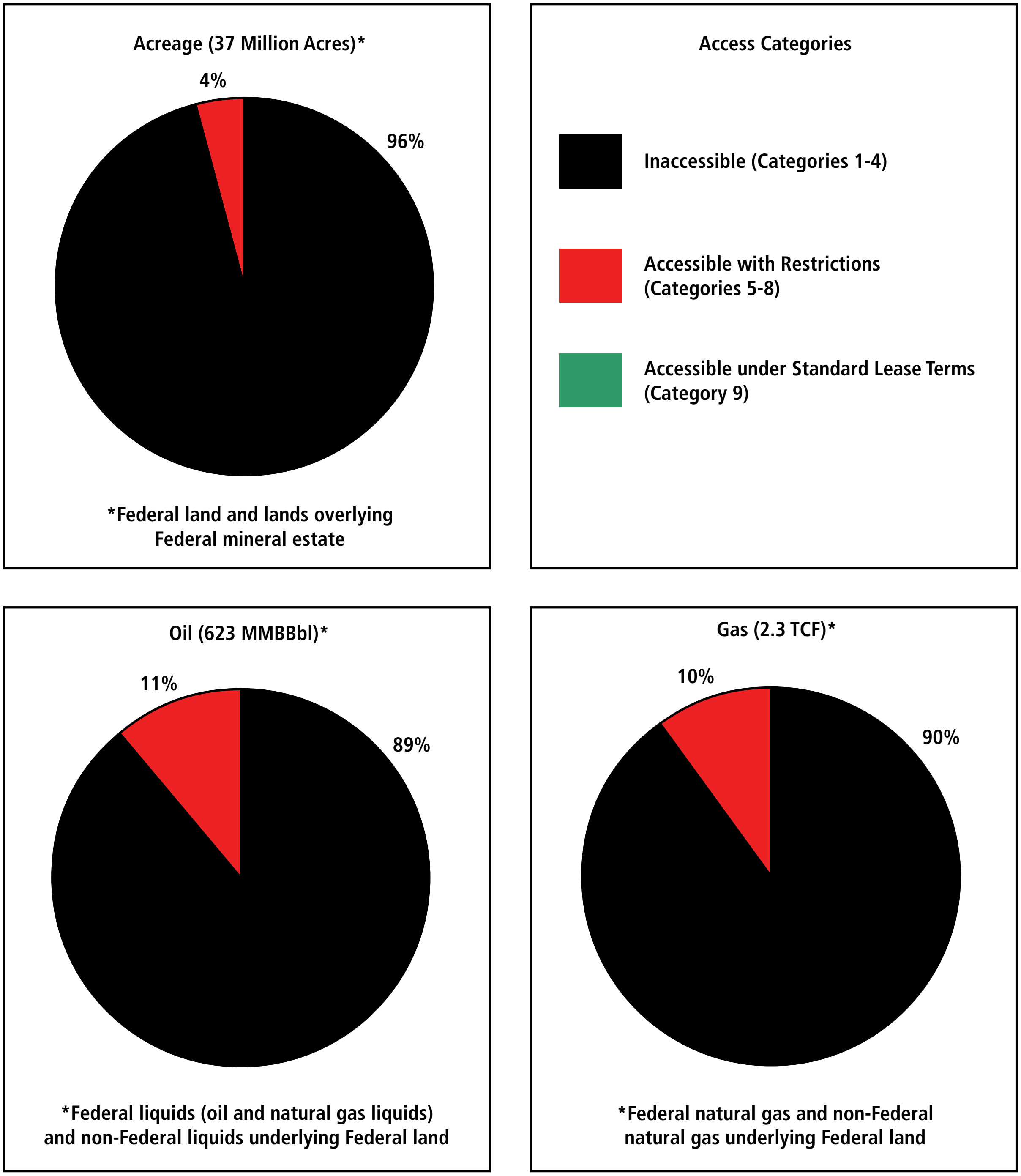

Figure 3-93. Simplified Chart of Results, Extrapolated Results for Alaska—Federal Land and Oil and Natural Gas Resources by Accessibility

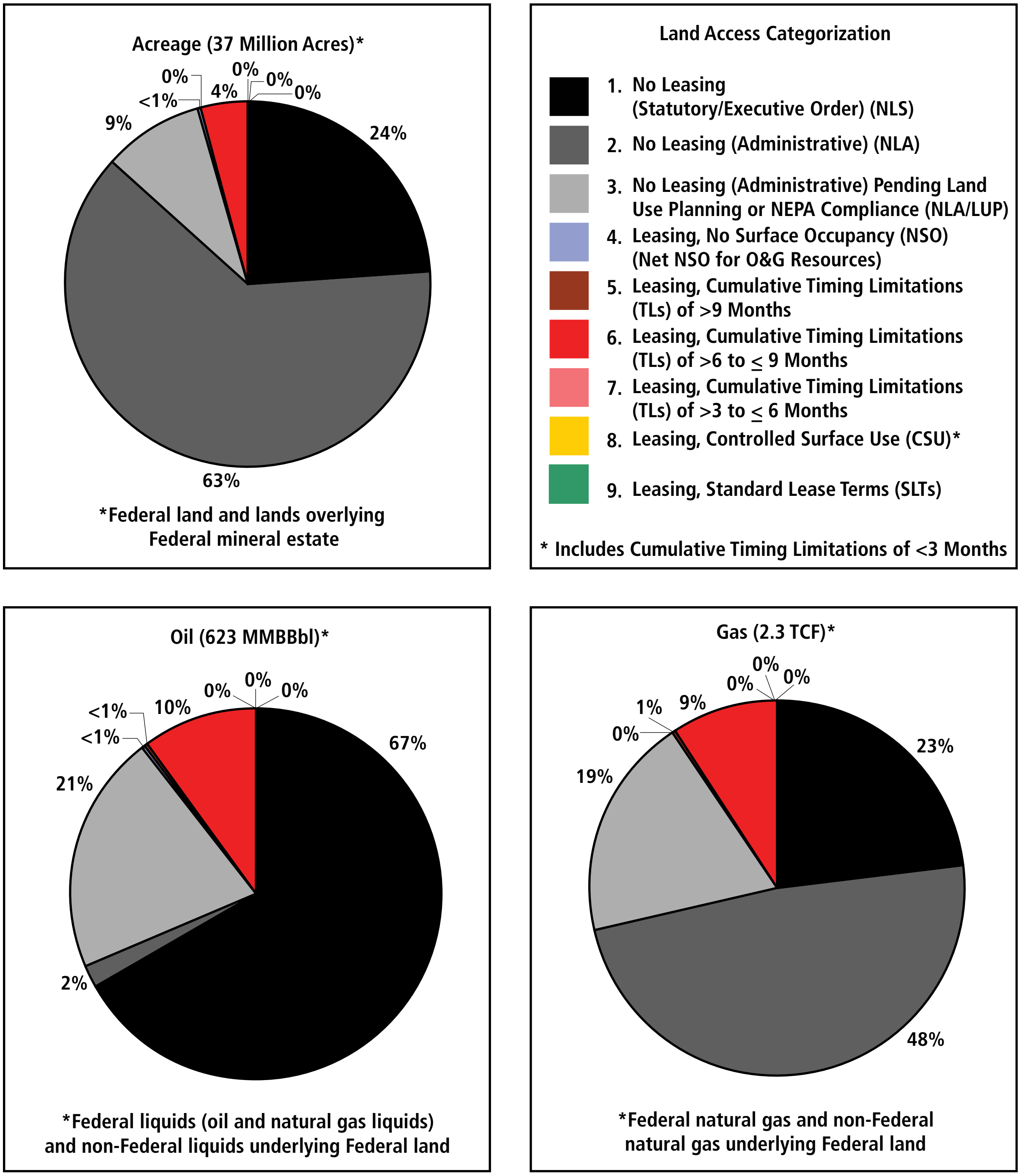

Figure 3-94. Chart of Results, Extrapolated Results for Alaska—Federal Land and Oil and Natural Gas Resources by Access Category

- Approximately 23 percent (10.3 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-95 and 3-96, Categories 5 through 8). Based on resource estimates, these lands contain 21 percent (1,068 MMbbls) of the Federal oil and 21 percent (3,071 BCF) of the Federal natural gas.
- Approximately 22 percent (10.2 million acres) of the Federal land is accessible under standard lease terms (Figures 3-95 and 3-96, Category 9). Based on resource estimates, these lands contain 22 percent (1,106 MMbbls) of the Federal oil and 21 percent (3,131 BCF) of the Federal natural gas.

3.1.21 Extrapolated Results for the Eastern Region

- Approximately 41 percent (5.1 million acres) of the Federal land is not accessible (Figures 3-97 and 3-98, Categories 1 through 4). Based on resource estimates, these lands contain 27 percent (25.0 MMbbls) of the Federal oil and 31 percent (449.5 BCF) of the Federal natural gas.
- Approximately 47 percent (5.8 million acres) of the Federal land is accessible with restrictions on oil and gas operations beyond standard lease terms (Figures 3-97 and 3-98, Categories 5 through 8). Based on resource estimates, these lands contain 58 percent (54.2 MMbbls) of the Federal oil and 55 percent (782.5 BCF) of the Federal natural gas.
- Approximately 12 percent (1.51 million acres) of the Federal land is accessible under standard lease terms (Figures 3-97 and 3-98, Category 9). Based on resource estimates, these lands contain 15 percent (14.0 MMbbls) of the Federal oil and 14 percent (202.8 BCF) of the Federal natural gas.

3.2 Regional Features

Figure 3-99 compares the access charts for the top five basins in each of the following categories: total Federal land, total Federal oil, and total Federal natural gas. The pie chart areas are scaled proportionately to one another within each category. Northern Alaska dominates both the resource categories, followed by the Rocky Mountain basins; however, the Eastern Great Basin contains the most Federal land.

Figure 3-100 is a map showing the Inventory study areas and extrapolated areas with the access category charts compiled by region, relatively sized, by total resources. The largest amount of oil and gas resources are found in the Western Region (206.4 quadrillion BTU). Alaska is second (195.7 quadrillion BTU), followed by the Eastern Region, a distant third in rank (5.7 quadrillion BTU).

About 35 percent of the resources in the Western Region are inaccessible, 37 percent are accessible with additional restrictions (primarily because of timing limitations and the impact of COAs), and 29 percent are accessible under standard lease terms.

About 73 percent of the resources in the Alaska Region are inaccessible, 27 percent are accessible with additional restrictions, and less than 1 percent are accessible under standard lease terms.

About 49 percent of the resources in the Eastern Region are inaccessible, 39 percent are accessible with additional restrictions, and 12 percent are accessible under standard lease terms.

Table 3-21 Extrapolated Results for the Western Region —Federal Land and Oil and Natural Gas Resources by Access Category

Access Category			Area		Resources[a]			
					Total Oil[b]		Total Gas[c]	
			(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
Less Constrained → More Constrained	1.	No Leasing (Statutory/ Executive Order) (NLS)	6,157	13.5%	786	15.5%	1,617	11.0%
	2.	No Leasing (Administrative) (NLA)	6,939	15.2%	801	15.8%	3,363	22.8%
	3.	No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	8,847	19.4%	934	18.5%	2,570	17.4%
	4.	Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	3,213	7.0%	368	7.3%	978	6.6%
	5.	Leasing, Cumulative Timing Limitations (TLs) of >9 Months	70	0.2%	7	0.1%	20	0.1%
	6.	Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	564	1.2%	54	1.1%	171	1.2%
	7.	Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	3,560	7.8%	355	7.0%	1,048	7.1%
	8.	Leasing, Controlled Surface Use (CSU)[d]	6,101	13.4%	652	12.9%	1,832	12.4%
	9.	Leasing, Standard Lease Terms (SLTs)	10,208	22.4%	1,106	21.8%	3,131	21.3%
Total, Federal Lands including Split Estate			**45,660**	100.0%	**5,064**	100.0%	**14,731**	100.0%
Total Non-Federal			**429,802**		**40,816**		**187,098**	
Total Inventory Area			**475,462**		**45,879**		**201,829**	

Summary						
Inaccessible (Categories 1-4)	25,157	55%	2,890	57%	8,529	58%
Accessible with Restrictions (Categories 5-8)	10,295	23%	1,068	21%	3,071	21%
Accessible under Standard Lease Terms (Category 9)	10,208	22%	1,106	22%	3,131	21%
Total, Federal Lands Including Split Estate	**45,660**	**100%**	**5,064**	**100%**	**14,731**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

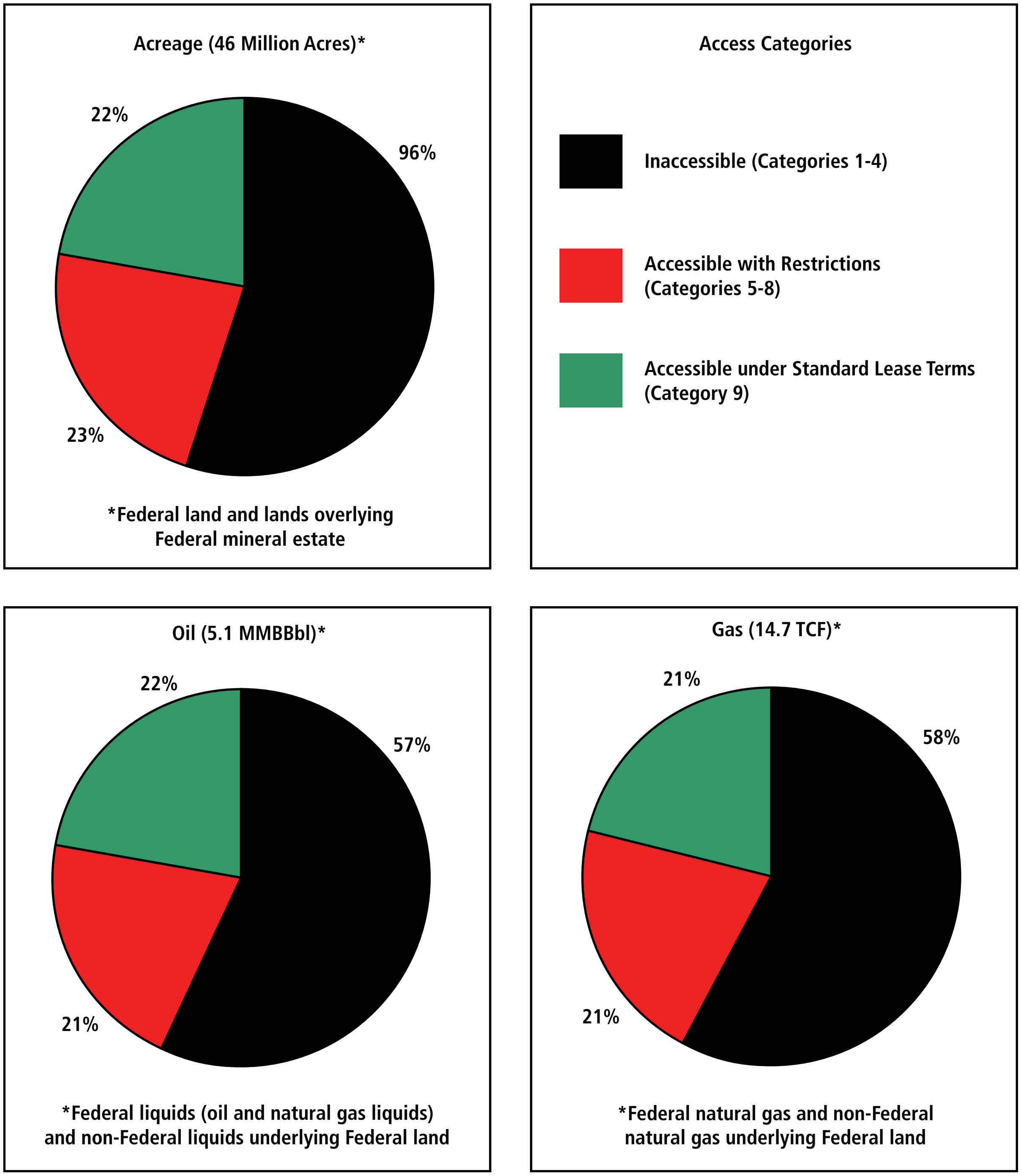

Figure 3-95. Simplified Chart of Results, Extrapolated Results for the Western Region —Federal Land and Oil and Natural Gas Resources by Accessibility

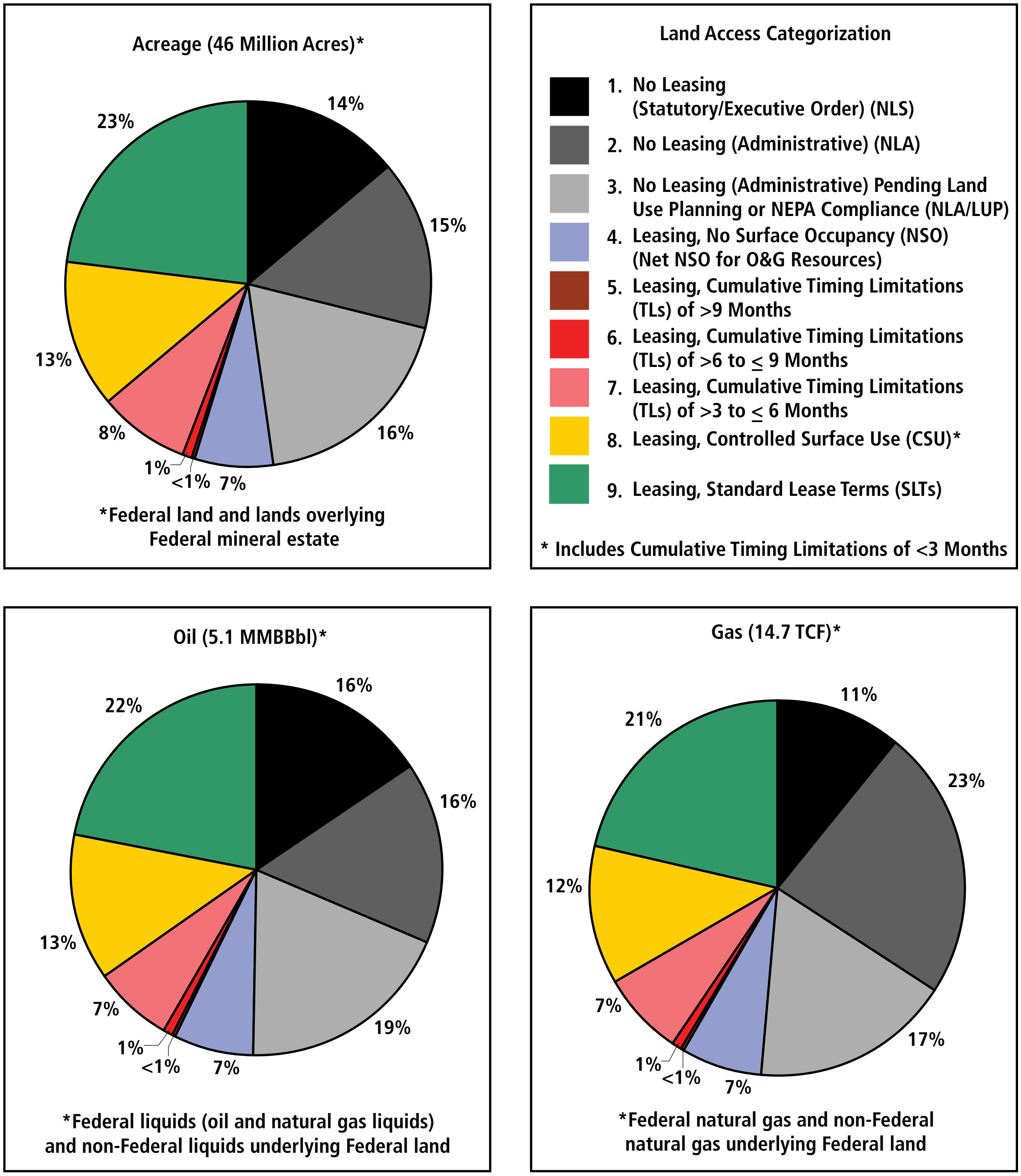

Figure 3-96. Chart of Results, Extrapolated Results for the Western Region—Federal Land and Oil and Natural Gas Resources by Access Category

Table 3-22 Extrapolated Results for the Eastern Region—Federal Land and Oil and Natural Gas Resources by Access Category

	Access Category	Area		Resources[a]			
				Total Oil[b]		Total Gas[c]	
		(acres x 1000)	Percent of Federal	(MMbbls)	Percent of Federal	(BCF)	Percent of Federal
More Constrained	1. No Leasing (Statutory/ Executive Order) (NLS)	671	5.4%	4	4.0%	61	4.2%
	2. No Leasing (Administrative) (NLA)	420	3.4%	1	1.3%	19	1.3%
	3. No Leasing (Administrative) Pending Land Use Planning or NEPA Compliance (NLA/LUP)	2,005	16.1%	5	5.9%	136	9.5%
	4. Leasing, No Surface Occupancy (NSO) (Net NSO for O&G Resources)	2,009	16.1%	15	15.7%	233	16.2%
	5. Leasing, Cumulative Timing Limitations (TLs) of >9 Months	-	0.0%	-	0.0%	-	0.0%
	6. Leasing, Cumulative Timing Limitations (TLs) of >6 to ≤9 Months	251	2.0%	2	2.4%	33	2.3%
	7. Leasing, Cumulative Timing Limitations (TLs) of >3 to ≤6 Months	1,400	11.2%	13	14.0%	188	13.1%
	8. Leasing, Controlled Surface Use (CSU)[d]	4,186	33.6%	39	41.7%	561	39.1%
Less Constrained	9. Leasing, Standard Lease Terms (SLTs)	1,515	12.2%	14	15.1%	203	14.1%
Total, Federal Lands including Split Estate		**12,458**	100.0%	**93**	100.0%	**1,435**	100.0%
Total Non-Federal		**198,406**		**1,109**		**19,380**	
Total Inventory Area		**210,864**		**1,202**		**20,814**	

Summary						
Inaccessible (Categories 1-4)	5,106	41%	25	27%	450	31%
Accessible with Restrictions (Categories 5-8)	5,837	47%	54	58%	783	55%
Accessible under Standard Lease Terms (Category 9)	1,515	12%	14	15%	203	14%
Total, Federal Lands Including Split Estate	**12,458**	**100%**	**93**	**100%**	**1,435**	**100%**

[a] Undiscovered technically recoverable resources and reserves growth

Small rounding errors may be present.

[b] Including oil, natural gas liquids (NGLs) and liquids associated with natural gas reservoirs

[c] Including associated dissolved and nonassociated natural gas

[d] Includes Cumulative Timing Limitations of ≤3 months

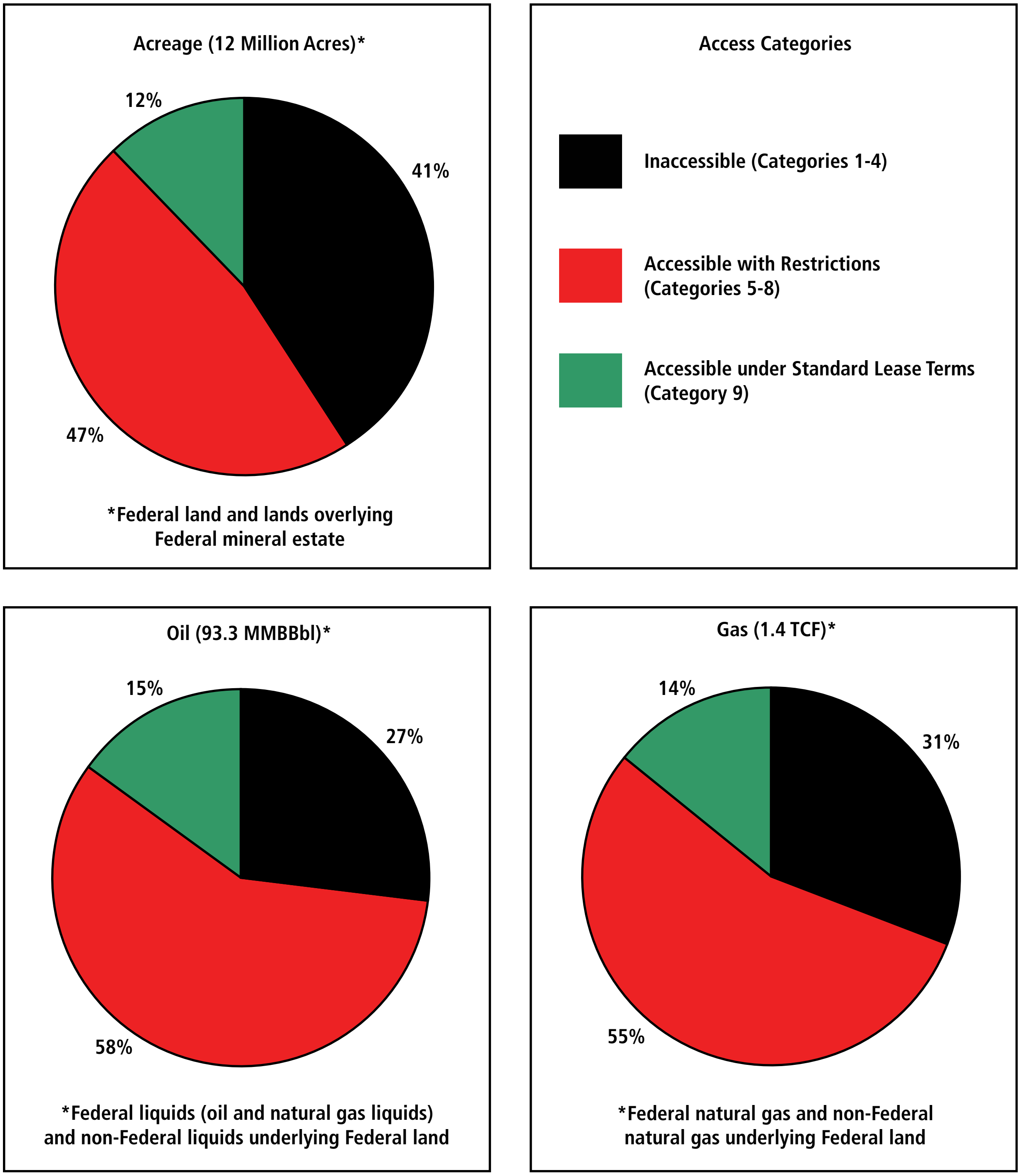

Figure 3-97. Simplified Chart of Results, Extrapolated Results for the Eastern Region—Federal Land and Oil and Natural Gas Resources by Accessibility

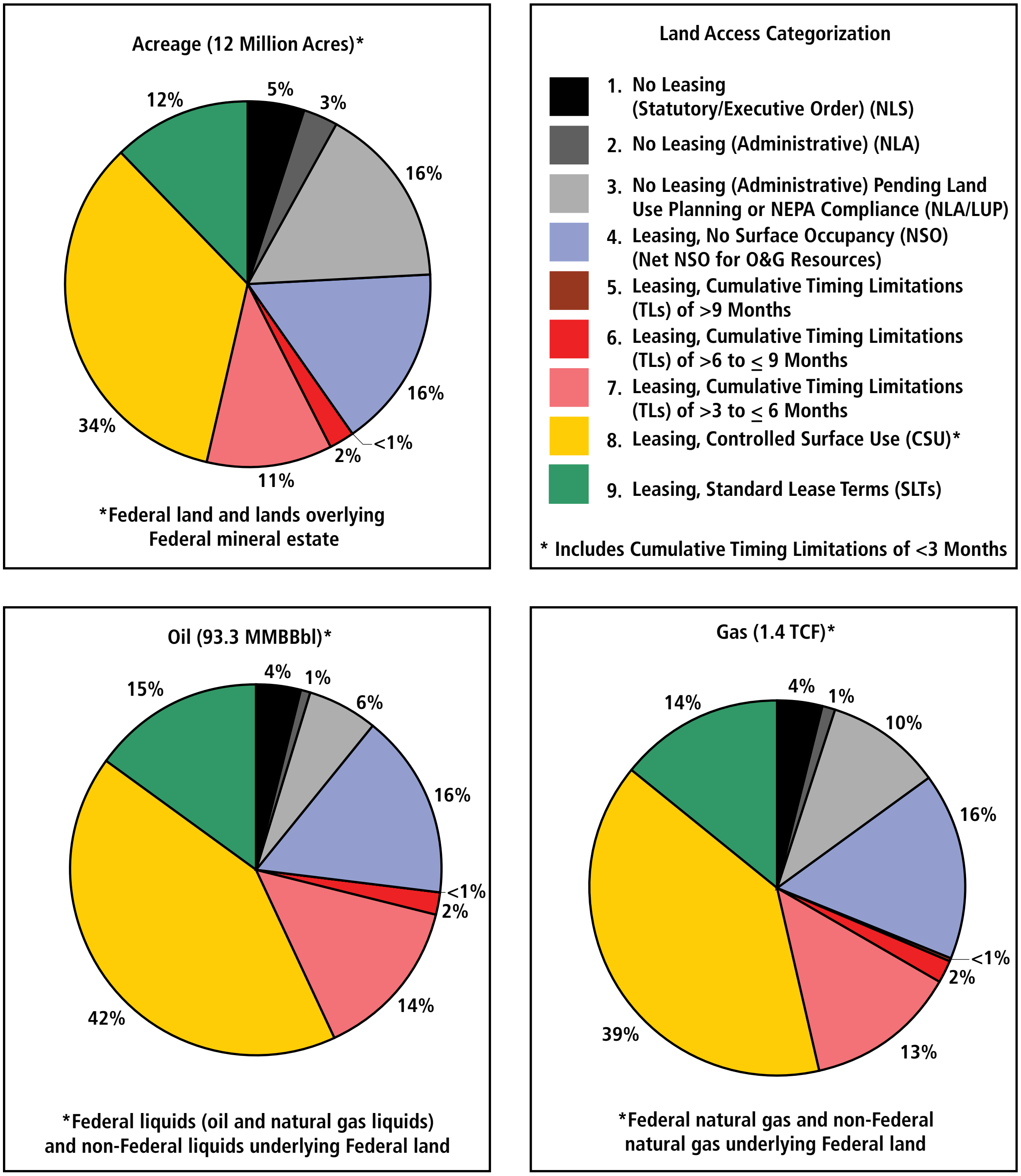

Figure 3-98. Chart of Results, Extrapolated Results for the Eastern Region—Federal Land and Oil and Natural Gas Resources by Access Category

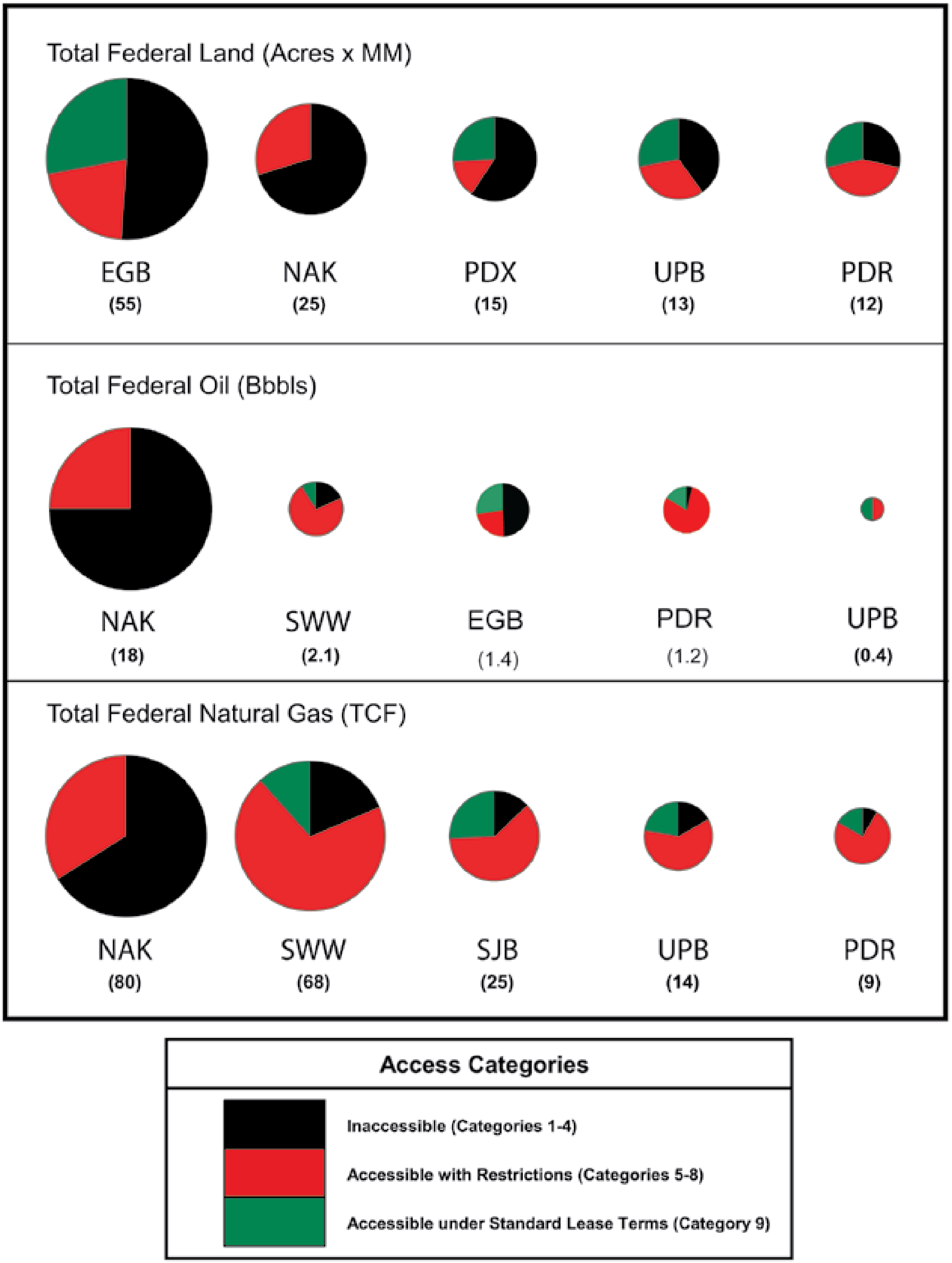

Figure 3-99. Charts of the Top Five Areas

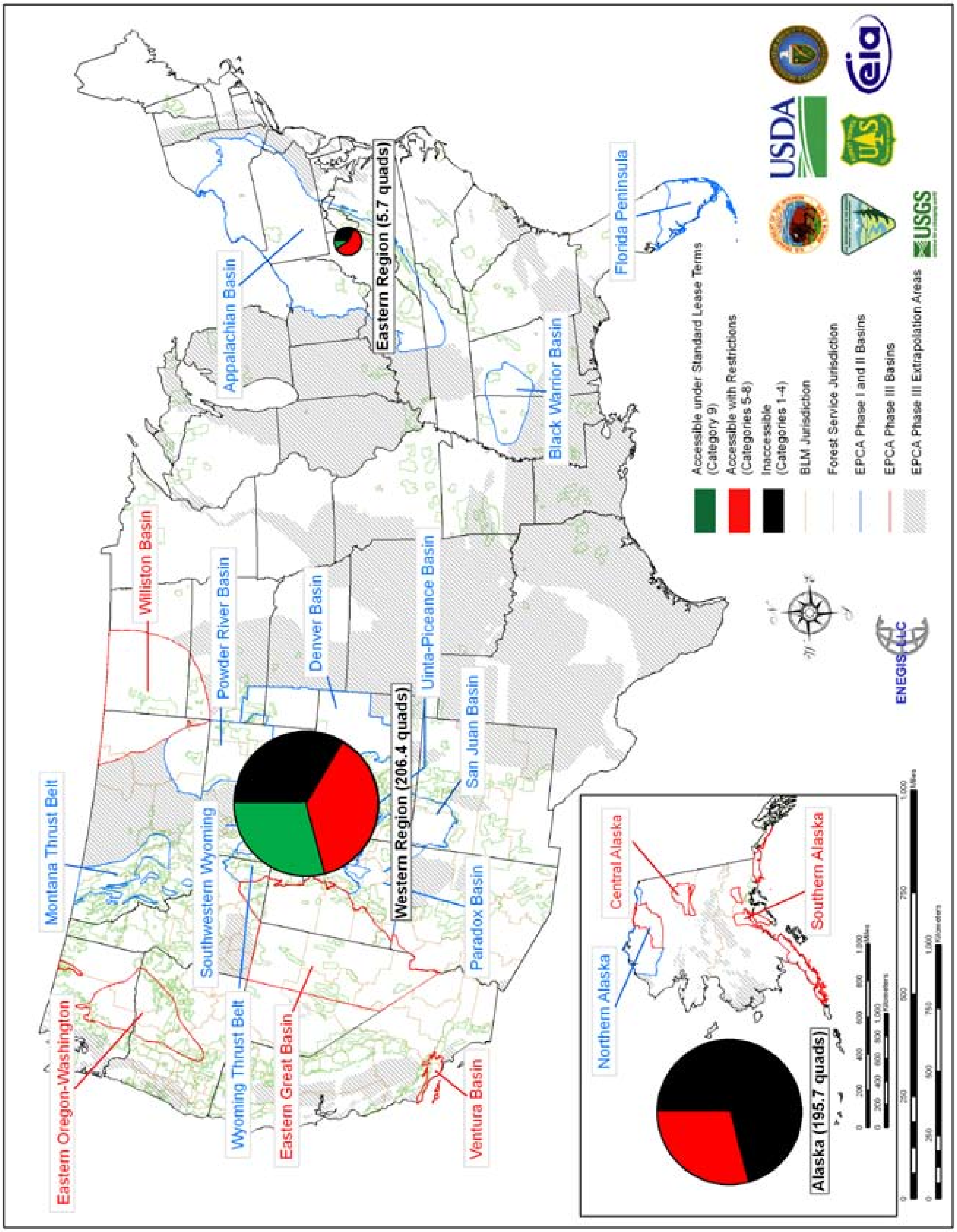

Figure 3-100. Regional Charts

4.0 Additional Federal Land Access Issues

Additional statutory and discretionary requirements beyond lease stipulations impact Federal land access for oil and gas development. Many of these impacts were not quantified because GIS data do not exist, or they are issues that are not amenable to quantitative analysis. Many of these requirements can be considered restrictions on drilling because they have effects similar to stipulations on oil and gas development activities.

These issues can directly or indirectly impact Federal land accessibility for oil and gas development. Tables 4-1 through 4-16 present office-specific issues that were recorded from discussions with BLM and FS staff during field visits. Average APD processing time was calculated for each office using input from the offices supplemented by an analysis of BLM's Automated Fluid Minerals Support System (AFMSS).[47]

4.1 Issues Directly Impacting Access

The National Environmental Policy Act of 1969. The NEPA is the nation's central environmental statute. It requires Federal agencies to consider environmental impacts before an action is taken. The NEPA process is intended to help public officials make better decisions based on an understanding of their environmental consequences.

The NEPA is embedded into the fabric of Federal land management decision-making and has become the most important procedural public land management statute because it requires agencies to comply with its processes in all situations where major actions are contemplated. When an activity or action is proposed on Federal lands, an interdisciplinary review of the environmental effects of the proposal is conducted and made available to citizens and public officials. The review can take one of four forms:

- a categorical exclusion (CX)
- documentation of NEPA adequacy (DNA)
- an environmental assessment (EA)
- an environmental impact statement (EIS)

The NEPA process can impact oil and gas development in terms of cost and time delays. Typically an EIS or EA is drafted in consultation with the cooperating agencies, presented for public comment, and reviewed by multiple agencies. A simple EIS can take 24 to 36 months to complete, while those with more complex issues may require three to six years to complete. The land use planning process as a whole takes in excess of 36 months, particularly if there is oil and gas involved. The NEPA documents analyze alternatives to the proposed action and must include a "no action" alternative. Impacts are classified as direct, indirect, and cumulative, and include the evaluation of economic impacts to counties and states to be considered, as well as impacts on resources.

When considering oil and gas leasing, the BLM has identified the need to obtain

[47] These tables include only offices that were visited or specifically contacted during EPCA Phase I, Phase II, and Phase III data collection. Not all offices responded. In addition, areas for which an extrapolation was conducted to determine land and resource access categorization (see Appendices 4 and 9) are not included in this section.

Table 4-1. Access Issues, Northern Alaska Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Fairbanks, AK BLM (Northern Field Office)	No EA: 60 days, with EA: 30 days	NE NPRA Final Integrated Activity Plan/EIS. NW NPRA Final Integrated Activity Plan/EIS.	Critical habitat not mapped, office takes conservative approach		Native coporations (subsistence resources), increased consultation required	

*Calculated based on office interviews and analysis of AFMSS data

Table 4-2. Access Issues, Southern Alaska Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Chugash NF		Revised Land and RMP for the Chugash NF, 2003	Raptors			
Tongass NF		Revised Land and RMP for the Tongass NF, 1997				

*Calculated based on office interviews and analysis of AFMSS data

Table 4-3. Access Issues, Eastern Oregon-Washington Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Deschutes NF	1-2 years	Deschutes NF Plan, 1990	Lynx, bald eagle, salmon, trout, steelhead, sage grouse		A need to keep tribes informed	
Lakeview, OR BLM		Lakeview RMP, 2003	Pygmy rabbit, sage grouse		Several tribes; back-and-forth interaction required	
Ochoco NF	1-2 years	Ochoco NF, Oil and Gas Leasing Analysis Final EIS, 1993	Lynx, bald eagle, salmon, trout, steelhead, sage grouse		A need to keep tribes informed	

National Historic Preservation Act	**O&G vs Coal and other Mineral Development**	**Visual Resources**	**Air Quality**	**Clean Water**	**Infrastructure Concerns**	**Others**
			Modeling required for each point source		Lack of infrastructure, ice roads	Coastal Zone Management Act, wetlands, oil spill plans, litigation, all slow down process

National Historic Preservation Act	**O&G vs Coal and other Mineral Development**	**Visual Resources**	**Air Quality**	**Clean Water**	**Infrastructure Concerns**	**Others**
Culturally rich area				Issue regarding salmon habitat preservation		ANILCA can be an issue relative to environmental preservation; subsistence uses, e.g., moose hunting and fishing; budget constraints; increased tourism for "pristine environment"
Culturally rich area				Issue regarding salmon habitat preservation		ANILCA can be an issue relative to environmental preservation; subsistence uses, e.g., moose hunting and fishing; budget constraints; increased tourism for "pristine environment"

National Historic Preservation Act	**O&G vs Coal and other Mineral Development**	**Visual Resources**	**Air Quality**	**Clean Water**	**Infrastructure Concerns**	**Others**
Large paleontological sites, cultural plants			Increasing O&G development would be problematic	Increasing O&G development would be problematic		Oil and gas skills lacking in office
						If leasing occurs, staffing would be a concern
Large paleontological sites, cultural plants						Oil and gas skills lacking in office

Table 4-3. Access Issues, Eastern Oregon-Washington Study Area (continued)

Jurisdiction	Issue or Characteristic Noted by Office				
	Average APD Processing*	**NEPA Documents**	**Endangered Species Act and Species Generally of Concern**	**Roadless Areas**	**Tribal Consultations**
Prineville, OR BLM	1-2 years	John Day River Management Plan, Two Rivers, John Day, and Baker RMP, 2001; Prineville - Two Rivers RMP; Prineville - Upper Deschutes RMP; Brothers/ LaPine RMP, 1989; challenges to NEPA documents	Lynx, bald eagle, salmon, trout, steelhead, sage grouse		A need to keep tribes informed
Spokane, WA BLM		Proposed Spokane RMP and Amended Final EIS, 1992			
Umatilla NF		Umatilla and Malheur NFs, Oil and Gas Leasing Final EIS, 1995; numerous challenges to NEPA documents	Fisheries: salmon, bull and steel trout; lynx		Significant consultation required
Vale, OR BLM	1-2 years	Baker RMP, 1989	Lynx, bald eagle, salmon, trout, steelhead, sage grouse		A need to keep tribes informed

*Calculated based on office interviews and analysis of AFMSS data

Table 4-4. Access Issues, Ventura Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office				
	Average APD Processing*	**NEPA Documents**	**Endangered Species Act and Species Generally of Concern**	**Roadless Areas**	**Tribal Consultations**
Angeles NF		Revised Land Management Plan and Final EIS for Angeles NF, 2000	Several species in riparian habitats (stickleback toad, frog, flycatcher)		
Bakersfield, CA BLM		Caliente RMP, 1997	Condor		
Los Padres NF		Revised Land Management Plan and Final EIS for Los Padres NF, 2005	Condor, riparian species		
Palm Springs, CA BLM		South Coast RMP and ROD, 1994			

*Calculated based on office interviews and analysis of AFMSS data

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Large paleontological sites, cultural plants						Suburban encroachment issues; oil and gas skills lacking in office
				80% of streams listed as impaired		Lack of cooperation with state agencies; Oregon state restrictive for surface access on split estate; if leasing were to occur, staffing would be inadequate
Large paleontological sites, cultural plants						Suburban encroachment issues; oil and gas skills lacking in office

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
		Open space presentation	Issue in non attainment area	Water usage issues	Traffic, unstable geology, road access is difficult due to geology and topography, high speed rail is proposed	Environmental justice, "Not In My Backyard" philosophy; if leasing were to occur, staffing would be inadequate
			Issue in non attainment area			Urban encroachment
May require a pre-lease inventory		Off-forest development impacting recreation NSO			Age of infrastructure issues	Urban encroachment, "Not In My Backyard" philosophy; if leasing were to occur, staffing would be inadequate
						Urban interface issues, especially Santa Clarita

Table 4-5. Access Issues, Eastern Great Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Arizona Strip, AZ BLM		Arizona Strip DO RMP / EIS, 1992	Desert tortoise			
Battle Mountain, NV BLM		Egan RMP Approved Oil and Gas Leasing Amendment and ROD, 1994; Tonopah RMP and ROD, 1997	Sage grouse, pygmy rabbits, trout, raptors		Tribes generally participate in consultation	
Burley, ID BLM		Cassia RMP, 1985; Monument RMP, 1986; challenges to NEPA documents are frequent	River snails			
Elko, NV BLM		Elko RMP and List of Stipulations, 1987; Wells ROD and List of Stipulations, 1985	Fisheries, bull trout, bats, pygmy rabbit, raptors		Shoshoni tribe prefers no development	
Ely, NV BLM		Egan RMP Approved Oil and Gas Leasing Amendment and ROD, 1994	Desert tortoise, sage grouse, pygmy rabbit (habitat not mapped), migratory birds			
Fillmore, UT BLM		House Springs Resource Area RMP and ROD Rangeland Program Summary, 1987; Warm Springs Resource Area RMP and Rangeland Program Summary, 1987	Critical big game habitat			
Idaho Falls, ID BLM		Big Desert Management Plan, 1981				
Las Vegas, NV BLM		Las Vegas RMP and Final EIS, 1998			Concern with some tribes	
Pocatello, ID BLM		Pocatello and Medicine Lodge Resource Areas RMP, 1988	Grey wolf, bald eagle, Snake River snails, Ute's lady's truss			
Salt Lake City, UT BLM		Bear River EA, 1994; ROD and Rangeland Program Summary for the Box Elder RMP, 1986; ROD for the Pony Express RMP and Rangeland Program Summary for Utah County, 1990				

*Calculated based on office interviews and analysis of AFMSS data

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Numerous cultural sites and trails - Spanish Trail, Mormon Trail						If leasing were to occur, staffing would be inadequate
Issue may arise with older surveys						If more leasing were to occur, staffing would be inadequate
Historic trails and ACECs exist	Potential conflicts with decorative stone mining in the Middle Mountain Area	Class I viewsheds			Access to FS lands via private lands	"Not In My Backyard" philosophy in Albion Valley; If leasing were to occur, staffing would be inadequate
Not many sites are greater than the EDZ buffer; Pine Valley Narrow Gague Railway		Issues with I-80 corridor				Issues with split estate in unincorporated areas; staffing adequate at present; citizens' general distrust of Federal government
Numerous cultural sites						Suburban encroachment; local handling of APDs would shorten processing time; if leasing were to occur, staffing would be inadequate
						Cumulative analysis shows that drilling >6 wells per year would require an amendment
				Sediment and nutrient loading issues		If leasing were to occur, staffing would be inadequate
	Tar sands					Recreation conflicts if O&G development occurs; Authorization Bill of 2000 hiners land use planning

Table 4-6. Access Issues, Paradox Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Cedar City, UT BLM		Cedar Beaver Garfield Antimony RMP, 1986	Raptors			
Kanab, UT BLM	6 to 12 months	Escalante MFP, 1981; Henry Mtn., Parker Mtn., and Mtn. Valley MFP, 1982; Paria MFP, 1981; Vermillion MFP, 1981; Zion MFP, 1981	Raptors, bald eagle, Mexican spotted owl, flycatcher			
Manti-La Sal NF	1 year	Land and RMP – Manti-La Sal NF, 1986. New plan to be released in December 2006; virtually all NEPA documents are challenged	Goshawks, raptors, Mexican spotted owl, sensitive plants			
Moab, UT BLM	Average 6 months, note deficient APDs from companies	Lopez Project, Utah State BLM Statewide Stipulations, Book Cliffs RMP, 1985	Mexican spotted owl, raptors, pedio, despainii and winklerii cacti			
Monticello, UT BLM	60 days	Lopez Project, Utah State BLM Statewide Stipulations	Mexican spotted owl, raptors		McCraken Extension (50,000 acres) is split estate with Navajo lands (3 or 4 APDs per year); Navajo wants to reclaim mineral rights	
Montrose, CO BLM (Uncompahgre Field Office)	30 to 60 days	San Juan/San Miguel RMP Amendment, October 1991. New plan to be released in December 2006				
Price, UT BLM	8 months	Lopez Project, Utah State BLM Statewide Stipulations. Price RMP in draft.	Despainii and winklerii cacti, raptors			
Richfield, UT BLM	30 days or less	Lopez Project, Utah State BLM Statewide Stipulations				
St. George, UT BLM		St. George FO – ROD and RMP, 1999. No site specific NEPA coverage	Mexican spotted owl, southwestern willow flycatcher, Desert tortoise		MOUs with Southern Piute and Hopis; Southern Piute generally not supportive of O&G activities	
Salt Lake City, UT BLM		Bear River EA, 1994; ROD and Rangeland Program Summary for the Box Elder RMP, 1986; ROD for the Pony Express RMP and Rangeland Program Summary for Utah County, 1990				

