Appendix D

Conservation and Management Action Implementation Support Information and Maps

D CONSERVATION AND MANAGEMENT ACTION IMPLEMENTATION SUPPORT INFORMATION AND MAPS

D.1 Introduction

This appendix includes information, including maps and methodologies, needed for implementing the conservation and management actions (CMAs) in the Approved LUPA. Each subsection, below, provides examples of CMAs that reference the resource. The CMAs listed in each subsection are not all inclusive; the BLM or third party applicant should refer to the CMAs in LUPA Section II.4. Also included is information useful for assisting in the implementation of CMAs, but is not referenced specifically in any one CMA.

The order of the subsections below follows the order in which the issue is addressed in the CMAs as contained in the Approved LUPA.

D.2 Biological Resources

D.2.1 Landscape Wildlife Linkages

Figure D-1, is to be utilized, at a minimum, in implementing CMAs LUPA-BIO-1, 3 and 13.

D.2.2 East Riverside DFA Multi-Species Linkages

Figure D-2, is to be used, at a minimum, in implementing CMAs LUPA-BIO-1, 3 and 13.

D.2.3 Bird Important Areas

Figure D-3, Audubon Important Bird Areas, is to be used, at a minimum, in implementing CMAs LUPA-BIO-1, 3, and 17.

D.2.4 Desert Vegetation Types

Figures D-4 through 14, are to be used, at a minimum, in implementing CMAs LUPA-BIO-1, 3, and 17, LUPA-BIO-RIPWET-1, and DFA-VPL-BIO-DUNE-1 and 2.

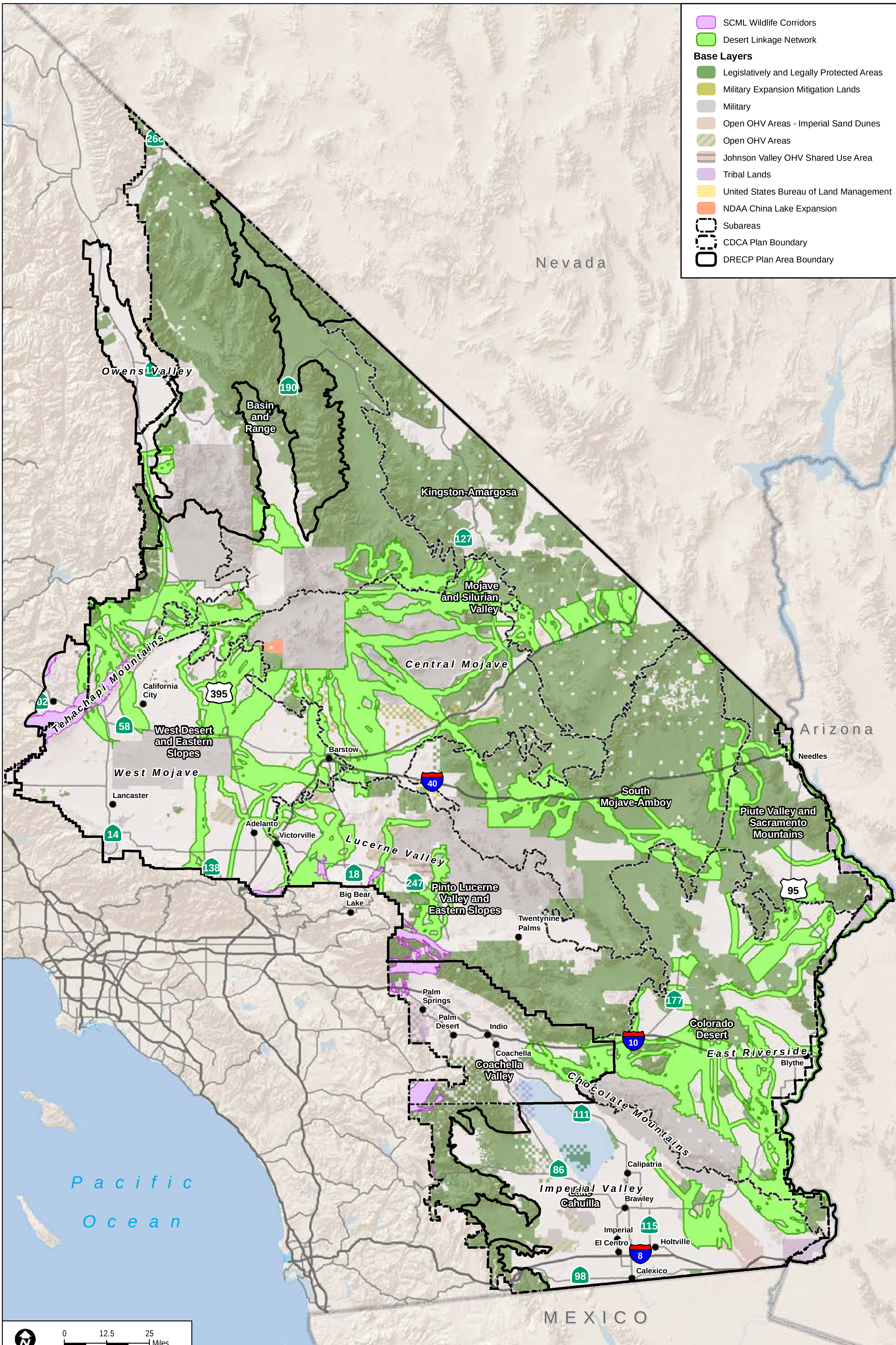
D.2.5 Aeolian and Sand Transport

Figure D-15 is to be used, at a minimum, in implementing CMAs LUPA-BIO-1 and 3, LUPA-BIO-DUNE-1 through 5, and DFA-VPL-BIO-DUNE-1 and 2.

D.2.6 Desert Tortoise

Figure D-16, Desert Tortoise TCAs and Linkages, is to be used, at a minimum, in implementing CMAs LUPA-BIO-1, LUPA-BIO-IFS-1 through 3, CONS-BIO-IFS-2 and 3, and DFA-VPL-BIO-IFS-1.

Figure D-17, Desert Tortoise Survey Areas, is to be used, at a minimum, in implementing CMAs LUPA-BIO-1, LUPA-BIO-IFS-5 and 6, CONS-BIO-IFS-1, and DFA-VPL-BIO-IFS-1 and 3.



Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-1

Landscape Wildlife Linkages

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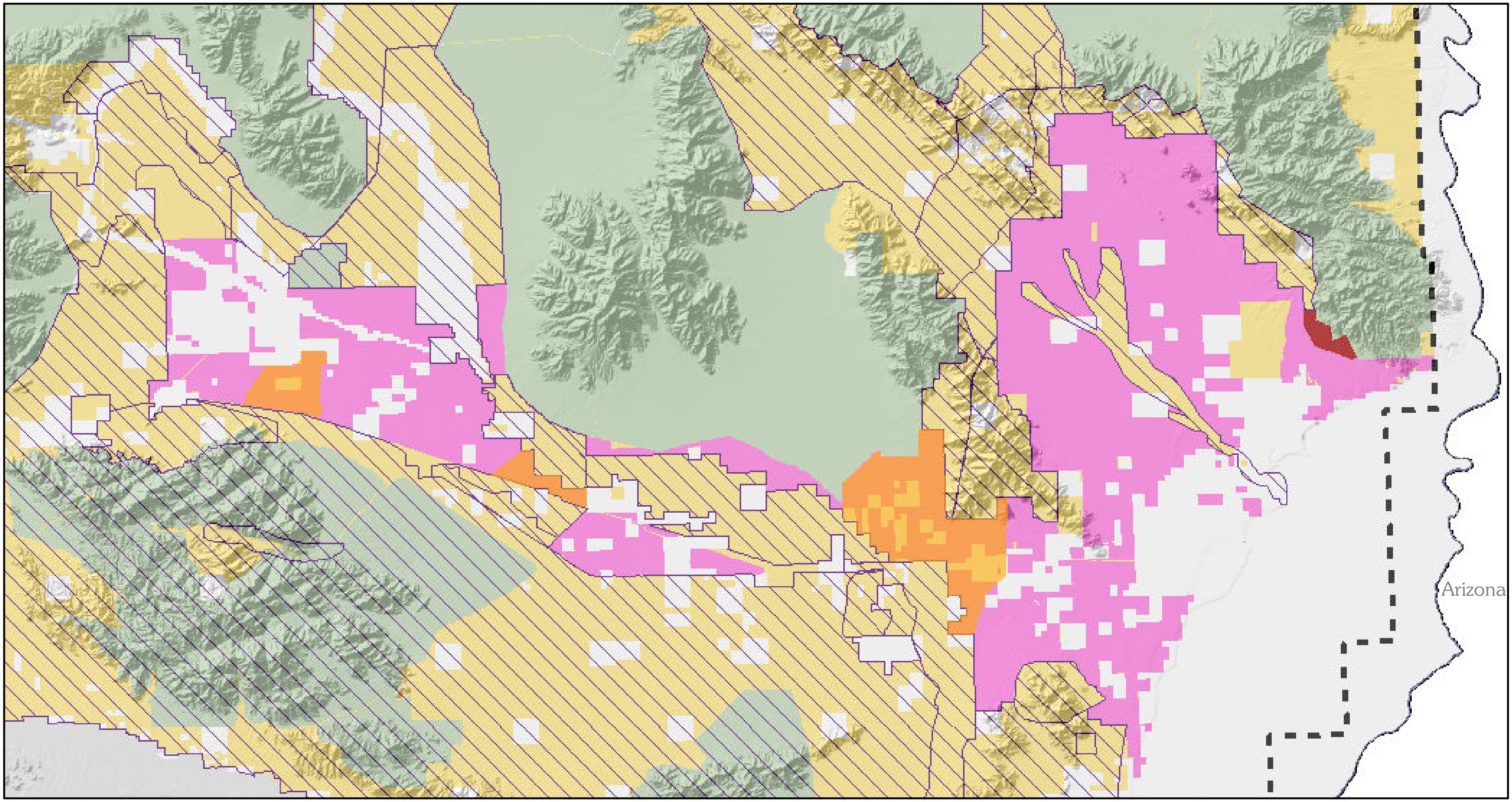


Multi Species Linkage

ACEC Boundaries

LLPA

Renewable Footprint

DFA

VPL

Land Status

Bureau of Land Management

Figure D-2

East Riverside DFA Mutispecies Linkages

(approximate locations per CMA LUPA-BIO-13)

8/15/2016

BLM California State Office

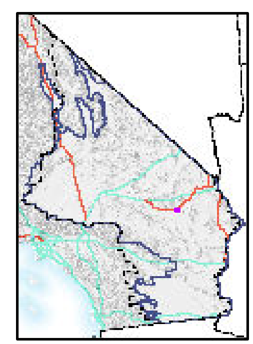
0 5 10

Kilometers

N

Miles

0 5 10



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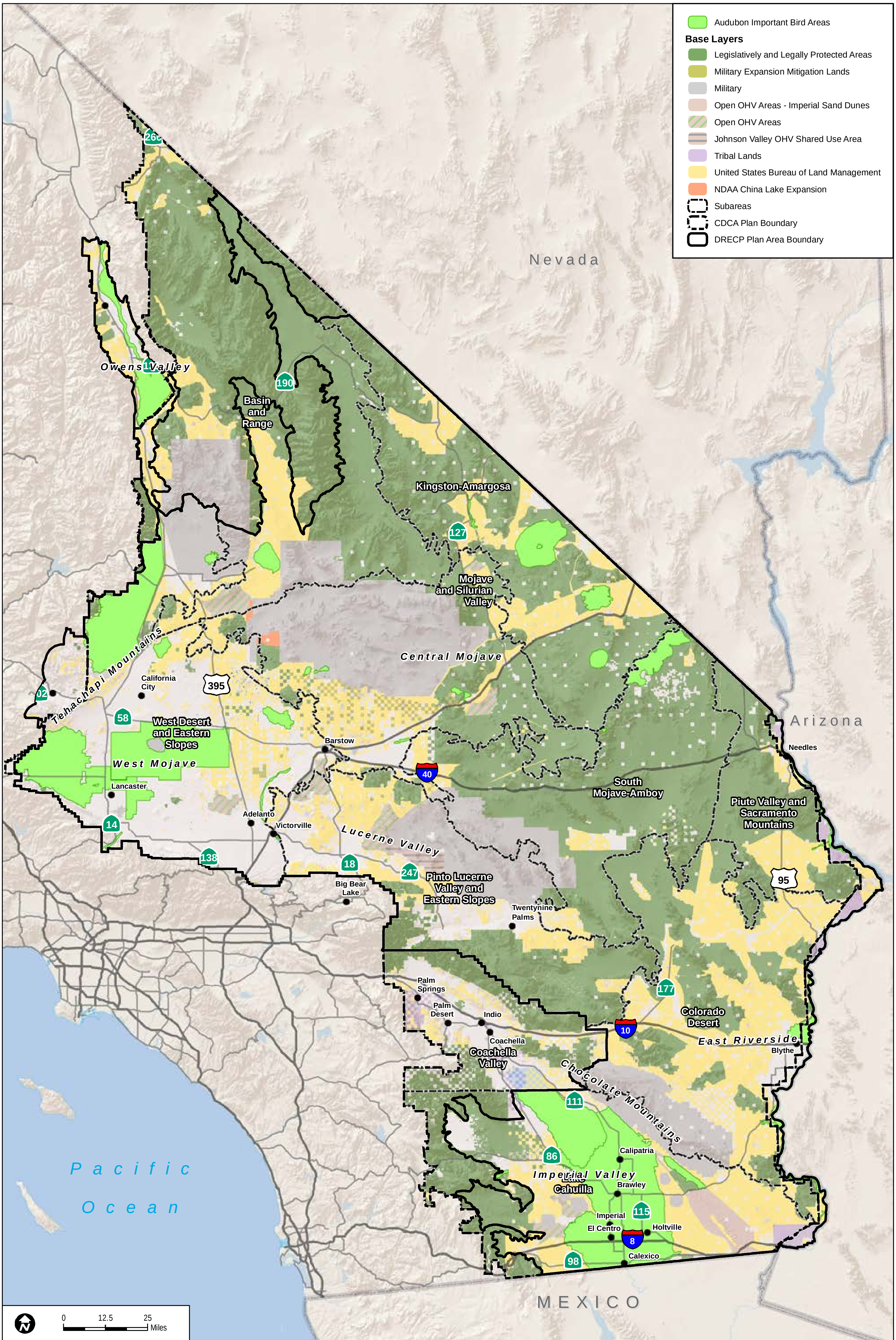

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-3

Audubon Important Bird Areas

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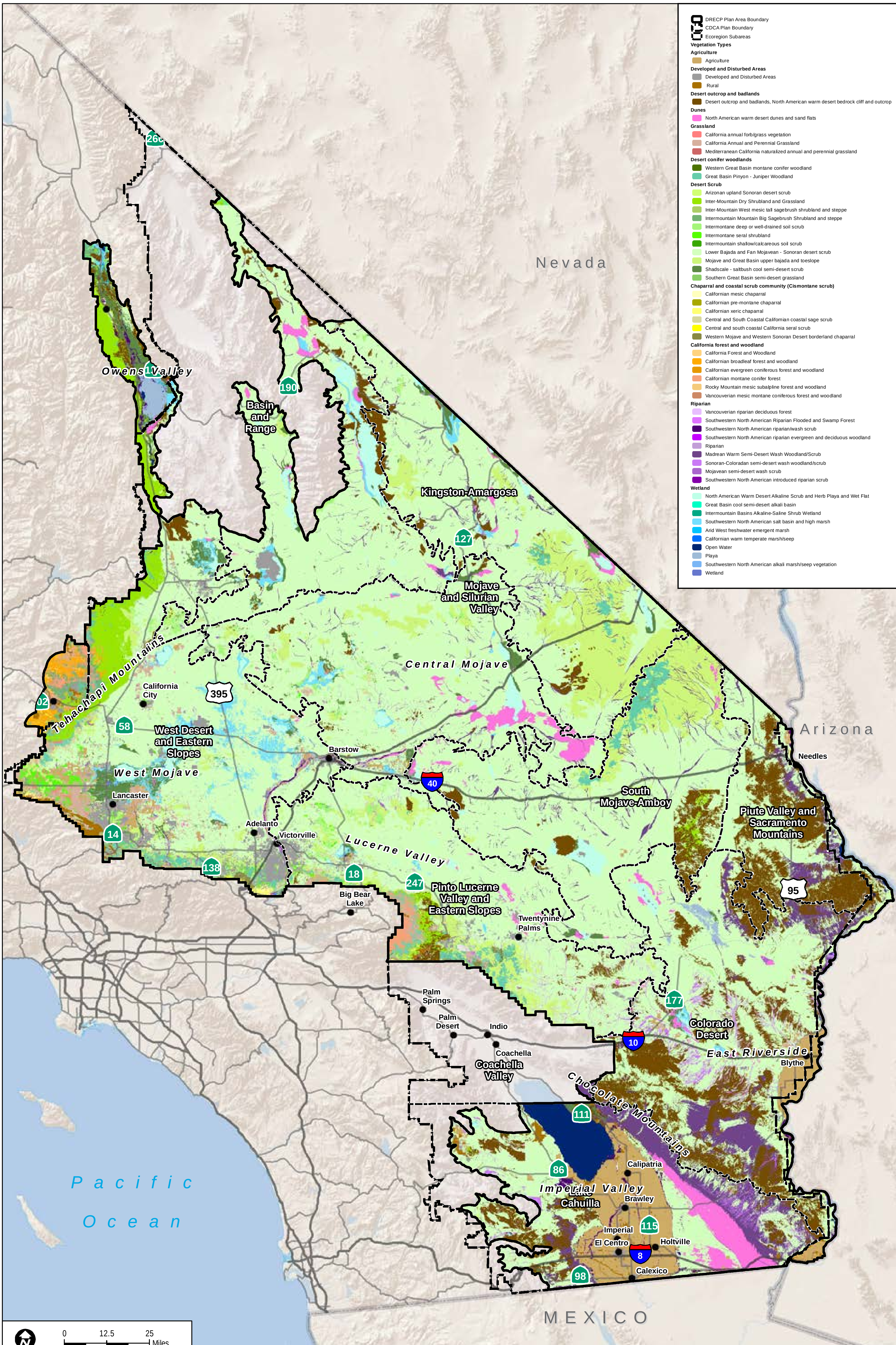

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-4

Vegetation Types and Other Land Covers - Ecoregion Subarea Index Map

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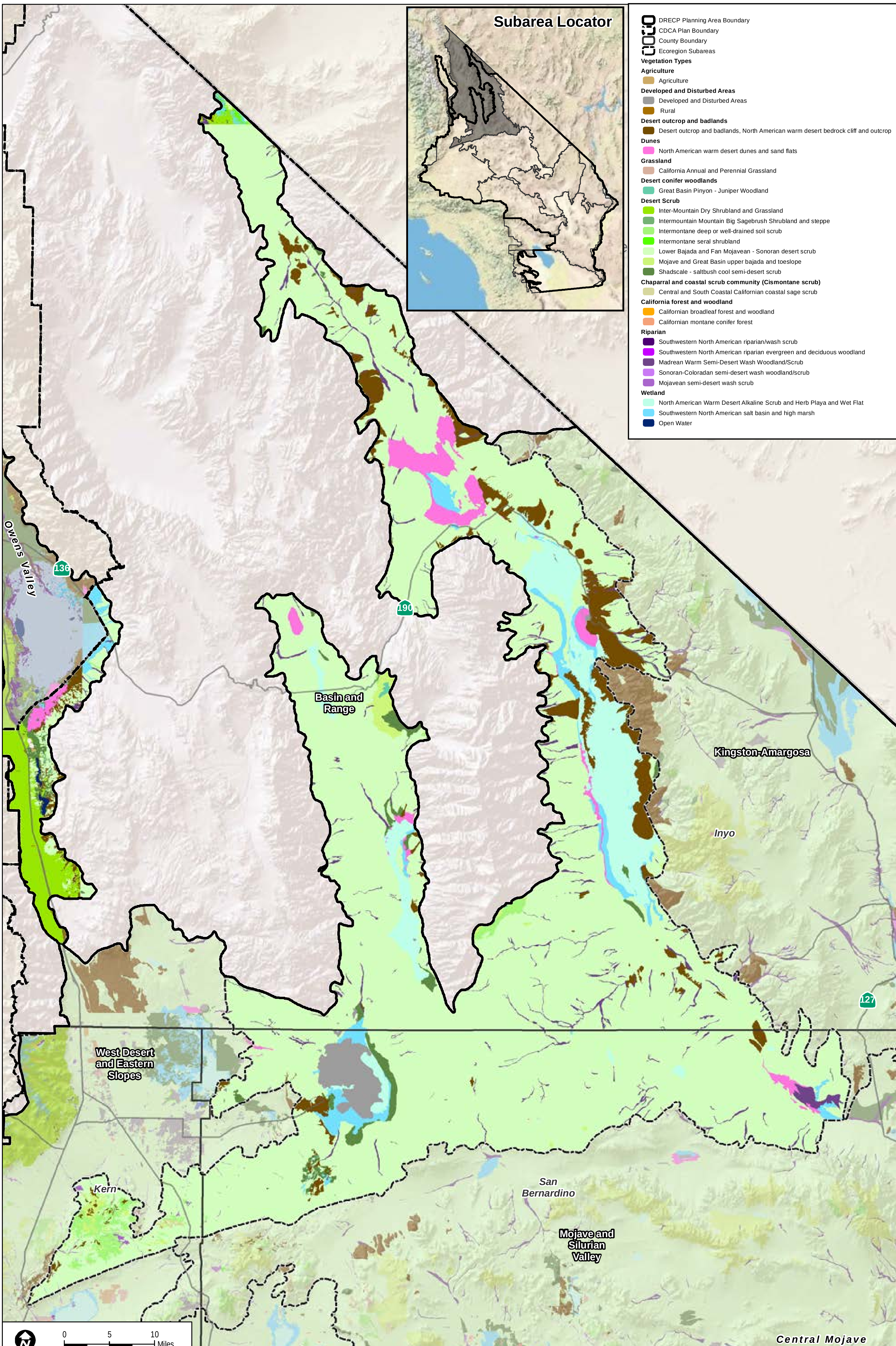

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-5

Vegetation Types and Other Land Covers - Basin and Range Ecoregion Subarea

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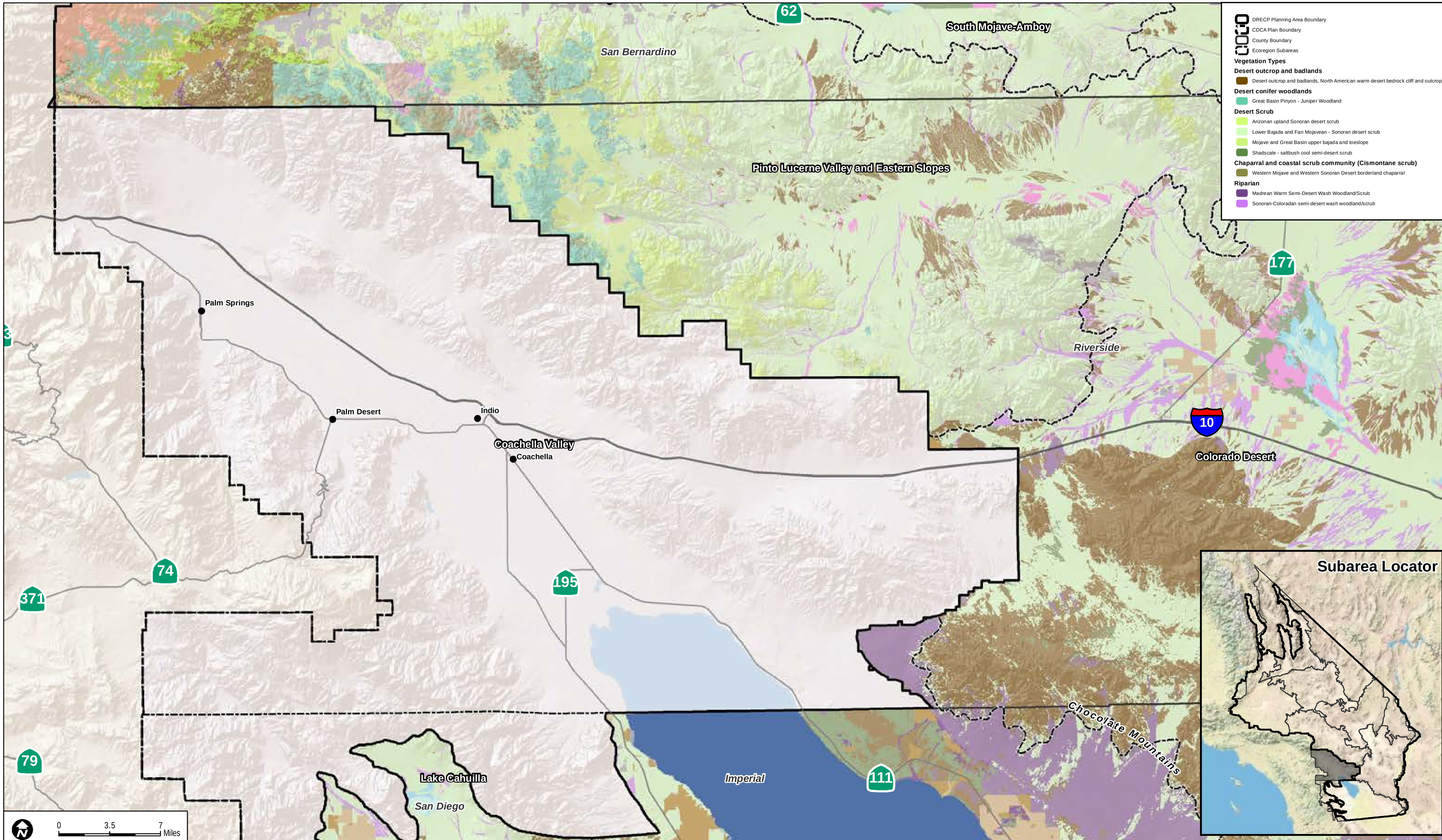

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-6

Vegetation Types and Other Land Covers - Coachella Valley Ecoregion Subarea

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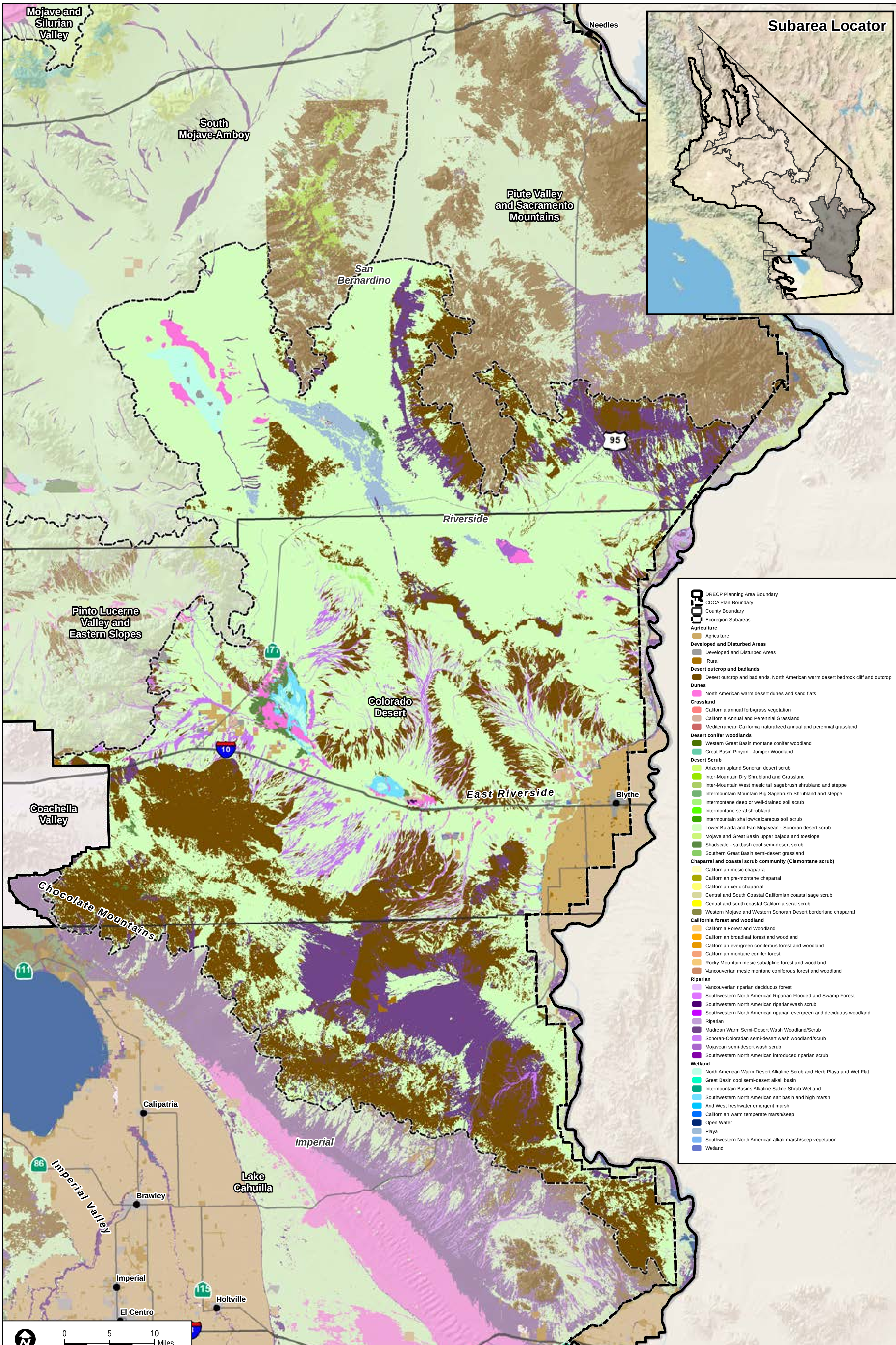

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-7

Vegetation Types and Other Land Covers - Colorado Deserts Ecoregion Subarea

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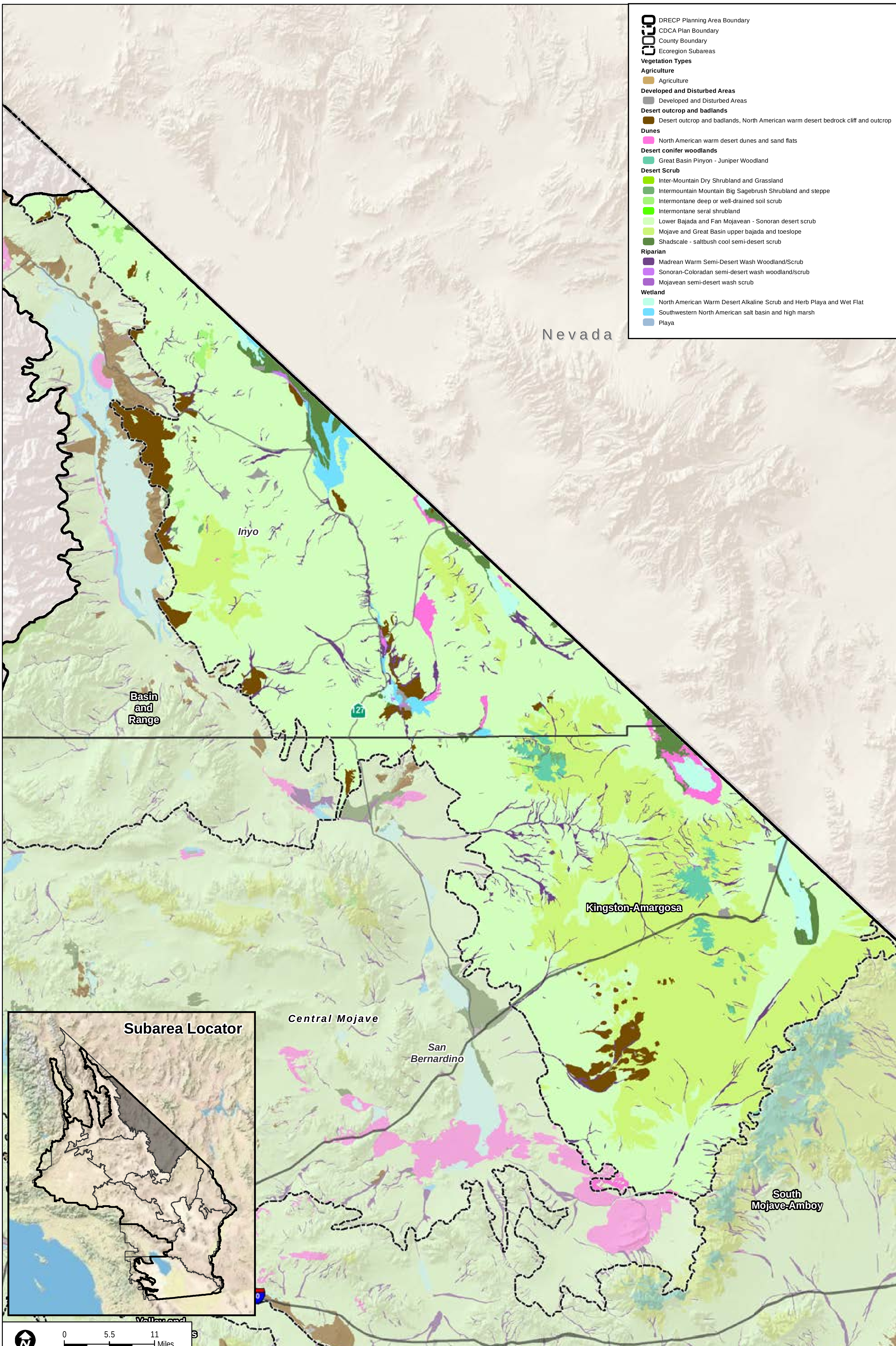

