APPENDIX F:

ECOREGIONS OF THE 11 WESTERN STATES AND DISTRIBUTION BY ECOREGION OF WIND ENERGY RESOURCES ON BLM-ADMINISTERED LANDS WITHIN EACH STATE

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F.1 DESCRIPTIONS OF THE ECOREGIONS

Ecoregions delineate areas that have a general similarity in their ecosystems and in the types, qualities, and quantities of their environmental resources. They are based on unique combinations of geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology (EPA 2004). Ecoregions are defined as areas having relative homogeneity in their ecological systems and their components. Factors associated with spatial differences in the quality and quantity of ecosystem components (including soils, vegetation, climate, geology, and physiography) are relatively homogeneous within an ecoregion.

A number of individuals and organizations have characterized North America on the basis of ecoregions (e.g., Omernik 1987; CEC 1997; Bailey 1997). The intent of such ecoregion classifications has been to provide a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. The ecoregion discussions presented in this draft programmatic environmental impact statement (PEIS) follow the Level III ecoregion classification based on Omernik (1987) and refined through collaborations among U.S. Environmental Protection Agency (EPA) regional offices, state resource management agencies, and other federal agencies (EPA 2004). The following sections provide brief descriptions of each of the Level III ecoregions that have been identified for the 11 western states in which potential wind energy development may occur on BLM-administered lands.

F.1.1 Coast Range

The Coast Range ecoregion encompasses approximately 20,600 mi^2 (53,354 km^2) along the coasts of Washington, Oregon, and northern California (Ecoregion 1, Figure F-1). This low mountain area is characterized by highly productive, rain-drenched coniferous forests, originally dominated by Sitka spruce and coastal redwood forests along the coast, with a mosaic of western red cedar, western hemlock, and seral Douglas fir in the inland areas (EPA 2002). The area is widely managed for timber production, being intensively logged and supporting Douglas-fir plantations.

F.1.2 Puget Lowland

The Puget Lowland ecoregion (Ecoregion 2, Figure F-1) occurs wholly within the western portion of the State of Washington. This ecoregion, covering about 6,300 mi^2, is a

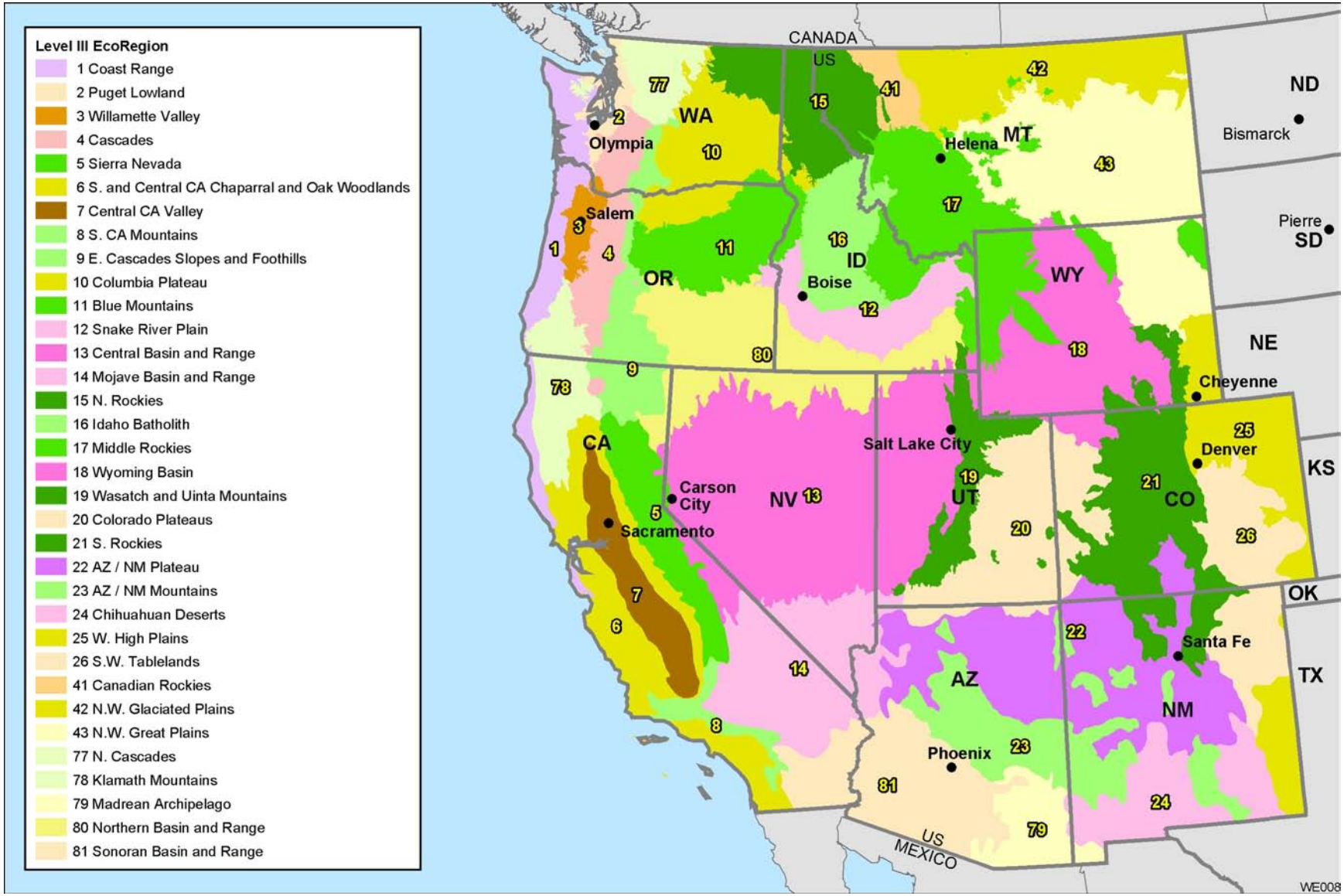

FIGURE F-1 Ecoregions of the 11 Western States (Source: EPA 2002)

broad, rolling lowland along the coastline of Puget Sound and is characterized by a maritime climate (EPA 2002). Originally supporting coniferous forests on the many ground moraines, outwash plains, floodplains, and terraces, this ecoregion now supports a mix of pasture, cropland, forests, and urban centers (Pater et al. undated).

F.1.3 Willamette Valley

The Willamette Valley ecoregion (Ecoregion 3, Figure F-1) occurs almost entirely in Oregon, with a small portion in southwestern Washington, and covers about 5,750 mi^2 (14,893 km^2) This broad, lowland valley is characterized by rolling prairies, deciduous and coniferous forests, and extensive wetlands (EPA 2002). The productive soils and temperate climate of the ecoregion make it an important agricultural region in Oregon. Most of the native plant communities have been replaced by agriculture and rural residential development, with pastureland, vineyards and tree farms, and orchards being common (University of Oregon 1999).

F.1.4 Cascades

The Cascades ecoregion occurs in portions of Washington, Oregon, and northern California (Ecoregion 4, Figure F-1), encompassing about 17,930 mi^2 (46,439 km^2). This mountainous ecoregion is characterized by steep ridges and river valleys in the west and a high plateau in the east, with both active and dormant volcanoes and elevations up to 14,403 ft (4,390 m) (EPA 2002). Its moist, temperate climate supports extensive and highly productive coniferous forests, with subalpine meadows occurring at high elevations.

F.1.5 Sierra Nevada

The Sierra Nevada ecoregion encompasses approximately 20,300 mi^2 (52,577 km^2), almost entirely in east-central California except for about 400 mi^2 (1,036 km^2) in extreme west-central Nevada (Ecoregion 5, Figure F-1). This ecoregion is a deeply dissected block fault, the eastern portion of which has been strongly glaciated but is mountainous (EPA 2002). Vegetation grades from mostly ponderosa pine at lower elevations in the west and lodgepole pine in the east, to fir and spruce at higher elevations. Alpine conditions exist at the highest elevations.

F.1.6 Southern and Central California Chaparral and Oak Woodlands

The Southern and Central California Chaparral and Oak Woodlands ecoregion encompasses about 38,650 mi^2 (100,103 km^2) entirely within California (Ecoregion 6, Figure F-1). The ecoregion exhibits a Mediterranean climate of hot, dry summers and moist, cool winters and supports mainly chaparral and oak woodlands vegetation (EPA 2002). Grasslands occur at lower elevations, and patches of pine occur at higher elevations. Most of the region is open low mountains or foothills, with some irregular plains in the south.

