Appendix D

Reserve Design Development Process and Methods

D RESERVE DESIGN DEVELOPMENT PROCESS AND METHODS

The following provides supplemental information regarding the reserve design process and methods for the Desert Renewable Energy Conservation Plan (DRECP or Plan) as summarized in Volume I, Section I.3.4.4, Develop Reserve Design. Drawing upon the wealth of input from wildlife agencies, other public agencies, and outside scientific and stakeholders, the reserve design development process was a collaborative and iterative process. The Renewable Energy Action Team (REAT) agency staff (U.S. Fish and Wildlife Service [USFWS], Bureau of Land Management [BLM], California Department of Fish and Wildlife [CDFW], and California Energy Commission [CEC]) from state and local field offices led the multiyear process along with the California State Lands Commission (CSLC) and other participating agencies, including National Park Service and California State Parks. The reserve design process focused on applying the best available data and expert knowledge from multiple agencies, regions, and disciplines.

D.1 Purpose of the Reserve Design Process

The reserve design development process incorporates a three-fold purpose:

- Develop a reserve design envelope that identifies important areas for conservation in the planning area—outside existing protected areas—to meet Plan-wide Biological Goals and Objectives (BGOs) for Covered Species, natural communities, and the associated landscape features and processes.
- Fulfill relevant requirements of the Natural Community Conservation Planning Act (NCCPA) of 2003, as amended.
- Identify areas not important for the conservation of Covered Species, natural communities, and associated landscape features and processes where siting renewable energy development would have the least conflicts with biological resources.

The reserve design envelope is the geographic area considered important for conservation to meet the Plan-wide BGOs for Covered Species, natural communities, and the associated landscape features and processes. The reserve design envelope developed through the reserve design process described here would not be implemented under any DRECP alternative. Instead, the reserve design envelope was used to create the DRECP Plan-Wide Reserve Design Envelope for each alternative, which includes the BLM LUPA conservation designations and Conservation Planning Areas (i.e., the portion of the reserve design where reserves would established by acquiring land or conservation easements from willing sellers) for each alternative as described in Volume II. Additionally, the reserve design process informed the development of the interagency Plan-wide Conservation Priority Areas for each alternative, which is the basis of the NCCP Conceptual Plan-Wide Reserve

Design of each alternative. Finally, the reserve design envelope described here was used in the identification of Development Focus Areas (DFAs) for each alternative, as described in Section I.3.6, Plan Integration.

D.2 Goals and Principles for the Reserve Design

The Plan-wide BGOs and the reserve design principles guided development of the reserve design envelope.

D.2.1 Plan-Wide Biological Goals and Objectives

The DRECP biological goals provide the overall conservation vision for the reserve design, and the DRECP biological objectives describe the desired conditions of the reserve design.

At the broad level, the DRECP Planning Agreement established the following planning goals:

- Provide for the long-term conservation and management of Covered Species within the Plan Area.
- Preserve, restore, and enhance natural communities and ecosystems that support Covered Species within the Plan Area.

As described further in Appendix C, Biological Goals and Objectives, the following primary Plan-wide biological goals guided reserve design development:

- At the landscape level, the primary Plan-wide goal is to:
  - Create a connected, landscape-scale reserve system consisting of large habitat blocks of all constituent natural communities that (1) maintain ecological integrity, ecosystem function, and biological diversity and allow adaptation to changing conditions (including activities not covered by the Plan) and (2) include temperature and precipitation gradients, elevation gradients, and a diversity of geological facets to accommodate range contractions and expansions in response to climate change.
- At the natural community level, the primary Plan-wide goal is to:
  - Promote biodiversity and ecological function within each natural community and benefit covered or native species dependent on, or closely associated with, each natural community.
- At the species level, the primary Plan-wide goal is to:
  - Protect, manage, and contribute to recovery of viable self-sustaining populations of Covered Species throughout the species' distribution in the Plan Area, including conserving sufficient habitat and resources to adapt to environmental change through time.

From these primary goals, the REAT agencies developed specific Plan-wide BGOs for landscape features and processes, natural communities, and Covered Species (Appendix C). These Plan-wide BGOs guided development of the reserve design envelope.

D.2.2 Reserve Design Principles

In addition to the direction provided by the Plan-wide BGOs, the following reserve design principles were used in developing the reserve design envelope. These principles are based on established scientific principles of conservation biology (Soulé 1985; Soulé 1987; Noss et al. 1997; Margules and Pressey 2000; Groom et al. 2006) and the goals of the NCCPA and Endangered Species Act. Likewise, these reserve design principles are consistent with the DRECP Independent Science Advisors' (DRECP ISA 2010) recommendations to design a comprehensive, connected, and resilient reserve system using "well-established scientific principles."

Maximize Conservation Area Size. Under the DRECP, conservation areas would be sufficiently large to offset impacts of Covered Activities and support self-sustaining populations of Covered Species that would contribute to their recovery in the Plan Area. Large conservation areas are important for three main reasons:

1. To protect and maintain habitat areas large enough to support self-sustaining populations within a particular conservation area (e.g., an endemic species) or within important population segments of Covered Species that contribute to their population-wide self-sustainability.
2. To maximize protection and provide a buffer for species sensitive to disturbances from adjacent land use.
3. To maximize protection of biodiversity.

Large conservation areas are more resilient and generally support more species for longer periods than small conservation areas. Large conservation areas are also generally more efficient to manage on a per-acre basis because they better allow for planning and implementing large-scale management actions, such as exotic species control, and do not impede natural disturbance regimes and events such as wildfire, flooding, and sand transport. Furthermore, because large conservation areas tend to have a larger "interior" area relative to "edge" area, they are less prone to adverse edge effects, which result in less intensive management requirements.

Maintain Connectivity. In principle, preserving connectivity reduces the detrimental effects of habitat fragmentation on ecosystem function and species demography. The reserve design would link existing protected areas with new conservation areas to ensure the habitat connectivity maintains the ecological integrity of the system. This would

maintain and enhance the ability of native species to move among conservation areas, facilitate exchange of genetic material, and support species migration, dispersal, and colonization. In theory, a single, large conservation area would be better for supporting self-sustaining species populations than several small, linked conservation areas of equal total size. In some cases, however, where a larger conservation area or direct connectivity among conservation areas is not feasible due to existing conditions (e.g., areas already reduced or isolated by irreversible land uses), small or isolated conservation areas can effectively protect certain features or populations with high biological importance (e.g., endemic and narrowly distributed populations). However, such small and/or isolated areas often require intensive management.