*Calculated based on office interviews and analysis of AFMSS data

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Cultural resource concerns on any area, but "can be mitigated"		Secondary issue				Steep slope issues; if leasing were to occur, staffing would be inadequate
		Issues associated with Bryce and Zion NPs		Water disposal may be a problem in Navajo Sandstone		
	Conflict with deep gas vs. coal	Retention and preservation areas near NPs (e.g., Arches, Canyonlands)			Roads used for nonsummer months require 8 inches of gravel	There exists a potential for land exchange with state such that these areas would not be leased; however, these areas have not been demarcated; need for hydrology and other specialists
		Can be an issue in larger field developments. RMP treats VR as an inventory process as opposed to management objective. Gas flaring would be an issue			Big flat areas-well spacing maximized and at capacity; in order for further field developments an EIS would be required.	Anticipate increased NSO due to wilderness recreation and wildlife concerns. Recreational conflicts vs APDs/geophysical surveys/oil & gas development
High density of cultural sites, cost issue for industry but does not prohibit activity		Similar to Moab office				It would be advantageous for companies to be educated in NEPA and APD requirements
				Concerned with surface water depletion		
		Last Chance field near Capital Reef NP				
Old Spanish Trail, Mormon Trail; an estimated 12,000 cultural sites in Washington County		Zion National Park proximity	Zion National Park proximity	In process of assessing Clean Water Act amendment; Virgin and Colorado Rivers - salinization requirements, highly erodible soils		Urbanization, rural development on Split Estate; if leasing were to occur, staffing would be inadequate
	Tar sands					Recreation conflicts if O&G development occurs; Authorization Bill of 2000 hiners land use planning

Table 4-7. Access Issues, San Juan Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Albuquerque, NM BLM (Rio Puerco Field Office)	60 days	Rio Puerco RMP, 1992. Updated in 2001			30 days for tribes to comment	
Carson NF	6 months	Carson NF Plan, 1986	Mexican spotted owls, goshawks, bald eagles		Potential issue, esp. Gobernador	
Cibola NF		Cibola NF Plan, 1985	Mexican spotted owls, goshawks, bald eagles		Pueblo and Navajo Nation–sacred Mt. Taylor	
Durango, CO BLM (San Juan Field Office)	3 months	San Juan/San Miguel RMP Amendment, October 1991. New plan to be released in 2007	Sage grouse, flycatcher, ferruginous hawk, bald eagle			
Farmington, NM BLM	60-180 days	Farmington Oil and Gas Leasing Amendment, 1991. Farmington RMP completed 01/2005	Bald eagle, Nolton's cactus, designated Mexican spotted owl habitat, razorback sucker		Split estate with Navajo surface requires 6 months to a year	
Grand Mesa/ Uncompahgre/ Gunnison NF	25 months	GMUG - Oil and Gas Leasing File EIS ROD, April 1993	Lynx	NLA		
San Juan NF	6 months	New plan to be released in December 2006	Willow flycatcher, Mexican spotted owl, Canada lynx			
Santa Fe NF		1987 Forest Plan, amended 1996	Mexican spotted owls, bald eagles		High density of cultural resources	
St. George, UT BLM		St. George FO – ROD and RMP, 1999. No site specific NEPA coverage	Mexican spotted owl, southwestern willow flycatcher, Desert tortoise		MOUs with Southern Piute and Hopis; Southern Piute generally not supportive of O&G activities	
Salt Lake City, UT BLM		Bear River EA, 1994; ROD and Rangeland Program Summary for the Box Elder RMP, 1986; ROD for the Pony Express RMP and Rangeland Program Summary for Utah County, 1990				

*Calculated based on office interviews and analysis of AFMSS data

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Lindrith Area-split estate with high density of cultural resources				Impaired watershed (Rio Puerco) not an issue yet but could develop; sediment loading issue		
Navajo–high density of cultural resources			Centralized compression	Sediment loading, produced water	Road density	Differing motivation (Fed. vs. state) for approval of well spacing (revenue issue for NM); compliance issues
High density archeological sites			Compressors	Sediment loading		Law suit in Zuni River watershed
Archeological sites, esp. Canyons of the Ancients (existing leases)				EIS in progress; moderate but increasing concern with surface water depletion and its effects on species	Conflicts due to increased infrastructure (public use vs. industry), esp. near Durango	
High density of cultural resources	Conflict with underground mines and CBM (oil & gas rights are senior), BLM continues to issue APDs but only in center of long wall panels		Additional compression (public concern)	Endangered fish, consultation with Army Corps of Engineers	Centralized compression (noise concerns)	
High density of cultural resources			Issues related to proximity to Durango	Residential concern about methane contamination	Public concerns about O&G development in general	Do not have forest-wide stipulations
High density of resources impacts road building		VR concerns make siting more difficult, esp. roads		Sediment loading from road construction	Aging infrastructure	Reclamation compliance and inspection
Old Spanish Trail, Mormon Trail; an estimated 12,000 cultural sites in Washington County		Zion National Park proximity	Zion National Park proximity	In process of assessing Clean Water Act amendment; Virgin and Colorado Rivers - salinization requirements, highly erodible soils		Urbanization, rural development on Split Estate; if leasing were to occur, staffing would be inadequate
	Tar sands					Recreation conflicts if O&G development occurs; Authorization Bill of 2000 hiners land use planning

Table 4-8. Access Issues, Montana Thrust Belt Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Beaverhead-Deerlodge NF		1996 Beaverhead Oil and Gas EIS, 1987 FP under revision	Lynx, sage grouse		Nez Pierce Trail	
Butte and Lewistown, MT BLM		1984 Headwaters RMP (under revision), 1981 Butte District Oil & Gas environmental assessment	Grizzly bears, grey wolf, Canada lynx, reptiles, plants, raptors, fish (spawning streams, trout)	Lease sale protest decision, 1989 impacts leasing	Old North trail (historical indian migration route but with no distinct area defined)	
Dillon, MT BLM		Dillon RMP, 2006	Cutthroat trout, sage grouse, lynx, wolf reintroduction, bald eagles		Spiritual sites	
Gallatin NF		1987 Forest Plan scheduled for 2009 revision	Lynx			
Helena NF	1 year	Helena NF Plan and ROD, 1986	Lynx, bear		"Sense of Place", religious sites, historical sites; tribes getting more active in Dry Range and Big Belt areas	
Kootenai, Bitterroot, Flathead, and Lolo NFs		Kootenai–FP revision to be completed winter 2006/2007, Bitterroot–1987 FP, under revision, Flathead-FP under revision, Lolo–1987 FP, under revision	Bull trout, grizzly bear, lynx, wolf reintroduction		Spiritual sites	
Lewis and Clark NF (east)		1996 FP, 1997 Oil and Gas Leasing Decision	Lynx	NSO		
Lewis and Clark NF (west)		1996 FP, 1997 Oil and Gas Leasing Decision	Lynx	NSO	Leases suspended due to tribal consultation	
Missoula, MT BLM		Garnett RMP, 1986	Lynx, bull trout, grizzly bear habitat, wolf reintroduction, bald eagle, cutthroat trout			

*Calculated based on office interviews and analysis of AFMSS data

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Lewis & Clarke Trail, Continental Divide Scenic Trail		Concerns near west side of Big Hole Valley		Sediment loading in streams	Potential concerns if development occurs in Big Hole	
"Sense of Place" (areas of spiritual interest to native tribes)			Sour gas production		Sour gas (only one sweetening plant), individual developments would require sweetening plants	Litigation appeals; recreation vs. wild land, infrastructure vs. vacation homes (Butte)
Trails		Concerns near Big Hole Battlefield		Sediment loading, esp. near steep slope areas		Private access on large ranches to public lands
						Gallatin community vehemently against development
High density of cultural resources: prehistoric and historic, modern cultural resources (homesteads, mining, etc.)				Cumulative impacts for sediment loading in streams (sensitive fish, total solids in streams)		Burned areas that will need stabilization for 3 to 6 years, such that potential for high levels of restriction; geographic constrainsts on concurrent activity
Trails (Bitterroot)				Sediment loading, esp. near steep slope areas	Flathead-FP Amendment for Grizzly Bear Habitat: 1 mile of road per square mile (limits new road construction, reclaims existing roads); road timing restrictions on roads (open only in summer)	Lolo and Flathead-900,000 acres of lease in suspension, FP 20 years out of date
						Plan calls for 4 wells per year
Traditional cultural district (10,000 acres) that impacts current lease suspension					H2S removal and facility location	
Historical mining sites and historical trails			Cumulative impacts, especially during winter; competition for discharge capacity	Sediment loading in streams	Roads and pipelines would be problematic because of local opposition and steep slopes	

Table 4-9. Access Issues, Williston Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Malta, MT BLM		Valley MFP, 1978	Sage grouse			
North Dakota BLM		North Dakota RMP, 1988	Sage grouse, raptor		Three Affiliated Tribes, Standing Rock Sioux; numerous protests, less protests if tribe is consulted	
North Dakota Prairie Grasslands		Dakota Prairie Grasslands Northern Region Land and RMP FEIS/ROD, 2002		Leasing occurs		

*Calculated based on office interviews and analysis of AFMSS data

Table 4-10. Access Issues, Powder River Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Belle Fourche, SD BLM (South Dakota Field Office)		1986 South Dakota RMP, 1994 Miles City Oil and Gas Amendment, Miles City RMP draft is to be released in 2007	Raptors, grouse		Three Affiliated Tribes, Cheyenne River Sioux; numerous protests, less protests if tribe is consulted	
Black Hills NF		Black Hills NF 1997 Land and RMP Phase II Amendment				
Buffalo, WY BLM	Conventional wells–35 days/APD, CBNG (32 well permits)–60 days/APD, APDs are sometimes information deficient	Buffalo RMP 2005	Big game, sage grouse, sharp-tailed grouse		Developing routine consultation program as part of EIS, TCs can create problems in lag times common near drainages	

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Cultural and Paleontological sites may exist, requiring road relocation					Water hauling/ truck traffic, noise compressors	Staffing adequacy is marginal
		Custer Trail; Little Missouri River			Noise mufflers	Reluctance to grant access on split estate lands; "Not In My Backyard" philosophy
		Custer Trail; Little Missouri River	Proximity to Theodore Roosevelt National Park			

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
High density areas in northern edge of South Dakota portion of study area;					Most wells drilled 1980 or before, such that continual break downs of infrastructure has closed down wells/ production	
Often Inadequate initial site investigation by companies	16 operating coal mines, but BLM addressing the issue adequately	Bozeman Trail-view shed preservation consideration	No. of vehicles results in increased road dust	In western and northern portions, sodium absorption ratios are a concern for produced water, coal aquifer being affected by drawdown.	Power requirment for submersible pumps will require small power plants that would result in surface disturbance, power line density increases and compressor noise, esp. around Gillette, increased compression	Split estate underlies over half of resources managed in the basin, requiring negotiations with surface owners, increased power lines result in increased raptor predation of sage grouse, prairie dogs, and mountain plover and raptor electrocution

Table 4-10. Access Issues, Powder River Basin Study Area (continued)

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Casper, WY BLM	60 days/APD	Casper RMP is currently being updated and is scheduled to be completed by 2008	Mountain plover (issue with seismic), bald eagle, golden eagle, greater sage grouse and black-tailed prairie dog (currently sensitive but potential of listing would make it an issue)		Problematic with seismic surveying	
Custer NF		Custer LRMP 1987, Sioux Ranger District O&G EIS 2005.			High density archeological sites, tribal sacred sites	
Miles City, MT BLM	3 months/APD	Powder River Amendments to the Powder River RMP was completed in 01/2005. Powder River RMP will be amended by the Miles City RMP, which draft is to be released in 2007	Bald eagle, mountain plover, black footed ferret (potential), prairie dog, sage grouse		Off-reservation cultural values and historical issues; Northern Cheyenne more conservative; Crow more open to development	
Newcastle, WY BLM	30-45 days	Newcastle RMP 2000				
Oglala NG, Buffalo Gap NG		Nebraska NF Revised Land and RMP, 2002	Habitat preservation is a concern			
Thunder Basin NG	12 months/ APD	Thunder Basin Nat. Grassland Land and RMP, 2002	Black footed ferret reintroduction, sage grouse, mountain plover			

*Calculated based on office interviews and analysis of AFMSS data

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Similar to Buffalo, religious concerns	Insitu uranium development vs. shallow coal-flooding uranium sediments but taking water out of coal will result in need to monitor "hot" water production. DOE to take over remediation of mile tailings 2005-2008	Trails often result in conflicts with linear facilities that bisect (pipelines, roads, etc.), esp. for the Mormon Trail	No. of vehicles results in increased road dust, increased amount of compression		Right of way corridors at capacity	Anticipate NSO stipulations in the future due to erodable soils
				CBNG water discharge potential issue		
Current approach to cultural resources is considered inadequate, "block surveys" preferred; Paleontological sites are a concern	Active coal mines near WY border (potential issue)	Remaining free stands, view sheds for Tongue, Rosebud and Rosebud rivers; major roads and Tongue River (potential issue)	Cumulative impacts from activities in WY as well as MT leading to limited discharge capacity; Northern Cheyenne is Class I air shed	CBNG ground and surface water impacts (cumulative) to be addressed in new EIS; WY uses 80% of allowable discharge capacity meaning only 20% left for MT; to the NW water quality decreasses; water quality effects on ranching	Locating infrastructure on agricultural lands associated with split estate is problematic	Socioeconomic-increased activity in remote areas puts ranching way of life at odds with O&G development, esp. with regard to water issues, visual intrusion, wildlife issues (migratory birds and raptor electrocution)
High density of cultural resources (potential issue); dinosaur fossils in Niobrara County			Receptor area relative to coal development, which may limit further development O&G or otherwise			Much split estate, litigation common
Could become an issue if development were to increase		Open grasslands often require view mitigations				
Moderate to high vertebrate/ paleo resources ("block surveys" used to assess CBM), such that all of Thunder Basin is CSU	Substantial CBM/coal mining conflicts		Increased road dust; increased amount of compression		Aging infrastructure. Road Analysis Process (RAP), above/below ground power lines is safety issue near coal mines	

Table 4-11. Access Issues, Wyoming Thrust Belt Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Bridger-Teton NF	180 days	Bridger-Teton NF Land and RMP, 1990	Pygmy rabbit, white tailed prairie dog, lynx			
Caribou-Targhee NF	120 days	Targhee NF Revised Forest Plan, 2000	Lynx, cutthroat trout, grizzly bear, wolves, sage grouse	NSO	Ancestral area, Ft. Hill Reservation, ancestral rights to land and resources	
Idaho Falls, ID BLM (Upper Snake Field Office)	120 days	Pocatello & Medicine Lodge Resource Areas RMP, 1988	Lynx, cutthroat trout, grizzly bear, wolves, sage grouse			
Kemmerer, WY BLM	3 months	Kemmerer RMP/ROD, 1986	Pygmy rabbit, white tailed prairie dog, lynx		Tribes hesitant to state all concerns. Regional issues beyond site specific, are important.	
Pinedale, WY BLM	3 months	Pinedale RMP, amended 2000 for oil & gas. New plan to be released 2007				
Pocatello, ID BLM	90 days	Pocatello & Medicine Lodge Resource Areas RMP, 1988	Lynx, cutthroat trout, grizzly bear, wolves, sage grouse, bald eagles, snails, Ute Ladies' Tress		Ancestral area, Ft. Hill Reservation, ancestral rights to land and resources	
Salt Lake, UT BLM	6 months	Lopez Project, Utah State BLM Statewide Stipulations, Isotract MFP, Randolph MFP, 1985	Sage grouse, lynx, pygmy rabbit, raptors			
Wasatch-Cache NF	1 year	Wasatch-Cache NF, Revised Forest Plan, 2003	Lynx			

*Calculated based on office interviews and analysis of AFMSS data

Table 4-12. Access Issues, Southwestern Wyoming Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Craig, CO BLM (Little Snake Field Office)	45 days	Little Snake RMP Oil and Gas Revision 1991, new plan release in 2008	White tailed prairie dog, pygmy rabbit, sage grouse are all candidate species with potential to severely impact O&G development			

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Congressionally designated trails and cutoffs, concerns protecting viewshed (measured in miles)			Limits due to air quality in Class I areas, currently close to thresholds			
Congressionally designated trails and cutoffs, concerns protecting viewshed (measured in miles)			An issue in SW Wyoming, compression is creating air quality problems	Change in size requirements from 5 acres to 1 acre for storm water discharge		Potential conflict with wind energy (cumulative effects and infrastructure conflicts)
						No Federal land in Wyoming Thrust Belt study area
Lack of cultural resource inventory				Sediment and nutrient loading in streams		

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
					Largely a "wildcat" region, there is no infrastructure to transport O&G out of area	

Table 4-12. Access Issues, Southwestern Wyoming Study Area (continued)

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Kremmling, CO BLM	28 days	Kremmling RMP, 1984. Revision planned for 2009	Sage Grouse		Tribes don't respond, O&G companies don't understand mandatory 30 day waiting period	
Medicine Bow-Routt NF	1 year	Medicine Bow LRMP, 2003. Routt LRMP, 1998. Thunder Basin LRMP, 2002.		Misnomer which causes conflicts with environ-mentalists		
Rawlins, WY BLM	6 months	Lease Stipulations, Rawlins BLM, 2001. New plan under revision			Affects timeliness	
Rock Springs, WY BLM	90 days	Green River RMP, 1997			Contact and scheduling of tribal representatives often precludes 30 day permitting goal. Need to define operator/ agency responsibility for tribal representative compensation.	

*Calculated based on office interviews and analysis of AFMSS data

Table 4-13. Access Issues, Denver Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Arapaho-Roosevelt NF	5 months	Arapaho-Roosevelt NFs, Pawnee NG Revision of the Land and Resource Management Plan, 1997				
Black Hills NF	1.5 years	Black Hills NF Plan of Land and RMP, 1997			Required for all lands	
Cañon City, CO BLM (Royal Gorge Field Office)	6 months	Royal Gorge RMP and NE Royal Gorge RMP, 1991				

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
O&G companies don't return complete survey with APD				Erosion and siltation issues	No pipelines, railway pulled out	
			Coal mines, O&G transport, trucks, contribute to air quality issues			
Trails are registered with NHPA, defined by rutting (which can be difficult to identify)		Looming issue, Fort Laramie, Pony Express, Oregon Trail				
30 day comment period for SHPO precludes meeting 30 day permitting goal. Need definitive guidance on visual impact distances and alternative mitigation regarding Historic Trails.						

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Could cause activities to be limited		Could require mitigation or surface limitations	Potential issue near Rapid City	Riparian areas	Inadequate road system	

Table 4-13. Access Issues, Denver Basin Study Area (continued)

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Casper, WY BLM	50 days	Casper RMP, 2001. Wyoming BLM Mitigation Guidelines for Surface-disturbing and Disruptive Activities				
Nebraska NF	60 days	Nebraska NF Revised Land and RMP FEIS/ROD, 2002				
Newcastle, WY BLM	30-45 days	Newcastle FO, ROD & Approved RMP, 2000				
Pike-San Isabel NF		Pike & San Isabel NF, Cimarron & Comanche NG RMP				
Rawlins, WY BLM	6 months	Lease Stipulations, Rawlins BLM, 2001. New plan to be released late 2006			Affects timeliness	

*Calculated based on office interviews and analysis of AFMSS data

Table 4-14. Access Issues, Florida Peninsula Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Big Cypress National Preserve		Big Cypress General Management Plan/ Final EIS, 1991	Florida panther, west Indian manatee, cape sable seaside sparrow, bald eagle, wood stork, red-cockaded woodpecker, snail kite, arctic peregrine falcon, American alligator, eastern indigo snake, Everglades mink, mangrove fox squirrel, Florida black bear, bachman's sparrow, swainson's hawk, reddish egret, swallow-tailed kite, southeastern kestrel, migrant loggerhead shrike, mangrove clapper rail			

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
Trails are registered with NHPA, defined by rutting (which can be difficult to identify)		Looming issue, Fort Laramie, Pony Express, Oregon Trail			Surface owner/ split estate surface access for roads and pipelines, urbanization conflict	
Often locations must be modified				Easily erodable soils	Easily erodable soils	
Trails are registered with NHPA, defined by rutting (which can be difficult to identify)		Looming issue, Fort Laramie, Pony Express, Oregon Trail			Surface owner/ split estate surface access for roads and pipelines, urbanization conflict	
		Recreation view sheds	Potential problem, incremental loading from O&G activity	Sedimentation concerns	Urban interface concerns, public concern about drilling, trucks	
Trails are registered with NHPA, defined by rutting (which can be difficult to identify)		Looming issue, Fort Laramie, Pony Express, Oregon Trail				

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
						Office not visited

Table 4-14. Access Issues, Florida Peninsula Study Area (continued)

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	**NEPA Documents**	**Endangered Species Act and Species Generally of Concern**	**Roadless Areas**	**Tribal Consultations**	
Fish and Wildlife Service in Florida						
Jackson, MS BLM		Florida RMP/ROD, 1995	Red-cockaded woodpecker			

*Calculated based on office interviews and analysis of AFMSS data

Table 4-15. Access Issues, Black Warrior Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	**NEPA Documents**	**Endangered Species Act and Species Generally of Concern**	**Roadless Areas**	**Tribal Consultations**	
National Forests in Alabama	6 months	Alabama NFs – Revised Land and RMP, 2004. APD requires project-level NEPA of 3-6 months	Gopher tortoise, red cockaded woodpecker			
Jackson, MS BLM	5 months	Assorted Leases	Red-cockaded woodpecker			
National Forests in Mississippi	2 months	Mississippi EA report – O&G leasing on the NF's, 1976. Done at APD stage. New plan to be released in 2007				

*Calculated based on office interviews and analysis of AFMSS data

Table 4-16. Access Issues, Appalachian Basin Study Area

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	**NEPA Documents**	**Endangered Species Act and Species Generally of Concern**	**Roadless Areas**	**Tribal Consultations**	
Allegheny NF	1 year	Allegheny NF Land and RMP, 1986. New plan to be released early 2007	Bald eagle, Canada lynx, Indiana bat		Need for consultation	
Daniel Boone NF	8-9 months (90 days for an APD on split estate lands)	Daniel Boone NF Revised Land and RMP, 2004	Black sided dace, mussels (several varieties), Indiana bat, primarily aquatic species		Some consultation on historic Cherokee lands	
Finger Lakes NF		Finger Lakes NF O&G Leasing ROD 2001. New plan to be released 2006	Bald eagle, Canada lynx, Indiana bat			
George Washington NF	1 year	George Washington NF – Final revised Land and RMP, 1993	Indiana bat, aquatic species	CSU		
Jackson, MS BLM		Assorted Leases	Red-cockaded woodpecker			

	National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
							Office not visited

	National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
							Office not visited

	National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
				Becoming an issue, coal plants, O&G activity near cities	State-listed impaired streams, sedimentation concerns		
						Forest benefits from energy infrastructure, good maintenance	

Table 4-16. Access Issues, Appalachian Basin Study Area (continued)

Jurisdiction	Issue or Characteristic Noted by Office					
	Average APD Processing*	NEPA Documents	Endangered Species Act and Species Generally of Concern	Roadless Areas	Tribal Consultations	
Jefferson NF	1 year	Jefferson NF – Revised Land and RMP, 2004	Indiana bat, aquatic species			
Milwaukee, WI BLM	5 months for COE and Federal minerals (split estate)	No RMPs to cover non-FS lands, develop NEPA on project-by-project basis	Indiana bat, running buffalo clover, bald eagle		Consultations done on ceded territories at the APD stage, often too late (consultations primarily needed in PA and NY)	
Monongahela NF	2 months	Monongahela NF Land and RMP, 2006	Bald eagle, Canada lynx, Indiana bat			
Wayne NF	1 year	Wayne NF Land and RMP, 2006	Bald eagle, Canada lynx, Indiana bat			

*Calculated based on office interviews and analysis of AFMSS data

additional data on such issues as air quality and clean water as a part of the cumulative impact analysis required by the NEPA and land use planning processes. This has been cited as an overarching issue that affects oil and gas lease parcel nominations. This lack of data can result in leasing delays when existing documents are deemed inadequate. The net result is that potential applicants are often aware of the problem and make decisions not to develop in areas that will be or could be held up by the NEPA process.

With respect to the NEPA process itself, concern was expressed by some government officials that individual documents provide "piecemeal" information and that better environmental decisions could be made based on larger scale studies that look at the "bigger picture." For example, wildlife habitat fragmentation is better characterized when it is examined in the context of larger rather than smaller areas.

Delays can increase costs for oil and gas operations because, rather than waiting for the Federal agency to complete the work, operators frequently pay a third-party contractor to perform the necessary work.

Section 366 of Energy Policy Act of 2005 (EPAct 2005) sets a deadline for the consideration of applications for permits. The permit must be issued within 30 days (if NEPA and other legal requirements have been met), or defer the decision and provide a notice to the applicant.

The Endangered Species Act of 1973. The ESA requires Federal agencies to conserve listed species. Under the ESA, species are treated as either listed, proposed, or candidate species. In BLM and FS jurisdictions, listed and proposed species are treated similarly. Candidate species are generally handled in a discretionary manner. All BLM administrative offices treat sensitive species as defined by the BLM and

National Historic Preservation Act	O&G vs Coal and other Mineral Development	Visual Resources	Air Quality	Clean Water	Infrastructure Concerns	Others
					Forest benefits from energy infrastructure, good maintenance	
Need agreements with state historical presentation offices (SHPOs), need state protocols, opportunity for streamlining	Minor in PA					COE & NY state cooperation is limited, Fed. leases in PA are being drained losing $50 million/year royalty revenue, for most minerals Fed. have < 100% ownership (and often far less), BLM stipulations are developed on an ad hoc basis

state governments the same as endangered species.

Federal agencies are responsible for managing wildlife habitat, while state governments manage the wildlife itself. In many areas habitat has not yet been mapped. If habitat information is required before leasing and permitting then additional delays are possible. Habitat for candidate species has been generally withheld from oil and gas leasing by Federal agencies during a consideration period of up to 2½ years.

Inventoried Roadless Areas. A total of over 18 million acres of National Forest Inventoried Roadless Areas (IRAs) exists within the boundaries of the Inventory's study areas. The FS representatives recognize the complexity surrounding the issue of IRAs. In July 2004, the FS published a proposed rule to revise the Roadless Area Conservation Rule published in January 2001, which was reversed in July 2003 by the Federal District Court for the District of Wyoming.

The final roadless rule was published in May 2005. The rule allows governors to petition the Secretary of Agriculture to develop regulations to manage roadless areas in order to meet specific needs within each state. The FS was to accept state petitions from governors for 18 months after the effective date of the final rule. In January 2006, the interim ruling from July 2004 was extended for another 18 months.[48] During the state-petitioning process, the FS will continue to maintain interim measures to conserve inventoried roadless areas.

Despite the controversy surrounding the issue, leasing does occur in a limited number of roadless areas. In such cases, leases are

[48] USDA-Forest Service Interim Directive #1920-2006-1. http://www.fs.fed.us/im/directives/fsm/1900/id_1920-2006-1.doc

issued with the caveat to industry that the disposition of roadless areas is unresolved and that the areas under lease may have to remain roadless.

Visual Impacts. Concern over visual impacts is affecting oil and gas development in some areas. For example, field developments can be delayed until impacts and other issues are assessed. Visual impacts were raised as a potential issue by many BLM and FS offices.

Suburban Encroachment. Opposition to oil and gas activities is increasing as residential construction spreads into previously undeveloped areas. This has not been a significant issue until recently and has not generally been incorporated into oil and gas planning activities. Some offices are considering NSO stipulations to maintain open space near housing developments.

Seasonal Restrictions in Alaska. The primary constraint to access in the National Petroleum Reserve-Alaska is the restriction that limits exploratory drilling activities to the winter season, which lasts approximately 5 months. During that time, ice roads need to be built, a task that can take one or 2 months and may be limited to 25-30 miles due to technology and weather. Coupled with timing limitations for threatened and endangered species, the cumulative effects of these limitations make drilling operations difficult and may significantly impact project economics.

4.2 Issues Indirectly Impacting Access

Clean Water. In the UPB, the issue of clean water has been raised in the context of the need for examining entire watersheds rather than just the local area. It is increasingly recognized that an entire watershed (rather than administrative jurisdictions) must be examined in instances where activity within one jurisdiction may affect another downstream. Often in the western U.S., states and counties object to drilling in municipal watersheds, often resulting in added stipulations and/or conditions of approval for protection. In addition, localized clean water issues include mitigating increased selenium concentrations, salinity, and sedimentation.

Air Quality. Air quality can be a contentious issue in Rocky Mountain basins, such as the SWW. Increasingly, air quality issues are being raised as a concern, especially in Utah.

Staffing. Workload requirements are increasing and the BLM is facing challenges with respect to the timely processing of APDs, energy-related rights of ways, and monitoring compliance. The number of APDs received has increased significantly. Recruitment and retention of professional oil and gas staff is challenging, in part because of competition with industry for qualified personnel. Other specialties, such as archeology, biology, and environmental protection are severely understaffed in some areas and have high turnover rates as well. These positions are needed for coordinating required clearances (e.g., ESA, NHPA) and participating on interdisciplinary teams. Inadequate staffing can create bottlenecks and high turnover often necessitates retraining new hires to perform the unique and complex tasks associated with the oil and gas program.

Section 365 of EPAct 2005 requires the Secretary of the Interior to establish a Federal Permit Streamlining Pilot Project to improve Federal oil and gas permit coordination. The Department of the Interior, Department of Agriculture, Environmental Protection Agency, and the Army Corps of Engineers signed a Memorandum of Understanding establishing staffing needs and funding protocols for the pilot offices on October 25, 2005. The seven pilot offices (Rawlins and Buffalo, Wyoming; Miles City, Montana; Farmington and Carlsbad, New Mexico; Grand Junction/ Glenwood Springs, Colorado; and Vernal, Utah) have been created.

In 2006, the BLM pilot offices processed more permits, and lowered their average turnaround time for individual permits. In the Farmington field office for example, the total number of permits processed increased from 817 in 2005 to 993 in 2006.

Native American Consultation. The large number of APDs and leases impacts the timeliness of completing the consultation requirements of the NHPA. Consultation with Tribes is increasing and can extend the time required to obtain leases and drilling permits.

Conflicts between Mineral and Coalbed Natural Gas (CBNG) Developers. In the PRB, conflicts can occur between coal mining operators and coalbed natural gas producers. It is BLM policy to encourage oil and gas and coal companies to resolve conflicts between themselves. When requested, the BLM will assist in facilitating agreements between the companies. The BLM will also exercise authority provided in the leases, applicable statutes, and regulations to manage Federal mineral development in the public's best interest.

Infrastructure. The physical infrastructure to support oil and gas development and production is often strained. Existing pipelines may be at capacity and new pipeline construction is often a lengthy process. County roads are typically not designed for the volume of truck traffic that they can experience during oil and gas field development. Infrastructure issues can act to constrain future marketing capacity, although new pipeline construction can relieve this bottleneck.

The BLM's energy-related rights-of-way processing workload has increased along with the increase in APDs. These authorizations are required for such infrastructure as pipelines, roads, and power lines that are located outside of a lease or unit boundary.

Snow Delays. In the higher elevation areas of the Rocky Mountains, snow depths can be so great as to preclude drilling even if there are no winter drilling stipulations. This situation potentially makes for a short drilling window, especially if there are timing limitations during non-snow months.

Industry Understanding of the Leasing and Permitting Process. There is often less-than-optimal understanding and planning within some companies with respect to these processes. The BLM encourages oil and gas operators to inform and work with the permitting agencies as early in the planned development process as possible. The issuance of the recently updated *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* (the "Gold Book," 4th edition, 2006, available at http://www.blm.gov/bmp/goldbook.htm) should enhance operators' understanding and expectations.

Appendix 1
Acronyms and Abbreviations

AAGF	Average Annual Growth Factor
AAPG	American Association of Petroleum Geologists
ACEC	Area of Critical Environmental Concern
AD	Associated Dissolved (natural gas)
AFMSS	Automated Fluid Minerals Support System
AGF	Annual Growth Factor
AK	Alaska
ANILCA	Alaska National Interest Lands Conservation Act
ANWR	Arctic National Wildlife Refuge
APB	Appalachian Basin
APD	Application for Permit to Drill
API	American Petroleum Institute
AL	Alabama
ALIS	Alaska Land Information System
ARMP	Approved Resource Management Plan
Bbbls	Billion Barrels
BCF	Billion cubic feet (of natural gas)
BCFE	Billion cubic feet (of natural gas) equivalent
BCGF	Basin Cumulative Growth Factor
BFPUR	Final Proved Ultimate Recovery for a Basin
BHL	Bottom-Hole Location
BLM	Bureau of Land Management
BMAGF	Basin Median Annual Growth Factor
BOE	Barrels of Oil Equivalent
BOEULT	Barrels of Oil Equivalent Ultimate
BOR	Bureau of Reclamation
BPUR	Basin Proved Ultimate Recovery
BTU	British Thermal Unit
BWB	Black Warrior Basin
CA	California
CAP	Coordinated Activity Plan
CBNG	Coalbed Natural Gas
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGF	Cumulative Growth Factor
CO	Colorado
COA	Conditions of Approval
COE	Army Corps of Engineers
CPA	Citizens' Proposal Area
CSU	Controlled Surface Use
CWP	Citizens' Wilderness Proposals
CWR	Critical Winter Range
DEM	Digital Elevation Model
DEN	Denver Basin
DFC	Desired Future Condition
DHS	Department of Homeland Security
DNR	Department of Natural Resources
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
DOL	Department of Labor
DR	Decision Record
DVA	Department of Veterans Affairs
EA	Environmental Assessment
EDZ	Extended Drilling Zone
EF	Exception Factor
EGB	Eastern Great Basin
EIA	Energy Information Administration
EIS	Environmental Impact Statement

EOW	Eastern Oregon-Washington Basin
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 2005
EPCA	Energy Policy and Conservation Act (Amendments of 2000)
ESA	Endangered Species Act
ESRI	Environmental Systems Research Institute
EUR	Estimated Ultimate Recovery
EV	Exceptional Value
FAA	Federal Aviation Administration
FCML	Field Code Master List
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FGDC	Federal Geographic Data Committee
FL	Florida
FlorRs	Federal Lands or Resources
FLP	Florida Peninsula Basin
FLPMA	Federal Land Policy Management Act
FLS	Federal Land Status
FO	Field Office
FOOGLRA	Federal Onshore Oil and Gas Leasing and Reform Act
FP	Forest Plan
FS	Forest Service, United States Department of Agriculture
Ft	Feet
GCDB	Geographic Coordinate Database
GIS	Geographic Information System
GNIS	Geographic Names Information System
GOR	Gas to Oil Ratio
GSA	General Services Administration
HCP	Habitat Conservation Plan
HUD	Department of Housing and Urban Development
IRAs	Inventoried Roadless Areas
ITCs	Incorporated Towns and Cities
LAC	Land Access Categorization
LGR	Liquids to Gas Ratio
LLD	Legal Land Description
LR	Legacy Rehost
LUEA	Land Use Emphasis Area
LUP	Land Use Plan
MA	Management Area
Mbbls	Thousands of Barrels
MBOE	Thousands of Barrels of Oil Equivalent
MCF	Thousand Cubic Feet
MD	Maryland
MFP	Management Framework Plan
MMbbls	Million Barrels
MMCF	Millions of Cubic Feet
MMS	Minerals Management Service
MS	Mississippi
MTB	Montana Thrust Belt Basin
NAK	Northern Alaska Basin
NAG	Non-Associated (natural gas)
NASA	National Aeronautics and Space Administration
NCA	National Conservation Area
NE	Nebraska
NEPA	National Environmental Policy Act
NF	National Forest
NGL	National Grasslands
NGLs	Natural Gas Liquids
NHPA	National Historic Preservation Act
NIMBY	Not In My Back Yard
NLA	No Leasing, Administrative
NLA/LUP	No Leasing, Administrative/ Land Use Planning
NLCS	National Landscape Conservation System
NLS	No Leasing, Statutory or Executive Order

NM	National Monument
NNSO	Net No Surface Occupancy
NOGA	National Oil and Gas Assessment
NPC	National Petroleum Council
NPRA	National Petroleum Reserve-Alaska
NPS	National Park Service
NRHP	National Register of Historic Places
NSF	National Science Foundation
NSO	No Surface Occupancy
NV	Nevada
O&G	Oil and Gas
OCS	Outer Continental Shelf
OGIFF	Oil and Gas Integrated Field File
OHV	Off-Highway Vehicle
OR	Oregon
P75	75th percentile
PDR	Powder River Basin
PDS	PetroDataSource
PDX	Paradox Basin
PGC	Potential Gas Committee
PL	Public Law
PLSS	Public Land Survey System
PR	Proved Reserves
PUR	Proved Ultimate Recovery
PURG	Proved Ultimate Recovery Growth
QC	Quality Control
QUAD	Quadrillion BTU
RMA	Resource Management Area
RMP	Resource Management Plan
RMU	Resource Management Unit
RNA	Research Natural Area
ROD	Record of Decision
ROP	Required Operating Procedure
ROW	Right-of-Way
RPD	Reserves and Production Division of the EIA
RPURG	Remaining Proved Ultimate Recovery Growth
SA	Study Area
SAK	Southern Alaska Basin
SC	Steering Committee
SHPO	State Historical Preservation Office
SJB	San Juan Basin
SLT	Standard Lease Terms
SMA	Special Management Area; Surface Management Agency
SMZ	Streamside Management Zone
SOPs	Standard Operating Practices
SORs	Surface Occupancy Restrictions
SPL	Split
SPR	Semi Primitive Recreation
SRMA	Special Recreation Management Area
STIPID	Stipulation Identification
SUPO	Surface Use Plan of Operations
SWW	Southwestern Wyoming Basin (called Greater Green River Basin in previous EPCA inventories)
T&E	Threatened and endangered (species)
TCF	Trillion cubic feet (of natural gas)
TCFe	Trillion cubic feet (of natural gas) equivalent
TIN	Triangular Irregular Network
TL	Timing Limitation
TN	Tennessee
TPS	Total Petroleum System
UPB	Uinta Piceance Basin
URA	Ultimate recovery appreciation
USC	United States Code
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USFS	USDA-Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UT	Utah

VA	Virginia
VBA	Visual Basic for Application
VEN	Ventura Basin
VQO	Visual Quality Objective
VRM	Visual Resource Management
WA	Washington
WIL	Williston Basin
WRAs	Wilderness Reinventory Areas
WSA	Wilderness Study Area
WTB	Wyoming Thrust Belt
WV	West Virginia
WY	Wyoming
WYNDD	Wyoming Natural Diversity Database
YKF	Central Alaska – Yukon Flats Basin

Appendix 2
Glossary Of Terms

-A-

Access Probability: The probability, expressed as a decimal fraction, of sufficient access (political and physical) to a particular assessment unit within a given time frame for the activities necessary to find an accumulation of minimum size and to add its volume to proved reserves. The time frame for this assessment is 30 years.

Accumulation: Consists of two types: conventional and continuous. A conventional accumulation is an individual producing unit consisting of a single pool or multiple pools of petroleum grouped on, or related to, a single structural or stratigraphic feature. A continuous accumulation is also an individual producing formation of regional extent that has among other features diffuse boundaries, no obvious oil water contact and no obvious relation to a structural or stratigraphic trap (see continuous-type accumulation).

Affected Environment: Surface or subsurface resources (including social and economic elements) within or adjacent to a geographic area that could potentially be affected by oil and gas activities; the environment of the area to be affected or created by the alternatives under consideration (40 CFR 1502.15).

Alternative: A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis as expressed in goals and objectives. One of several policies, plans, or projects proposed for decision-making. An alternative need not substitute for another in all respects.

Alternative, No Action: An alternative that maintains established trends or management direction and implements those actions previously analyzed and/or approved.

Application: A written request, petition, or offer to lease lands for the purpose of oil and gas exploration and/or the right of extraction.

Application for Permit to Drill (APD): An application to drill a well submitted by a lessee or operator to the BLM. The APD consists of a Drilling Plan that discusses downhole specifications and procedures (reviewed by the BLM) and a Surface Use Plan of Operations (SUPO) that examines surface uses, including access roads, well site layout, cut and fill diagrams, reclamation procedures, production facility locations, etc. (reviewed by the surface-managing agency). The approved APD is a contract between the operator and the Federal government and cannot be changed or modified unless authorized by the BLM and the surface-managing agency.

Aquifer: (1) A sand, gravel, or rock formation capable of storing or conveying water below the surface of the land (USDA, Natural Resources Conservation Services). (2) The down-dip portion of a water-drive hydrocarbon reservoir that contains predominantly water.

Archeological/historic site: A site that contains either objects of antiquity or cultural value relating to history and/or prehistory that warrant special attention.

Area of Critical Environmental Concern (ACEC): Places that receive special management attention because of potential hazards and/or to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources or other natural systems or processes.

Assessment Unit: A mappable volume of rock within a total petroleum system that encompasses accumulations (discovered and undiscovered) that share similar geologic traits and socio-economic factors. Accumulations within an assessment unit should constitute a sufficiently homogeneous population such that the chosen methodology of resource assessment is applicable. A total petroleum system might equate to a single assessment unit. If necessary, a total petroleum system can be subdivided into two or more assessment units in order that each unit is sufficiently homogeneous to assess individually. An assessment unit may be identified as conventional, if it contains conventional accumulations, or as continuous, if it contains continuous accumulations.

Assessment Unit Probability: Represents the likelihood, expressed as a decimal fraction, that, in a given assessment unit, at least one undiscovered accumulation of a selected minimum size exists that has the potential for its volume to be added to proved reserves in a given time frame. The assessment unit probability is the product of the probabilities of the three geologic attributes (charge, rocks, and timing) and the probability of access.

Associated/Dissolved Gas: Natural gas that occurs in an oil accumulation, either as a free gas cap or in solution; synonymous with gas in oil accumulations.

-B-

Barrels of Oil Equivalent (BOE): A unit of petroleum volume in which the gas portion is expressed in terms of its energy equivalent in barrels of oil. For this assessment, 6,000 cubic feet of gas equals 1 BOE.

Basin: (1) An area largely enclosed by higher lands. (2) A low in the Earth's crust of tectonic origin in which sediments have accumulated.

Basin Median Annual Growth Factor: The Median of the Annual Growth Factors of all fields in all vintages at the same point in time (n) (the same year after first production or after field discovery) within a given basin. This number is used to help determine the reserves growth.

Big Game: Larger species of wildlife that are hunted, such as elk, deer, bighorn sheep, and pronghorn antelope.

Big Game Winter Range: An area available to and used by big game (large mammals normally managed for sport hunting) through the winter season.

Buffer Zone: (1) An area between two different land uses that is intended to resist, absorb, or otherwise preclude developments or intrusions between the two use areas. (2) A strip of undisturbed vegetation that retards the flow of runoff water, causing deposition of transported sediment.

Bureau of Land Management: An agency within the U.S. Department of the Interior that administers 261 million surface acres of America's public lands, located primarily in 12 Western States. The BLM sustains the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations. The BLM also manages 699 million subsurface acres for mineral leasing and development.

-C-

Candidate Species: (1) A species for which substantial biological information exists on file to support a proposal to list it as endangered or threatened, but for which no proposal has yet been published in the Federal Register. The list of candidate species is revised approximately every two years in the Notice of Review. (2) Any species not yet officially listed, but undergoing a status review or proposed for listing according to Federal Register notices published by the Secretary of the Interior or the Secretary of Commerce.

Case Recordation: Information on leases, permits, contracts, grants, agreements, mineral patents, etc. issued by the BLM on federal actions affecting public lands of the United States.

Casing: Steel pipe placed in an oil or gas well to prevent the hole from caving and to anchor well control equipment.

Cell: A subdivision or area within an assessment unit having dimensions related to the drainage areas of wells (not to be confused with finite-element cells). Three categories of cells are recognized: cells tested by drilling, untested cells, and untested cells having potential to provide additions to reserves within the forecast span of the assessment. A continuous-type assessment unit is a collection of petroleum-containing cells.

Coalbed Natural Gas: Natural gas found in coalbeds. Also termed "coalbed methane" or "coalbed gas".

Completion: The activities and methods to prepare a well for production. Includes installation of equipment for production from an oil or gas well.

Composite Total Petroleum System: A mappable entity encompassing all or a portion of two or more total petroleum systems. Composite total petroleum systems are used when accumulations within an assessment unit are assumed to be charged by more than one source rock.

Continuous-Type Accumulation: A petroleum accumulation that is pervasive throughout a large area that is not significantly affected by hydrodynamic influences, and has no obvious seal or trap. Continuous-type accumulations lack well-defined down-dip water contacts. The terms "continuous-type accumulation" and "continuous accumulation" are used interchangeably. Examples of continuous-type accumulations include basin-centered gas, coalbed methane and shale gas.

Controlled Surface Use (CSU): Allowed use and occupancy (unless restricted by another stipulation) with identified resource values requiring special operational constraints that may modify the lease rights. The CSU stipulation is used as an operating guideline, not as a substitute for NSO or Timing Limitations (TLs) stipulations.

Conventional Accumulation: A discrete petroleum accumulation, commonly bounded by a down-dip water contact that is significantly affected by the buoyancy of petroleum in water. Conventional accumulations occur as the result of discrete stratigraphic or structural traps.

Council on Environmental Quality (CEQ): An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews Federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

Crucial Winter Range (CWR): Winter habitat on which a wildlife species depends for survival. Because of severe weather conditions or other limiting factors, no alternative habitat would be available.

Cultural Resources: Those fragile and nonrenewable physical remains of human activity, occupation, or endeavor reflected in districts, sites, structures, buildings, objects, artifacts, ruins, works of art, architecture, burial mounds, petroglyphs, and natural features that were of importance in past human events. These resources consist of (1) physical remains; (2) areas where significant human events occurred, even though evidence of the event no longer remains; and (3) the environment immediately surrounding the resource. Cultural resources are commonly discussed in terms of prehistoric and historic values; however, each period represents a part of the full continuum of cultural values from the earliest to the most recent.

Cumulative Petroleum Production: Reported cumulative volume of petroleum that has been produced. Cumulative oil, cumulative gas, and cumulative production are sometimes used as abbreviated forms of this term.

-D-

Directional Drilling: The intentional deviation of a wellbore from vertical to reach subsurface targets, which are not located directly below the drilling site.

-E-

Endangered Species: As defined in the Federal Endangered Species Act, any species that is in danger of extinction throughout all or a significant portion of its range. For terrestrial species, the U.S. Fish and Wildlife Service determines endangered status.

Environmental Assessment (EA): A public document for which a Federal agency is responsible that serves to: (1) briefly provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement (EIS) or a finding of no significant impact; (2) help an agency comply with the NEPA when no EIS is necessary; and (3) facilitate the preparation of an EIS when one is necessary. An EA includes brief discussions of the need for the proposal and of the environmental impacts of the proposed action and other alternatives.

Environmental Impact Statement (EIS): A written analysis of the impacts on the natural, social, and economic environment of a proposed project or resource management plan.

Estimated Ultimate Recovery (EUR): The total expected recoverable volume of oil, gas, and natural gas liquids production from a well, lease, or field under present economic and engineering conditions; synonymous with total recovery.

Extended Drilling Zone (EDZ): A buffer zone along the perimeter of NSO areas into which directional drilling can occur in a generalized (as opposed to specific) sense. An EDZ relates NSO to NNSO areas (see below).

-F-

Federal Land: For the purpose of this Inventory, land owned by the United States, without reference to how the land was acquired or which Federal agency administers the surface; includes mineral estates underlying private surface.

Field: A production unit consisting of a collection of oil and gas pools that, when projected to the surface, form an approximately contiguous area that can be circumscribed.

Field Growth: The increases in known petroleum volume that commonly occur as oil and gas fields are developed and produced; synonymous with reserve growth.

Forecast Span: A specified future time span in which petroleum accumulations have the potential to provide additions to reserves. A 30-year forecast span is used in the USGS assessments, which affects (1) the minimum undiscovered accumulation size, (2) the number of years in the future that reserve growth is estimated, (3) economic assessments, (4) the accumulations that are chosen to be considered, and (5) the risking structure as represented by access risk.

Forest Plan (FP): A land use plan for a unit of the National Forest system.

Forest Service (FS): An agency of the U.S. Department of Agriculture that manages 193 million acres of public lands in national forests and grasslands.

-G-

Gas Accumulation: An accumulation with a gas to oil ratio of 20,000 cubic feet/barrel or greater.

Gas in Gas Accumulations: Gas volumes in gas accumulations.