F.1.7 Central California Valley

The Central California Valley ecoregion occurs on about 17,750 mi^2 (45,972 km^2) completely within California (Ecoregion 7, Figure F-1). This ecoregion is a flat, intensively farmed plain that has long, hot, and dry summers and cool winters (EPA 2002). Nearly half the region is cropland, and about three-quarters is irrigated. The region once supported an array of prairies, oak-grass savannahs, desert grasslands, riparian woodlots, and wetlands. However, agricultural development, urban expansion, alteration of hydrologic regimes and channelization, grazing by domestic livestock, fires, and introduced plants and animals affected most of the native plant communities in the region (Olson and Cox 2001).

F.1.8 Southern California Mountains

The Southern California Mountains ecoregion occurs on about 6,900 mi^2 in southwestern California (Ecoregion 8, Figure F-1). This ecoregion has a Mediterranean climate of hot, dry summers and moist, cool winters (EPA 2002), but with slightly cooler temperatures and more moisture than are found in the adjacent Southern and Central California Chaparral and Oak Woodlands ecoregion. The vegetation is dominated by relatively dense chaparral and oak woodlands and also stands of ponderosa pine.

F.1.9 Eastern Cascades Slopes and Foothills

The Eastern Cascades Slopes and Foothills ecoregion is found in portions of California, Oregon, and Washington and occupies about 21,690 mi^2 (56,177 km^2) (Ecoregion 9, Figure F-1). The ecoregion is located in the rain shadow of the Cascade Mountains (EPA 2002) and has vegetation distinguished by forests of ponderosa pine, Douglas fir, and hemlock, with oak savannahs in some areas, and sagebrush and bunchgrass in upland areas (Pater et al. undated).

F.1.10 Columbia Plateau

The Columbia Plateau ecoregion, which covers about 32,100 mi^2 (83,139 km^2), occurs in portions of Idaho, Oregon, and Washington (Ecoregion 10, Figure F-1). The ecoregion is an arid sagebrush steppe and grassland, which formerly supported large expanses of native bluebunch wheatgrass, Idaho fescue, and other grasses. Much of this ecoregion has been converted to agriculture and now supports extensive wheat cultivation, with patches of shrubsteppe grassland (Noss et al., 2001; EPA 2002).

F.1.11 Blue Mountains

The Blue Mountains ecoregion occurs on 27,380 mi^2 (70,914 km^2) in Idaho, Oregon, and Washington (Ecoregion 11, Figure F-1). The native vegetation includes sagebrush steppe and

saltbrush-greasewood as well as deciduous and coniferous forest (McGrath et al. 2002; Idaho Gap Analysis Project 2004), with extensive areas of old-growth coniferous forest (DellaSalla et al. 2001) that include some of the largest stands of western juniper in the world (Oregon Progress Board 2000).

F.1.12 Snake River Plain

The Snake River Plain ecoregion is a xeric intermontane basin and range area covering about 20,700 mi^2 (53,613 km^2) in Idaho and Oregon (Ecoregion 12, Figure F-1). Crop production, cattle feedlots, and dairy operations are common in the area. Except for scattered barren lava fields, the ecoregion was dominated by sagebrush steppe vegetation that is now used for cattle grazing (McGrath et al. 2002).

F.1.13 Central Basin and Range

The Central Basin and Range is the largest ecoregion represented within the 11 western states, occurring on about 119,672 mi^2 (309,950 km^2) in California, Nevada, and Utah (Ecoregion 13, Figure F-1). This is an internally drained ecoregion characterized by a mosaic of xeric basins, scattered mountains, and salt flats (EPA 2002). Native vegetation of the ecoregion includes sagebrush grassland, saltbush-greasewood, and mountain brush, with some woodland (EPA 2002; McGrath et al. 2002). Some portions of this ecoregion are very sparsely vegetated desert, while other areas support saltbrush-greasewood, shadscale, winterfat, sagebrush, and a variety of perennial grasses and herbaceous plants (Woods et al. 2001). Juniper-pinyon woodlots and coniferous forest occur in areas of higher elevation and precipitation.

F.1.14 Mojave Basin and Range

The Mojave Basin and Range ecoregion occupies about 50,000 mi^2 (129,500 km^2) in portions of Arizona, California, Nevada, and Utah (Ecoregion 14, Figure F-1). It has a warm, temperate climate with little precipitation and includes the Mojave Desert (Holland et al. 2001; EPA 2002a). Elevations range from below sea level in Death Valley (−479 ft [−146 m]) to more than 5,249 ft (1,600 m) on some mountains (Holland et al. 2001). The ecoregion is rich in endemic ephemeral plants. Natural vegetation is dominated by mesquite, creosote bush, all-scale, brittlebush, desert holly, and sagebrush at low elevations (Holland et al. 2001); by big sagebrush, blackbrush, Mormon tea, yellowbrush, galleta, Indian ricegrass, cheatgrass, and cholla at elevations of 3,000 to 5,000 ft (940 to 1,524 m); and by pinyon, juniper, and oak woodlots at elevations of 4,000 to 7,000 ft (1,219 to 2,134 m) (Woods et al. 2001; Bryce et al. 2003).

F.1.15 Northern Rockies

The Northern Rockies ecoregion encompasses about 31,600 mi^2 (81,844 km^2) in northern Idaho, northwestern Montana, and northeastern Washington (Ecoregion 15, Figure F-1).

The high, rugged Northern Rockies ecoregion is mountainous, and, despite an inland position, its climate and vegetation are marine-influenced (EPA 2002). Douglas fir, subalpine fir, Englemann spruce, ponderosa pine, and Pacific indicators, such as western red cedar, western hemlock, and grand fir, are found in the ecoregion (McGrath et al. 2002).

F.1.16 Idaho Batholith

This ecoregion is found in central Idaho and in extreme west-central Montana. It covers about 23,750 mi^2 (61,512 km^2) (Ecoregion 16, Figure F-1). The Idaho Batholith is a dissected, partially glaciated, mountainous plateau with numerous perennial streams. Grand fir, Douglas-fir, and, at higher elevations, Engelmann spruce and subalpine fir occur. Sagebrush, bunchgrass, and Ponderosa pine grow in valley floors and deep canyons (McGrath et al. 2002).

F.1.17 Middle Rockies

The Middle Rockies ecoregion occurs on about 60,400 mi^2 (156,436 km^2) in portions of Idaho, Montana, and Wyoming (Ecoregion 17, Figure F-1). Open forest is present in this ecoregion, and foothills are partly wooded or shrub- and grass-covered. Intermontane valleys are grass- and/or shrub-covered. In Idaho, Douglas-fir, subalpine fir, lodgepole pine, Engelmann spruce, aspen, and sagebrush occur in mountain and plateau areas, while shadscale and greasewood occur in areas of low precipitation (McGrath et al. 2002).

F.1.18 Wyoming Basin

The Wyoming Basin ecoregion is found in portions of Colorado, Idaho, Montana, Utah, and Wyoming and covers about 51,470 mi^2 (133,307 km^2), mostly in Wyoming (Ecoregion 18, Figure F-1). This ecoregion is a broad intermontane basin dominated by arid grasslands and shrub lands supporting bunchgrasses and sagebrush, interrupted by high hills and low mountains (EPA 2002). Poorly drained floodplains and low terraces support sedges, rushes, cattails, and grasses. Well-drained alluvial fans and foothills support sagebrush grasslands (McGrath et al. 2002). Wetland plants occur in poorly drained floodplains, alluvial fans, and terraces (Woods et al. 2001). Much of the region is used for livestock grazing, although many areas lack sufficient vegetation to support this activity.

F.1.19 Wasatch and Uinta Mountains

The Wasatch and Uinta Mountains ecoregion occurs primarily in central Utah and extends northward into extreme southwestern Wyoming and southeast Idaho (Ecoregion 19, Figure F-1) and covers about 17,600 mi^2 (45,584 km^2). This ecoregion is composed of a core area of high, precipitous mountains with narrow crests and valleys flanked in some areas by dissected plateaus and open high mountains (EPA 2002). Middle elevations support Douglas-fir and aspen parkland; Engelmann spruce and subalpine fir occur at the highest elevations; and

alpine meadows occur at elevations above 11,000 ft (3,352 m) (Woods et al. 2001; McGrath et al. 2002). The semiarid foothills support widely spaced juniper in a sagebrush grassland.