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-8

Vegetation Types and Other Land Covers - Kingston-Amargosa Mountains Ecoregion Subarea

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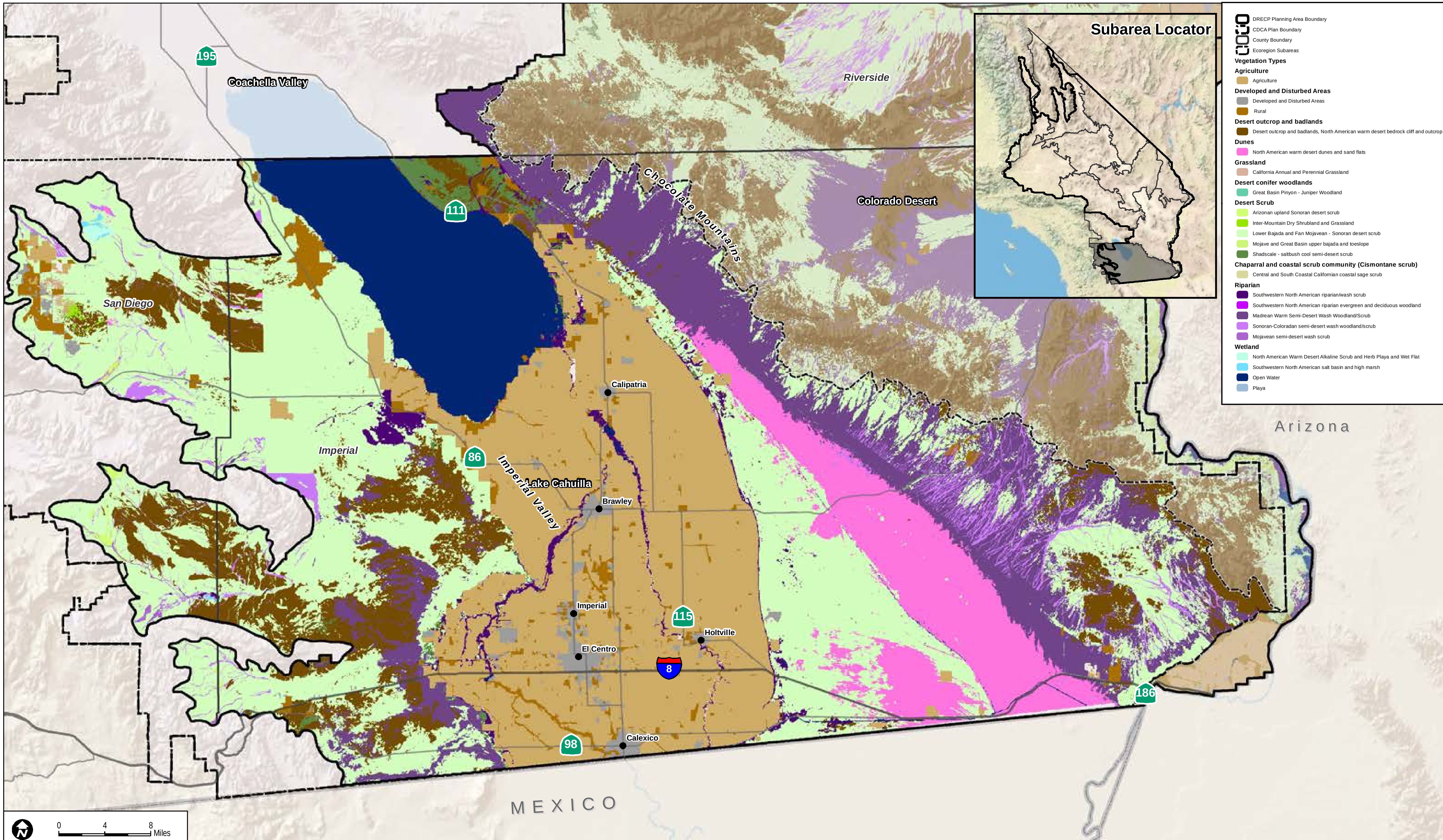

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-9

Vegetation Types and Other Land Covers - Lake Cahuilla Ecoregion Subarea

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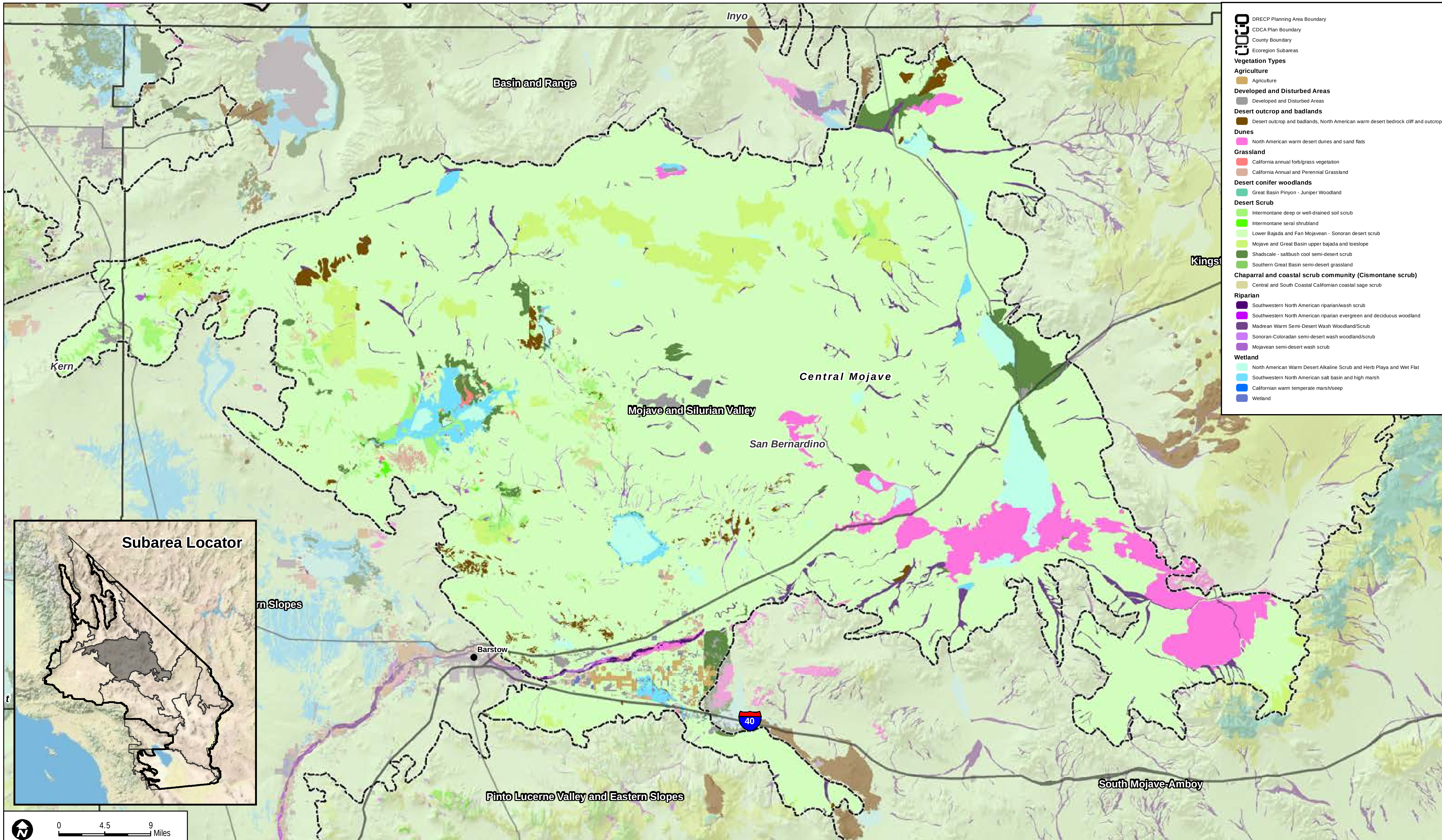

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-10

Vegetation Types and Other Land Covers - Mojave and Silurian Valley Ecoregion Subarea

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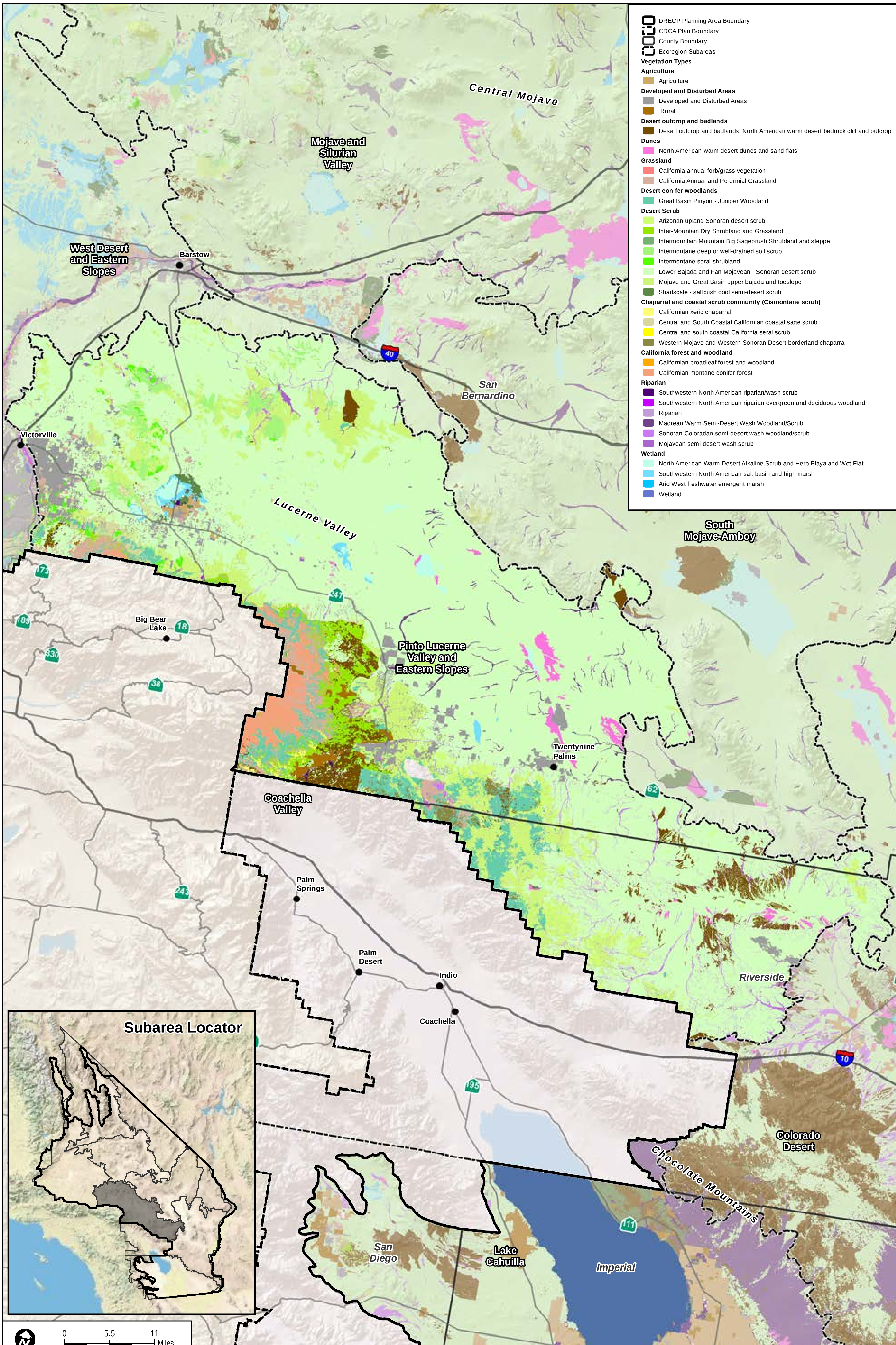

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-11

Vegetation Types and Other Land Covers - Pinto Lucerne Valley and Eastern Slopes Ecoregion Subarea

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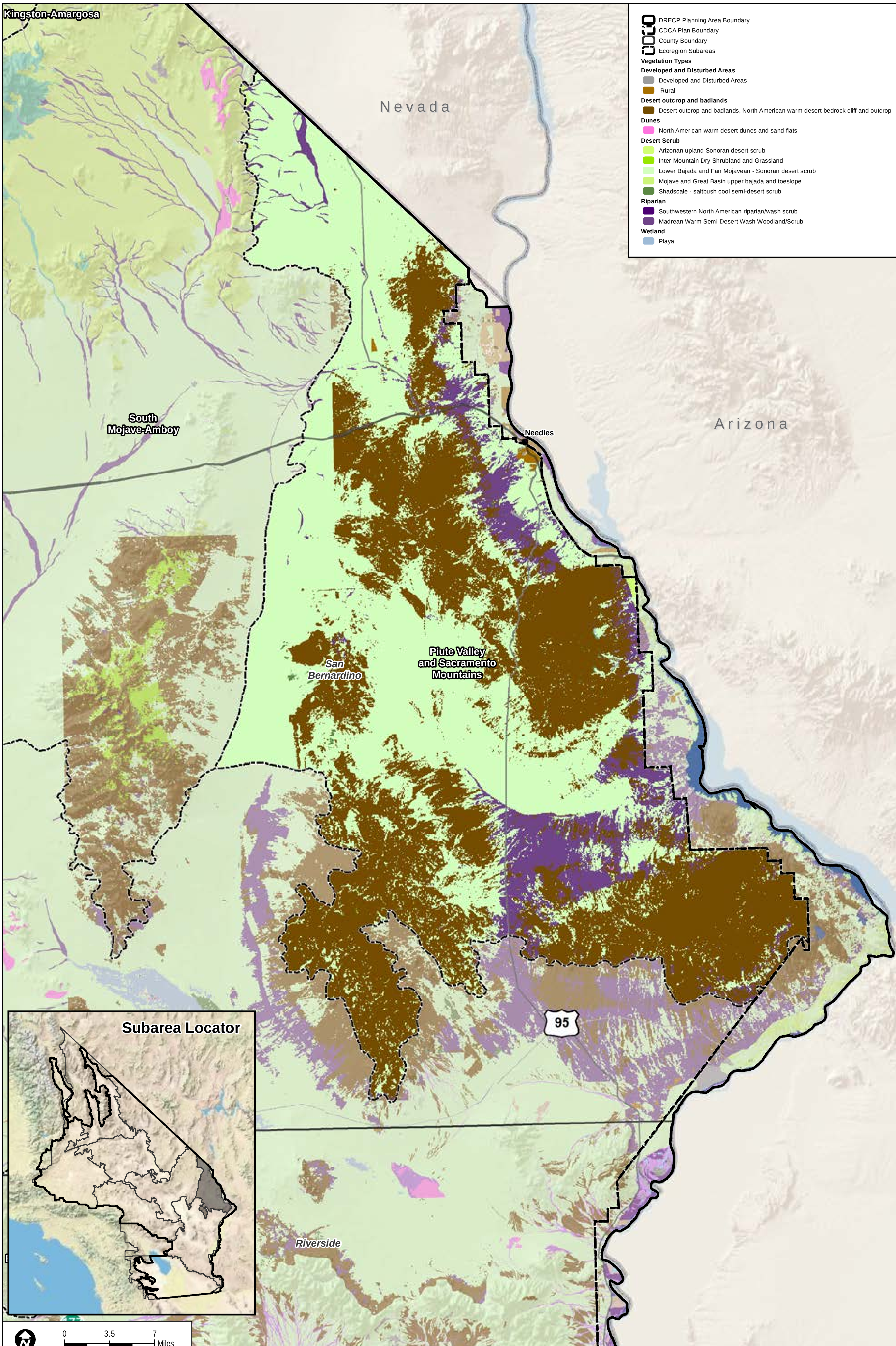

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-12

Vegetation Types and Other Land Covers - Piute Valley and Sacramento Mountains Ecoregion Subarea

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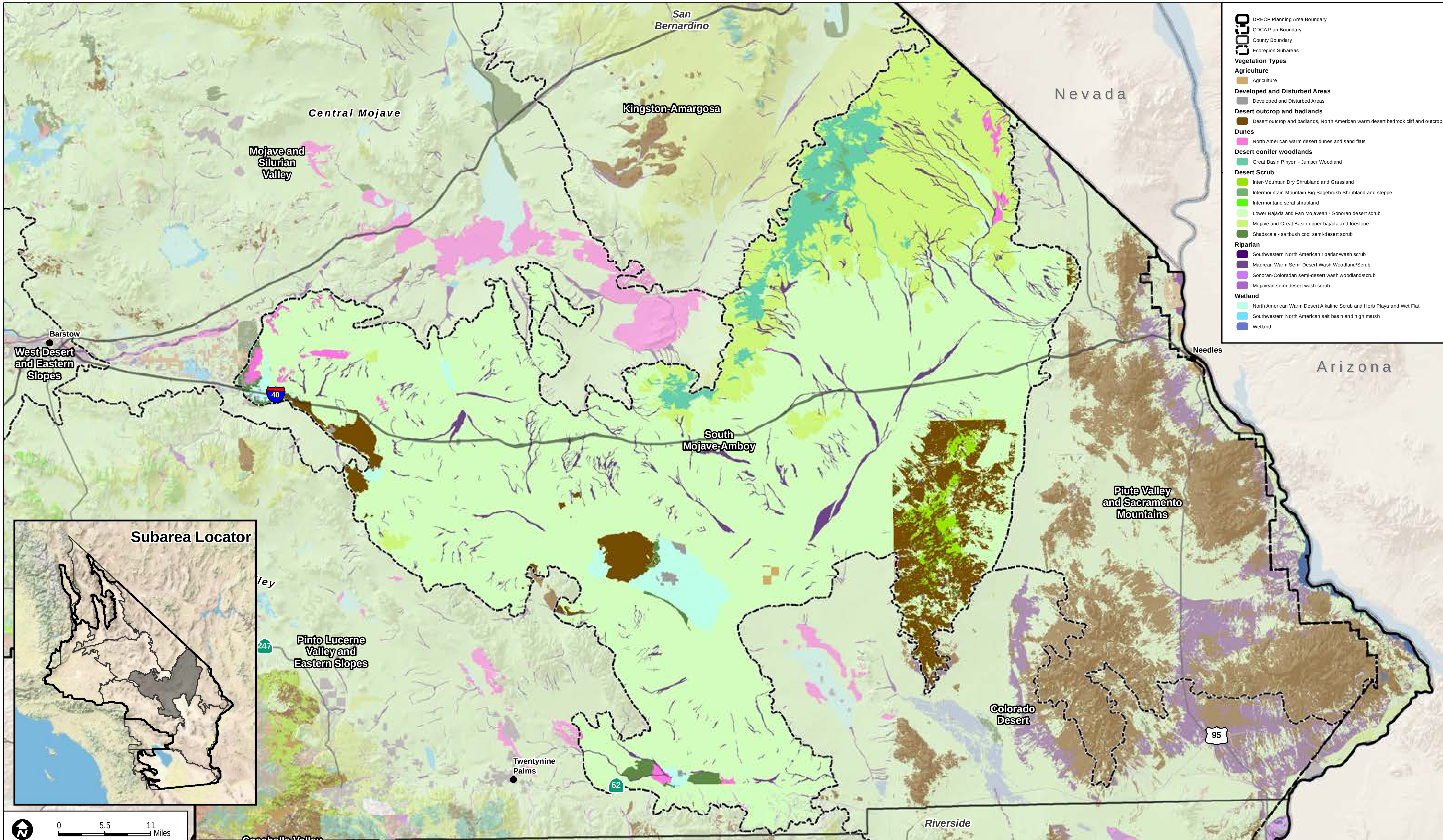

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-13

Vegetation Types and Other Land Covers - South Mojave-Ambo Ecoregion Subarea

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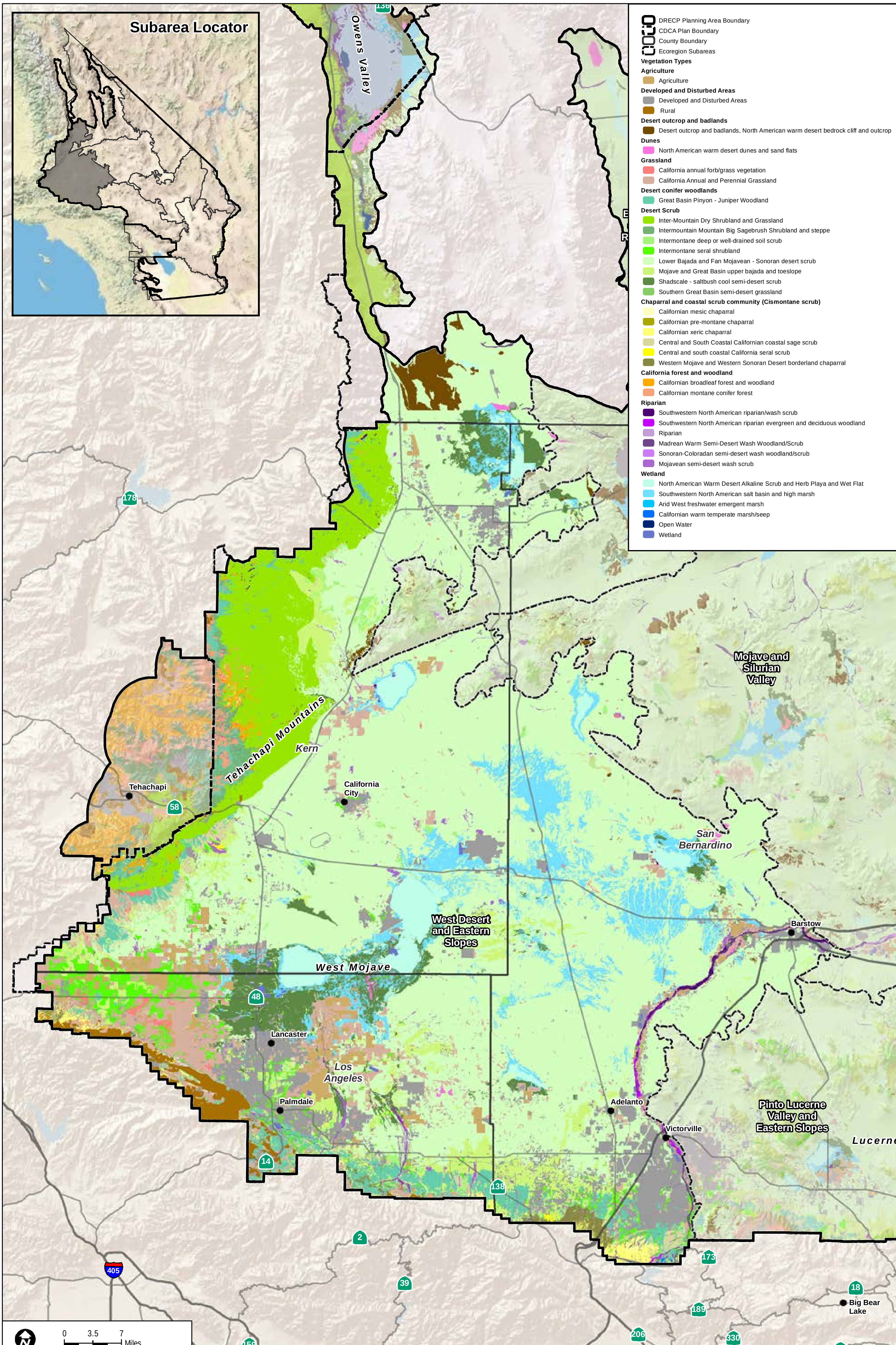

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-14

Vegetation Types and Other Land Covers - West Desert and Eastern Slopes Ecoregion Subarea

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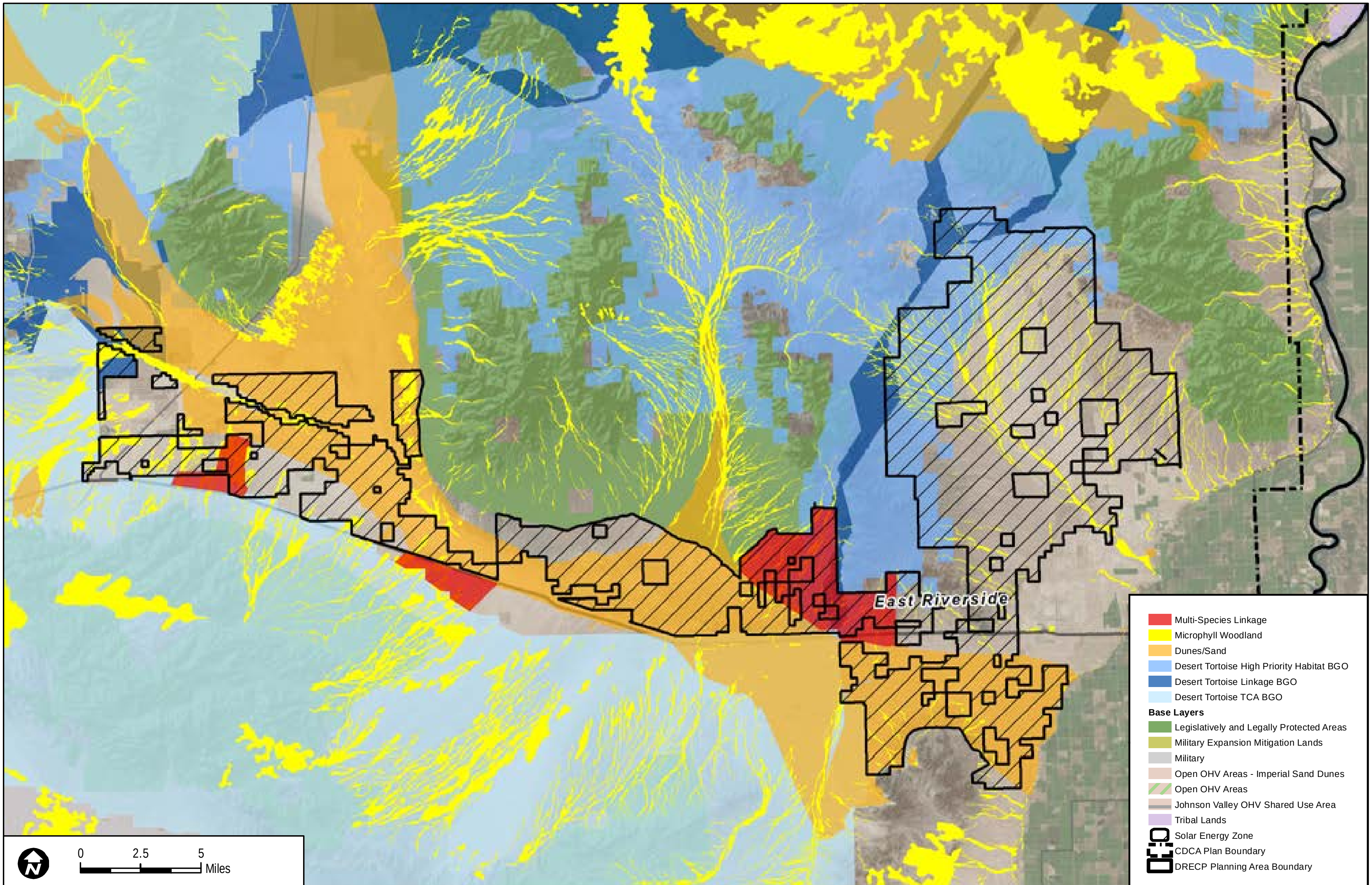

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-15

Eastern Riverside SEZ Linkages

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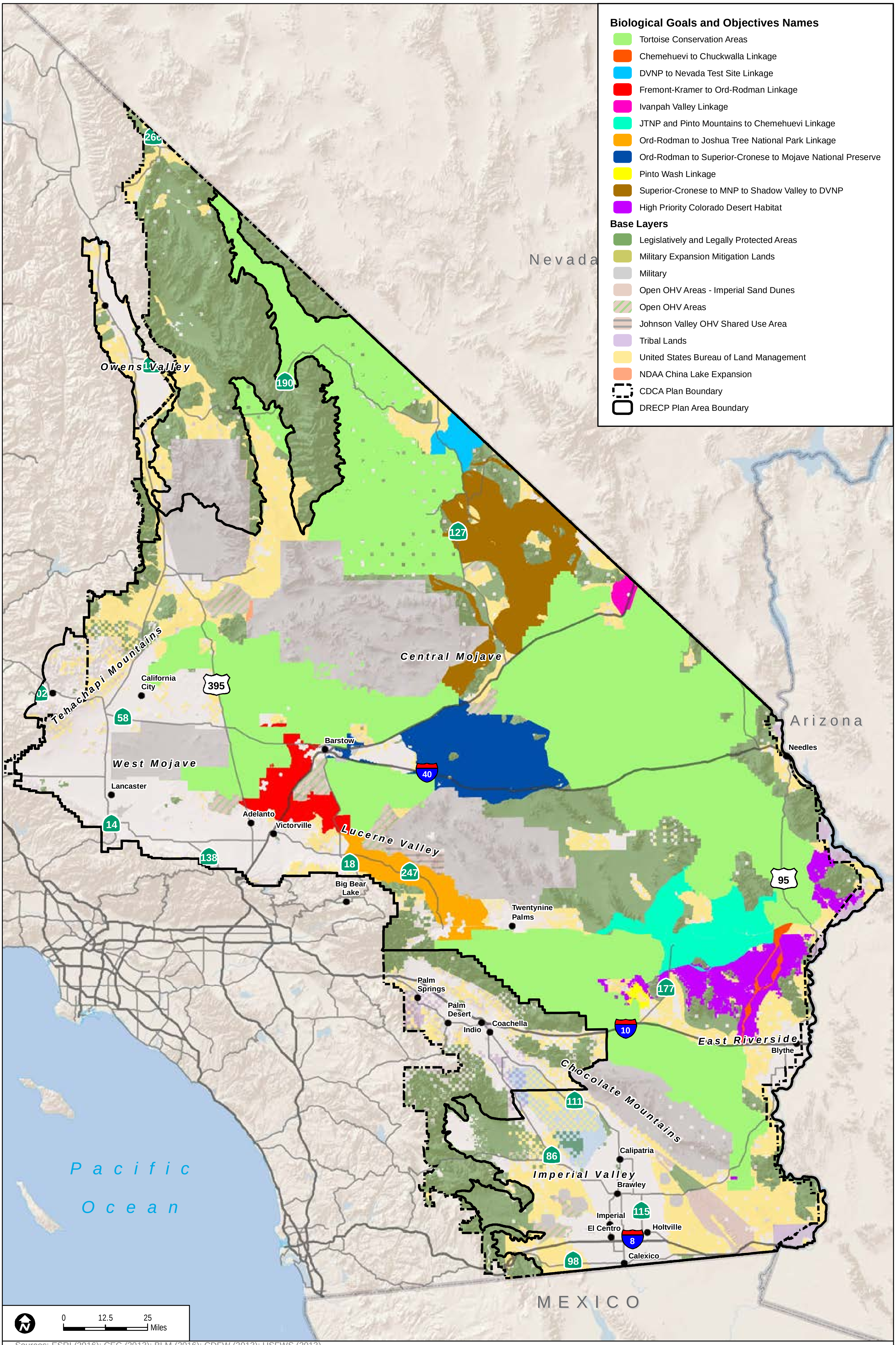

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-16

Desert Tortoise TCAs and Linkages

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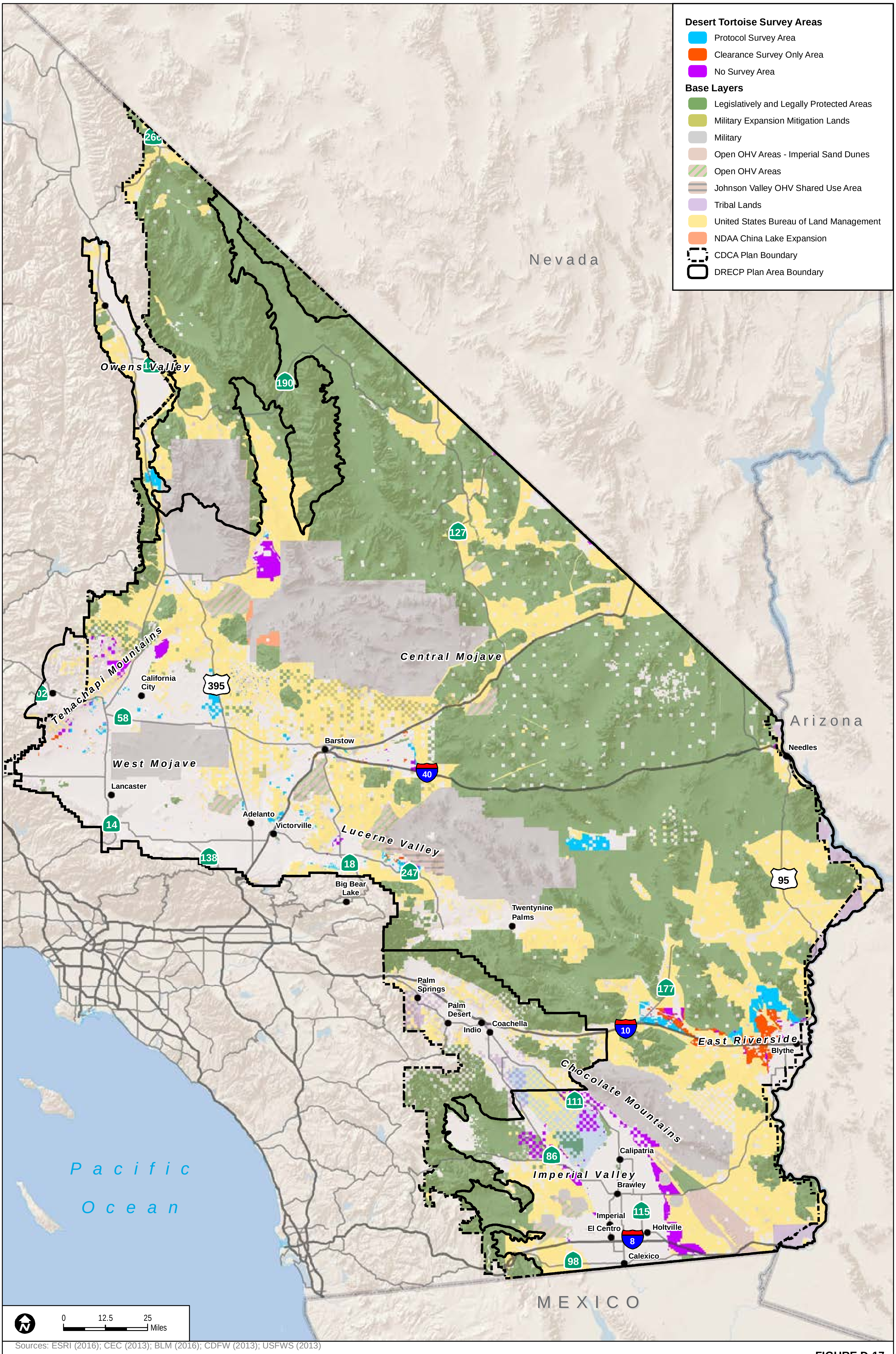

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-17

Desert Tortoise Survey Areas

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D.2.7 Burrowing Owl

The follow provides recommended methods and details for Burrowing Owl exclusion and verification as per CMA LUPA-BIO-IFS-13.