Minimize Edge. The reserve will be designed to share the minimum amount of edge with nonconservation lands (especially urban development) as feasible. That is, the reserve design would have the greatest feasible area-to-perimeter ratio to minimize the direct and indirect adverse effects of adjacent land uses on Covered Species and natural communities. Minimizing the reserve edge to the extent feasible would also reduce management costs. Discrete conservation areas that approximate round or square configurations have higher area-to-perimeter ratios and less edge than long and narrow areas. Likewise, the straighter the edge boundary of the conservation area, the less edge the conservation area would have. However, conservation areas with lower area-to-perimeter ratios may be necessary to protect defined or linear features with high biological value, such as streams, desert washes, or desert riparian woodlands essential to wildlife movement and plant dispersal.

Target High-Quality Natural Communities. The reserve design will target high-quality, intact natural communities and habitat for Covered Species in the Plan Area. "High quality" is defined using various parameters and differs according to community type and species habitat needs. High-quality habitats are frequently characterized by an abundance and diversity of native species, intact natural processes, and few roads or other forms of human disturbances. As part of the reserve design, the best examples of each natural community are identified and would be protected to the extent feasible. High-quality habitat would conserve core populations of Covered Species. Degraded communities may also need protection in some areas to include unique or highly imperiled habitats or species populations, link conservation areas, function as buffers from incompatible land uses, and/or provide opportunities for enhancement and restoration.

Target Areas With Limited Access. The reserve design will target habitat blocks with limited human access. Human contact and activity are considered major causes of decline in certain special-status species, such as desert tortoise (*Gopherus agassizii*). Populations of such species in habitats where access related to certain human activities (e.g., development, mining, and recreation) is restricted are more likely to persist than species in habitats where human activities are less restricted. The reserve design should protect

roadless areas whenever possible, and the conservation strategy should manage authorized road use in conservation areas.

Buffer Urban and Rural Use Impacts. The reserve design will include buffer lands within its boundaries where conservation areas are adjacent to existing or planned urban and rural areas (i.e., areas zoned for urban development by local jurisdictions). The purpose of buffers is to reduce adverse effects on Covered Species and natural communities from urban and rural development. The size of an effective buffer will depend on site-specific conditions such as topography, the types and intensity of adjacent urban development and related activities, separation of the natural community from development, the condition of the buffer lands, and whether Covered Species are known or expected to be present. Buffer areas are expected to be located within the reserve, rather than within adjacent land uses.

Preserve Irreplaceable and Threatened Biological Resources. Irreplaceability is a measure of the degree to which conservation goals can be met by preservation of multiple sites. A site with high biological irreplaceability has unique species or natural communities that cannot be preserved or restored elsewhere. Threatened biological resources are those most at risk from natural or anthropogenic factors. The reserve design will prioritize protecting biological diversity and natural communities that have a high level of irreplaceability and a high degree of threat.

Fully Represent Environmental Gradients. The reserve design will include a range of contiguous environmental gradients (e.g., topography, elevation, soil types, geologic substrates, slopes, and aspects) to allow for shifting, expanding, or contracting species distributions in response to anthropogenic change (e.g., habitat removal, climate change) (Beier and Brost 2010). Preservation of environmental gradients would better accommodate species' response to natural catastrophic events such as fire or prolonged drought. Environmental gradients can also maintain species' genetic and ecological diversity.

Consider Ecoregion Subareas and Watersheds. The reserve design will capture a full range of biogeographic conditions across ecoregion subareas and watersheds. This approach can help to maintain ecosystem function, water availability, habitat, and species diversity.

Consider Full Ecological Diversity Within Communities. The reserve design will reflect the full ecological diversity and heterogeneity within natural communities (e.g., species composition, vegetation structure, physical, and climatic factors) to maintain sufficient habitat diversity and species and population interactions. This principle is also called "representativeness" and "comprehensiveness."

Consider Management Needs. The reserve design will be manageable; that is, desired management treatments, such as invasive species control, must be feasible within each conservation area, and the source of funding must be identified. In general, larger

conservation areas are more efficient to manage on a per-acre basis, but other factors, such as adjacent land uses, topography, parcel configuration, and access, must also be considered. Management needs may be driven by factors on or off site (e.g., adjacent land uses and watershed processes such as upstream erosion or ongoing contamination) that are consistent with the Plan's overall management program.

D.3 Reserve Design Methods

The following describes the reserve design methods used to develop the reserve design envelope through the phased planning process. This description focuses exclusively on reserve design methods. Other components of the conservation planning process (i.e., Covered Species and natural communities list development, data assembly, BGOs, Conservation and Management Actions [CMAs], and the Monitoring and Adaptive Management Program) are summarized in Section I.3.4, DRECP Biological Conservation Planning Process, and explained in more detail in specific appendices.

D.3.1 Reserve Design Planning Process Overview

The reserve design envelope was developed over several years using a phased planning process, as recommended by DRECP Independent Science Advisors (DRECP ISA 2010), and was guided by the DRECP BGOs and principles of conservation planning (see Section D.2, Goals and Principles for the Reserve Design). The reserve design envelope was developed from a systematic and objective approach (Margules and Pressey 2000; Carroll et al. 2003; Moilanen et al. 2009) using several independent methods that were iteratively evaluated and refined. The reserve planning process is a key element of the DRECP biological conservation planning process (see Section I.3.4), which is one of the major components of the overall DRECP integrated planning process (Chapter I.3).

The following provides an overview of the reserve design planning process, which is also illustrated in Exhibit D-1.

- **Identify Reserve Design Planning Area and Existing Protected Areas.** The initial step in the reserve design process was to identify the reserve design planning area (Section D.3.2) and existing protected areas (Section D.3.3). Within the Plan Area, certain areas were considered unavailable for reserve design planning. These "Other Lands" (see DRECP Glossary of Terms) were not included in the reserve design envelope: military lands, BLM Open Off-Highway Vehicle (OHV) areas, BLM Imperial Sand Dunes Recreation Area Management Plan Open OHV area, and tribal lands. Additionally, reserve design was not conducted within existing protected areas. Existing protected areas serve as building blocks for the reserve design envelope and include Legislatively and Legally Protected Areas (LLPAs) and Military Expansion Mitigation Lands (MEMLs).