F.1.20 Colorado Plateaus

The Colorado Plateaus ecoregion encompasses approximately 48,790 mi^2 (126,133 km^2) in Arizona, Colorado, and Utah and the extreme northwest corner (about 1 mi^2 or 2.59 km^2) of New Mexico (Ecoregion 20, Figure F-1). This ecoregion is typified by a rugged tableland topography, with rapid changes in local relief from 984 to 1,969 ft (300 to 600 m). The higher elevations include pinyon-juniper woodlands, while low-lying areas contain saltbrush-greasewood (typical of hotter, drier areas) (EPA 2002). The region has conspicuous but irregular vegetation zones (Primm 2001). The woodland zone is the most extensive, dominated by forests of pinyon pine and several species of juniper. Between the trees, the ground is sparsely covered by grama, other grasses, herbs, and various shrubs, such as big sagebrush and alderleaf cercocarpus.

F.1.21 Southern Rockies

The Southern Rockies ecoregion in Colorado, New Mexico, Utah, and Wyoming (Ecoregion 21, Figure F-1) covers about 55,420 mi^2 (143,538 km^2). It is at a high elevation, with steep, rugged mountains (EPA 2002). Although coniferous forests cover much of the region, the vegetation and the soil and land use follow a pattern of elevational banding. The lowest elevations are generally grass- or shrub-covered and heavily grazed. Low to middle elevations are also grazed and covered by a variety of vegetation types, including Douglas fir, ponderosa pine, aspen, and juniper oak woodlands. Middle to high elevations are largely covered by coniferous forests and have little grazing activity. The highest elevations have alpine characteristics.

F.1.22 Arizona/New Mexico Plateau

The Arizona/New Mexico Plateau encompasses about 73,900 mi^2 (191,401 km^2) in Arizona, Colorado, New Mexico, and Nevada (Ecoregion 22, Figure F-1). The ecoregion represents a large transitional region between the semiarid grasslands to the east; the drier shrublands and woodland-covered, higher-relief tablelands to the north; and the lower, hotter, less vegetated basins, ranges, and deserts to the west and south (EPA 2002). Vegetation communities include shrublands, which contain big sagebrush, rabbitbrush, and winterfat as well as shadscale saltbrush and greasewood, and grasslands that contain blue grama, wheatgrass, and needlegrass (Gallant and Omernik 1989). Higher elevations may support pinyon pine and juniper forests.

F.1.23 Arizona/New Mexico Mountains

The Arizona/New Mexico Mountains ecoregion covers about 41,870 mi^2 (108,443 km^2) of Arizona and New Mexico (Ecoregion 23, Figure F-1). It is distinguished from neighboring mountainous ecoregions by its lower elevations and an associated vegetation indicative of drier, warmer environments. Forests of spruce, fir, and Douglas fir are found only in a few high-elevation parts of this region. Chaparral is common on the lower elevations; pinyon-juniper and oak woodlands are found on the lower and middle elevations; and open to dense ponderosa pine forests occur at higher elevations (EPA 2002).

F.1.24 Chihuahuan Deserts

The Chihuahuan Deserts ecoregion covers about 29,300 mi^2 (75,887 km^2) of southern Arizona and New Mexico (Ecoregion 24, Figure F-1). The ecoregion consists of broad basins and valleys bordered by sloping alluvial fans and terraces. Isolated mesas and mountains are located in the central and western parts of the region. Vegetative cover is predominantly arid grass and shrubland, except on the higher mountains, where oak-juniper woodlands occur (EPA 2002).

F.1.25 Western High Plains

The Western High Plains ecoregion (Ecoregion 25, Figure F-1) occurs in the eastern portions of Colorado, New Mexico, and Wyoming as well as the western portions of Texas, Oklahoma, Kansas, and Nebraska. It consists of smooth to slightly irregular plains that have a high percentage of cropland (EPA 2002a). In the three states of Colorado, New Mexico, and Wyoming, this ecoregion covers about 40,953 mi^2 (106,068 km^2) and includes the second-largest grassland ecoregion in North America (Cook et al. 2001). Grama and buffalo grass dominate the natural vegetation in this region, which includes grama-buffalo grass prairie, bluestem-grama prairie, sandsage-bluestem prairie, and wheatgrass-bluestem-needlegrass prairie.

F.1.26 Southwestern Tablelands

The Southwestern Tablelands ecoregion encompasses about 35,660 mi^2 (92,359 km^2) of south-central Colorado and northeastern New Mexico (Ecoregion 26, Figure F-1). The ecoregion is a subhumid grassland and semiarid rangeland (EPA 2002). The natural vegetation in this ecoregion is grama-buffalo grass, with some mesquite-buffalo grass in the southeast, and with midgrass prairie and open and low shrubs along the Canadian River.

F.1.27 Canadian Rockies

The Canadian Rockies ecoregion encompasses about 7,270 mi^2 (18,829 km^2) in northwest Montana (Ecoregion 41, Figure F-1) only. Most of the ecoregion, however, is located

in Canada (EPA 2002). At lower elevations, the vegetation is mostly Douglas fir, spruce, and lodgepole pine; alpine fir occurs at middle elevations; and treeless alpine habitats occur at the higher elevations.

F.1.28 Northwestern Glaciated Plains

The Northwestern Glaciated Plains ecoregion (Ecoregion 42, Figure F-1) is a transitional region between the generally more level, moister, more agricultural Northern Glaciated Plains ecoregion to the east and the generally more irregular and drier Northwestern Great Plains ecoregion to the west and southwest (EPA 2002). Of the 11 western states, Montana is the only one in which this ecoregion occurs, where it encompasses about 37,000 mi^2 (95,830 km^2) in the north-central and northeastern portions of the state. Vegetation of this ecoregion is primarily grass, such as grama, wheatgrass, and needlegrass, with areas of shortgrass prairie and sagebrush steppe (EPA 2002). Portions of this ecoregion include a moderately high concentration of semipermanent and seasonal wetlands, locally referred to as prairie potholes.

F.1.29 Northwestern Great Plains

The Northwestern Great Plains ecoregion (Ecoregion 43, Figure F-1) covers about 77,900 mi^2 (201,761 km^2) in Montana and Wyoming. It also occurs in portions of Nebraska and the Dakotas. The ecoregion, which is part of the largest grassland area in North America (Primm et al. 2001), is a semiarid, rolling plain with erratic precipitation (EPA 2002). Native grasslands, largely replaced on level ground by spring wheat and alfalfa, persist in rangeland areas on broken topography. The dominant grass communities include grama-needlegrass and wheatgrass, and wheatgrass-needlegrass (Primm et al. 2001). A variety of shrubs and herbs also occur, with sagebrush being most abundant.

F.1.30 North Cascades

The North Cascades ecoregion encompasses about 11,700 mi^2 (30,303 km^2) in northwest Washington (Ecoregion 77, Figure F-1). It also encompasses portions of Canada. The terrain of this ecoregion is composed of high, rugged mountains (EPA 2002). This ecoregion contains the greatest concentration of active alpine glaciers in the conterminous United States and has a variety of climatic zones. Forest communities at higher elevations support Engelmann spruce, subalpine fir, lodgepole pine, white spruce, Douglas fir, and quaking aspen (Kavanagh and Sims 2001). The lowest elevations in the eastern portions of the ecoregion contain parkland of scattered ponderosa pine in a matrix of bluebunch wheatgrass and sagebrush.

F.1.31 Klamath Mountains

The Klamath Mountains ecoregion occurs in north-central California and south-central Oregon, on about 18,700 mi^2 (48,433 km^2) (Ecoregion 78, Figure F-1). The ecoregion is

physically and biologically diverse (EPA 2002), with highly dissected, folded mountains, foothills, terraces, and floodplains. The mild, subhumid climate of the Klamath Mountains ecoregion is characterized by a lengthy summer drought and supports diverse vegetation, including chaparral and mixed conifer forests with oak woods, Douglas-fir, Ponderosa pine, and grasslands with bunchgrass and wheatgrass (Thorson et al. 2003).