Burrow Exclusion

- Ideally, exclusion and burrow closure is employed only where adjacent natural alternative burrows and non-impacted, sufficient habitat for burrowing owls to occupy or occupy in a higher density with permanent protection mechanisms in place. Monitoring should follow the CDFW Staff Report on Burrowing Owl (2012) and prior to any burrow exclusions or excavations, confirmation that the burrow is not currently supporting nesting or fledgling activities is required. Burrowing owls are not to be excluded from burrows unless or until:
    - Biological monitoring is conducted prior to, during, and after exclusion of burrowing owls from their burrows sufficiently to ensure that take is avoided. If the exclusion will occur immediately after the end of the breeding season, conduct daily monitoring for one week to confirm young of the year have fledged.
- Before burrow excavation, there must be verification that burrows are empty. This will be achieved through biological monitoring and burrow scoping. After implementing the avoidance CMAs if burrowing owl burrow excavation is deemed necessary, the following burrow closure actions will be implemented for burrows to be impacted/excavated:
    - Confirm by biological monitoring that the burrow(s) is empty of burrowing owls and other species preceding burrow scoping.
        - Use appropriate type of scope and appropriate timing of scoping to avoid impacts to burrowing owls.
    - Occupancy factors to look for and methods to employ to guide determination of vacancy and excavation timing:
        - Leaving one-way doors in place for a minimum of 48 hours to ensure burrowing owls have left the burrow before excavation, visited twice daily and monitored for evidence that owls are inside and can't escape (i.e., look for sign immediately inside the door).
        - Verify that the sides of the one-way doors have not been excavated thereby bypassing the one-way door exclusion by the burrowing owl.
- Excavation using hand tools and backfilling to prevent reoccupation is preferable whenever possible. This practice may include using piping to stabilize the burrow to

prevent collapsing until the entire burrow has been excavated and it can be determined that no owls reside inside the burrow.

- Photograph the excavation and closure of the burrow to demonstrate success and sufficiency.
- As practicable, render the site inhospitable to burrowing owls and fossorial mammals to avoid re-colonization until construction is complete through measures that could include allowing vegetation to grow tall, heavy disking, or immediate, continuous grading and removal of other potential owl burrow surrogates or refugia on the site.
- Monitor the site to evaluate success and, if needed, to implement remedial measures to prevent subsequent owl use and to avoid take.

D.2.8 Mohave Ground Squirrel

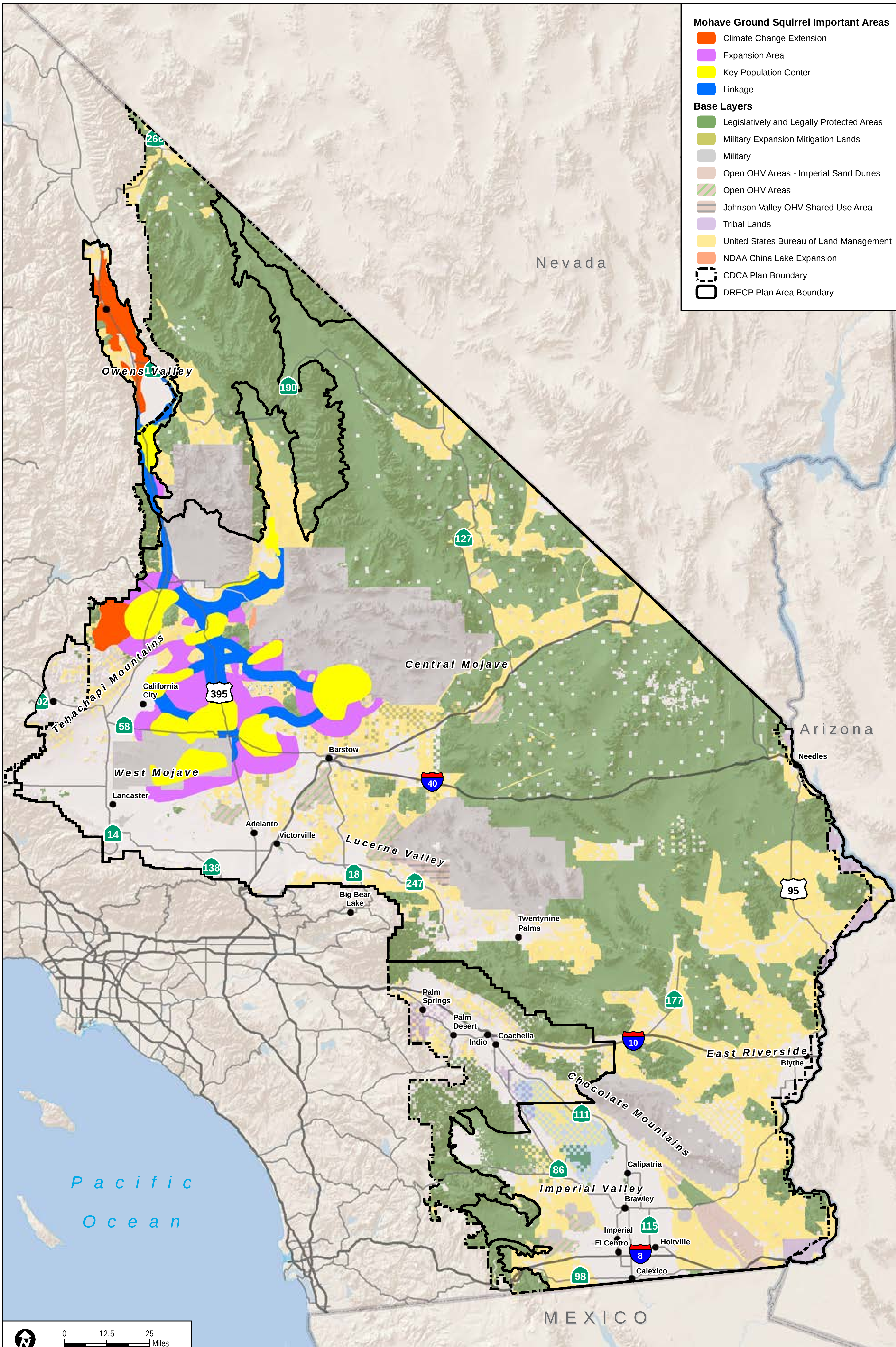
Figure D-18, Mohave Ground Squirrel Important Areas, is to be used, at a minimum, in implementing CMAs LUPA-BIO-1, LUPA-BIO-IFS-35 through 40, LUPA-BIO-COMP-1, DFA-VPL-2, DFA-BIO-IFS-1 and 2, and DFA-BIO-IFS-4 and 5.

Figure D-19, Mohave Ground Squirrel Survey Areas, is to be used, at a minimum, in implementing CMAs LUPA-BIO-1, LUPA-BIO-IFS-35 and 39, CONS-BIO-IFS-9, and DFA-VPL-2.

D.2.9 Bird and Bat Compensation

As part of the CMA LUPA-BIO-COMP-5, the compensation for the mortality impacts to bird and bat Focus and BLM Special Status Species from activities will be determined based on monitoring of bird and bat mortality and a fee re-assessed every 5 years to fund compensatory mitigation. The initial compensation fee for bird and bat mortality impacts will be based on pre-project monitoring of bird use and estimated bird and bat species mortality from the activity.

Each activity, as determined appropriate by BLM in coordination with USFWS, and CDFW as applicable, will include a monitoring strategy program to provide activity-specific information on mortality effects on birds and bats in order to determine the amount and type of compensation required to offset the effects of the activity. Monitoring data will be collected using methodologies and reporting formatting which allows for scientifically robust cross-comparisons. Compensation will be satisfied by restoring, protecting, or otherwise improving habitat such that the carrying capacity or productivity is increased to offset the impacts resulting from the activity. Compensation may also be satisfied by non-restoration actions that reduce mortality risks to birds and bats (e.g., increased predator control and protection of roosting sites from human disturbance). Compensation will be consistent with the most up to date DOI mitigation policy.



Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-18

Mohave Ground Squirrel Important Areas

DRECP BLM Land Use Plan Amendment

September 2016

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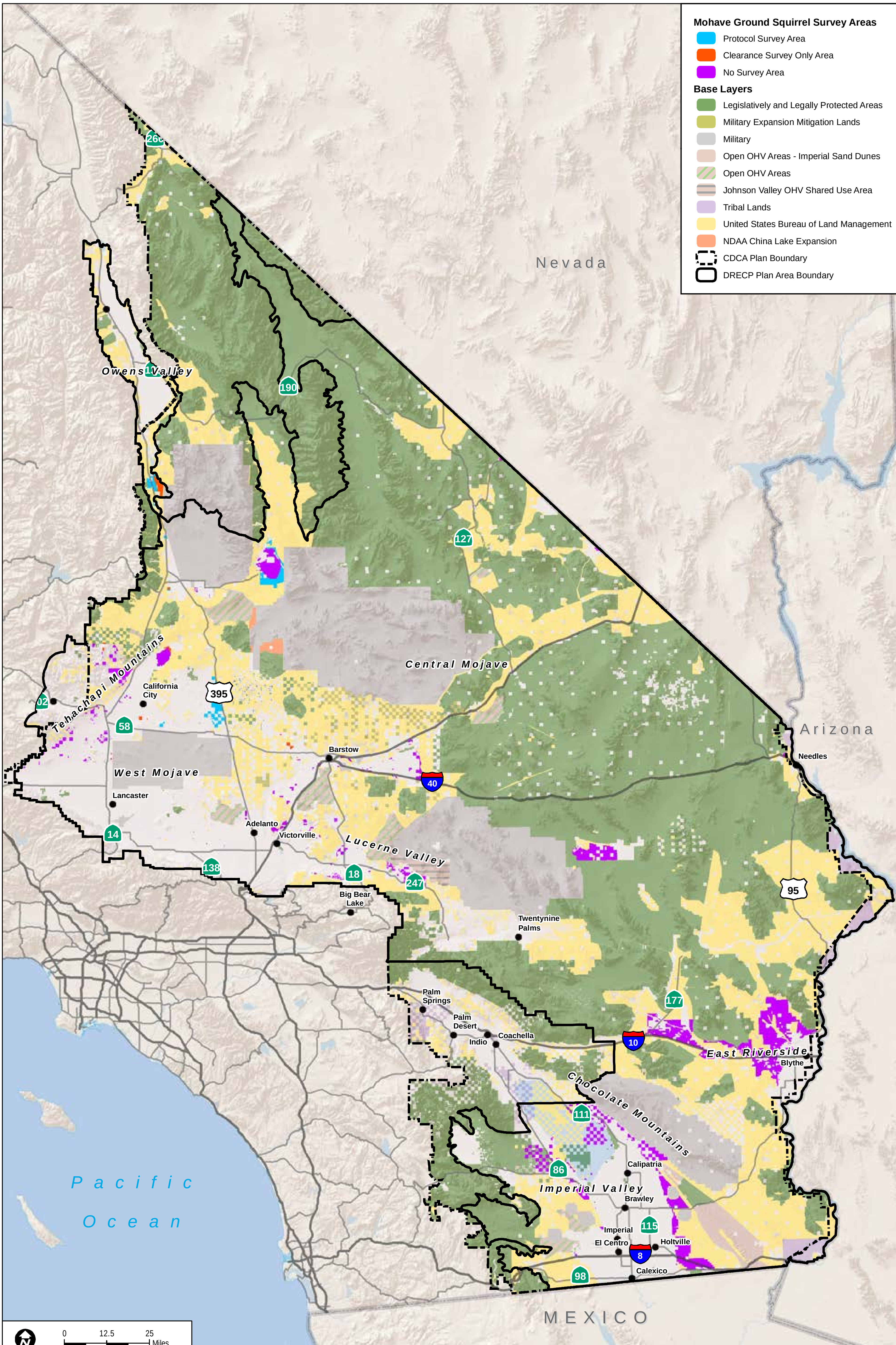

Sources: ESRI (2016); CEC (2013); BLM (2016); CDFW (2013); USFWS (2013)

FIGURE D-19

Mohave Ground Squirrel Survey Areas

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The approach to calculating the operational bird and bat compensation is based on the total replacement cost for a given resource, a Resource Equivalency Analysis (REA). This involves measuring the relative loss to a population (debt) resulting from an activity and the productivity gain (credit) to a population from the implementation of compensatory mitigation actions. The measurement of these debts and gains is used to estimate the necessary compensation fee. It is important to recognize that both sides of the balance sheet, estimate the debt and credit in the same currency, to clearly and transparently estimate the degree of compensation necessary. In this case, the currency is the number of bird/bat-years gained or lost because of activity related impacts and the resulting compensation.

The accuracy with which the debt/credit of bird/bat-years can be estimated is dependent upon the extent to which the life history, demographics, reproductive rate, and susceptibility to operational impacts are known. The ability to estimate the relative debt varies. For example, the method developed for the REA for golden eagle and wind turbine collisions is relatively sophisticated; the age-specific susceptibility to collisions turbines is known and provides an age-specific estimate of future loss of productivity, which allows a multi-generational estimate of resource debt in bird-years (USFWS 2013b). Simplification of the model is necessary where parameters are unknown, for example, the use of average age rather than age classes for estimating loss of productivity of sea eagles in Norway to wind turbines (Cole 2011). Similarly, the ability to estimate the credit given as a consequence of a compensation action is also based in an understanding of the life history of a given species, except in this case it is the overall credit in terms if increased productivity and increased bird-years that is the measure of the effectiveness of compensation.

D.2.9.1 Estimating Loss

Using the method described in Cole (2011) the direct (individual loss) and indirect (life-time productivity) cost of losing an average aged individual to a population were estimated. Life tables for each species were developed based on published life history parameters.

Given the uncertainty of the age-specific mortality rates birds and bats, high and low estimates for the loss of individuals were estimated to set upper and lower boundaries on the size of the loss. The low estimate assumed an initially high juvenile mortality rate with a constant age-specific mortality rate for adults (typical of many bird populations); while the high estimate assumes the same high initial mortality rate for juveniles, with most of the remaining mortality occurring in old age, i.e., the last 2-4 years of published maximum lifespan. Table D-1 presents bird/bat-years lost for the loss of an average aged individual due to operations of Covered Activities; this is the measure against which any compensation would be measured. The estimates given in Table D-1 are based on published lifespan data and generalized age-specific mortality rates. This method compensates for the direct “injury” to the population (Zafonte & Hampton 2005), no compensation for the time delay between the original loss and the successful compensation is explicitly built into the calculation.

Table D-1
Population Debt in Comparison to Compensatory Restoration Credits for Birds and Bats

Functional Group	Species	Population debt per Whole Bird Loss (bird-years)[1]	Restored Nesting Habitat Compensation Acreage per Whole Bird Loss	Population credit per Whole Bird Gain (bird-years)[2]
		A	*B*	*C*
Riparian Woodland	SW Willow Flycatcher[3]	5.5-6.5	5	5.0-7.0
	Least Bell's Vireo[4]	5.0-6.5	2	4.0-5.5
	Western yellow billed cuckoo[5]	2.5-3.0	Minimum 20	2.5-3.0
	Gila woodpecker[6]	4.5-8.0	24	5.5-6.0
Wetland	Yuma clapper rail[7]	5.5-6.5	2	5.0-7.0
	California black rail[8]	5.0-6.5	2	4.0-5.5
Scrub/desert	Bendire's thrasher[9]	4.5-8.0	N/A[11]	5.5-6.0
Bats[10]	Pallid	4.5-8.0	N/A[12]	5.5-6.0
	California leaf-nosed	4.5-8.0	N/A[12]	5.5-6.0
	Townsend's big eared[13]	unknown	unknown	unknown

Notes:

1 Bird/bat-years lost per average aged bird/bat lost, including future productivity, assuming 0.5 offspring per individual per year.
2 bird-years per additional individual contributed to population
3 Sedgwick 2000; USGS 2014
4 Kus et al 2010
5 Janice 1999; USGS 2014
6 Edwards & Schnell 2000
7 Scott et al. 2012
8 Edelman et al 2004
9 England and Laudenslayer 1993
10 Wilkinson & South 2002
11 Insufficient information to estimate nesting habitat compensation.
12 Only threat reduction management actions such as roost protection available.
13 Insufficient Life history information to estimate credits and debts.

D.2.9.2 Estimating Habitat Restoration and Enhancement Compensation

The compensation framework emphasizes compensation through in-kind ecological restoration and/or management activities that aim to increase population level productivity, or reduce mortality factors (avoided cost). To implement these programs effectively, the population productivity gains are evaluated so that credits can be accurately calculated (Column C of Table D-1). Under this framework, it is infeasible to evaluate fully the benefits of compensatory programs *a priori*. Therefore, the MAMP includes bird and bat impacts and compensation effectiveness monitoring.

The productivity of breeding habitat provides an example of how the effectiveness of compensation can be measured using REA. Table D-1 lays out the population credits (bird-years) resulting from a given acreage of successfully restored or managed breeding habitat for covered bird species. The measure of success, for a successfully restored or managed breeding territory (Column B of Table D-1) is the expected bird-years per bird fledging (Column C of Table D-1). This method assumes that each fledging bird would live to an average age. For example, the loss of a single Yuma clapper rail due to operational activities would result in the loss of 3.0-4.0 bird-years (both direct and indirect) from a population (Column A of Table D-1). The restoration or improved management of a breeding territory of about 2-25 acres (Column B of Table D-1) would, if successful, offset the loss of a single individual with the successful fledging of 1 individual from that habitat (Column C of Table D-1)[1]. The implication of this approach is that one successfully restored and managed breeding territory, could generate multiple population credits over the lifetime of the activity. The compensation for the impacts to bird and bat from activities will be determined based on annual monitoring of bird and bat mortality and a fee for re-assessed every 5 years to fund compensatory mitigation. Initial compensation fee for bird and bat impacts would be based on pre-project monitoring of bird use and estimated bird and bat mortality as a result of the activity.

For species that do not breed within the DRECP LUPA Plan Area (e.g., mountain plover and greater sandhill crane), restoration or improved management of breeding habitat is not feasible. However, restoration and maintenance of foraging habitat, with the aim of increasing winter survival may be possible. A greater understanding of the relationship between restoration of foraging habitat and winter survival is needed to determine the degree of compensation necessary to offset impacts. For Bendire’s thrasher, too little is understood about the nesting behavior to establish an acreage restoration requirement; again further research is required. Swainson’s hawk are not territorial, except to defend the nest, therefore, compensatory restoration of nesting habitat would an inappropriate measure.

For bats, it is possible to establish both the population debt and compensatory credit for successful compensatory actions. However, since bat compensation would rely on threat reduction compensation a restoration acreage is not a relevant measure for restoration.

1 The subsequent productivity of the fledgling is not included in the calculation because this is an estimate of breeding habitat contribution to the population not the future productivity of an individual.

D.2.9.3 Threat Reduction Compensation

Compensation management actions for birds and bats are a wide variety of potential compensation actions that could reduce mortality factors. Actions that result in avoided cost to the population (i.e., avoided mortality) would use the framework described above if avoided cost to the population can be quantified. Assessment of these compensation actions relies on understanding the relative success of a population prior to the implementation of compensation actions (i.e., an understanding of baseline conditions), in order to evaluate and subsequent gains. For avoided cost mitigation actions, population monitoring is critical so that the effectiveness of compensation can be attributed accurately.

Threat-reduction compensation actions that benefit the populations of impacted bird and bat species include the following:

- Nest site and roost protections.
- Retrofitting or undergrounding transmission lines - Power line retrofitting following current Avian Power Line Interaction Committee (APLIC) standards in the LUPA Plan Area could reduce the risk of future electrocutions and undergrounding transmission lines would remove the threat. As a compensation action, power line retrofitting must be in addition to existing, ongoing retrofitting programs being conducted by the utilities.
- Repowering existing wind facilities – Aging, inefficient wind power generation facilities that may kill or injure birds and bats may present an opportunity to repower or re-site or remove them to reduce the amount of ongoing mortality.
- Predator control and management programs, such as cowbird control for least Bell's vireo. Again, the effectiveness of these compensation actions require an understanding of both the lifetime contribution of an individual and the gains to the population in terms of avoided losses. It is unknown if the scale at which it would need to be implemented would make this a feasible approach for compensation.
- For bats, compensation would almost entirely consist of management actions designed to reduce threats from encroachment of human activity on significant roosts. For example, human access to mines may be restricted by funding gating and/or fencing that does not block bat access at abandoned mine features.

At present insufficient information is available to estimate the linkage between avoided losses and threat reduction actions for Townsend's big-eared bat, pallid bat, and California leaf-nosed bat.

D.3 Native American Interests

Figure D-20, 1980 CDCA Plan Native American Element and Cultural Resources Element, resulted from interviews and discussions with tribal elders. The Tribes consider this map to be one of the more accurate depictions of specific areas of concern to the Tribes. This map is for use in implementation of LUPA-CUL-, CONS-CUL-, and DFA-VPA-CUL- CMAs regarding Native American and tribal interests.

D.4 Livestock Grazing

Figure D-21, Grazing Allotments within DRECP/CDCA, is for use in implementing CMAs associated with grazing and grazing allotments.

D.5 Minerals

Figure D-22, High Potential Mineral Areas within DRECP/CDCA, is for use in implementing LUPA-MIN-, NLCS-MIN-, and ACEC-MIN- CMAs.

D.6 Transmission

D.6.1 Transmission Technology Description

New or modified/expanded transmission facilities will be necessary for implementation of renewable generation projects in the DRECP Plan Area. Transmission facilities generally include transmission lines, access roads, and substations.

Transmission Lines (including Generator Tie Lines)

Extending or expanding a transmission line may require acquisition and/or expansion of right-of-way (ROW). Most transmission line activities would generally occur within an existing ROW, but in some cases access roads may be located outside of the designated ROW. Support structures for transmission lines may include lattice steel towers, wood poles, steel monopoles, and transition structures that are specially designed support structures for changing line direction and terminal or "dead-end" line features. Foundations and guy wires may be part of the support structures. In addition, safety features, such as aerial marker spheres and aircraft warning lighting, may also be required. Transmission facilities would also require access and spur roads for both construction and operation/maintenance.

For the purpose of the DRECP LUPA, all acreage within a given ROW was assumed to be affected by transmission construction and operation impacts, which incorporates the individual effects of activities such as tower footprints, laydown yards, pulling sites, and access roads. A Transmission Technical Group (TTG) was convened to identify potential transmission lines that could connect renewable energy generation in the DRECP Plan Area to load centers. See Appendix K of the 2014 Draft DRECP and EIR/EIS and 2015 Proposed LUPA and Final EIS for the report completed by the TTG. As part of this effort, the TTG developed assumptions for standard transmission components. Transmission line length and width are based on the approximate distance (length) to substation locations and the ROW (width) requirements. Access road length and width are based on the size of the substation, the length of the transmission line, and standard construction methods. Each 230 kV and 500 kV line is assumed to require a permanent access road. The use of helicopters to install transmission lines may reduce the need for access roads in certain situations. Table D-2 below provides the typical characteristics of standard bulk transmission components that the TTG used to calculate the acreage of impacts required for new transmission lines.

Table D-2
Typical ROW Widths and Linear Impacts of Bulk Transmission

Transmission Line Voltage	Transmission ROW Corridor Width (feet)	Access Road Width (feet)	Impact Extent for 1 Linear Mile (Acres)
34.5 and 66 kV			
Double Circuit Tower Line	30	N/A	3.6
230 kV			
Double Circuit Tower Line	100	24	15
500 kV			
Single Circuit Tower Line	200	24	27
Two Single Circuit Tower Lines	450	24	57
Three Single Circuit Tower Lines	700	24	88
Four Single Circuit Tower Lines	950	24	118

Notes:
ROW spacing is based on Western Electricity Coordinating Council adjacent circuit's definition in order to avoid credible N-2 contingency considerations for lines operated above 300 kV.
Access road width is added to ROW width for total width of linear disturbance.

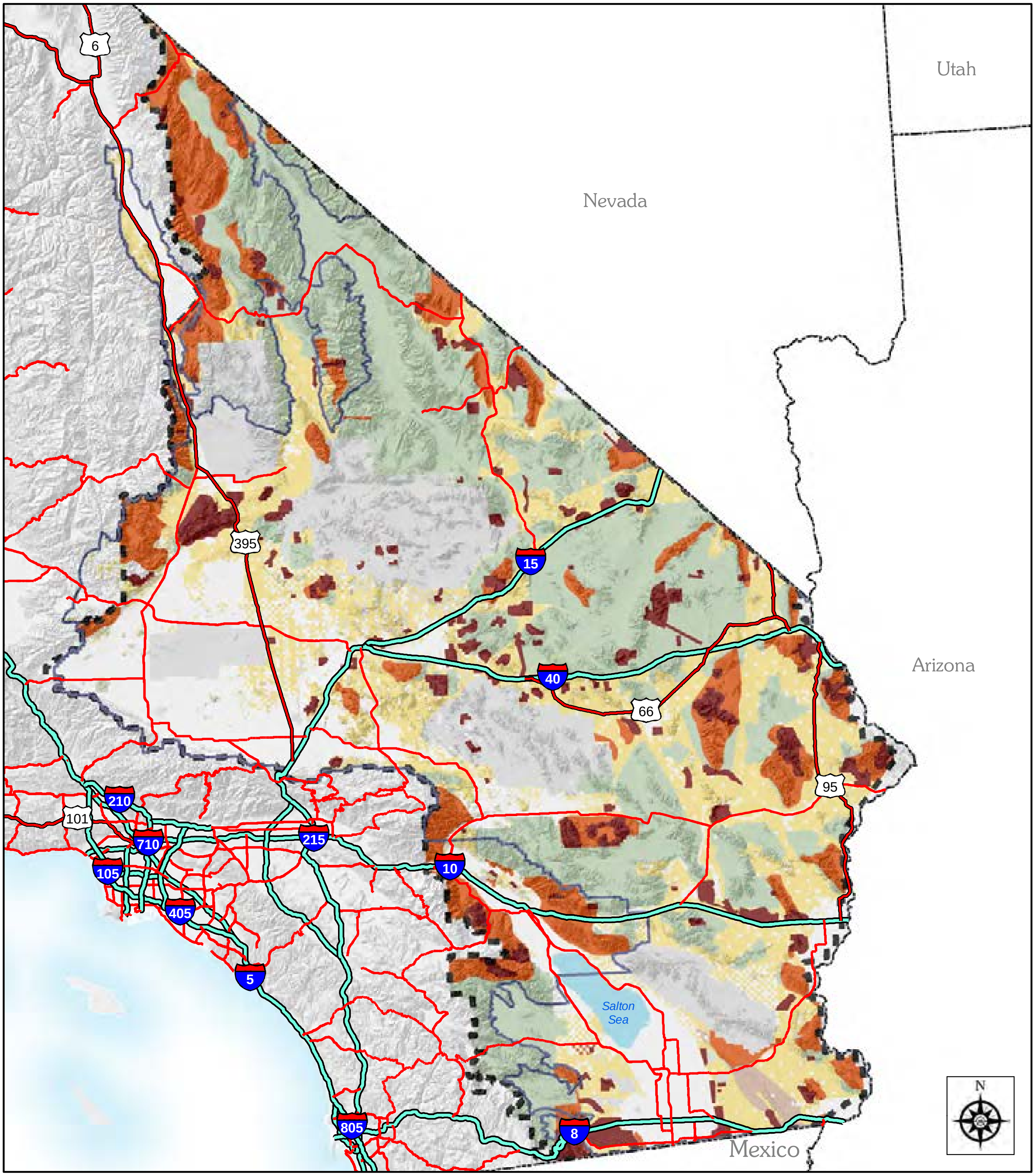

Figure D-20

1980 CDCA Plan Native American Element and Cultural Resources Element

8/1/2016

BLM California State Office

- Cultural Resources Element
- Native American Element
- DRECP Boundary
- CDCA Boundary
- LLPA
- Imperial Sand Dunes Open OHV Area