Gas in Oil Accumulations: Gas volumes in oil accumulations.

Gas to Oil Ratio (GOR): The ratio of gas to oil (in cubic feet/barrel) in an accumulation. GOR is calculated using known gas and oil volumes at surface conditions.

Geographic Information System (GIS): A computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e., data identified according to their locations.

Geologic Province: A USGS-defined area having characteristic dimensions of perhaps hundreds to thousands of kilometers encompassing a natural geologic entity (for example, a sedimentary basin, thrust belt, or delta) or some combination of contiguous geologic entities.

Geospatial: Information that identifies the geographic location and characteristics of natural or constructed features and boundaries on the earth. This information may be derived from remote sensing, mapping, and surveying technologies, or from other sources.

Grown Petroleum Volume: Known petroleum volume adjusted upward to account for future reserve growth. Thirty years of reserve growth is considered for the USGS assessments.

-H-

Habitat: A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

Hibernacula (Indiana bat): The caves and mines in which the Indiana Bat hibernates.

-I-

-J-

-K-

Known Petroleum Volume: The sum of cumulative production and remaining reserves as reported in the databases used in support of an assessment. Also called estimated total recoverable volume (sometimes called "ultimate recoverable reserves" or "estimated ultimate recovery").

-L-

Landscape: A relatively large area of land with common climate, geology, and soils containing predictably occurring terrain features such as slopes, drainage channels, rock outcrops, etc.

Lease (Oil and Gas): An authorization to use Federal lands and minerals issued under the Act of February 25, 1920, as amended (30 U.S.C. 181, et seq.); the Act of May 21, 1930 (30 U.S.C. 351-359); the Act of August 7, 1947 (30 U.S.C. 351, et seq.); or the Act of November 16, 1981 (PL 97-98, 95 Stat. 1070).

Lease Stipulations: See Stipulations.

Legal Land Description: Cadastral survey data including meridian, township, range, section, survey type (aliquot part, homestead survey, mineral survey, tracts, parcels, etc.), acreage, and geopolitical information including the geographic state, county, field office, and surface management agency.

Liquids to Gas Ratio (LGR): Ratio of total petroleum liquids (including oil, condensate, and natural gas liquids) to gas (in barrels/million cubic feet) in a gas accumulation. The LGR is calculated using known petroleum liquids and gas volumes at surface conditions. This ratio is used to assess the liquid co-products associated with undiscovered gas in gas accumulations.

-M-

Mineral: Organic and inorganic substances occurring naturally, with characteristics and economic uses that bring them within the purview of mineral laws; a substance that may be obtained under applicable laws from public lands by purchase, lease, or pre-emptive entry.

Minimum Accumulation Size: The smallest accumulation size (volume of oil in oil accumulations or volume of gas in gas accumulations) that is considered in the USGS assessment process for conventional accumulations.

Minimum Petroleum System: The mappable part of a total petroleum system for which the presence of essential elements has been proved by discoveries of petroleum shows, seeps, and accumulations.

Minimum Total Recovery Per Cell: The smallest total recovery per cell (volume of oil or gas) that is considered in the USGS assessment process for continuous-type accumulations.

Mitigation: Includes the following:
(1) Avoiding an impact altogether by not taking a certain action or parts of an action.
(2) Minimizing impacts by limiting the degree of magnitude of the action and its implementation.
(3) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
(4) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
(5) Compensating for the impact by replacing or providing substitute resources or environments.

Monitoring: The orderly collection, analysis, and interpretation of resource data to evaluate progress toward meeting resource management objectives.

-N-

National Environmental Policy Act (NEPA): An Act to establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes. The law requires the assessment and documentation of the environmental and social impacts of Federal actions. (PL 91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by PL 94-52, July 3, 1975, PL 94-83, August 9, 1975, and PL 97-258, § 4(b), Sept. 13, 1982)

National Forest (NF): Created by an act of Congress in 1892, National Forests are Federal land reservations that are administered by the United States Department of Agriculture-Forest Service for multiple uses, including grazing, logging, minerals, and recreation.

National Register of Historic Places (NRHP): A Federal Government list of ". . . districts, sites, buildings, structures, and other objects significant in American history, architecture, archeology, and culture." The National Register is maintained by the National Park Service, U.S. Department of the Interior, and is published in its entirety in the Federal Register each year in February.

Natural Gas Liquids (NGL): Petroleum that occurs naturally as a gas in the reservoir, but that is a liquid under surface conditions. Natural gas liquids are typically reported separately from crude oil.

Natural Gas Liquids to Gas Ratio (for oil accumulations): Ratio of natural gas liquids to gas (in barrels/million cubic feet) in an oil accumulation, calculated using known natural gas liquids and gas volumes at surface conditions. This ratio is used to assess the natural gas liquids associated with undiscovered gas in oil accumulations.

Net No Surface Occupancy (NNSO): The NSO areas are areas that can be leased but stipulations prohibit surface occupancy for natural gas and oil drilling activities to protect identified resources. To access O&G resources under NSO areas in the Inventory, use of directional drilling technology is taken into consideration resulting in NNSO resources. The impacts of NNSO are similar to NLA areas. See also No Surface Occupancy.

Non-Associated Gas: Natural gas that occurs in a gas accumulation; synonymous with gas in gas accumulations.

No Surface Occupancy (NSO): An area where no surface-disturbing activities of any nature or for any purpose are allowed. For example, construction or the permanent or long-term placement of structures or other facilities would be prohibited. It is also used as a stipulation or mitigation requirement for controlling or prohibiting selected land uses or activities that would conflict with other activities, uses, or values in a given area. When used in this way, the NSO stipulation or mitigation requirement is applied to prohibit one or more specific types of land and resource development activities or surface uses in an area, while other—perhaps even similar— types of activities or uses (for other purposes) would be allowed. For example, protecting important rock art relics from destruction may require closing the area to the staking of mining claims and surface mining, off-road vehicle travel, construction or long-term placement of structures or pipelines, power lines, general purpose roads, and livestock grazing. Conversely, the construction of fences (to protect rock art from vandalism or from trampling or breakage by livestock), an access road or trail, and other visitor facilities to provide interpretation and opportunity for public enjoyment of the rock art would be allowed. Additionally, if there were potential and interest for leasing and consequent mineral development in the area, then leases for gas and oil, coal, etc., could be issued with a NSO stipulation or mitigation requirement for the rock art site, which would still allow access to the minerals from adjacent lands and underground. The term “no surface occupancy” has no relationship or relevance to the presence of people in an area. In the NPRA, NSO stipulations generally apply only to permanent facilities but provide for wintertime exploration.

Notice: The communication of a pending Federal action; the notification to parties of Federal actions about to the taken. This is a part of due process.

-O-

Occupancy: Actual possession and use of land in something more than a slight or sporadic manner. As defined as a multiple use component, it is the management of public lands for occupancy involving the protection, regulated use, and development of lands as sites for economically and socially useful structures, either publicly or privately owned.

Oil Accumulation: An accumulation with a gas to oil ratio of less than 20,000 (in cubic feet/barrel).

Oil in Gas Accumulations: Oil volumes in gas accumulations. For the EPCA Inventory, oil in gas accumulations was calculated with other liquids rather than separately.

Oil in Oil Accumulations: Oil volumes in oil accumulations.

Operator: An individual, group, association, or corporation authorized to conduct, for example, livestock grazing or oil and gas drilling on public lands.

-P-

Petroleum: A collective term for oil, gas, natural gas liquids, and tar.

Play: A set of known or postulated oil and gas accumulations sharing similar geologic, geographic, and temporal properties, such as source rock, migration pathway, timing, trapping mechanism, and hydrocarbon type. A play may or may not differ from an assessment unit; an assessment unit can include one or more plays.

Proposed Species: A species of plant or animal formally proposed by the U.S. Fish and Wildlife Service (USFWS) to be listed as threatened or endangered under the Endangered Species Act.

Proved Reserves: Quantities of crude oil, natural gas, or natural gas liquids that geological and engineering data demonstrate with reasonable certainty (defined as 90 percent or more probable) to be recoverable in future years from known reservoirs under existing economic and operating conditions.

Public Lands: Any land and interest in land owned by the United States that are administered by the Secretary of the Interior through the BLM, without regard to how the United States acquired ownership, except for (1) lands located on the Outer Continental Shelf and (2) lands held for the benefit of Indians, Aleuts, and Eskimos; includes public domain and acquired lands (see definitions). Vacant, unappropriated, and unreserved public lands, or public lands withdrawn by Executive Order 6910 of November 26, 1934, as amended, or by Executive Order 6964 of February 5, 1935, as amended, and not otherwise withdrawn or reserved, or public lands within grazing district established under Section 1 of the Act of June 28, 1934 (48 Stat. 1269), as amended, and not otherwise withdrawn or reserved.

Proved ultimate recovery: The sum of estimated proved reserves and recorded cumulative production of an oil or gas field at a particular point in time.

Proved ultimate recovery growth: The increase in proved ultimate recovery over time that is observed for most oil and gas fields. A field's proved ultimate recovery estimate normally increases significantly in the early post-discovery years as a field is developed for production and its areal limits are better discerned.

-Q-

-R-

Remaining Petroleum Reserves: Volume of petroleum in discovered accumulations that has not yet been produced. Remaining reserves is sometimes used as an abbreviated form of this term.

Reserve Growth: The increases in known petroleum volume that commonly occur as oil and gas accumulations are developed and produced; synonymous with field growth.

Resource Management Plan (RMP): A land use plan that provides the basic, general direction and guidance for BLM-administered public lands, usually within a specific administrative area.

Right-of-Way (ROW): A permit or easement which authorizes the use of public land for certain specified purposes, commonly for pipelines, roads, telephone lines, etc.; also, the lands covered by such an easement or permit. It does not grant an estate of any kind, only the right of use.

Riparian Areas: The vegetation along the banks of rivers and streams and around springs, bogs, wet meadows, lakes, and ponds.

Roadless: Refers to an absence of roads that have been constructed and maintained by mechanical means to ensure regular and continuous use.

Roads: Vehicle routes that have been improved and maintained by mechanical means to ensure relatively regular and continuous use. (A way maintained strictly by the passage of vehicles does not constitute a road).

-S-

Shapefile: The GIS file format usable with ESRI (such as ArcView) and other commercial GIS software. It is a nontopological data structure that does not explicitly store topological relationships. However, unlike other simple graphic data structures, one or more rings represent shapefile polygons. A ring is a closed, non-self-intersecting loop. This structure can represent complex structures, such as polygons, that contain "islands." The vertices of a ring maintain a consistent, clockwise order so that the area to the right, as one "walks" along the ring boundary, is inside the polygon, while the area to the left is outside the polygon.

Split-Estate Lands: Federal mineral estate administered by the BLM, which is under either private lands, state lands, or lands administered by another Federal agency. On split-estate lands, the surface owner or managing agency controls the surface uses but the mineral estate is the dominant estate. The BLM coordinates with surface owners on mineral leasing and development. In a few cases, the BLM administers the surface, but the minerals are owned by the state or a private entity.

Stipulations: Conditions, promises, or demands added to a lease when the environmental and planning record demonstrates the necessity for the stipulations. Stipulations, as such, are neither "standard" nor "special"; they are a necessary modification of the terms of the lease. In order to accommodate the variety of resources encountered on Federal lands, stipulations are categorized as to how the stipulation modifies the lease rights, not by the resource(s) to be protected. What, why, and how this mitigation/protection is to be accomplished is determined by the land management agency through land use planning and NEPA analysis. If, upon weighing the relative resource values, uses, and/or users, conflict with oil and gas operations is identified that cannot be adequately managed and/or accommodated on other lands, then a lease stipulation is necessary. Land use plans serve as the primary vehicle for determining the necessity for lease stipulations. Documentation of the necessity for a stipulation is disclosed in planning documents or through site-specific analysis. Land use plans and/or NEPA documents also establish the guidelines under which future waivers, exceptions, or modifications may be granted. Substantial modification or waiver of stipulations subsequent to lease issuance is subject to public review for at least a 30-day period in accordance with Section 5102.f of the Federal Onshore Oil and Gas Leasing Reform Act of 1987. Stipulations may be necessary if the authority to control the activity on the lease does not already exist under laws, regulations, or orders. An authorized Federal officer has the authority to modify the site location and design of facilities, control the rate of development and timing of activities, and require other mitigation under standard lease terms. The necessity for individual lease stipulations is documented in the lease-file record with reference to the appropriate land use plan or other leasing analysis document. The necessity for exceptions, waivers, or modifications is documented in the lease-file record through reference to the appropriate plan or other analysis.

Study Areas: Northern Alaska, Central Alaska, Southern Alaska, Eastern Oregon-Washington, Ventura Basin, Eastern Great Basin, Uinta-Piceance Basin, Paradox Basin, San Juan Basin, Montana Thrust Belt, Powder River Basin, Wyoming Thrust Belt, Southwestern Wyoming, Denver Basin, Williston Basin, Florida Peninsula, Black Warrior Basin and the Appalachian Basin, which were selected as the geologic provinces for detailed study within this Inventory.

Subsurface Allocation: An allocation of potential additions to reserves to land entities based on subsurface ownership of mineral rights.

Surface Allocation: An allocation of potential additions to reserves to land entities based on surface ownership.

Sweet Spot: An area within a continuous-type deposit where production characteristics are relatively more favorable.

-T-

Technically Recoverable Resources: In-place resources that are producible using current recovery technology but without reference to economic profitability. These resources are generally conceived as existing in accumulations of sufficient size to be amenable to the application of existing recovery technology.

Timing Limitations (TLs): Prohibit surface use during specified (usually seasonal) time periods to protect identified resource values. They do not apply to the operation and maintenance of production facilities unless there is a continued need for such mitigation and less stringent, project-specific mitigation measures would be insufficient. Also called a Seasonal Restriction.

Total Petroleum System (TPS): A mappable entity encompassing genetically related petroleum that occurs in seeps, shows, and accumulations (discovered or undiscovered) that have been generated by a pod or by closely related pods of mature source rock, together with the essential mappable geologic elements (source, reservoir, seal, and overburden rocks) that controlled fundamental processes of generation, migration, entrapment, and preservation of petroleum.

Total Recovery: The total expected recoverable volume of oil, gas, and natural gas liquids production from a well, lease, or field under present economic and engineering conditions; synonymous with estimated ultimate recovery.

-U-

Ultimate Recovery Appreciation (URA): The generally observed increase of Estimated Ultimate Recovery over time.

Undiscovered Petroleum Resources: Resources postulated from geologic information and theory to exist outside of known oil and gas accumulations.

USGS-Assessed Petroleum Volumes: The quantities of oil, gas, and natural gas liquids that have the potential to be added to reserves within some future time frame, which for this assessment is 30 years. The USGS assessed petroleum volumes include both those from undiscovered accumulations, whose sizes are greater than or equal to the selected minimum accumulation size, and those from the reserve growth of fields already discovered.

-V-

-W-

Wetlands: Permanently wet or intermittently flooded areas where the water table (fresh, saline, or brackish) is at, near, or above the soil surface for extended intervals; where hydric wet soil conditions are normally exhibited; and where water depths generally do not exceed two meters. Marshes, shallows, swamps, muskegs, lake bogs, and wet meadows are examples of wetlands.

Wilderness: A Congressionally designated area of undeveloped Federal land retaining its primeval character and influence, without permanent improvement or human habitation, that is protected and managed so as to preserve its natural conditions and that (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and, (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Wildlife: Animals that are neither human nor domesticated.

Withdrawal: An action that restricts the disposition of public lands and that holds them for specific public purposes; also, public lands that have been dedicated to public purposes (for example, recreation sites, office or warehouse sites, etc.).

-X-

-Y-

-Z-

Appendix 3
Federal Land Status Preparation

A3.1 Sources of Data

Federal lands mapping for the Inventory was completed based upon detailed research of multiple sources of information that describe the nature and extent of Federal surface and mineral interests. Spatial data themes were created that define various ownership characteristics and categories for lands within the study area boundaries. The final data sets were rendered to delineate both surface and subsurface U.S. rights. Ownership cases were extracted from the BLM's LR-2000 Database, processed, and used to create polygon themes for the project. The primary digital datasets processed and mapped include LR-2000 Status, Case Recordation, Legal Land Description, and various competitive oil and gas lease sales. In the Alaska study areas, data from the Alaska Land Information System (ALIS) were obtained from the State of Alaska web site and supplemented by other records from Federal and state governments. Digital land title records were supplemented with paper maps, land ownership ledgers, resource management plans and other miscellaneous real property records. The primary BLM land record databases are shown on the following schematic in Figure A3-1.[1]

In the Public Land Survey System (PLSS) states, the BLM's Geographic Coordinate Data Base (GCDB), where available, was utilized as the survey framework to create Federal land ownership and parcel boundaries. In areas where GCDB was not available, alternate sources were used to establish the positions of PLSS corners and subdivisions. In the Eastern states where only non-rectangular surveys exist, the best data available from Federal, state and county sources were used. Geographic coordinates were not available in all cases and therefore may be somewhat generalized.

A3.2 Data Preparation

Polygon themes were created for over 390,000 individual ownership cases within the study areas that were extracted from the BLM's LR-2000 Database.

The Surface Management Agency (SMA) and ownership polygon boundaries reflect parcel geometry as described by the legal land description maintained in the electronic records. All land descriptions were processed, including minor subdivisions where available down to and including 2.5 acres or smaller. Lands described by lot, tract or special surveys where GCDB was not available were processed against the BLM Legal Land Description (LLD) file to convert the lot references to nominal aliquot descriptions. Depending on the actual survey type and special survey geometry, the resulting polygon may contain a degree of generalization. Additionally, the BLM record systems do not contain individual records for public domain lands. The location of these lands was determined

[1] Information is available at http://www.geocommunicator.gov which provides searching, accessing and dynamic mapping of data for Federal land stewardship, land and mineral use records, and land survey information. It also provides spatial display for land and mineral cases from BLM's LR2000 system.

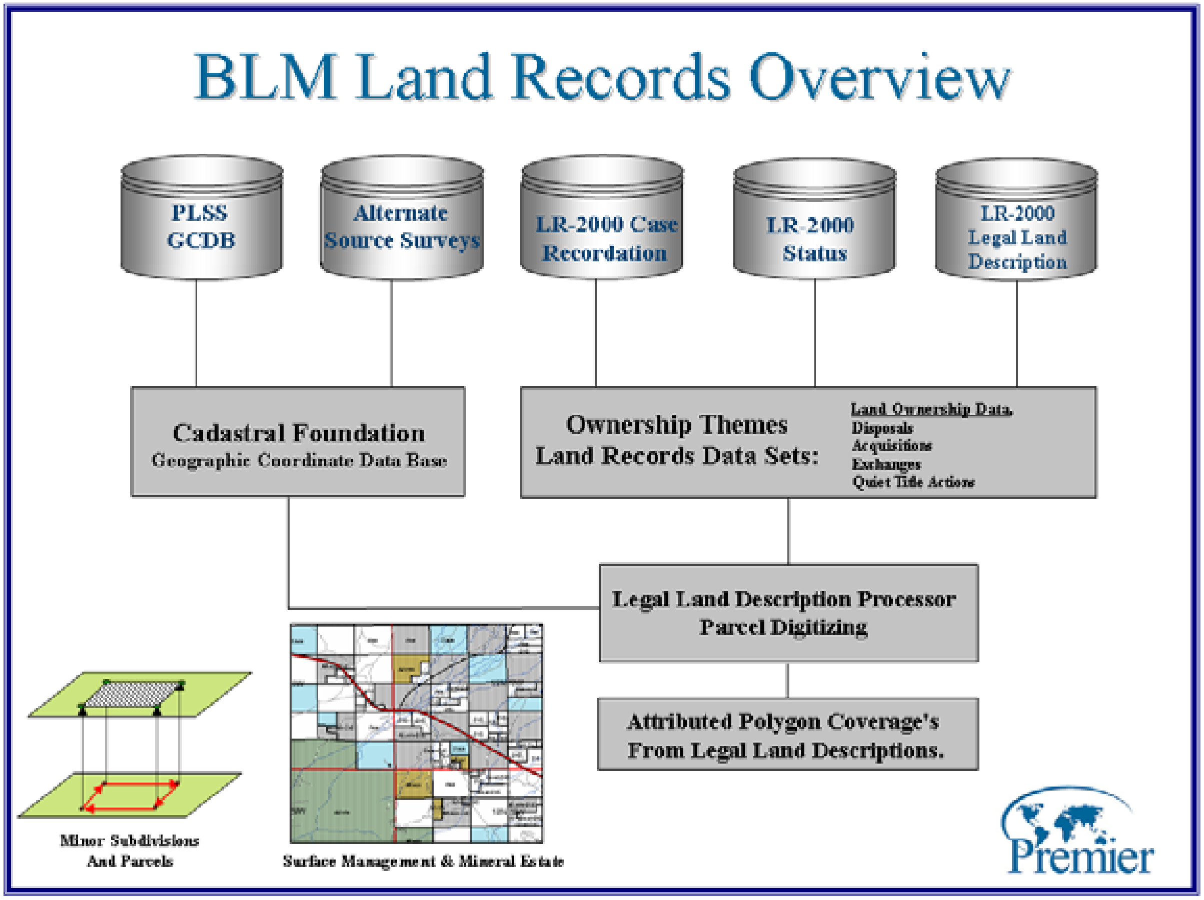

Figure A3-1. Schematic of BLM's Primary Land Records Databases

through various subtractive polygon-processing steps.

The primary information that defines U.S. ownership is data elements associated with various title transactions and business events recorded and maintained within the LR-2000 Database. Case records that fall within the following four general categories were extracted and mapped.

1. Land Disposals - including patents, grants, deeds, land sales and all other transactions that conveyed ownership rights in lands from the Federal government.
2. Acquired Lands - including lands that were re-acquired by the United States under various legal authorities.
3. Land Exchanges - including lands exchanged between the Federal government and other parties.
4. Quiet Title Cases - including all records established to cure title and quiet adverse claims.

These four major categories formed the basis to extract the desired records from the BLM's databases. The four queries were processed against both the Status and Case Recordation datasets. Due to formatting differences between the two databases, the resulting polygon attributes contained in the GIS shape files varied slightly. Additionally, in some records extracted from the Case Recordation system, U.S. Rights were not readily available but were determined as accurately as possible through interpretation from land records obtained at BLM state and field offices.

The following attribute fields shown in Table A3-1 lists the data elements contained in the shape files produced from each of the LR-2000 datasets:

In the Western study areas, the data simplification process was completed through numerous steps that combined data associated with each of the four broad record categories described above.

A general discussion of the processing steps is described below:

1. The GCDB or alternate source PLSS data was used as the cadastral reference framework. The PLSS grid contains data elements and coordinates that define both townships, sections, and 1/16 subdivisions. Where legal descriptions described parcels less than 40 acres, CartéView[2] software was used to map the minor aliquot parts down to 2.5 acres or smaller.
2. After the PLSS base was loaded, a master polygon (Figure A3-2) was created to represent the original U.S. land purchases and annexations. For example, lands that fall within the geographic extent of the Denver Basin study area were acquired in 1803 through the Louisiana Purchase. All surface and subsurface rights were claimed by the United States of America.
3. The next step involved processing textual legal land descriptions against the PLSS framework file by subdividing according to the survey rules embedded in the CartéView software. The data

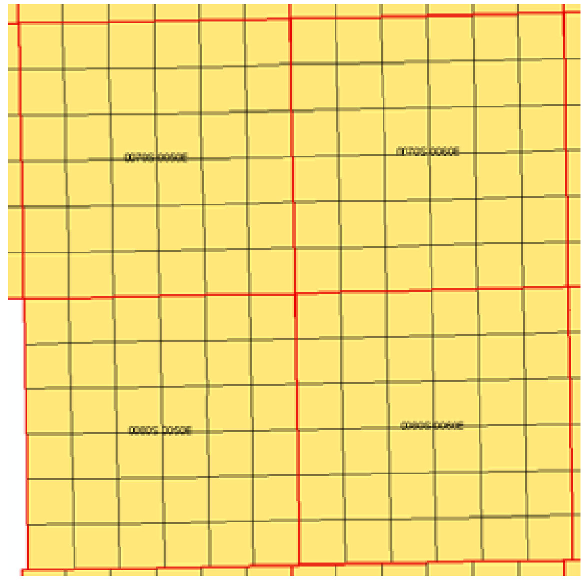

Figure A3-2. Master Polygon

Table A3-1. Polygon Attributes from the LR-2000 Datasets

Status Attributes	Case Recordation Attributes
Shape Meridian Township Range Section Survey Type Aliquot Admingenc County State Serialnumb Docid Patent_num Case_type Usright1 Usright2 Usright3 Usright4 Patentissu (mm/dd/yy) Patentiss1 (year) Acres Patentee Id **Note: Data fields will be populated if data are entered in the Status dataset. If U.S Rights are recorded in the U.S Rights field, they will be included in the Commodity field.**	Meridian Township Range Section Surveytype Aliquot Serialnumb Surveynumb Name Percentint Price Acres Dispositio Casetype Commodity Expiredate Expireyear Effectdate Royaltyrt Geoname Hbp Or Id **Note: Data fields will be populated if data are entered in the Case Recordation dataset. If US Rights are entered, they will be included in the Commodity field.**

[2] CartéView is proprietary software of Premier Data Services, Englewood, CO.

shown in Table A3-2 shows a typical input file.

4. After the records from the Status and Case Recordation datasets were processed, the resulting polygon themes were re-attributed to facilitate merging them together. These polygons were then overlaid on the Master Polygon to establish the location of lands where ownership left the Federal government by virtue of patent, grant or other title transfer authority. The result is represented in the following graphic, Figure A3-3.

   The yellow polygons shown on the above map represent lands in the public domain where surface and subsurface rights are managed by the BLM.

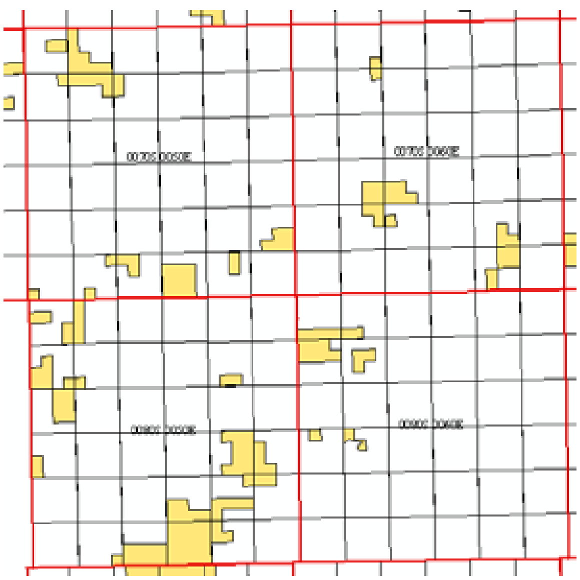

Figure A3-3. Public Domain Lands

5. The next step involved constructing a series of queries of the U.S. rights data associated with lands that were disposed through various title transfers. This query process, (Figure A3-4) involved a very complex analysis against the attribute tables in the spatial datasets. The results of these processes delineate all lands where subsurface oil and gas mineral rights are owned by the United States.

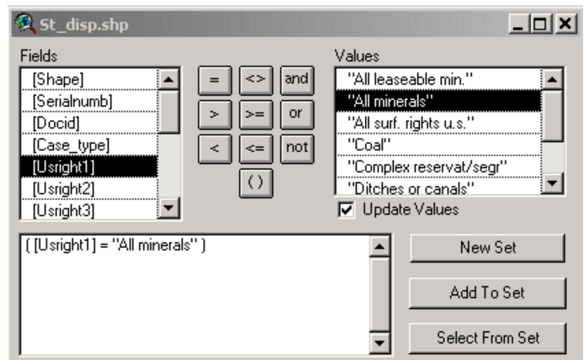

Figure A3-4. Query of U.S. Rights Data

Figure A3-5 illustrates the distribution of split-estate mineral ownership within a four township area. The parcels shaded gray represent patented lands where the United States retained rights to the oil and gas mineral estate.

6. The last step in the spatial query and overlay process was to define any other Federal management agencies or state surface ownership. These determinations were made by completing a series of queries against the ownership fields in the parcel base. The results of this query are shown in Figure A3-6.

Table A3-2. Typical CarteView Input File

	A	B	C	D	E	F	G	H	I	J	K	L
1	Status	Generic	USRight1	SerialNumber								
2	Meridian	Township	Range	Section	SurveyTy	Aliquot	County	State	SerialNumber	DocID	Case_Type	USRight1
1348	6	0180N	0920W	28	T	NWNW,NWSW,SWNW;	7	WY	WYC 0001269	165770	HE ORIGINAL	Coal
1349	6	0180N	0920W	29	T	NENE,NESE,NWNE,NWSE,SENE,SW	7	WY	WYC 0001269	165770	HE ORIGINAL	Coal
1350	6	0180N	0920W	20	T	NESE,NWSE,SESE,SWSE;	7	WY	WYC 0001270	163248	HE ORIGINAL	Coal
1351	6	0180N	0920W	21	T	NWSW,SWSW;	7	WY	WYC 0001270	163248	HE ORIGINAL	Coal
1352	6	0180N	0920W	28	T	NWNW;	7	WY	WYC 0001270	163248	HE ORIGINAL	Coal
1353	5	0150N	0920W	29	T	NENE,NWNE;	7	WY	WYC 0001270	163240	HE ORIGINAL	Coal

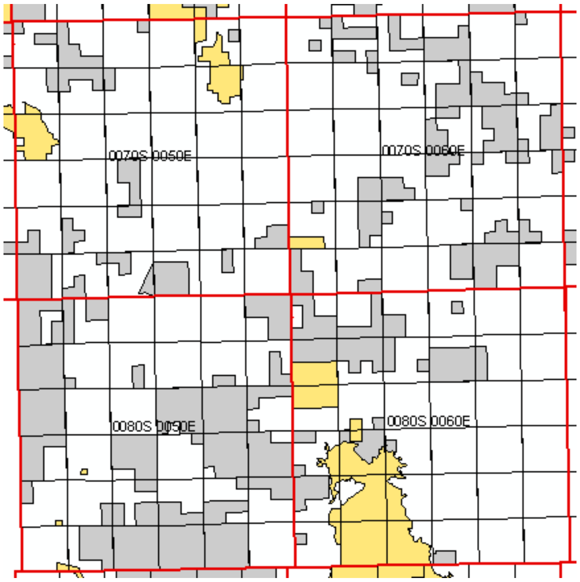

Figure A3-5. Federal Split Estate Oil and Gas Ownership

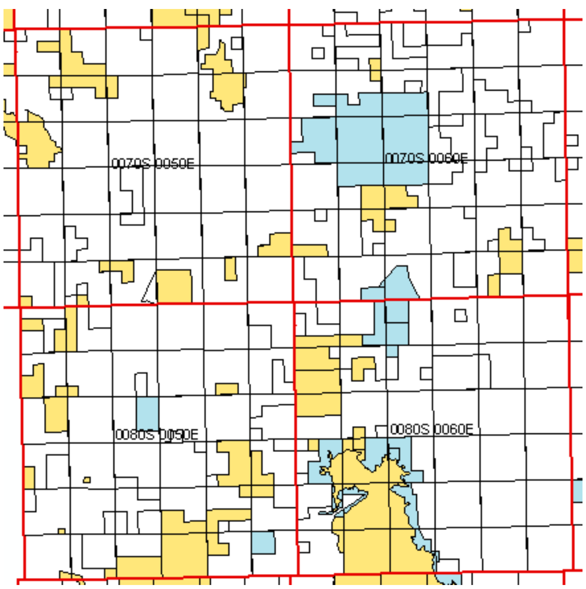

Figure A3-6. Defining Ownership

The parcels shaded blue represent lands that were granted to the State of South Dakota.

7. The final processing step was to dissolve the individual parcels into ownership categories that define the surface and mineral estates. The view in Figure A3-7 shows the surface management agencies and how land ownership is distributed within an area of the Denver Basin in South Dakota.

In contrast to the surface management view, the mineral estate in the view shown in Figure A3-8 covers the same area and yields a much different picture. The yellow areas represent lands where the Federal government manages oil and gas rights.

A3.3 Data Limitations

The data sets created from the processes described above reflect the legal land descriptions contained in the BLM databases. There was no attempt to analyze and review all of the error logs that were generated from the parcel generation process. If legal land descriptions were not properly entered and formatted according to BLM's published LR-2000 standards, an error log was generated.

Other limitations:

- The BLM Case Recordation System is not consistently populated with U.S. Rights data. The split-estate ownership generated from LR-2000 was verified by contacting BLM state and field offices. These data may carry a minor degree of generalization.
- The Interagency Steering Committee advised against processing certain withdrawal cases from the BLM's Status and Case Recordation datasets. This decision made it necessary to integrate Surface Management Agency information from GIS data obtained from multiple sources. During the spatial processing and merging of this data, sliver polygons were created. These sliver polygons were not edited and may be present in certain ownership themes.

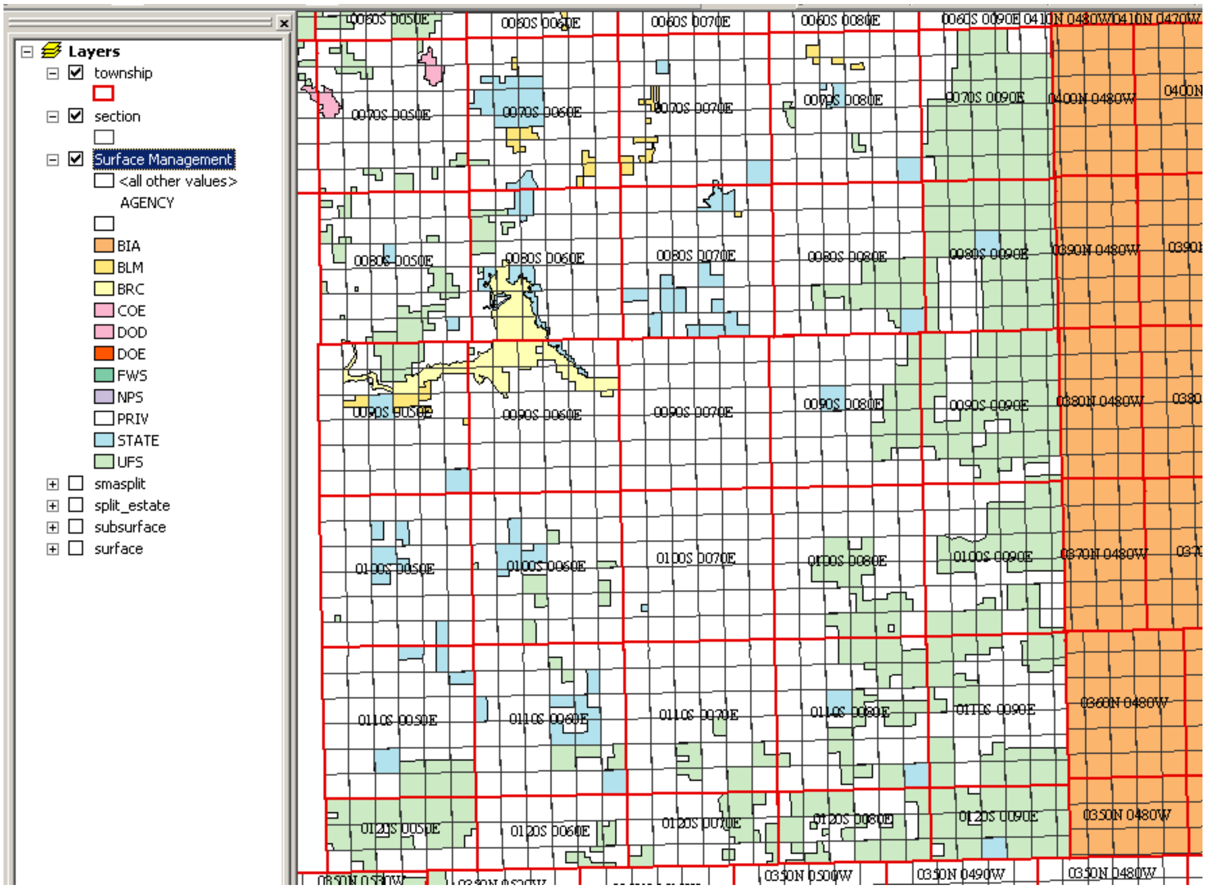

Figure A3-7. Surface Management View

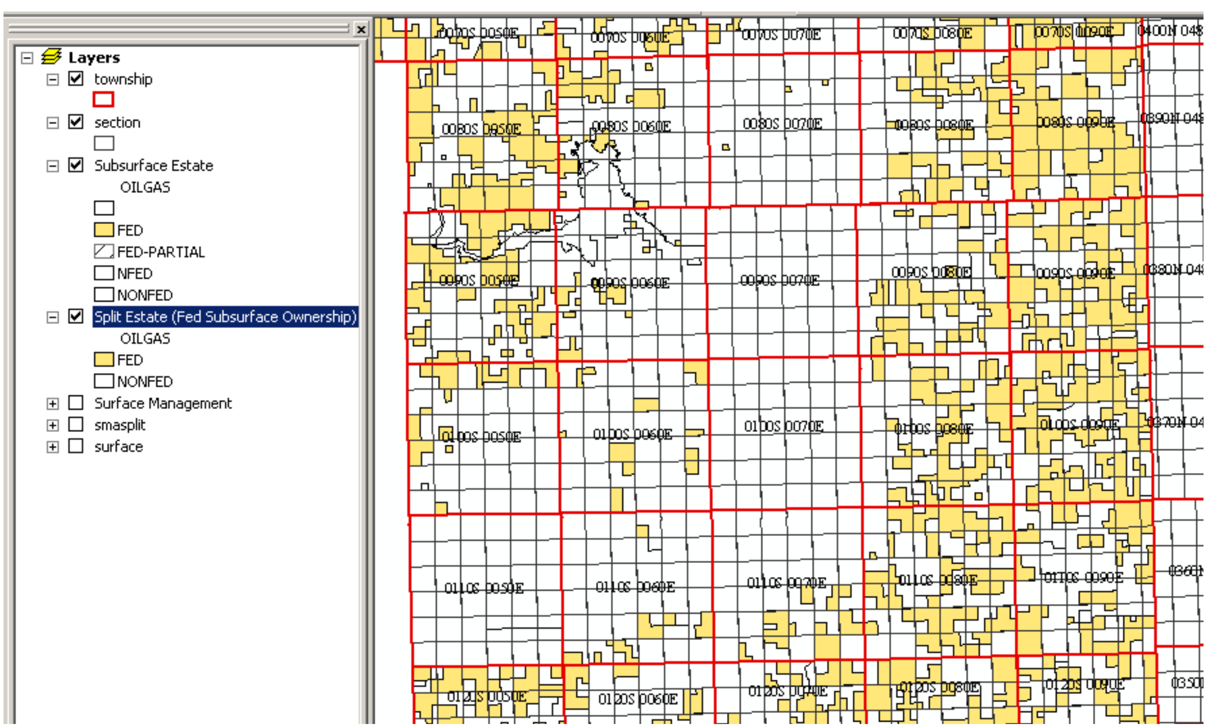

Figure A3-8. Subsurface Oil and Gas Ownership View

- The PLSS data were not edge matched across state boundaries.

A3.4 Data Source by Agency

Data were provided by agencies as described below:

- Bureau of Land Management: Digital land records, hard copy maps and GIS shapefiles of Federal mineral ownership.
- USDA-Forest Service: Hard copy maps and digital polygon files showing surface and subsurface ownership. Verbal confirmation for individual polygons overlapping other agency datasets.
- U. S. Fish and Wildlife Service: Hard copy maps and digital shapefiles.
- National Park Service: Digital shapefiles.
- U. S. Army Corps of Engineers: Hard copy maps, aerial photos, digital shapefiles of ownership polygons, county and municipal parcel datasets.
- Department of Defense: Hard copy maps and digital shapefiles of ownership polygons. State, county and local datasets provided boundaries, verbally confirmed by direct contact with installation.
- Department of Energy: Hard copy maps from the BLM and digital data provided by county and municipal datasets.
- Department of Homeland Security: Digital shapefiles of ownership polygons, local county and municipal parcel datasets.
- Department of Justice: Local tax GIS datasets. Federal prisons were verified by phone and digitized from hard copy maps.
- Department of Labor: Local tax GIS datasets.
- Department of Veterans Affairs: Hard copy maps from the BLM and digital polygons provided by county and municipality datasets.
- Federal Aviation Administration: County and municipal parcel datasets.
- General Services Administration: Local tax GIS datasets.
- National Aeronautics and Space Administration: Hard copy maps from the BLM
- Tennessee Valley Authority: Digital shapefiles provided by the primary administrative and local agency offices.
- United States Department of Agriculture (other): Local tax GIS datasets.

Merging of datasets for Federal surface and subsurface ownership followed three basic rules in order of priority:

- Data extrapolated from deed records were considered to have the highest confidence level.
- Newer data and map publication dates were used over older sources.
- Verbal verification by agency was obtained.

Appendix 4
Federal Oil and Gas Lease Stipulation Data Preparation

The bulk of the data preparation for lease stipulations consisted of data gathering, digitization, and compilation in a multi-layered GIS format (ESRI shapefiles). Federal Geographic Data Committee (FGDC) -compliant metadata for the resulting GIS layers were also created. GIS coverages from SMA land status, stipulations, and the analyses, as well as the associated metadata, are presented on the DVD-ROM accompanying this report.

Where necessary, the shapefiles obtained from the Federal land management agencies were processed using ArcGIS version 9.2 software by matching specific leasing stipulations found in the guidance documents.

This Inventory is limited to those Federal lands within the aggregate resource play boundaries of the eighteen study areas, which are based on geology as defined in the USGS National Assessment of Oil and Gas Resources. The land status and stipulation shapefiles, which correspond to Federal land management agency jurisdiction boundaries, were "clipped" using the GIS to the appropriate study boundary. Some of the shapefiles fell into multiple study areas, in which case the clipping process was repeated for each area. The attribute tables of the compiled shapefiles were then queried for unique leasing stipulation values. The query results were then saved as separate polygon shapefiles. Each shapefile represents a unique stipulation value.

The following discussion of the specific data preparation steps uses the Wyoming Thrust Belt study area as an example:

1. The first step entails loading the study area (union of resource plays) boundary shapefile and the compiled stipulation shapefile into ArcGIS (Figure A4-1).

   The next step in this process is to "clip" or cut the compiled stipulation shapefile to the study boundary. Figure A4-2 shows the GIS coverage after it has been clipped.

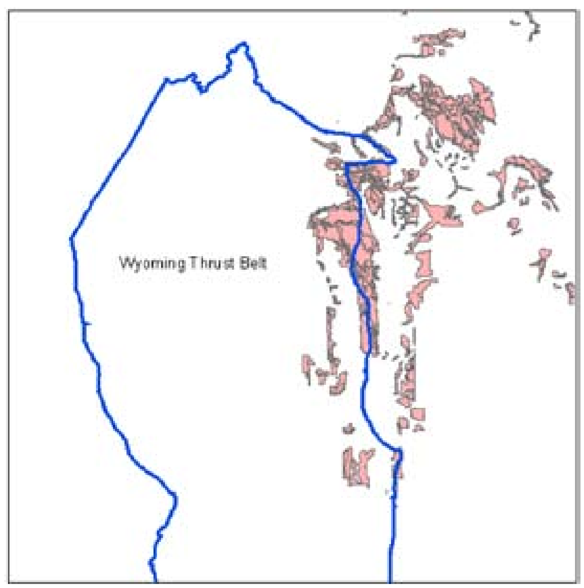

Figure A4-1. Stipulation Polygons and Study Area Boundary

Figure A4-2. Example of Polygons after Clipping to Study Area Boundary

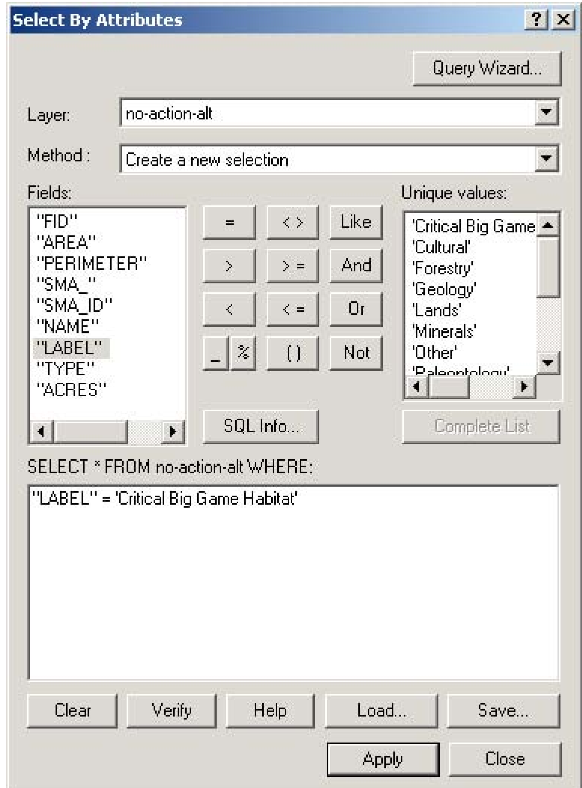

Figure A4-3. Query in ArcGIS for all "Critical Big Game Habitat" Stipulations

2. The compiled stipulation shapefile is then queried for unique stipulation attributes values as shown in the ArcGIS Query Builder (Figure A4-3). For this example, all polygons covered by the leasing stipulation "Critical Big Game Habitat" were selected. The highlighted rows in the attribute table (Figure A4-5) show which records are selected.
3. Using the ArcGIS function "Create layer from Selected Features," a new shapefile is created that contains only polygons labeled with the attribute "Critical Big Game Habitat". Figure A4-5 shows the new shapefile that is created.

For certain stipulations, such as steep slopes, for which GIS data were not available from the BLM or FS offices, shapefiles were created from available data in conformance with stipulation requirements. For example,

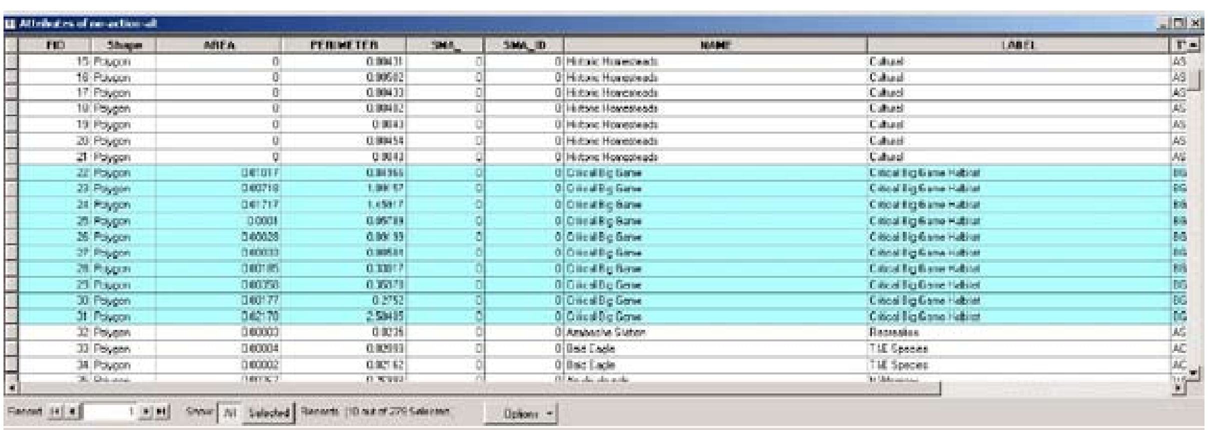

Figure A4-4. Attribute Table Showing all "Critical Big Game Habitat" Polygons

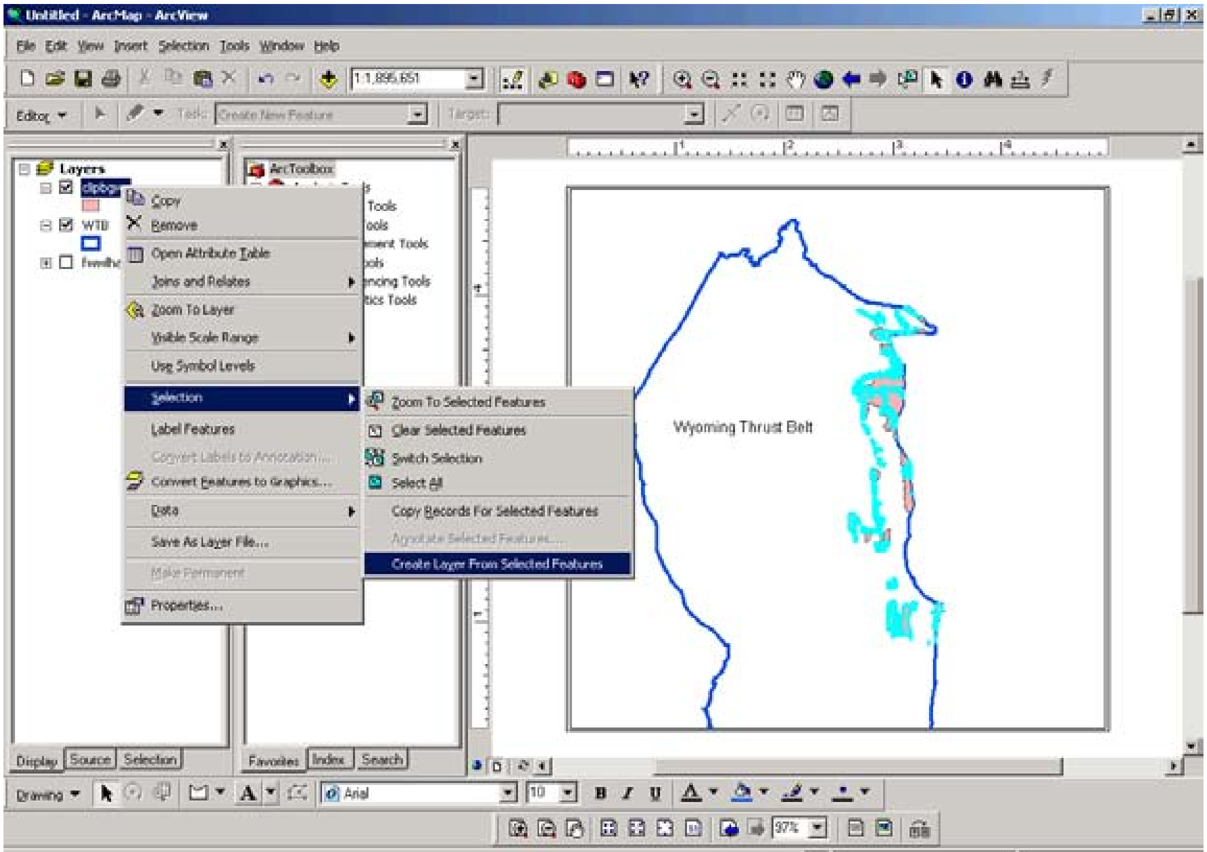

Figure A4-5. New Polygons Representing Land with Leasing Stipulation for "Critical Big Game Habitat"

a typical steep slope stipulation impacts leasing in areas where slopes exceed 25 percent. Polygon themes were created from slope data derived from USGS 1:24,000 Digital Elevation Models (DEMs). These raster data sets contain elevation information on 100-meter grid spacing.