F.1.32 Madrean Archipelago

The Madrean Archipelago ecoregion encompasses about 16,100 mi^2 (41,699 km^2) in the southern portions of Arizona and New Mexico (Ecoregion 79, Figure F-1). It consists of basins and ranges with medium to high local relief, typically 3,281 to 4,921 ft (1,000 to 1,500 m) (EPA 2002). Native vegetation in the region is mostly grama-tobosa shrubsteppe in the basins and oak-juniper woodlands on the ranges, except at higher elevations, where ponderosa pine is predominant.

F.1.33 Northern Basin and Range

The Northern Basin and Range ecoregion occupies about 54,905 mi^2 (142,204 km^2) in portions of California, Idaho, Nevada, Oregon, and Utah (Ecoregion 80, Figure F-1). This ecoregion contains arid tablelands, intermontane basins, dissected lava plains, and scattered mountains (EPA 2002). Nonmountainous areas have sagebrush grassland or saltbrush greasewood steppe vegetation, with cool-season grasses being common (McGrath et al. 2002; EPA 2002). The ranges in this ecoregion are generally covered in Mountain sagebrush, mountain brush, and Idaho fescue at lower and middle elevations. Douglas-fir and aspen are common at higher elevations (Woods et al. 2001; Bryce et al. 2003). Valleys within the ecoregion support sagebrush steppe or saltbush vegetation; and juniper woodlands occur on rugged, stony uplands. Portions of this ecoregion are used as rangeland, with some areas being used for cropland (Thorson et al. 2003).

F.1.34 Sonoran Basin and Range

The Sonoran Basin and Range ecoregion encompasses about 45,100 mi^2 (116,809 km^2) of southern Arizona, California, and New Mexico (Ecoregion 81, Figure F-1). This ecoregion contains scattered low mountains and large areas of palo verde-cactus shrub and giant saguaro cactus (EPA 2002).

F.2 DISTRIBUTION OF WIND ENERGY RESOURCES

This PEIS evaluates the potential ecological impacts of wind energy development on BLM-administered lands in the western United States. To do so, it examines the distribution of potential wind energy development across Level III ecoregions within each of the states. Figures F-2 through F-11, which appear at the end of this appendix after the references, depict

the in-state distribution of BLM-administered lands that have been determined to exhibit a medium to high potential to support wind energy development, by ecoregion.

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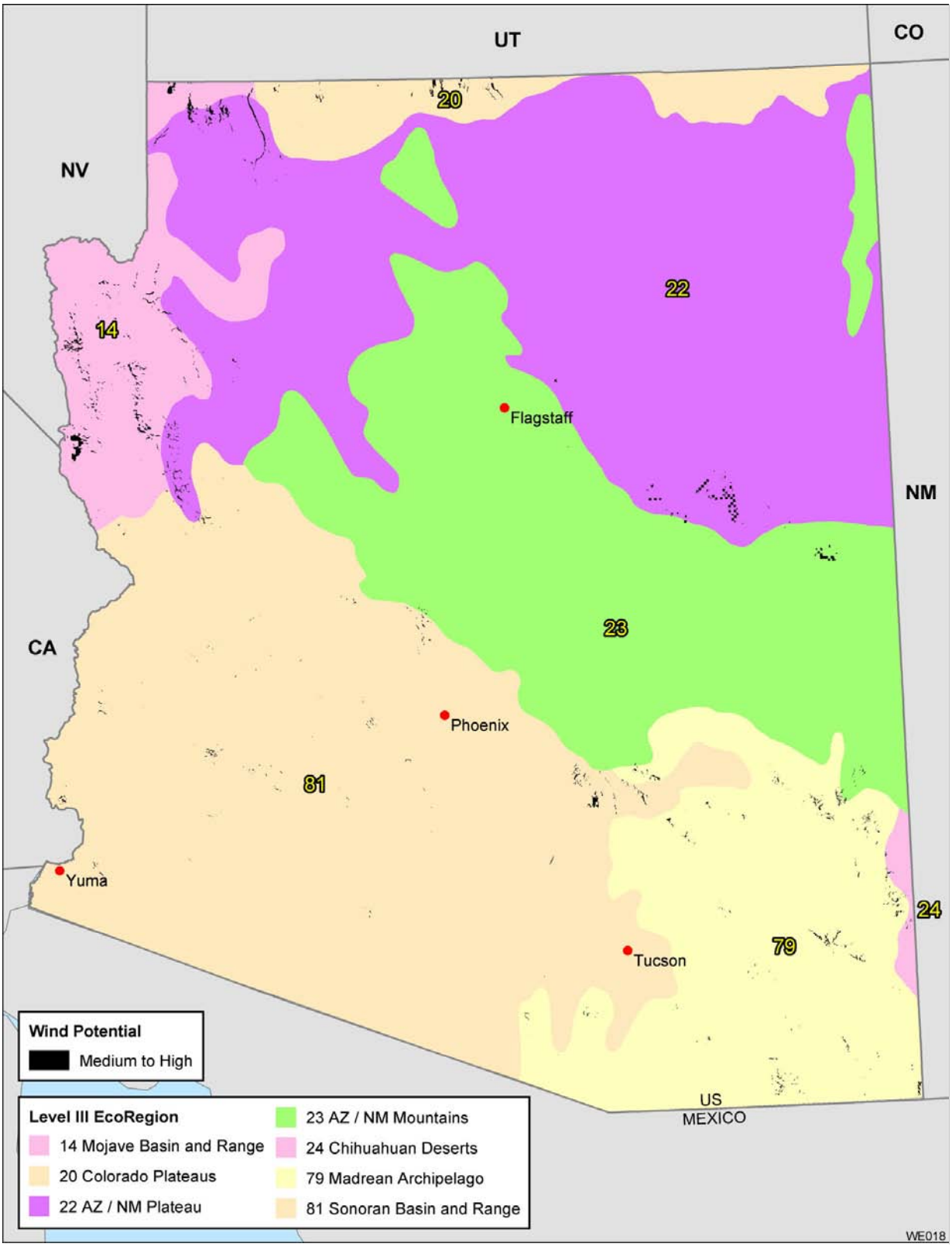