Land Status

- Bureau of Land Management
- Department of Defense

0 50 100
Kilometers

Miles
0 50 100

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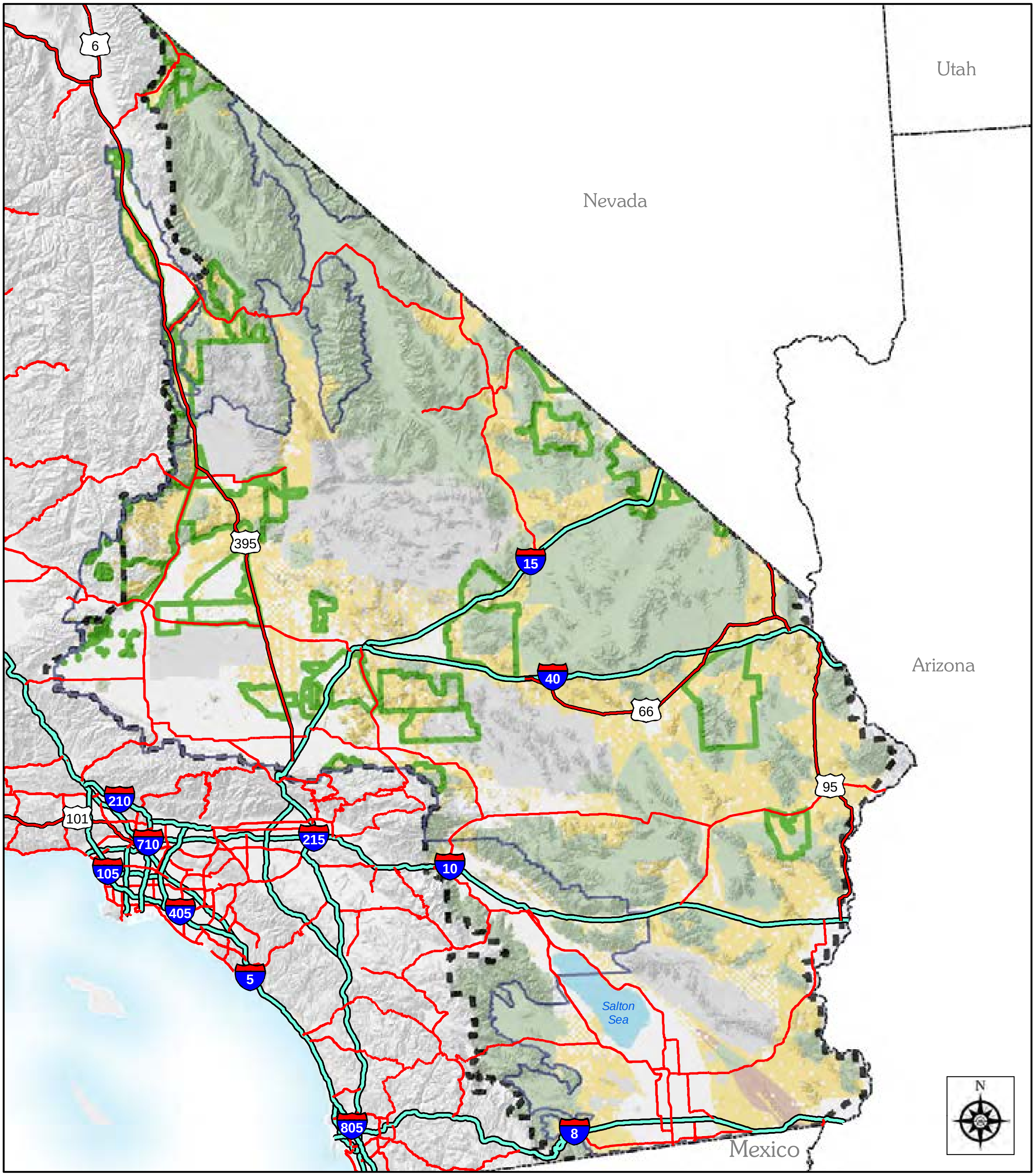


Grazing Allotments
DRECP Boundary
CDCA Boundary
LLPA
Imperial Sand Dunes Open OHV Area

Land Status

Bureau of Land Management
Department of Defense

Figure D-21

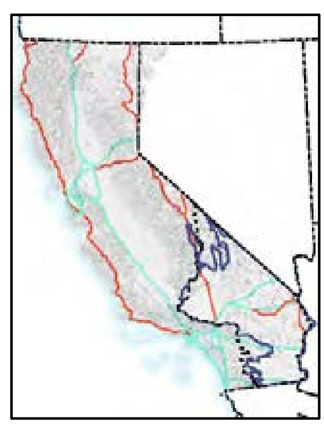
Grazing Allotments within DRECP/CDCA

8/1/2016

BLM California State Office

0 50 100
Kilometers

Miles
0 50 100



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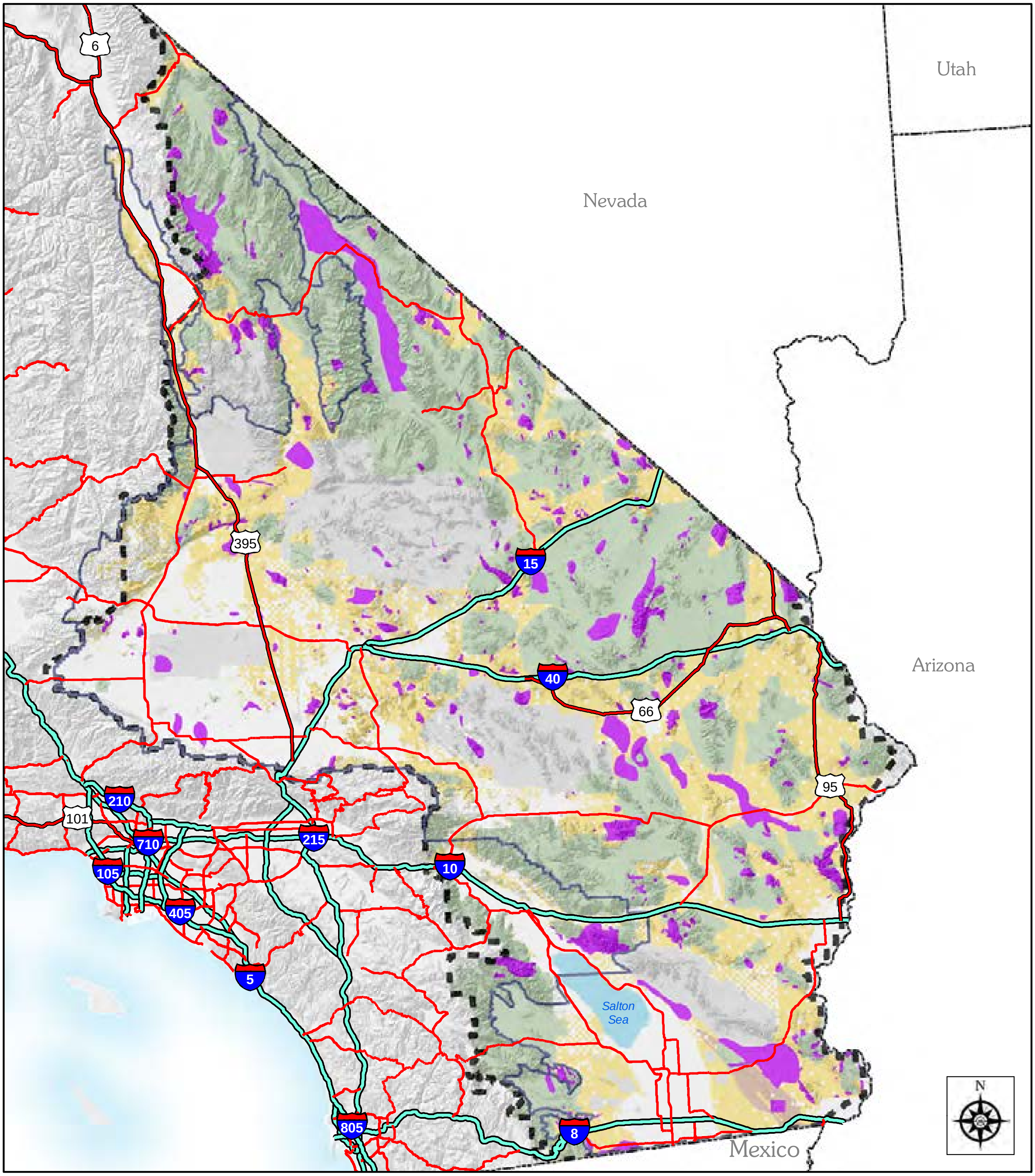


High Potential Minerals
DRECP Boundary
CDCA Boundary
LLPA
Imperial Sand Dunes Open OHV Area

Land Status

Bureau of Land Management
Department of Defense

Figure D-22

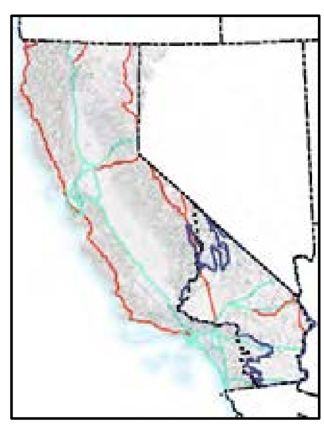
High Potential Mineral Areas within DRECP/CDCA

8/1/2016

BLM California State Office

0 50 100
Kilometers

Miles
0 50 100



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Substations and Switchyards

Substations and switchyards are hubs for electrical power sources, and provide a junction and control power flow between the generation facilities and the transmission lines in the area. Substations and switchyards typically contain transformers, shunt capacitors, breakers, disconnect switches, protective relays, metering and Supervisory Control and Data Acquisition system equipment, emergency power generators, fire prevention systems (including hydrants, water tanks, and walls between transformer phases), relay/ control shelters, storage buildings, oil and chemical containment systems, and communications facilities. Telecommunication lines are often required for substations and are often, but not always, strung on transmission structures.

A new or expanded substation may require ground disturbance to accommodate additional transformers, new distribution line outlets, and possibly new fencing for safety and security. Substation sites are typically graded, paved, or surfaced with hardscape. Table D-3 describes the sizes of various types of substations. Table D-4 describes activities generally associated with transmission, substations, and generator tie lines.

Table D-3
Typical Substation Size

Substation Type	Description	Size (Acres)
66 kV Collector Substation	Receiving transmission from generators or from smaller collector substations. Serves as the receiving point for 66 kV collector transmission lines	39 acres
230/66 kV Collector Substation	Serves as the receiving point for both 230 and 66 kV collector transmission lines	77 acres
500/230 kV Collector Substation	Serves as the receiving point for 500 kV and 230 kV collector lines and 230/66 kV collector substations	176 acres
500/230/66 kV Super Collector Substation	The largest and most flexible substation, as it can serve as the receiving point for 500 kV, 230 kV, and 66 kV collector lines and 230 and 500 kV lines that connect this facility to the bulk electric grid	215 acres

Table D-4
General Description of Activities Associated with Transmission, Substations, and Generator Tie Lines

Activity	Description
Initial (Pre-Construction) Activities	
Geotechnical borings	Full geotechnical testing to establish the suitability of the site for construction would vary depending on the size of transmission facilities needed.

Table D-4
General Description of Activities Associated with Transmission, Substations, and Generator Tie Lines

Activity	Description
Temporary access routes and staging areas for geotechnical borings	Temporary vehicular access to undertake pre-construction activity may result in unusual vehicular disturbance but generally, access corridors would be identified. This would include utilizing existing tracks and roadways where possible.
Site reconnaissance (including species-specific surveys)	Site surveyors would utilize the existing roads, tracks and access or may assess the areas on foot.
Construction	
Access roads/spur roads (permanent and temporary)	33kV to 69kV Power Lines - no permanent road is assumed to be constructed adjacent to the transmission ROW. 220-500kV Transmission Lines - Construction of a permanent road within the ROW would allow access for construction and subsequently maintenance inspections and repair. Roads would typically run along the ROW, and consist of compacted gravel surface assumed to be no more than 24 feet wide. Helicopters could be used for construction reducing the need for access roads
Ground-disturbance activities (including grading and clearing vegetation)	Grades within tower construction/erection areas would be made level to facilitate lifting-equipment placement and operation If helicopters are used for construction tower staging access pads would be required and may be graded
Site preparation (e.g., excavation for foundations)	Tower foundations would be constructed in accordance with sound engineering practice and in consideration of local conditions. Foundations for towers would be installed at a nominal depth of 14 to 35 feet, after consideration of climate and local soil and subsurface conditions. At least four such foundations would be required for each typical lattice-type tower, while only one foundation would be required for each monopole tower; however, the monopole foundation typically would be deeper (by as much as 20%) and wider than the corresponding dimensions of a lattice tower's foundation installed in the same subsurface conditions. Foundations would likely utilize steel-reinforced annular concrete rings of nominal widths of 4 feet and nominal thicknesses of 8 inches, the centers of which would be backfilled with indigenous soils. Substations and switchyards would be located near the mainline ROW; expansions to ROW dimensions would be made to accommodate such essential facilities when necessary.

Table D-4
General Description of Activities Associated with Transmission, Substations, and Generator Tie Lines

Activity	Description
	Substations are assumed to include land that allows for the permanent location of transformers and operations and maintenance facilities as well as a surrounding buffer of land to allow for the orderly organization of transmission lines that intersect at the substation. In total, the acreage of land required for a substation varies between 77–215 acres including the surrounding transmission buffer. Substation facilities would be underlain with grounding grids generally extending over the entire ground extent of the substation; in arid areas, grounding grids may need to extend beyond the substation footprint or, alternatively, wells would be drilled to the nearest aquifer for the purpose of establishing adequate electrical ground.
Tower Construction (220 kV and 500 kV lines)	Tower construction/erection activities include tower construction and cable stringing and pulling. Typically, each tower would require an assembly area of at least 100 feet by 200 feet, resulting in approximately 0.23 acre/mile of short term impacts. Lattice towers would require at least 80,000 square feet per tower for construction. For cable pulling activities two cable-pulling sites of 37,500 square feet each (150 feet by 250 feet) would be needed for each section under construction. The affected acreage associated with these activities is included within the overall ROW estimates and disturbance assumed by the TTG.
Clearing, staging, parking, construction trailer, and equipment and material storage areas	Temporary construction areas include laydown yards, on-site construction trailers, and material storage. Laydown areas would be maintained free of vegetation throughout the construction period for fire safety. Minimal grade alterations would be made. Temporary roads would be constructed for access to laydown areas by haul vehicles. Laydown areas for substations would be located entirely within the footprint granted in the lease for the substation.

Table D-4
General Description of Activities Associated with Transmission, Substations, and Generator Tie Lines

Activity	Description
	Laydown areas would not be used for long-term storage of equipment or materials (except that such storage would occur at substations). Laydown areas would be reclaimed at the end of the construction period, or as soon as the need for each laydown area has ended. Already disturbed areas would be used as laydown areas when available.
Fencing (temporary and permanent, for both wildlife and security)	Temporary security fencing would be installed around laydown yards, on-site construction trailers, material storage. Permanent security fencing would be required around substations.
Temporary drainage and erosion control (e.g., diversion channels, retention/detention basins, silt fences, erosion fabrics)	Temporary drainage and erosion control may be required at laydown yards and temporary sites, and would be determined on a project specific basis, and comply with county, state and federal requirements.
Permanent drainage: conveyance or semi-natural	Culverts and drainage modification may be necessary to divert and control runoff from road ways. It is assumed that such drainage systems would be constructed to federal and state standards.
Flood control structures	Temporary drainage control may be required at laydown yards and temporary sites including temporary roads, but would be determined at the on a project specific basis.
Operation and Maintenance	
Cleaning, maintenance, repair, and replacement of access roads and spur road, including trimming/removal of native vegetation growing in roadways	Cleaning repair and maintenance would be undertaken on an as needed basis following standard industry best management practices and guidance laid down on a project-by-project basis. Line re-conducting activities would require laydown areas and cable pulling sites similar to construction activities.
Cleaning and maintenance of transmission line	Biannual Transmission line inspection and insulator cleaning would take place either via vehicle or helicopter.
Hazardous materials treatment and disposal	Disposal of hazardous materials would be undertaken on an as needed basis following standard industry best management practices that minimize impacts on biological resources to the extent feasible. Substations transformers, capacitors, switches, bushings, and other electrical devices typically containing dielectric fluids would be free of polychlorinated biphenyls. Electrical equipment containing liquid

Table D-4
General Description of Activities Associated with Transmission, Substations, and Generator Tie Lines

Activity	Description
	dielectric fluids would be installed within adequate secondary containment features.
Vegetation management and weed/pest control including fire hazard/fuel management/clearing	Vegetation management and weed control would be undertaken to reduce fire risk. Clearance of and fuel management with power/transmission ROWs would be subject to California Public Utilities Commission, General Order 95 (CPUC GO 95)[1]
Decommissioning	
Removal structures	Decommissioning would involve removal of all aboveground facilities and gravel workpads and roads; subsurface facilities (grounding rods and grids, tower and building foundations, natural gas pipelines, etc.) would be removed to a depth of 3 feet belowground surface and otherwise abandoned in place. Laydown areas, each nominally 3 acres in size, would be established to support decommissioning; some may be located on the laydown areas used during construction. Dismantled components would be staged at laydown areas for only as long as necessary to arrange for their removal to disposal, reclamation, or recycling facilities.
Restoration and re-vegetation	All spills and contaminated soils would be remediated. All gravel packs would be removed. Reclamation of generation facilities laydown areas, substations, access roads, and other "deconstruction" areas would commence immediately upon completion of the dismantlement of the system.

Note:
1 This General Order controls the construction and operational safety of transmission facilities. It specifies the amount of clearance that is required between transmission facilities and encroaching vegetation, either to ensure that lines aren't affected by vegetation or to reduce the fire risk.

D.6.2 Designated Transmission and Utility Corridors

Figure D-23, Designated Transmission and Approved Utility Corridors, is a reference tool for implementing all CMAs that mention designated and approved transmission and utility corridors. Figure 23 only displays the major (i.e. primary) corridors. During design of a proposed activity, consult with the local BLM Office to determine all the designated and approved corridors in the vicinity of a proposed activity.

D.7 National Scenic and Historic Trail Corridors

Figures D-24 through D-34 display the National Scenic and Historic Trail (NSHT) corridors, by ecoregion subarea. These Figures are for use in implementing CMAs involving the NSHT corridors and for consultation during activity design in the vicinity of a HSHT or its corridor.

D.8 Renewable Energy

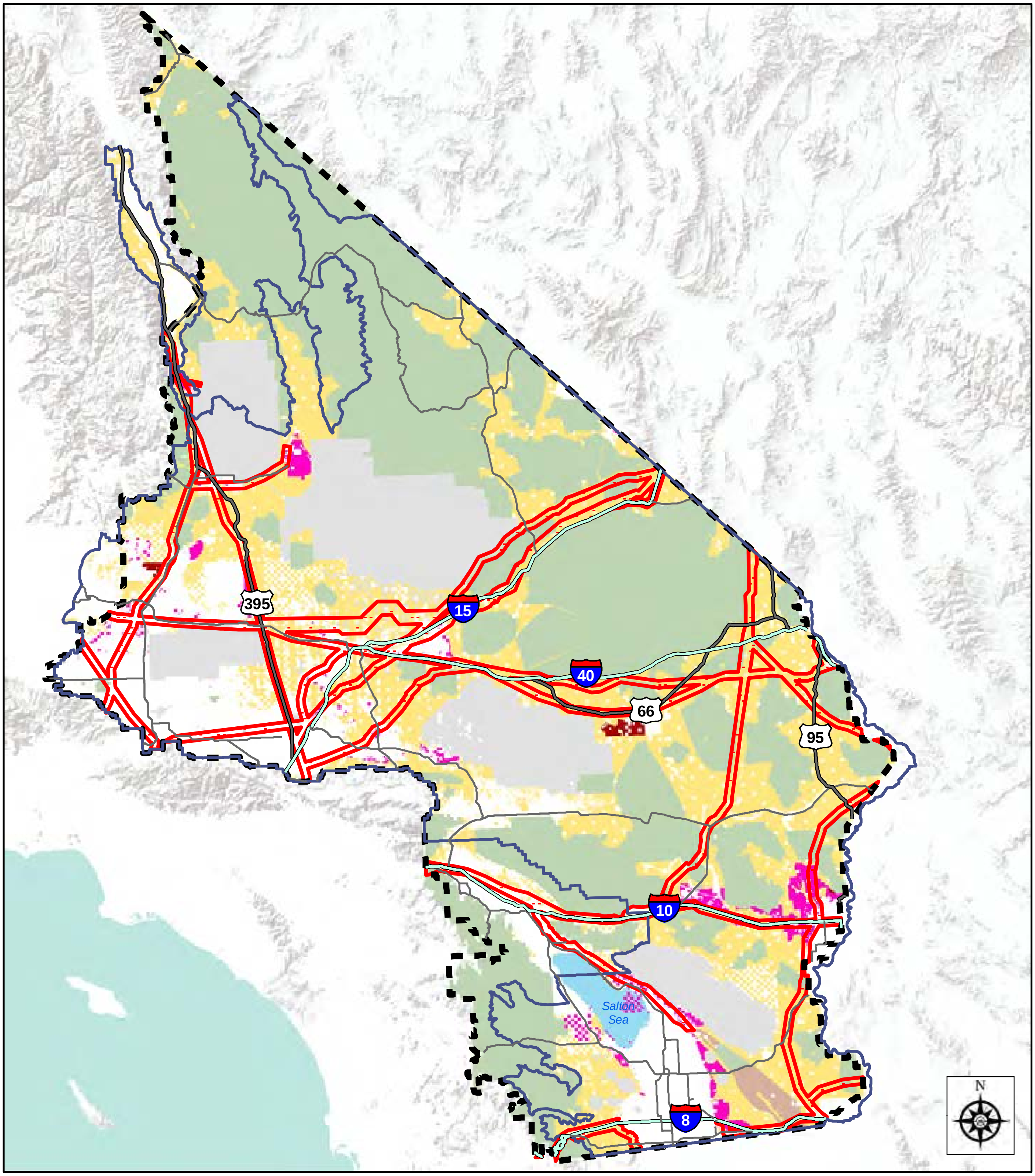
D.8.1 Technology Descriptions

This subsection describes the various renewable energy generation technologies for solar, wind and geothermal, in operation in the year 2016, including some of specific characteristics of current technology and design. Future advances in technology may affect the design of facilities within the timeframe of the DRECP LUPA; therefore, this information is for informational purposes only. This same information was provided in the Draft DRECP and EIR/EIS (2014) and the DRECP Proposed LUPA and Final EIS (2015).

D.8.1.1 Solar Energy Generation

Solar power facilities convert sunlight into electricity, either directly using photovoltaic (PV) technology, or indirectly with concentrated solar power (CSP). CSP focuses the sun's energy to heat a working fluid, such as heat transfer fluid, hydrogen, or water, which is then used to drive turbines or engines to produce electricity.

Features that are common to all solar projects include ancillary facilities, such as operation and maintenance buildings that may be used for storage and maintenance purposes. All solar projects would require access roads for construction, routine maintenance, and operations. Within a project site, maintenance roads would be required to provide access for washing and maintenance of the solar fields. In addition, on-site energy storage may also be included within the design of the solar projects. Large-scale electrical power storage technology is in developmental stages at present, but would likely be part of future projects.



- DFA
- VPL
- Transmission Corridors
- DRECP Boundary
- CDCA Boundary
- LLPA
- Imperial Sand Dunes Open OHV Area

Land Status

- Bureau of Land Management
- Department of Defense

Figure D-23

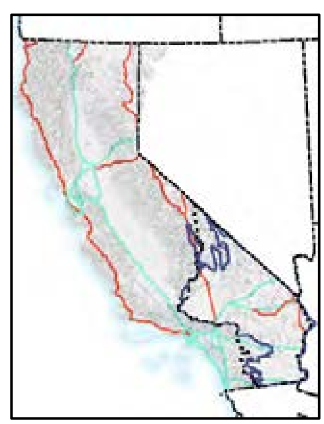
Designated Transmission and Approved Utility Corridors

8/10/2016

BLM California State Office

0 50 100 Kilometers

Miles 0 50 100



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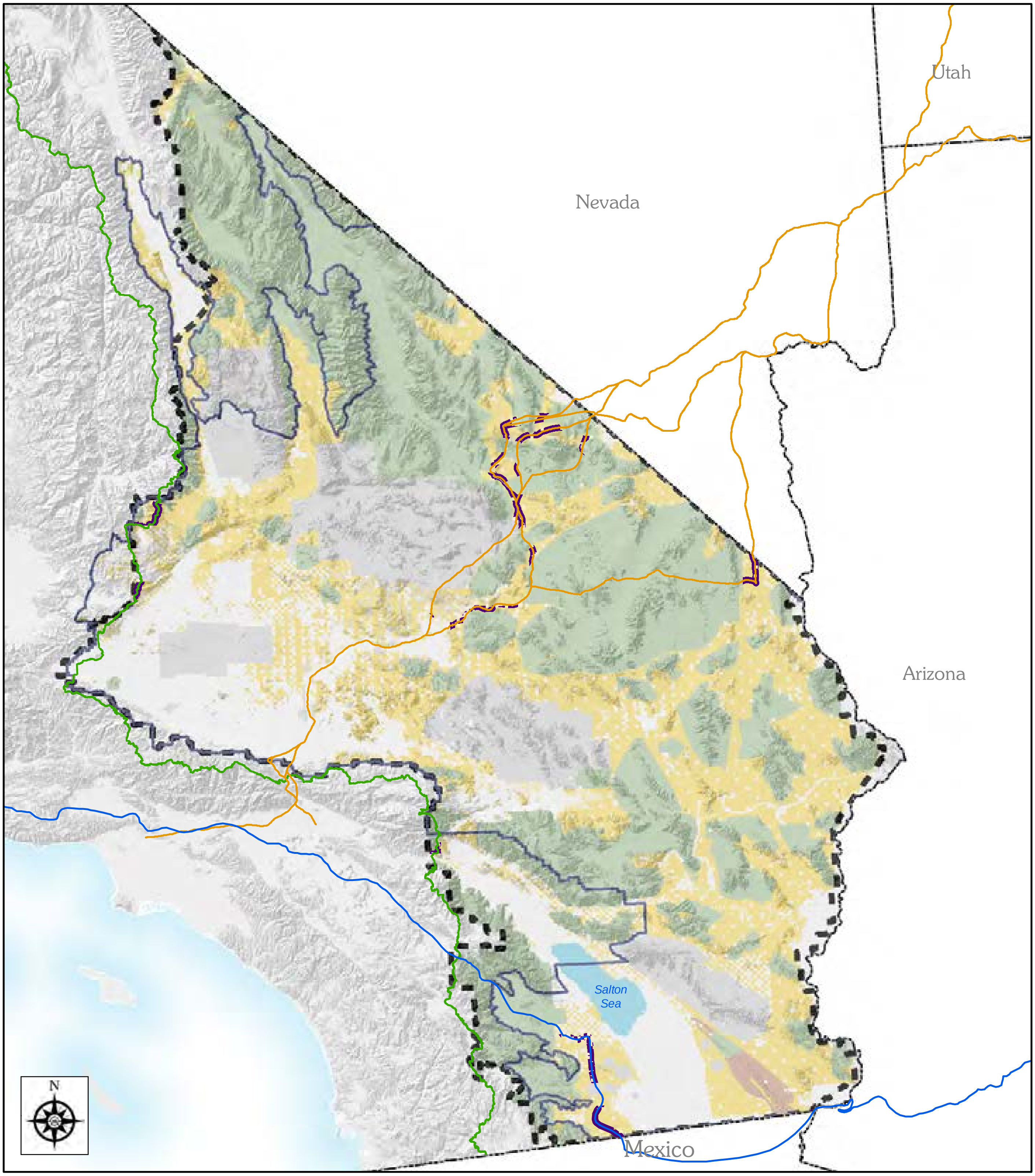


Juan Bautista de Anza Trail
Old Spanish Trail
Pacific Crest Trail
NSHT Corridor (BLM land only)
DRECP Boundary
CDCA Boundary
LLPA
Imperial Sand Dunes Open OHV Area

Land Status

Bureau of Land Management
Department of Defense

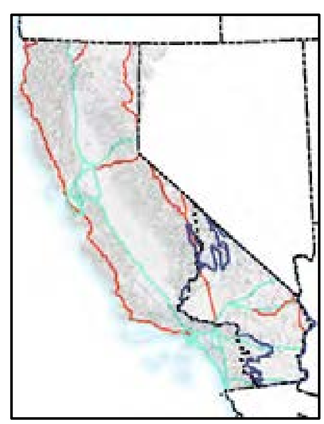
Figure D-24
National Scenic and Historic Trails

8/1/2016

BLM California State Office

0 50 100
Kilometers

Miles
0 50 100



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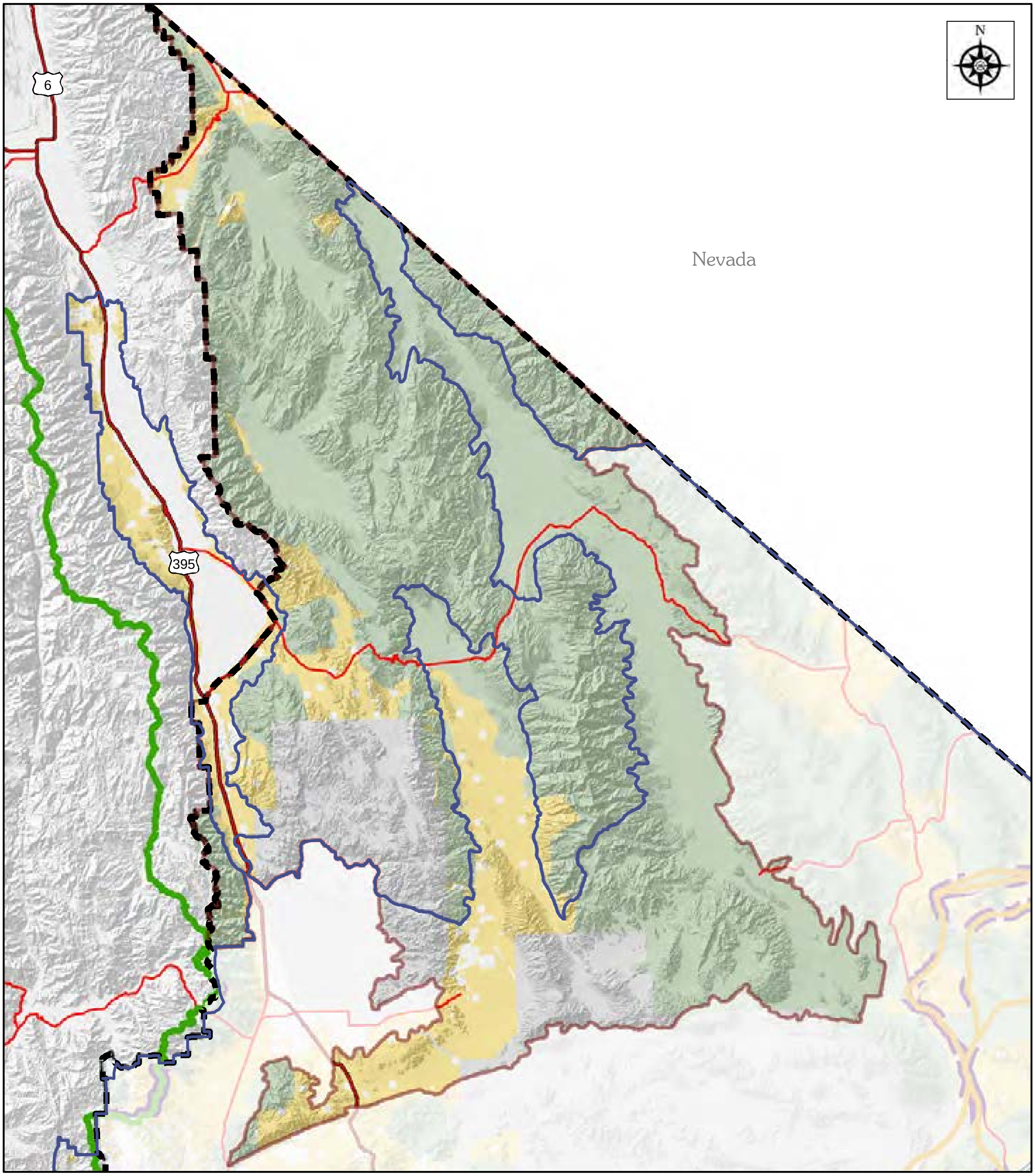


Old Spanish Trail
Pacific Crest Trail
NSHT Corridor (BLM land only)
DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Land Status

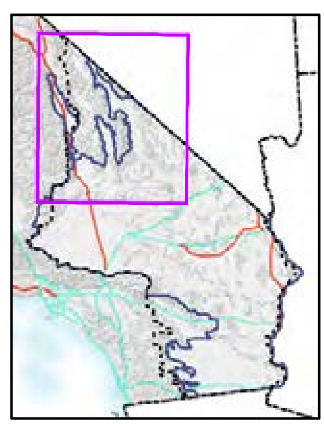
Bureau of Land Management
Department of Defense