- **Incorporate Existing Planning and Early Coarse-Level Approaches.** Existing planning and early coarse-level (or "coarse-filter") approaches provided initial inputs into the reserve design process and included existing BLM land use planning designations (i.e., resource conservation areas identified through the BLM California Desert Conservation Area [CDCA] and Resource Management Plans [RMPs]), Renewable Energy Transmission Initiative (RETI) planning products, REAT Starting Point Maps, the DRECP Preliminary Conservation Strategy map, and the Marxan reserve optimization analysis. For information on these early designations and a description of the Marxan approach, see Section D.3.4. These existing plans and coarse-level approaches helped establish the early conservation context for the phased reserve design planning process and helped identify areas where renewable energy development would have the least conflict with biological resources, which helped to shape the DFAs through the renewable energy planning process (see Section I.3.5, Renewable Energy Goals and Planning Process).
- **Incorporate Disturbed Lands Mapping and Intactness Information.** Disturbed lands mapping and intactness analyses, from multiple sources, were used to further identify degraded and less ecologically intact areas considered less important for the reserve design (Section D.3.5). These mapping products and analyses were included in the evaluation and refinement phase (Section D.3.7) leading to the reserve design envelope.
- **Apply the Focal Species, Communities, and Processes Approach.** As the phased reserve design planning process progressed, the biological resource mapping data quality improved and the resulting reserve design planning became more robust with less uncertainty. Species distribution models for Covered Species were vetted internally and externally, detailed natural community mapping was completed and incorporated, and habitat linkage and process information was integrated. These data improvements facilitated and served as inputs to a focal species, communities, and processes approach (Section D.3.6), which created an initial reserve design envelope from "driver" resources.
- **Evaluate and Refine.** The initial results from the disturbed lands mapping and intactness analyses and the focal species, communities, and processes approach were evaluated and refined in the context of existing planning and early coarse-level approaches. These evaluations comprised collaborative GIS mapping sessions, agency expert field reconnaissance, iterative quantitative GIS analyses, and comparisons with newly released data (e.g., new intactness modeling) (see Section D.3.7.). Multiple iterations of evaluation and refinement yielded the reserve design envelope summarized in Section D.4. Data layers used to develop the reserve design envelope are inventoried and available on the DRECP portal.

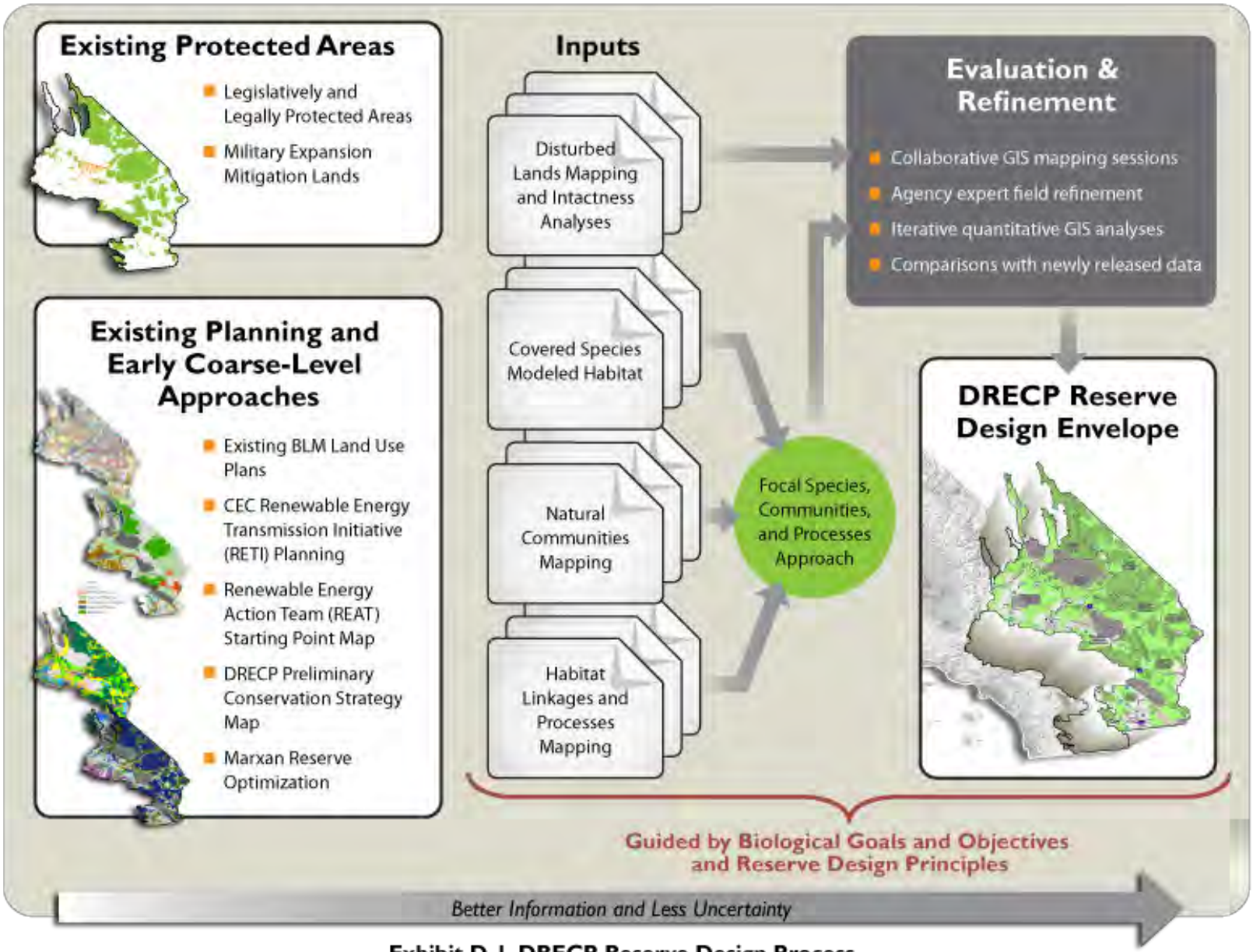


Exhibit D-1. DRECP Reserve Design Process

D.3.2 Reserve Design Planning Area

The reserve design planning area includes the entire Plan Area outside of Other Lands. Other Lands not considered part of the reserve design planning area include military lands, BLM Open OHV areas, BLM Imperial Sand Dunes Recreation Area Management Plan Open OHV area, and tribal lands. Although Other Lands may contain biological resources important to the reserve design, these lands are not within the reserve design envelope and are not addressed in the DRECP conservation strategy.