The USGS DEMs were first clipped to the BLM or FS jurisdictional area. In situations where more than one agency had the same stipulations, the DEM was clipped to the agencies' combined jurisdictional area. A raster coverage was then created containing slope percentage data as calculated by ArcGIS. This coverage was then queried to isolate the areas covered by the stipulation (e.g., all areas steeper than 25 percent). The selected raster data was then converted to a vector polygon coverage, and the coverage was coded and attributed as described above. Figure A4-6 shows the creation of steep slope polygons. The 100-meter USGS DEM for this portion of the Denver Basin is shown in shades of gray. The red theme represents the polygon shapefile showing areas with a greater than 25 percent slope.

Following the above procedures, the GIS shapefiles of the stipulations were coded with their respective descriptions from the various land use plans. These stipulations can be found in Appendix 11.

For quality control, completed lists of stipulations and their corresponding geometries were made available to the BLM and FS offices for their review. After

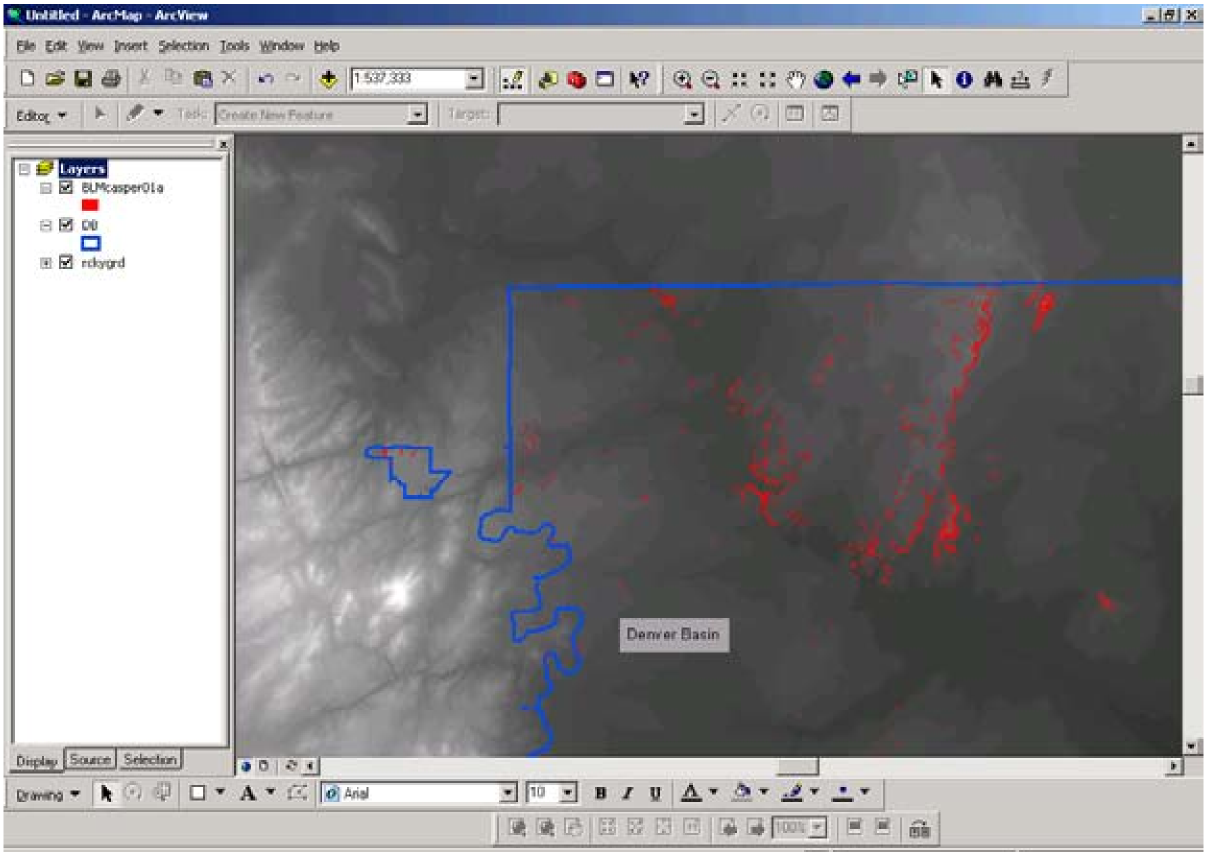

Figure A4-6. Creation of Steep Slope Restriction Polygons

soliciting responses, all feedback received from the offices was incorporated into the final datasets.

A4.1 Differences Between the Phase III and Phase II Inventories

The Phase III Inventory is a cumulative effort and incorporates data from the Phase II Inventory. Significant differences between the two arise from four sources: (1) an increased number of basins, (2) inclusion of extrapolation areas to extend the Inventory to all onshore Federal lands in the U.S., (3) receipt of additional or revised data from field offices often in association with revised LUPs, and (4) inclusion of new (replacement) oil and gas assessments from the USGS completed as a part of their National Oil and Gas Assessment.

A4.1.1 Methodological Changes

Extrapolation. To account for all Federal onshore resources, the EPCA Phase III Inventory accounts for areas and resources outside of the delineated study areas by extrapolation. The Inventory extrapolates land and resource categorizations based on the Federal land owner and access categorized in the detailed study areas. The resources from USGS assessments (see Appendix 6) outside of the detailed study areas were tallied by Federal land owner and assigned categorizations based on extrapolation from the detailed study areas. Further, where the total resource for a land use plan or office was less than 5 BCF (equivalent) within the study areas, the land and resource categorizations were extrapolated using the categorization by Federal land owner for that basin. For more details on this process, see Appendix 9.

Exception Factors Defined by Study Area. The EPCA III Inventory took into greater account the handling of exception factors for land use plans that span multiple study areas (for a complete explanation of exception factors, see Appendix 9.1 and Table A9-3). Certain stipulations in a given land use plan have different exception factors for different study areas, for reasons such as an increased concentration of a given species in a certain section of a planning boundary. Examples of areas that have different exception factors in different basins are the Glenwood Springs and Uncompahgre, CO BLM offices and the Kemmerer, WY BLM office. This change had only a minor impact on results.

Study Area Boundaries. The EPCA II study area boundary for Northern Alaska was greatly increased for the EPCA III Inventory. In EPCA II, the total Inventory area for Northern Alaska was about 25 million acres, while the EPCA III Inventory area is now nearly 40 million acres due to the inclusion of the USGS North Slope Middle-ground Area assessment. The Denver and Powder River Basins borders were also changed slightly from the EPCA II Inventory where a small area of what was the Denver Basin in EPCA II is now part of the Powder River Basin study area. In the EPCA II Inventory, the Paradox/San Juan Basin had been handled as a single study area. For the EPCA III Inventory, there are two distinct basins, the Paradox and the San Juan Basins (See Figure ES-1 for a complete map of the study areas, including updated basins). This change has been made to conform to the USGS NOGA province delineations.

Resource Allocation. Slight changes have been made in the EPCA III Inventory for oil and gas resource allocation due the inclusion of more plays overlapping from new study areas. The Paradox Basin has additional resources from the Eastern Great Basin. In the Uinta-Piceance Basin, an additional play was included in the analysis that was not in the EPCA II Inventory. The Denver Basin received an additional resource-dense play from the Williston Basin, and the Powder River Basin also received an additional play from the Williston Basin.

A4.1.2 Additions to the Phase III Inventory

Additional Data Received from Offices. For the Phase III effort, additional data were received from some offices. Each office inventoried in Phase III was canvassed to supply any additional GIS data that had not been in the Phase II Inventory, and many had minor updates for data that had previously not been available. Conversely, some offices had significant changes or new GIS data, including Farmington, NM BLM; Taos, NM BLM; Grand Junction, CO BLM; Buffalo, WY BLM; Lander, WY BLM; Pinedale, WY BLM; Rock Springs, WY BLM; all UT BLM offices (replacing the "Lopez Project", see below), Bridger-Teton NF; Uinta NF; Beaverhead NF; George Washington NF; Nebraska NF; Thunder Basin National Grassland; the National Forests of Alabama and Mississippi; North Dakota Game and Fish Department; and Big Cypress National Preserve.

In addition, an updated national GIS layer for Wilderness Areas, Inventoried Roadless Areas, Special Designated Areas, National Conservation Areas, Wilderness Reinventory Areas, Incorporated Towns and Cities, Wilderness Study Areas, Research Natural

Areas, National Monuments, National Wildlife Refuges, Wild and Scenic Rivers, and National Scenic and Historic Trails was provided by the BLM's National Landscape Conservation System and the USDA-Forest Service.

New GIS data for coastlines from the BLM were used in the EPCA III Inventory. The coastlines are now analyzed in greater detail than in the EPCA II Inventory, thus giving slightly different results for study areas in Alaska, Florida, and the Appalachian Basin.

Updated Land Status GIS data was used in the Phase III Inventory for Northern Alaska and the Powder River Basin.

Areas Deferred from Leasing Until Completion of an Updated Land Use Plan. As a land use plan is under revision, an office may decide to defer any lease applications until completion of the new plan. The Northeast NPRA BLM planning area, and the San Juan and Santa Fe NFs are examples where leasing decisions are suspended until completion of a new plan or plan revision, and are classified as NLA\LUP for the EPCA III Inventory. Also, the Roan Plateau area in the Glenwood Springs, CO BLM office was not completed at the time of this Inventory, and is categorized as NLA\LUP.

Land Use Plans Now Subject to Stipulations. In the EPCA II Inventory, there were a number of offices undergoing planning and, as such, they were listed as NLA\LUP. Several of these plans have been completed and signed into effect, and are now incorporated into the Phase III Inventory. Examples of such areas are the Dillon, MT and Gunnison, CO BLM offices, Bighorn NF, Caribou NF, and the Jack Morrow Hills Core Area of the Rock Springs, WY BLM office. The entire Humboldt-Toyiabe NF was NLA\LUP in the EPCA II Inventory, but now sections of the Forest are NLA or NSO, while other sections remain NLA\LUP until further NEPA analysis is completed.

New Land Use Plans Superseding EPCA II Land Use Plans. The EPCA II Inventory contained several land use plans that have since been superseded by new or different plans. In the Salt Lake, UT BLM office the Bear River EA, supersedes the Isotract and the Randolph and Park City MFPs, which were used in the EPCA II Inventory. Likewise, new land use plans were analyzed in EPCA III for Monongahela NF and Wayne NF, among others. While most of the new plans contain similar restrictions on oil and gas leasing, there are also differences that lead to different land access categorizations for areas within the plan boundary.

Use of Discrete Land Use Plans. In the EPCA I and II inventories, the Utah BLM Lopez Project had been provided by the UT State Office of the BLM. For the EPCA Phase III Inventory in the Paradox and Uinta-Piceance Basin areas in Utah, discrete land use plans, where available, were used in place of the Lopez Project. GIS data associated with the discrete plans were incorporated into the Inventory, thus creating different land access categorization results for these study areas.

A4.1.3 Other Changes for Phase III

Refined Stipulation Lists. For some land use plans, the stipulations lists were refined since Phase I and/or Phase II of the Inventory. The Montana Thrust Belt is one area in which further analysis of the LUPs resulted in alterations to the stipulation lists.

There are also updates to the stipulations list in the Miles City, MT BLM district.

Analytical Errors. There were about 1300 stipulations having GIS data in the Phase II Inventory. A small number of miscellaneous analytical errors were made that slightly impacted the results presented in published version of that Inventory. After further analysis of the land use plan and consultation with the specific management unit, several changes were made to stipulations in the EPCA II Inventory. The errors are:

- In the Alabama NFs, two stipulations were changed to conditions of approval, and several other stipulations were added.
- In Carson NF, a stipulation was added for riparian areas. Also, the LAC for stipulations 005 and 006 were reversed in the Phase II Inventory.
- In Ashley NF, stipulations were added for riparian areas, steep slopes, and wetlands.
- After consultation with the field office, the San Juan, CO BLM added several stipulations.

Publication Errors. In the Phase II Inventory publication, the Powder River Basin Study Area – Federal Land and Oil and Natural Gas Resources by Access Category table was displayed incorrectly. The table for the Montana Thrust Belt Study Area was displayed instead. In the PRB, four plays had erroneous listings for resource values (but were analyzed correctly in modeling).

Rendering Errors. In the EPCA II report, reserves growth for both oil and gas resources were not displayed in maps for the Uinta-Piceance Basin, Powder River Basin, Wyoming Thrust Belt, Southwestern Wyoming and Black Warrior Basin study areas. Despite not being shown in the map, the resource values were included in the analysis.

Name Change. The Southwestern Wyoming study area was previously called the Greater Green River Basin in the EPCA II Inventory. This change was made to be consistent with USGS nomenclature.

Appendix 5
APD Conditions of Approval Data Preparation

The Inventory included a large-scale statistical sampling and categorization of COAs and related data for APDs.

The data preparation consisted primarily of the creation of a Federal oil and gas permit/well GIS point data theme. This task was performed by processing legal description data from the BLM's AFMSS against the PLSS dataset collected as described in Appendix 3. Data gathering, compiling, categorizing, digitizing and analysis followed as described below.

1. Excel spreadsheets were used to collect the COA data during visits to the BLM Field Offices (FO) listed in Table A5-1. They included attributes from the AFMSS database identifying lease number, surface location legal description (including footage calls, if available), surface managing agency, operator name, well name, well number, well type, received date, approval date, spud date, and completion date. The MTB study area was not included because it is approximately 97 percent closed to access and has little drilling history. SAK, EOW and the FLP were also excluded given the relative lack of drilling history.
2. All APDs approved between and including the dates of October 1, 1999 and September 30, 2004 were included. Wells on non-Federal minerals within Federal agreements and on Indian lands were excluded. The COAs and related data were collected from approved APDs issued by the BLM FOs (Table A5-2) wholly or partially within the

Table A5-1. Study Areas Sampled for COAs

Northern Alaska
Central Alaska
Ventura Basin
Eastern Great Basin
Uinta-Piceance Basin
Paradox Basin
San Juan Basin
Williston Basin
Powder River Basin
Southwestern Wyoming
Wyoming Thrust Belt
Denver Basin
Black Warrior Basin
Appalachian Basin

Table A5-2. BLM Field Offices for which COAs Data were Abstracted

State	BLM Field Offices
Alaska	Northern (Fairbanks)
California	Bakersfield
Colorado	Little Snake (Craig), White River (Meeker), Grand Junction, Glenwood Springs, Royal Gorge (Cañon City), Uncompahgre (Montrose), Gunnison, and San Juan (Durango)
Eastern States	Jackson, MS, and Milwaukee, WI
Montana	Miles City, Billings, North Dakota (Dickinson), and South Dakota (Belle Fourche)
Nevada	Ely, Battle Mountain
New Mexico	Farmington, Rio Puerco (Albuquerque), and Taos
Utah	Salt Lake, Vernal, Richfield, Price, Moab, Cedar City, Monticello, St. George, Kanab, and Grand Staircase-Escalante National Monument (Escalante)
Wyoming	Buffalo, Newcastle, Casper, Pinedale, Kemmerer, Rock Springs, Rawlins, and Lander

study areas. This well/permit data theme was then spatially intersected with the study area polygons to eliminate points outside of their boundaries. The distribution of the resultant APDs was then geographically mapped.

3. The above data theme was then randomly sampled to generate a new GIS point data theme. A stratified random sampling method was used with two data strata: BLM FO and surface managing agency. The samples from each stratum were weighted by total APDs approved for each FO. The resultant total sample was approximately 10 percent of the total population of APDs and followed the guidance presented on Table A5-3.

Table A5-3. Stratified Random Sampling Guidance

APD Population (FY 2000-2004) within Field Office	Sample Size
0 – 30	100%
31 – 200	30 APDs
201 – 1333	15%
>1333	200 APDs

4. Contractor personnel, accompanied by BLM personnel, visited BLM FOs and abstracted COA and other related information from the hardcopy well files identified by the sampling process. Those offices whose sample count within the study areas fell below six were generally not visited. Instead, the FO was requested to transmit the COAs to the BLM Washington Office where they were examined.

   The abstracted information contained site-specific restrictions or impediments that affect the ability of the permittee and/or lessee to access the underlying lease for the purpose of exploring for and developing oil and gas resources. All abstracted information was restricted to Federal lands and limited to the 13-point surface use plan of the APD and related documents.

5. Other relevant information for the study was obtained through interviews held with FO personnel. This information was essential to determine the extent, through a qualitative analysis, of negotiations that occur prior to the submission of an APD, including adjustments at the time of well staking. This included the determination of:

   - Whether applicant-funded surveys (e.g., wildlife or archeological) are a prerequisite to acceptance of an APD as administratively complete (Table A5-4a).
   - The number of APDs not actually applied for because the cumulative effects of lease stipulations and probable COAs were prohibitive (Table A5-4b).

6. COA data were compiled into spreadsheets and spatial displays (GIS, etc.) that can be used to assist BLM management in decisions regarding APD approvals. The compilation process consisted of grouping of COAs by class (e.g., wildlife, soils, archeological, construction, sage grouse, etc.), and subsequent assignment of a unique identifier for each type of COA within a class. Only COAs that were more restrictive than (and not merely a restatement of) the stipulations on the underlying lease were considered.

Table A5-4a. Findings from Interviews with BLM Field Personnel – Applicant Funded Surveys

Survey Question: Are applicant funded surveys (e.g., wildlife or archeological) a prerequisite to acceptance of an APD as administratively complete?

Field Office	Response	Remarks
Bakersfield	Yes	
Battle Mountain	Yes	
Buffalo	Yes	BLM asks companies to plan APD activities from 12 to 18 months prior to the formal submission. This includes meetings to plan activities, supply maps and discuss requirements.
Burley	Yes	
Canon City	No	However, occasionally a survey is required (happened four times in the last fourteen years).
Casper	Yes	
Craig	See remarks	Without the archeological survey the archeologist usually won't finish their portion of the EA, so NEPA work will not be completed. Applicant funded surveys are encouraged to help speed up the processing of an APD, especially for archeology. Applicant funded wildlife surveys are rarely encouraged because usually the BLM has enough information. Applicant funded surveys are encouraged for special projects. Specialists like to have the surveys completed before the NEPA work is finished. It is unlikely for an APD to be approved and before the surveys are received.
Dickenson (North Dakota)	Yes, but see remarks	The wildlife survey is required, the archeological survey is not.
Dickenson (South Dakota)	Yes	
Durango	Yes	
Elko	No	
Ely	Yes	
Farmington	Yes	
Fillmore	No	
Glennallen	Yes	
Glenwood Springs	Yes	
Grand Junction	No	Surveys are typically completed by a contractor. If the operator asks the BLM to perform the survey, long delays may occur as the archeological/cultural staff at the Field Office are quite busy.
Jackson	No	However, if a survey is required, it must be received prior to APD approval.
Kemmerer	Yes	
Lander	Yes	
Malta	Yes	
Meeker	No	However, rather than waiting for the BLM to do the surveys, operators have paid a private consultant to perform them. Generally speaking, the survey comes in after the BLM has received the APD and is already processing it.
Miles City	Yes	However, an applicant funded survey is not required for wildlife

Table A5-4a. Findings from Interviews with BLM Field Personnel – Applicant Funded Surveys (continued)

Survey Question: Are applicant funded surveys (e.g., wildlife or archeological) a prerequisite to acceptance of an APD as administratively complete?

Field Office	Response	Remarks
Milwaukee	No	Not automatically required. BLM tries to identify if any survey will be needed during the leasing process, and if so, places a notice on the lease parcel to that effect. Normally the required surveys are archeological.
Moab	Yes	
Newcastle	Yes	
Palm Springs	Yes	
Pinedale	Generally yes, but see remarks	Archaeological surveys can performed after permitting, but must be received before drilling (frozen ground is an issue).
Pocatello	Yes	
Rawlins	No	However, lack of a cultural report will often delay approval of the APD. Except for a few black footed ferret surveys, wildlife surveys from the applicant are seldom required. These are generally done in house as part of the NEPA process
Richfield	No	
Rock Springs	Yes	Surveys are required to be in the Environmental Assessment.
Salt Lake City	No	
St. George	No	
Vernal	Generally yes, but see remarks	Because the specific wildlife presence may not be determined and may change over time, some APDs have COAs that call for routine wildlife surveys after the permit is issued.

Table A5-4b. Findings from Interviews with BLM Field Personnel – Prohibitive Lease Stipulations/COAs

Survey Question: Are there any known cases where APDs were not submitted or were withdrawn because the cumulative effects of lease stipulations and probable COAs were deemed prohibitive by the operator?

Field Office	Response	Remarks
Bakersfield	No	
Battle Mountain	No	
Buffalo	No	
Burley	No	
Canon City	Yes	One case in the mid-nineties
Casper	No	
Craig	No	
Dickenson (North Dakota)	Yes	Two permits due to raptors.
Dickenson (South Dakota)	No	
Durango	No	
Elko	No	

Table A5-4b. Findings from Interviews with BLM Field Personnel – Prohibitive Lease Stipulations/COAs

Survey Question: Are there any known cases where APDs were not submitted or were withdrawn because the cumulative effects of lease stipulations and probable COAs were deemed prohibitive by the operator?		
Field Office	**Response**	**Remarks**
Ely	No	
Farmington	No	
Fillmore	No	
Glennallen	No	
Glenwood Springs	No	
Grand Junction	No	However, there was one case where the operator chose to look for another site on the lease that did not have an NSO stipulation.
Jackson	Yes	Occurred rarely. The FO recalls one particular case in which an operator withdrew an APD after finding an archeological site (ancient cemetery) that would have required the well to be moved.
Kemmerer	No	
Lander	No	
Malta	No	
Meeker	No	
Miles City	No	
Milwaukee	No	
Moab	No	
Newcastle	No	
Palm Springs	No	
Pinedale	No	
Pocatello	n/a	
Rawlins	Yes	However, there have been some instances where APDs were withdrawn after field review and/or NEPA analysis indicated the need for intensive mitigation and/or relocation of the well site. A few APD's for coalbed natural gas were withdrawn because the lessee could not reach an agreement with the holder of the coal lease. In these instances, the holder of the coal lease had prior existing rights.
Richfield	No	
Rock Springs	No	
Salt Lake City	No	
St. George	No	
Vernal	No	

7. A total of 226 unique COAs were identified which were then categorized by the Interagency Steering Committee. The categorization was performed relative to the COAs' impact on access to oil and gas resources. The result was that COAs fell either into controlled surface use (CSU) or cumulative timing limitation (TL) categories that correspond with the leasing hierarchy described in Table 2-8. Changes in land access categorization arising from COAs were integrated into the spatial model. This recategorization methodology

consisted of first computing for each unique COA the percentage of wells having that COA (% unique-COA) with respect to the total number of wells sampled within a given FO and also within the non-NSO leasable areas as represented by the equation:

$$\%uniqueCOA = \frac{(\# \; Wells)_{uniqueCOA}}{(\# \; Wells)_{Acc.Area}}$$

Where:

$\%uniqueCOA$: Percentage of wells with a unique COA

$(\# \; Wells)_{uniqueCOA}$: Number of wells with a unique COA

$(\# \; Wells)_{Acc.Area}$: Total number of wells in the accessible area.

Table A5-5 is a breakdown of the COAs by BLM FO and includes the categorization, number of occurrences, and percentage of the wells in the sample that have that COA.

8. Subsequently this percentage value was extrapolated to the overall leasable area to estimate the change in accessibility. A grid composed of 400 by 400 meter cells (approximately 40 acres) was created for each FO or NF containing a study area. Cells were then randomly selected at the previously calculated percentage rate to create a potential access constraint theme. Figure A5-1 illustrates the process to extrapolate the effects of COAs on accessibility. This is an example for a case where 10 percent of the leasable area is potentially subject to a particular COA type.
9. Once the recategorization was accomplished, the resulting areas and volumes of the undiscovered technically recoverable oil and gas resources and reserve growth affected by the cumulative impact of COAs were computed. The land access categorization was then performed using the method for lease stipulations described in Section 2 and Appendix 9.

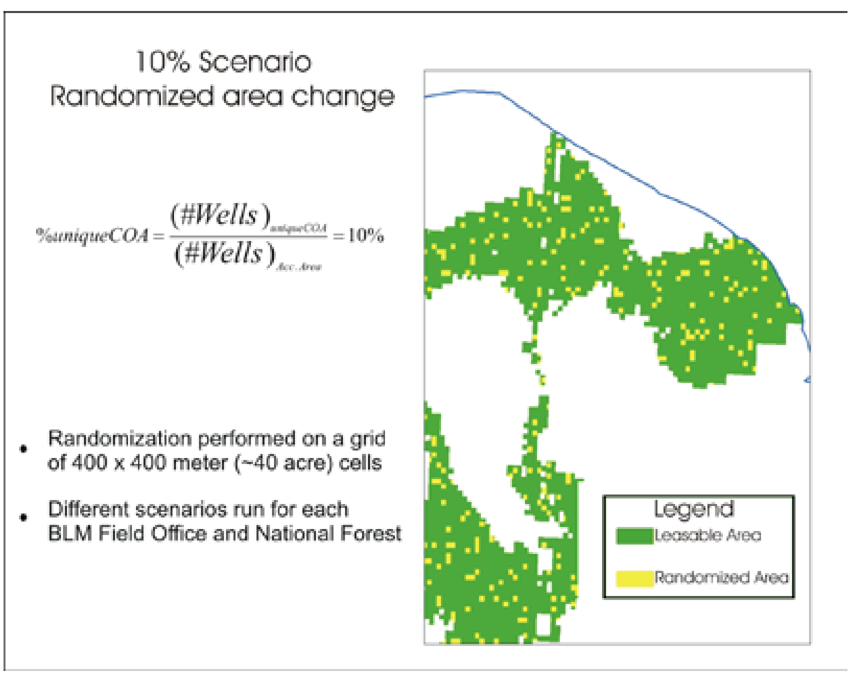

Figure A5-1. Example of Extrapolating the Effects of COAs on Accessibility

Table A5-5. COA Statistics by Field Office

BLM FO	Well Population	Sample Size	Sample Wells w/ COAs
COA ID	COA Category	Occurrence	% of Sample
Rio Puerco	48	30	4
archeo002	CSU	2	7%
noise001	CSU	2	7%
Bakersfield	11	11	1
raptor008	TLS	1	91%
Buffalo	5077	200	69
archeo002	CSU	2	1%
cultur001	CSU	2	1%
cultur002	CSU	2	1%
hydro001	CSU	4	2%
hydro005	TLS	1	1%
plover002	CSU	3	2%
plover003	CSU	4	2%
plover004	CSU	3	2%
plover013	TLS	1	1%
plover032	TLS	3	2%
raptor002	CSU	15	8%
raptor003	CSU	3	2%
raptor004	TLS	1	1%
raptor006	TLS	1	1%
raptor007	TLS	17	9%
raptor018	TLS	1	1%
raptor023	CSU	1	1%
raptor024	CSU	1	1%
raptor027	CSU	2	1%
raptor029	CSU	2	1%
roads001	CSU	2	1%
roads002	CSU	1	1%
sagegr001	CSU	5	3%
sagegr003	CSU	9	5%
sagegr005	TLS	10	5%
sagegr008	TLS	5	3%
sagegr022	CSU	8	4%
sagegr033	TLS	3	2%
sagegr038	CSU	1	1%
soils001	CSU	14	7%
wildlf002	CSU	1	1%
wildlf002	TLS	1	1%
wildlf004	CSU	4	2%
wildlf005	TLS	1	1%
wildlf012	TLS	1	1%
wildlf018	CSU	3	2%
Casper	170	30	25
archeo001	CSU	1	3%
constr001	CSU	2	7%
constr008	CSU	18	60%
constr014	TLS	1	3%
cultur002	CSU	2	7%
plover030	TLS	1	3%
raptor003	CSU	1	3%
raptor007	TLS	2	7%
raptor019	TLS	1	3%
raptor023	CSU	19	63%
raptor029	CSU	2	7%
sagegr005	TLS	1	3%
soils001	CSU	21	70%
sslope001	CSU	18	60%
wildlf003	CSU	18	60%
wildlf004	CSU	2	7%
Ely	13	13	2
pipel_004	CSU	1	8%
wildlf004	CSU	2	15%
Farmington	2713	200	74
archeo001	CSU	1	1%
archeo002	CSU	14	7%
bgame008	TLS	10	5%
bgame011	TLS	1	1%
bgame012	TLS	1	1%
bgame014	TLS	1	1%
constr004	TLS	10	5%
noise001	CSU	7	4%
pipel002	CSU	19	10%
pipel008	CSU	19	10%
raptor017	TLS	1	1%
roads001	CSU	1	1%
soils001	CSU	64	32%
wildlf003	CSU	1	1%
wildlf004	CSU	3	2%

Table A5-5. COA Statistics by Field Office (continued)

BLM FO	Well Population	Sample Size	Sample Wells w/ COAs
COA ID	COA Category	Occurrence	% of Sample
Glenwood Springs	349	53	16
archeo002	CSU	1	2%
bgame003	TLS	1	2%
bgame007	TLS	3	6%
bgame017	TLS	1	2%
bgame019	CSU	2	4%
constr001	CSU	1	2%
constr003	TLS	2	4%
constr007	TLS	1	2%
constr009	TLS	2	4%
pipel002	CSU	1	2%
pipel008	CSU	1	2%
vrm001	CSU	3	6%
wildlf001	TLS	1	2%
wildlf006	TLS	1	2%
Grand Junction	40	30	22
bgame003	TLS	19	63%
bgame017	TLS	1	3%
pipel002	CSU	1	3%
roads001	CSU	1	3%
wildlf006	TLS	2	7%
wildlf017	TLS	1	3%
Kemmerer	96	30	22
archeo002	CSU	1	3%
bgame002	TLS	8	27%
bgame015	TLS	6	20%
pipel008	CSU	2	7%
plover009	TLS	5	17%
plover035	TLS	7	23%
raptor033	TLS	1	3%
sagegr018	TLS	3	10%
sagegr036	TLS	4	13%
soils001	CSU	17	57%
wildlf003	CSU	1	3%
Lander	11	11	7
archeo002	CSU	2	18%
bgame002	TLS	1	9%
constr001	CSU	1	9%
pipel004	CSU	1	9%
plover009	TLS	1	9%
raptor007	TLS	2	18%
soils001	CSU	4	36%
Little Snake	63	30	23
bgame003	TLS	1	3%
constr002	CSU	2	7%
erosio001	CSU	8	27%
raptor006	TLS	10	33%
sagegr009	TLS	7	23%
soils001	CSU	8	27%
sslope002	CSU	1	3%
wildlf016	TLS	1	3%
Miles City	93	30	30
bgame007	TLS	1	3%
bgame008	CSU	26	87%
bgame013	CSU	25	83%
constr013	CSU	25	83%
raptor003	CSU	25	83%
raptor018	CSU	25	83%
sagegr005	TLS	26	87%
sagegr023	TLS	1	3%
soils001	CSU	25	83%
sslope003	CSU	1	3%
wildlf001	CSU	25	83%
wildlf008	TLS	3	10%
wildlf011	TLS	1	3%
Milwaukee	14	14	2
constr016	TLS	2	14%
pipel008	CSU	2	14%
Moab	23	23	10
bgame016	TLS	1	4%
bgame020	TLS	4	17%
constr001	CSU	3	13%
pipel001	CSU	3	13%
raptor007	TLS	1	4%
raptor016	TLS	2	9%
soils003	TLS	1	4%
soils004	TLS	1	4%
Monticello	9	9	3
paleo002	CSU	2	22%
pipel008	CSU	1	11%

Table A5-5. COA Statistics by Field Office (continued)

BLM FO	Well Population	Sample Size	Sample Wells w/ COAs
COA ID	COA Category	Occurrence	% of Sample
Newcastle	76	30	8
archeo001	CSU	1	3%
archeo002	CSU	2	7%
constr001	CSU	1	3%
noise001	CSU	1	3%
sagegr031	TLS	1	3%
soils001	CSU	2	7%
North Dakota	175	30	15
noise_001	CSU	6	20%
pipel_001	CSU	3	10%
pipel_003	CSU	5	17%
pipel_008	CSU	1	3%
soils_001	CSU	1	3%
constr013	CSU	2	7%
constr014	TLS	2	7%
constr015	CSU	1	3%
raptor007	TLS	2	7%
sagegr004	TLS	1	3%
Northern Alaska	39	30	4
wildlf004	CSU	4	13%
Pinedale	710	107	72
archeo002	CSU	10	9%
bgame002	CSU	49	46%
bgame006	TLS	2	2%
bgame015	TLS	7	7%
constr001	CSU	4	4%
cultur003	TLS	3	3%
pipel003	CSU	5	5%
pipel004	CSU	2	2%
pipel008	CSU	3	3%
raptor005	TLS	1	1%
raptor007	TLS	14	13%
raptor011	TLS	3	3%
raptor021	TLS	4	4%
raptor028	CSU	2	2%
raptor034	TLS	2	2%
sagegr002	TLS	12	11%
sagegr004	TLS	3	3%
sagegr007	TLS	5	5%
sagegr010	TLS	4	4%
sagegr011	TLS	3	3%
sagegr012	TLS	13	12%
sagegr013	TLS	25	23%
sagegr015	TLS	1	1%
sagegr017	TLS	7	7%
sagegr019	TLS	1	1%
sagegr021	TLS	2	2%
sagegr030	CSU	15	14%
sagegr034	TLS	2	2%
sagegr035	TLS	9	8%
sagegr037	TLS	1	1%
soils001	CSU	43	40%
vrm001	CSU	1	1%
wildlf003	CSU	1	1%
Rawlins	714	107	50
constr001	CSU	3	3%
constr012	CSU	13	12%
plover001	CSU	6	6%
plover009	TLS	15	14%
plover011	TLS	1	1%
plover016	TLS	1	1%
plover033	TLS	2	2%
raptor007	TLS	2	2%
raptor030	TLS	6	6%
roads001	CSU	1	1%
roads003	CSU	3	3%
sagegr009	TLS	14	13%
soils001	CSU	26	24%

Table A5-5. COA Statistics by Field Office (continued)

BLM FO / COA ID	Well Population / COA Category	Sample Size / Occurrence	Sample Wells w/ COAs / % of Sample
Rock Springs	173	30	15
archeo002	CSU	1	3%
bgame002	TLS	5	17%
hydro001	CSU	2	7%
plover007	TLS	1	3%
plover014	TLS	1	3%
plover015	TLS	1	3%
raptor007	TLS	3	10%
raptor009	TLS	1	3%
raptor014	TLS	1	3%
raptor032	TLS	1	3%
sagegr016	TLS	1	3%
soils001	CSU	4	13%
wildlf004	CSU	1	3%
wildlf007	TLS	1	3%
wildlf019	CSU	1	3%
Royal Gorge	39	30	23
constr001	CSU	1	3%
constr011	TLS	1	3%
constr015	CSU	1	3%
noise001	CSU	2	7%
pipel002	CSU	5	17%
pipel004	CSU	1	3%
pipel008	CSU	6	20%
plover005	TLS	7	23%
plover006	TLS	3	10%
plover031	TLS	1	3%
wildlf014	TLS	5	17%
San Juan	35	30	22
archeo002	CSU	8	27%
bgame001	TLS	4	13%
bgame003	TLS	4	13%
bgame020	TLS	7	23%
constr002	CSU	3	10%
hydro001	CSU	1	3%
noise001	CSU	13	43%
pipel002	CSU	1	3%
raptor015	TLS	1	3%
sagegr018	TLS	1	3%
wildlf013	TLS	1	3%
South Dakota	6	6	1
constr016	CSU	1	17%
Uncompahgre	7	7	7
archeo001	CSU	1	14%
bgame003	TLS	1	14%
bgame010	TLS	2	29%
bgame020	TLS	1	14%
constr002	CSU	1	14%
constr013	CSU	1	14%
noise001	CSU	2	29%
pipel008	CSU	2	29%
roads001	CSU	2	29%
soils001	CSU	2	29%

Table A5-5. COA Statistics by Field Office (continued)

BLM FO	Well Population	Sample Size	Sample Wells w/ COAs
COA ID	**COA Category**	**Occurrence**	**% of Sample**
Vernal	861	130	35
archeo002	CSU	1	1%
bgame009	TLS	2	2%
constr001	CSU	2	2%
noise001	CSU	10	8%
paleo001	CSU	1	1%
paleo002	CSU	5	4%
pipel001	CSU	1	1%
pipel002	CSU	7	5%
plover007	TLS	2	2%
plover008	TLS	2	2%
plover010	TLS	2	2%
plover012	TLS	3	2%
plover034	TLS	3	2%
raptor002	CSU	2	2%
raptor008	TLS	2	2%
raptor009	TLS	6	5%
raptor010	TLS	2	2%
raptor012	TLS	2	2%
raptor013	TLS	4	3%
raptor016	TLS	1	1%
raptor020	TLS	2	2%
raptor022	CSU	4	3%
raptor025	CSU	2	2%
raptor031	TLS	2	2%
raptor032	TLS	3	2%
sagegr009	TLS	3	2%
sagegr020	TLS	5	4%
sagegr033	TLS	2	2%
soils001	CSU	5	4%
wildlf002	CSU	4	3%
wildlf003	CSU	2	2%
wildlf004	CSU	2	2%
White River	320	48	22
archeo002	CSU	1	2%
bgame003	TLS	2	4%
bgame005	TLS	1	2%
constr001	CSU	1	2%
constr002	CSU	1	2%
paleo002	CSU	11	23%
pipel002	CSU	1	2%
soils001	CSU	17	35%
wildlf008	TLS	1	2%
wildlf009	TLS	1	2%
wildlf010	TLS	3	6%
wildlf015	TLS	1	2%

Appendix 6

U.S. Geological Survey Methodology for the Assessment of Undiscovered Oil and Gas Resources

By U.S. Geological Survey National Assessment Review Team[1]

A6.1 Introduction

The USGS conducts assessments of technically recoverable undiscovered oil and gas resources of the onshore and state waters of the United States. The last comprehensive USGS oil and gas assessment was completed in 1995, and comprises the onshore and state waters portion of 71 geologic provinces (Gautier and others, 1996). In 1999, the USGS launched a new initiative to produce incremental assessments of the most significant U.S. oil and gas provinces.

To meet the requirements of Section 604 of EPCA, the USGS reorganized the priority list for the new assessments. For the Phase I Inventory (released 2003), new assessments were conducted for the Uinta-Piceance Basin, San Juan Basin, Montana Thrust Belt, Powder River Basin, and Greater Green River Basin. The 1995 assessment results were used for the Paradox Basin. For the Phase II Inventory, new assessments were conducted for Northern Alaska (NPRA and ANWR-1002), Wyoming Thrust Belt, Denver Basin, Florida Peninsula, Black Warrior Basin, and Appalachian Basin. For the Phase III Inventory, new assessments were conducted for Yukon Flats, Eastern Oregon-Washington and Eastern Great Basin. Inventories for Southern Alaska, Ventura Basin and the Williston Basin were conducted using the 1995 resource assessment results. Updated resource assessments were also conducted for the San Joaquin Basin, Hanna Basin, Wind River Basin, Raton Basin, Bend Arch-Fort Worth Basin, Western Gulf, East Texas Basin, and LA-MS Salt Basins, and the Michigan Basin which were included in the extrapolated areas.

The general assessment methodology has not changed from the 1995 assessments; however, some refinements have been made to accommodate increased geologic understanding of the occurrence of resources and more sophisticated means of capturing the range of uncertainty inherent in these variables. For example, the assessment model for continuous resources in the 1995 assessment assumed a homogenous distribution of oil and gas resources in a play. For the new assessments, that model has been replaced with an analysis of geologically controlled sweet spots of production, which demonstrate the geologic heterogeneity common to continuous oil or gas accumulations. The recognition of production sweet spots is a

[1] EPCA Geology and Assessment Review Team: Schenk, Christopher J., Charpentier, Ronald R., Klett, Timothy R., Pollastro, Richard M., Cook, Troy A., and Crovelli, Robert A.

major advancement in the assessment of continuous resources. [2]

A6.2 Terminology

Terminology used in this report reflects standard definitions and usage of the oil and natural gas industry and the petroleum resource assessment community. Several terms have been developed by the USGS for oil and gas assessment purposes (see Glossary in Appendix 2). The 1995 USGS assessment focused on the definition and assessment of geologic plays. In the latest USGS assessments, the focus is on understanding total petroleum systems and defining assessment units within total petroleum systems. The total petroleum system approach is designed to focus the geologic studies on the hydrocarbon source rocks, processes that create hydrocarbons, migration pathways, reservoirs, and trapping mechanisms. For discussion purposes in this report, the term play will be used throughout to represent both assessment units and plays.

The USGS assesses two main categories of hydrocarbon occurrence: conventional and continuous (Figure A6-1). Conventional oil and gas accumulations are defined as discrete fields with well-defined hydrocarbon-water contacts, where the hydrocarbons are buoyant on a column of water. Conventional accumulations commonly have relatively high matrix permeabilities, have obvious seals and traps, and have high recovery factors. In contrast, continuous accumulations (also called unconventional accumulations) commonly are regional in extent, have diffuse boundaries, and are not buoyant on a column of water. Continuous accumulations have very low matrix permeabilities, do not have obvious seals and traps, are in close proximity to source rocks, are abnormally pressured, and have low recovery factors. Included in the category of continuous accumulations are hydrocarbons that occur in tight reservoirs, shale reservoirs, unconventional reservoirs, basin-centered reservoirs, fractured reservoirs, and coal beds.

[2] The production sweet spots were not used in creation of the study areas and resource estimates for the EPCA Inventory. Although the USGS has done significant work in defining these areas, the EPCA Steering Committee decided that the uncertainty associated with the sweet spots is too great for use in the Inventory.

A6.3 Overview of the Oil and Gas Assessment Procedure

The assessment process is based on the characterization of the petroleum geology of each province. The geologists define the geologic elements of the total petroleum systems, and, in conjunction with an analysis of historic oil and gas production and exploration/discovery data, define the oil and gas plays within the provinces. The geologists then develop probability distributions for sizes and numbers of undiscovered conventional accumulations, or numbers of cells and EUR for continuous accumulations, using all available geologic information and historic oil and gas data. These distributions are then used to generate probability distributions for undiscovered oil and gas resources.

A6.4 Role of Geologic Information in the Assessment

The strength of the USGS oil and gas resource assessments is the province geologists' understanding of the petroleum geology of the provinces being assessed. These fundamental geologic studies allow new concepts and hypothetical plays to be incorporated into the assessment of undiscovered resources. A purely statistical

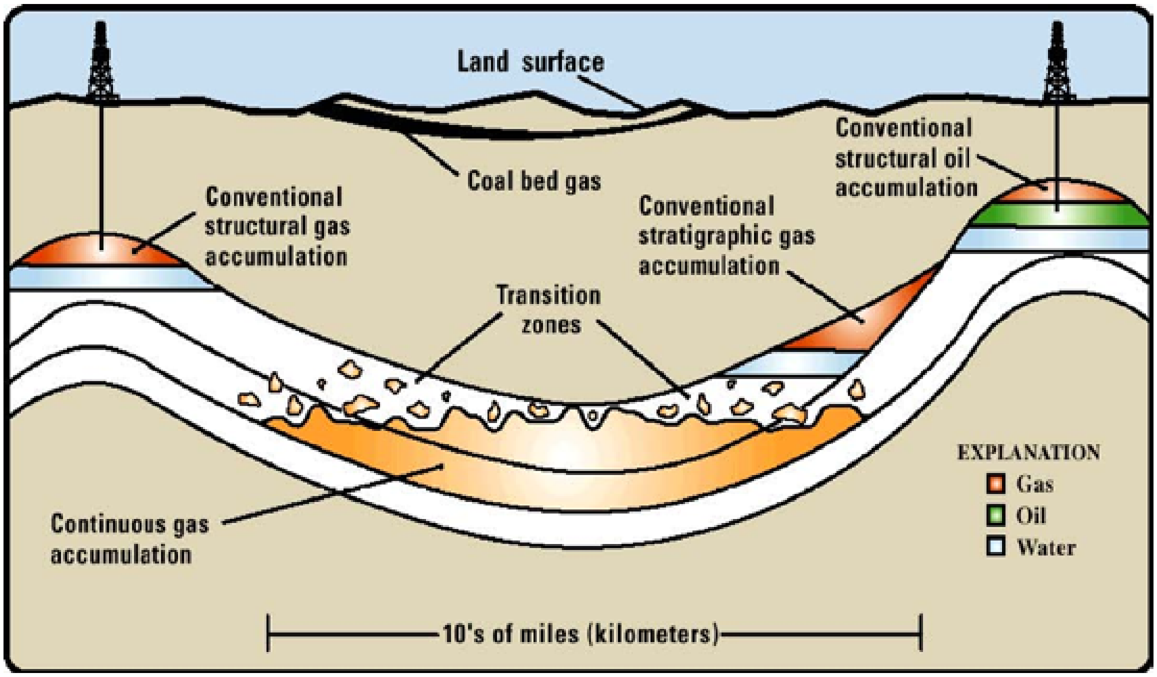

Figure A6-1. Conventional vs. Continuous Accumulations

approach to an assessment such as discovery process modeling that uses only historical data will overlook any new geologic concepts, models, or hypothetical plays.

The team of geologists develops an understanding of the province petroleum geology using published, proprietary, and original research and data. Studying the total petroleum systems within a province includes: (1) identification and mapping the extent of the major hydrocarbon source rocks; (2) understanding the thermal evolution of each source rock, the extent of mature source rock, and the timing of hydrocarbon generation, expulsion, and migration; (3) estimating migration pathways and all forms of hydrocarbon trapping; (4) modeling the timing of structural development and the timing of trap formation relative to hydrocarbon migration; (5) determining the sequence stratigraphic evolution of reservoirs, and the presence of conventional or continuous reservoirs, or both; and (6) modeling the burial history of the basin and the effect burial and uplift has had on the preservation of conventional and continuous hydrocarbons.

Once the total petroleum systems of the province are known in satisfactory detail, the team of geologists defines oil and gas plays, which represent a synthesis of all geologic information, including production and exploration data. The key component of this analysis is a geologic model for the assessment of each play. The geologic model encompasses all elements of the total petroleum system, and is commonly summarized by a total petroleum system events chart.

A6.5 Sources of Oil and Gas Data

Data for domestic oil and gas fields, reservoirs, and wells are derived from commercial databases purchased annually by the USGS. With more than 2.5 million domestic oil and gas wells and 40,000 oil and gas fields, the USGS has opted to purchase the data from commercial vendors rather than attempt to generate a comprehensive database. The oil and gas wells and production databases are now purchased from the IHS Energy Group (IHS) (2000 a, b). Previous assessments used the predecessors to IHS: PetroROM Production Data (Petroleum Information/ Dwights LLC, 1999a) and the Well History Control System (Petroleum Information/ Dwights LLC, 1999b). The USGS also relies on the NRG Associates, Inc. Significant Oil and Gas Fields of the United States (NRG Associates, 2001). Data from these commercial databases are subject to proprietary constraints, and the USGS cannot publish, share, or serve any data from these databases. However, derivative representations in the form of graphs and summary statistics can be prepared and presented for each play. The USGS, however, cannot verify the accuracy, completeness, or currency of data reported in commercial databases.

The IHS production database provides oil and gas production data for wells, leases, or producing units (collectively called "entities" in these databases). The IHS oil and gas wells database provides individual well data (including data for dry holes) that include well identification, locations, and information on penetrated and producing formations. Oil and gas field databases provide location, geologic characterization, and oil and gas production data for domestic oil and gas fields and reservoirs.

Additional oil and gas data are obtained, where available, from operators, state agencies, and other government sources, such as the U.S. Department of Energy's Energy Information Administration proprietary files, publications from the former Bureau of Mines, and other sources.