Figure D-25
National Scenic and Historic Trails
Basin and Range Ecoregion

8/1/2016
BLM California State Office

0 10 20
Kilometers

Miles
0 10 20



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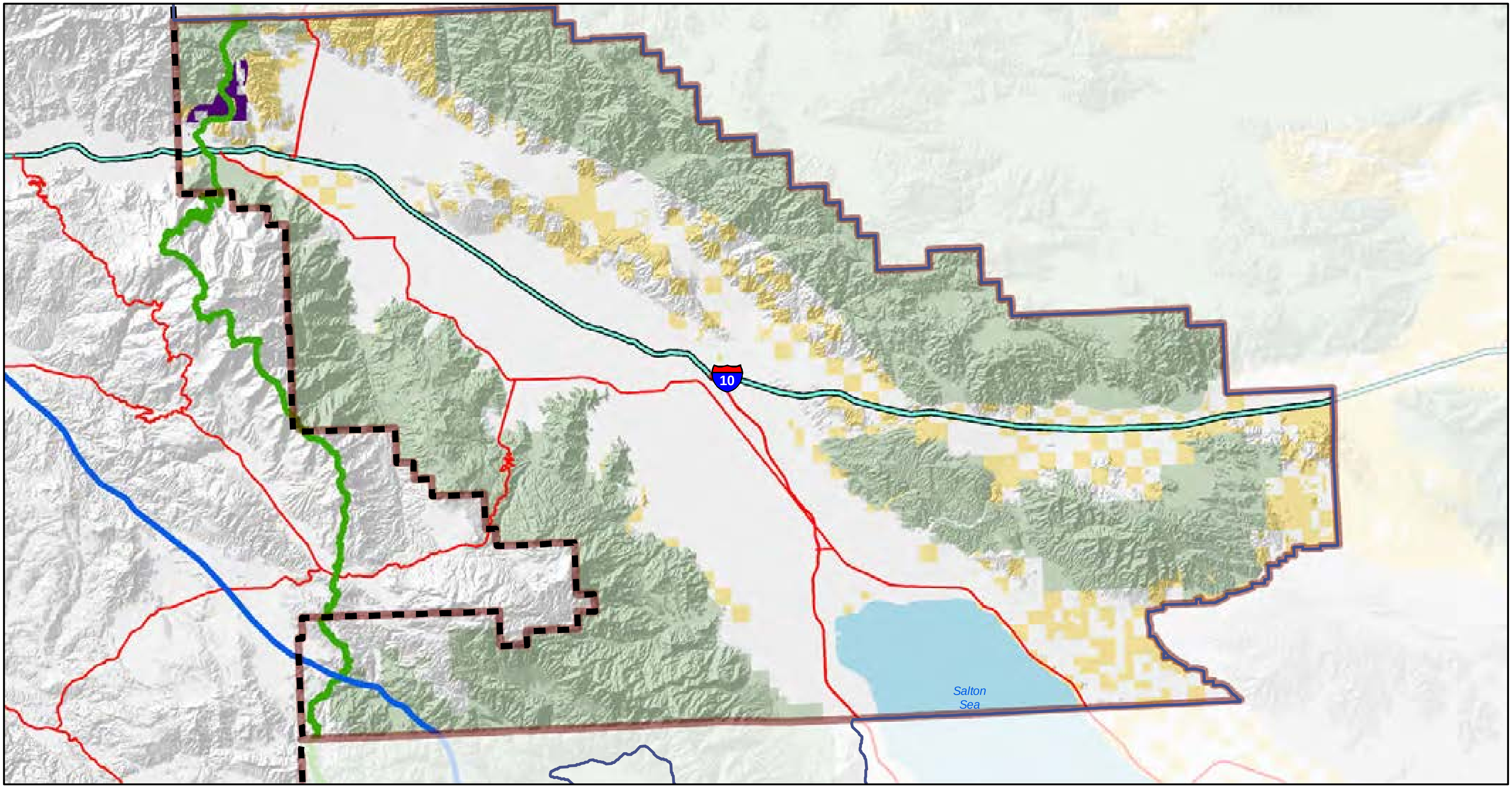


Juan Bautista de Anza Trail
Pacific Crest Trail
NSHT Corridor (BLM land only)
DRECP Ecoregion

DRECP Boundary
CDCA Boundary
LLPA

Land Status

Bureau of Land Management
Department of Defense

Figure D-26

National Scenic and Historic Trails

Coachella Valley Ecoregion

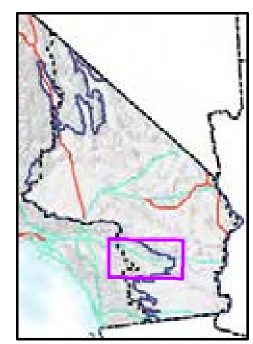
8/1/2016

BLM California State Office

0 5 10
Kilometers

N

Miles
0 5 10



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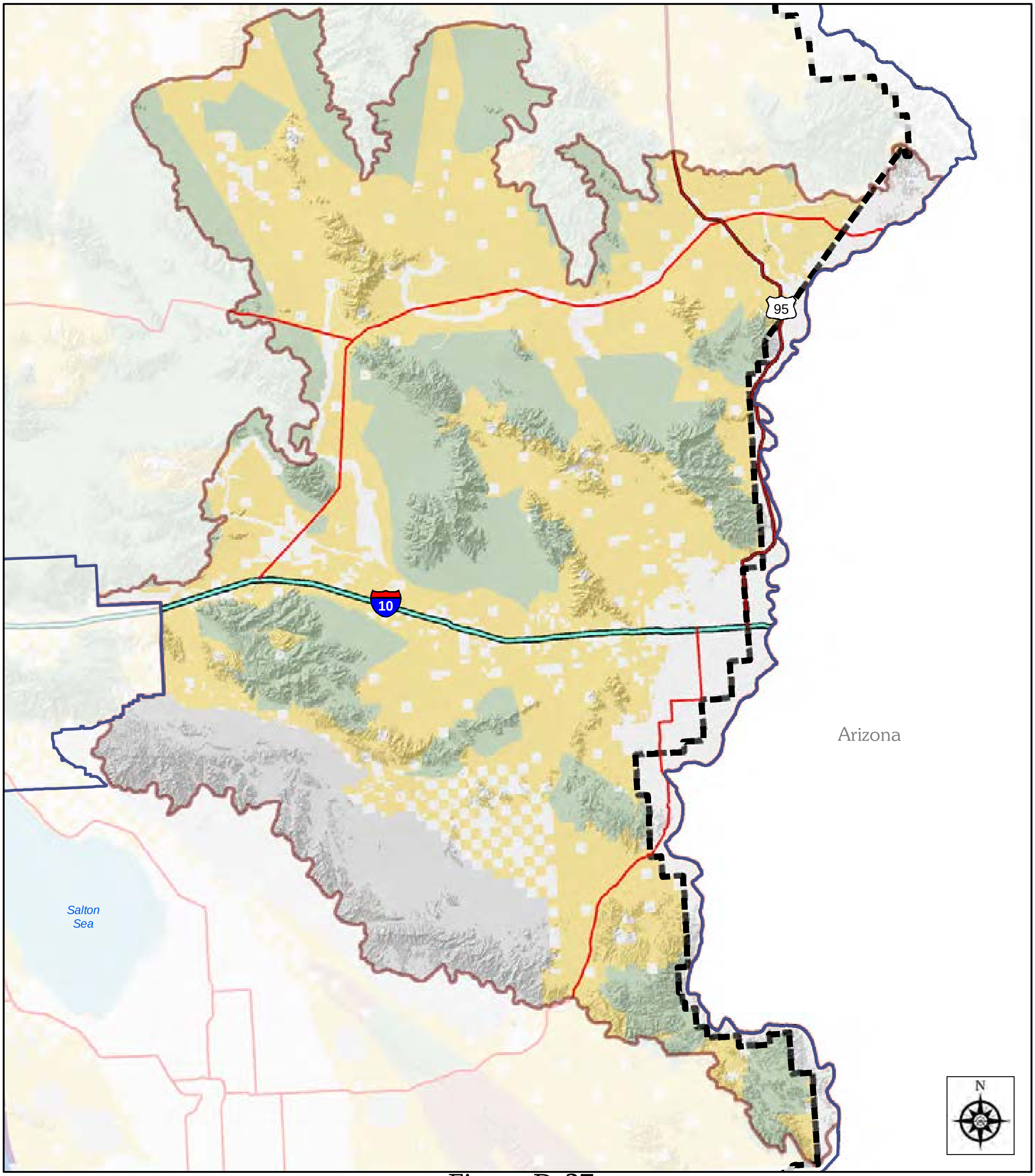


Figure D-27
National Scenic and Historic Trails
Colorado Desert Ecoregion

8/1/2016
BLM California State Office

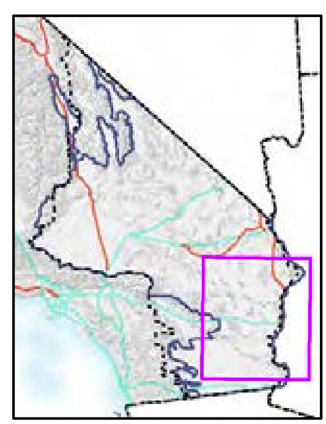
- Juan Bautista de Anza Trail
- DRECP Ecoregion
- DRECP Boundary
- CDCA Boundary
- LLPA
- Imperial Sand Dunes Open OHV Area

Land Status

- Bureau of Land Management
- Department of Defense

0 10 20
Kilometers

Miles
0 10 20



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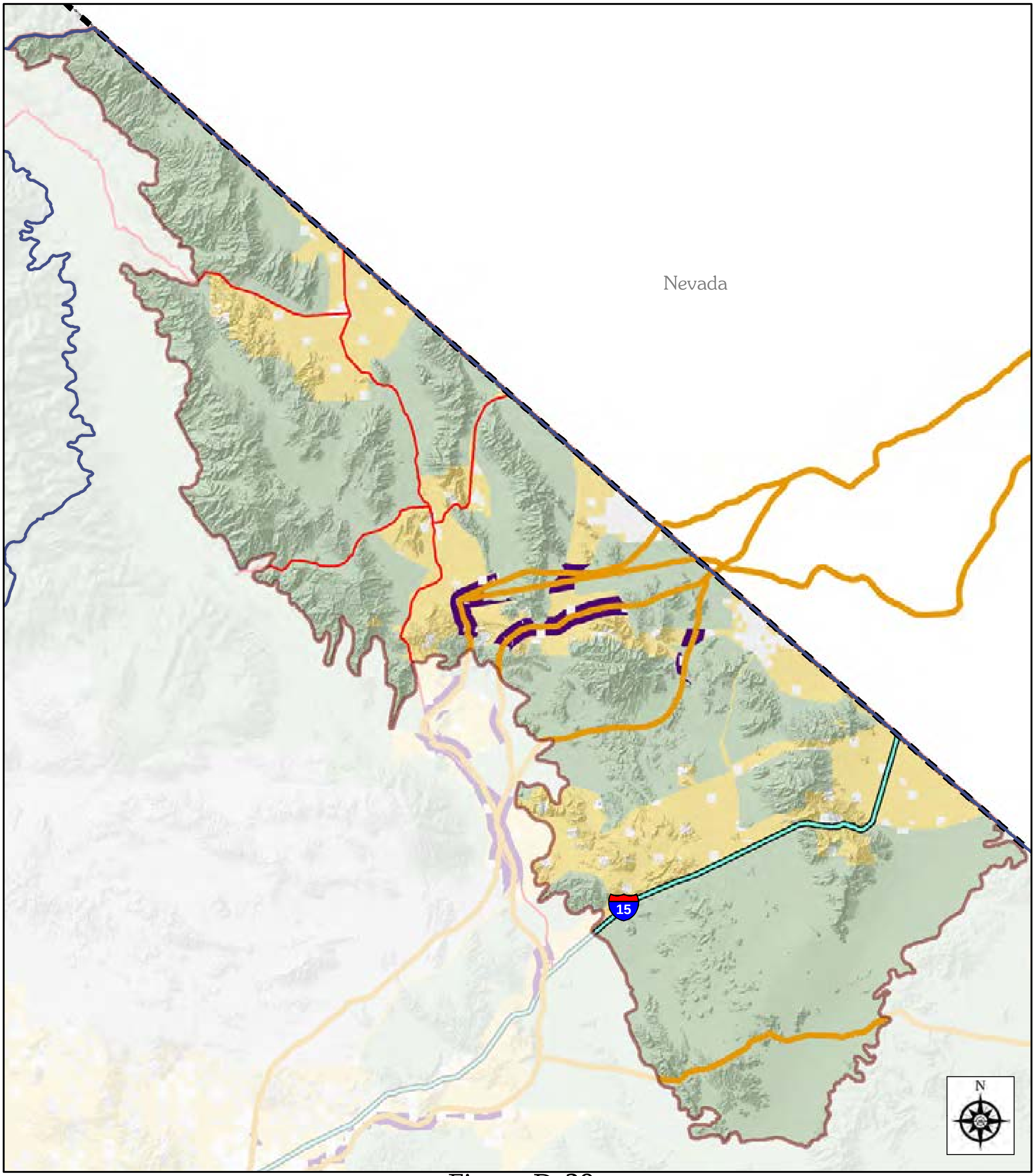

Figure D-28

National Scenic and Historic Trails

Kingston - Amargosa Ecoregion

8/1/2016

BLM California State Office

Old Spanish Trail
DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Land Status

Bureau of Land Management
Department of Defense

0 10 20
Kilometers

Miles
0 10 20

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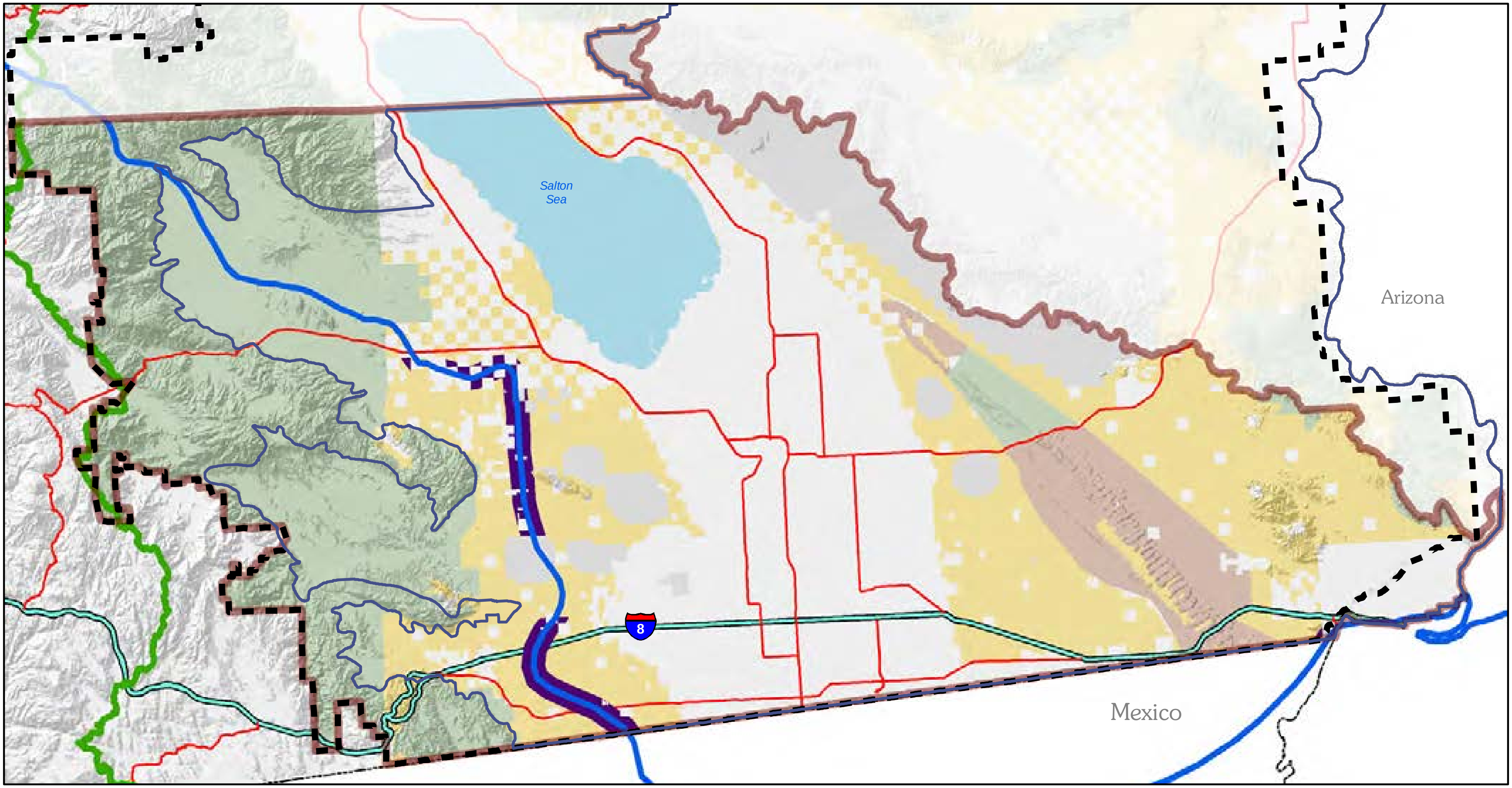


Juan Bautista de Anza Trail
Pacific Crest Trail
DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA
Imperial Sand Dunes Open OHV Area

Land Status

Bureau of Land Management
Department of Defense

Figure D-29
National Scenic and Historic Trails
Lake Cahuilla Ecoregion

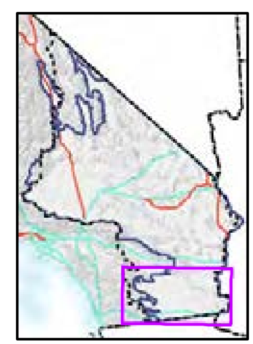
8/1/2016

BLM California State Office

0 5 10
Kilometers

N

Miles
0 5 10



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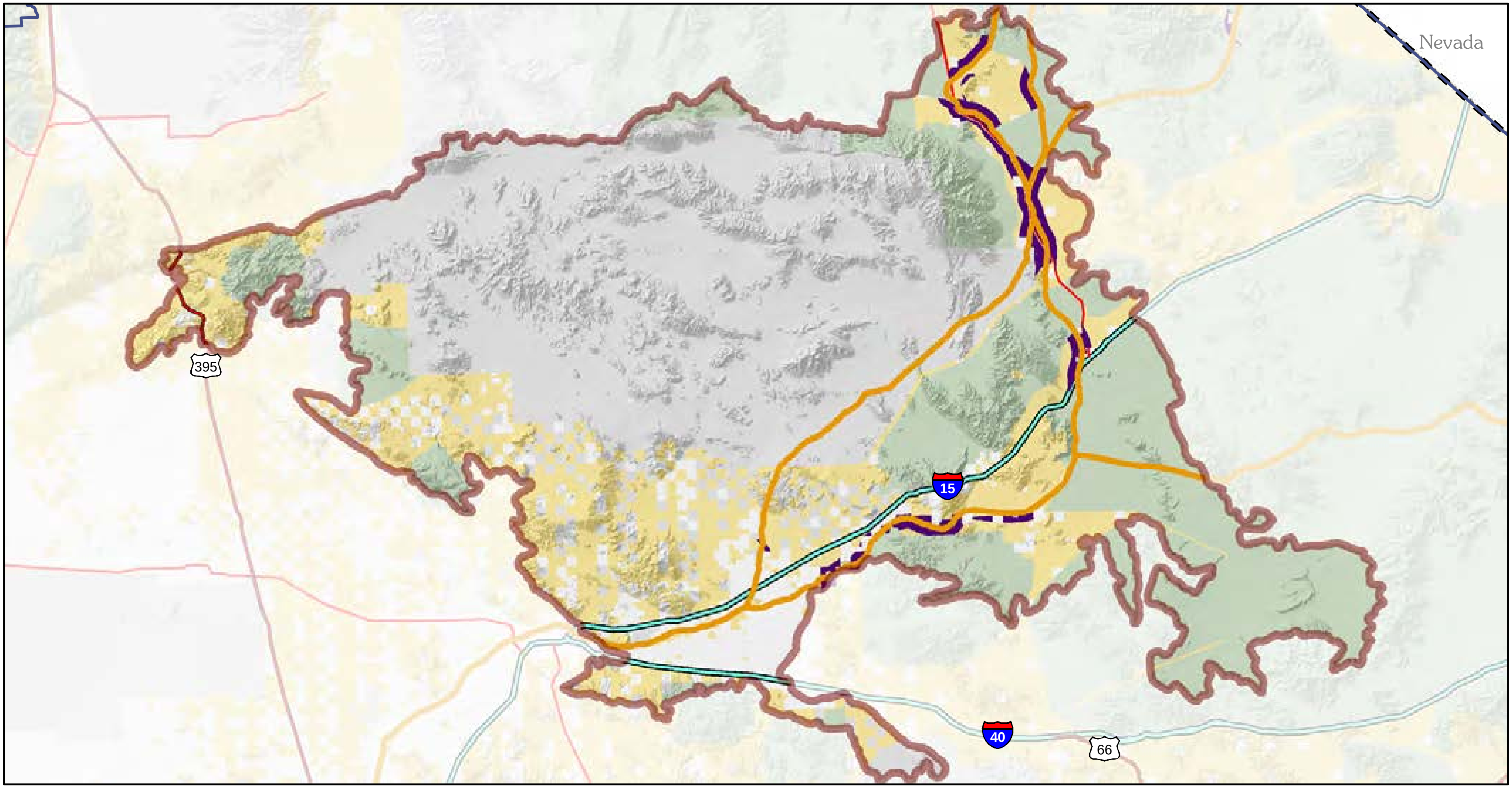


Old Spanish Trail
DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Land Status

Bureau of Land Management
Department of Defense

Figure D-30
National Scenic and Historic Trails
Mojave and Silurian Valley Ecoregion

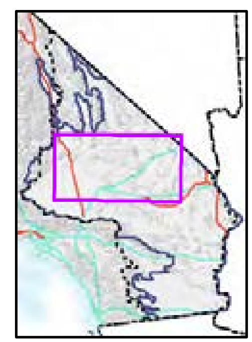
8/1/2016

BLM California State Office

0 10 20
Kilometers

N

Miles
0 10 20



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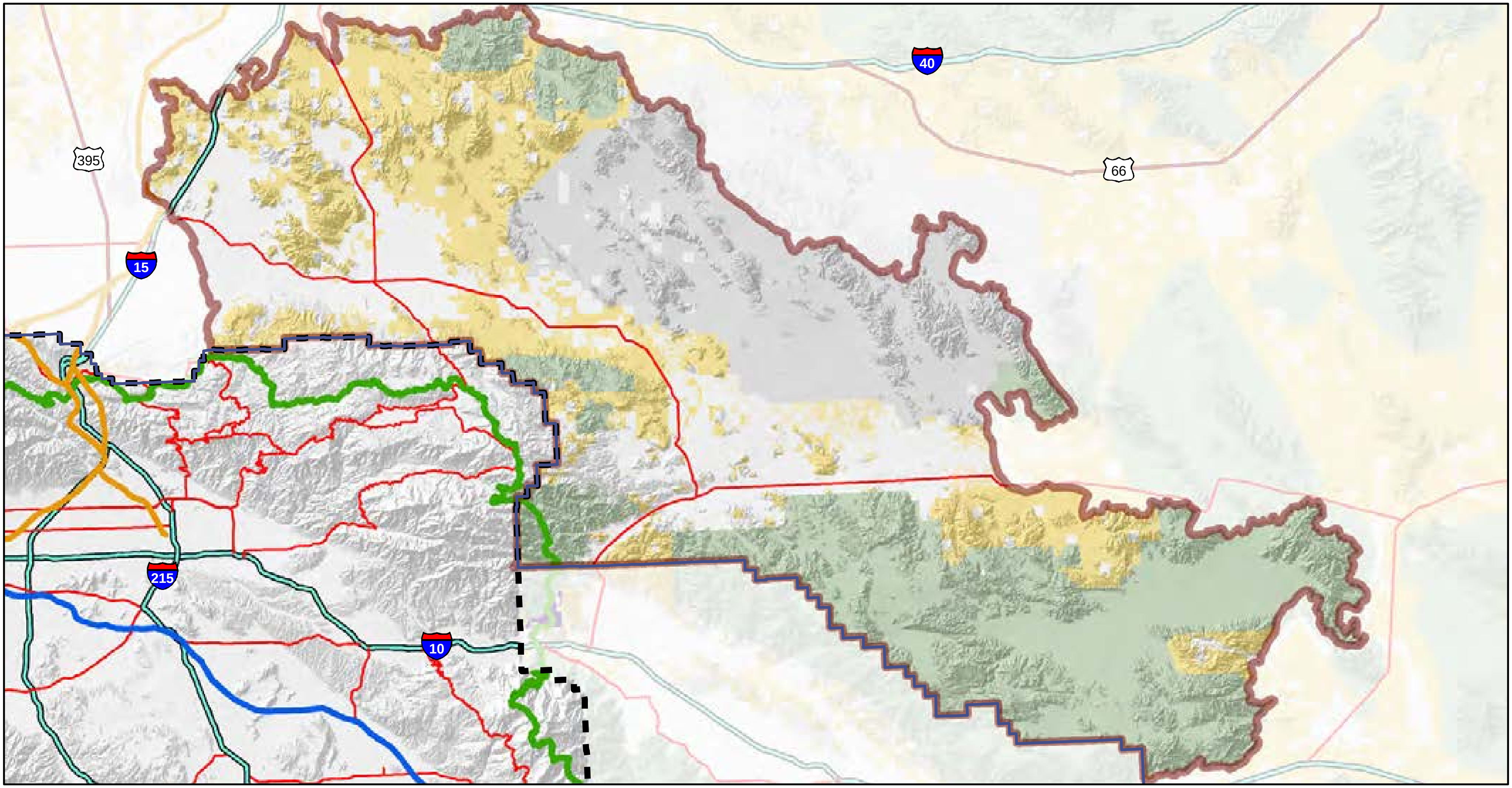

Juan Bautista de Anza Trail
Old Spanish Trail
Pacific Crest Trail
NSHT Corridor (BLM land only)
DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA
Land Status
Bureau of Land Management
Department of Defense

Figure D-31
National Scenic and Historic Trails
Pinto Lucerne Valley and Eastern Slopes Ecoregion

8/1/2016
BLM California State Office

0 10 20
Kilometers

N

Miles
0 10 20

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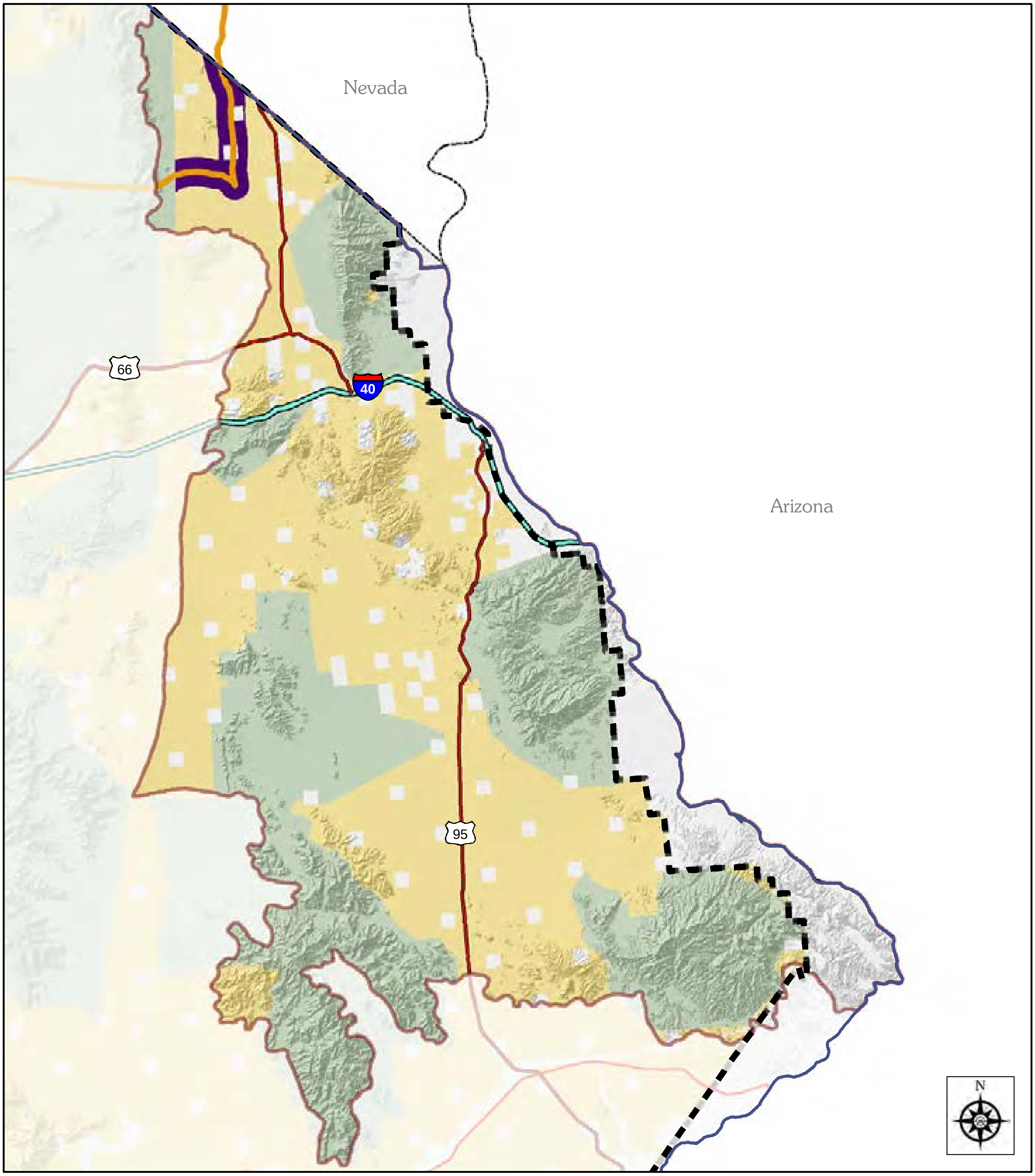


Old Spanish Trail
DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Land Status

Bureau of Land Management

Figure D-32

National Scenic and Historic Trails

Piute Valley and Sacramento Mountains Ecoregion

8/1/2016

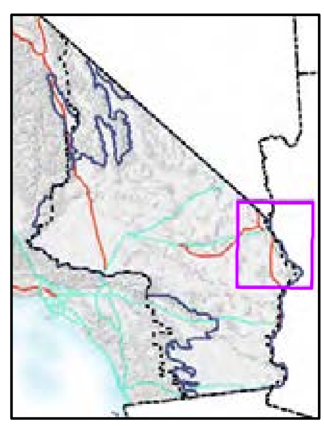
BLM California State Office

0 10 20

Kilometers

Miles

0 10 20



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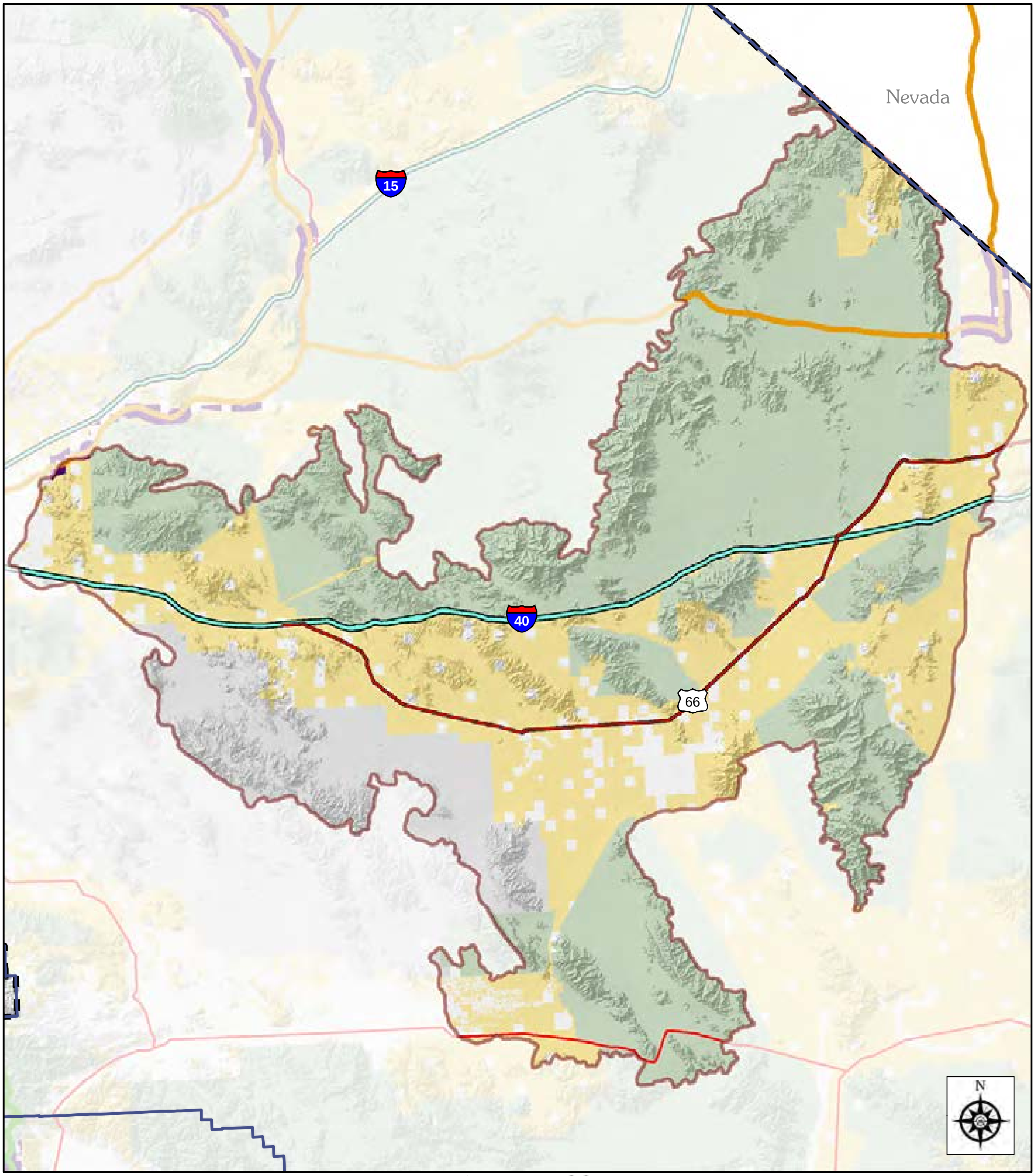