FIGURE F-2 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in Arizona

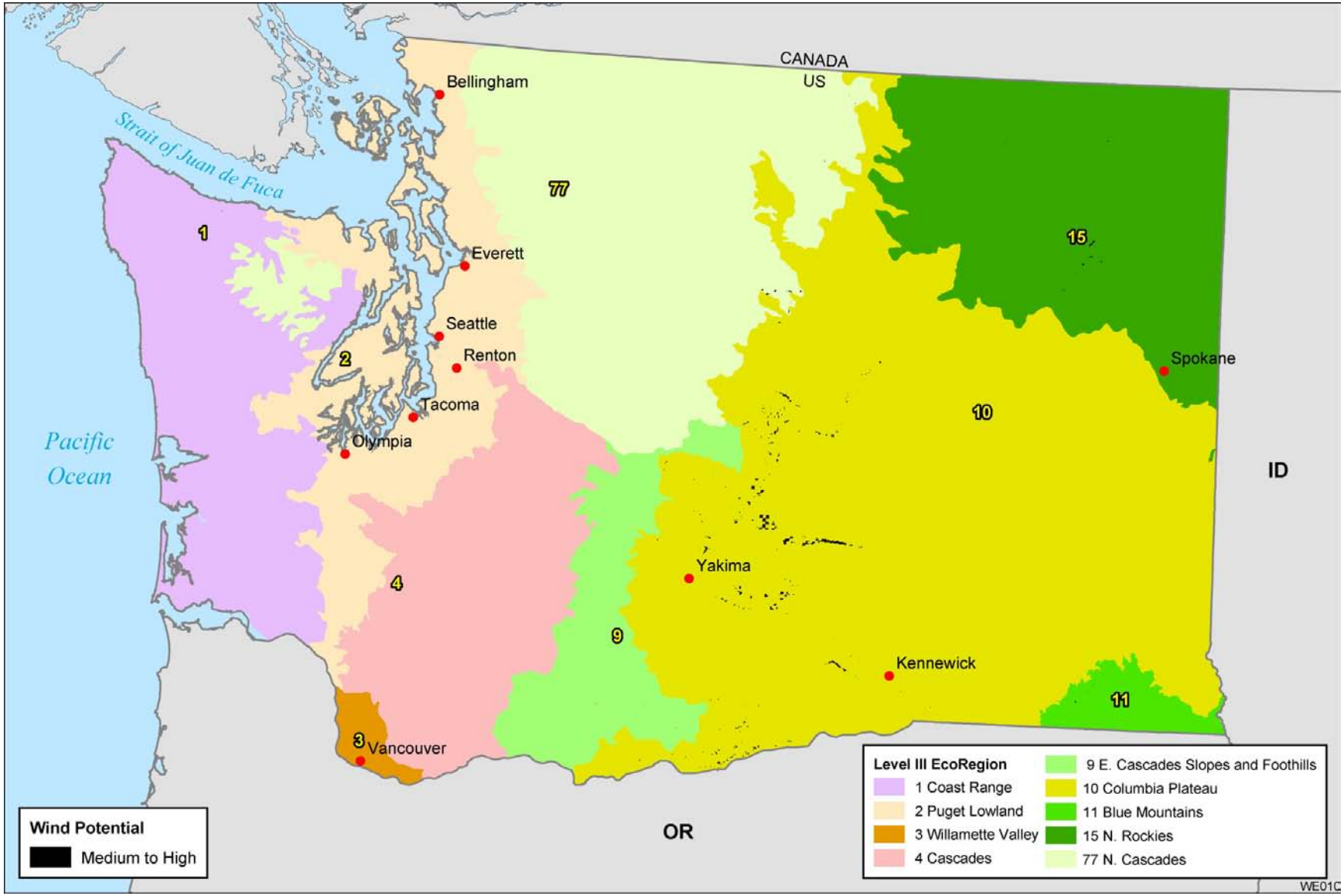

FIGURE F-3 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in Washington

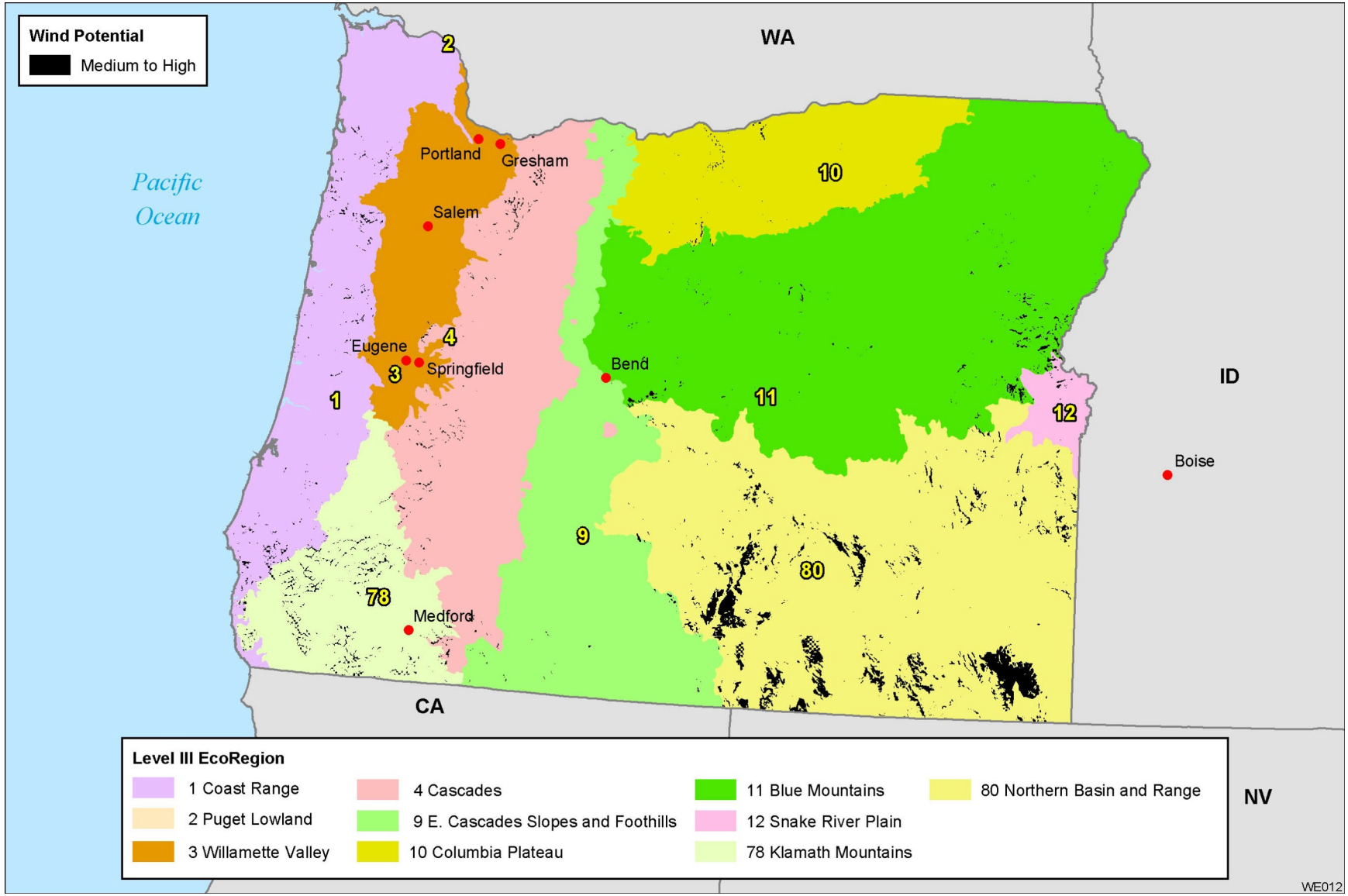

FIGURE F-4 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in Oregon

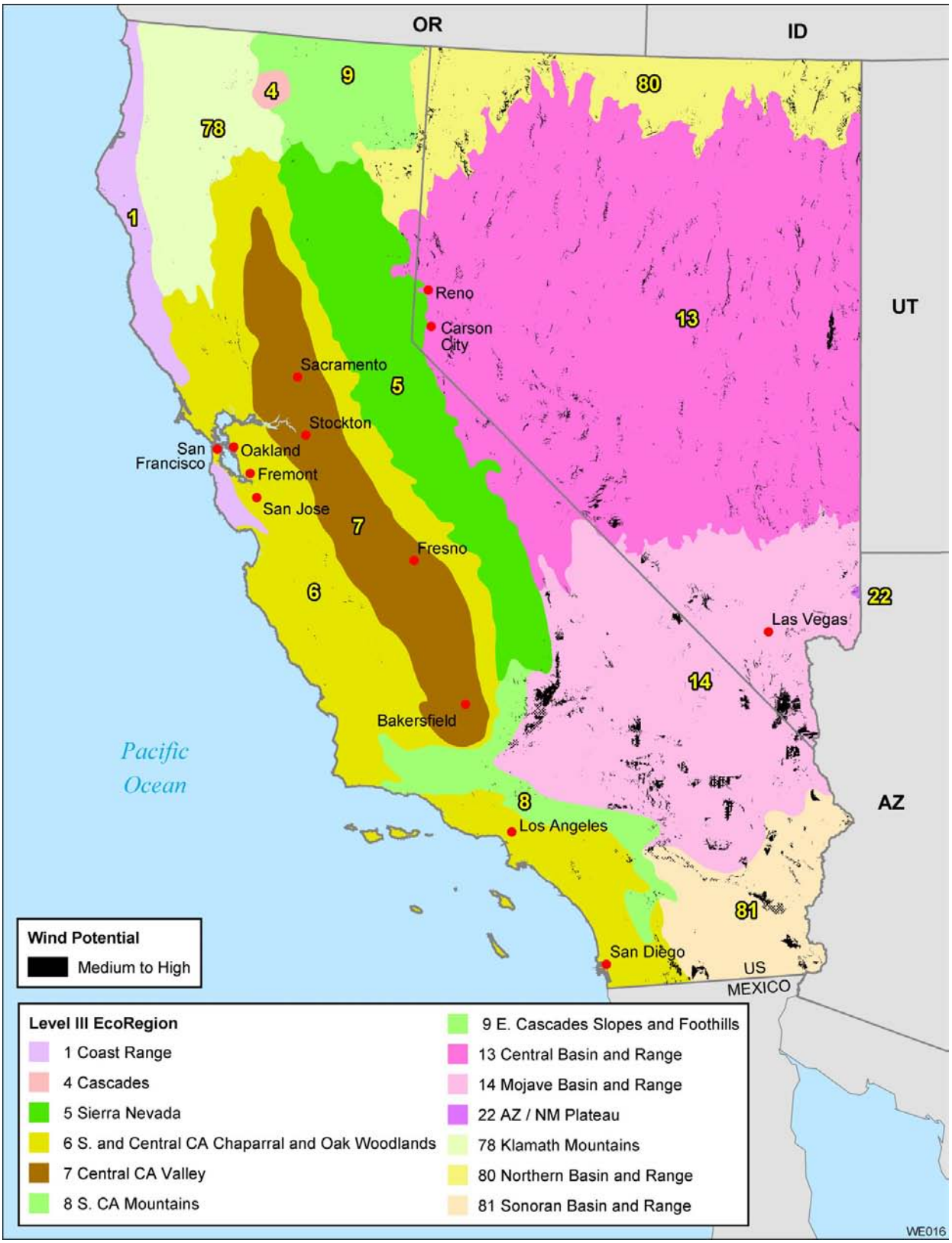

FIGURE F-5 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in California and Nevada