A6.6 Assigning Accumulations and Wells to Plays

Digital maps of plays are created using a GIS.[3] Digital play maps are used to assign oil and gas wells and accumulations to their respective plays, and these assignments are entered into the databases. Oil and gas accumulations are assigned to only one play. Wells, however, can be assigned to more than one play if they penetrate vertically stacked plays. Oil and gas accumulations and well assignments are reviewed to ensure proper assignments, identify inconsistent data, and examine the need for minor revisions of play boundaries.

Historic production and exploration/ discovery data are collected for each play using oil and gas accumulations or well assignments. Types of data retrieved include: (1) known volumes (sum of cumulative production and remaining reserves) of recoverable oil, gas, and natural gas liquids (NGLs) of accumulations; (2) discovery dates of accumulations (the year the first reservoir in the accumulation was discovered); (3) monthly production and cumulative production of wells; (4) initial classification and final classification of wells (for example, new-field wildcat, development, producing, abandoned, etc.) of wells; and (5) completion dates of wells.

[3] The oil and gas play boundaries are available at http://energy.cr.usgs.gov/oilgas/noga.

A6.7 Oil and Gas Production Data

The historic oil and gas production data are compiled for each play so that the data from discovered accumulations can be used as a guide for potential undiscovered accumulations. For conventional plays, these data include: (1) field name, (2) field discovery year or date of completion of the discovery well, (3) known volumes of oil, gas (non-associated and associated-dissolved), and NGLs, and (4) depth to the top of each reservoir. All of the production data for conventional assessment units are arranged in terms of oil accumulations and gas accumulations and sorted by size and discovery date for statistical calculations and plotting. A list of new-field wildcat wells and their completion dates is compiled and organized into the number of wells drilled per year for conventional plays. (A new-field wildcat well is an exploratory well drilled at least two miles from a producing field to test a separate trap). Once organized, the number of wells drilled in a given year is used as a measure of exploration effort. These data are then combined with the production data using the discovery dates of the accumulations and the completion dates of the wells.

Oil and gas production data compiled for each producing well in continuous-type plays include past monthly production of liquids (oil and NGL) and gas (non-associated and associated-dissolved), from which EURs are estimated using well decline-curve analysis, the date of first production, and depth to the topmost perforation. A list of all wells and completion dates are compiled and organized. However, the number of wells drilled in a given year is not combined with production data, but analyzed separately.

Co-product ratios (GOR; NGLs to gas ratio; and LGR) are calculated and major commodities (oil or gas) are identified for each conventional accumulation. Co-product ratios are based on accumulation-level oil, gas, and NGL volumes. Oil and gas accumulations are treated separately; an oil accumulation is defined as one having a GOR less than 20,000 cubic feet/barrel whereas a gas accumulation has a GOR equal to or greater than 20,000 cubic feet/barrel.

Supplemental data from individual reservoirs within the accumulations include thickness (net and gross), average porosity, average permeability, temperature, pressure, fluid properties (for example, sulfur content of oil, API gravity of oil, non-hydrocarbon gas contents), trap type, drive type, and well spacing. These data are combined with the data from the commercial databases to help refine the geologic interpretations and assessment process.

A6.8 Graphs and Statistics for Conventional Plays

Two sets of graphs and statistics are generated for conventional plays–one set using known accumulation sizes as of the effective date of the assessment and one set using accumulation sizes that are corrected for anticipated reserve growth (grown accumulation size) within the forecast span of the assessment.

The set of graphs and statistics generated for conventional plays includes sizes and number of accumulations with respect to discovery date and exploration effort, exploration effort through time, size distributions of accumulations, reservoir depth versus discovery date and exploration effort, co-product ratios versus reservoir depth, and a histogram of the API gravity. Accumulations containing less than a specified minimum volume of oil or gas (that is, the smallest accumulation size that is considered in the assessment process) are not included in these graphs or statistics. Counts of new-field wildcat wells are used as a measure of exploration effort for finding new accumulations.

A6.9 Assessment Input for Conventional Plays

Critical input data for conventional plays are probability distributions for sizes and numbers of undiscovered oil and gas accumulations and co-product ratios. The geologists develop these distributions by synthesizing all petroleum systems information and historic oil and gas data. For hypothetical plays, the geologist may utilize an analog data set for sizes and numbers of discovered fields as a guide to the distributions of sizes and numbers of undiscovered fields in the play or assessment unit being assessed. Geologists provide information on oil and gas quality, range of drilling depths, and range of water depths for future economic analyses.

A6.10 Graphs and Statistics for Continuous-Type Plays

A set of graphs and statistics comparable to that for conventional plays is generated for continuous-type plays, but the EUR per cell and numbers of tested cells are used rather than accumulation sizes and number of discovered accumulations. Tested cells of less than the specified minimum EUR per cell are not included in these graphs or statistics, and reserve-growth adjustments for cells are not incorporated.

The set of graphs and statistics generated for continuous-type plays includes number of wells drilled through time (all wells as opposed to new-field wildcat wells), probability distributions of EUR, EUR versus production-start year and number of all wells drilled, cumulative EUR versus production-start year and number of wells drilled, cumulative EUR versus depth of the topmost perforation, and GOR versus ranked EUR. All of this information is provided to the assessor as a guide to generating distributions for the assessment of undiscovered resources.

A6.11 Assessment Input for Continuous Plays

Critical input data for the continuous play assessment model include numbers of cells that have potential to be added to reserves, the EUR distribution for these cells, and the co-product ratios. For hypothetical plays, the geologist may utilize an analog data set for distribution of cell size and for the EUR distribution as guides to the distributions of cell sizes and EUR's of undiscovered area in the play being assessed. The geologist provides information on oil and gas quality, range of drilling depths, and range of water depths for future economic analyses.

A6.12 USGS Assessment Review

The province geologist must present the geology of the play and the input data to a team of USGS personnel for a formal review. The team consists of geologists, geophysicists, and assessment methodologists with broad expertise in petroleum geology, which together promotes a consistent geological and methodological approach to the assessment. Every aspect of the geology and input data are reviewed, and any changes are incorporated into the input data at this time. Once the input data have been finalized, the input data are ready for quantitative analysis.

A6.13 Calculation of Undiscovered Conventional and Continuous Resources

The final reviewed assessment input forms are the basis of the quantitative calculations of undiscovered oil and gas resources. For conventional plays, the probability distributions for sizes and numbers of undiscovered accumulations and the co-product ratios provided by the assessor are entered into a Monte Carlo simulator and run for a specified number of iterations to provide distributions of undiscovered oil, gas, and NGL resources. In the 1995 assessment, a Truncated Shifted Pareto Distribution (Gautier and Dolton, 1996) was used for the shape of the curve for the distribution of sizes of oil and gas fields. For the present assessment, a Truncated Shifted Lognormal Distribution is used for this purpose (Charpentier and Klett, 2000).

For continuous plays, the distributions for assessment-unit area, untested percentage of assessment unit area, potential percentage of untested area, and area per cell of untested cells are combined analytically to determine the distribution for number of potential untested cells. The distribution for numbers of potential untested cells EUR per cell, and the co-product ratios are combined using an Analytic Probability Method (Crovelli, 2000) to directly calculate the probability distribution of undiscovered oil and gas resources.

A6.14 Assessment Results

The results and maps of the resource assessment of the oil and gas plays from the USGS are available on the internet and can be downloaded at http://energy.cr.usgs.gov/oilgas/noga.

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Appendix 7
Initial Estimates of Remaining Proved Ultimate Recovery Growth

The Proved Ultimate Recovery (PUR) of an oil or gas field at a particular point in time is defined as the sum of its estimated proved reserves and its recorded cumulative production at that time.

$$PURG_n = R_n + CumProd_n$$

where:

PUR	=	Proved Ultimate Recovery
PR	=	Proved Reserves
CumProd	=	Cumulative Production
n	=	Years after First Production (or Discovery)

Proved Ultimate Recovery Growth (PURG) is the increase in proved ultimate recovery over time that is observed for most oil and gas fields.

$$PURG_n = PUR_n - PUR_{n=1}$$

where:

PURG	=	Proved Ultimate Recovery Growth
PUR	=	Proved Ultimate Recovery
n	=	Years after First Production (or Discovery)

A field's PUR estimate normally increases significantly in the early post-discovery years as it is developed for production and its areal limits are better discerned. The PUR estimates may also be conservative early in a field's life owing to the smaller knowledge base than available regarding its potential productive performance. A field's later years are usually characterized by slower growth arising from a variety of possible causes including the installation of improved recovery techniques, increased knowledge of the field's productive performance, the addition of new reservoirs to the field, and infill drilling. Cumulative growth factors calculated from most fields' ultimate recovery histories thus usually increase rapidly as initial field development occurs and then asymptotically approach a maximum value as growth slows in later years. A more complete discussion of this phenomenon and its many causes is presented in The Intricate Puzzle of Oil and Gas "Reserves Growth," available online at http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/1997/intricate_puzzle_reserves_growth/m07fa.pdf.

The PURG, and the remaining (future) portion thereof, Remaining Proved Ultimate Recovery Growth (RPURG), can be estimated from the observed historical PUR. In a given year (n) for a group of fields of the same vintage (age) the Annual Growth Factor (AGF) is the sum of the estimated proved ultimate recovery of the fields in that year divided by the sum of estimated proved ultimate recovery of the same fields for the prior year.

$$AGF_n = \frac{PUR_n}{PUR_{n-1}}$$

where:

AGF	=	Annual Growth Factor
PUR	=	Proved Ultimate Recovery
n	=	Years after First Production (or Discovery)

Going one step further, for a basin the Basin Median Annual Growth Factor (BMAGF) for its multiple fields in multiple vintages is the Median of the Annual Growth Factors of all fields in all vintages at the same point in time (n) (the same year after first production or after field discovery).

$$BMAGF_n = MedianAGF_n$$

where:

BMAGF	=	Basin Median Annual Growth Factor (multiple vintages)
AGF	=	Annual Growth Factor (multiple vintages)
n	=	Years after First Production (or discovery)

The Cumulative Growth Factor (CGF) for the Basin in a particular year is the product of the Basin Median Annual Growth Factors for all vintages through that year beginning with the first production or discovery year.

$$BCGF_n = 1 * BMAGF_2 * BMAGF_3 \ldots BMAGF_n$$

where:

BCGF	=	Basin Cumulative Growth Factor (multiple vintages)
BMAGF	=	Basin Median Annual Growth factor (multiple vintages)
n	=	Years after First Production (or discovery)

Final PUR for the basin (BFPUR) at some final time can be calculated as the product of the ratio of the final time Basin Cumulative Growth Factor (BCGF) to the current time BCGF and the current Basin Proved Ultimate Recovery (BPUR).

$$BFPUR_t = \frac{BCGF_t}{BCGF_n} * BPUR_n$$

where:

BFPUR	=	Basin Future Proved Ultimate Recovery Volume at Final Time (t)
BCGF	=	Basin Cumulative Growth Factor
BPUR	=	Basin Proved Ultimate Recovery Volume at Current Time (n)
n	=	Current Time Years After First Production (or discovery)
t	=	Final Time Years After First Production (or discovery) (300 years)

Equivalently, the estimate of additional ultimate recovery that may be realized in the future based on reserves growth during the future can be stated as:

$$RPURG_{t-n} = FPUR_t - PUR_{n=1}$$

where:

RPURG	=	Remaining Proved Ultimate Recovery Growth Volume at Time (n)
FPUR	=	Final Proved Ultimate Recovery at Time (t)
PUR	=	Proved Ultimate Recovery at Current Time (n)
n	=	Current Time Years After First Production (or discovery)
t	=	Final Time Years After First Production (or discovery) (300 years)

Database Preparation

A database was created containing annual oil and gas production, estimates of cumulative production for that production which occurred prior to the beginning date of the available annual production, annual oil and gas proved reserves, field name, date of first production, and field discovery date for fields located in the EPCA Phase I basins (Southwestern Wyoming, Montana Thrust Belt, Powder River Basin, Paradox-San Juan Basin, and Uinta-Piceance Basin), the EPCA Phase II basins (Denver Basin, Black Warrior Basin, and Wyoming Thrust Belt), and the EPCA Phase III basins (Alaska, Eastern Great Basin, Ventura Basin, and Williston Basin). The available data for the Appalachian Basin were insufficient for PURG analysis. Data sources included the EIA Reserves and Production Division's Oil and Gas Integrated Field File, the EIA Field Code Master List, the EIA-23 Reserves Survey, various state web sites, and commercial data vendors.

Each field in a basin was assigned to a vintage year according to its date of first production or its date of discovery dependent on which date was available or which date was deemed the most reliable indicator of initial production when both dates were available. While the earliest field vintage was 1901, the annual proved reserves estimates and therefore the PUR estimates were usually available only from 1977 to present. The resulting files contained vintage year, number of fields in each vintage, annual barrel of oil equivalent proved ultimate recovery for each vintage, annual natural gas proved ultimate recovery for each vintage, and annual liquid proved ultimate recovery for each vintage.

Significant effort went into quality control of the data. Many field names and codes had to be altered, corrected, and matched across the multiple data sources in order to properly accumulate the field data. Quality control beyond that point was, however, deliberately conservative. While obvious major errors had to be corrected, the desire to seek "correction" of things that were merely suspicious had to be resisted for two reasons: first they might well be correct, and second the available task resources and time were limited. Therefore, for example, the reserves data were used as reported by the field operators unless very obvious errors were found. Data discontinuities and variations within vintages mostly had to be accepted "as-is." Specific vintages that did not fit the trend of most of the data of a basin were excluded from the history matching and forecasting. Attempts to divide the data within a basin into conventionally reservoired, tight formation, and coal gas sources were largely unsuccessful because of the limited number of vintages, the short histories available for some of the fields, and frequent inability to separate the data by reservoir type within a field.

Estimation of Remaining Proved Ultimate Recovery Growth

The remainder of this appendix describes the model that was used to estimate RPURG by basin and fuel type within a basin for the EPCA Phase III study areas. Because this model is a new one that differs significantly from the two models used to develop the initial RPURG estimates for the Phase I and II study areas, the RPURG values of those study areas have been re-estimated using the new model too.

The new model implements a hyperbolic function with three fit parameters that is dependent on incremental growth factors by vintage and is an asymptotic function for which time serves as the sole driver. Even though other potential drivers such as drilling rates or wellhead prices are not directly used, they have affected the historical data that feeds into the model. The initial dataset was limited to PUR estimates from 1977 to 2003 and there were significant data gaps in some of the data series. To limit the influence of data extremes, the median annual reserves growth across vintages for the same number of years since first production was selected for use as a central tendency measure of basin-wide PURG. Unlike the mean value, which can be greatly influenced by a few extreme values, the median value is not subject to their influence.

The methodology for fitting and using the hyperbolic model involves the following sequential steps:

A) Sort the field-level PUR estimates by fuel and vintage year.

B) Calculate the annual growth factors for each year of a vintage by dividing successive PUR estimates by the previous year estimate.

C) Determine the Annual Growth Factor for common years since first production for all vintages as the median of the data (BMAGF).

D) Calculate the Cumulative Growth Factor.

E) Create a time-based hyperbolic model curve using the following formula:

$$CGF_{TBHM} = \left[C * \left(1 - \frac{1}{(1 + A * (n))^{B-1}} \right) \right] + 1$$

where:

CGFTBHM	=	Cumulative Growth Factor of the Time-Based Hyperbolic Model.
A, B, and C	=	Curve Fit Parameters
n	=	Years After First Production (or discovery), a time difference factor that is the number of years between the current year and the vintage year (i.e., 1995-1901).

F) Perform a least squares fit of the cumulative increase of the model with the actual data, solving for A, B, and C. In some cases, A was constrained to: A ≥ 0.

G) Calculate the CGF to a time of 300 years from first basin production.

H) Plot the results by basin and fuel using 300 years as x-axis length.

I) Using the known current PUR for the basin, and the actual years after first production (or discovery) time difference, use the performance of the model curve fit to predict the RPURG volume from current time to a final time of 300 years after first basin production.

The results obtained using this model for EPCA I, EPCA II, and EPCA III are presented by basin and fuel in Tables A7-1, A7-2, and A7-3 and Figures A7-1 through A7-11. The EPCA I Montana Thrust Belt study area had just 3 vintages, insufficient for modeling purposes.

Table A7-1. EPCA I Median Method, Hyperbolic Fit, 300 Year Ultimate Recovery Growth

Basin	Type	Cumulative Growth Factor		Future Growth Factor Ratio	2003 Ultimate	300 Year Ultimate	Remaining Ultimate	Future Growth as % of 2003 Ultimate
Paradox-San Juan	Oil Equivalent	**2003**	**2222**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		2.7194	3.5907	1.320	1.763	2.328	0.565	32.0%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	2.3703	2.6809	1.131	0.903	1.021	0.118	13.1%
	Gas				**tcf**	**tcf**	**tcf**	
		4.6412	6.6924	1.442	5.157	7.436	2.279	44.2%
Powder River	Oil Equivalent	**2003**	**2215**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		6.6600	8.1861	1.229	4.112	5.054	0.942	22.9%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids (1)	6.5552	7.9853	1.218	3.458	4.212	0.754	21.8%
	Liquids (2)	7.6210	10.0889	1.324	3.458	4.578	1.12	32.4%
	Gas				**tcf**	**tcf**	**tcf**	
		9.4613	10.7815	1.140	3.925	4.473	0.548	14.0%
Uinta-Piceance	Oil Equivalent	**2003**	**2226**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		3.5633	5.5676	1.588	1.756	2.788	1.032	58.8%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	3.4801	5.4126	1.555	0.782	1.216	0.434	55.5%
	Gas				**tcf**	**tcf**	**tcf**	
		3.4228	5.389	1.574	5.838	9.192	3.354	57.4%
Southwestern Wyoming	Oil Equivalent	**2003**	**2201**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		6.7172	8.921	1.328	6.391	8.488	2.097	32.8%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	5.5068	6.5566	1.191	1.059	1.261	0.202	19.1%
	Gas				**tcf**	**tcf**	**tcf**	
		6.7728	8.9447	1.321	31.995	42.255	10.26	32.1%
Montana Thrust Belt	Insufficient Data (3 Vintages)							

Source: Energy Information Administration, Reserves and Production Division

Table A7-2. EPCA II Median Method, Hyperbolic Fit, 300 Year Ultimate Recovery Growth

Basin	Type	Cumulative Growth Factor		Future Growth Factor Ratio	2003 Ultimate	300 Year Ultimate	Remaining Ultimate	Future Growth as % of 2003 Ultimate
Denver	Oil Equivalent	**2003**	**2201**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		3.417	3.7704	1.103	2.579	2.846	0.267	10.3%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	3.2578	3.6864	1.132	1.290	1.460	0.170	13.2%
	Gas				**tcf**	**tcf**	**tcf**	
		2.799	3.1022	1.109	7.730	8.569	0.839	10.9%
Black Warrior	Oil Equivalent	**2003**	**2252**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		3.5877	4.5408	1.266	0.808	1.023	0.215	26.6%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	2.3306	2.7072	1.162	0.016	0.019	0.003	16.2%
	Gas				**tcf**	**tcf**	**tcf**	
		4.2045	5.2206	1.242	4.756	5.905	1.149	24.2%
Wyoming Overthrust	Oil Equivalent	**2003**	**2275**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		1.5985	1.721	1.076	1.756	1.890	0.134	7.6%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	1.6427	1.6772	1.021	0.351	0.358	0.007	2.1%
	Gas				**tcf**	**tcf**	**tcf**	
		2.8208	3.4721	1.231	4.788	5.894	1.106	23.1%

Source: Energy Information Administration, Reserves and Production Division

Table A7-3. EPCA III Median Method, Hyperbolic Fit, 300 Year Ultimate Recovery Growth

Median method, post-1985 data, 3-parameter hyperbolic fit

Basin	Type	Cumulative Growth Factor		Future Growth Factor Ratio	2004 Ultimate	300 Year Ultimate	Remaining Ultimate	Future Growth as % of 2003 Ultimate
Alaska	Oil Equivalent	**2004**	**2257**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		1.703	2.805	1.647	22.171	36.518	14.347	64.7%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	1.971	2.585	1.312	18.375	24.099	5.724	31.2%
	Gas				**tcf**	**tcf**	**tcf**	
		2.588	4.211	1.627	22.779	37.064	14.285	62.7%
Eastern Great Basin	Oil Equiv. - w/o '54 vintage	**2004**	**2254**		**boeult x 10^6**	**boeult x 10^6**	**boeult x 10^6**	
		5.871	7.339	1.250	57.356	71.697	14.341	25.0%
					bliq x 10^6	**bliq x 10^6**	**bliq x 10^6**	
	Liquid - w/o '54 vintage	5.865	7.329	1.250	57.291	71.592	14.301	25.0%
Ventura	Oil Equivalent	**2004**	**2192**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		1.383	2.053	1.484	2.804	4.162	1.358	48.4%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	1.374	2.013	1.465	2.149	3.148	0.999	46.5%
	Gas				**tcf**	**tcf**	**tcf**	
		1.202	1.556	1.295	3.926	5.082	1.156	29.5%
Williston	Oil Equivalent	**2004**	**2251**		**boeult x 10^9**	**boeult x 10^9**	**boeult x 10^9**	
		4.781	7.506	1.570	3.692	5.796	2.104	57.0%
					bliq x 10^9	**bliq x 10^9**	**bliq x 10^9**	
	Liquids	4.531	6.944	1.533	3.082	4.723	1.641	53.3%
	Gas				**tcf**	**tcf**	**tcf**	
		4.489	7.924	1.765	3.66	6.461	2.801	76.5%

Source: Energy Information Administration, Reserves and Production Division

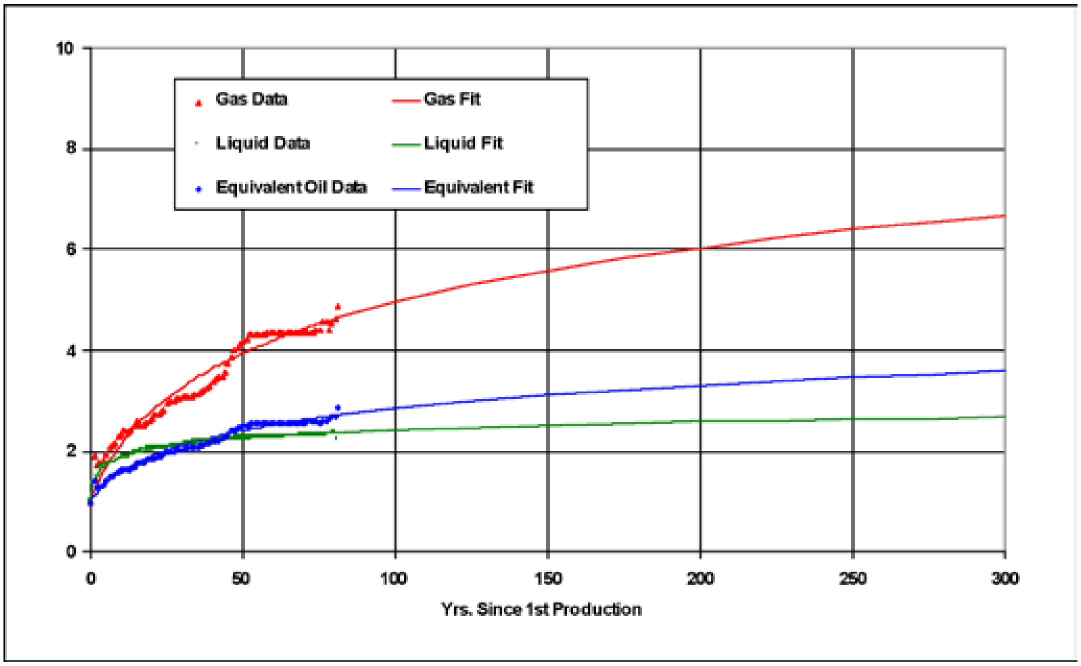

Figure A7-1. Paradox-San Juan Ultimate Reserve Growth, Median Method, Hyperbolic Fit

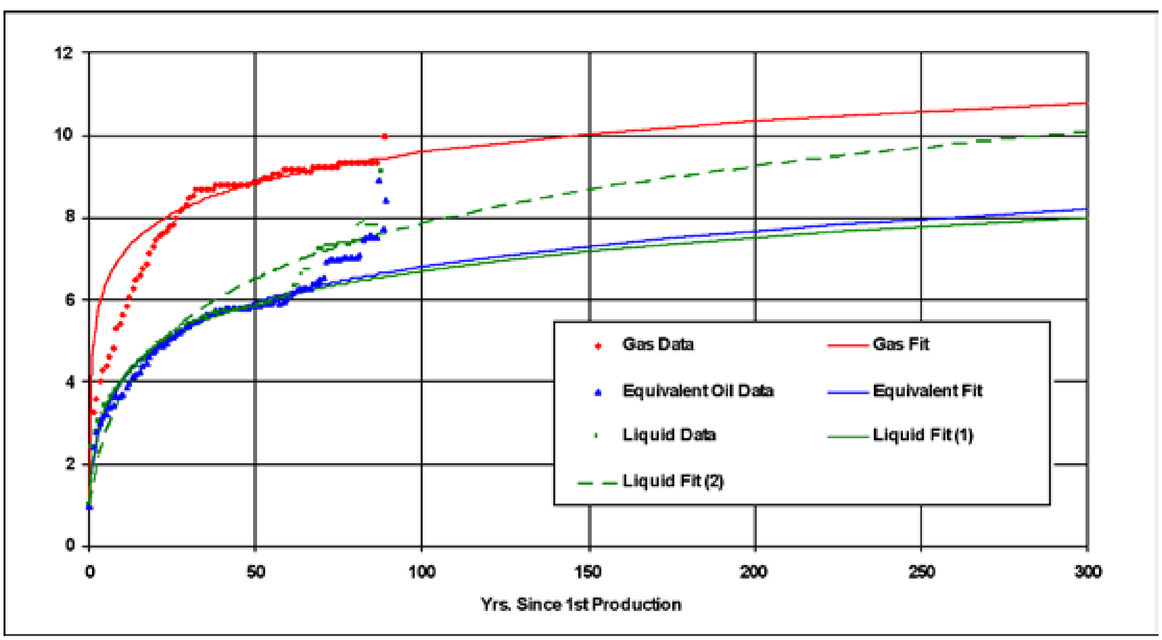

Figure A7-2. Powder River Basin Ultimate Reserve Growth, Median Method, Hyperbolic Fit

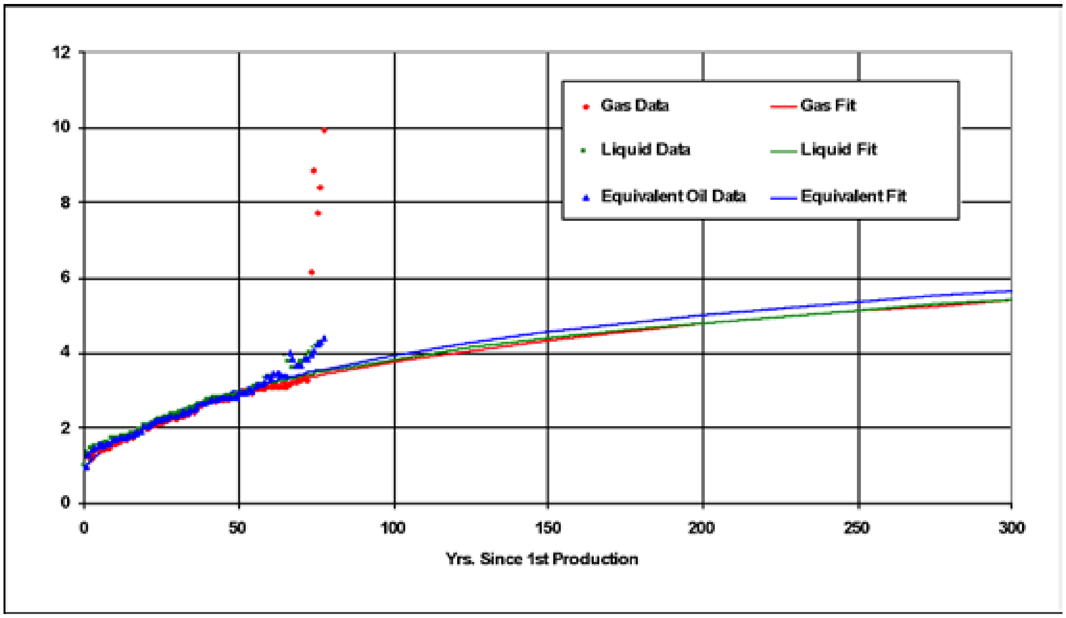

Figure A7-3. Uinta-Piceance Basin Ultimate Reserve Growth, Median Method, Hyperbolic Fit

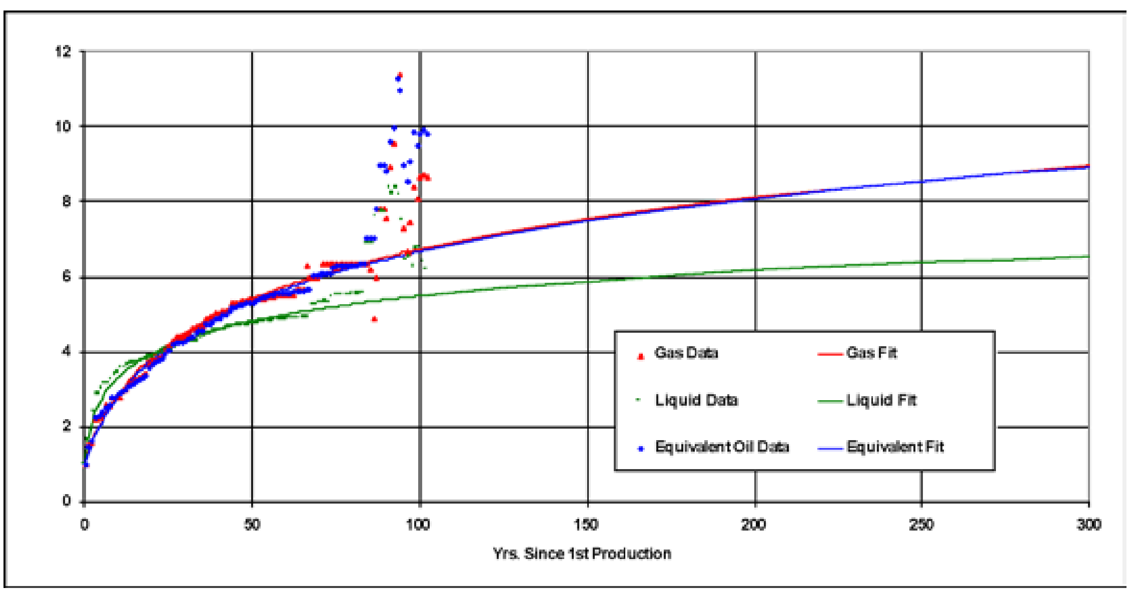

Figure A7-4. Southwestern Wyoming Ultimate Reserve Growth, Median Method, Hyperbolic Fit

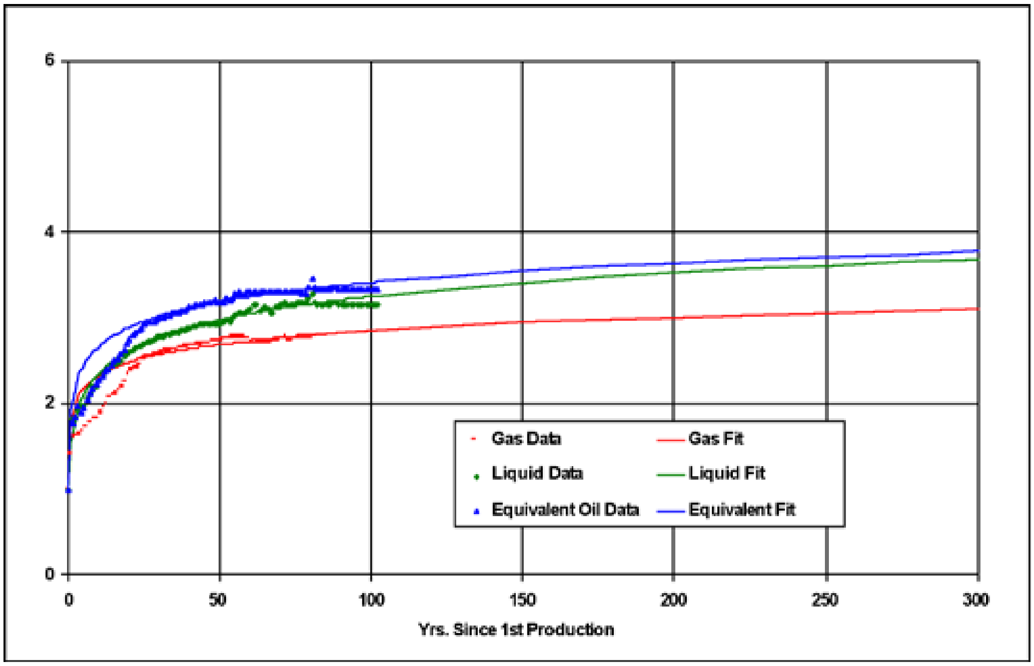

Figure A7-5. Denver Basin Ultimate Reserve Growth, Median Method, Hyperbolic Fit

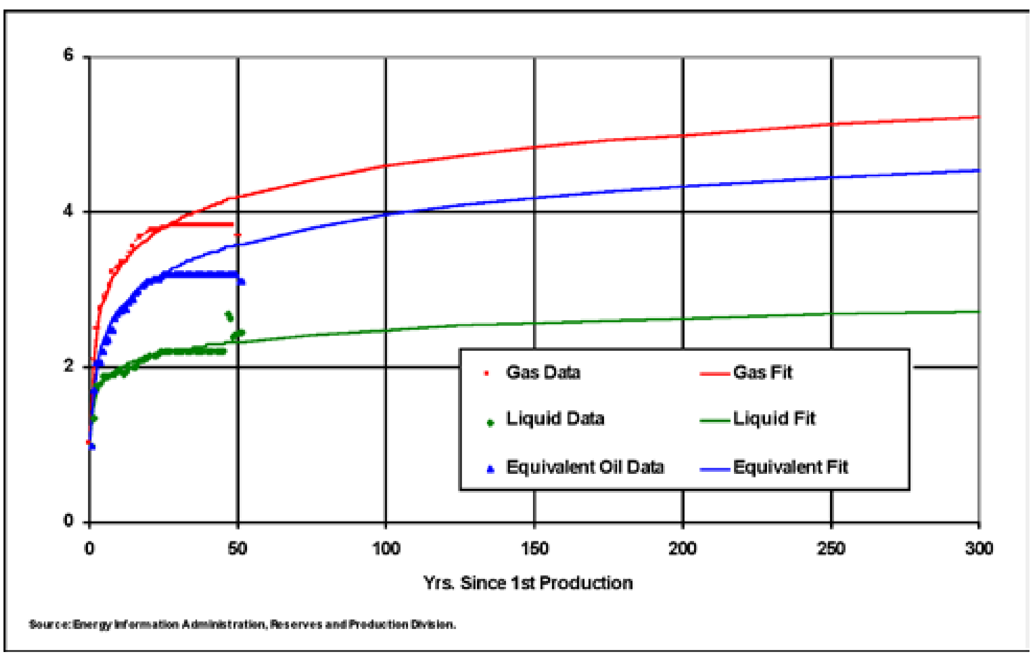

Figure A7-6. Black Warrior Basin Ultimate Reserve Growth, Median Method, Hyperbolic Fit

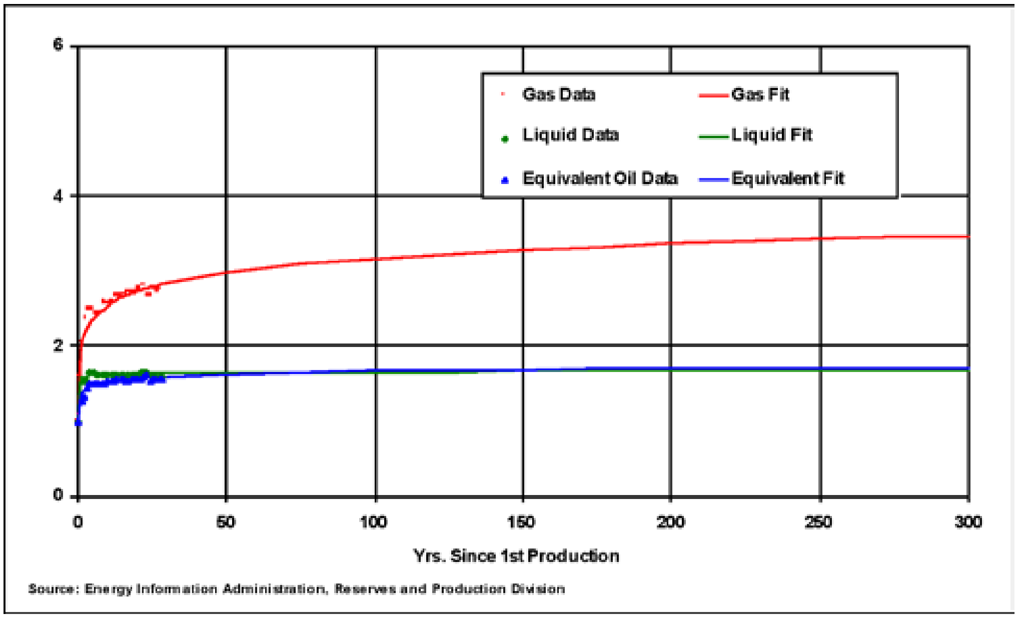

Figure A7-7. Wyoming Overthrust Belt Ultimate Reserve Growth, Median Method, Hyperbolic Fit

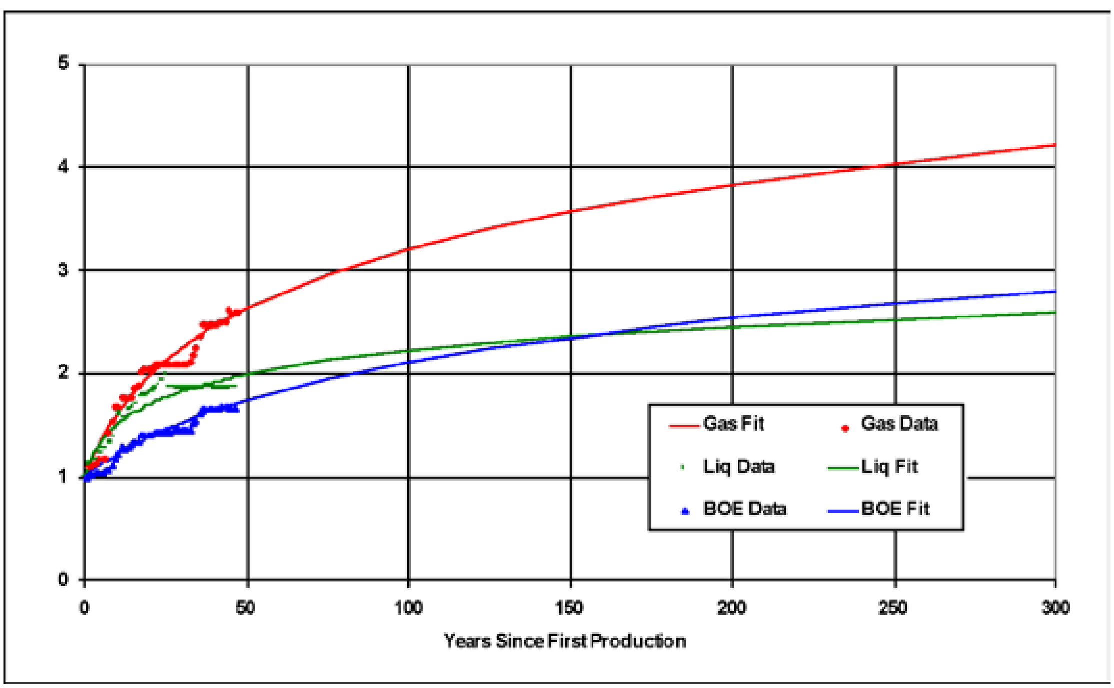

Figure A7-8. Alaska Basin Ultimate Reserve Growth, Median Method, Hyperbolic Fit

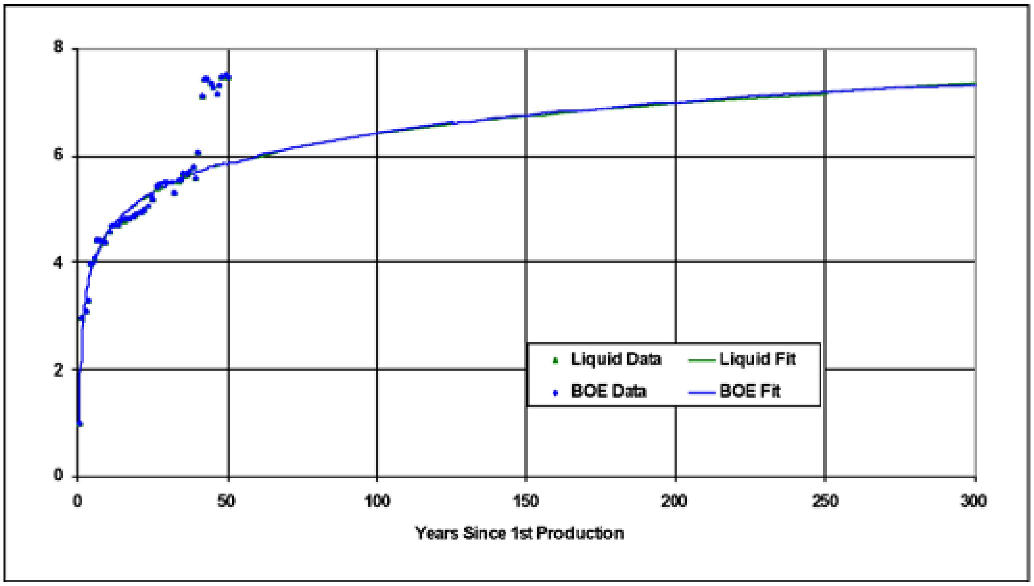

Figure A7-9. Eastern Great Basin Ultimate Reserve Growth, Median Method, Hyperbolic Fit

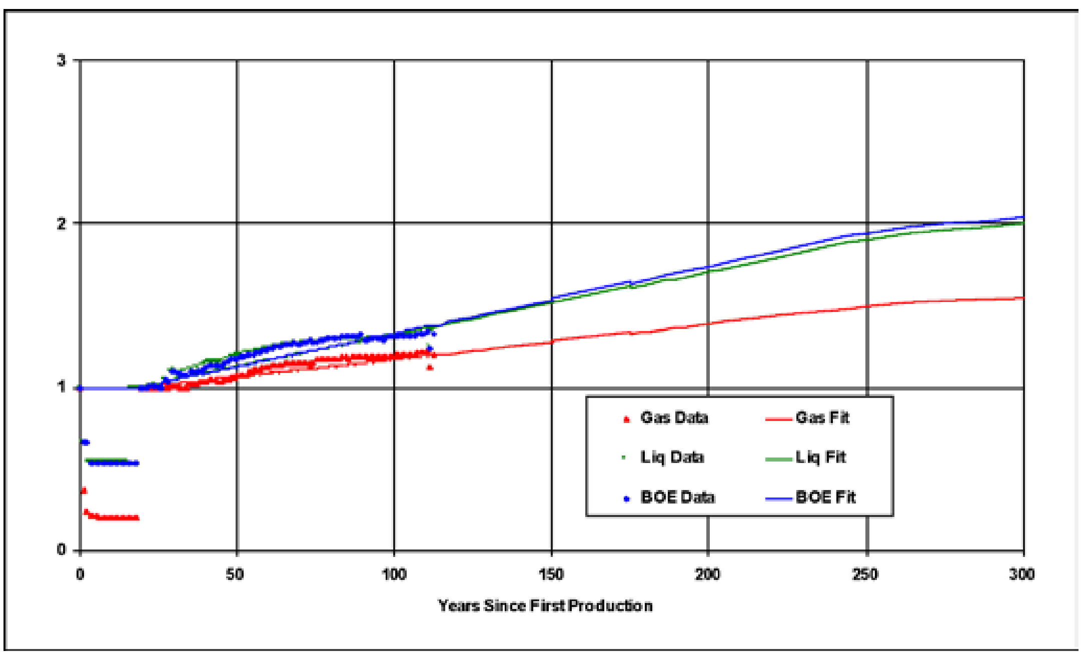

Figure A7-10. Ventura Basin Ultimate Reserve Growth, Median Method, Hyperbolic Fit

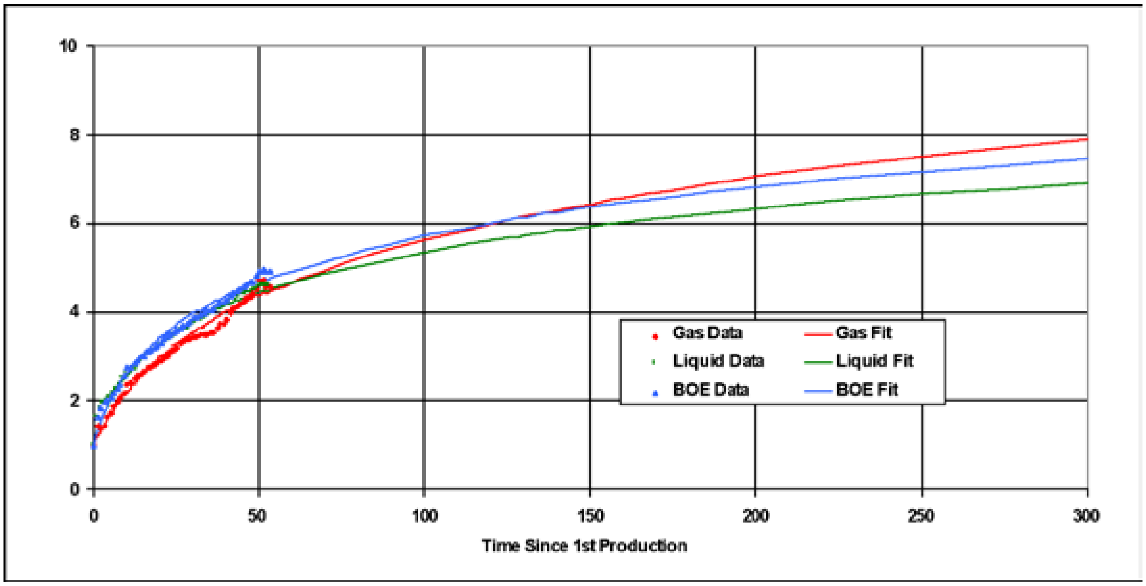

Figure A7-11. Williston Basin Ultimate Reserve Growth, Median Method, Hyperbolic Fit

Appendix 8
Proved Reserves Estimation and Field Boundary Construction

A8.1 Summary

The Reserves and Production Division, Office of Oil and Gas, Energy Information Administration estimated proved reserves of crude oil, natural gas and natural gas liquids on Federal lands located in selected geologic basins of the Rocky Mountain, Appalachian, Alaska, West Coast and Southeastern United States regions. This task involved attributing reported and imputed proved reserves to individual fields, development of field boundaries, and allocating these to Federal lands. The primary results are presented in a multi-layered GIS format accompanied by metadata compliant with the Federal Geographic Data Committee Metadata Standard. Most of the methods used were modified from those developed for the EPCA Phase I and II Inventories in 2002 and 2005. Some modifications were made to accommodate geological differences between the Phase I, II and III basins, whereas other modifications represent the implementation of planned improvements. A complete methodology for the Phase I and II basins can be found in the previous Inventory reports.[1]

Data Sources and Conditioning

Data was obtained from four major sources during the project:

- Federal agencies
  - The 2004 Form EIA-23 Reserves Survey was the source for the bulk of the proved reserves estimates
  - The Federal lands boundary data were provided by the BLM.
  - EIA's US PetroSystems (USPS) production data set was a source of field names, reservoir names and 2004 production data for the States of Utah (UT), Nevada (NV), California (CA), Montana (MT), North Dakota (ND) South Dakota (SD) and Alaska (AK)
- State agencies (oil and gas regulatory agencies and geological surveys) provided well and production data either directly or via their website
- Consultant Don French of Billings, MT was the source for Nevada (NV) well location data
- Commercial vendors
  - HPDI was a source of well data for the States of UT, CA, MT, ND and SD

Several steps were involved in the data assembly and conditioning phase:

- Identification of all wells, reservoirs, and fields in the subject basins.
- Standardization of reservoir and field names to make them consistent from source to source.
- Assigning wells to fields where field names were missing from the well records.
- Identification and standardization of well types.
- Merging of the state data, commercial vendor data, and Form EIA-23 survey data.
- Identification and name editing of those fields that had wells located both inside

[1] See < http://www.blm.gov/epca >

and outside of the defined EPCA basin boundaries and fields that crossed state boundaries.

Construction of Field Boundaries

To compare the fields and their proved reserves to Federal lands it was necessary to construct a boundary or field outline for each field. Field boundaries and areas were determined by placing reasonable and appropriate buffers around individual wells, followed by their union. Buffer size was based on well spacing as determined by measuring the distances between wells in a reservoir or field. When buffering was determined on a reservoir basis the resulting boundaries for each reservoir were unioned together to create the field boundary.