Figure D-33

National Scenic and Historic Trails

South Mojave - Amboy Ecoregion

8/1/2016

BLM California State Office

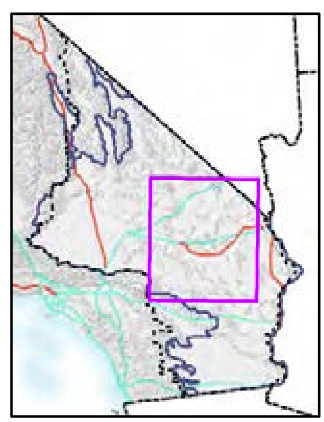
Old Spanish Trail
Pacific Crest Trail
NSHT Corridor (BLM land only)
DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Land Status

Bureau of Land Management
Department of Defense

0 10 20
Kilometers

Miles
0 10 20



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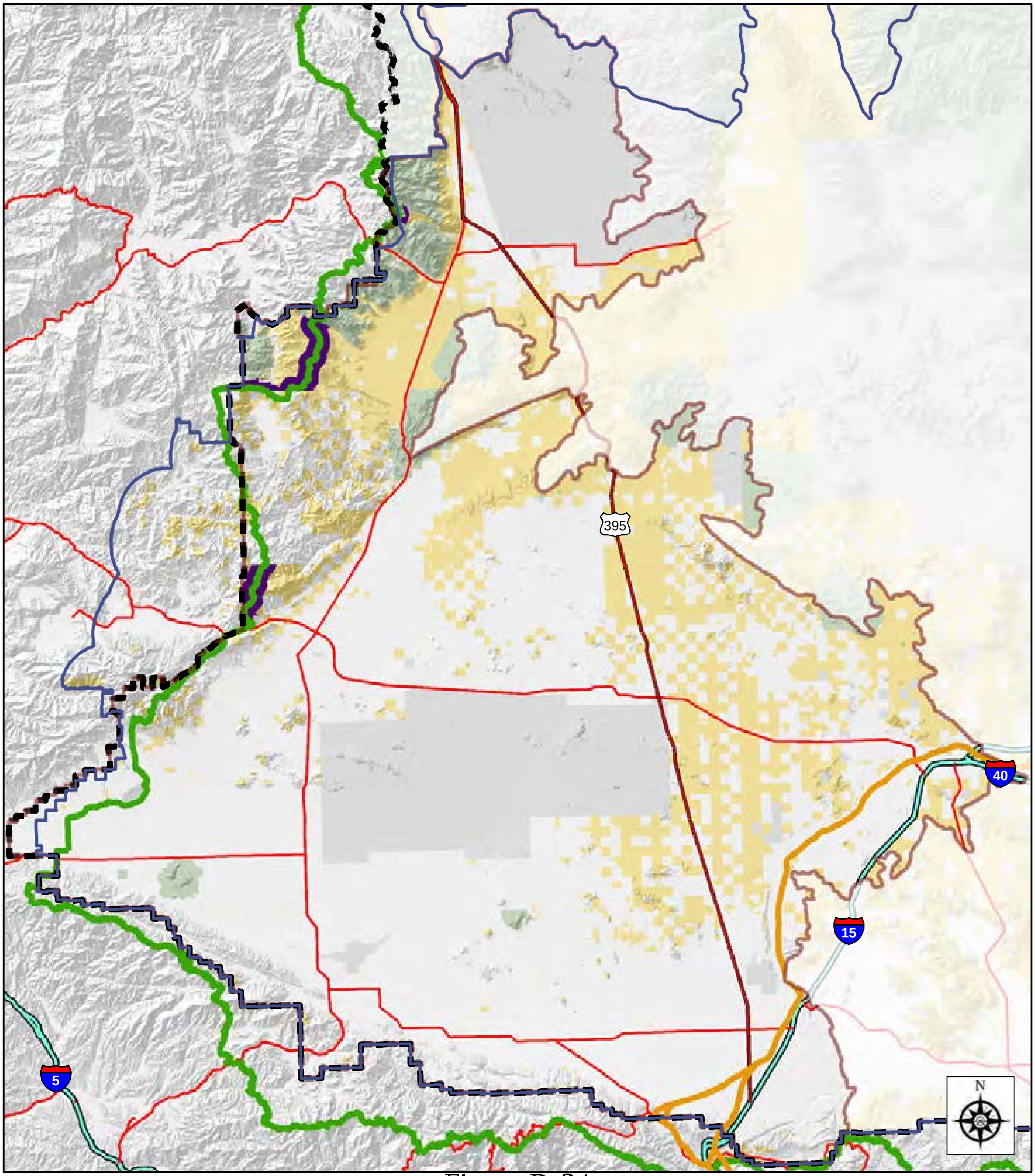


Figure D-34

National Scenic and Historic Trails West Desert and Eastern Slopes Ecoregion

8/1/2016

BLM California State Office

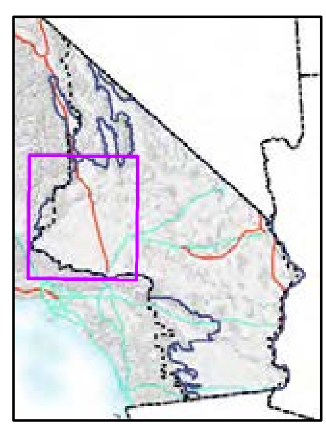
Old Spanish Trail
Pacific Crest Trail
NSHT Corridor (BLM land only)
DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Land Status

Bureau of Land Management
Department of Defense

0 10 20
Kilometers

Miles
0 10 20



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Solar Thermal

Solar thermal plants consist of two major subsystems: a collector system that collects solar energy and converts it to heat, and a power block that converts heat energy to electricity. CSP power plants produce electricity by collecting the sun's energy to generate heat using various mirror or lens configurations. The technologies discussed include:

- Parabolic trough
- Parabolic dish
- Power tower
- Compact Linear Fresnel Reflector

For solar thermal electric systems, the heat is transferred to a turbine or engine for power generation.

All CSP systems make use of the direct normal insolation component of solar radiation, that is, the radiation that comes directly from the sun. While the collection systems vary among the types of solar thermal facilities described below, the power block facility is common to all facilities. A power block facility typically includes an electrical building, auxiliary boilers, an air emission control system for the combustion of natural gas or propane in the auxiliary boilers, a steam turbine generator, a cooling tower, water treatment equipment, a hazardous materials storage area, petroleum-based fuel storage and delivery system, auxiliary equipment (emergency diesel generator, diesel fire pump, etc.), and water storage tanks. The acreage requirement for all solar thermal systems is 7.1 acres of per megawatt (MW), with reported mean capacity factors of 43.3% and a reported range of values from 22% to 65%.

Parabolic Trough Solar Thermal Systems. Parabolic trough systems concentrate direct normal insolation using single-axis tracking, parabolic curved, trough-shaped reflectors onto a receiver pipe or heat collection element located at the focal line of the parabolic surface. A high temperature heat transfer fluid picks up the thermal energy in the heat collection element. Heat in the heat collection element is then used to make steam in the steam generator. The steam drives a conventional steam-Rankine power cycle to generate electricity. A collector field typically contains many parallel rows of troughs connected in series. Rows are typically placed on a north–south axis, allowing the single-axis troughs to track the sun from east–west during the day.

Parabolic Dish-Engine Systems. A solar parabolic dish-engine system comprises a solar concentrator (or "parabolic dish") and the power conversion unit. The concentrator consists of mirror facets that combine to form a parabolic dish. The dish redirects direct normal insolation to a receiver mounted on a boom at the dish's focal point. The system uses a two-axis tracker such that it points at the sun continuously.

The power conversion unit includes the thermal receiver and the engine-generator. In the solar receiver, radiant solar energy is converted to heat in a closed hydrogen loop, driving the Stirling engine-generator. Power conversion units are air-cooled.

Power Tower Systems. A power tower uses thousands of sun-tracking mirrors called heliostats to redirect direct normal insolation to a receiver at the top of a tower. Heliostats are placed around the power tower, directing solar radiation towards the power tower. The heliostats are connected with communication cables between each heliostat that are utilized to transmit signals from a computer that ensures the heliostats are moved throughout the day to track the movement of the sun across the sky. A solar power tower is located within the center of the heliostats and is utilized to capture the solar radiation being reflected off the heliostats. The receiver at the top of the tower either generates steam directly, or heats a molten nitrate salt heat transfer fluid to generate steam. The steam is used in a conventional turbine generator to produce electricity.

Compact Linear Fresnel Reflector. The compact linear fresnel reflector is a solar thermal technology in which rows of mirrors focus sunlight onto a fixed absorber located at a common focal point of the reflectors. Compact linear fresnel reflector solar systems alternate the inclination of the mirrors to focus solar energy on multiple absorbers. The compact linear fresnel reflector is similar to the more common solar parabolic trough systems in that it uses one-axis tracking to focus solar radiation on a linear receiver.

Solar Photovoltaic

Solar PV converts sunlight (also known as insolation) directly into electricity. The power produced depends on the material involved and the intensity of the solar radiation incident on the cell. Single or polycrystalline silicon cells are most widely used today. Single crystal cells are manufactured by growing single crystal ingots, which are sliced into thin cell-size material. Thin film solar cells are made from layers of semiconductor materials only a few micrometers thick. These materials make applications more flexible, as thin film PV can be integrated into roofing tiles or windows. Thin film cells significantly reduce cost per unit area, but also result in lower efficiency cells. Gallium arsenide cells are among the most efficient solar cells and have other technical advantages, but they are also more costly and typically are used only where high efficiency is required even at a high cost, such as space applications or in concentrating PV applications. Additional advanced technologies are under development including dye sensitized solar cells and organic light emitting diodes.

Concentrating Solar Photovoltaic Systems. Concentrating photovoltaic plants provide power by focusing solar radiation onto a PV module, which converts the radiation directly to electricity. Either mirrors or lenses can be used to concentrate the solar energy for a concentrating photovoltaic system. Most concentrating photovoltaic systems use two-axis tracking to achieve point focus images on PV cells. The acreage requirement for PV systems is 7.1 acres per MW, with reported mean capacity factors of 23.3% and a reported range of from 15.5% to 28%.

Ground-Mounted Distributed Generation

Ground-mounted distributed generation is not a specific type of technology, but could include any of the above technologies. Ground-mounted distributed generation is a classification of generation defined by the limited size of the projects and the likely distribution of projects. For the purpose of analysis, ground-mounted distributed generation was considered to be projects of 20 MWs, occupying 142 acres that would be sited on disturbed and agricultural land. The acreage requirement for ground-mounted distributed generation systems is 7.1 acres per MW, with reported mean capacity factors of 23.3% and a reported range of from 15.5% to 28%.

Activities Associated with Solar Energy Generation

This section describes the activities associated with solar projects addressed by the LUPA. Both construction and operational activities are described in Table D-5 and individual activities are quantified by acreage, where feasible.

Table D-5
Description of Activities Associated with Solar Energy Generation

Activity	Description
Pre-Construction and Construction Activities	
Geotechnical borings	Full geotechnical testing to establish the suitability of the site for construction would vary depending on the size and technology.
Installation of temporary meteorological stations	Meteorological towers would be installed across a potential site to assess the generation potential. The number of towers is typically dependent upon the size of the project terrain although typically there may be 2–4 towers on each site. These stations could also include sonic detection and ranging (SODAR) units.
Temporary access routes and staging areas for meteorological towers and geotechnical borings	Temporary vehicular access to undertake pre-construction activity may result in unusual vehicular disturbance off existing routes, and require the use of established tracks and roadways where possible.
Site reconnaissance (including species-specific surveys)	Site surveys would be required prior to any permitting or construction activities. Activities would be required to utilize existing roads, tracks, and access.

Table D-5
Description of Activities Associated with Solar Energy Generation

Activity	Description
Access roads/spur roads (permanent and temporary)	Off-site road construction or improvements may be required if local roads necessary for site access are not designed for gross vehicle weights of up to 80,000 lb (36,000 kg), the federal limit for tractor-trailer trucks on most U.S. highways. State-specific and local limits may also apply. Contact with local transportation authorities would be made to assure proper signage is placed to notify the public of traffic hazards. Generally, a primary road would be required to access a site that is sufficiently large to accommodate a large daily construction workforce and delivery traffic. Such an access road would reach as far as parking areas (paved or non-paved) for construction workers, laydown areas for equipment and supplies, or other major site locations. Roads leading to the facility would be constructed to federal and state standards and would typically consist of a 20 foot wide two lane road with graded 5-foot shoulders as recommended for average daily traffic volumes greater than 400 vehicles (AASHTO 1994) for an overall road width of 30 feet. If access road construction were required, the construction right-of-way (ROW) width would likely be less than 60 feet, corresponding to a two-lane highway with 12-foot lanes and 3-foot shoulders. A 60-foot ROW would result in a disturbed area of about 7 acres per mile of road constructed. On-site access roads would be required to access facilities and generation arrays. Construction of permanent roads within the boundary of the facility would mostly consist of compacted gravel. For the purpose of estimating disturbance, impacts of roads within a solar project boundary are assumed to be part of the generation facilities.
Ground-disturbance activities (including grading and clearing vegetation)	Solar facilities generally require relatively flat sites, and show varying degrees of sensitivity to gradient depending on technology. Heavy equipment that may be used in the site preparation phase would include bulldozers, graders, excavators, scrapers, front-end loaders, trucks, cranes, rock drills, chain saws, chippers, trenching machines, and equipment for blasting operations if required. Vegetation clearance and site grading is assumed across the entirety of the area required for generation facilities (solar arrays, troughs mirrors towers, etc.). The site may be partially re-vegetated but cannot be considered fully restored while operational. Impacts to the entire site within, the perimeter boundary are considered permanent.
Site preparation (e.g., excavation for foundations)	The size of foundations for generation facilities would be dependent on wind shear, and consequently foundations may be installed at various

Table D-5
Description of Activities Associated with Solar Energy Generation

Activity	Description
	depths. For tower-based CSP technologies wind loading and the structure weight of towers, and the weight and vibration of steam turbines, dictate more robust foundations that would typically require excavations to 30–45-foot depths, depending on existing subsurface conditions. Other solar technologies such as PV and solar trough require foundations at grade level. Permanent buildings, including operation and maintenance buildings, would typically require a concrete-on-slab foundation at grade level. Transmission switchyards typically have drilled pier, mat, and pad type foundations that are installed with a grounding grid, before being backfilled to grades.
Operations and maintenance buildings, and general facilities	Permanent operations and maintenance buildings, including control rooms, would be constructed utilizing standard building and construction techniques. Ancillary facilities are assumed to include parking and equipment storage facilities and would typically occupy 5–10 acres.
Clearing, staging, parking, construction trailer, and equipment and material storage areas	Temporary construction areas, including laydown yards, on-site construction trailers, and material storage would require clearing and grading and are assumed to be occupy 40–50 acres per project. For analysis purposes temporary construction facilities are assumed to occupy 40–50 acres per project situated within the footprint of the final development. Therefore, no additional acreage beyond that of the final long-term project footprint is assumed for solar facilities.
Evaporation ponds	Evaporation ponds may be required as part of cooling structures for solar thermal projects. They are often lined with clay or plastic to enable water retention. These facilities would be designed to deter use by birds and bats.
Fencing (temporary and permanent, for both wildlife and security)	Temporary security fencing around laydown yards, on-site construction trailers, material storage, and on site cement batch plants would be required. Permanent security fencing may surround the perimeter of the site; however, site permeability must also be considered in site design and used unless operationally infeasible.
Temporary drainage and erosion control (e.g.,	Temporary drainage and erosion control may be required at laydown yards and temporary sites, and would be determined on a project

Table D-5
Description of Activities Associated with Solar Energy Generation

Activity	Description
diversion channels, retention/detention basins, silt fences, erosion fabrics)	specific basis to comply with county, state, and federal requirements.
Permanent drainage: conveyance or semi-natural	Culverts and drainage modification may be necessary to divert and control runoff. Drainage systems would be constructed to federal and state standards. Permanent drainage management systems would be designed seek to minimize the disruption to natural flow. Further, the design would minimize areas of direct vegetation removal, grading, re-routing, and leveling; and minimize the amount of active stormwater management using re-routed or man-made channels, ponds and culverts.
Flood control structures	Temporary flood control may be required at laydown yards and temporary sites including temporary roads, and would be determined on a project specific basis.
Installation of utility services	Utility services would be required for operation and maintenance buildings. Installation may include trenching and backfilling activities, and would use established ROW. Utility services include: • Electric distribution lines, facilities, and interconnects • Natural gas lines • Sewage facilities/pipelines • Telecommunication lines and facilities • Trash collection and disposal • Water wells or municipal water supply and pipelines
Meteorological stations	Permanent meteorological stations are assumed to be up to 265 feet tall, self-supporting monopole structures with an assumed permanent disturbance footprint of 0.02 acre.
Transmission collector lines	Transmission collector lines for a solar facility are typically trenched 48 inches below grade. Where collector systems run overhead, they may be strung on steel or wood monopoles 60–80 feet high.
Generator tie line (gen-ties)	Generator tie-lines are sole-use facilities constructed by an electric generator to interconnect and transmit its power to the electric grid. Depending on the size of the generation facility and the substation to which the facility is being connected, these lines can be between 69 and 500 kilovolts (kV). For 69 kV lines, conductors are typically installed on 68–120-foot tall steel or wood monopole structures. Higher voltages can be installed on either monopole or lattice steel structure of up to 160 feet tall. Generator tie lines are described as part of transmission impacts because of the possibility that impacts may occur outside DFAs.

Table D-5
Description of Activities Associated with Solar Energy Generation

Activity	Description
Operation and Maintenance Activities	
Steam turbine and generation operations (solar thermal including power towers and parabolic trough systems)	Solar thermal plant operations may require substantial amounts of water for steam generation, cooling, and other industrial processes. Systems can be wet cooled, hybrid, or dry cooled, which would use up to 14.5 AFY/MW, 2.9 AFY/MW, or 1.0 AFY/MW of water, respectively. Dry-cooling reduces the amount of water used, but it also reduces efficiency and output capacity, particularly in hotter climates such as the desert.
Solar thermal power tower operation (solar flux)	Heliostat technologies use a centrally located tower to collect the focused sunlight from the surrounding arrays of heliostats. Power towers are currently up to 765 feet high and glow with the reflected light from the heliostats when in operation. The concentration of light and heat from the surrounding heliostats may increase the energy flux and consequently the air temperature in the flux zone. A safe flux limit (measured in kW/m^2) has not been determined.
Cleaning of generation facilities, including solar arrays, mirrors, etc.	Regular cleaning of solar thermal heliostats and parabolic troughs is necessary to maintain optimal performance. For the purpose of analysis, water usage was assumed to be 0.5 AFY/MW for parabolic troughs and heliostats. For PV facilities, regular cleaning using water may not be required. The assumed water demand for PV is 0.05 AFY/MW.
Dust suppression	Activities required to reduce fugitive dust as the consequence of plant operation that would be undertaken on an as needed basis following standard industry best management practices. Activities include water spraying and use of chemical suppressants.
Fire and fuel management	Fire fuel load management would be undertaken on an as needed basis following standard industry best management practices that minimize impacts on biological resources to the extent feasible. Vegetation management undertaken to reduce fire risk within transmission ROW would be necessary.
Integrated pest management, including trapping and regulated use of pesticides and herbicides	Pesticides may have to be applied during the operation of a project to control pests and weeds. Such applications must comply with the Federal Insecticide, Fungicide, and Rodenticide Act and state equivalent requirements. In addition, energy sites are subject to federal provisions to control noxious weeds and invasive species and may be subject to regulations governing state-established control areas. Use on BLM-administered lands would comply with the terms of the BLM lease and/or ROW grant.
Cleaning, maintenance, repair, and replacement of access roads and spur road	Cleaning, repair, and maintenance would be undertaken on an as needed basis following standard industry best management practices and additional guidance on a project-by-project basis.

Table D-5
Description of Activities Associated with Solar Energy Generation

Activity	Description
Cleaning and maintenance of facilities	Maintenance, repair, and replacement of generation facilities includes but is not limited to: cleaning, maintenance, repair, and replacement of metrological stations; cleaning, maintenance, repair, and replacement of lines/pipelines and facilities, including those used for utility services; cleaning, maintenance, repair, replacement, and repainting of buildings/structures (including towers/poles); and fence repair and replacement. Cleaning and maintenance would be undertaken on an as needed basis following standard industry best management practices and additional guidance assessed on a project-by-project basis. Activities are assumed to be undertaken within the boundary of already disturbed areas. Maintenance of flood control structures would be undertaken on an as needed basis following standard industry best management practices that minimize impacts on biological resources to the extent feasible.
Hazardous materials treatment and disposal	Disposal of hazardous waste would be undertaken on an as-needed basis following applicable federal and state laws and regulations and standard industry best management practices that minimize impacts on biological resources to the extent feasible.
Night lighting	Lighting would be installed throughout the project sites for security and nighttime use of facilities. It is assumed that lighting management would be undertaken following standard industry best management practices that project lighting downwards to minimize impacts on sensitive biological resources to the extent feasible. Lighting configuration, color, and flash patterns would be coordinated with the Federal Aviation Administration where necessary.
Solid waste disposal	All solid waste disposal is assumed to be off site at facilities permitted to receive such waste.
Decommissioning	
Removal of structures	Decommissioning would involve removal of all aboveground facilities and gravel workpads and roads. Subsurface facilities (grounding rods and grids, tower and building foundations, natural gas pipelines, etc.) would be removed to a minimum depth of 3 feet from the surface and otherwise abandoned in place. Laydown areas, each nominally 3 acres in size, would be established to support decommissioning; some may be located on the laydown areas used during construction. Dismantled components would be staged at laydown areas for only as long as necessary to arrange for their removal to disposal, reclamation, or recycling facilities.

Table D-5
Description of Activities Associated with Solar Energy Generation

Activity	Description
Restoration and re-vegetation	All spills and contaminated soils would be remediated. All gravel packs would be removed. Reclamation of laydown areas, substations, access roads, and other "deconstruction" areas would commence immediately upon completion of the dismantlement of the system.

Notes:
lb = pounds; kg = kilograms; kV = kilovolts; AFY = acre-feet per year; MW = megawatts; kW = kilowatts; m^2 = square meters

Although the area available to solar generation would be more extensive in the DFAs than for other technologies, not all DFAs were considered suitable for solar development. Areas where construction was considered infeasible, for example where the slope was greater than 5%, were excluded from consideration (a more detailed discussion of constraints is presented in Section I.3.5 of the 2014 Draft DRECP and EIR/EIS).

Solar projects can range from small-scale developments of a few MWs that occupy tens of acres up to 1,000 MW projects that occupy thousands of acres. When estimating the impacts of solar projects, it was assumed that the construction of projects would result in the permanent loss of all resources within the boundary of the project. Two reasons are given for this: (1) unlike other technologies, solar projects are generally fenced to exclude wildlife and result in modification to natural processes for the life of the project; and (2) although some vegetation may be preserved at some project locations, this would not be universal and conditions of service often lead to the removal of vegetation to reduce fire risk. Further, the extensive removal, modification and grading within the project boundary, even if vegetation were not completely removed, could lead to edge effects that effectively modify the remaining vegetation communities. Therefore, the acreage requirements for roads, operation and maintenance facilities, and switchyards required for each facility should be included in the overall estimated boundary of the solar project. Similarly, short term impacts, such as construction and laydown yards, should also be assumed to be within the final boundary of the project and therefore subsumed within the boundary estimate of impacts.

- **Total Long-Term Ground Disturbance Impacts**. Estimated total acreage affected by solar development activities such as vegetation clearance, grading, and construction. This is effectively a summation of the solar generation facility footprints, including operations and maintenance building, switchyard, and road construction impacts. Due to the difficulty of restoration in a desert environment, all activities that result in vegetation removal or disturbance are considered permanent for the purpose of analysis.

- **Total Project Area**. An estimate of the total area occupied by a given project. For dense technologies like solar generation, the total project area is identical to the total permanent ground-conversion impacts.

D.8.1.2 Wind Energy Generation

Wind energy generation projects typically consist of ancillary facilities, supporting infrastructure and multiple arrays of wind turbines distributed across a project site to best take advantage of prevailing winds. Features that are common to all wind projects include operation and maintenance (O&M) buildings, switchyards and substations, and wind turbines. All wind projects would also require access roads for construction, routine maintenance, and operations.

Wind turbines consist of three main parts: the turbine tower, turbine rotor, and nacelle. The turbine tower typically consists of tubular steel pole sections. Turbines generally would be spaced no less than 1.2 rotor diameters apart, but may be spaced farther apart for environmental considerations and to prevent wind shadowing (wind blockage by other turbine structures). Modern turbines are generally a horizontal-axis design. A turbine is composed of a tower, nacelle, hub, blades/rotor, controller, central Supervisory Control and Data Acquisition system for communication, transformer, braking system, safety lighting, and lightning protection system. For current turbines the total height at the highest point of the rotor blade rotation would be between 388 feet and 492 feet above ground surface. The ground clearance for the rotor blades at their lowest point of rotation would be between 91 feet and 138 feet above ground surface. Turbines typically include a transformer located either in the turbine unit or at the base of each turbine that is utilized to step-up the electricity received from the wind turbine for distribution in the collector cable system. The collector system connects the individual turbines and transmits electricity to a centrally located collector substation.

Activities Associated with Wind Energy Generation

This section describes the activities associated with wind projects. Both construction and operational activities are listed and described in Table D-6. Where feasible, acreage impacts of individual activities are quantified, although it is not feasible to quantify all activities as the impacts may be too site-specific (i.e., dependent on a particular geographic location); where this is the case, a general description of the activity is provided.

Table D-6
Description of Activities Associated with Wind Energy Generation

Activity	Description
Pre-Construction And Construction Activities	
Geotechnical borings	Full geotechnical testing of multiple bores to a depth of up 40 feet may be required at each proposed turbine location before construction begins.
Installation of temporary meteorological stations	Meteorological towers are installed across a potential site to assess the wind generation potential. The number of towers is typically dependent upon the size of the project terrain although typically there may be 2–4 towers on each site. Meteorological towers assess wind density at a height similar to typical turbine towers, and are typically 200-foot-tall guyed monopole structures.
Temporary access routes and staging areas for meteorological towers and geotechnical borings	Temporary vehicular access may result in disturbance, but access corridors would be identified, utilizing existing tracks and roadways where possible.
Site reconnaissance (including species-specific surveys)	Site surveys would be required prior to any permitting or construction activities. Activities are assumed to utilize existing roads, tracks, and access.
Access roads/spur roads (permanent and temporary)	Construction of a permanent road to each turbine is necessary for both construction and operations. The extent of road construction is dependent upon the site topography, condition, and extent of current roads. Access roads require a shallow gradient (typically less than 10%) to enable heavy lifting cranes to access the turbine sites. In steep or complex terrain, road width may be 40 feet or wider to accommodate the turning circle of vehicles delivering turbine components. Access roads for turbine construction may have to be temporarily widened to accommodate heavy vehicles that transport tower components and nacelles. Additionally, access roads may be required to install desert tortoise fencing or other structures in support of mitigation, including radar equipment to detect golden eagles and other raptors, aforementioned desert tortoise fencing, and fencing of temporary ponds or water sources for construction. For example, recent construction for the Ocotillo Express Wind project in Imperial County required the construction of 42 miles of new road for the 350 MW project. Similarly, the nearby Tule Wind project required 23 miles of access road for a 201 MW project. For the purpose of analysis 0.33–0.35 acre of road impacts were assumed for each 2 MW turbine.
Ground-disturbance activities (including grading and clearing vegetation)	Vegetation clearance for construction and operational activities would occur at all sites. At each turbine site, vegetation clearance and grading would be necessary to prepare the ground for heavy lifting cranes and transport vehicles. Typically, an area about 400 feet in diameter (2.885

Table D-6
Description of Activities Associated with Wind Energy Generation

Activity	Description
	acres) is cleared for each turbine, within which an area is compacted and stabilized to enable the use of heavy lifting cranes. Additional clearance would be required for substations, control and maintenance buildings etc. The expected effects associated with these components are discussed below.
Site preparation (e.g., excavation for foundations)	Grading and foundations would be necessary for all permanent structures, including turbine sites, switchyards, and operations and maintenance buildings. Different methods are used for constructing the foundations for wind turbines, depending upon geotechnical conditions and loading: **Patrick and Henderson Inc. Foundation.** This patented foundation type would be drilled or dug to approximately 15 to 35 feet deep and would be approximately 18 feet in diameter. The foundation would be in the configuration of an annulus—two concentric steel cylinders. The central core of the smaller, inner cylinder would be filled with soil removed during excavation. In the cavity between the rings, bolts would be used to anchor the tower to the foundation, and the cavity would be filled with concrete. Bolting the tower to the foundation would provide post-tensioning to the concrete. **Rock Anchor.** For each foundation, 6 to 20 holes would be drilled approximately 35 feet into the bedrock, and steel anchors would be epoxy-grouted in place. A reinforced concrete cap containing the anchor bolts would be poured on the top of the steel anchors to support the tower structure. **Spread-Footing.** This foundation for turbines or other structures may be round, square or octagonal and formed with reinforcing steel and concrete. This type of foundation could be as large as 35 feet by 35 feet and 6 feet to 10 feet thick. Transmission switchyards would typically have drilled pier, mat and pad type foundations installed with a grounding grid below grade before back filling occurs. Permanent buildings would typically require no more than a concrete slab on foundations at grade level.
Turbine erection	To enable the lifting and erection of each turbine, a cleared and graded temporary work area 400 feet in diameter is assumed. Ground disturbance during construction would lead to soil compaction and while the area may be re-vegetated it should be considered permanently

Table D-6
Description of Activities Associated with Wind Energy Generation

Activity	Description
	disturbed. Therefore, each turbine would result in up to 2.885 acres of permanent disturbance.
Ancillary buildings and general facilities.	Permanent operations and maintenance buildings would be constructed utilizing standard building and construction techniques. Ancillary facilities are assumed to include parking and equipment storage facilities and would typically occupy 5 acres.
Clearing, staging, parking, construction trailer, and equipment and material storage areas	Temporary construction areas, including laydown yards, on-site construction trailers, material storage, and on-site cement batch plants, would require clearing and grading and are assumed to occupy 40–50 acres.
Fencing (temporary and permanent, for both wildlife and security)	Temporary security fencing around laydown yards, on-site construction trailers, material storage, and on-site cement batch plants would usually be required. Permanent fencing is only required around operations and maintenance buildings, switchyards, and met towers. Individual turbines are not usually fenced.
Temporary drainage and erosion control (e.g., diversion channels, retention/detention basins, silt fences, erosion fabrics)	Temporary drainage and erosion control may be required at laydown yards and temporary sites, and would be determined on a project specific basis, and comply with county, state, and federal requirements.
Permanent drainage: conveyance or semi-natural	Culverts and drainage modification may be necessary to divert and control runoff. Drainage systems would be constructed to federal and state standards. It is assumed that permanent drainage management systems would seek to minimize the disruption to natural flow. Further, the design would minimize areas of direct vegetation removal, channel re-routing, grading, and leveling; and minimize the amount of active stormwater management using channels, ponds, re-routing and man-made channels, and culverts.
Flood control structures	Temporary drainage control may be required at laydown yards and temporary sites including temporary roads, but would be determined on a project-specific basis.
Installation of utility services	Utility services would be required to operations and maintenance buildings. Installation may include trenching and backfilling activities, but would seek to use established ROW. Utility services include: • Electric distribution lines, facilities, and interconnections • Sewage facilities/pipelines/septic tanks, etc. • Telecommunication lines and facilities

Table D-6
Description of Activities Associated with Wind Energy Generation

Activity	Description
	• Trash collection and disposal • Water wells or municipal water supply and pipelines
Meteorological stations	Permanent meteorological stations are assumed to be self-supporting monopole structures up to 265 feet above ground surface with a permanent disturbance footprint of 0.02 acre
Transmission collector lines	Transmission collector lines for a wind facility are typically run at 34.5 kV. Collector systems may be installed overhead on steel or wood monopoles between 60–80 feet high, or may be installed underground in a trench 4 feet deep.
Generator tie lines (gen-ties)	Generator tie lines are sole-use facilities constructed by an electric generator to interconnect and transmit its power to the electric grid. Depending on the size of the generation facility and the substation to which the facility is being connected, these lines can be between 69 and 500 kV. For 69 KV lines, conductors are typically installed on 68–120-foot-tall steel or wood monopole structures. Higher voltages can be installed on either monopole or lattice steel structure of up to 160 feet tall.
Operation and Maintenance Activities	
Wind turbine operations	Operation of wind turbines, by definition, requires the blades to spin to generate electricity. Turbines are typically between 300 and 500 feet above ground surface, including blade length, and for the purpose of analysis turbines are assumed to be 492 feet above ground surface, to blade tip and 344 feet above ground surface to the turbine nacelle. Under operational conditions each turbine results in a blade swept area of between 2.47–2.55 acres, depending upon the length of the blades. Blades may be operational at any time of the year and in wind speeds between 3.5 m/s and 5.5 m/s (15–55 mph). For analysis purposes, each turbine was assumed to be 2 MW with a blade swept area of 2.55 acres.
Dust suppression	Activities required to reduce fugitive dust as the consequence of plant operation would be undertaken on an as needed basis following standard industry best management practices. Activities include water spraying and use of chemical suppressants.
Fire and fuel management	Fire fuel load management would be undertaken on an as needed basis following standard industry best management practices that minimize impacts on biological resources to the extent feasible. Vegetation management undertaken to reduce fire risk within transmission ROW would be necessary.
Integrated pest management, including trapping and regulated use of pesticides	Herbicides may have to be applied during the operation of a project to control invasive weed species. Such applications must comply with all applicable federal and state laws and regulations, including but not limited to the Federal Insecticide, Fungicide, and Rodenticide Act and state equivalent requirements. In addition, energy sites are subject to federal provisions to control noxious weeds and invasive species and

Table D-6
Description of Activities Associated with Wind Energy Generation

Activity	Description
	may be subject to regulations governing state-established control areas. Use on BLM-administered lands would comply with ROW grant.
Cleaning, maintenance, repair, and replacement of access roads and spur road	Cleaning, repair, and maintenance would be undertaken on an as needed basis following standard industry best management practices and additional guidance on a project-by-project basis.
Cleaning and maintenance of facilities	Maintenance, repair, and replacement of generation facilities would, on average, require each turbine to undergo 8 to 16 hours of scheduled mechanical and electrical maintenance per year. Routine maintenance may include, but would not be limited to, replacing lubricating fluids, checking parts for wear and replacing as required and recording data from data-recording chips in all pertinent equipment including anemometers. Maintenance of other facilities would include: cleaning, maintenance, repair, and replacement of metrological stations; cleaning, maintenance, repair, and replacement of lines/pipelines and facilities, including those used for utility services; cleaning, maintenance, repair, replacement, and repainting of buildings/structures (including towers/poles); fence repair and replacement; access roads, crane and turbine pads, erosion control systems, and perimeter fencing would be regularly inspected and maintained to ensure minimal degradation. Cleaning and maintenance would be undertaken on an as needed basis following standard industry best management practices and additional guidance assessed on a project-by-project basis. Activities are assumed to be undertaken within the boundary of already disturbed areas. Maintenance of flood control structures would be undertaken on an as needed basis following standard industry best management practices that minimize impacts on biological resources to the extent feasible.
Hazardous materials treatment and disposal	Disposal of hazardous waste would be undertaken on an as needed basis in compliance with all applicable federal and state laws and following standard industry best management practices that minimize impacts on biological resources to the extent feasible.
Night lighting	Lighting would be installed throughout the project sites for site for security and nighttime use of facilities. It is assumed that lighting management would be undertaken following standard industry best management practices that project lightings downwards to minimize impacts on sensitive biological resources to the extent feasible.
Solid waste disposal	All solid waste disposal is assumed to be off site at a facility permitted to receive such waste.