D.3.3 Existing Protected Areas

As part of the conservation planning process, existing Conservation Designations were identified to determine where existing resource protection and management exists across the Plan Area. Areas outside Conservation Designations were considered gaps in protection—where the DRECP conservation strategy and reserve design should focus. This analysis was conducted early in the planning process and yielded two primary categories of lands considered Existing Conservation Areas: the Legislatively and Legally Protected Areas (LLPAs) and Military Expansion Mitigation Lands (MEMLs). The LLPAs and MEMLs are considered existing conservation for the purpose of the DRECP conservation strategy and reserve design. These areas of existing conservation include state and federal wilderness areas; national parks, preserves, and wildlife refuges; California State Parks; CDFW Conservation Areas (ecological reserves and wildlife areas); CDFW mitigation and conservation easement areas; privately held conservation areas including mitigation banks and land trust lands; proposed wilderness and wilderness study areas; National Wild and Scenic Rivers; National Scenic and Historic Trails; and lands conserved as mitigation for the expansion of Department of Defense installations. Identifying these existing protected areas focused the conservation strategy on areas outside LLPAs and MEMLs that are most vulnerable to adverse effects and those that would benefit most from the CMAs (e.g., acquisition, restoration, management, and monitoring). Table D-1 provides a list of the components of the LLPAs. Figure D-1 shows the existing protected areas.

Table D-1
Components of Legislatively and Legally Protected Areas

Legislatively and Legally Protected Areas (LLPAs) Components	Description and Units
Federal Components	
BLM Wilderness Areas	Includes the following designated wilderness areas managed by the BLM: • Argus Range • Big Maria Mountains • Bigelow Cholla Garden

Table D-1
Components of Legislatively and Legally Protected Areas

Legislatively and Legally Protected Areas (LLPAs) Components	Description and Units
	• Bighorn Mountain • Black Mountain • Bright Star • Bristol Mountains • Cadiz Dunes • Carrizo Gorge • Chemehuevi Mountains • Cleghorn Lakes • Clipper Mountains • Coso Range • Coyote Mountains • Dead Mountains • El Paso Mountains • Fish Creek Mountains • Funeral Mountains • Golden Valley • Grass Valley • Hollow Hills • Ibex Pass • Indian Pass • Inyo Mountains • Jacumba • Kelso Dunes • Kiavah • Kingston Range • Little Chuckwalla Mountains • Little Picacho • Malpais Mesa • Manly Peak • Mesquite • Newberry Mountains • Nopah Range • North Algodones Dunes • North Mesquite Mountains • Old Woman Mountains • Owens Peak • Pahrump Valley • Palen/McCoy • Palo Verde Mountains

Table D-1
Components of Legislatively and Legally Protected Areas

Legislatively and Legally Protected Areas (LLPAs) Components	Description and Units
	• Picacho Peak • Piute Mountains • Resting Spring Range • Rice Valley • Riverside Mountains • Rodman Mountains • Sacatar Trail • Saddle Peak Hills • San Gorgonio • Sheephole Valley • South Nopah Range • Stateline • Stepladder Mountains • Surprise Canyon • Trilobite • Turtle Mountains • Whipple Mountains
National Parks and National Preserves	Includes the following areas managed by the National Park Service: • Death Valley National Park • Joshua Tree National Park • Mojave National Preserve
National Wildlife Refuges	Includes the following areas managed by the USFWS: • Sonny Bono Salton Sea National Wildlife Refuge Complex
Wild and Scenic Rivers	Includes the following segments: • Amargosa River • George Creek • Independence Creek • Middle Fork Whitewater River • South Fork Whitewater River
Wilderness Study Areas	Includes the following areas managed by BLM: • Avawatz Mountains • Big Morongo Canyon[1] • Bighorn Mountain • Bright Star • Cady Mountains • Death Valley National Park Additions • John Muir

Table D-1
Components of Legislatively and Legally Protected Areas

Legislatively and Legally Protected Areas (LLPAs) Components	Description and Units
	• Joshua Tree National Park Additions • Kingston Range • Pleasant View • San Gorgonio • Soda Mountains[2]
State Components	
California State Parks	Includes the following areas managed by California State Parks: • Anza-Borrego Desert State Park • Antelope Valley California Poppy Reserve • Antelope Valley Indian Museum • Arthur B. Ripley Desert Woodland State Park • Heber Dunes State Vehicular Recreation Area • Mitchell Caverns Natural Preserve • Ocotillo Wells State Vehicular Recreation Area • Picacho State Recreation Area • Providence Mountains State Recreation Area • Red Rock Canyon State Park • Saddleback Butte State Park • Tomo-Kahni State Historic Park
CDFW Conservation Areas (ecological reserves, wildlife areas, and mitigation/conservation easements)	Includes the following areas managed by CDFW: • Camp Cady Wildlife Area • Cartago Wildlife Area • Chuckwalla Bench • Colorado River Access • Desert Tortoise Habitat areas • East Mojave Desert • Fremont Valley Ecological Reserve • Imperial Wildlife Area • Indian Joe Spring Ecological Reserve • Indian Wells Valley • Kelso Peak and Old Dad Mountains Wildlife Area • King Clone Ecological Reserve • Marble Mountains Wildlife Area • Mission Creek • Mojave River • Mountain Sheep Watering Area • Old Woman Mountains Bighorn Sheep Range • Ord-Rodman

Table D-1
Components of Legislatively and Legally Protected Areas

Legislatively and Legally Protected Areas (LLPAs) Components	Description and Units
	• Palo Verde Ecological Reserve • Piute Creek Ecological Reserve • San Felipe Creek Ecological Reserve • Tabaseca • West Mojave Desert Ecological Reserve
Other Components	
Conservancy lands and privately held conservation areas[3] (including mitigation banks and land trust-protected areas)	Includes lands held by the following entities: • Anza-Borrego Foundation • Friends of the Desert Mountains • Riverside Land Conservancy • The Nature Conservancy • The Wildlands Conservancy • Wilderness Land Trust

Notes:
1 The Big Morongo Canyon area is an existing BLM Area of Critical Environmental Concern (ACEC) and part of the proposed Sand-to-Snow National Monument. It is included as part of the DRECP LLPAs.
2 The southern portion of the Soda Mountains Proposed Wilderness Area that overlaps with the BLM Superior-Cronese Desert Wildlife Management Area was not included as part of the DRECP LLPAs.
3 Other conservancy lands and privately held conservation areas not inventoried here would also be considered Legislatively and Legally Protected areas, including lands held by the Desert Tortoise Preserve Committee, Transmission Habitat Conservancy, and Wildlife Heritage Foundation.