Well locations for buffer determination were based on the latitude and longitude of each well's spud point or surface location (SL) for vertical wells, or, when available, the latitude and longitude of the bottom-hole location (BHL) for directional and horizontal wells, relative to those of neighboring wells. BHL data was available only for the states of AK, UT, MT, ND and SD. Of the three EPCA Phase III states which did not have BHL data (CA, WA and NV), only CA was a problem because so many wells in the Ventura Basin are drilled directionally The BHL data is available at the CA Division of Oil, Gas and Geothermal in individual well record paper records, but has not been tabulated digitally. Thus the CA field outlines and areas are based on buffered SL's and may considerably under-represent the areas for fields containing many directional or horizontal wells. WA and NV do not have any known horizontal or directionally drilled producing wells in the study areas so lack of BHL data was not an issue there.

For the States of CA, NV and WA, wells within the same field were used to determine the appropriate buffer size rather than wells within the same reservoir because reservoir information was frequently absent or incomplete. Rules were developed on the basis of the well to well distance measurements within a field (or reservoir) to determine which standard well spacing (buffer size) should be used for each field. After assigning the appropriate standard well spacing-based buffers to each field, field boundary polygons were then generated using ESRI's ArcGIS Version 9.0 software.

For vertical and directional wells, the completed production interval was considered to be represented by a point on a map. Circular buffers were created around the points representing the SL's and BHL's for vertical and directional wells, respectively. A Visual Basic application was written to automate this process. The GIS mapping software performed these main steps:

- Selection of all wells with a specific field name
- Creation of a buffer around each well in the field using the assigned standard well spacing (based on buffer distance)
- Unioning (or joining) of the buffers in each field to dissolve the inner boundaries of overlapping buffers
- Outputting of a boundary outline polygon (sometimes more than one polygon if one or more wells are located far from the other field wells) for each field

Horizontal wells were treated differently because the completed production interval of a directional well typically extends in map view from a point close to the SL to the BHL. Thus, the line connecting SL and BHL for a horizontal well was buffered for field boundary construction.

Boundary Editing and Smoothing

Portions of field boundaries that extended outside of the defined EPCA Phase III basin boundaries were clipped at the basin boundary and removed. The fraction of the total field area that was within the basin boundary was then calculated. This fraction was used to reduce the field's proved reserves to the field portion inside the basin boundary.

The outer boundaries of the resultant multi-well field polygons (outlines) often have a scalloped appearance. The polygons also often have small internal non-field "islands." Numerous alternative methods were tested during the EPCA Phase II evaluation to identify and develop an algorithm which would adequately automate smoothing of scalloped-appearing field boundaries and fill in the small "islands" while acceptably limiting the polygon area increase. The resultant smoothing algorithm, automated by a Visual Basic application in ArcGIS, was applied to all field boundary polygons. Ninety-nine percent of the resultant smoothed EPCA Phase III outlines have areas that are less than 108 percent of the unsmoothed polygon areas.

Federal Land Area and Reserves

Geographic comparison (intersection) of the smoothed field boundary polygons to the Federal lands polygons was then performed, resulting in output of a Federal lands fraction for each field.

Proved reserves estimates submitted on the 2004 Form EIA-23 survey were used in the proved reserves estimation process. For those fields in which only some of the operators reported on Form EIA-23, the minimum reserves-to-production ratio of those that had reported was multiplied by the production of non-reporting operators to impute the latter's proved reserves. To impute proved reserves for those fields in which no operator had reported on Form EIA-23, regression equations were developed from other reported observations in the basin that were used to estimate proved reserves for these typically small fields. The portion of proved reserves associated with Federal lands within the field was then computed using the Federal lands fraction. Each field was then assigned to a proved reserves size class sufficiently narrow to be useful for EPCA purposes while at the same time broad enough to ensure confidentiality of each Form EIA-23 respondent's proprietary proved reserves estimates.

For the combined Phase III basins proved Federal lands liquid reserves (crude oil plus condensate) were estimated to be 3.8 percent of total proved reserves with the percentage for individual basins ranging from 0.1 to 99.5 percent. Similarly, the combined basins' proved Federal lands gas reserves were estimated to be 2.8 percent of total proved reserves with the percentage for individual basins ranging from 0.1 to 94.7 percent. The Federal lands proved barrel of oil equivalent (BOE) reserves of the combined basins were estimated to be 3.6 percent of their total proved reserves, with the percentage for individual basins ranging from 0.1 to 99.5 percent.

Table A8-1. Targeted Basins and Their State and County Affiliations

Study Area	State	Counties
Ventura Basin	CA	Los Angeles (part), Santa Barbara (part), Ventura (part)
Eastern Oregon-Washington	WA	Adams (part), Benton (part), Chelan (part), Columbia (part), Douglas (part), Franklin (part), Grant (part), Kittilas (part), Lincoln (part), Walla Walla (part), Yakima (part)
	OR	Crook (part), Deschutes (part), Gillam (part), Grant (part), Jefferson (part), Klamath (part), Lake (part), Morrow (part), Sherman (part), Umatilla (part), Union (part), Wasco (part), Wheeler
Eastern Great Basin	NV	Clark, Elko, Eureka, Lander (part) Lincoln, Nye (part), White Pine
	UT	Beaver, Box Elder (part), Cache (part), Davis (part), Iron (part), Juab (part), Millard, Salt Lake (part), Sanpete (part), Sevier (part), Tooele, Utah (part), Wasatch (part), Washington (part), Weber (part)
	ID	Bannock (part), Cassia (part), Franklin (part), Oneida (part), Power (part)
	AZ	Mojave (part)
Williston Basin	SD	Butte (part), Corson (part), Harding, Perkins (part), Ziebach (part)
	ND	Adams, Benson (part), Billings, Bottineau, Bowman, Burke, Burleigh, Divide, Dunn, Emmons (part), Golden Valley, Grant, Hettinger, Kidder (part), McHenry, McKenzie, McLean, Mercer, Morton, Mountrail, Oliver, Pierce, Renville, Rolette, Sheridan, Sioux, Slope, Stark, Ward, Wells (part), Williams
	MT	Part of Carter, Custer, Fallon, McCone, Prairie, Valley; all of Daniels, Dawson, Richland, Roosevelt, Sheridan, Wibaux
Central Alaska- Yukon Flats	AK	Bethel (part), Dillingham (part), Fairbanks North Star (part), Lake and Peninsula (part), Matanuska-Susinta (part), Nome (part), NW Arctic (part), SE Fairbanks (part), Valdez-Cordova (part), Wade Hampton (part), Yukon-Koyukuk (part)
Northern Alaska	AK	North Slope (part)
Southern Alaska	AK	Aleutians East (part), Anchorage (part), Kenai Peninsula (part), Kodiak Island (part), Lake and Peninsula (part), Matanuska-Susinta (part), Skagway-Yakutat-Angoon (part), Valdez-Cordova (part)

A8.2 Study Areas

The study area basins targeted in the EPCA Phase III inventory and the states and counties pertinent to them are listed in Table A8-1. Boundaries for the study areas were provided by the USGS. All wells in the listed states and counties for which location information (in the form of latitude and longitude coordinates or projected coordinates) were available were selected if within the study area boundaries. Wells not located within the study area boundaries were discarded unless they were in a field that had wells located both inside and outside of the study area boundaries.

A8.3 Data Sources

Three principal sources of data were used for this study:

- Federal Agency Data
  - The 2004 Form EIA-23 Survey files which contain field-by-field proved reserves estimates and production data as reported by large operators.
  - Federal lands boundary data were provided by the BLM.

  - EIA's US PetroSystem database was the source of field and reservoir names, production data at the well for gas or the lease for crude oil, associated-dissolved gas, nonassociated gas, and condensate production in the states of AK, CA, MT, NV, ND, SD and UT.

- State Agency Data
  - Many of the oil and gas regulatory entities and the geological surveys of the producing states have official websites where tables with the following data can be downloaded and/or queried: well spud point location (latitude and longitude), field name, and well type at time of completion. Several states also have online interactive web-mapping (webmapper) applications where wells can be viewed on a map and queries about them can be made. A few states have constructed their own oil and gas field boundary or outline files; these were used, where available, to check the reasonableness of the field boundaries constructed for this project. Oil and gas production data, usually annual by well, is available to download or query for some states. Links to the websites used in this study are listed in Table A8-2.
  - Some data cannot be downloaded from the state websites even though it can be queried online and must therefore be obtained directly from a state agency. The following data were obtained from the listed state agencies (and contact person) in Table A8-3.

- Commercial Data
  - Well data tables with spud point location (latitude and longitude), field name, production, and well type at time of completion for the states of CA, MT, NV, ND, SD and UT were purchased from vendor HPDI.

A8.4 Limitations Imposed by the Available Data Sources

A variety of shortcomings and flaws in the presently available data impose unavoidable limitations either on what can be done or on the achievable level of accuracy. Chief among these are:

- Field and reservoir names are frequently non-standard, i.e., their content and/or spelling varies widely. This makes accurate automated—and often even manual—matching of field and well records across data sources difficult and sometimes not possible. While standardized field codes are assigned and supported by EIA, most field names and their spellings are assigned by state agencies. Much of the problem is rooted in the fact that, for more than two decades, many of the producing states have trimmed the resources devoted to this task, with the result that the current staff is overburdened and large backlogs exist. When reporting well or production information for a field on which the state has not yet given an official name, the field operator is free to use any name or spelling.

  An additional factor was the demise of the American Association of Petroleum Geologists' (AAPG) Committee on Statistics of Drilling, which for many years performed an essential quality control function relative to U.S. well statistics and field and reservoir names. Staffed by industry volunteers, the Committee was disbanded in 1986

Table A8-2. Links to Websites Used

AK well data	http://www.dog.dnr.state.ak.us/oil/products/data/wells/wells.htm
AK field outlines	http://www.dog.dnr.state.ak.us/oil/products/data/downloads/downloads.htm#accum
AK production	http://www.state.ak.us/local/akpages/ADMIN/ogc/publicdb.shtml
AZ production	http://www.azogcc.az.gov/
CA well data	http://www.consrv.ca.gov/dog/maps/goto_welllocation.htm
CA production	http://www.consrv.ca.gov/dog/prod_injection_db/index.htm
MT well & production	http://bogc.dnrc.state.mt.us/jdpintro.asp
MT webmapper	http://bogc.dnrc.state.mt.us/web_mapper.asp
NV well data	http://www.nbmg.unr.edu/dox/dox.htm > OF04-1
NV production	http://minerals.state.nv.us/forms/forms_ogg.htm
ND wells (subscription)	https://www.dmr.nd.gov/oilgas/subscriptionservice.asp
ND webmapper	https://www.dmr.nd.gov/oilgas/ > GIS Map server
OR well data	http://www.oregongeology.com/sub/oil/oil-gas-permits-spreadsheet07-14-06.xls
SD well data	http://www.state.sd.us/denr/DES/Mining/Oil&Gas/well_data.htm
SD Production	http://www.state.sd.us/denr/DES/Mining/Oil&Gas/producti.htm
UT well data & production	http://www.ogm.utah.gov/oilgas/DOWNLOAD/downpage.htm
UT webmapper	http://atlas.utah.gov/oilgaswells2/viewer.htm
UT field outlines	http://ogm.utah.gov/oilgas/MAP%20SEARCH/Utah_map.htm
WA well data	http://www.dnr.wa.gov/geology/energy.htm

Table A8-3. State Agencies Contacted

AK well data	Alaska Oil and Gas Conservation Commission (Steve McMains)
AK field outlines	Alaska Dept. of Natural Resources, Div. of Oil and Gas (Christine Beaty)
AZ well data	Arizona Geological Survey (Steve Rauzi)
CA field outlines	California Div. of Oil, Gas and Geothermal (Joy Arthur-Silva)
CA production	California Div. of Oil, Gas and Geothermal (Steve Fields)
MT wells, production	Montana Board of Oil & Gas (Jim Halvorson)
NV production	Nevada Division of Minerals (Christy Morris)
NV well data	Nevada Bureau of Mines & Geology (Ron Hess)
NV well locations	Don French (Consultant Geologist)
NV well locations	Jerry Hansen & Carl Shaftenaar (Consultant Geologists)
ND production data	North Dakota Industrial Commission Dept. of Mineral Resources (Jim Lindholm)
ND field outlines	North Dakota Industrial Commission Dept. of Mineral Resources (Kirby Latham)
OR well data	Oregon Dept. of Geology (Bob Houston)
SD well data, field outlines	South Dakota Dept. of Environment & Natural Resources, Oil & Gas Section (Mack McGillivray)
UT field outlines	Utah Geological Survey (Sharon Wakefield)
UT production	Utah Div. of Oil, Gas and Mining (Dan Jarvis, Vicki Dyson, Don Staley)

and its files were turned over to the American Petroleum Institute (API), which for many years maintained them absent the "in-the-field" quality control that the AAPG Committee had provided. Eventually this task was transferred to two competing commercial data vendors for continued maintenance and updating. Both recipient firms are now subsumed in IHS Energy Group.

- Related to the field name problem is the problem of unknown and/or unassigned field names. This was most prevalent in the Ventura Basin where numerous wells exist that do not have field names assigned, and was also an issue to lesser extents in UT, SD, ND and MT. Such wells were assigned field names by proximity to existing fields. Due to the much larger volume of unknown field wells in the EPCA Phase II study areas, an automated process was developed to assign field names for such wells based on the field names of nearby named-field wells. It was not necessary to use that technique in Phase III because of the smaller numbers of such wells. The process used for Phase III involved viewing of mapped well locations and the manual assignment of unknown wells to match nearby wells associated with field names. After this there were still wells that could not be assigned field names. These were assigned temporary numeric names prefaced by the letters RPD and the county name.

- Well misclassification is a perennial problem. For the most part it is caused by insufficient recursive quality control. For example, a new well may initially be classified as a wildcat well, which by definition has discovered a new field. Subsequent drilling of extension wells in this or an adjacent field may, over time connect the two adjacent fields. At this point both fields will shift to the field name of the earliest discovered of the two. This and other similar reclassifications occur frequently, but that fact often never filters backward, i.e., in this case to re-classification of the wildcat well type to extension or even development status.

- With the notable exception of fields located on the Federal OCS, the Federal government does not have access to subsurface data other than the well data available in state or vendor well files and state well log files. Because seismic data and interpretations, surface and subsurface geologic maps, and many well logs are proprietary data, in the context of the EPCA study this limits what can be done concerning the construction of field boundaries to a purely geometric approach based on the buffering of well locations around their surface spud points (or bottom hole locations for the States of AK, ND, MT and SD only).

For these reasons, the resultant field boundaries are approximations, the accuracy of which, in the absence of adequate subsurface information, depends to a greater or lesser extent from case-to-case on the professional judgment of the EIA RPD's experienced petroleum geologists and engineers. Collectively the field boundaries provided here are likely to be of sufficient accuracy for policy formulation concerning access to Federal onshore lands. In specific instances they may not be accurate enough for the application of policy and regulation.

A8.5 Process Overview

Figure A8-1 is a flow chart of the major steps followed in estimation of field-level proved reserves (on the left-hand side) and the construction of field boundaries (on the right-hand side), plus their merger into the final principal reserves product. The following discussion provides details for each of the indicated steps.

A8.6 Quality Checking and Combination of Data Sources for Each State

Owing to different oil and gas industry activity tracking histories and to non-standardization, each state's data posed unique challenges relative to assembling the most complete and accurate well data set possible for later use in constructing field boundaries. State agencies were a primary source of well data for all 8 of the producing states involved in the Phase III basins. These data were augmented with vendor or US PetroSystem well data in 6 of the 8 producing states (see Table A8-4).

A8.7 Merging of Well Data Files

For the states of NV, UT, CA, MT, ND and SD well data sets with location data were used from multiple sources (see table AA8-4). The API well number, present in the state, HPDI, and US PetroSystem well data files, was the common key for this merging process.

The merged well records that did not match with US PetroSystem Production records were most often dry holes, injection wells or storage wells. If these did not match well records in other state or vendor files for that state, they were discarded. The original database not only contained oil, gas and injection wells, but also other types of wells, such as CO2 (carbon dioxide), D&A (drilled and abandoned), dry holes, SWD (salt water disposal), STEAM, PSEUDO, SERVICE, STORAGE and WD (water disposal) wells. To create valid field boundaries only oil and gas wells were retained, whether or not they had recorded 2004 production data, excepting in Alaska where the injection wells were retained.

For the states with multiple state and/or vendor sources, the available well data sets were merged using the API number of the well (or the state permit number if the API number was not available) as the common data field. The following rules and procedures were developed and used to merge the files:

A8.7.1 Preparation of Spud Point Location Information (Well Latitude and Longitude at the Surface) and Bottom-Hole Location Information

For each state with multiple well data sources, the wells from each source were plotted on a map using the ArcGIS software. Location quality of the data sets was checked by looking for wells located far from a field's core location, wells with locations out of state, and wells located in the wrong county. This information was used to determine which source of location coordinates was the best one to use as the primary source. If location information was not available from any source the well record was deleted from the data used for field boundary construction but was retained for merger with the Form EIA-23 database and subsequent use in the determination of production and reserve volumes.

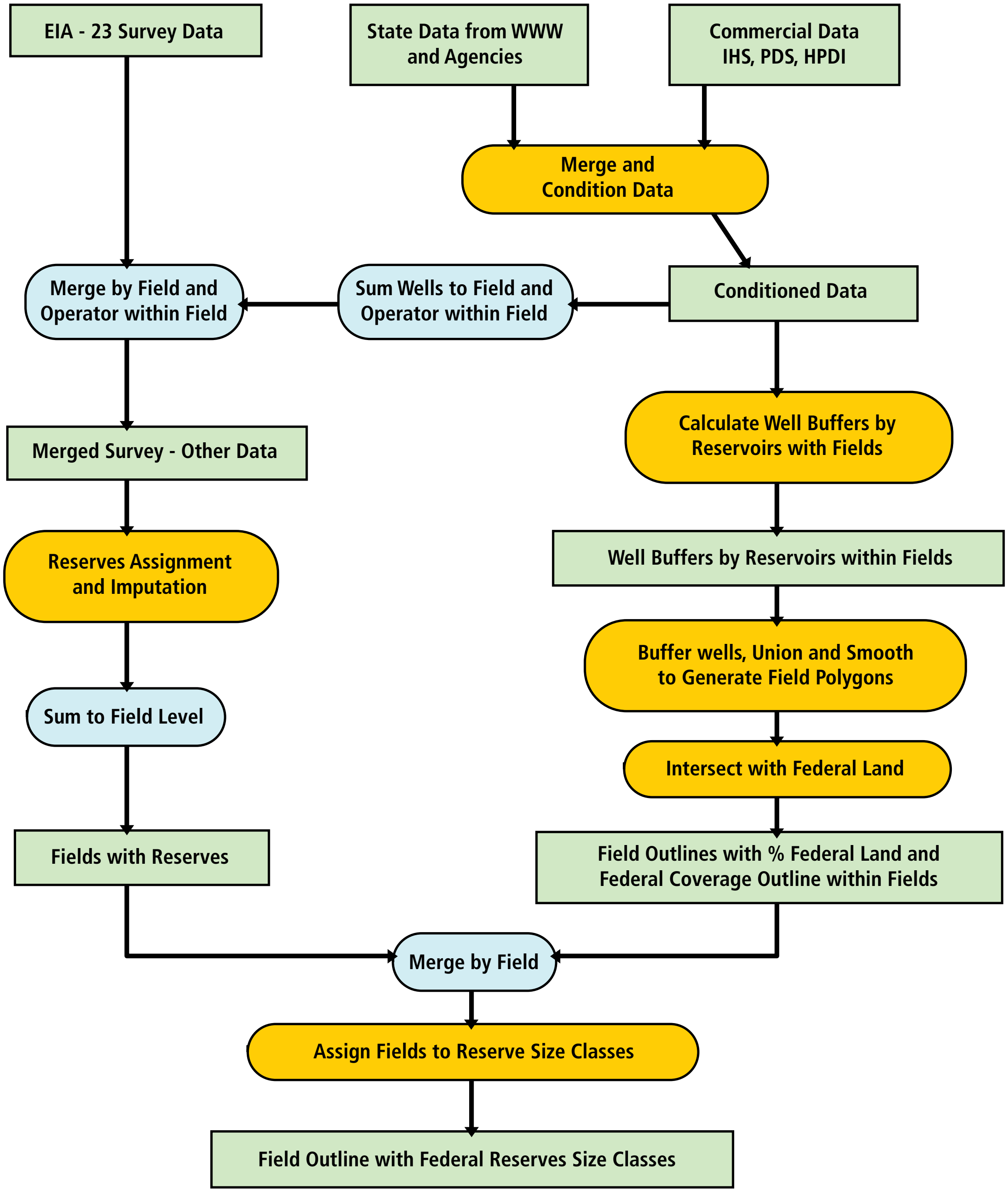

Figure A8-1. EPCA III Process Flows

Table A8-4. Well Data Sources by State Used for EPCA Phase III

Well Data Sources Used For EPCA III Evaluation					
EPCA III Area	State	Source			Comments
		Vendor	EIA	State Agency or Other Source	
North Alaska	AK			AK Oil & Gas Conservation Commission	Bottomhole locations used
South Alaska	AK			AK Oil & Gas Conservation Commission	Bottomhole locations used
Central Alaska-Yukon Flats	AK			AK Oil & Gas Conservation Commission	No producing wells
Eastern Oregon-Washington	OR			OR Department of Geology and Inustrial Minerals	No producing wells
	WA			WA Department of Natural Resources	No digital records (digitized fr. IC-75)
Eastern Great Basin	NV		USPS	Don French (Consultant)	
	UT		USPS	UT Division of Oil, Gas & Mining	Bottomhole locations used
	ID			ID Dept. of Lands, Surface & Min. Resources Bur.	No production in ID
	AZ			AZ Geological Survey	No producing wells
Ventura Basin	CA	HPDI	USPS	CA Division of Oil, Gas & Geothermal	No bottomhole locations
Williston Basin	MT		USPS	MT Board of Oil & Gas	Bottomhole locations used
	ND		USPS	ND Industrial Com, Dept. of Mineral Resources	Subscription req'd, Best BHL data
	SD		USPS	SD Dept. of Environment & Nat. Res, Oil & Gas Sect.	BHL's calculated from footage calls

For Nevada the state agency (NV Bureau of Mines and Geology) warned EIA that the calculated latitudes and longitudes for their well surface locations were not precise, having been calculated from the centers of quarter sections rather than by the more precise footage call from section line method. Several independent consultant geologists who specialize in Great Basin exploration were therefore contacted to see if they had better NV well location data. Because NV wells are all drilled in a desert environment it is possible to see cleared well pads very distinctly on aerial photography. NV well locations obtained from USPS, HPDI, the state agency, and two consultant geologists were plotted over USGS aerial photos using GIS. Although it was not possible to directly tie wells pads on the photos with specific wells being plotted, it was obvious that the well locations obtained from consultant Don French were most often in the center of the well pads on the imagery. These latitude and longitude data were therefore used for the NV wells.

Because horizontal or highly deviated wells are increasingly being drilled in the US onshore, it would be better to use the latitude and longitude of a bottom-hole location

(BHL) to locate wells rather than the surface spud-point location. Only the States of AK, ND, SD, MT and UT had sufficient BHL location data so for all other states the spud point (surface) location had to be used.

South Dakota provided its BHL data for horizontal wells in units of footage calls from the surface spud-point location. These data were converted in a GIS to the latitude and longitude of the BHL.

A8.7.2 Field and Reservoir Name Respelling and Renaming

Variation in field and reservoir names and spellings is common among the commercial data files and state sources. Names were altered as necessary to make them as consistent as possible across sources. To achieve better field boundaries it was assumed that the buffers created for wells should be calculated on a reservoir level where possible (otherwise on a field level) and that the field boundary would then be constructed by unioning of the reservoirs in the field. Reservoir names were only consistently available for the States of, UT, AK, MT, ND and SD.

Names carried on the US PetroSystem production database were used when available because they were most consistent with the names in the EIA Field Code Master List. Otherwise, names from the state files or non-US PetroSystem files were used.

A8.7.3 Missing Field Names

Well files for every state had records where the field name was missing or that contained values such as 'UNKNOWN,' 'UNDESIGNATED', 'UNKNWN' or 'WILDCAT.' For all areas the field name data field for these wells was populated manually. Wells with missing field names were plotted on a map showing the field outlines of all named fields. Unnamed field wells located within or in close proximity to a named field boundary were given the name of that field. Unnamed wells judged as too far from named field outlines to be considered part of any field were given RPD field names incorporating identification of the well's county location was used to replace it (e.g. a new field name like "RPD_ Washington_Cnty-1" was created. These wells were grouped manually into fields if their buffers intersected.

If a reservoir name was abbreviated, the full reservoir name was assigned. If a reservoir name was augmented by a layer/zone/ horizon modifier (e.g. "11250 A Washita-Freder," "11300 Washita-Freder") the modifier was removed (e.g. all were changed to "Washita-Freder"). Most records did not contain horizon information so the zone name was used instead as the best available data for reservoir naming.

Some field names were changed based on information obtained from state data sets, state websites, and conversations with state agency personnel. A few states such as AK, UT, CA, ND and MT have developed their own spatial data files of field boundaries. These are often digitized versions of geologic outlines originally drawn by hand on paper, or in some case they represent land units and therefore have a more rectilinear look (e.g. MT and ND) than do smoothly rounded geologic field outlines (e.g. CA and UT). When these state outlines were overlaid on the field boundaries created in the present study some discrepancies were noted and investigated. This comparison resulted in additional field name edits in some instances.

A8.7.4 Identification of Well Types for Later Buffering

Deciding which wells to include in the buffering process is critically important in the construction of field boundaries. All wells where type=oil or type=gas in at least one of the source datasets were retained and classified as oil or gas. Wells which were not of type=oil or type=gas in at least one source were classified as a dry hole, a CO_2 producer, or an injection well. Following final assignment of the well type only the positively identified oil and gas wells were retained for input to the well buffering process. The exception was for injection wells located in Alaska which had a significant impact on the field outlines and were therefore retained and buffered.

Some of the state well files indistinguishably group dry holes which never produced (usually typed as "drilled and abandoned" or "D&A") with former oil or gas producing wells that are now plugged and abandoned (usually typed as "P&A"). This makes the task of separating present and former producers from wells that never produced difficult and emphasizes the importance of having good historical production data records.

A8.7.5 Merging with Production Data from Other-Sources

Well-level production data from state or vendor sources other than the USPS were merged to the well files by API number or by drilling permit number. Some states have incomplete production data. For example, WA does not have any production data for the single gas field located in the Eastern OR-WA study area.

A8.8 Construction of Well Buffers

The procedure used to generate well buffers consisted of several development and application steps. Creation of oil and gas field boundaries was accomplished using ArcGIS 9.0 software and the methodologies developed by EIA for Phase I of the EPCA inventory which are documented in detail in the EPCA Phase I report.

The basic method used to construct field boundaries was to buffer each well in a reservoir or a field with a circle. The radius of the circle was determined by analysis of the spacing pattern for the wells in each reservoir in a field if reservoir names were consistently available, or for the wells in each field if consistent reservoir names were not available. The resulting circular buffer polygons were then unioned into a single field boundary polygon set (note that if wells are far enough apart there can be more than one non-contiguous polygon per resultant single field boundary). Given the large volume of data involved and the fiscal constraints on the EPCA project, this method was used because it most effectively utilizes the available information on the different well spacing patterns present within a field and it is relatively easy to perform on a large data set.

This technique was modified for EPCA Phase III due to the abundance of horizontal wells in the study areas and, for the first time in the three EPCA phases, the availability of ample BHL data in some of the states which, along with the SL data, define the extent of a horizontal wellbore on a map. Vertical, horizontal, and directional (i.e., "slant" or

”deviated”) wells were buffered differently (see Figure A8-2). Some of the states only have vertical wells, and others have all three types. For some of the states, bottom hole location (BHL) data that is needed to define the geometry of horizontal and directional wells was not available, or there was no attribute in the data to differentiate horizontal from directional wells.

Most of the horizontal wells for the EPCA Phase III study areas are in the Williston Basin (ND, SD and MT) and Alaska. The State of North Dakota (ND Industrial Commission, Dept. of Mineral Resources, Oil and Gas Division) keeps the most detailed directional survey records which have latitude, longitude and subsea depth (feet) for numerous points between the SL and BHL. Horizontal wells in a number of ND regions were plotted on maps using GIS, with the production interval marked along the wellbore track between SL and BHL. In most cases, the production interval begins from a point just below the SL (in map view) and extends to the BHL. This observation led to the generalization that the entire distance between SL and BHL for a horizontal well should be buffered for field outline construction purposes (see Figure A8-3).

A number of different techniques were tested to build field outlines for horizontal wells: (1) buffering the SL points only, (2) buffering the BHL points only, and (3) buffering a line connecting SL and BHL. The resultant outlines from the first two techniques left too many gaps in the judgment of the EIA geologists and engineers, so the third technique was selected, resulting in a “hot dog”-shaped buffer.

In previous EPCA evaluations (EPCA Phase I and EPCA Phase II), very little BHL data was available from vendors or state agencies other than Alaska’s. For EPCA Phase III, as stated above, ND had the most complete data, plus a “hole_type” classification for each well. Thus for ND it was possible to separate and treat differently vertical wells (SL is buffered), directional wells (BHL is buffered) and horizontal wells (line between SL and BHL is buffered). The state of MT’s well data had BHL latitude and longitude data, but not the points in-between, nor identification of directional versus horizontal well type. The MT wells with BHL different from SL (either directional or horizontal) were all treated as horizontal wells because in the adjacent state of ND, horizontal well types outnumber directional well types by a ratio of 12:1. Subsequent to this analysis, the MT Board of Oil and Gas added the attribute “slant” (with values of horizontal, horizontal re-drill/re-entry, vertical, and directional) to their online oil and gas information system. The relevant wells were queried, revealing that less than 1 percent of the directional plus horizontal wells in the MT portion of the Williston Basin are directional hole types.

Only since 2001 has the state of AK maintained a data attribute that distinguishes horizontal from directional wells. Although 57 percent of the AK producing wells from 2001 to present are classified as “horizontal”, it was decided to treat all non-vertical wells in AK as directional (buffering the BHL) because so many of the pre-2001 Cook Inlet wells are directionally drilled from onshore, and to assume they are horizontal and thus buffer the entire SL to BHL line would add a lot of non-productive area between the onshore SL and the offshore BHL’s. This is also the case to a lesser extent on the North Slope.

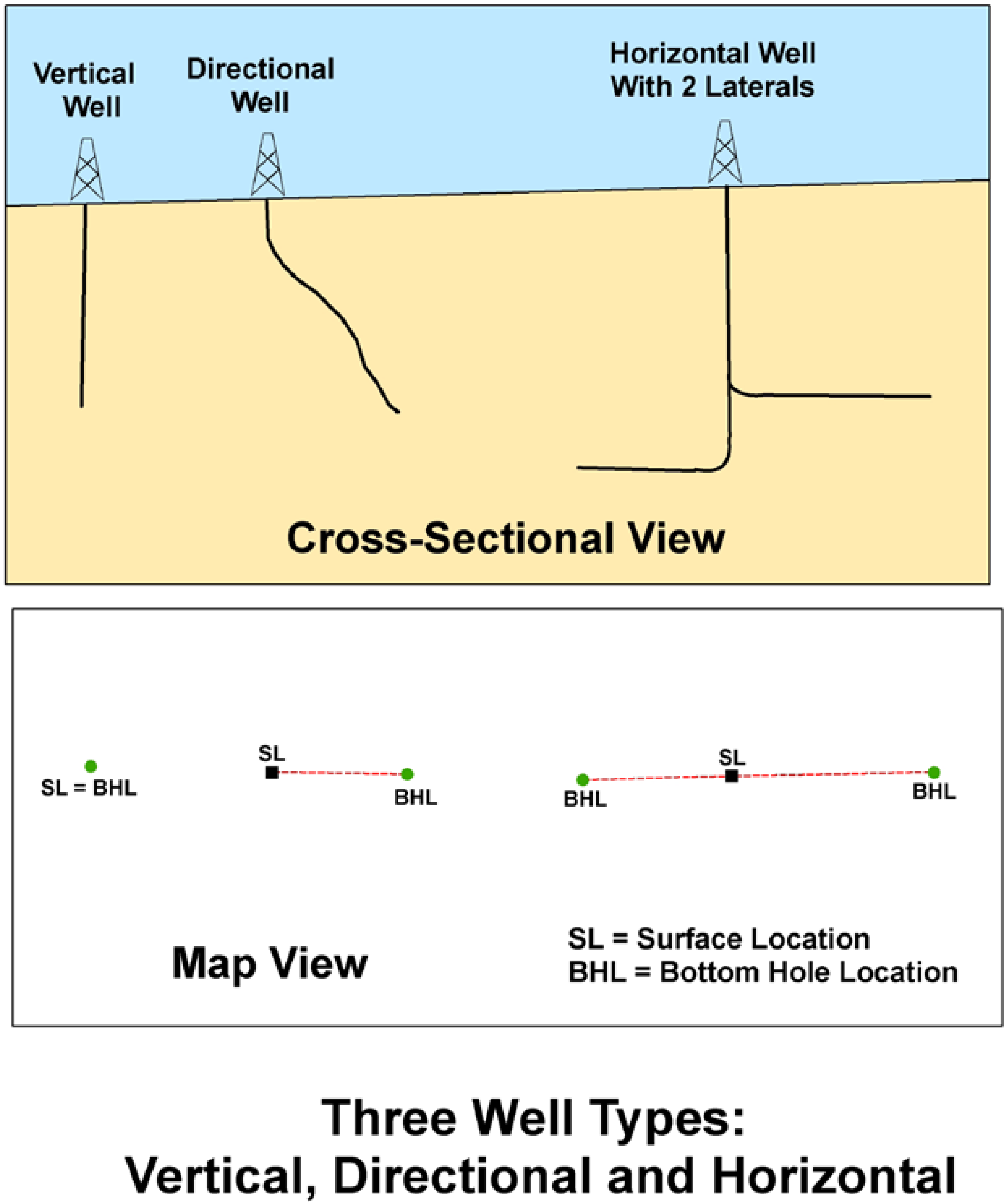

Figure A8-2. Three Well Types

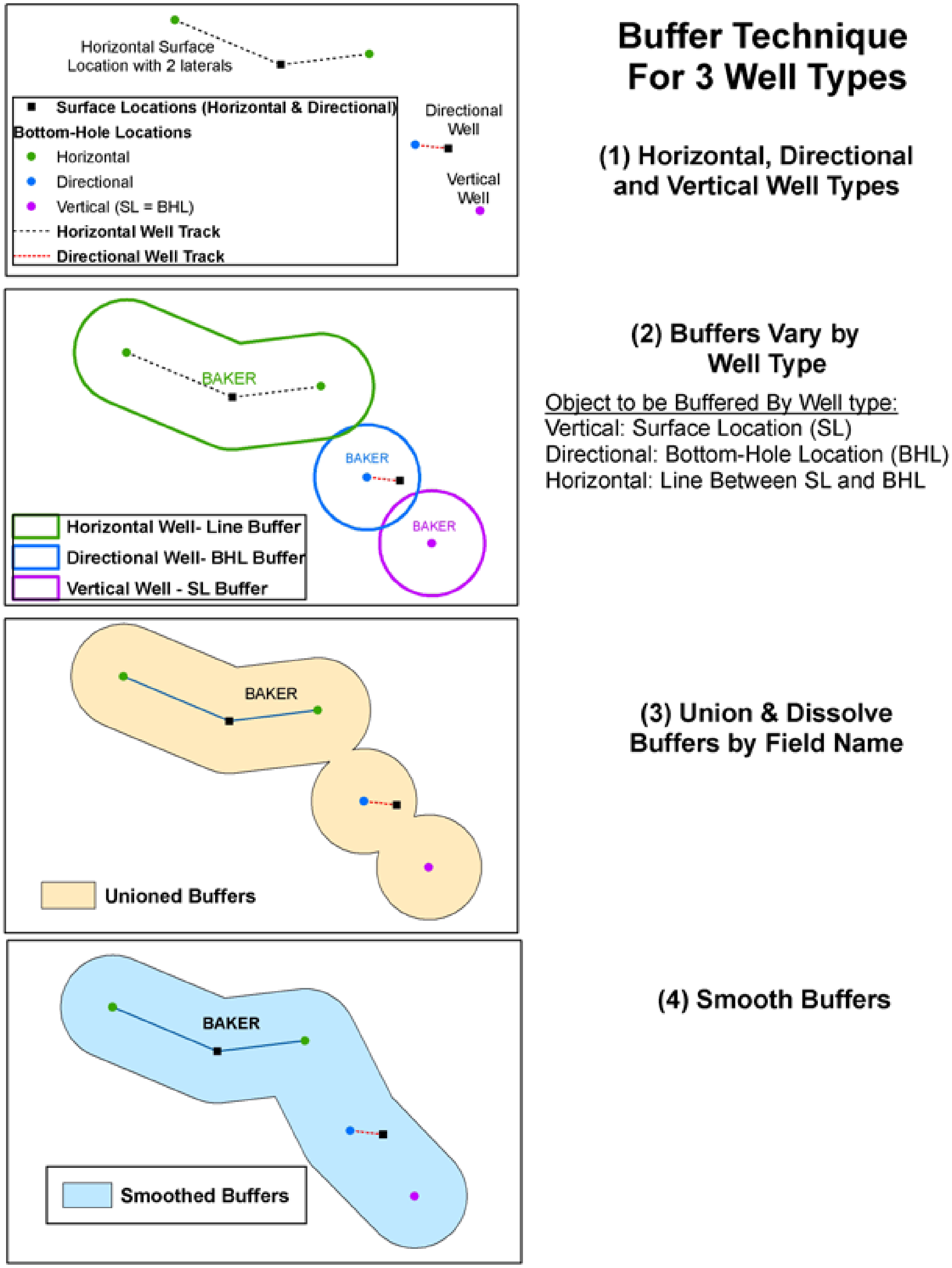

Figure A8-3. Buffer Technique for Three Well Types

A8.8.1 Determination of Nominal Well Spacing and the Assignment of Buffer Radii

An analysis of the distances between wells in a reservoir or a field, calculated from their spud point locations (or their bottom-hole locations in AK, MT, ND, UT and SD), was used to assign a standard well spacing unit to each reservoir or field. The same technique was used in Phases I and II of the EPCA project. Nearest neighbor inter-well separation distances were calculated separately for oil wells and gas wells. The upper and lower bounds of the observed spacing ranges are shown in the two left-hand columns of Table A8-5. The corresponding nominal standard well spacings (a geometric distribution) and buffer radii are shown in the two right-hand columns. The 75th percentile (P75) of the observed inter-well distance distribution was taken to be the observed inter-well distance. This statistic was selected because, as judged by the RPD project team, it yielded the best match to nominal well spacings in an extensive set of map trials done for EPCA Phase I. If the P75 distance fell within the corresponding interval shown in the two left-hand columns of the table then the corresponding nominal spacing was selected and its buffer size was initially assigned to every well in the reservoir (or field).

Table A8-5. Inter-Well Distance Ranges, Nominal Standard Well Spacings, and Buffer Radii

Inter-Well Distance		Nominal Spacing Unit (acres)	Corresponding Buffer Radius (Feet)
Lower Bound (feet)	Upper Bound (feet)		
0	277	1.25	233
277	392	2.5	330
392	555	5	467
555	785	10	660
785	1110	20	933
1110	1570	40	1320
1570	2220	80	1867
2220	3140	160	2640
3140	4440	320	3734
> 4440		640	5280

A8.8.2 Well Buffer Construction Rules

Rules for the assignment of buffers were created to handle reservoirs (or fields if no reservoir names were available) that did not, for whatever reason, readily conform to a nominal spacing. The rules are based on well types and well counts:

- For oil reservoirs the maximum spacing allowed was 160 acres, i.e. a buffer radius of 2,640 feet
- If the reservoir had between 1 and 10 oil wells or the reservoir name was ‘UNNAMED’ a spacing of 160 acres was assigned.
- If the reservoir in CA had between 1 and 10 oil wells a spacing of 20 acres was assigned.
- For gas reservoirs the maximum spacing allowed was 640 acres, i.e. a buffer radius of 5,280 feet.
- If the reservoir had only 1 gas well or the reservoir was named ‘UNNAMED’ a spacing of 320 acres was assigned.
- If a gas reservoir in MT, ND, NV, SD and UT had 3 or fewer wells a spacing of 320 acres was assigned. If it had more than 3 wells and less than 10 wells the nominal spacing unit was used per Table A8-5 up to a maximum spacing of 320 acres.
- If a gas reservoir in AK had 3 or fewer wells a spacing of 320 acres was

assigned. If it had more than 3 wells and less than 9 wells the nominal spacing unit was used per Table A8-5 up to a maximum spacing of 320 acres.

- If a gas reservoir in CA had 3 or fewer wells a spacing of 20 acres was assigned. If it had more than 3 wells and less than 10 wells the nominal spacing unit was used per Table A8-5 up to a maximum spacing of 20 acres.
- For coalbed methane wells a maximum spacing of 160 acres was assigned, i.e. a buffer radius of 2,640 feet.
- If the oil well count divided by the sum of the oil well count and the gas well count was less than or equal to 0.05 <u>and</u> if the oil well spacing was greater than the gas well spacing, the oil well spacing was set to the gas well spacing; otherwise, the original oil well spacing was retained.
- If the ratio of gas well count to the sum of the oil well count and the gas well count was less than or equal to 0.05 the gas well spacing was set to the oil well spacing for the field or reservoir; otherwise, the original gas well spacing was retained.
- For the ORION field in AK, 160-acre spacing (2640 ft buffer radius) was assigned in both oil and gas reservoirs.
- For the LA GOLETA field in CA, 20-acre spacing (933 ft buffer radius) was assigned to gas wells.
- For the SAN VICENTE, HOPPER CANYON and CASCADE fields in CA, 2.5-acre spacing (330 ft buffer radius) was assigned to oil wells.
- For the TORREY CANNYON, NEWHALL, EUREKA CANYON, ELWOOD SOUTH OFFSHORE, CAPITAN, SANTA CLARA AVENUE, and CURATA OFFSHORE fields of CA, 5-acre spacing (467 ft buffer radius) was assigned to oil wells.
- For the RINCON, VENTURA, PLACERITA, SHIELLS CANYON, RAMONA, DEL VALLE, BARDSDALE, SAN MIGUELITO, TIMBER CANYON, TAPO CANYON SOUTH, SANTA PAULA, NEWHALL-POTRERO, ALISO CANYON, PIRU, HOLSER, HASLEY CANYON, and SANTA SUSANA fields in CA, 10-acre spacing (660 ft buffer radius) was assigned to oil wells.
- For the BIG MOUNTIAN, SOUTH MOUNTAIN, SESPE, OJAI, MONTALVO WEST, OXNARD, SIMI, TAPO NORTH, CARPINTERIA OFFSHORE, SUMMERLAND OFFSHORE, CONCEPTION OFFSHORE, SATICOY, ELWOOD, WEST MOUNTAIN, and TEMESCAL fields in CA, 20-acre spacing (933 ft buffer radius) was assigned to oil wells.

A8.9 Construction of Field Boundaries

A SAS file containing the oil and gas well data with field name attribute “Field” (and reservoir name attribute “Reservoir” if that data was available) was imported into ArcGIS as a dBase (.dbf) file. The wells were then plotted using the latitude/longitude information in the file and converted to a geodatabase point feature class file. The coordinate system used was UTM NAD27 with the following UTM zones for each study area: Northern Alaska, Central Alaska-Yukon Flats, Southern Alaska–Zone 7, Eastern Oregon-Washington, Ventura Basin-Zone 11, Eastern Great Basin–Zone 12, and Williston Basin–Zone 14.

Before field boundary construction the following procedure was performed to ensure that all wells in the fields of interest lay entirely inside the study area boundaries. Two dbf files were made for each state, one of all wells inside the study area and another of all wells outside the study area. SAS queries were performed on those files to identify, for each state, all field names that had wells both inside and outside the study areas. These fields were then researched to determine if they were fields that actually extended across the study area boundaries or if they were geographically separate fields (not in reservoir communication) with the same name in the same state. In instances of the latter case, county names were appended to the field names (e.g. CACTUS_Morgan vs. CACTUS_Garfield) so that they would be put into different fields when the field boundaries were constructed.

Well files for each state were built that included only those wells located inside the study area/basin boundaries and all well records for fields that extended across the study area boundaries. These files were then used to construct the gross field boundary polygons. For fields that are partially outside the study area boundary, the outside portions were deleted later in the process as described below.

The Visual Basic for Applications (VBA) code implemented within ArcGIS for Phase I of the EPCA project was used to automatically create polygonal field boundaries from the buffered wells. The principal steps performed were:

- Select the “field name” attribute and “buffer distance” attribute from the well file. Select all wells with the first “field name” encountered.
- Create a buffer around each selected well using “buffer distance” (see Figure A8-4).
- Union the buffers.
- Dissolve the barriers between overlapping buffers.
- Iteratively perform the above steps for each unique “field name”.
- Output a polygon feature class with one polygon (often consisting of multiple polygon rings) for each field.
- Convert to a shapefile.

Figures A8-5 and A8-6 show the buffered field boundary of a field with two reservoirs. Figure A8-5 displays buffers by reservoir: Reservoir A is composed of oil wells with 80 acre buffers while reservoir B contains oil wells with 160 acre buffers and gas wells with 640 acre buffers. The final product of the field boundary creation process with buffers for both reservoirs unioned into one polygon record is shown on Figure A8-6 (these are un-smoothed buffers).

If a state or study area had horizontal wells with BHL data, the following steps were additionally performed:

- Create a separate horizontal wells shapefile with data fields of surface latitude, surface longitude, bottom hole latitude, bottom hole longitude and buffer_distance (calculated from the BHL point). Since many horizontal wells consist of two or three lateral horizontals from a single surface location, there is one shapefile record for each lateral.
- For each lateral, create a line between SL and BHL in ArcGIS.
- Buffer each line using the buffer distance (this creates a hot dog shape rather than a circle) and union by field name.
- Merge the horizontal well buffers to the vertical/directional well buffers, unioning by field name.