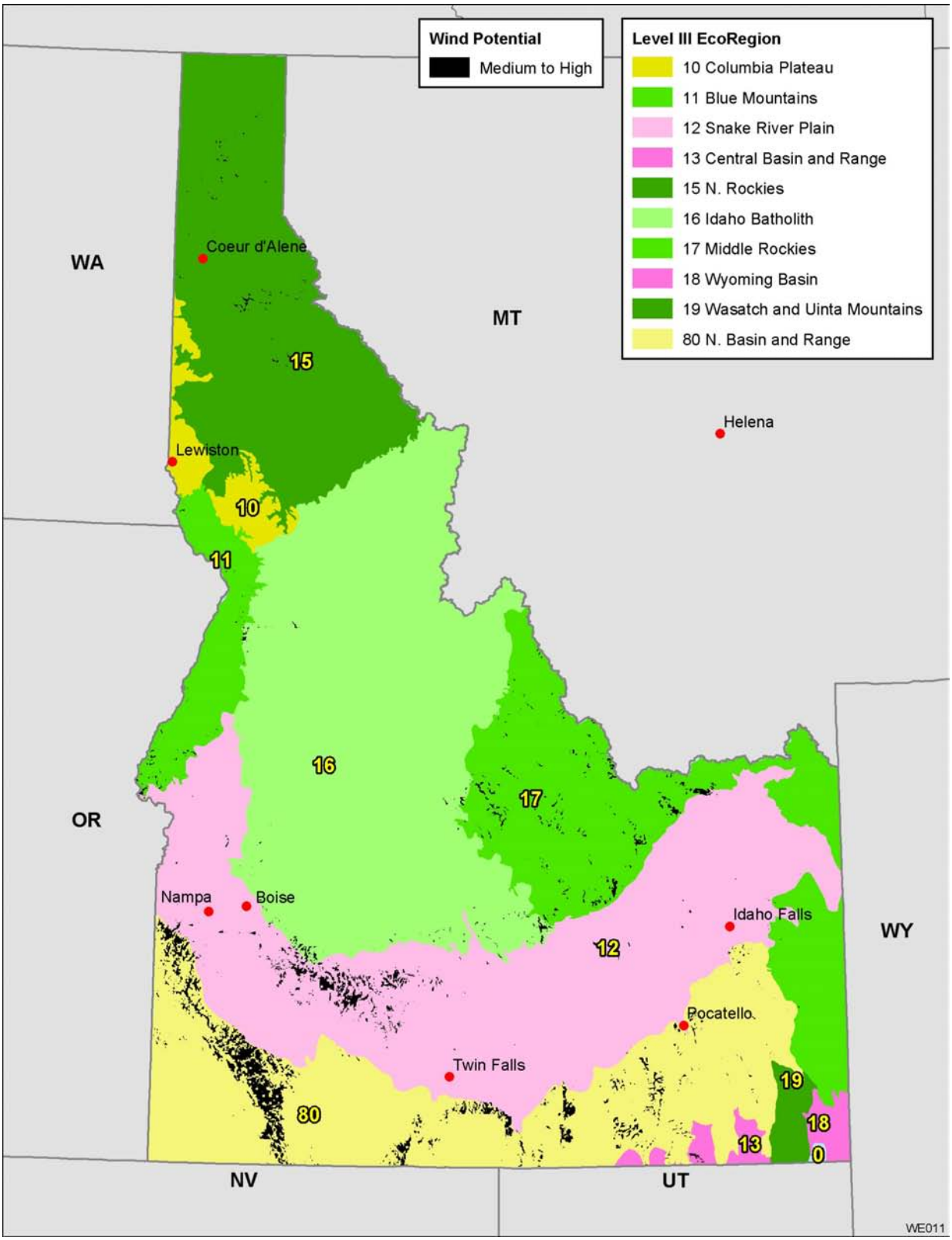

FIGURE F-6 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in Idaho

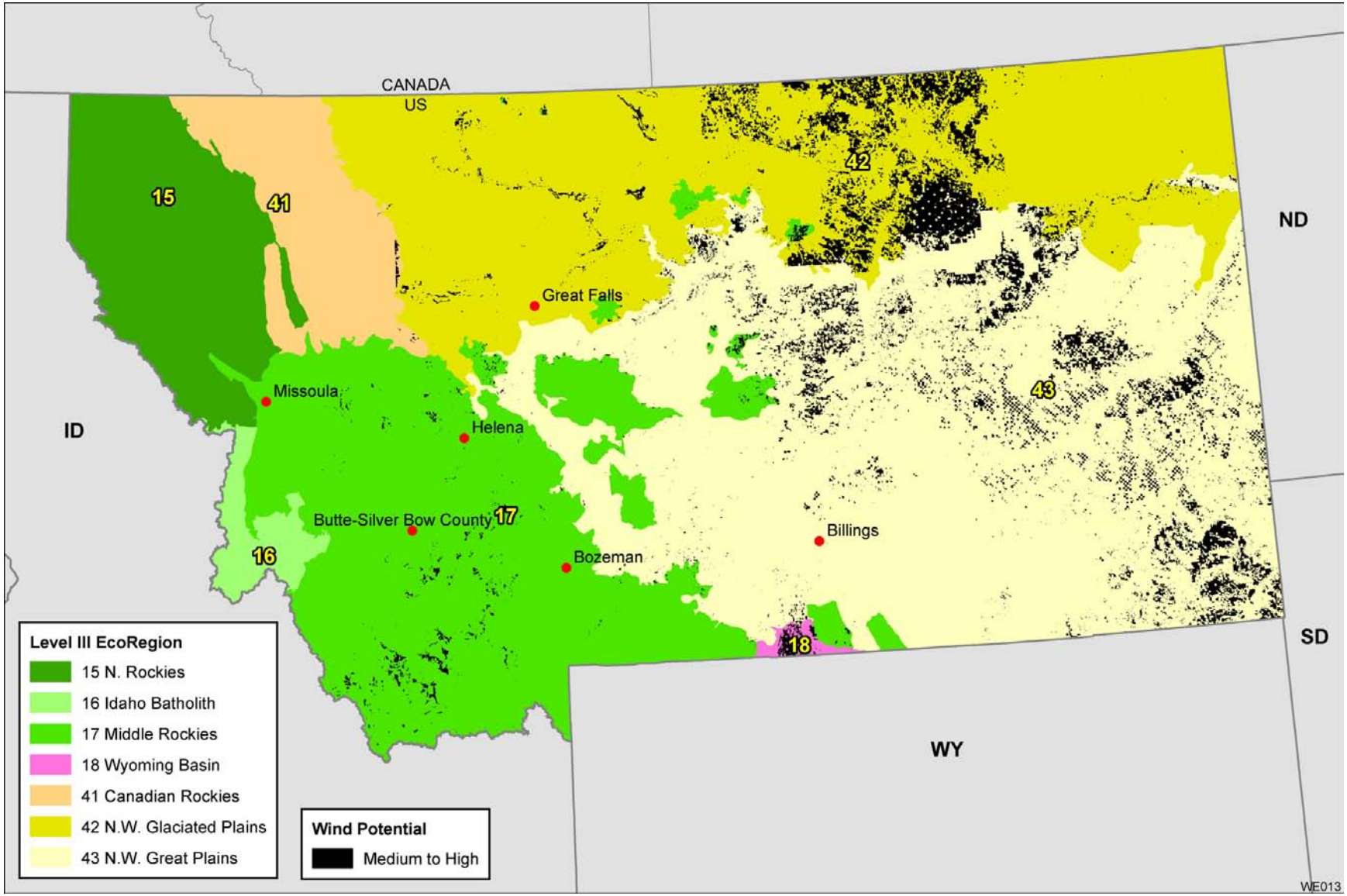

FIGURE F-7 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in Montana