Table D-6
Description of Activities Associated with Wind Energy Generation

Activity	Description
Decommissioning	
Removal of structures	Decommissioning would involve removal of all aboveground facilities and gravel workpads and roads. Subsurface facilities (grounding rods and grids, tower and building foundations, natural gas pipelines, etc.) would be removed to a minimum depth of 3 feet from the surface and otherwise abandoned in place. Laydown areas, each nominally 3 acres in size, would be established to support decommissioning; some may be located on the laydown areas used during construction. Dismantled components would be staged at laydown areas for only as long as necessary to arrange for their removal to disposal, reclamation, or recycling facilities.
Restoration and re-vegetation	All spills and contaminated soils would be remediated. All gravel packs would be removed. Reclamation of generation facilities laydown areas, substations, access roads, and other “deconstruction” areas would commence immediately upon completion of the dismantlement of the system.

Notes: kV = kilovolts; MW = megawatts; m/s = meters per second; mph = miles per hour

The area available to wind development was constrained by several factors, including areas where construction was considered infeasible, and areas where turbine construction has been precluded by ordinance or general policy.

Wind projects can range from small-scale developments of a few megawatts that occupy tens of acres up to several hundred megawatt projects that occupy thousands of acres. Wind projects result in relatively diffuse impacts spread across a wide area. Turbines are widely spaced and connected by permanent access roads, and transmission infrastructure, with centralized maintenance facilities and switchyards. Unlike solar, not all the land within the boundary of a wind project is assumed to be permanently disturbed by project activities. Estimates of disturbed acreage should be the sum of the estimated acreage required for turbine pads, roads, ancillary facilities, and supporting infrastructure. Short term construction activities, such as laydown yards, are assumed to result in long-term disturbance within the project boundary, and should be included in the estimate of permanently disturbed acreage. In addition to estimates of ground disturbance, the area likely to be impacted by the operation of the turbine rotors (airspace) should also be estimated. For analysis purposes in the LUPA, turbines were grouped into conceptual projects of up to 200 MWs to enable an estimation of impacts from ancillary facilities, roads, turbines etc. The long-term impacts for wind technologies should be broken out as follows:

- **Total Project Area**. An estimate of the total area occupied by a given project. For technologies where the project may be spread across a greater area (e.g., wind energy generation), the permanent impacts are distributed over a larger area.
- **Estimated Long-Term Ground Disturbance**. Estimated total acreage directly disturbed by activities described above. This is effectively a summation of all potential wind generation facility footprints, including individual turbine pad, operations and maintenance building, switchyard, and road construction impacts. This estimate also includes the additional impacts that would occur as a consequence of construction activities including construction areas, laydown yards, and storage facilities. Due to the difficulty of habitat restoration in a desert environment all activities that result in vegetation removal or disturbance were considered permanent for the purpose of analysis.
- **Turbine Rotor Swept Area** – An estimate of the total aerial acreage affected by the rotation of turbine blades while a wind facility is operating.

D.8.1.3 Geothermal Energy Generation

Geothermal resources can provide energy for power production and other applications by using subsurface heat from the earth to generate steam and drive turbine generators. Geothermal power can be developed where subsurface temperature gradients are elevated, such as in areas of young volcanism. However, there are other geologic settings favorable to geothermal development, including areas where the earth's crust is relatively thin, which leads to greater heat flow from the earth's interior. Tectonically active (but not necessarily volcanic) areas are also favorable because of the presence of significant faulting and fracturing that can allow deep circulation and heating of groundwater. Subsurface temperature gradients measured in wells help to determine the potential for geothermal development and the type of geothermal power plant installed. High-energy sites are suitable for electricity production, while low-energy sites are suitable for direct heating. Most of the known and most easily accessible geothermal resources in the United States are concentrated in the west and southwest parts of the country. In the DRECP LUPA Plan Area, the geothermal resources are known to occur in Imperial and Inyo Counties.

Geothermal power generation facilities generally consist of a production well that is drilled into a known geothermal reservoir. Typically, an injection well is also drilled to return used geothermal fluids to the geothermal reservoir. Hot, pressurized geothermal fluid, or a secondary working fluid, is allowed to expand rapidly and provide rotational or mechanical energy to turn the turbine blades on a shaft. Three geothermal power plant technologies are typically used to convert hydrothermal fluids to electricity. The conversion technologies are dry steam, flash, and binary cycle. The type of conversion used depends on the state of the fluid (whether steam or water) and its temperature. Dry steam power plant systems use the steam from the geothermal reservoir as it comes from wells, and route it directly through turbine/generator units to produce electricity. Flash steam plants are the most common type of geothermal power generation plants in operation today, and use water at temperatures greater than 360°F that is pumped under high pressure to the generation equipment at the surface. Binary cycle geothermal power generation plants pass moderately hot geothermal water by a secondary fluid with a much lower boiling point than water. This causes the secondary fluid to flash to vapor, which then drives the turbines.

Activities Associated with Geothermal Energy Generation

This section describes the activities associated with geothermal projects. Both construction and operational activities are listed and described in Table D-7. Where feasible, acreage impacts of individual activities are quantified, although it is not feasible to quantify all activities as the impacts may be too site-specific (i.e., dependent on a particular geographic location); where this is the case, a general description of the activity is provided.

Table D-7
Description of Activities Associated with Geothermal Energy Generation

Activity	Description
Pre-Construction and Construction Activities	
Geotechnical borings	Full geotechnical testing to establish the suitability of the site for construction would vary depending on the size and technology. Exploratory borings to test temperature gradients are assumed to require up to 12 individual holes disturbing up to 0.15 acres per hole or about 2 acres per project.
Temporary access routes and staging areas for geotechnical borings	Temporary vehicular access to undertake pre-construction activity may result in disturbance but access corridors would be identified, utilizing existing tracks and roadways where possible.
Site reconnaissance (including species-specific surveys)	Site survey would utilize the existing roads, tracks and access or may assess the areas on foot.
Access roads/spur roads (permanent and temporary)	Generally, a single road would be required to access the site. Roads leading to the facility would be constructed to federal and state standards and would typically consist of a 20-foot-wide two-lane highway with 2 feet for shoulders on either side. Construction of permanent roads to access wells is necessary for both construction and operations. The extent to which roads would need to be constructed is dependent upon the site topography, condition, and extent of current roads. Access roads within the boundary of a project site would consist of compacted gravel no more than 10 feet wide.

Table D-7
Description of Activities Associated with Geothermal Energy Generation

Activity	Description
Ground-disturbance activities (including grading and clearing vegetation)	Grading and clearing of vegetation would be necessary for the construction of the main generation site, and for each well pad. Up to 40 acres of permanent clearing and grading would be required for the main site and about 2 acres for each well pad. For a 50 MW plant consisting of a power plant site and about 30 well pads, about 100 acres of permanent ground disturbance would occur.
Site preparation (e.g., excavation for foundations)	Geothermal power plant facilities may require excavation 6–8 feet below grade due to the weight and size of facilities such as cooling towers where applicable. Permanent buildings, including operation and maintenance buildings would typically require no more than a concrete-on-slab foundation at grade level. Transmission switchyards typically have drilled pier, mat and pad type foundations that are installed with a grounding grid, below grade before back filling occurs.
Well-field facilities	Well-fields consist of multiple injection and production wells situated on concrete pads that hold all the equipment necessary to operate a well. Geothermal production fluid pipelines and injection fluid pipelines run throughout the well-field to circulate steam and fluids between the well-field and the generation site. Piping is extensive throughout the well-field, with a 50 MW facility requiring between 7–10 miles of co-located pipelines. Well-fields can be extensive and occupy the bulk of the affected acreage for a geothermal facility. The total affected area for a geothermal facility is estimated at 5 acres per MW. For a 50 MW facility the affected area would be about 250 acres.
Generation facilities	For the purposes of analysis, all generation facilities are assumed to be co-located on a single cleared and graded site. Construction of the central energy production facilities includes power generation units, fluid pressure vessels, vapor recovery units, cooling facilities, and regenerative thermal oxidizer scrubbers. For the purposes of analysis, the facilities are assumed to occupy 40 acres of graded and cleared land for a 50 MW unit.
Ancillary buildings and general facilities	Permanent operations and maintenance buildings would be constructed utilizing standard building and construction techniques.

Table D-7
Description of Activities Associated with Geothermal Energy Generation

Activity	Description
	Ancillary buildings are assumed to be located at a central power plant site, include parking and equipment storage facilities, and would typically occupy 5 acres.
Clearing, staging, parking, construction trailer, and equipment and material storage areas	Temporary construction areas, including laydown yards, on-site construction trailers, material storage, and on-site cement batch plants would require clearing and grading and are assumed to occupy 40–50 acres.
Fencing (temporary and permanent, for both wildlife and security)	Temporary security fencing around laydown yards, on-site construction trailers, material storage, and on site cement batch plants would usually be required. Permanent security fencing would surround the perimeter of the site.
Temporary drainage and erosion control (e.g., diversion channels, retention/detention basins, silt fences, erosion fabrics)	Temporary drainage and erosion control may be required at laydown yards and temporary sites, and would be determined on a project specific basis, and comply with county, state, and federal requirements.
Permanent drainage: conveyance or semi-natural	Culverts and drainage modification may be necessary to divert and control runoff. Drainage systems would be constructed to federal and state standards. It is assumed that permanent drainage management systems would seek to minimize the disruption to natural water flow. Further, the design would minimize areas of direct vegetation removal, stream re-routing, grading, and leveling; and minimize the amount of active stormwater management using channels, ponds, re-routing and man-made channels, and culverts.
Flood control structures	Temporary drainage control may be required at laydown yards and temporary sites including temporary roads, but would be determined on a project specific basis.
Installation of utility services	Utility services would be required for operations and maintenance buildings. Installation may include trenching and backfilling activities, but would seek to use established ROW. Utility services include: • Electric distribution lines, facilities, and interconnects • Sewage facilities/pipelines • Telecommunication lines and facilities • Trash collection and disposal • Water wells or municipal water supply and pipelines
Generator tie lines (gen-ties)	Generator tie lines are sole-use facilities constructed by an electric generator to interconnect and transmit its power to the electric grid. Depending on the size of the generation facility and the substation

Table D-7
Description of Activities Associated with Geothermal Energy Generation

Activity	Description
	to which the facility is being connected, these lines can be between 69 and 230 kV. For 50 MW geothermal facilities, generator tie lines would usually be wood or steel 69 kV monopole structures. In some facilities that are closely located to other generation sites a 230 kV line may be shared between different sites. Generator tie line ROW requirements are described as part of transmission impacts because of the possibility that impacts may occur outside DFAs.
Operations and Maintenance Activities	
Steam turbine and generation operations	Steam turbines are driven by the geothermal gradients to produce electricity. The operational impacts of geothermal plants are dependent on the technology and the cooling system being used being used. Closed loop systems using wet cooling technology may require significant quantities for water for cooling. Cooling towers for closed loop wet cooling facilities can use up to 110 AFY/MW, such as the East Brawley facility in Imperial County. Other facilities, using flash plant and hybrid or dry cooling technologies may use considerable less water, such as the 2.37–3.83 AFY/MW for Black Rock 1, 2, 3 Geothermal Power Project, Imperial County.
Dust suppression	Includes any activities required to reduce fugitive dust as the consequence of plant operation that would be undertaken on an as needed basis following standard industry best management practices. Activities include water spraying and use of chemical suppressants.
Fire and fuel management	Fire fuel load management would be undertaken on an as needed basis following standard industry best management practices that minimize impacts on biological resources to the extent feasible. Vegetation management undertaken to reduce fire risk within transmission ROW would be necessary.
Integrated pest management, including trapping and regulated use of pesticides	Pesticides may have to be applied during the operation of a project to control pests and weeds. Such applications must comply with the Federal Insecticide, Fungicide, and Rodenticide Act and state equivalent requirements. In addition, energy sites are subject to federal provisions to control noxious weeds and invasive species. They may be subject to regulations governing state-established control areas. Use on BLM would comply with terms ROW.

Table D-7
Description of Activities Associated with Geothermal Energy Generation

Activity	Description
Cleaning, maintenance, repair, and replacement of access roads and spur road.	Cleaning, repair, and maintenance would be undertaken on an as needed basis following best management practices and additional guidance on a project-by-project basis.
Cleaning and maintenance of facilities	Maintenance, repair, and replacement of generation facilities includes but is not limited to: cleaning, maintenance, repair, and replacement of metrological stations; cleaning, maintenance, repair, and replacement of lines/pipelines and facilities, including those used for utility services; cleaning, maintenance, repair, replacement, and repainting of buildings/structures (including towers/poles); fence repair and replacement. Cleaning and maintenance would be undertaken on an as needed basis following standard industry best management practices and additional guidance assessed on a project by project basis. Activities are assumed to be undertaken within the boundary of already disturbed areas. Maintenance of flood control structures would be undertaken on an as needed basis following standard industry best management practices that minimize impacts on biological resources to the extent feasible.
Hazardous materials treatment and disposal	Disposal of hazardous waste would be undertaken on an as needed basis following standard industry best management practices that minimize impacts on biological resources to the extent feasible.
Night lighting	Lighting would be installed throughout the project sites for site for security and nighttime use of facilities. It is assumed that lighting management would be undertaken following standard industry best management practices that project lights downwards to minimize impacts on sensitive biological resources to the extent feasible.
Solid waste disposal	All solid waste disposal is assumed to be off site at a facility permitted to handle such waste.
Decommissioning	
Removal of structures	Decommissioning would involve removal of all aboveground facilities and gravel workpads and roads. Subsurface facilities (grounding rods and grids, tower and building foundations, natural gas pipelines, etc.) would be removed to a minimum depth of 3 feet from the surface and otherwise abandoned in place. Laydown areas, each nominally 3 acres in size, would be established to support decommissioning; some may be located on the laydown areas used during construction. Dismantled components would be staged at laydown areas for only

Table D-7
Description of Activities Associated with Geothermal Energy Generation

Activity	Description
	as long as necessary to arrange for their removal to disposal, reclamation, or recycling facilities.
Restoration and re-vegetation	All spills and contaminated soils would be remediated. All gravel packs would be removed. Reclamation of generation facilities laydown areas, substations, access roads, and other "deconstruction" areas would commence immediately upon completion of the dismantlement of the system.

Notes: kV = kilovolts; AFY = acre-feet per year; MW = megawatts

The area available to geothermal development in the LUPA is limited to areas in the Imperial Borrego Valley and part of the Owens River Valley ecoregion subareas where geothermal resources are concentrated.

Geothermal projects would be more limited in size (in the DRECP Plan Area) than other renewable energy projects. Recent projects vary from about 50 MW to 160 MW. For analysis within the DRECP, geothermal projects were assumed to be typically 50 MW in size. Geothermal projects result in extensive impacts associated with the power block and ancillary facilities, with more dispersed impacts resulting from the well-fields. Well heads that inject and collect heat transfer fluids, are widely spaced and connected by permanent access roads and pipelines to the centrally located power block and steam turbine facilities. All land within the boundary of a geothermal project should be assumed permanently (i.e. long term) disturbed by project activities. Estimates of disturbed acreage include the acreage required for well head pads, roads, ancillary facilities, and supporting infrastructure, and also includes the land fragmented by the roads, pipelines and well pads in the well-field, which was assumed to retain no conservation value. Short-term construction activities, such as laydown yards, should also be determined and were assumed to result in permanent disturbance (i.e. long term) within the project boundary.

- **Estimated Long-Term Ground Disturbance**. Estimated total acreage affected by activities such as vegetation clearance, grading, and construction. This is effectively a summation of all potential geothermal generation facility footprints, including operations and maintenance building, switchyard, and road construction impacts, plus the additional impacts that occur as a consequence of construction activities, and the fragmented land within the well-field. Due to the difficulty of restoration in an arid environment, all activities that result in vegetation removal or disturbance were considered permanent for the purpose of analysis.

- **Total Project Area.** An estimate of the total area occupied by a given project. For technologies where the impacts may be spread across a greater area (e.g., geothermal energy generation), the permanent impacts are distributed over a larger area.

D.8.2 Renewable Technology in Development Focus Areas

Figures D-35 through D-44 display the technology allowed in each of the DFAs by ecoregion subarea. Most DFAs allow all three renewable technologies, solar, wind and geothermal. But, there are DFAs that limit the type of technology and require stipulations.

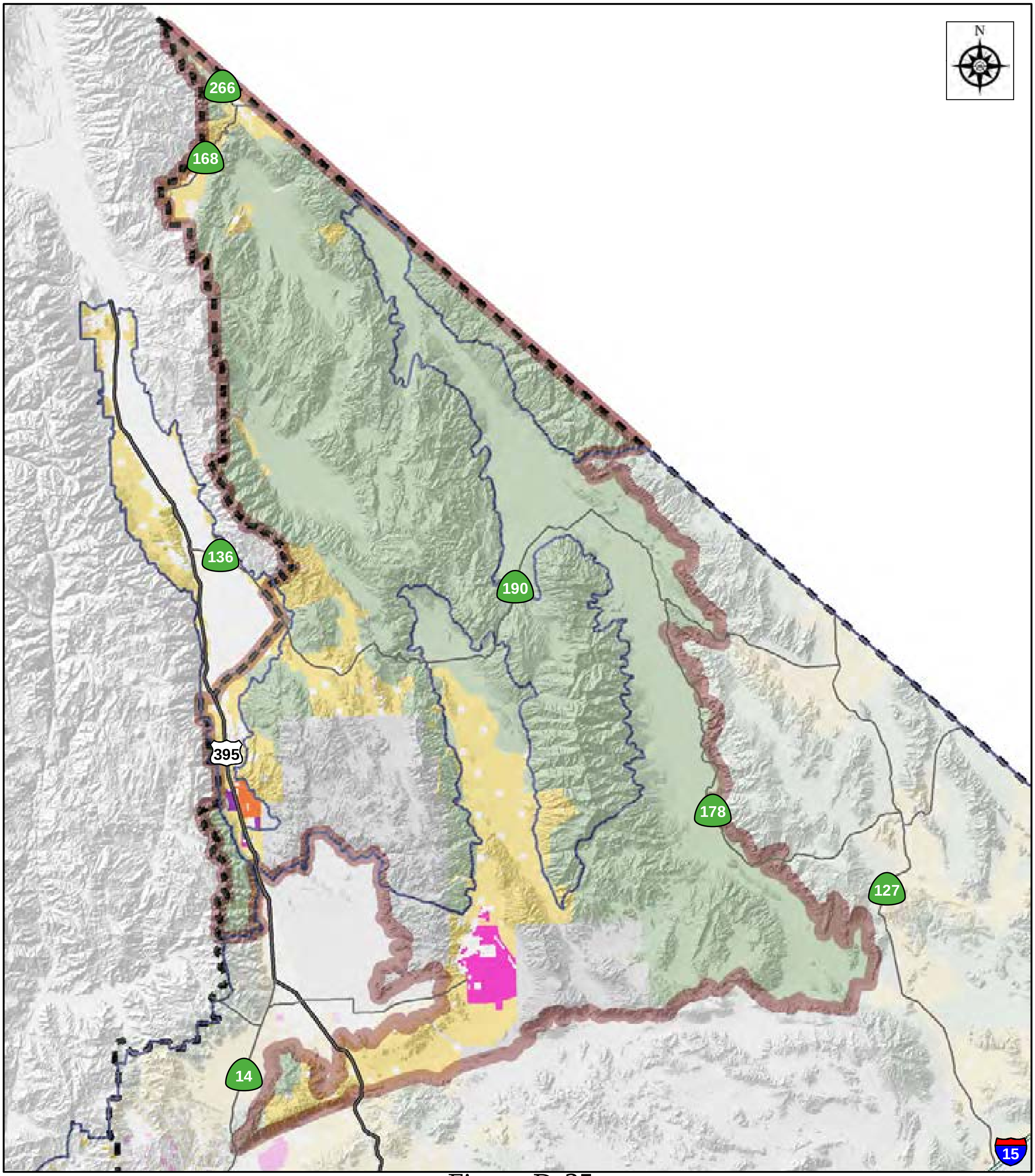


Figure D-35
Basin and Range
Ecoregion DFA Technologies

8/10/2016

BLM California State Office

DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Renewable Footprint

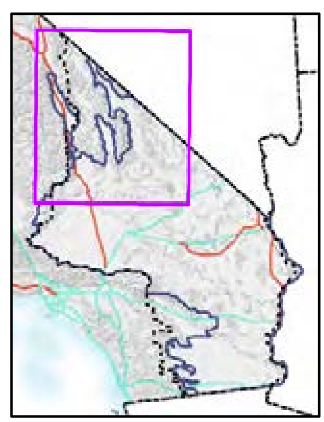
All Technologies
Geothermal Only
Solar and Geothermal Only
Variance Process Lands

Land Status

Bureau of Land Management
Department of Defense

0 20 40
Kilometers

Miles
0 20 40



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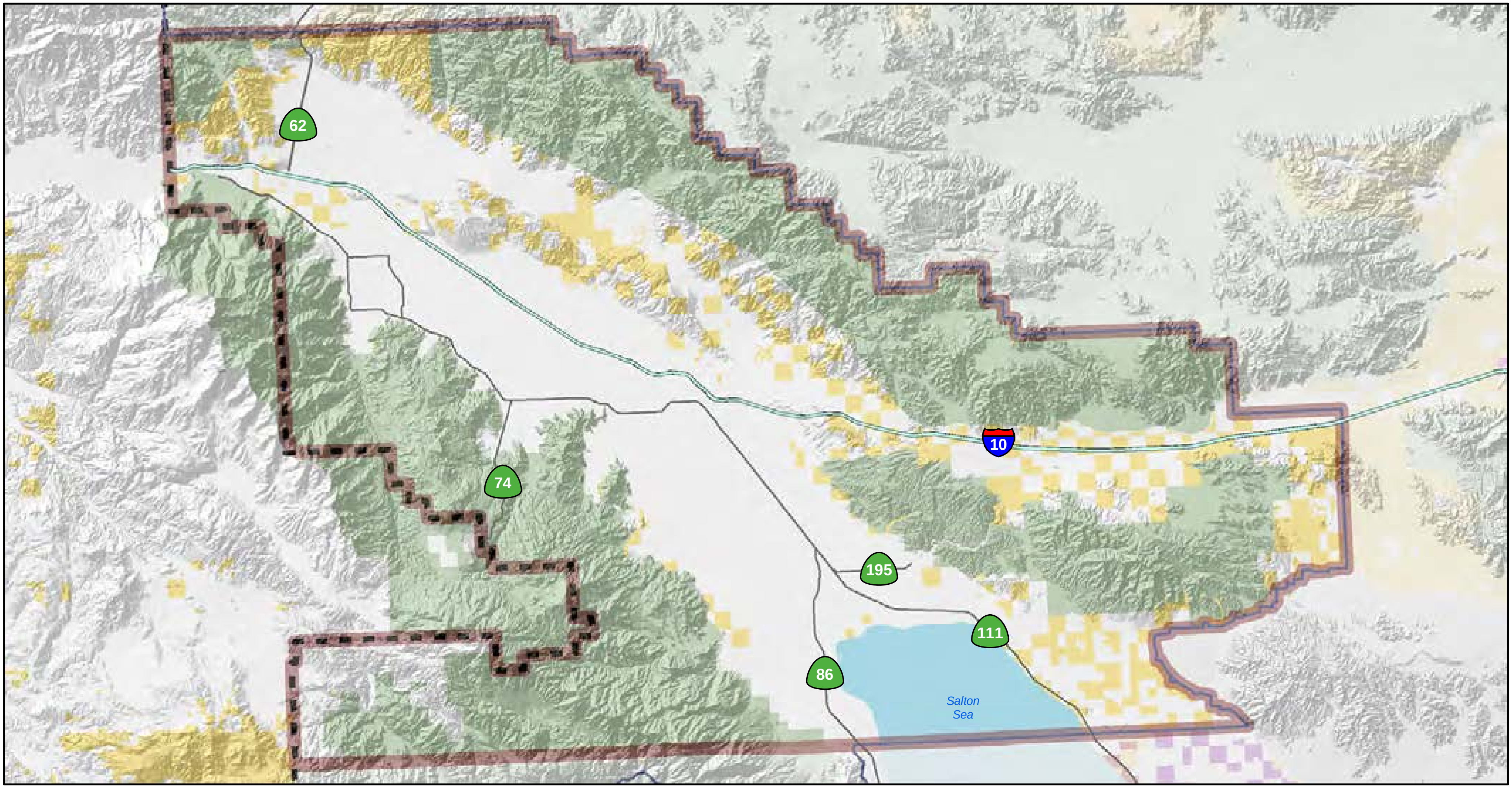


DRECP Ecoregion

DRECP Boundary

CDCA Boundary

LLPA

Land Status

Bureau of Land Management

Department of Defense

Figure D-36

Coachella Valley Ecoregion

DFA Technologies

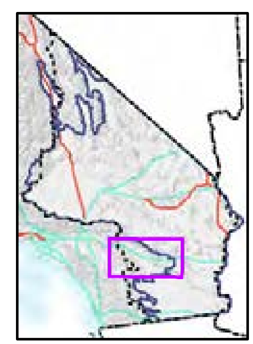
8/10/2016

BLM California State Office

0 5 10
Kilometers

N

Miles
0 5 10



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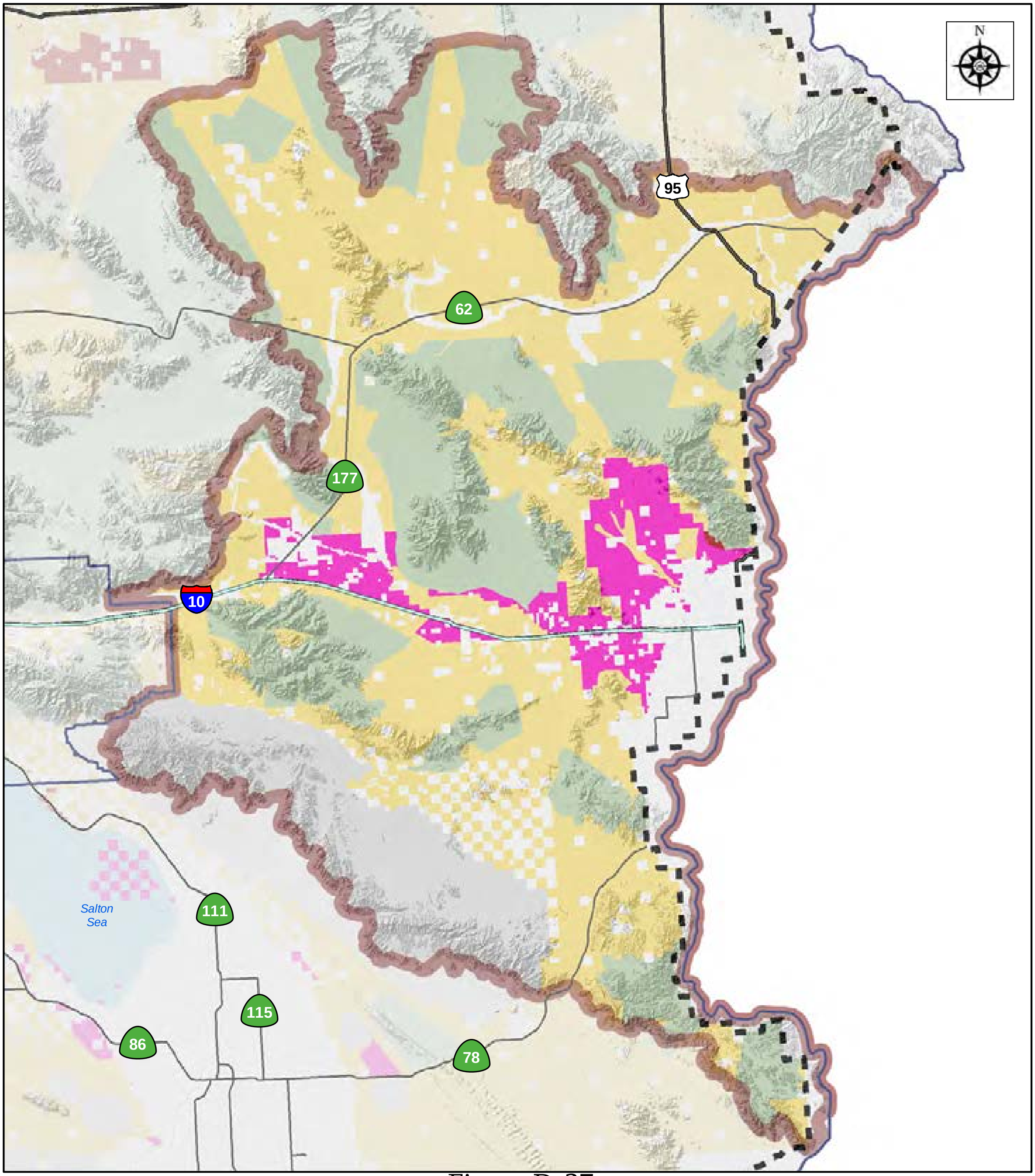