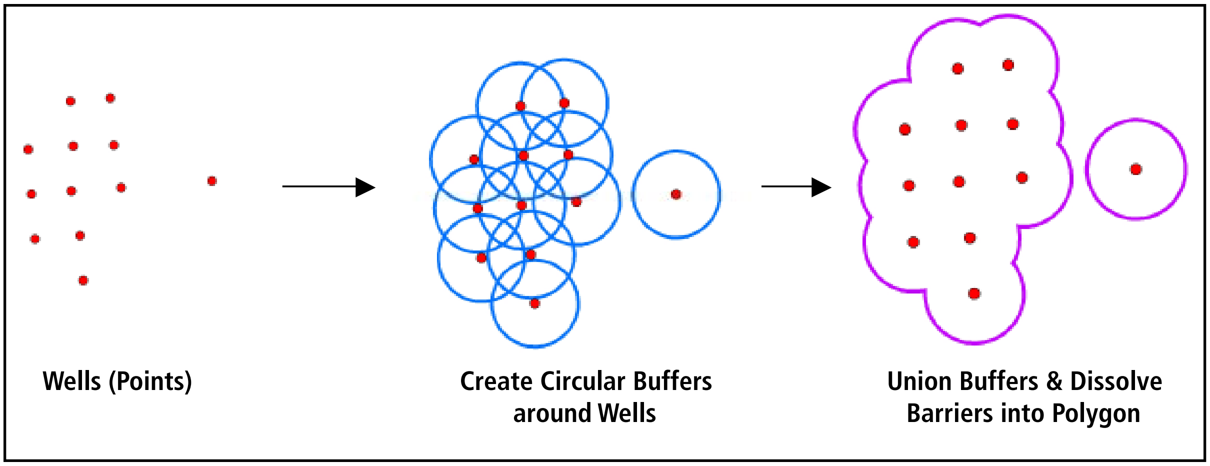

Figure A8-4. Buffering Process

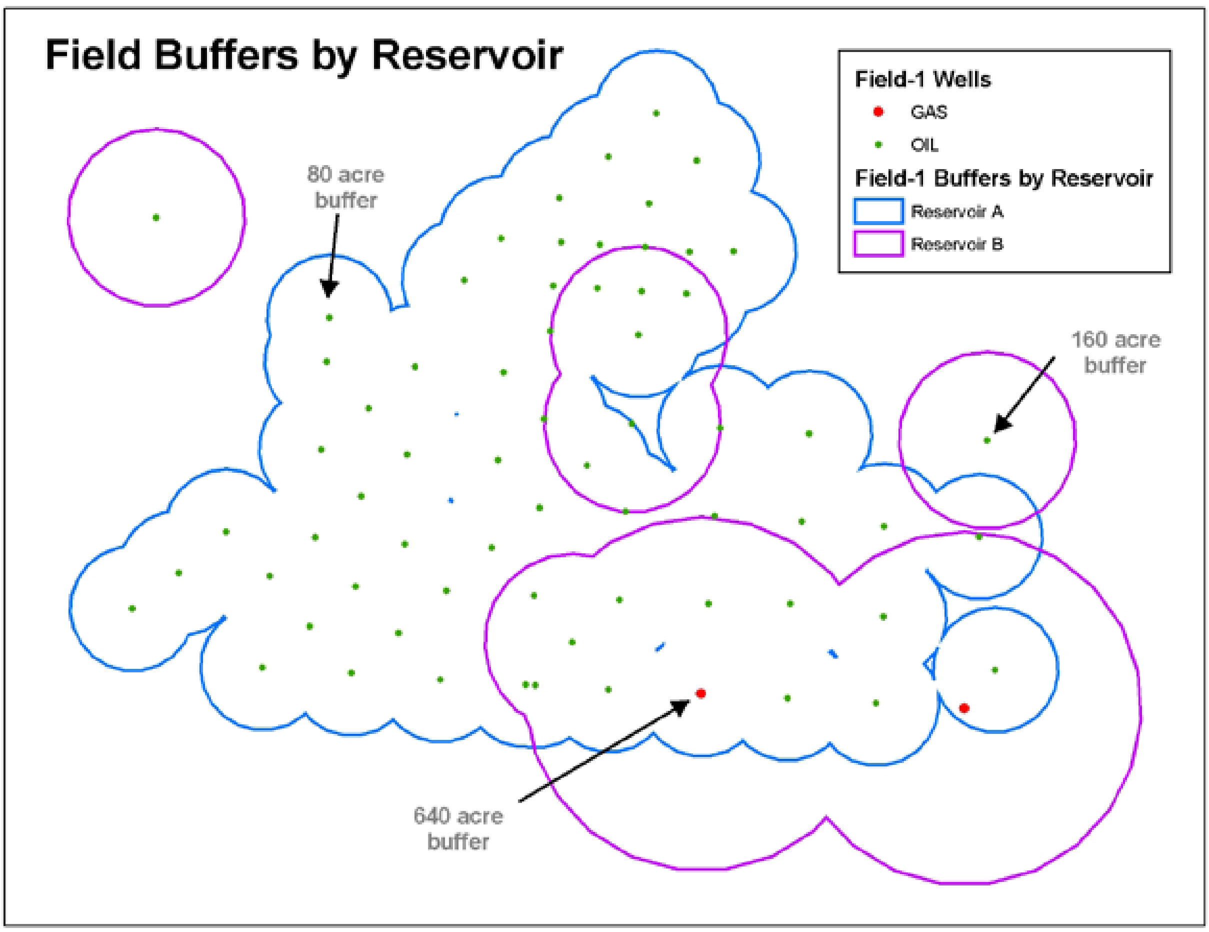

Figure A8-5. Field Buffers by Reservoir

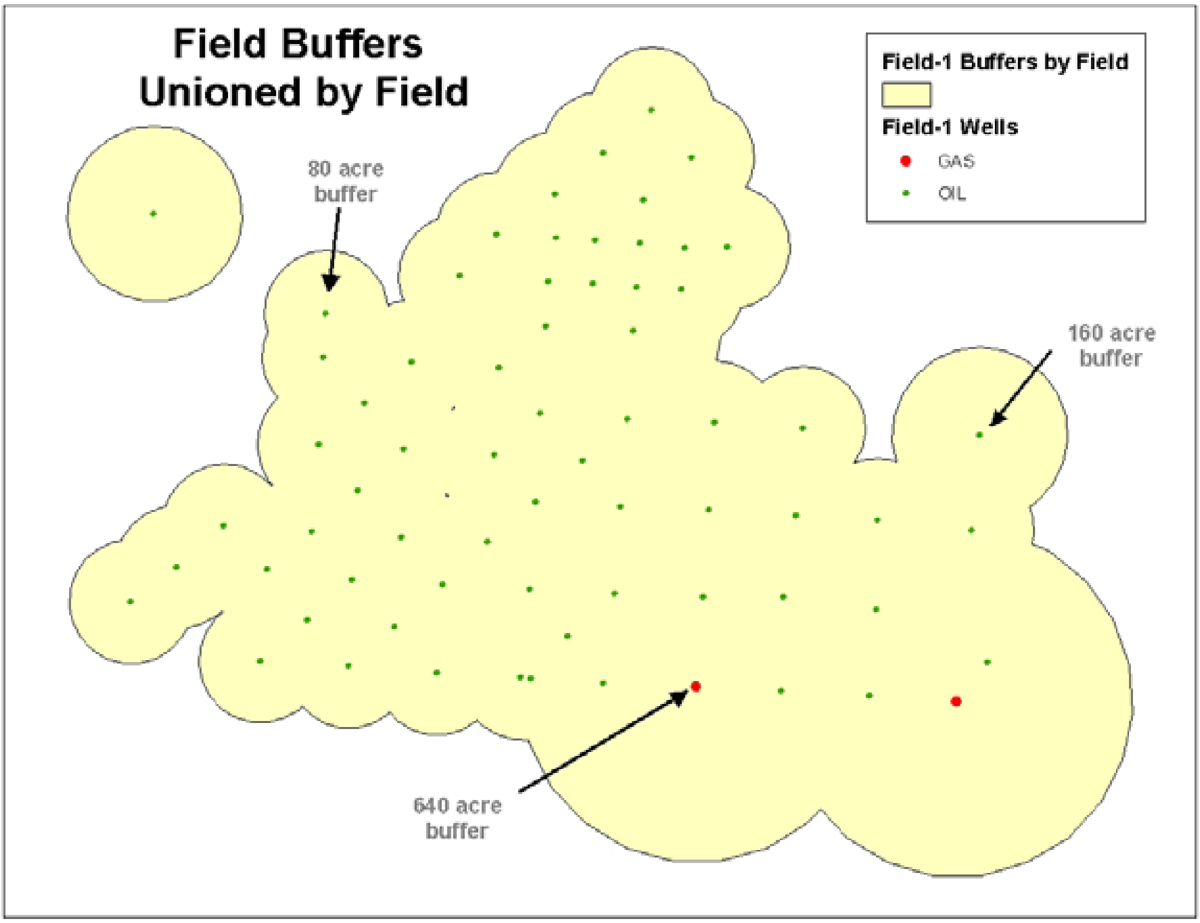

Figure A8-6. Field Buffers by Field

A8.10 Smoothing of the Field Boundaries

An algorithm was developed during the EPCA Phase I study to smooth field boundaries, the logic and processes of which are repeated below.

An artifact of the well buffer approach to field boundary construction is that multi-well field boundaries inevitably have an irregularly scalloped, botryoidal (grape cluster-like) appearance. Field boundaries tend to be much smoother than that in their natural reality. Other artifacts that result from the well buffering approach include small interior non-field "islands" and small separations between multiple polygon "rings" of a single field boundary (see Figure A8-7). It is probable that in most instances (1) the interior islands are legitimately part of the field area and should therefore be included in it, and (2) that the "outlier" polygons of a field should be joined with (i.e., bridged into) the main field boundary when the separation distance is sufficiently small. That is the way a geologist or petroleum engineer would subjectively draw the field boundary by hand based on only the well spud point location and well spacing information available for use in the EPCA studies (i.e., absent subsurface information). For EPCA Phase II the field boundary construction effort was therefore enhanced by development and inclusion of a methodological extension

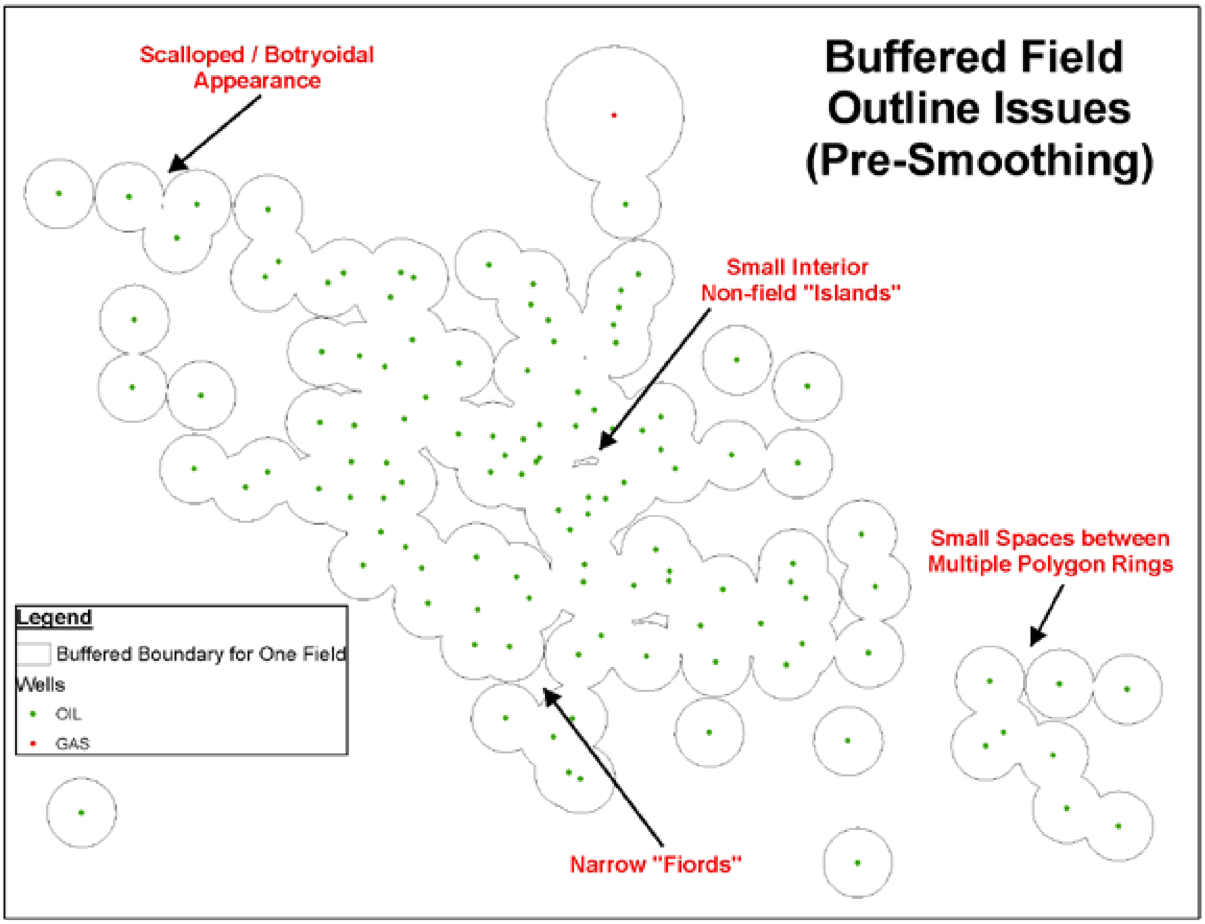

Figure A8-7. Buffered Field Outline Issues

that both automatically and more closely approximates what a geologist or petroleum engineer would draw as the field boundary. To have a consistent set of field boundaries for all of the EPCA phases, this extended methodology was also applied to upgrade the Phase I study area/basin field boundaries.

A Visual Basic application that could be implemented within ArcGIS to smooth the irregular boundaries and fill in the smaller spaces in an automatic, quick, systematic, consistent, and repeatable manner was developed. The guiding principles adhered to in development of the smoothing application were to (1) add field area to the concave indented portions to smooth the scalloped look, (2) not add or subtract area from the convex portions in order to maintain the well buffer spacing, (3) fill in the interior non-field "islands" that are smaller than the buffer size as these are very likely part of the actual field area, (4) join separated polygon "rings" of the same field by a "bridge" if they are sufficiently close together, and (5) minimize the concomitant increase in the field's area. A number of alternative smoothing techniques were considered, tested, and rejected before the implemented technique was selected. These included:

- Raster Filters: Buffered field boundaries were converted from vector (point-line-polygon) format to raster (pixel) format. A variety of neighborhood statistical operators (filters) were applied to the raster and then converted back to vector format. This approach was not satisfactory because it always added field area to the convex portions of boundaries.

- Generalize and Smooth methods: These two vector-based methods are built into the ArcGIS software. The Generalize method was not chosen because it consistently subtracts area from the convex portions of field boundaries. The Smooth method results in inconsistent addition and subtraction of field area in the convex and concave portions of a field boundary, also not acceptable.
- Maximum angle technique: This technique first filled in and merged all interior non-field islands smaller in area than the maximum field buffer size. It then stepped along each vertex in a polygon and moved the vertex out until the angle formed by that vertex and the two vertices on either side of it was less than a maximum specified angle. Because moving one vertex out affects the angles of adjacent vertices, it required many iterations to get all angles to be less than the maximum allowed angle. Also, narrow fiord-like indentations in the field boundaries were particularly problematic with this technique and needed to be manually addressed prior to automated movement of the vertices. The increased complexity, human resource needs, longer processing time, and inconsistent handling of problems made this technique undesirable.

A technique based on tangent trapezoids was ultimately selected for field boundary smoothing because it focuses on how close wells in a field should be in order for their associated buffers to be unioned and is also simpler than the other tested techniques. It's begins by comparing the distance between each pair of wells within a field boundary to the average of the two wells' calculated buffer sizes. Three cases for the tangent trapezoid technique based on that relative distance are summarized in Figure A8-8. If the inter-well distance is less than or equal to two times the average buffer size, the buffers are either tangent (just touching) or overlapping (Figure A8-8a). When that is the case a trapezoid is constructed through both wells that extends to the full diameter of the buffers and is then unioned to the boundary polygon for that field. If the inter-well distance is between 2 to 2.5 times the average buffer size a trapezoid of one-half the buffer diameter is constructed and unioned to the boundary polygon for that field (Figure A8-8b). This thinner union of the well buffers reflects a higher uncertainty that the field is hydraulically connected in the subsurface within the space between the wells. If the inter-well distance is greater than 2.5 times the average buffer size no trapezoid is drawn and the field outline remains segmented (Figure A8-8c).

In addition to filling in the concave boundary areas, the tangent trapezoid technique aptly handles the matter of interior non-field "islands," fiord-like indentations in the field boundary, and spaces between multiple polygon "rings" belonging to the same field. Figure A8-9 shows an example of a field boundary before and after smoothing via the tangent trapezoid technique. The ratio of smoothed boundary area to unsmoothed boundary area was calculated in each instance to ensure that field area additions were sufficiently minimized. The mean increase in field area from unsmoothed to smoothed boundaries was 4.2 percent for all basins combined. Less than 1 percent of all fields examined

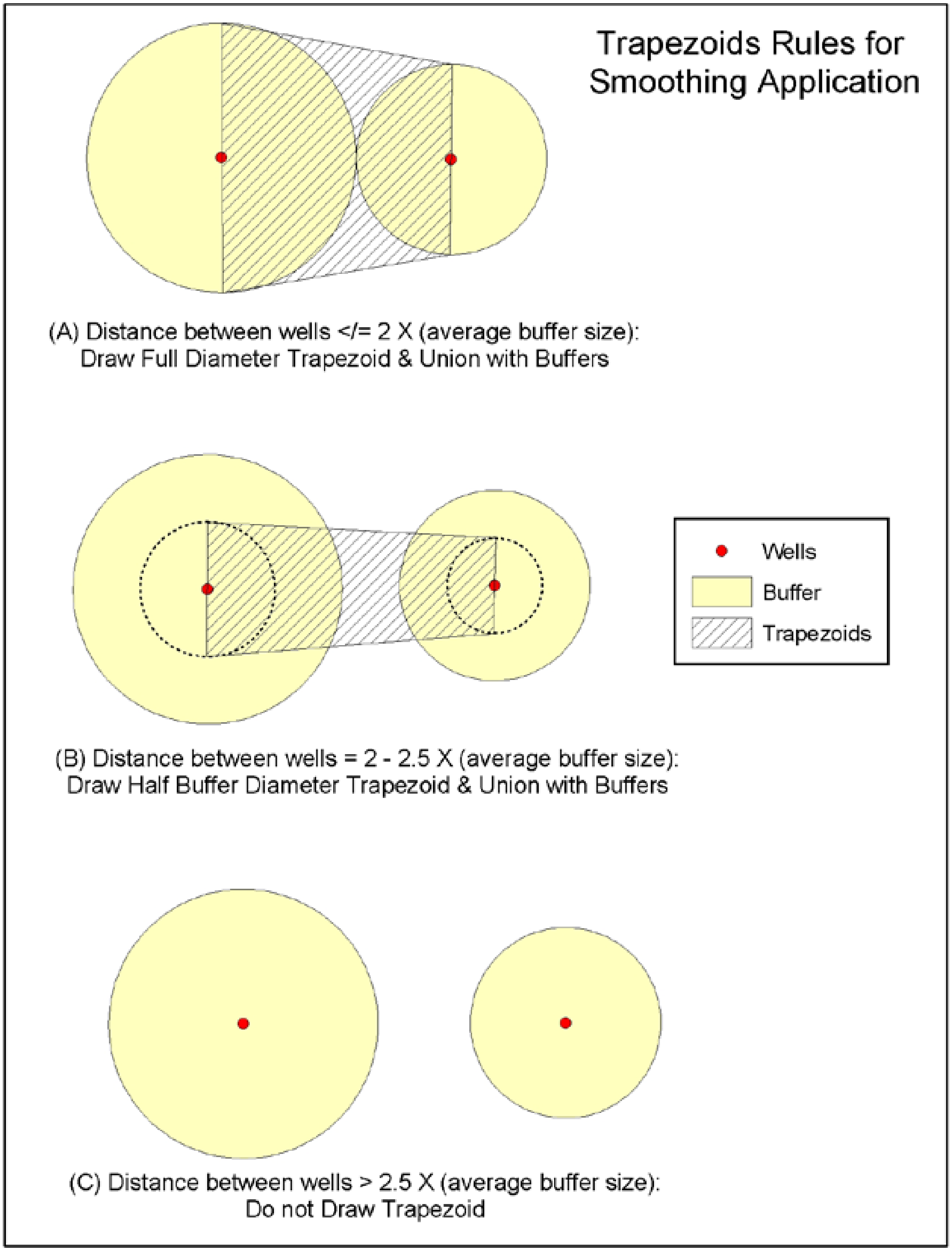

Figure A8-8. Tangent Trapezoid Smoothing Rules

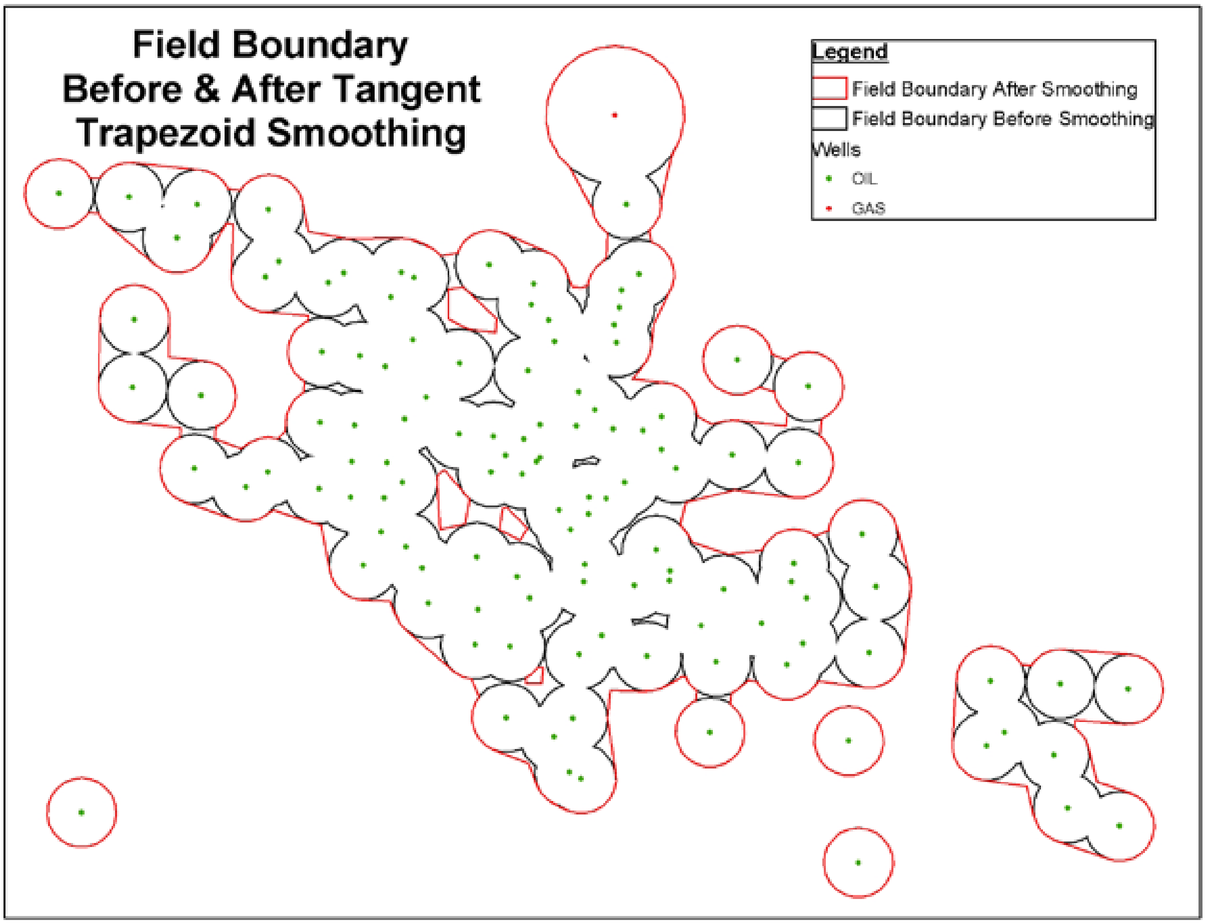

Figure A8-9. Field Boundary Before and after Smoothing with Tangent Trapezoid Technique

in EPCA Phase II exceeded an 8 percent change, and only 0.02 percent of all fields had a 10 to 14 percent change.

Field boundary polygons that crossed study area/basin boundaries were exported as a separate file, and were then clipped to the study area/basin boundary polygon files. For each of these fields the ratio of field area after clipping (area inside basin) to total field area (area inside + area outside basin) was calculated as the attribute INBAS_FRC (in-basin fraction). The value of this attribute is 1 for fields located entirely inside a study area/basin and ranges from greater than zero to less than 1 for those fields that cross a study area/basin boundary. Because the EPCA study only covers onshore areas, it was also necessary to clip (remove) the offshore portions of fields located in the Cook Inlet (Southern AK), the Arctic Ocean (Northern AK), and the Pacific Ocean (Ventura Basin). It was necessary to clip these fields before calculating the Federal land fraction because the BLM-provided Federal land coverages do not always extend far enough outside the study area/basin boundaries to permit its calculation for the entire unclipped field boundaries. Exceptions to this technique were if the field had only one well, or if the clipped portion extended outside of the USA into Canada (from MT or ND, Williston Basin). In these cases the outlines were clipped, but the in-basin fraction was assumed to be equal to one. The attribute INBAS_FRC is later multiplied by the field reserves to derive field reserves located inside the study area/basin boundary.

A8.11 Calculation of the Federal Lands Fraction Within a Field's Boundary

The Federal land ownership coverages provided by the BLM, DOI (one coverage per basin) were intersected with the field boundary outlines to ascertain the Federal ownership aspect of each field's area. For the purposes of this study, split estate lands where either the surface rights or the mineral rights are owned by a Federal government agency are considered to be "Federal lands". An automated procedure (developed for EPCA Phase I) was used to calculate the fraction of Federal land within each oil and gas field polygon. The procedure intersected the Federal land coverages with the field polygons and then populated a column in the field boundary polygon table "PctFedLand."

A8.12 Review and Quality Control of the Resulting Maps

Maps were printed at an appropriate scale for each study area/basin to facilitate quality checking of the constructed field boundaries both before and after the smoothing algorithm was applied. These maps displayed the wells in the field and the field boundary polygons. They also showed selected field attributes such as state, county, basin, and percent Federal land. Figure A8-10 provides an example of a quality control map.

A8.13 Field-Level Proved Reserves Estimation

The conditioned state/vendor well history and production data were summed to the field/operator level and then merged with the field proved reserves estimates reported on Form EIA-23 by the largest operators. Fields were classified into four types for the purpose of reserves estimation:

- Fields with no 2004 production data or reserves estimate data.
- Fields that were completely reported by both USPS and the EIA survey, with 2004 production and all operators in the fields being surveyed by EIA. The proved reserves estimates submitted by the operators for these fields were used as reported.
- Fields that were partially reported and partially imputed. These fields are represented in both the USPS and EIA survey data by 2004 production volumes, but only part of the total field reserves estimate was reported to EIA because some operators in the field were not required to report proved reserves on Form EIA-23. The remainder of the field's proved reserves was therefore imputed by RPD by assigning the weighted average reserves-to-production ratio of the reporting operators to the non-reporting operators and multiplying it by the non-reporting operators' reported production volumes as taken from state/vendor data.
- Fields that were completely estimated based on state/vendor 2004 production

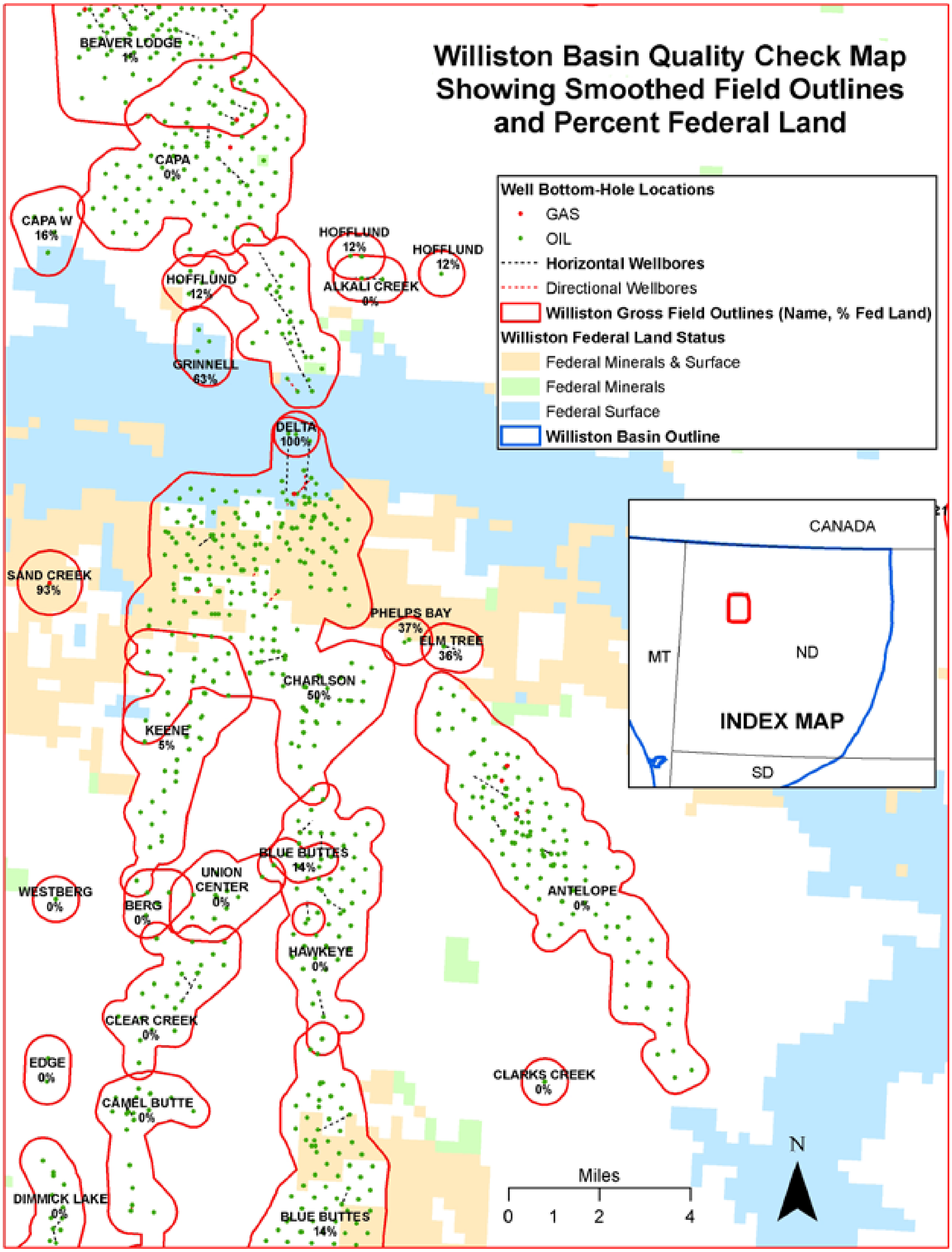

Figure A8-10. Williston Basin Quality Check Map Showing Smoothed Field Outlines and Percent Federal Land data because the operators of these fields were not required to submit a Form EIA-23. Although these fields constitute a sizeable fraction of the total number of fields in the study areas/ basins, their aggregate proved reserves represent only a small portion of total proved reserves. The proved reserves and corresponding production data reported on the 2004 Form EIA-23 were used to develop predictive least squares regression equations quantitatively descriptive of their relationship. These equations were then used to estimate proved reserves for this class of fields based on the state/vendor production data available for them. The estimation equations were developed using SAS statistical software, one each for oil, associated-dissolved gas, non-associated gas, and condensate, for each basin, state (including fields both in-basin and outside-basin) and the United States as a whole. The form of the equation is:

$$\log_e(\textit{Proved Reserves}) = a + b\,\log_e(\textit{Production})$$

Table A8-6 lists the resulting regression parameters. For any field where reserves were imputed, the basin-level parameters were used if available, followed in their absence by state-level parameters if available, followed in the absence of both by US-level parameters. Where no parameter is listed in the table there was not sufficient data available for that basin or state to validly estimate the parameter.

The resultant crude oil proved reserves estimates were then summed with the proved condensate reserves estimates to yield the proved liquid reserves estimates. Similarly, the proved associated-dissolved gas reserves estimates and the proved non-associated gas

Table A8-6. Regression Equation Parameters for the Estimation of Non-Reported Reserves for EPCA Phase III

		Regression Parameters							
		Crude Oil		Associated-Dissolved Gas		Non-Associated Gas		Condensate	
		a	b	a	b	a	b	a	b
Basin	EASTERN GREAT BASIN								
Equations	NORTH ALASKA BASIN								
	SOUTH ALASKA BASIN								
	VENTURA BASIN								
	WILLISTON BASIN	1.58	1.11	1.68	1.05	1.35	1.10		
State	AK	1.21	1.08	1.35	1.12	3.42	0.76		
Equations	CA	1.67	1.09	1.92	1.02	1.41	0.96		
	MT	1.58	1.14	1.54	1.15	2.29	0.96		
	ND	1.66	1.07	1.74	1.01	.	.		
	NV	1.72	1.09	2.05	0.97	1.56	1.07		
	SD	1.66	1.07	1.74	1.01	.	.		
	UT	1.72	1.09	2.05	0.97	1.56	1.07		
Country Equation	USA	1.68	1.01	1.74	0.96	2.10	0.91	1.54	0.84

reserves estimates were summed to yield the total proved gas reserves estimates. Lastly, a gas-to-oil ratio of 6000 cubic feet per barrel was used to convert the total proved gas reserves to their oil equivalent, which was then summed with the proved liquid reserves estimates to yield the proved barrel of oil equivalent reserves estimates.

For each of the four reserve types Table A8-7 summarizes by study area/basin the number of fields, the basin field count, the barrel of oil equivalent production, and the barrel of oil equivalent proved reserves. The percentage of each reserve type in the study area/basin is also shown.

A8.14 Calculation of Federal Reserves

The Federal reserves for each field were estimated by multiplying the fraction of Federal land for each field (derived by GIS analysis as described above) by the proved reserves estimates for each product. This procedure assumes that the distribution of proved reserves per unit area within a field boundary is uniform. While that is never precisely the case, this procedure is sufficiently precise for a regional study such as this one.

A8.15 Reserves Classification

In order to sufficiently protect the proprietary proved reserves data submitted to EIA, each field was then assigned to a gross reserves size class and a Federal reserves size class, by product, per the following classification scheme:

Class Number	Proved Liquid Reserves
0	Zero reserves (i.e., no recorded 2004 production)
1	Greater than zero but less than 10 Mbbls liquid

Table A8-7. Field Count, BOE Production & BOE Reserves for Four Reserve Types in Each Study Area/Basin of EPCA Phase III

Study Area/ Basin Name	Reserve Type	Field Count	% Basin Fld Cnt	BOE Prod	% Basin BOE Prod	BOE Res	% Basin BOE Res
EASTERN GREAT BASIN	No 2004 Production/Reserves	16	55.17	-	0.00	-	0.00
EASTERN GREAT BASIN	Completely Estimated	13	44.83	464	100.00	3,764	100.00
NORTH ALASKA BASIN	No 2004 Production/Reserves	4	17.39	-	0.00	-	0.00
NORTH ALASKA BASIN	Completely Reported	19	82.61	336,711	100.00	5,089,638	100.00
SOUTH ALASKA BASIN	No 2004 Production/Reserves	10	37.04	-	0.00	-	0.00
SOUTH ALASKA BASIN	Completely Reported	17	62.96	22,711	100.00	225,148	100.00
VENTURA BASIN	No 2004 Production/Reserves	33	38.37	-	0.00	-	0.00
VENTURA BASIN	Completely Estimated	14	16.28	223	1.44	1,544	0.60
VENTURA BASIN	Completely Reported	22	25.58	9,353	60.38	165,217	64.10
VENTURA BASIN	Partialy Reported/Imputed	17	19.77	5,916	38.19	90,982	35.30
WILLISTON BASIN	No 2004 Production/Reserves	403	42.15	-	0.00	-	0.00
WILLISTON BASIN	Completely Estimated	228	23.85	4,280	6.15	30,777	3.38
WILLISTON BASIN	Completely Reported	162	16.95	21,233	30.50	298,873	32.80
WILLISTON BASIN	Partialy Reported/Imputed	163	17.05	44,143	63.40	581,494	63.82

2	Greater than 10 but less than 100 Mbbls liquid
3	Greater than 100 but less than 1000 Mbbls liquid
4	Greater than 1000 but less than 10,000 Mbbls liquid
5	Greater than 10,000 Mbbls liquid

Class Number	**Proved Gas Reserves**
0	Zero reserves (i.e., no recorded 2004 production)
1	Greater than zero but less than 10 MMCF gas
4	Greater than 10 but less than 100 MMCF gas
5	Greater than 100 but less than 1000 MMCF gas
4	Greater than 1000 but less than 10,000 MMCF gas
5	Greater than 10,000 but less than 100,000 MMCF gas
6	Greater than 100,000 MMCF gas

Class Number	**Proved Barrel-of-Oil Equivalent Reserves**
0	Zero reserves (i.e., no recorded 2004 production)
1	Greater than zero but less than 10 MBOE
2	Greater than 10 but less than 100 MBOE
3	Greater than 100 but less than 1000 MBOE
4	Greater than 1000 but less than 10,000 MBOE
5	Greater than 10,000 but less than 10,000 MBOE
6	Greater than 10,000 MBOE

Note: M=1,000; MM=1,000,000; bbls=barrel; CF=cubic feet

A8.16 Merging Of Proved Reserves Classes With Field Boundaries And Fraction Of Federal Land

A table with the gross reserves classes by field (range 0 to 6) and the field name was merged with the gross field boundaries to produce a gross field boundary shapefile with reserve classes. A Federal field boundary GIS file was produced that contains the intersection of the Federal land coverages with the gross field boundaries. Owing to the existence of multiple Federal land parcels within each field boundary, the resultant boundary polygons were then dissolved on the attribute field to union the data into one polygon record per field. A table with the Federal reserves classes by field (range 0 to 6) and the field name was then joined to the shapefile associated with the Federal field boundary shapefile. The latter was then converted to coverage format and thence to interchange file format (.e00).

For all basins there was good correspondence between the production file and the map file with Federal land percentages.

A8.17 Summary of Results

GIS is clearly the information conveyance method of choice where both analysis of Federal lands policy and regulations and their application are concerned. The primary proved reserves result is therefore a GIS layer containing field boundary polygons attributed with field name and a proved reserves size class for each field product. Unfortunately, none of this very detailed information can be usefully conveyed on a piece of paper this size. You have to use a GIS workstation to view it and a wide-format printer to print it at a size where the detail can be distinguished. Therefore, in lieu of a close look at the reserves results, basin-by-basin summary statistics are provided in Table A8-8.

Table A8-8. Summary of 2004 Federal Lands Proved Reserves by Study Area for EPCA Phase III

Study Area	Number of Fields	Total Oil Reserves (MMbbl)	Federal Land Oil Reserves (MMbbl)	Federal Portion of Total Oil Reserves	Total Gas Reserves (Bcf)	Federal Land Gas Reserves (Bcf)	Federal Portion of Total Gas Reserves
Northern Alaska*	23	4,034.0	3.3	0.1%	6,334.1	4.8	0.1%
Central Alaska	0	0.0	0.0	0.0%	0.0	0.0	0.0%
Southern Alaska*	27	2.7	0.2	8.0%	1,334.7	47.8	3.6%
Eastern Oregon/Washington	0	0.0	0.0	0.0%	0.0	0.0	0.0%
Ventura Basin*	86	215.5	12.1	5.6%	253.5	19.2	7.6%
Eastern Great Basin*	29	3.8	3.7	99.5%	0.0	0.0	94.7%
Uinta-Piceance Basin	180	254.3	142.9	56.2%	7,181.7	3,794.1	52.8%
Paradox Basin	171	119.4	36.3	30.4%	14,156.0	7,497.4	53.0%
San Juan Basin	79	54.8	16.7	30.4%	6,497.7	3,441.3	53.0%
Montana Thrust Belt	0	0.0	0.0	-	0.0	0.0	-
Williston Basin*	955	769.0	172.9	22.5%	840.6	173.0	20.6%
Powder River Basin	543	193.5	109.0	56.3%	2,398.6	935.8	39.0%
Wyoming Thrust Belt	28	34.6	13.8	39.8%	1,141.3	474.5	41.6%
Southwestern Wyoming	281	177.4	122.4	69.0%	12,703.0	10,063.5	79.2%
Denver Basin	1,638	148.3	2.5	1.7%	2,736.7	30.4	1.1%
Florida Peninsula	21	20.4	0.0	0.0%	0.0	0.0	0.0%
Black Warrior Basin	235	0.6	0.0	0.4%	1,248.3	17.7	1.4%
Appalachian Basin	3,354	79.1	0.2	0.2%	9,550.2	28.0	0.3%
Total	7,650	6,107	636	10.4%	66,376	26,528	40.0%

* *Reserves calculated for Phase III*

Appendix 9
GIS Methodology

Following are further descriptions of how Federal lands were assigned into the nine categories referred to in Table 2-8 and a detailed description of the GIS methodology used.

Based upon guidance from BLM and FS offices, Table A9-1 shows the NLA/LUP jurisdictions within the Inventory area.

Table A9-2 shows how agency jurisdictions were used to categorize lands for this Inventory.

While GIS files were available to define most of the access categories, for the NLA/LUP category, they had to be created. To accomplish this, an administrative boundary (such as a National Forest) was extracted

Table A9-1. Jurisdictions Classified as NLA/LUP

Jurisdiction	Comments
Anchorage, AK, BLM Field Office	
Ashley NF	Northern unit only
Battle Mountain, NV, BLM Field Office	Shoshone-Eureka and Caliente areas only
Bitterroot NF	
Bridger-Teton NF	Areas east of of Highway 189
Corps of Engineers	Black Warrior Basin
Custer NF	
Deerlodge NF	
Department of Defense	Selected areas in the Denver Basin
Dixie NF	
Ely, NV, BLM Field Office	Schell and Caliente areas only
Fairbanks BLM Field Office	Northeast and Southern NPRA only
Finger Lakes NF	
Fish Lake NF	
Flathead NF	
Gallatin NF	
Helena NF	
Kootenai NF	
Lewistown, MT, BLM Field Office	Western portion only
Lolo NF	
Milwaukee BLM Field Office	All Federal subsurface interests
San Juan NF	
Santa Fe NF	
Sawtooth NF	
Ten Thousand Islands FWS	
Uinta NF	Unmapped western portions only
Wasatch-Cache NF	Western portion only
White River, CO, BLM Field Office	Roan Plateau area only

Table A9-2. Federal Land Categorization

Federal Land Management		Categorization	Level
Bureau of Land Management	BLM	Subject to stipulations	
Bureau of Reclamation	BOR	Subject to stipulations	
Department of Agriculture*	USDA	No Leasing (Administrative), general category (NLA)*	2
Department of Defense**	DOD	No Leasing (Administrative), general category (NLA)**	2
Federal Split Estate	SPLIT	Subject to stipulations	
Fish and Wildlife Service	FWS	No Leasing (Administrative), general category (NLA)	2
USDA Forest Service	FS	Subject to stipulations	
Miscellaneous Federal Land Managers (DOE, DOJ, DHS, etc.)		On Advisement from Office	
National Park Service	NPS	No Leasing (Statutory/Executive Order), (NLS)	1
Federal Land Use Designations			
Inventoried Roadless Areas	IRA	Subject to stipulations	
National Conservation Areas	NCA	No Leasing (Statutory/Executive Order), (NLS)	1
National Monuments	NM	No Leasing (Statutory/Executive Order), (NLS)	1
National Recreation Areas	NRA	No Leasing (Statutory/Executive Order), (NLS)	1
National Wildlife Refuges	NWR	No Leasing (Statutory/Executive Order), (NLS)	1
Special Designated Areas	SDA	No Leasing (Statutory/Executive Order), (NLS)	1
Wilderness Areas	WILD	No Leasing (Statutory/Executive Order), (NLS)	1
Wilderness Reinventory Areas	WRA	Subject to stipulations	
Incorporated Towns and Cities	ITC	No Leasing (Statutory/Executive Order), (NLS)	1
Wilderness Study Areas	WSA	No Leasing (Statutory/Executive Order), (NLS)	1

* *Ft. Keo Agricultural Experimental Station, MT, only*

** *Except for the Naval Petroleum Reserve, Casper Field Office, which is subject to stipulations*

from the surface ownership data and the resultant polygon was then attributed as NLA/LUP as appropriate. For example in Figure A9-1, the Wasatch-Cache National Forest boundary in the Wyoming Thrust Belt is shown in green. The grey represents the area within the forest that is undergoing land use planning, which is categorized as NLA/LUP in the Inventory.

A9.1 Stipulation Exceptions

Exceptions (also including waivers and modifications) to stipulations are sometimes granted. For example, a crucial elk winter range timing limitation exception may be granted if seasonal conditions (e.g., an early spring and snowmelt) are such that the elk have moved out of and are not using the general areas during a particular year. Because proper records of exceptions to lease stipulations are not available to address this issue specifically, BLM and FS field personnel were asked to determine, based on their experience, which lease stipulations were granted exceptions for drilling and how often. The field personnel were asked to surmise the long-term (measured in decades that energy development would take place) relative to the hypothetical situation where

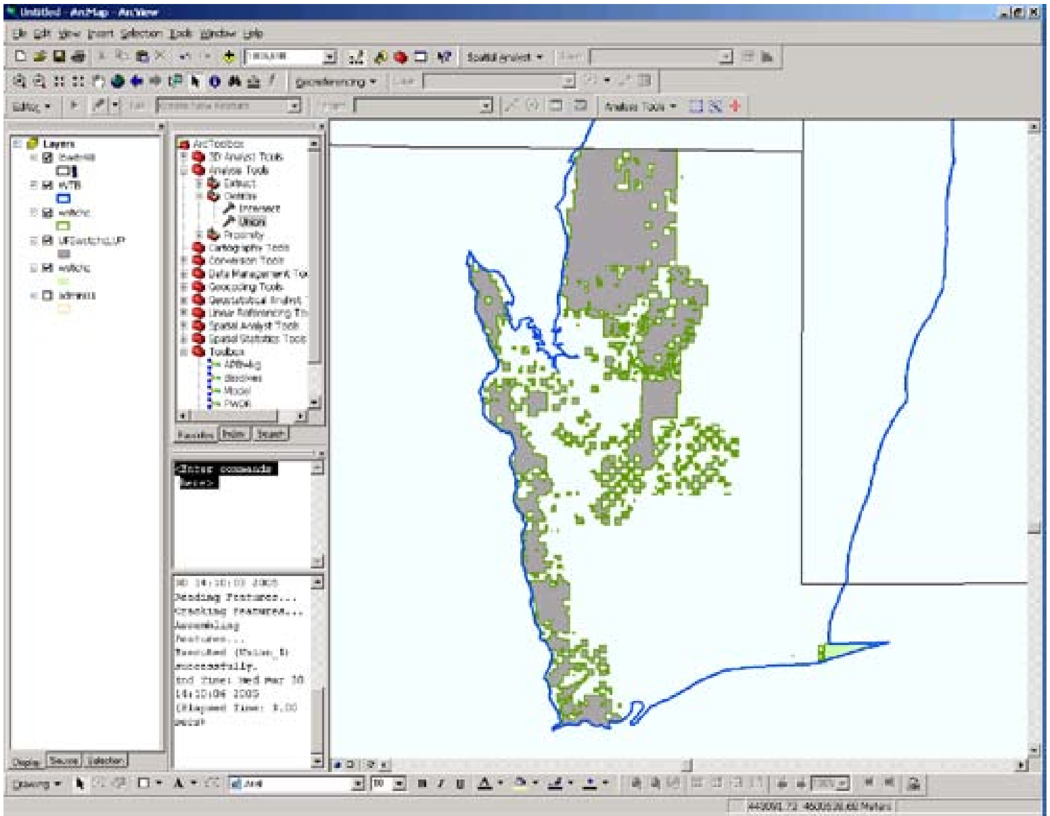

Figure A9-1. Creation of NLA/LUP Polygons

virtually all drilling permit requests in the affected habitat asked for exceptions. The personnel then provided an estimate of the portion of request for which exceptions would be granted. The exception factors thus determined are shown by jurisdiction in Table A9-3.

Lease stipulations, particularly timing limitations, can overlap. Where exception factors overlap, the cumulative effect is calculated by multiplying the overlapping factors (from Table A9-3). This calculation implicitly assumes that exceptions for multiple stipulations would likely not be obtained for a given area. For example, cumulative effects of excepted stipulations for the Wyoming Thrust Belt study area are determined as shown in Table A9-4. The application of these exception factors is described below in Section A9.3.

A9.2 Treatment of NSO Areas

Directional drilling (or "extended reach drilling") is technology that can be employed to reach subsurface targets not located directly underneath the drilling rig. In this Inventory resources beyond a certain EDZ are assumed to not be technically recoverable (Figure A9-2). While it is true that directional drilling horizontally out to distances of 5 or 6 miles is possible in production settings such as Alaska, this type of drilling is not the general case in the lower 48 and is impracticable for exploration.

Directional drilling for exploratory purposes occurs in some areas but is much more limited in scope. As in the case of stipulation exceptions, BLM and FS field personnel were interviewed to determine the

Table A9-3. Stipulation Exception Factors by FS and BLM Office

Jurisdiction	Study Area	Exception Factors								
		Big Game Winter Range	Indiana Bat	Steep slopes	Raptors	Scenic Landscapes	Designated Non-motor Sites	Calving and Fawning	Visual Resources Management	Designated Historic Sites
Allegheny NF	APB		10%							
Arapaho Roosevelt NF	DEN				10%					
Big Cypress NP	FLP									
Black Hills NF	DEN					60%	40%			25%
Bridger-Teton NF	WTB	10%		10%				10%		
Buffalo, WY, BLM Field Office	PDR				25%					
Caribou-Targhee NF	WTB	10%								
Carson NF	SJB	10%								
Casper, WY, BLM Field Office	PDR, DEN	25%			25%					
Chugach NF	SAK									
Dakota Prairie Grasslands	WIL									
Ely, NV, BLM Field Office	EGB									
Fillmore, UT, BLM Field Office	EGB	60%			75%					
Glenwood Springs, CO, BLM Field Office	UPB									
Glenwood Springs, CO, BLM Field Office	SWW	20%			30%					
Grand Junction, CO, BLM Field Office	UPB, PDX	70%		15%						
Idaho Falls, ID, BLM Field Office	WTB	10%								
Kemmerer, WY, BLM Field Office	WTB	10%			10%					
Kemmerer, WY, BLM Field Office	SWW	20%			30%					
Lakeview, OR, BLM Field Office	EOW	10%					20%			
Lander, WY, BLM Field Office	SWW	20%			30%					
Little Snake, CO, BLM Field Office	SWW	20%			30%					
Los Padres, NF	VEN			30%					40%	
Malta, MT, BLM Field Office	WIL	10%								
Manti La Sal NF	UPB, PDX, EGB			50%				80%		
Medicine Bow-Routt NF Thunder Basin NG	SWW, PDR, UPB, DEN	20%			30%					
Miles City, MT, BLM Field Office	PDR	50%			50%					
Miles City, MT, BLM Field Office	WIL	5%								
Milwaukee, WI, BLM Field Office	APB		10%							
Missoula, MT, BLM Field Office	MTB	20%		15%	20%					
Moab, UT, BLM Field Office	UPB, PDX	70%								
Monongahela NF	APB		10%							
Nebraska NF	DEN									
North Dakota, BLM Field Office	WIL									
Pinedale, WY, BLM Field Office	SWW	20%			30%					
Pocatello, ID, BLM Field Office	EGB	20%								
Pocatello, ID, BLM Field Office	WTB	20%								
Rawlins, WY, BLM Field Office	SWW, DEN	20%			30%					
Rock Springs, WY, BLM Field Office	SWW	20%			30%					
Royal Gorge, CO, BLM Field Office	DEN			15%					20%	
San Juan, CO, BLM Field Office	PDX, SJB	50%			50%					
St. George, UT, BLM Field Office	EGB	10%			75%					
Uncompahgre, CO, BLM Field Office	UPB	10%			10%					
Uncompahgre, CO, BLM Field Office	PDX	50%			50%					
White River, CO, BLM Field Office	UPB	80%			25%					
White River NF	UPB, SWW							50%		

	Exception Factors																
	Spotted owl, Lynx (T&E)	Sharp-tailed Grouse and Sage Grouse Display Grounds	Sage Grouse	Birds	Recreation Sites	Riparian/flood Areas	Sedimentation (roads)	Bald Eagle Winter Roost	City of Rifle Watershed	Sensitive Resources	Antelope Fawning	Soils, Watershed	Marshes	Inventoried Roadless Areas	Bighorn Sheep	Golden Eagle	Mangrove Forests
				10%													
													5%				5%
			25%														
							10%										
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		5%													5%	5%	
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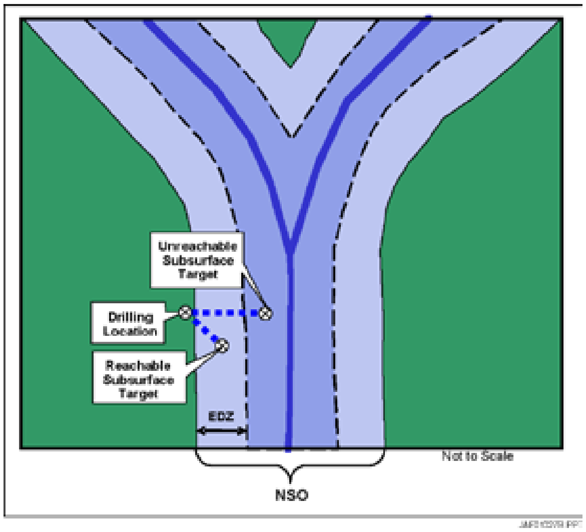

Figure A9-2. Extended Drilling Zone Conceptual Diagram

Table A9-4. Exception Factors Example for Overlapping Stipulations (WTB Study Area)

Stipulation	Exception Factor (EF)
Big Game	10%
Sage Grouse	10%
Raptors	10%
Big Game and Sage Grouse	1%
Big Game/Raptors	1%
Sage Grouse/Raptors	1%
Big Game, Sage Grouse and Raptors	0.10%

practicable width of the EDZ. The width of the EDZ is partially a function of the depth to the drilling objective—generally the deeper the objective, the larger the EDZ. The EDZ distances supplied by the offices and used in this Inventory are shown in Table A9-5.