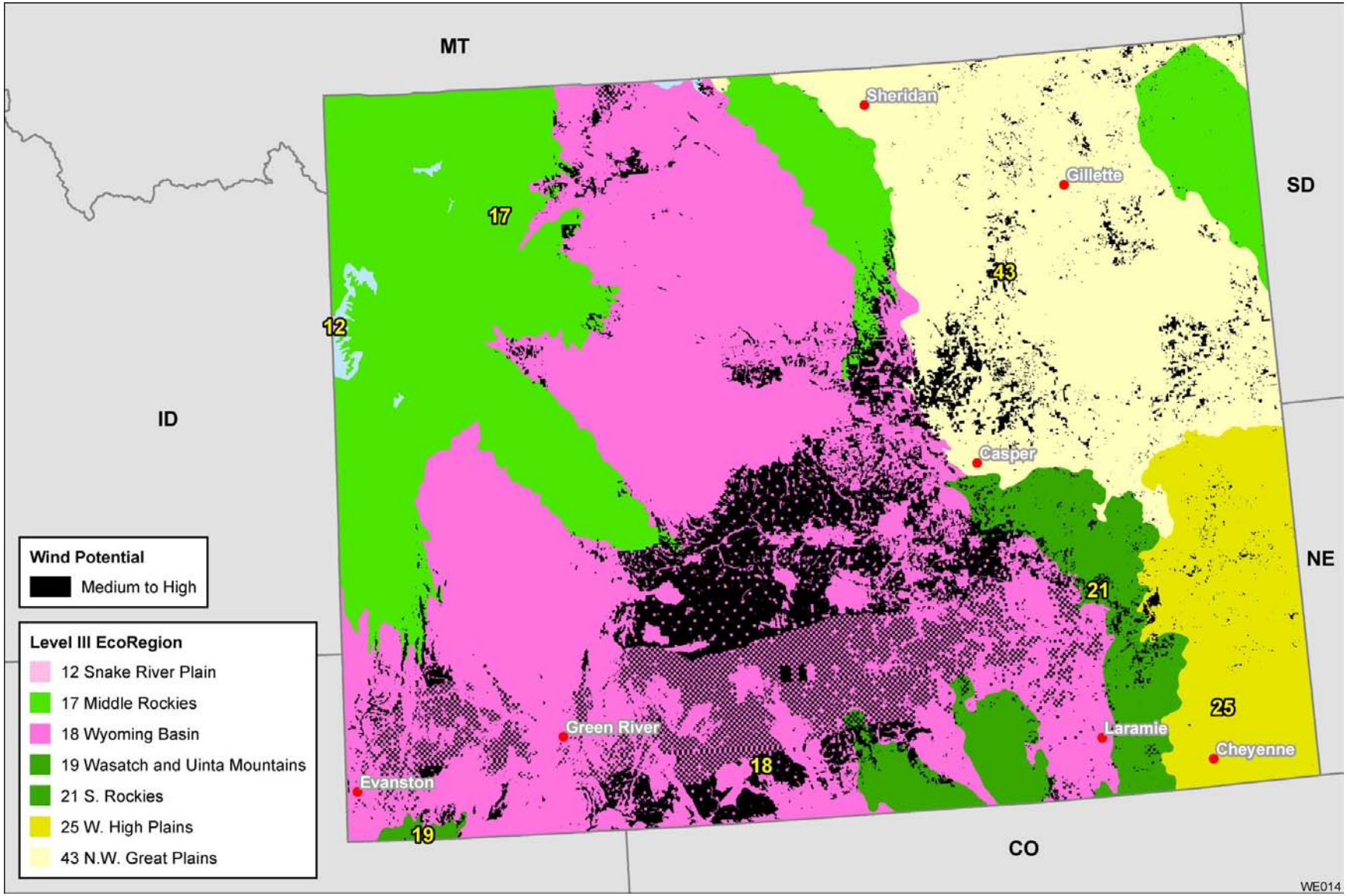

FIGURE F-8 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in Wyoming

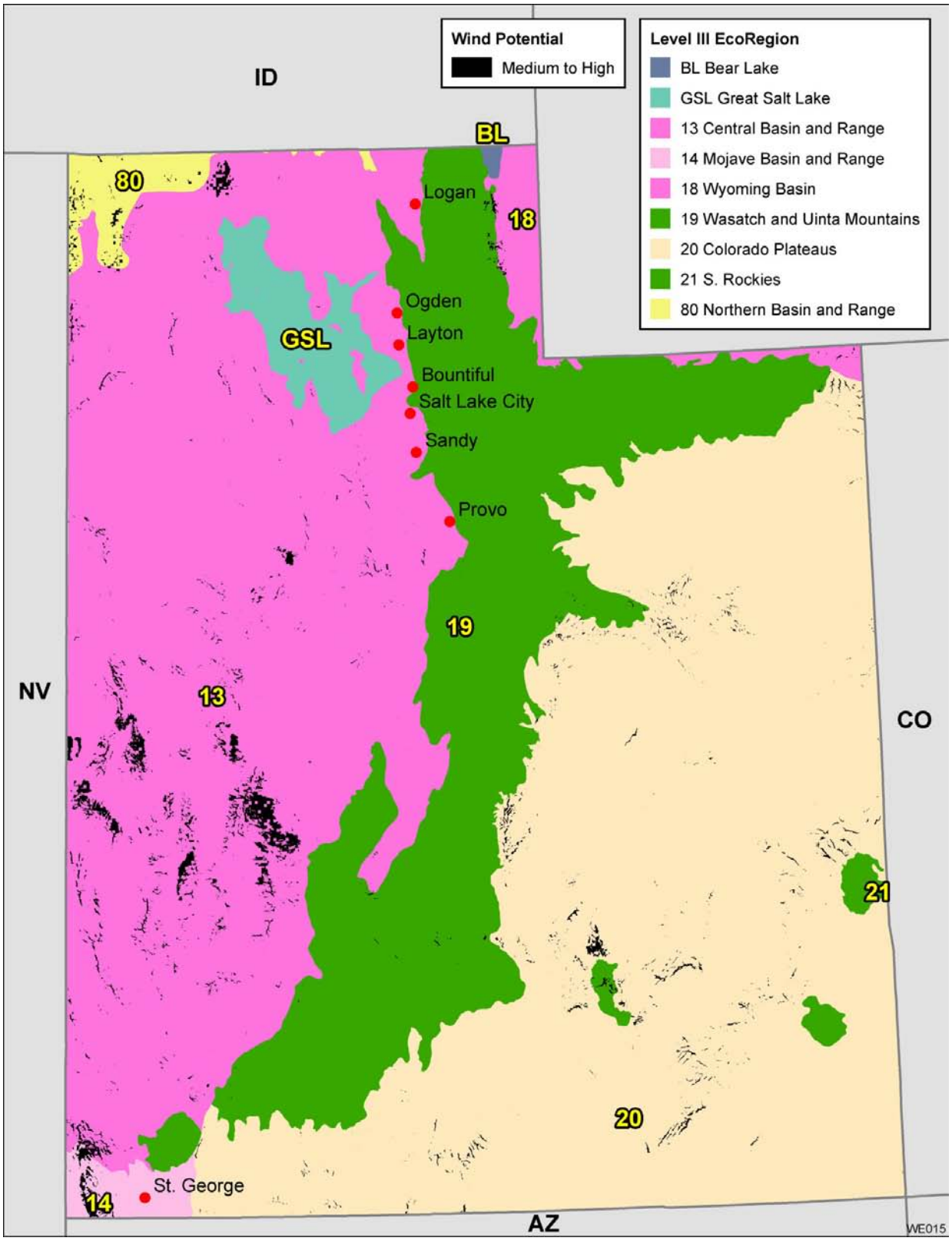

FIGURE F-9 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in Utah

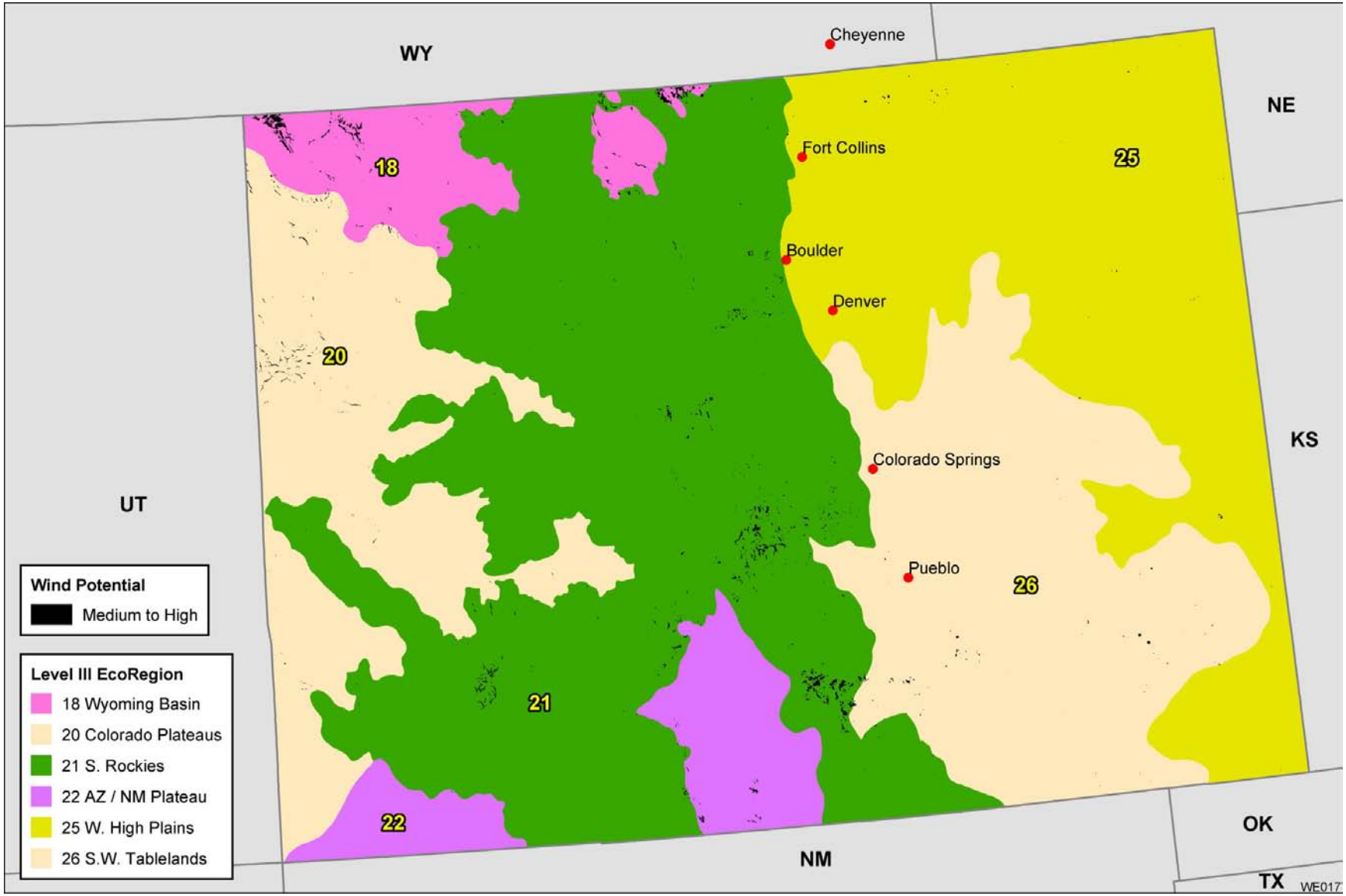