Figure D-37
Colorado Desert
Ecoregion DFA Technologies

8/10/2016
BLM California State Office

DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Renewable Footprint

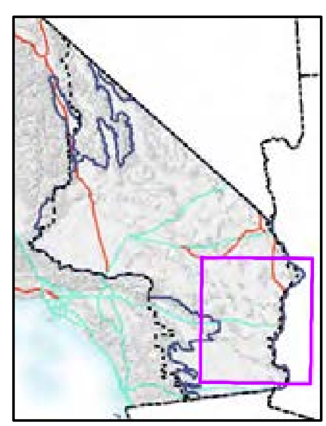
All Technologies
Variance Process Lands

Land Status

Bureau of Land Management
Department of Defense

0 10 20
Kilometers

Miles
0 10 20



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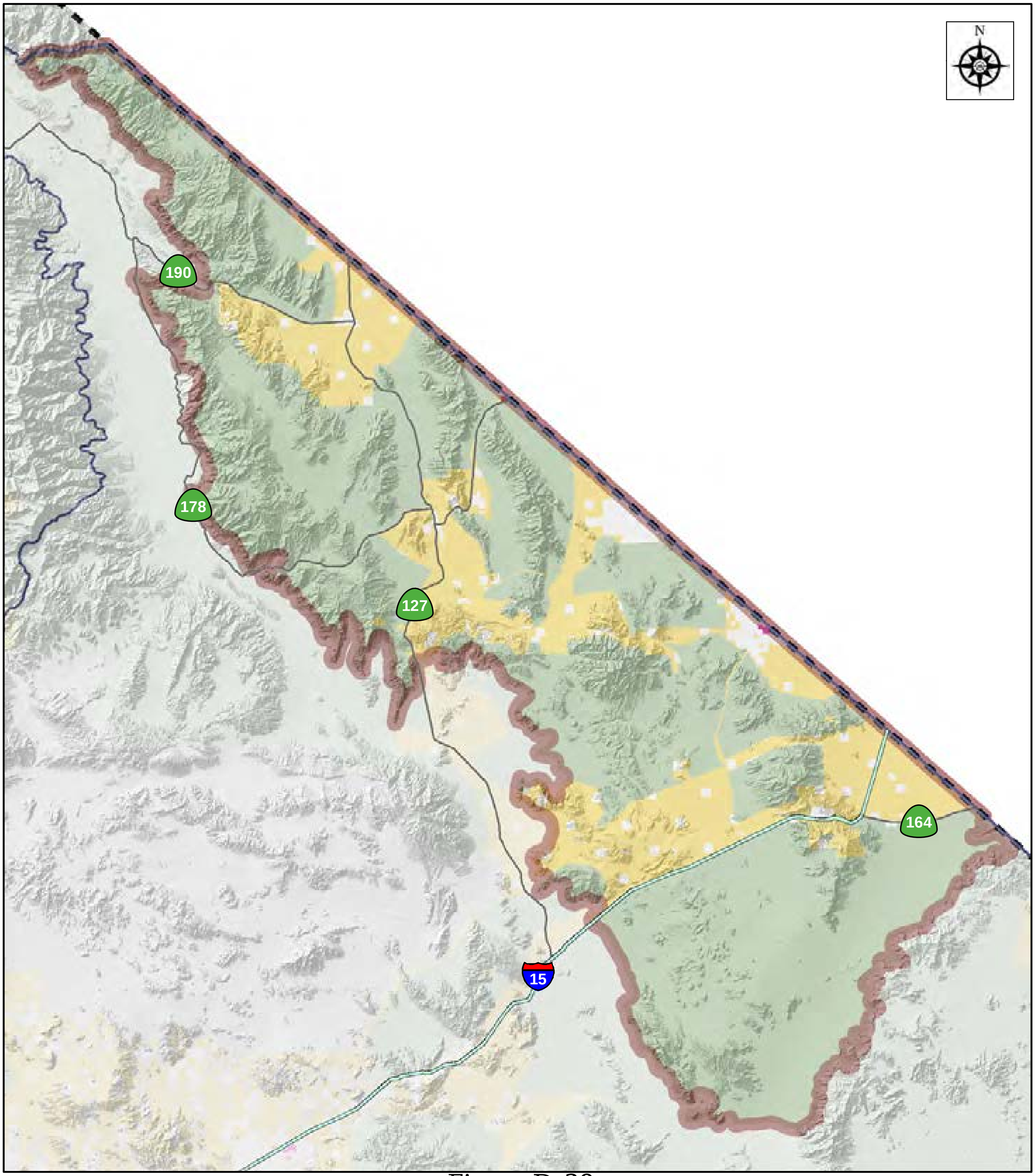
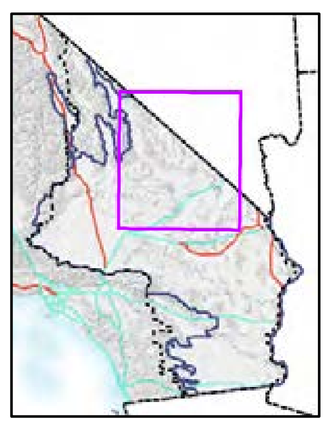


Figure D-38
Kingston - Amargosa
Ecoregion DFA Technologies

8/10/2016

BLM California State Office



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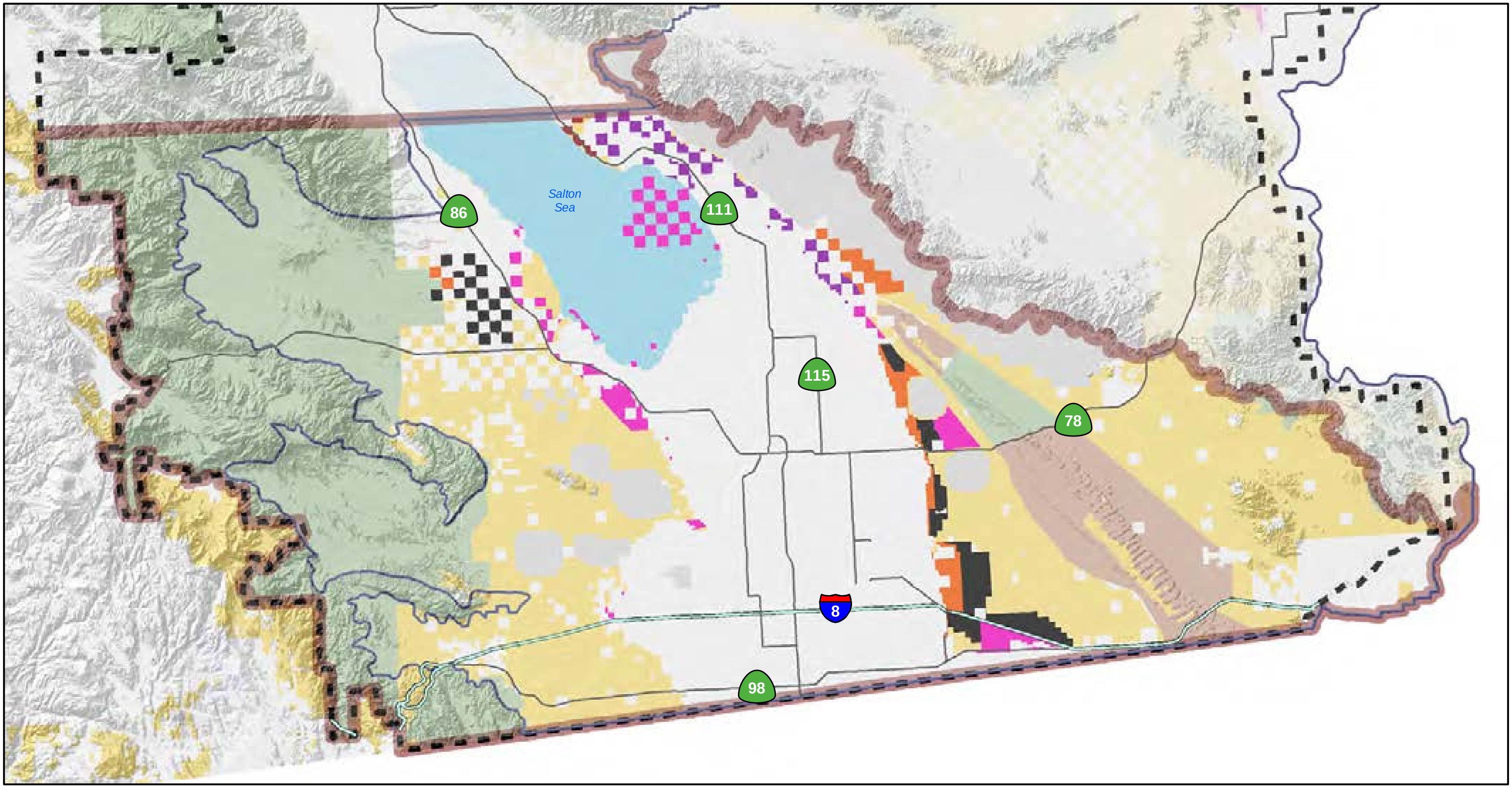

DRECP Ecoregion

Renewable Footprint

All Technologies

Geothermal, No Surface Occupancy

Geothermal Only

Solar and Geothermal Only

Variance Process Lands

DRECP Boundary

CDCA Boundary

LLPA

Imperial Sand Dunes Open OHV Area

Land Status

Bureau of Land Management

Department of Defense

Figure D-39
Lake Cahuilla
Ecoregion DFA Technologies

8/10/2016

BLM California State Office

0 10 20 Kilometers

N

Miles 0 10 20

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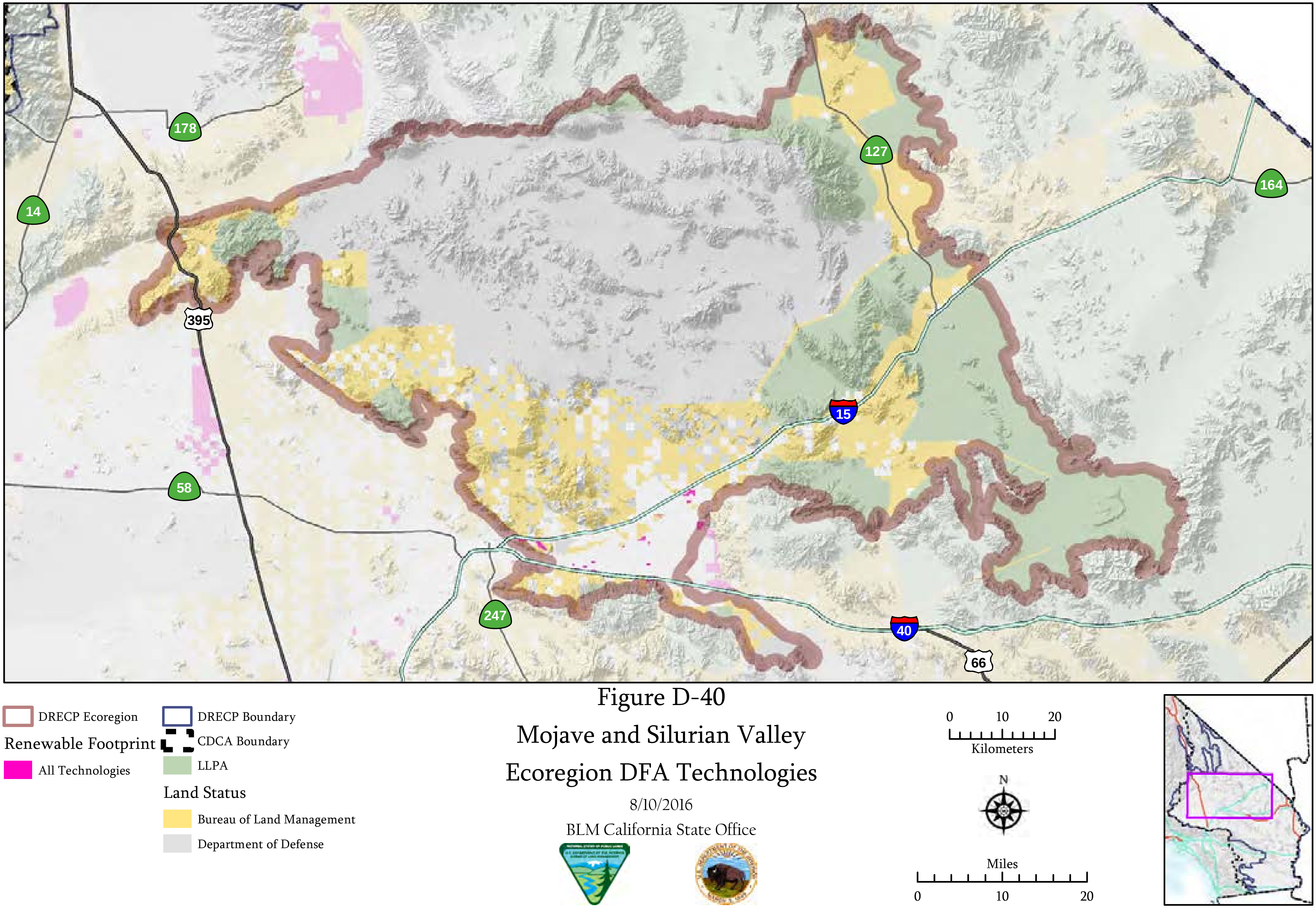

Figure D-40
Mojave and Silurian Valley
Ecoregion DFA Technologies
8/10/2016
BLM California State Office

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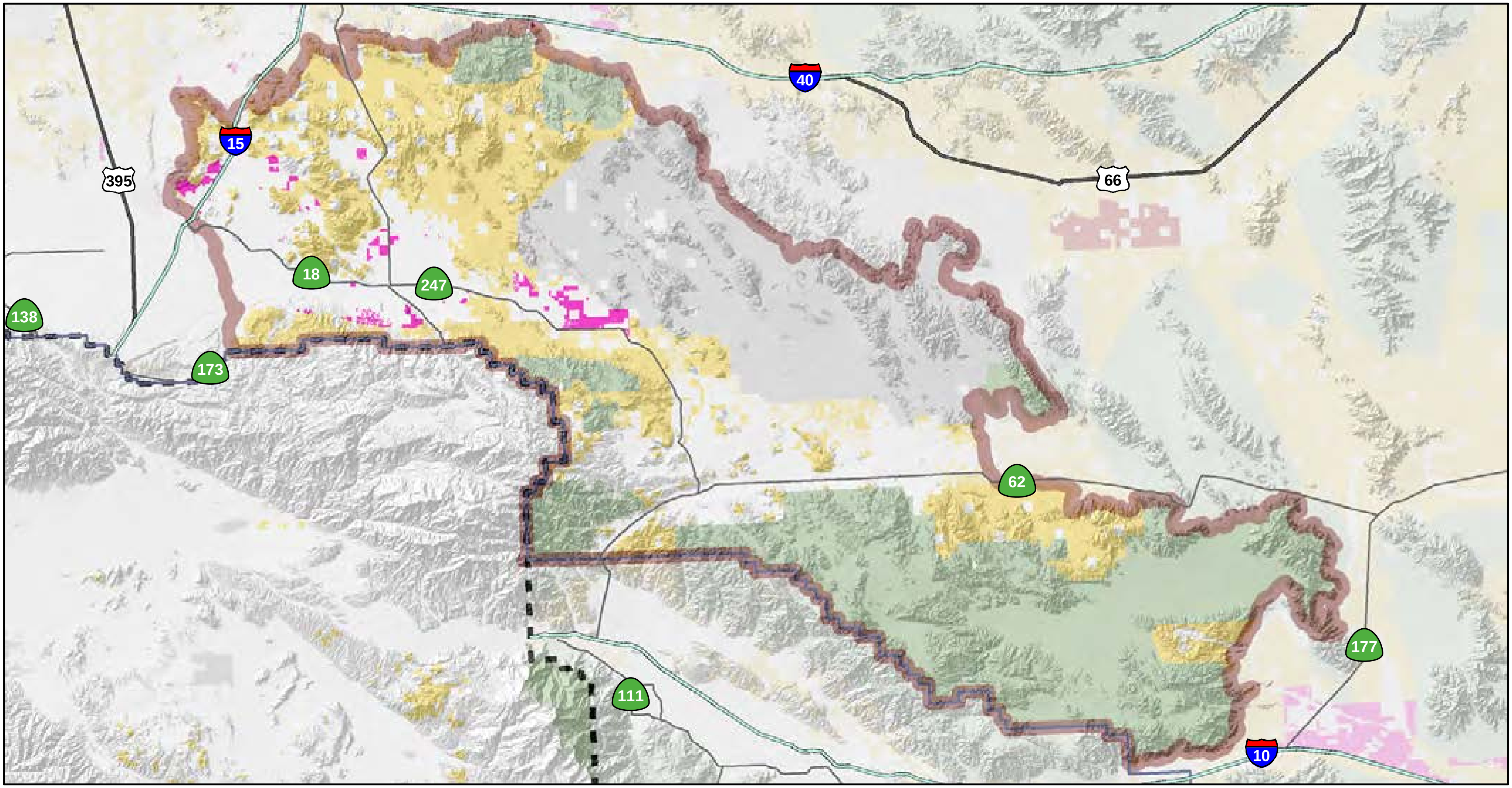


DRECP Ecoregion

Renewable Footprint

All Technologies

Variance Process Lands

DRECP Boundary

CDCA Boundary

LLPA

Land Status

Bureau of Land Management

Department of Defense

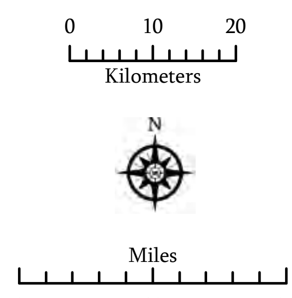
Figure D-41

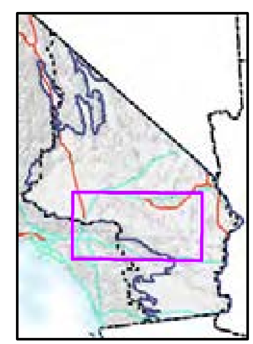
Pinto Lucerne Valley and Eastern Slopes

Ecoregion DFA Technologies

8/10/2016

BLM California State Office





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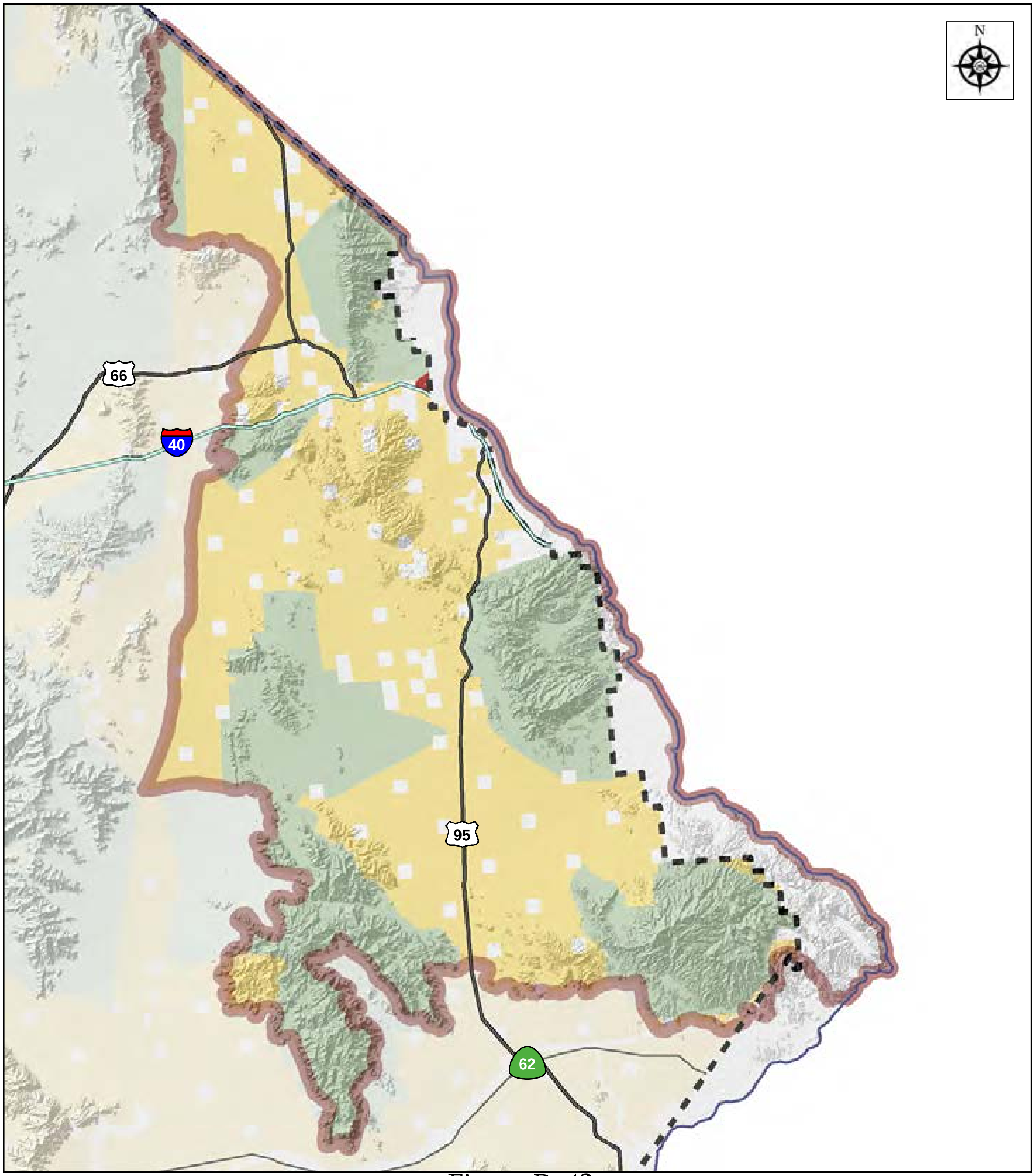


Figure D-42
Piute Valley and Sacramento Mountains Ecoregion DFA Technologies

DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Renewable Footprint

Variance Process Lands

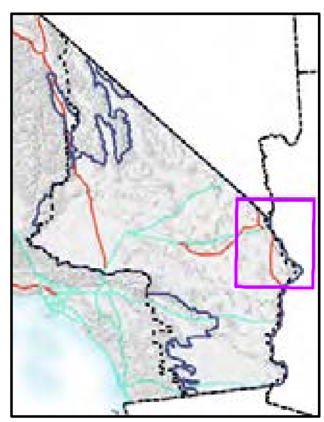
Land Status

Bureau of Land Management

8/10/2016
BLM California State Office

0 10 20
Kilometers

Miles
0 10 20



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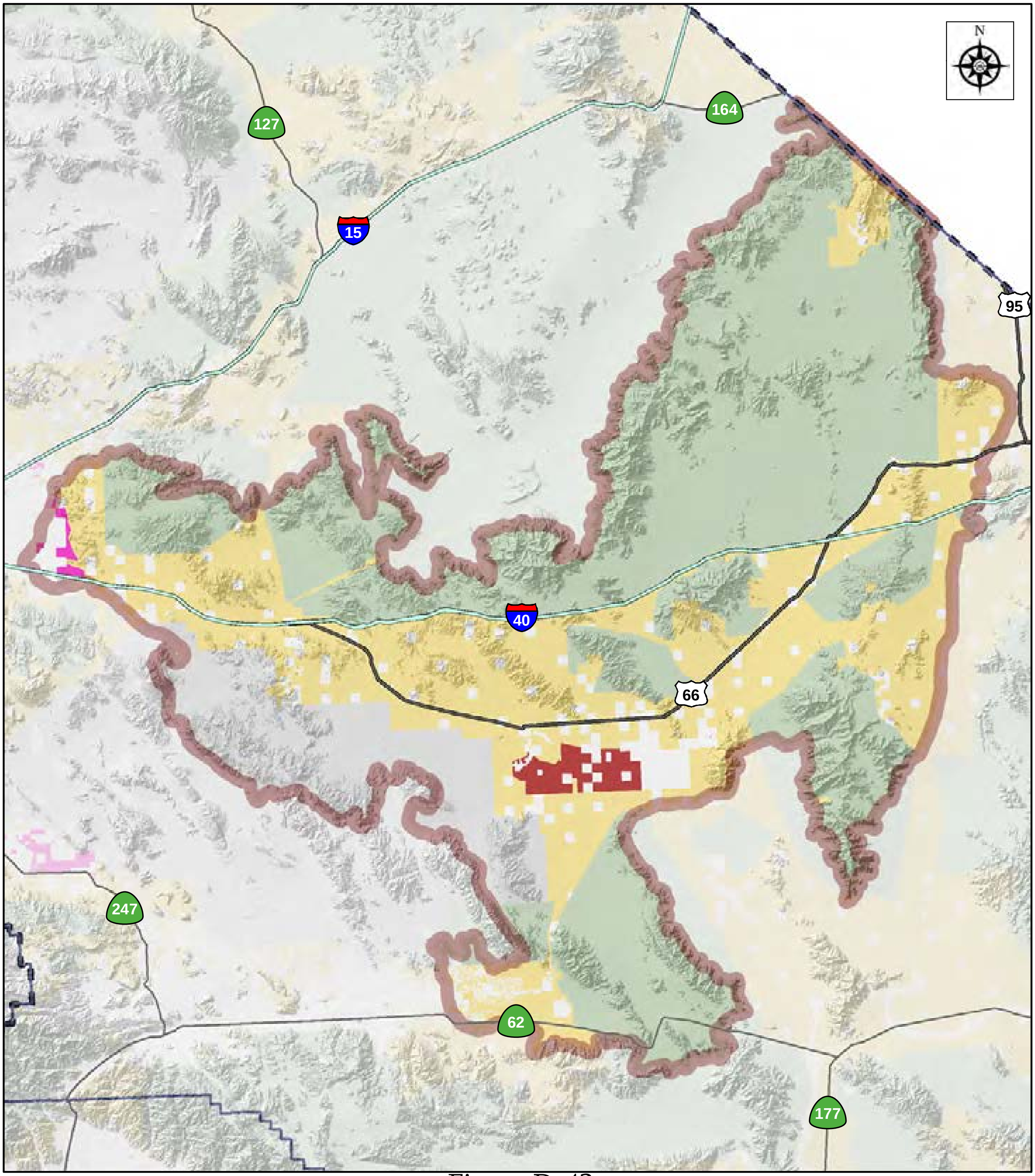


DRECP Ecoregion

DRECP Boundary

CDCA Boundary

LLPA

Renewable Footprint

All Technologies

Variance Process Lands

Land Status

Bureau of Land Management

Department of Defense

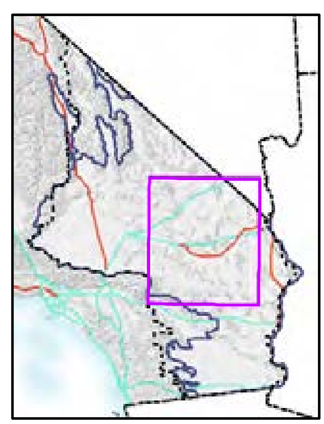
Figure D-43
South Mojave - Amboy
Ecoregion DFA Technologies

8/10/2016

BLM California State Office

0 10 20
Kilometers

Miles
0 10 20



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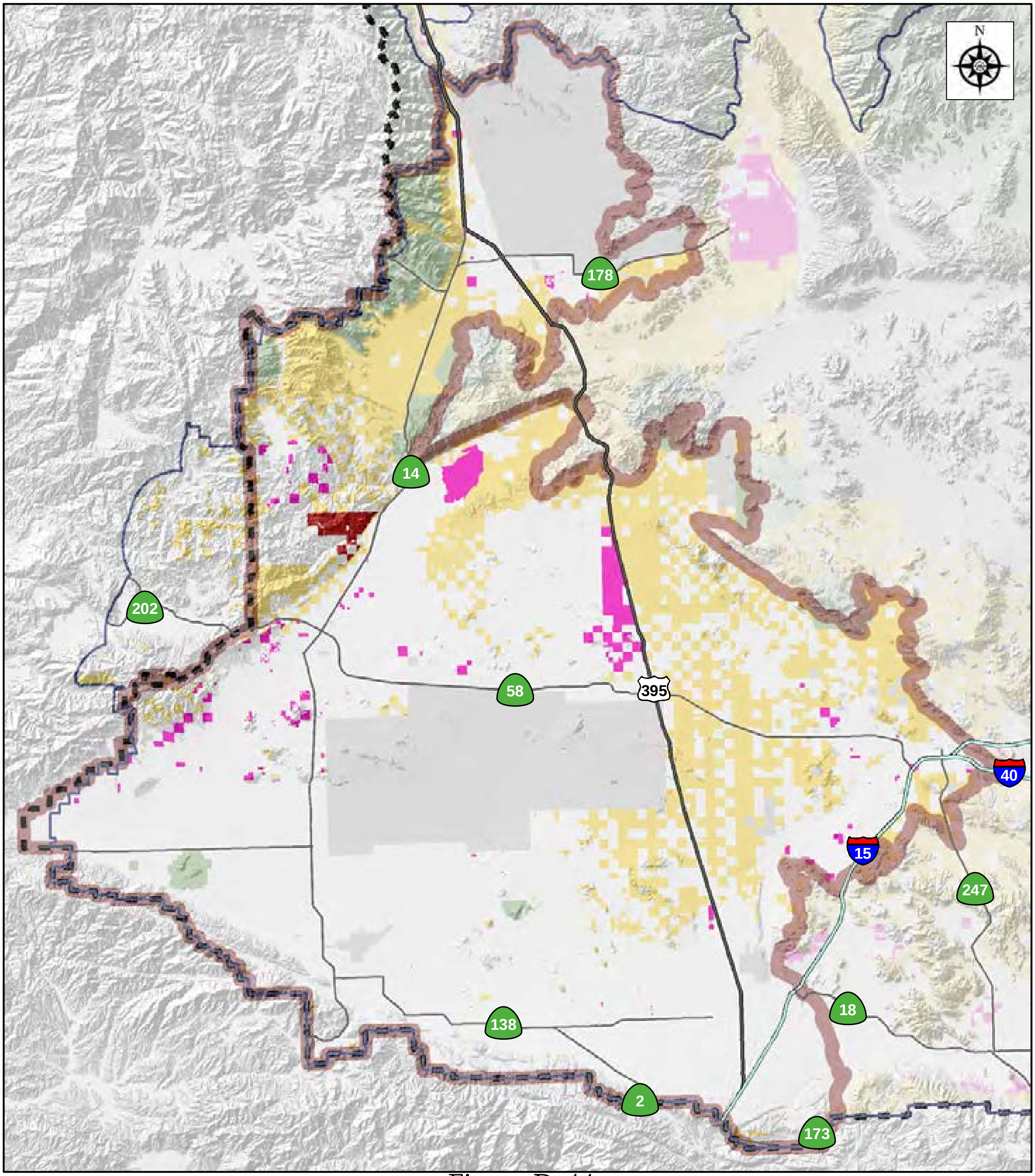


DRECP Ecoregion
DRECP Boundary
CDCA Boundary
LLPA

Renewable Footprint

All Technologies
Variance Process Lands

Land Status

Bureau of Land Management
Department of Defense

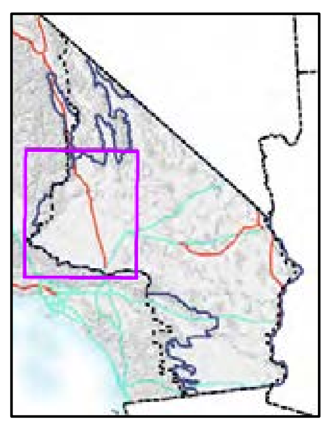
Figure D-44

West Desert and Eastern Slopes Ecoregion DFA Technologies

8/10/2016
BLM California State Office

0 10 20
Kilometers

Miles
0 10 20



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