The effect of the inclusion of the EDZs in the analysis is to remove an area of land from the perimeters of NSO polygons. The width of this area removed via GIS processing is determined by Federal jurisdiction (Table A9-5) as determined by each field office. The area removed then defaults to the resource access category that would otherwise apply in the absence of the NSO stipulation. The net effect is that the underlying resource is no longer considered inaccessible even though the surface above it cannot be occupied by drilling equipment.

Table A9-5. Extended Drilling Zones by Jurisdiction

Jurisdiction	Study Area	EDZ (miles)
Alabama NF	BWB	0.25
Albuquerque, NM, BLM Field Office	SJB	0.25
Allegheny NF	APB	0.13
Anchorage, AK, BLM Field Office	SAK	0.00
Angeles NF	VEN	0.50
Arapaho Roosevelt NF	DEN	0.25
Arizona Strip, AZ, BLM Field Office	EGB	0.25
Ashley NF	UPB, SWW	0.25
Bakersfield, CA, BLM Field Office	VEN	0.50
Battle Mountain, NV, BLM Field Office	EGB	0.25
Beaverhead-Deerlodge NF	MTB	0.50
Big Cypress NP	FLP	0.25
Bighorn NF	PDR	0.00
Billings, MT, BLM Field Office	PDR	0.00
Bitterroot NF	MTB	N/A (NLA/LUP)
Black Hills NF	PDR, DEN	0.25
Bridger-Teton NF	WTB, SWW	0.50
Buffalo, WY, BLM Field Office	PDR	0.25
Burley, ID, BLM Field Office	EGB	0.25
Butte, MT, BLM Field Office	MTB	0.25
Caribou-Targhee NF	WTB	0.50
Caribou NF	EGB, WTB	0.25
Carson NF	SJB	0.25
Casper, WY, BLM Field Office	PDR, DEN	0.25
Cedar City, UT, BLM Field Office	PDX	0.00
Cedar City, UT, BLM Field Office	EGB	0.50
Chugach NF	SAK	0.25
Cibola NF	SJB	0.25
Custer NF	PDR, WIL	N/A (NLA/LUP)
Dakota Prairie NG	WIL	0.00
Daniel Boone NF	APB	0.00
Deschutes NF	EOW	0.25
Dillon, MT, BLM Field Office	MTB	0.25
Dixie NF	EGB, PDX	N/A (NLA/LUP)
Elko, NV, BLM Field Office	EGB	0.25
Ely, NV, BLM Field Office	EGB	0.25
Fairbanks, AK, BLM Field Office–AK NPR-A NE	NAK	3.00
Fairbanks, AK, BLM Field Office–AK NPR-A NW	NAK	1.00
Fairbanks, AK, BLM Field Office–AK NPR-A S	NAK	N/A (NLA/LUP)
Fairbanks, AK, BLM Field Office–AK Utility Corridor	NAK	1.00
Fairbanks, AK, BLM Field Office–ANWR	NAK	N/A (NLA/LUP)
Farmington, NM, BLM Field Office	SJB	0.25
Fillmore, UT, BLM Field Office	EGB	0.25
Fillmore, UT, BLM Field Office	UPB	0.00
Finger Lakes NF	APB	0.25
Fishlake NF	EGB, UPB, PDX	N/A (NLA/LUP)
Flathead NF	MTB	N/A (NLA/LUP)
Gallatin NF	MTB	N/A (NLA/LUP)
George Washinton NF	APB	0.25
Glenallen, AK, BLM Field Office	SAK	0.00
Glenwood Springs, CO, BLM Field Office	UPB, SWW	0.25
Grand Junction, CO, BLM Field Office	UPB, PDX	0.25
Grand Mesa Uncompahgre/ Gunnison NF	UPB	0.25
Grand Mesa Uncompahgre/ Gunnison NF	PDX	0.00
Gunnison, CO, BLM Field Office	UPB	0.25
Helena NF	MTB	0.25
Humboldt NF	EGB	0.25
Idaho Falls, ID, BLM Field Office	WTB, EGB	0.50
Jackson, MS, BLM Field Office	FLP, BWB, APB	0.50
Jefferson NF	APB	0.25
Kanab, UT, BLM Field Office	PDX	0.00
Kemmerer, WY, BLM Field Office	WTB	0.50
Kemmerer, WY, BLM Field Office	SWW	0.25
Kootenai NF	MTB	N/A (NLA/LUP)
Lakeview, OR, BLM Field Office	EOW	0.25
Lander, WY, BLM Field Office	SWW	0.25
Las Vegas, NF, BLM Field Office	EGB	0.50
Lewis and Clark NF	MTB, eastern portions	0.25
Lewistown, MT, BLM Field Office	MTB	0.25
Little Snake, CO, BLM Field Office	UPB, SWW	0.25
Lolo NF	MTB	N/A (NLA/LUP)
Los Padres NF	VEN	0.50
Malta, MT, BLM Field Office	WIL	0.50
Manti La Sal NF	UPB, EGB	0.50
Manti La Sal NF	PDX	0.25
Medicine Bow-Routt NF Thunder Basin NG	SWW, PDR, UPB, DEN	0.25
Miles City, MT, BLM Field Office	PDR	0.25
Miles City, MT, BLM Field Office	WIL	0.00

Table A9-5. Extended Drilling Zones by Jurisdiction (concluded)

Jurisdiction	Study Area	EDZ (miles)
Milwaukee, WI, BLM Field Office	APB	N/A (NLA/LUP)
Mississippi NF	BWB	0.13
Missoula, MT, BLM Field Office	MTB	0.50
Moab, UT, BLM Field Office	UPB, PDX	0.25
Monongahela NF	APB	0.25
Monticello, UT, BLM Field Office	PDX	0.25
Nebraska, Oglala, Buffalo Gap NF	PDR	0.13
Nebraska, Oglala, Buffalo Gap NF	DEN	0.00
Newcastle, WY, BLM Field Office	PDR	0.00
Newcastle, WY, BLM Field Office	DEN	0.25
North Dakota, BLM Field Office	WIL	0.00
Northern, AK, BLM Field Office	YKF, NAK	1.00
Ochoco NF	EOW	0.25
Palm Springs/South Coast, CA BLM Field Office	VEN	0.50
Las Vegas, NF, BLM Field Office	EGB	0.50
Lewis and Clark NF	MTB, eastern portions	0.25
Lewistown, MT, BLM Field Office	MTB	0.25
Little Snake, CO, BLM Field Office	UPB, SWW	0.25
Lolo NF	MTB	N/A (NLA/LUP)
Los Padres NF	VEN	0.50
Malta, MT, BLM Field Office	WIL	0.50
Manti La Sal NF	UPB, EGB	0.50
Manti La Sal NF	PDX	0.25
Medicine Bow-Routt NF Thunder Basin NG	SWW, PDR, UPB, DEN	0.25
Miles City, MT, BLM Field Office	PDR	0.25
Miles City, MT, BLM Field Office	WIL	0.00
Milwaukee, WI, BLM Field Office	APB	N/A (NLA/LUP)
Mississippi NF	BWB	0.13
Missoula, MT, BLM Field Office	MTB	0.50
Moab, UT, BLM Field Office	UPB, PDX	0.25
Monongahela NF	APB	0.25
Monticello, UT, BLM Field Office	PDX	0.25
Nebraska, Oglala, Buffalo Gap NF	PDR	0.13
Nebraska, Oglala, Buffalo Gap NF	DEN	0.00
Newcastle, WY, BLM Field Office	PDR	0.00
Newcastle, WY, BLM Field Office	DEN	0.25
North Dakota, BLM Field Office	WIL	0.00
Northern, AK, BLM Field Office	YKF, NAK	1.00
Ochoco NF	EOW	0.25
Palm Springs/South Coast, CA BLM Field Office	VEN	0.50
Pike-San Isabel NF	DEN	0.25
Pinedale, WY, BLM Field Office	SWW	0.25
Pinedale, WY, BLM Field Office	WTB	N/A (NLA/LUP)
Pocatello, ID, BLM Field Office	WTB	0.50
Pocatello, ID, BLM Field Office	EGB	0.25
Price, UT, BLM Field Office	UPB	0.25
Price, UT, BLM Field Office	PDX	0.00
Prineville, OR, BLM Field Office	EOW	0.25
Rawlins, WY, BLM Field Office	SWW, DEN	0.25
Richfield, UT, BLM Field Office	UPB, EGB	0.25
Richfield, UT, BLM Field Office	PDX	0.00
Ridgecrest, CA, BLM Field Office	VEN	N/A (NLA/LUP)
Rock Springs, WY, BLM Field Office	SWW	0.25
Royal Gorge, CO, BLM Field Office	DEN	0.25
Salt Lake, UT, BLM Field Office	UPB, EGB	0.25
Salt Lake, UT, BLM Field Office	WTB	0.00
San Juan, CO, BLM Field Office	SJB	0.00
San Juan, CO, BLM Field Office	PDX	0.50
San Juan NF	PDX, SJB	N/A (NLA/LUP)
Santa Fe NF	SJB	0.25
Sawtooth NF	EGB	0.25
South Dakota BLM Field Office	PDR, DEN, WIL	0.25
Spokane, WA, BLM Field Office	EOW	0.50
St. George, UT, BLM Field Office	PDX, EGB	0.00
Taos, NM, BLM Field Office	SJB	0.00
Tennessee Valley Authority	BWB	0.50
Tennessee Valley Authority	APB	0.00
Tongass NF	SAK	0.25
Uinta NF	UPB, EGB	0.25
Umatilla NF	EOW	0.13
Uncompahgre, CO, BLM Field Office	UPB	0.25
Uncompahgre, CO, BLM Field Office	PDX	0.50
Vale, OR, BLM Field Office	EOW	0.25
Vernal, UT, BLM Field Office	UPB	0.00
Wasatch-Cache NF	WTB, EGB, SWW	0.50
Wayne NF	APB	0.13
White River, CO, BLM Field Office	UPB, SWW	0.25
White River NF	UPB, SWW	0.25

Figure A9-3 shows an actual example from the Wyoming Thrust Belt. Areas shown in light blue represent a 1/2-mile extended drilling zone removed from the NSO areas for the resource categorization. Areas shown in blue represent the resource Net NSO. The black area depicts an area of no leasing; as such the EDZ was not applied to these lands as a rig cannot be sited in no-lease areas.

A9.3 Analytical Modeling of Federal Lands and Resources

The analytical goal of the Inventory is to calculate the area of Federal lands (including non-Federal lands overlying federally owned oil and gas estate [split estate]) in each access category in the hierarchy and the volume of oil and gas resources underlying the Federal lands in each access category, while at the same time accounting for stipulation exceptions and the accessibility of the EDZ.

One of the primary objectives for the development of the categorization is to achieve geographic independence for a given parcel of land subject to overlapping stipulations (hence, the use of the categorization hierarchy where that parcel of land would be subject to only one category).

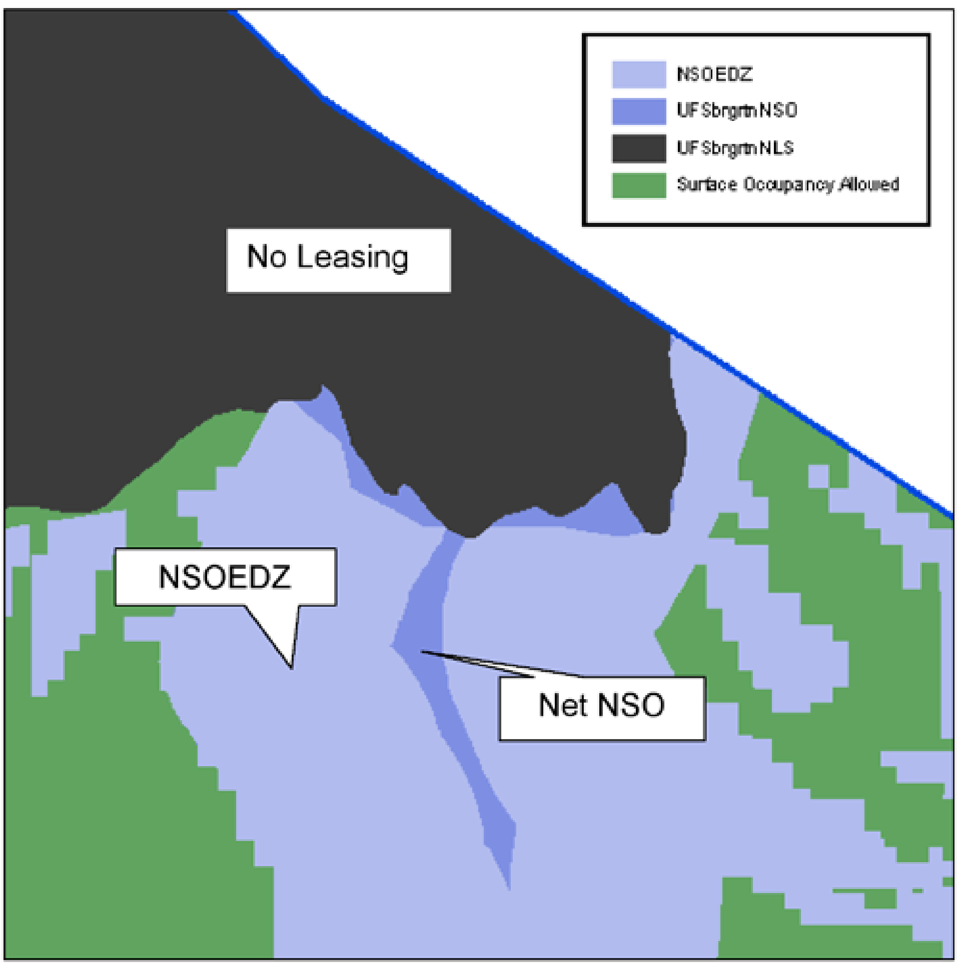

Figure A9-3. Removal of the Extended Drilling Zone from NSO Areas

The following discussion illustrates the application of the land access categorization for an area of multiple stipulations from the Kemmerer, WY, BLM FO in the Wyoming Thrust Belt, where sage grouse leks and nesting habitat and big game winter range define an access category. These types of stipulations are among the most common found in the study areas.

Figure A9-4 shows a selected point where the stipulations overlap and the resultant categorization is "Timing Limitation Stipulations >6 to ≤9". A query at that point brings up a dialog box which lists the stipulations in effect. Table A9-6 contains the corresponding stipulation data extracted from a corresponding master stipulations list.

Figure A9-5 shows the land categorization as determined by the stipulations listed in the relevant land use plan. Note that the core nesting habitat of the sage grouse (shown in blue), is designated a "no surface occupancy" area. The remaining area is under various timing limitations (colored in shades of red), controlled surface use (gold) or standard lease terms (green).

Note that in the Inventory, with regard to NSO areas, lands and resources are treated differently due to the application of EDZs. Figure A9-6 shows the effect where the EDZ is applied to NSO areas to determine the resource categorization. Note that the application of the EDZ in this example renders the resources under the sage grouse nest area accessible. While the acreage

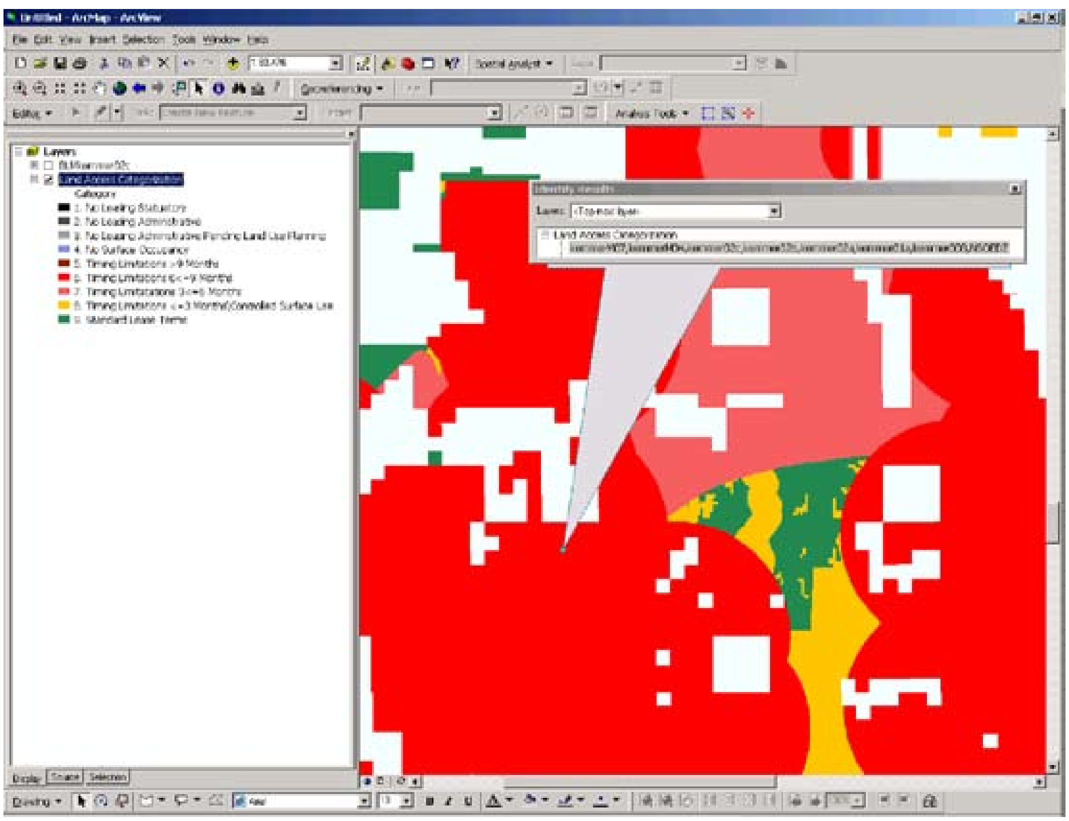

Figure A9-4. Display of Overlapping Timing Limitations (WTB Study Area)

Table A9-6. Sample Master Stipulations List for a Selected Area

Agency	STIPID	Description	LUP Source	Category	TLS months	Exception Factor	EDZ (mi)	Study Area	
								WTB	GGRB
BLM	kemmer003	Green River formation paleontologic survey	p. 11	CSU				X	X
BLM	kemmer007	Slopes >25%	p. 55	CSU				X	X
BLM	kemmer011	Big game winter range	p. 55	TLS	_AB0123	10%		X	X
BLM	kemmer013	Sage and sharp-tailed grouse nesting habitat	p. 55	TLS	123456	10%		X	X
BLM	kemmer015	Wildlife habit protection ~~grouse~~ leks and other important habitat	p. 55	NSO			WTB - 0.5, GGRB - 0.25	X	X
BLM	kemmer030	Sage and sharp-tailed grouse strutting grounds	WY SO	CSU				X	X
BLM	kemmer032	Big game winter range	WY SO	CSU				X	X

Figure A9-5. Display of Federal Land Access Categorization (WTB Study Area) figures for each access category faithfully reflect the management prescriptions contained in the land use plans, the oil and gas volumes are calculated using this adjustment. The net result is that more oil and gas resources are accessible than would be assumed if NSO stipulations were taken at face value.

In addition, to account for stipulation exceptions, the GIS model determined the effects due to the presence or absence of the stipulations by selectively removing excepted stipulations in the computer. This is illustrated by Figure A9-7, which shows an example for the Wyoming Thrust Belt where the sage grouse nesting habitat stipulation has been removed. Note that in the case of an excepted stipulation, the analysis defaults to the underlying stipulation or standard lease terms, as appropriate.

For example, if sage grouse nesting stipulations are excepted 10 percent of the time (as shown on Table A9-6), then, for an area represented by the sage grouse polygon (where sage grouse stipulations do not overlap other excepted stipulations), 90 percent of the resources is categorized according to the stipulation and 10 percent is categorized according to the underlying stipulation category next in the hierarchy. This calculation is performed accordingly

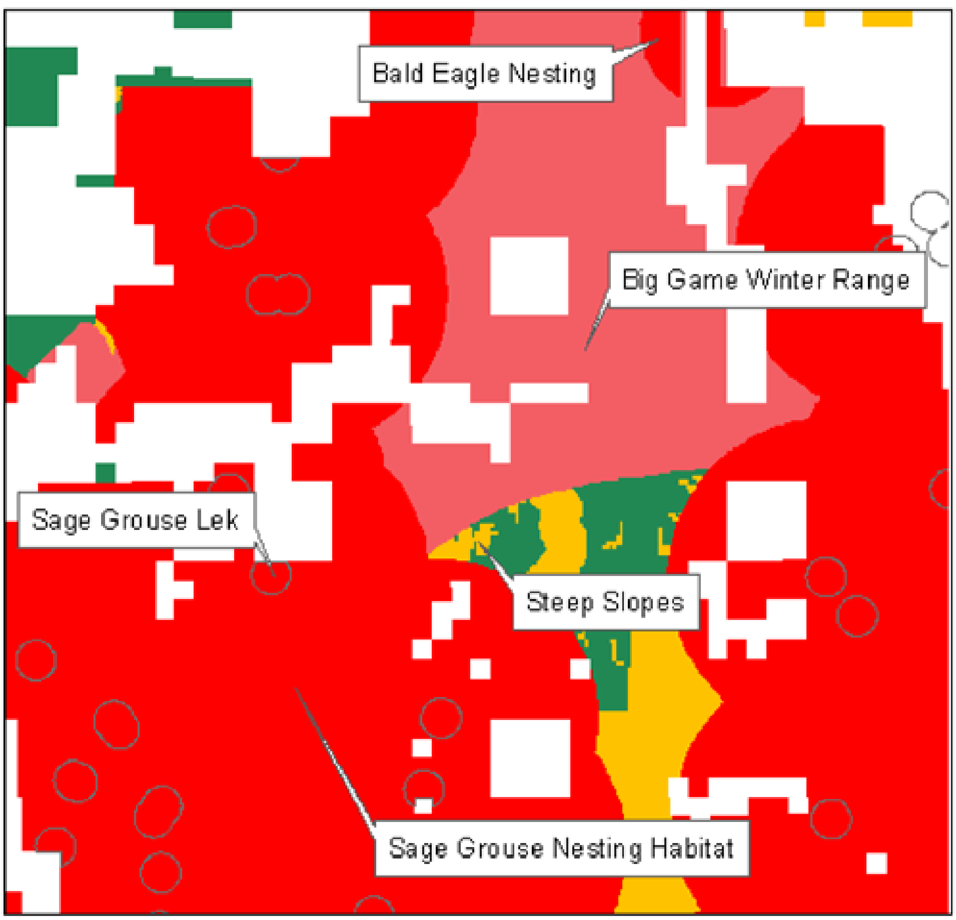

Figure A9-6. Display of Resource Access Categorization with Extended Drilling Zone Applied (WTB Study Area)

Figure A9-7. Display of Federal Land Access Categorization with Extended Drilling Zone Applied and with Sage Grouse Nesting Habitat Stipulation Excepted (WTB Study Area)

for all of the exception factors within a given office jurisdiction (see Table A9-3) or where combinations of these exceptions exist (see Table A9-4).

Access categorization of the Federal lands and resources was determined in aggregate based upon discrete examination of individual GIS polygons using the following equation:

$$FLorRs = \sum((1-EF) * FLorRs_{(EDZ)} + (EF * FLorRs_{(EDZ\ w/\ Excepted)}))$$

Where FlorRs = Federal Lands or Resources
EF = Exception Factor (e.g., see Table A9-4)
$FLorRs_{(EDZ)}$ = FLorRs determined using the Extended Drilling Zone
$FLorRs_{(EDZ\ w/\ Excepted)}$ = FLorRs determined using the EDZ plus removal of stipulations for which exceptions are granted

This equation accounts for the occurrence of the extended drilling zone and stipulation exceptions. For excepted stipulations the model defaults to the underlying stipulation category in the hierarchy.

This process results in the generation of numerous individual GIS polygons for each study area. These data are then summed and reported by access category and Federal management agency. For oil and gas resources, categorization is provided by specific resource type (presented on spreadsheets on the accompanying DVD).

A9.4 Quality Control of Modeling Results

A rigorous quality control (QC) check was instituted for the Phase III model. During processing a typical study area will generate more than one million discrete GIS polygons, each with unique characteristics in terms of land status, oil and gas resources, stipulations and exception factors. Complex study areas generate two to three million polygons each. As such, imprecision in GIS mapping data that are insignificant for individual polygons can be amplified in the aggregate. Such imprecision is a direct function of the quality of the data received from the various sources contributing to the Inventory.

For all study areas, the quality of the model output is high. For QC purposes, input oil and gas resource volumes and land areas were compared to outputs. A comparison of the study areas inputs and outputs revealed percentage differences ranging from zero to a maximum of 0.62 percent, with the vast majority well below 0.1 percent.

The model's land output data differs by 0.1 percent from the input data on an aggregate basis. For oil and gas resources, model output data differs by 0.1 percent from the input data on an aggregate basis.

A9.5 Extrapolated Areas

The EPCA study areas, which were examined comprehensively, comprise 18 oil and natural gas resource basins. Where additional oil and natural gas resources occur outside the comprehensively studied areas extrapolations were made and were split into three regions, Alaska, Western U.S. and Eastern U.S., using the Mississippi River and the border of Louisiana as the boundary for the continental U.S., for the purpose of reporting the results. Figure A9-8 depicts the extrapolated resource areas relative to the EPCA study areas.

The USGS National Oil and Gas Assessment (NOGA)[1] was used as the base for the undiscovered resources for the extrapolation effort, and excludes areas where the resource was not quantitatively assessed. The oil and natural gas resources in USGS provinces not comprehensively studied during the Inventory were then unioned with the Federal land status layer created by the National Atlas.[2] A list of all the provinces and resources that were included in the extrapolation analysis can be found in Table A9-7.[3] The undiscovered resources with an extrapolation area were distributed to access categories based on the distribution of access categorizations within the comprehensively studied basins for a given land status type.

1 The USGS National Oil and Gas Assessment. http://energy.cr.usgs.gov/oilgas/noga/

2 The National Atlas of the United States. http://www.nationalatlas.gov/

3 Differences in this table compared to Table 2-8 are the result of resources associated with state waters and overlap with comprehensively studied basins.

Table A9-7. Resources Associated with Extrapolated USGS 1995 NOGA and EPCA-Updated Basins

USGS Province Name	Extrapolation Region	Total Oil (MMBbl)	Total Natural Gas (Bcf)	Latest Assessment Update
(1) Northern Alaska	Alaska	33.3	11,333.0	2007
(2) Central Alaska	Alaska	61.2	2,387.4	1995
(1) Northern Alaska	Comprehensively Studied	22,152.5	118,462.8	2006
(13) Ventura Basin	Comprehensively Studied	739.4	1,194.8	1995
(19) Eastern Great Basin	Comprehensively Studied	1,666.8	264.5	1995
(2) Central Alaska - Yukon Flats	Comprehensively Studied	299.3	5,462.6	2004
(20) Uinta-Piceance Basin	Comprehensively Studied	154.3	21,658.3	2002
(21) Paradox Basin	Comprehensively Studied	394.3	1,004.6	1995
(22) San Juan Basin	Comprehensively Studied	271.9	50,808.1	2002
(27) Montana Thrust Belt	Comprehensively Studied	348.5	8,638.0	2002
(3) Southern Alaska	Comprehensively Studied	622.1	1,334.3	1995
(31) Williston Basin	Comprehensively Studied	591.5	1,223.9	1995
(33) Powder River Basin	Comprehensively Studied	1,622.1	18,742.9	2007
(36) Wyoming Thrust Belt	Comprehensively Studied	81.4	574.2	2003
(37) Southwestern Wyoming	Comprehensively Studied	2,724.0	84,930.0	2002
(39) Denver Basin	Comprehensively Studied	154.6	1,885.7	2003
(5) Eastern Oregon-Washington	Comprehensively Studied	9.8	2,429.1	2006
(50) Florida Peninsula	Comprehensively Studied	286.3	1,023.9	2001
(65) Black Warrior Basin	Comprehensively Studied	13.5	8,164.7	2002
(67) Appalachian Basin	Comprehensively Studied	891.3	67,694.1	2002
(48/49) East Texas Basin and LA-MS Salt Basins	East	19.9	410.1	1995
(51) Superior Basin	East	47.5	335.8	1995
(52) Iowa Shelf	East	-	-	1995
(53) Cambridge Arch-Central Kansas Uplift	East	69.4	142.0	1995
(54/59) Salina/Sedgwick Basin	East	33.1	136.3	1995
(55) Nemaha Uplift	East	101.5	324.0	1995
(56) Forest City Basin	East	7.7	470.9	1995
(57) Ozark Uplift	East	-	-	1995
(58) Anadarko Basin	East	505.1	11,111.6	1995
(60) Cherokee Platform	East	77.1	2,077.2	1995
(61) Southern Oklahoma	East	210.9	740.0	1995
(62) Arkoma Basin	East	78.3	4,637.6	1995
(63) Michigan Basin	East	871.9	8,662.2	2004
(64) Illinois Basin	East	36.9	3,812.0	1995
(66) Cincinnati Arch	East	17.2	1,405.5	1995
(68) Blue Ridge Thrust Belt	East	-	23.2	1995
(69) Piedmont	East	-	348.2	1995
(70) Atlantic Coastal Plain	East	-	-	1995
(71) Adirondack Uplift	East	-	-	1995
(72) New England	East	-	-	1995
(10) San Joaquin Basin	West	478.6	1,650.1	2004
(11) Central Coastal	West	357.1	107.4	1995
(12) Santa Maria Basin	West	132.0	74.0	1995
(14) Los Angeles Basin	West	405.3	1,127.2	1995
(15) San Diego Oceanside	West	-	-	1995
(16) Salton Trough	West	-	-	1995
(17) Idaho-Snake River Downwarp	West	0.9	11.2	1995
(18) Western Great Basin	West	0.6	4.4	1995
(23) Albuquerque-Santa Fe Rift	West	46.1	258.8	1995

Table A9-7. Resources Associated with Extrapolated USGS 1995 NOGA and EPCA-Updated Basins (continued)

USGS Province Name	Extrapolation Region	Total Oil (MMBbl)	Total Natural Gas (Bcf)	Latest Assessment Update
(24) Northern Arizona	West	57.0	133.5	1995
(25) Southern Arizona-Southwestern New Mexico	West	38.0	193.3	1995
(26) South-Central New Mexico	West	-	-	1995
(28) North-Central Montana	West	175.7	41,829.3	1995
(29) Southwest Montana Basin	West	24.8	291.4	1995
(30) Hanna Basin	West	109.9	298.0	2005
(32) Sioux Arch	West	-	-	1995
(34) Big Horn Basin	West	397.4	1,013.0	1995
(35) Wind River Basin	West	493.9	2,198.8	2005
(38) Park Basin	West	29.9	549.5	1995
(39) Denver Basin	West	-	984.1	2002
(4) Western Oregon-Washington	West	20.8	1,316.7	1995
(40) Las Animas Arch	West	117.0	525.9	1995
(41) Raton Basin	West	28.1	2,353.0	2004
(42) Pedernal Uplift	West	-	-	1995
(43) Palo Duro Basin	West	6.5	4.1	1995
(44) Permian Basin	West	2,256.7	11,861.3	1995
(45) Bend Arch-Fort Worth Basin	West	1,260.6	26,713.3	2003
(46) Marathon Thrust Belt	West	113.5	191.3	1995
(47) Western Gulf	West	3,878.4	39,933.7	1995
(48/49) East Texas Basin and LA-MS Salt Basins	West	33.8	535.1	1995
(6) Klamath-Sierra Nevada	West	-	-	1995
(7) Northern Coastal	West	21.1	811.9	1995
(8) Sonoma-Livermore Basin	West	3.7	25.8	1995
(9) Sacramento Basin	West	5.9	2,128.4	1995
Hawaii	West	-	-	NA
	Total	45,688.1	580,977.7	

"–" Denotes no assessed resources

An approach to determine reserves growth associated with extrapolated areas, presented below, was developed with Steering Committee guidance. First, proved reserves associated with extrapolated areas needed to be determined. To do so, total proved reserves by state based upon EIA data were obtained[4] and aggregated by extrapolation region. By region, the proved reserve totals for the comprehensively studied EPCA basins (see Appendix 8) were then subtracted from the proved reserves totals for each region to determine the remaining reserves to be associated with the extrapolation areas.

Subsequently, to determine reserves growth associated with each of the extrapolation areas, a weighted ratio of reserves growth to proved reserves[5] based on individual ECPA study area was established. These ratios were then applied to the proved reserves associated with the extrapolation areas outside the EPCA study areas to determine

[4] The Energy Information Administration. http://www.eia.doe.gov/

[5] Performed on a technical basis and thus includes state waters, a feature important in the Alaska extrapolation area.

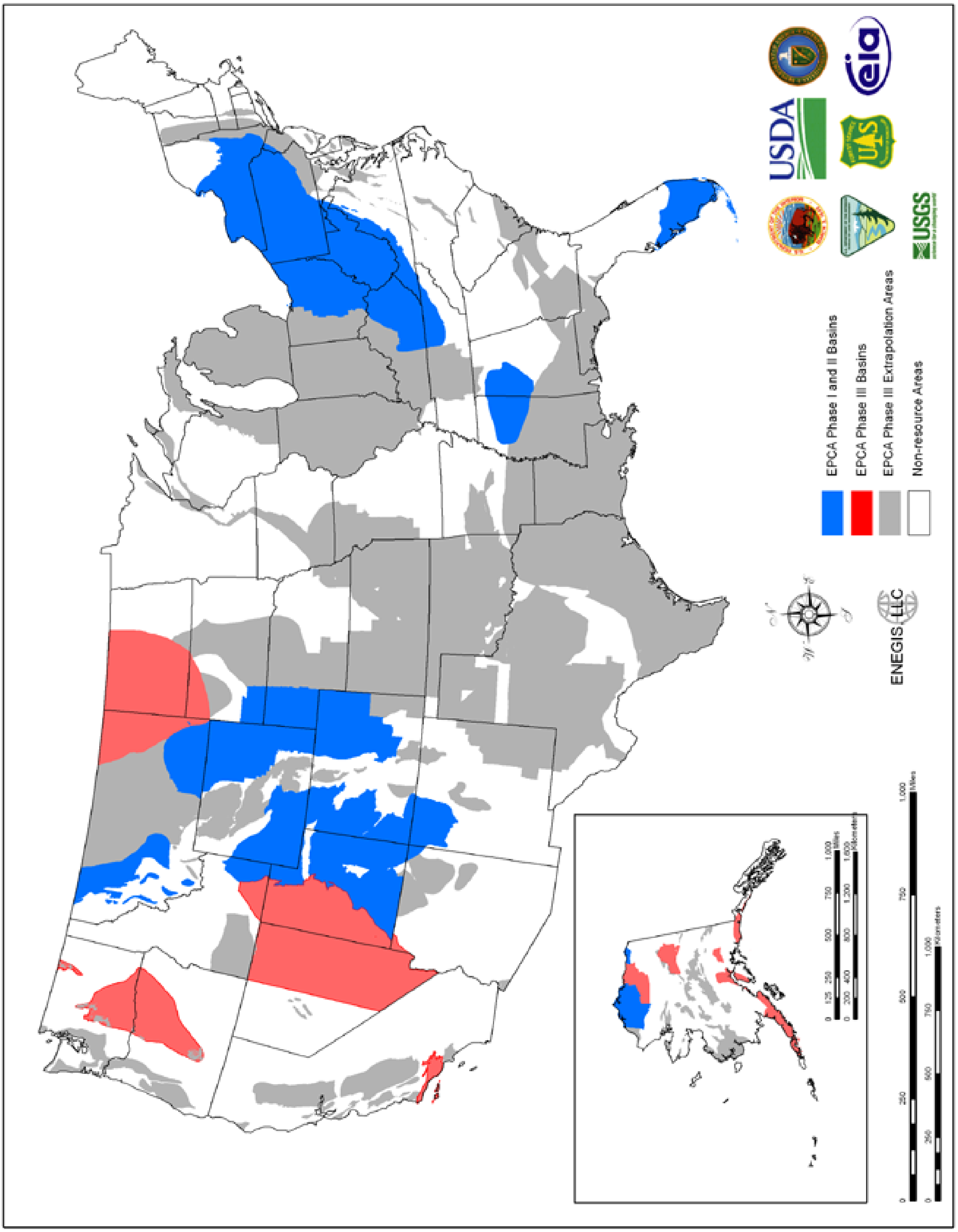

Figure A9-8. Map of EPCA Study Areas and Extrapolated Resource Areas

the reserves growth associated with respective extrapolation areas.

To determine reserves growth associated Federal lands within an extrapolation area, the total reserves growth was multiplied by the portion of Federal resources in the extrapolation area. Subsequently, reserves growth were distributed to access categories relative to the portion of Federal resources within a respective category.

While the above approach is simplistic, given the absence of comprehensive data outside of the EPCA study areas, it does provide an estimate of reserves growth that can be associated with the extrapolation areas. To the extent that reserves growth cannot be associated with proved reserves and resource distribution, it will be in error.

In a similar process, extrapolation of land and oil and gas resources associated with each access categorization was made within each extrapolated area based upon the results for individual Federal land types within correlative EPCA study areas.

Within the EPCA study areas, based on Steering Committee guidance, Federal lands that had less than 5 BCFE of undiscovered resource were also extrapolated using the land and resource access categorization by Federal land type within the study area. A list of the areas and the basins where this occurred can be found in Table A9-8.

Table A9-8. Extrapolated BLM and FS Areas

Unit	EPCA Study Area	Notes
Colville National Forest	EOW	
Elko, NV BLM	EGB	Jarbidge RMP Area only
Fremont National Forest	EOW	
Gifford-Pinchot National Forest	EOW	
Kremmling, CO BLM	SWW	
La Jara, CO BLM	SJB	
Lakeview, OR BLM	EOW	Klamath Falls Resource Area only
Mt. Baker-Snoqualmie National Forest	EOW	
Mt. Hood National Forest	EOW	
Okanogan National Forest	EOW	
Wenatchee National Forest	EOW	
Winema National Forest	EOW	

Appendix 10
Federal Land Use Planning Documents Used For The Phase III Inventory

Federal Land Use Plan Name	LUPCode	LUPYear
Rio Puerco LUP	alburpLUP	1992
Allegheny NF Land and RMP	alghnyLUP	1986
Revised Land Management Plan and Final EIS for Angeles NF	angeleLUP	2000
Arapaho-Roosevelt NFs, Pawnee NG Revision of the Land and RMP	arprsvLUP	1997
Ashley NF Stipulation for Lands of the NF System	ashleyLUP	1992
Arizona Strip DO RMP / EIS	azstazLUP	1992
Bear River EA	bearrvLUP	1994
Beaverhead NF EIS	beaverLUP	1996
Berlin Lake Project DR	berlinLUP	1985
Bighorn NF Revised Land and RMP	bghornLUP	2005
Big Cypress General Management Plan/ Final EIS	bigcypLUP	1991
Big Desert Management Plan	bigdidLUP	1981
Big Dry RAMP - Maintenance Version	bigdryLUP	1996
Billings RMP	billinLUP	2003
Book Cliffs RMP ROD and Rangeland Program Summary	bkclffLUP	1985
Black Hills NF1997 Land and RMP Phase II Amendment	blhillLUP	2005
ROD and Rangeland Program Summary for the Box Elder RMP	boxeutLUP	1986
Bureau of Reclamation Reclamation Manual Directives and Standards LND 06-01	breccoLUP	1999
Bureau of Reclamation Great Plains Region Oil & Gas Lease Stipulations	brecgpLUP	1991
Bureau of Reclamation Reclamation Manual Directives and Standards LND 08-01	brecmpLUP	2002
Bureau of Reclamation Pacific Northwest Region Oil and Gas Lease Stipulations	brecpnLUP	2006
Utah Bureau of Reclamation Land Use Stipulations for Oil & Gas Drill Sites and Access Roads	brecutLUP	1972
Bridger-Teton NF Land and RMP	brgrtnLUP	1990
Brothers/LaPine Resource Management Plan	brolapLUP	1989
Buffalo RMP	buffloLUP	2001
Caliente RMP	calnteLUP	1997
Revised Forest Plan for the Caribou NF	carbouLUP	2003
Carson NF Plan	carsonLUP	1986
Platte River RMP Revised & Updated Decisions	casperLUP	2001
Cassia RMP	cassidLUP	1985
Cedar Beaver Garfield Antimony RMP	cedarbLUP	1986
Revised Land and RMP for Chugach NF	chugnfLUP	2003
Cibola NF Plan	cibolaLUP	1985
Army Corps of Engineers Omaha District Oil and Gas Lease Stipulations	coeomaLUP	1987
Conemaugh River Lake LUP	conemaLUP	1900
Deschutes NF Plan	deshnfLUP	1990
Dillon RMP	dillonLUP	2006

Federal Land Use Plan Name	LUPCode	LUPYear
Diamond Mountain Recreation Area ARMP/ROD	dmdmtnLUP	1994
Daniel Boone NF Revised Land and RMP	dnlbonLUP	2004
Dakota Prairie Grasslands Northern Region Land and RMP FEIS/ROD	dpgrasLUP	2002
Egan RMP Approved OG Leasing Amendment and ROD	egannvLUP	1994
Elko RMP and List of Stipulations	elkonvLUP	1987
Escalante MFP	esclntLUP	1981
Farmington RMP with ROD	farminLUP	2003
Federal Land Use Designations	fedludLUP	2006
Florida RMP/ROD	flridaLUP	1995
Glenwood Springs Resource Area Final Supplemental EIS	glenspLUP	1999
GMUG NFs ROD OG Leasing Final EIS	gmuncgLUP	1993
George Washington NF - Final revised Land and RMP	grgwshLUP	1993
Grand Junction RMP Area and ROD	grjuncLUP	1987
Gunnison Gorge NCA	gungorLUP	2005
Gunnison Resource Area RMP	gunnisLUP	1993
Headwaters RMP/EIS	hdwtrsLUP	1983
Henry Mtn, Parker Mtn, and Mtn Valley MFP	henrutLUP	1982
House Range Resource Area RMP and ROD Rangeland Program Summary	housutLUP	1987
Humbolt & Toiyabe Forest Plan and Amendments – On Office Advisement	humtoiLUP	2003
Leasing Guidance from Jackson BLM – On Office Advisement	jcksonLUP	2004
Jefferson NF - Revised Land and RMP	jffrsnLUP	2004
John Day River Management Plan, Two Rivers, John Day, and Baker Resource Management Plan Amendments	jhndayLUP	2001
ROD and Jack Morrow Hills CAP/Green River RMP Amendment	jmhcapLUP	2006
San Juan / San Miguel RMP Amendment	juanfoLUP	1991
Kemmerer RMP/ROD	kemmerLUP	1986
Lakeview RMP	lakevwLUP	2003
Lander RMP	landerLUP	1987
Lewis and Clark NF, OG Leasing Final EIS	lewclkLUP	1997
Leasing Stipulations, Craig-Little Snake BLM	ltlsnkLUP	1991
Las Vegas RMP and Final EIS	lvegasLUP	1998
Medicine Bow NF Revised Land and RMP	medbowLUP	2003
Garnet RMP	misgarLUP	1986
Monongahela NF Land & RMP	mnghlaLUP	2006
Final EIS for OG Leasing on Lands Administered by the Manti-La Sal NF	mntsalLUP	1992
Grand Resource Area RMP	moabfoLUP	1985
San Juan ROD & Rangeland Program Summary	monticLUP	1991
Monument RMP	monuidLUP	1986
Mosquito Creek Lake DR	moscrkLUP	2000
Nebraska State RMP	nebblmLUP	1992
Nebraska NF Revised Land and RMP	nebskaLUP	2002
Northeast RMP Amendment	nerogoLUP	1991

Federal Land Use Plan Name	LUPCode	LUPYear
Alabama NFs - Revised Land and RMP	nfalabLUP	2004
Mississippi EA report - O&G leasing on the NFs	nfmissLUP	1976
Final Farmington Resource Management Plan Errata	nmbrecLUP	2004
North Dakota RMP	nordakLUP	1988
Newcastle FO, ROD & Approved RMP	nwcstlLUP	2000
NW NPRA Final Integrated Activity Plan/EIS	nwnpraLUP	2003
Ochoco NF, O&G Leasing Analysis Final EIS	ochocoLUP	1993
Revised Land Management Plan and Final EIS for Los Padres NF	padresLUP	2005
Pinedale Anticline OG Exploration and Development Project EIS ROD	panticLUP	2000
Paria MFP	pariapLUP	1981
Pinedale RMP	pindalLUP	2000
Pinyon MFP	pinyutLUP	1983
Pocatello & Medicine Lodge Resource Areas RMP	poctelLUP	1988
ROD for the Pony Express RMP and Rangeland Program Summary for Utah County	ponyutLUP	1990
Powder River RAMP - Maintenance Version (plus 1994 Miles City O&G Amendment)	powderLUP	1985
Price River Resource Area Management Framework Plan	pricebLUP	1982
Prineville - Two Rivers RMP	prinecLUP	1900
Prineville - Upper Deschutes RMP	prinedLUP	1900
Pike & San Isabel NF, Cimarron & Comanche NG, Final O&G Leasing EIS Forest Plan Amendment 23	psniccLUP	1992
Rawlins BLM Lease Stipulations	rawlinLUP	1990
ROD and Green River RMP	rcksprLUP	1997
Routt NF Land and RMP Revision	routnfLUP	1998
Royal Gorge Resource Area ROD and Approved RMP	rylgrgLUP	1996
San Rafael RMP	sanrafLUP	1991
South Coast RMP and ROD	scoastLUP	1994
Seneca Army Depot and Sampson State Park Oil and Gas Lease Stipulations	senacoLUP	1993
St. George FO—ROD and RMP	sntgeoLUP	1999
South Dakota RMP (plus 1994 Miles City O&G amendments)	soudakLUP	1986
Proposed Spokane RMP and Amended Final EIS	spokanLUP	1992
RMP for the Steese National Conservation Area	steeseLUP	1986
Taos Field Office Oil & Gas Leasing Stipulations – On Office Advisement	taosnmLUP	1985
Targhee NF Revised Forest Plan	targheLUP	2000
Thunder Basin Nat. Grassland Land and RMP	thundeLUP	2002
Revised Land and RMP for the Tongass NF	tongasLUP	1997
Tonopah RMP and ROD	tononvLUP	1997
Land and RMP Revision - Uinta NF	uintnfLUP	2003
Umatilla and Malheur NFs, O&G Leasing Final EIS	umatilLUP	1995
Uncompahgre Basin RMP and ROD	uncompLUP	1989
Utility Corridor Proposed RMP and Final EIS (Fairbanks BLM)	utiltyLUP	1989
Valley MFP	valleyLUP	1978
Baker RMP	vbakerLUP	1989
Vermilion MFP	vermilLUP	1981

Federal Land Use Plan Name	LUPCode	LUPYear
Warm Springs Resource Area RMP Rangeland Program Summary	warmutLUP	1987
Wayne NF ROD for the Final EIS Land and RMP	waynefLUP	2006
Wells ROD and List of Stipulations	wellnvLUP	1985
RMP for the White Mountains National Recreation Area	whimntLUP	2004
White River Resource Area RMP and Amendments	wrivblLUP	1997
White River NF, OG Final EIS/ROD	wrivnfLUP	1993
Wasatch-Cache NF, Revised Forest Plan	wstchcLUP	2003
Zion MFP	zionnpLUP	1981