FIGURE F-10 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in Colorado

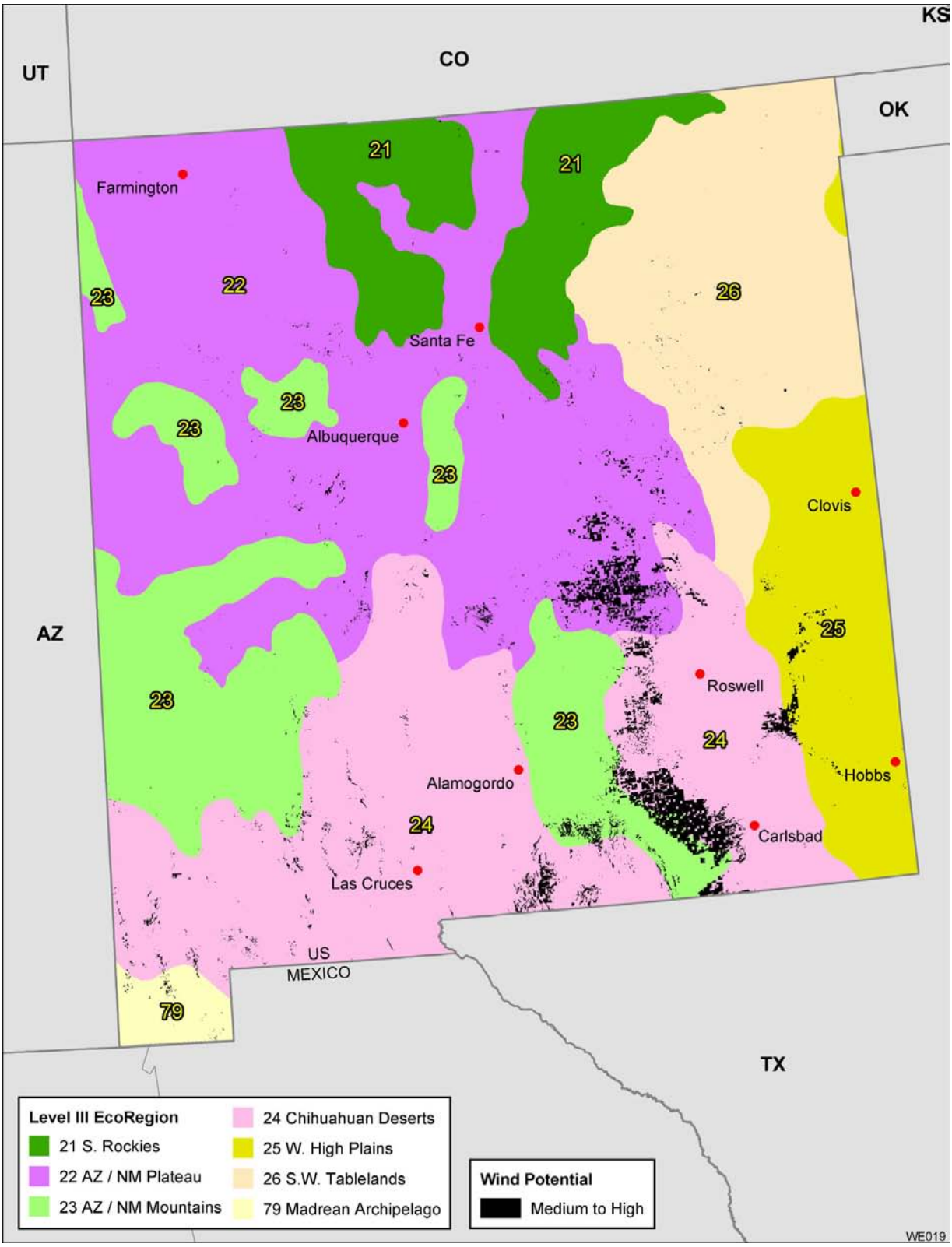

FIGURE F-11 Distribution of BLM-Administered Lands with Medium to High Wind Potential across Ecoregions in New Mexico