D.3.4 Existing Planning and Early Coarse-Level Approaches

Existing resource planning helped to establish the initial conservation context for the reserve design process, including:

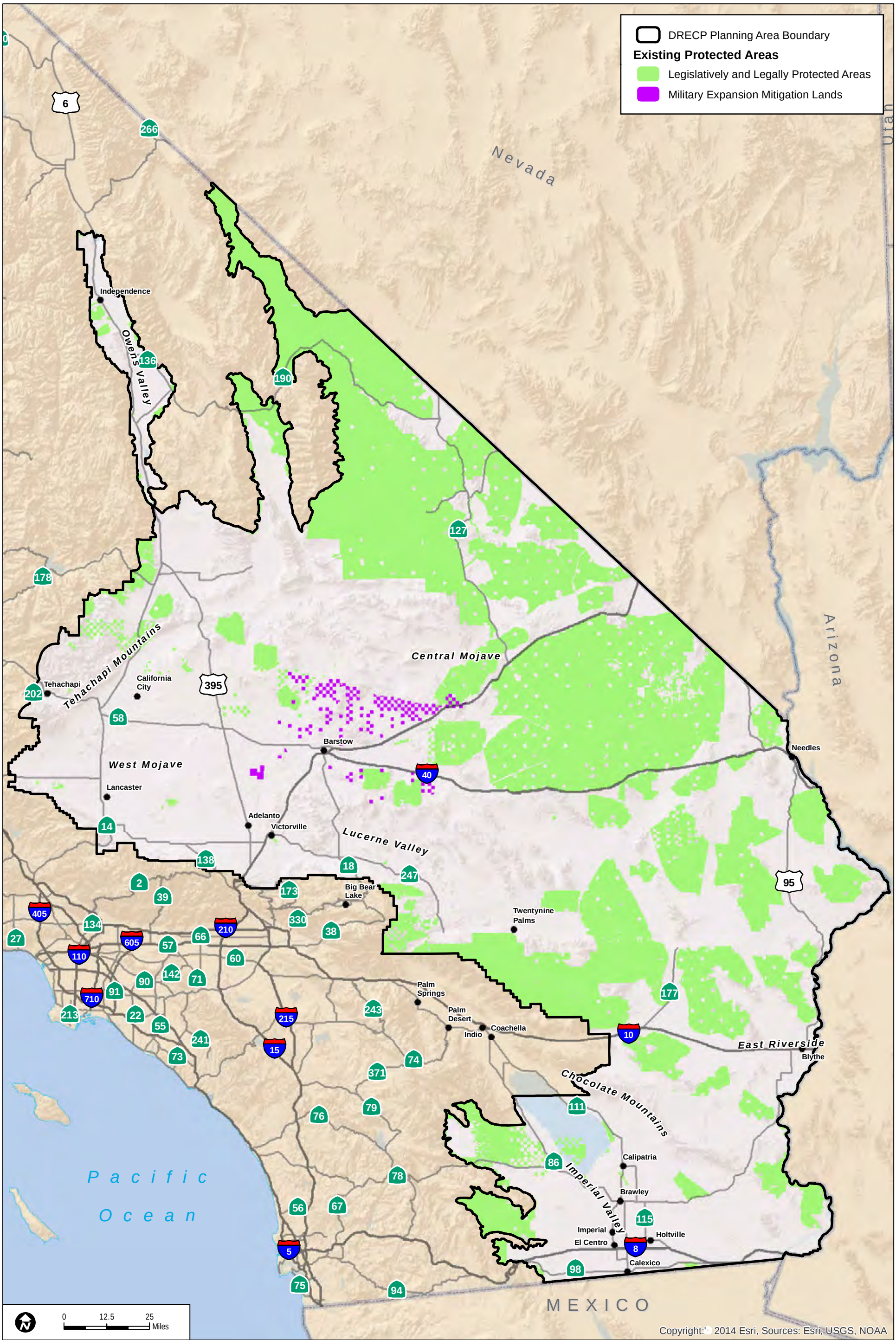
- **BLM land use planning documents and designations:** The existing BLM land use planning documents under the CDCA (West Mojave Plan, Northern and Eastern Colorado Desert Plan, and Northern and Eastern Mojave Desert Plan) and the BLM RMPs (Bishop RMP and Caliente RMP) provided valuable resource management documentation to establish the initial conservation context for the reserve design (BLM 2002a, 2002b, 2005, 2006). Important areas to consider for the reserve envelope include designated Areas of Critical Environmental Concern (ACECs) established by these plans.
- **California Energy Commission (CEC) Renewable Energy Transmission Initiative (RETI) documents and mapping:** The RETI process aimed to identify areas for renewable energy development and the supporting transmission infrastructure (CEC 2011). Through this planning effort, stakeholder and agency input was gathered to

identify environmental "black-out" areas and other areas of high biological conflict where renewable energy and transmission facility siting should be avoided. The documentation and mapping developed through this process provided conservation context during the initial phase of the reserve design process.

During the early phases of the reserve design development, several coarse-level (or "coarse-filter" opposed to "fine-filter") approaches were used to explore geospatial configurations of areas important and not important for conservation in the reserve design planning area.

- **Renewable Energy Action Team (REAT) agency Starting Point Map:** During early DRECP planning, the REAT agencies released the Starting Point Map, which was an approach aimed at identifying areas of least conflict for renewable energy development (i.e., Renewable Energy Study Areas [RESAs]) and areas of high biological value (i.e., Conservation Opportunity Areas) (http://www.drecp.org/maps/Starting_Point_Maps.pdf).
- **DRECP Preliminary Conservation Strategy Map:** The Preliminary Conservation Strategy (PCS) map was released as part of the Preliminary Conservation Strategy document in October 2011 (http://www.drecp.org/documents/docs/preliminary_conservation_strategy) (Dudek and ICF 2011). The PCS map provided early context for development of preliminary conservation and development alternative scenarios. The PCS map provided an early synthesis of available physical, biological, and land use data in a single map; developed the preliminary draft of RESAs in which renewable energy development may be focused in one or more conservation strategy alternatives; and developed the preliminary draft of areas where DRECP conservation actions would be focused.
- **Marxan Reserve Optimization:** This early approach used a computer-based reserve selection algorithm as a tool to develop "optimized" reserve configurations. A reserve selection algorithm called Marxan with Zones (Watts et al. 2009) was used (herein referred to as "Marxan") to (1) evaluate the distribution of all GIS-based biological data (i.e., early versions of the land cover map, species habitat models, and species occurrence points) and existing conservation and (2) identify clusters of habitat where the most efficient reserve design can effectively meet the quantitative conservation targets.

These early exploratory approaches helped focus subsequent reserve design approaches.



Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-1

Existing Protected Areas

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D.3.5 Disturbed Lands Mapping and Intactness Analyses

Disturbed lands and areas of low terrestrial intactness were considered lower biological conflict for renewable energy siting and are not important for inclusion in the reserve design. The following describes disturbed lands mapping data assembled for the Plan Area. The disturbed lands mapping was used in conjunction with the REAT agency field reconnaissance in the Renewable Energy Study Areas; mapping was then compared to several independent analyses of intactness to assess areas more suitable for renewable energy development and areas more suitable for conservation.

DRECP Disturbed Lands Mapping

The DRECP land cover map evolved as new and better data became available and a more refined hierarchical classification system developed (for more information see Appendix Q, DRECP *Baseline Biology Report*). The initial DRECP land cover map used during this phase of the reserve design process identified disturbed lands as including cultivated croplands, quarries, mines, gravel pits, oil wells, other disturbed lands, and rural lands with high road densities. The initial data sources for mapping disturbed lands included the California Gap Vegetation data layer (Lennartz et al. 2008), the California Farmland Mapping and Monitoring Program (FMMP) data (California Department of Conservation 2009), and a rural lands model based on road density (Dudek and ICF 2011). Where new mapping data was subsequently available (CDFG 2012; Aerial Information Systems Inc. 2013), the DRECP land cover map (and mapping of disturbed lands) has been updated with the new information, which was subsequently used in the focal species, natural communities, and processes approach (Section D.3.6) and during the evaluation and refinement process (Section D.3.7).

In general, the DRECP disturbed lands mapping identified aggregations of disturbed and agricultural lands in:

- Imperial Valley (Imperial County)
- Palo Verde Valley (Riverside County)
- Morongo Basin (San Bernardino County)
- Barstow area (San Bernardino County)
- Antelope Valley (Los Angeles and Kern counties)
- Urban and rural areas and agricultural lands in and around Victorville, Adelanto, Lancaster, Palmdale, California City, Mojave, and Ridgecrest (San Bernardino, Los Angeles, and Kern counties)

REAT Agency Field Reconnaissance of the Renewable Energy Study Areas

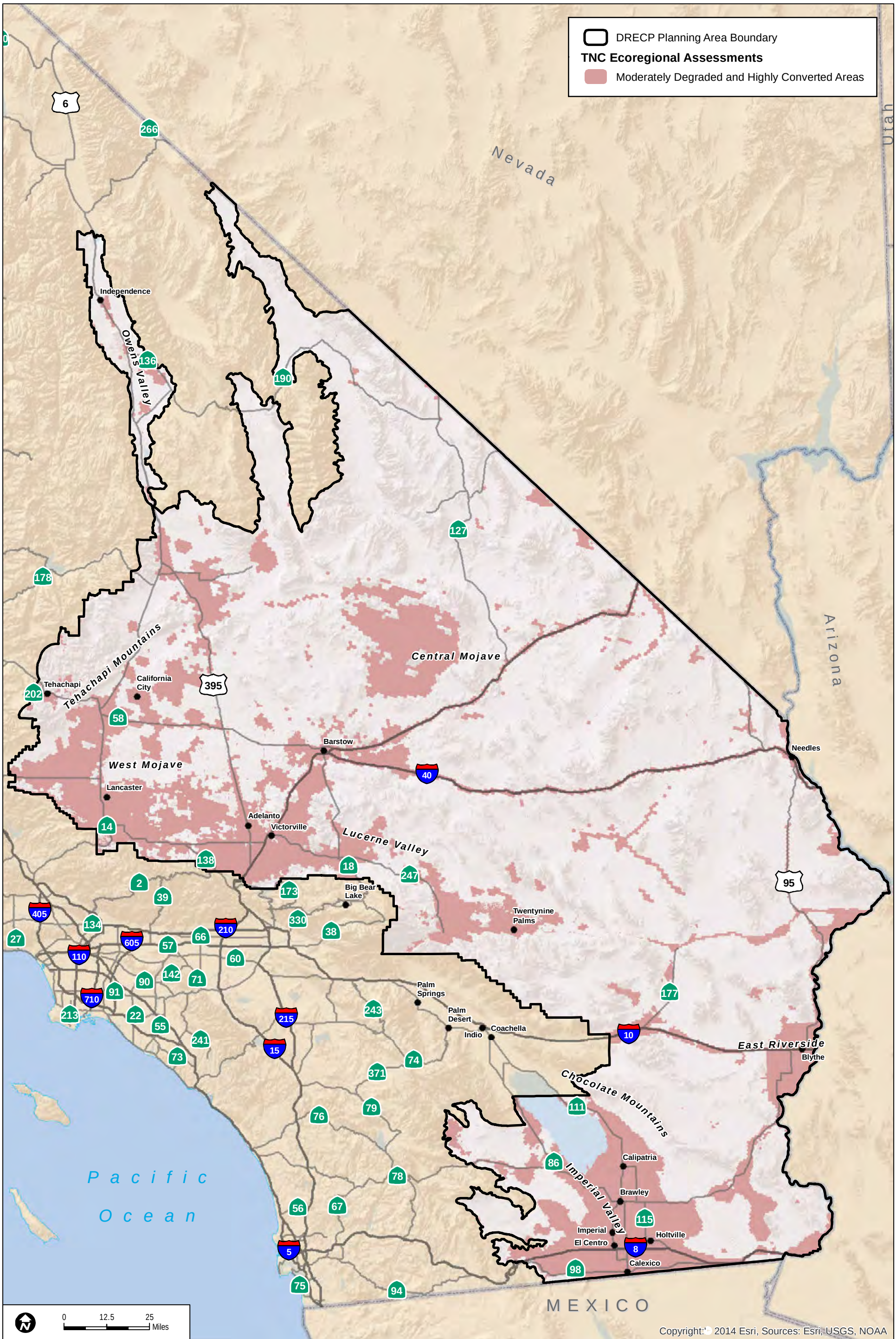
The DRECP Preliminary Conservation Strategy (Dudek and ICF 2011) identifies RESAs to be studied further for the siting of renewable energy development. As part of the RESAs, REAT agency field staff conducted field reconnaissance and imagery interpretation to refine the RESAs by identifying disturbed areas and other lower biological conflict areas where DFAs could be developed. This step also identified areas of high biological value where DFAs should not be developed. Documentation of the REAT agency RESA field reconnaissance is proved in Attachment A.

Intactness Analyses

The intactness analyses used during this phase of the reserve design planning process included:

- *Mojave Desert Ecoregional Assessment* (Randall et al. 2010)
- *An Ecological Analysis of Conservation Priorities in the Sonoran Desert Ecoregion* (Marshall et al. 2000)
- *Western Mojave Desert Assessment of Least Environmental Conflict for Solar Development and Compensatory Mitigation Framework* (Cameron et al. 2012)
- *Mapping Compatibility to Minimize Biodiversity Impacts of Solar Energy Development in the California Deserts: On-Site Degradation Score* (Stoms et al. 2011)

These intactness analyses were each developed for separate planning purposes not associated with the DRECP; however, they provided independent, objective sources of information on terrestrial intactness with which to compare the DRECP disturbed lands mapping. Figure D-2 illustrates the areas of highly converted and moderately degraded lands (Randall et al. 2010 and Marshall et al. 2000) and Figure D-3 illustrates the degraded value within a majority of the Plan Area (Stoms et al. 2011). In general, the intactness analyses are in agreement with the DRECP disturbed lands mapping and lower biological conflict areas. The mapped disturbed lands and lower biological conflict areas had low terrestrial intactness or high degradation. These data, as well as intactness modeling by Conservation Biology Institute (CBI), were also used during the reserve design envelope evaluation and refinement process (Section D.3.7).



Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013); The Nature Conservancy (2011)

FIGURE D-2

Intactness Method: The Nature Conservancy Ecoregional Assessments

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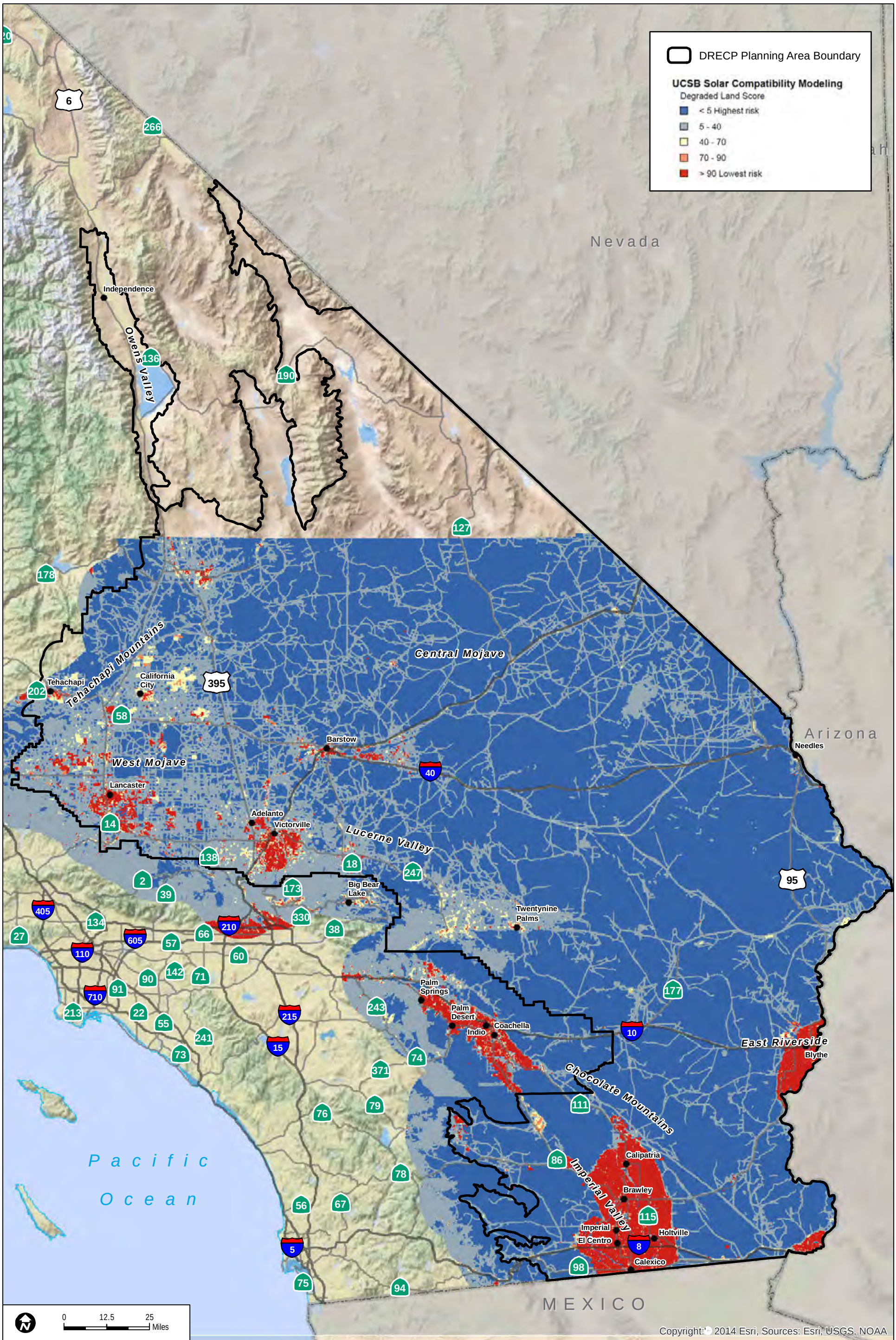

Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013); UCSB (2011)

FIGURE D-3

Intactness Method: UC Santa Barbara Degraded Land Score

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D.3.6 Focal Species, Natural Communities, and Processes Approach

As documented Volume III, Chapter III.7, Biological Resources, and in Appendix Q, DRECP *Baseline Biology Report*, vast improvements to key biological databases have been made over the course of the DRECP planning process. The focal species, natural communities, and processes approach leveraged many of these new data sources and improvements to create an initial reserve design envelope utilizing better information with less uncertainty. The following provides highlights of the key biological database improvements used in this approach:

- **Covered Species modeled habitat:** Species distribution models for all Covered Species have been updated and vetted internally and externally. CBI, UC Berkeley, UC Davis, UC Santa Barbara, U.S. Geological Survey, and Dudek developed the species models. Source data and documentation is available on http://drecp.databasin.org/.
- **Natural community mapping:** Approximately 6 million acres of the Mojave Desert and Colorado/Sonoran Desert within Inyo, Kern, Los Angeles, San Bernardino, Riverside, and Imperial counties were recently mapped at the fine-grained alliance level (CDFG 2012; Aerial Information Systems Inc. 2013). Additionally, the existing DRECP land cover map for the remainder of the DRECP Plan Area without new data was analyzed and converted into the seamless, hierarchical classification system used across the entire Plan Area. Therefore, the entire Plan Area can be mapped and classified using a unified system of general community groupings, natural communities, and (where available) community alliances.
- **Habitat linkage and process mapping:** Improvements in information related to habitat linkages were incorporated into the planning process, including Desert Linkage Network data (Penrod et al. 2012) and desert tortoise least-cost corridors (Averill-Murray et al. 2013). Additionally, improved mapping of dunes and sand resources was integrated (CDFG 2012; Aerial Information Systems Inc. 2013; California Department of Conservation 2000; Dean 1978).

The focal species, natural communities, and processes approach was developed to create an initial reserve design envelope. This approach involved creating a composite map of important areas for key Covered Species, natural communities, and processes (i.e., the reserve drivers). The reserve drivers used in this approach included desert tortoise, Mohave ground squirrel, bighorn sheep, microphyll woodland, dunes and sand resources, flat-tailed horned lizard, hydrologic features, and West Mojave corridors, rare natural communities, and environmental gradients. Reserve drivers were selected because these resources are important to the overall DRECP conservation strategy and generally occur across a range of ecoregion subareas and habitats of the Plan Area, such that conserving the areas important for the reserve drivers would also conserve areas important for the other Covered Species and natural communities. Important areas for desert tortoise, Mohave

ground squirrel, and bighorn sheep were based on REAT agency interpretations of the species distribution models for these species, which are the focus of the biological objectives for these species. Table D-2 provides a description and source of information used for each of the driver layers. Figures D-4 through D-11 illustrate the reserve driver layers used in this analysis.

Table D-2
Focal Species, Natural Communities and Processes Approach – Reserve Driver Layer Descriptions

Focal Species Approach Component	Description and Source
Desert tortoise	Identifies important areas for desert tortoise conservation based on a composite of Tortoise Conservation Areas (USFWS 2011), modeled linkages (Averill-Murray et al. 2013), and habitat potential (Nussear et al. 2009).
Mohave ground squirrel	Includes the important areas to focus on for conservation of Mohave ground squirrel habitat within the Plan Area. Includes data based on the Leitner (2008) status review (revised in 2012 and 2013) based on input and reports from Leitner and other Mohave ground squirrel experts (Leitner 2013a, 2013b). The habitats were defined using field observations; historic and current species occurrence records; habitat suitability, including disturbance analysis and the U.S. Geological Survey 2013 habitat suitability model developed for Inman et al. (2013); expert input; and topography. The following areas were described: population centers, habitat linkages, habitat expansion areas, and climate change extensions.
Bighorn sheep	Includes the important areas to focus on for conservation of Desert Bighorn Sheep habitat within the Plan Area. Based on data compiled by the CDFW for "A Conservation Plan for Desert Bighorn Sheep in California" and "Optimizing Dispersal and Corridor Models using Landscape Genetics" (Wehausen 2012; Epps et al. 2007). The data comprised (1) a raster set showing the mountains with slopes of 15% or greater within the habitat range and (2) a vector set showing the entirety of the intermountain habitat. The intermountain habitat includes low slopes or valley floors with up to 16.4 kilometers between mountain ranges, including stepping stones of mountain habitat between mountain ranges, where applicable.
Microphyll woodland	Based on a selection set from the DRECP land cover map (CDFG 2012) that included the following alliances mapped in the MOWS, MAWW, and SCOWS natural communities: Blue palo verde–ironwood woodland (Parkinsonia florida–Olneya tesota), Smoke tree woodland (Psorothamnus spinosus), Honey mesquite riparian form (Prosopis glandulosa), and Desert willow (Chilopsis linearis), as well as the desert wash woodland selection from the vegetation map used in the BLM Northern and Eastern Colorado Coordinated Management Plan (BLM 2002a).

Table D-2
Focal Species, Natural Communities and Processes Approach – Reserve Driver Layer Descriptions

Focal Species Approach Component	Description and Source
Dunes and sand resources	Based on a composite of a selection set from the DRECP land cover map (CDFG 2012) that included "North American warm desert dunes and sand flats," a selection set from the surficial geology dataset that included "Sand dunes" (California Department of Conservation 2000), and California desert sand dunes mapping (Dean 1978).
Flat-tailed horned lizard	The reserve driver layer used for this species included the following areas based on the interagency flat-tailed horned lizard management strategy: Borrego Badlands Management Area, Ocotillo Wells Recreation Area, West Mesa Management Area, Yuha Basin Management Area (with extension), and East Mesa Management Area (with extension) as described in the BGOs for this species.
Hydrologic features	Limited to major rivers (Mojave River, Amargosa River, and Owens River) buffered 0.25 mile and the Salton Sea based on the U.S. Geological Survey National Hydrography Dataset.
West Mojave corridors and rare natural communities and environmental gradients	Based on a composite of a selection set from the DRECP land cover map that included all rare (State Rank 1, 2, or 3) alliances and locally rare occurrences in the West Mojave ecoregion subarea, Desert Linkage network corridors in the West Mojave ecoregion subarea (Penrod et al. 2012), and Los Angeles County Significant Ecological areas.

D.3.7 Evaluation and Refinement

The evaluation and refinement phase of the reserve design process was the critical step in developing the reserve design envelope. Evaluation and review is where all data inputs were combined and synthesized. The evaluation and refinement phase generally included the following elements:

- Collaborative GIS mapping sessions
- Agency expert field refinement
- Iterative quantitative GIS analyses
- Comparisons with newly released data and models

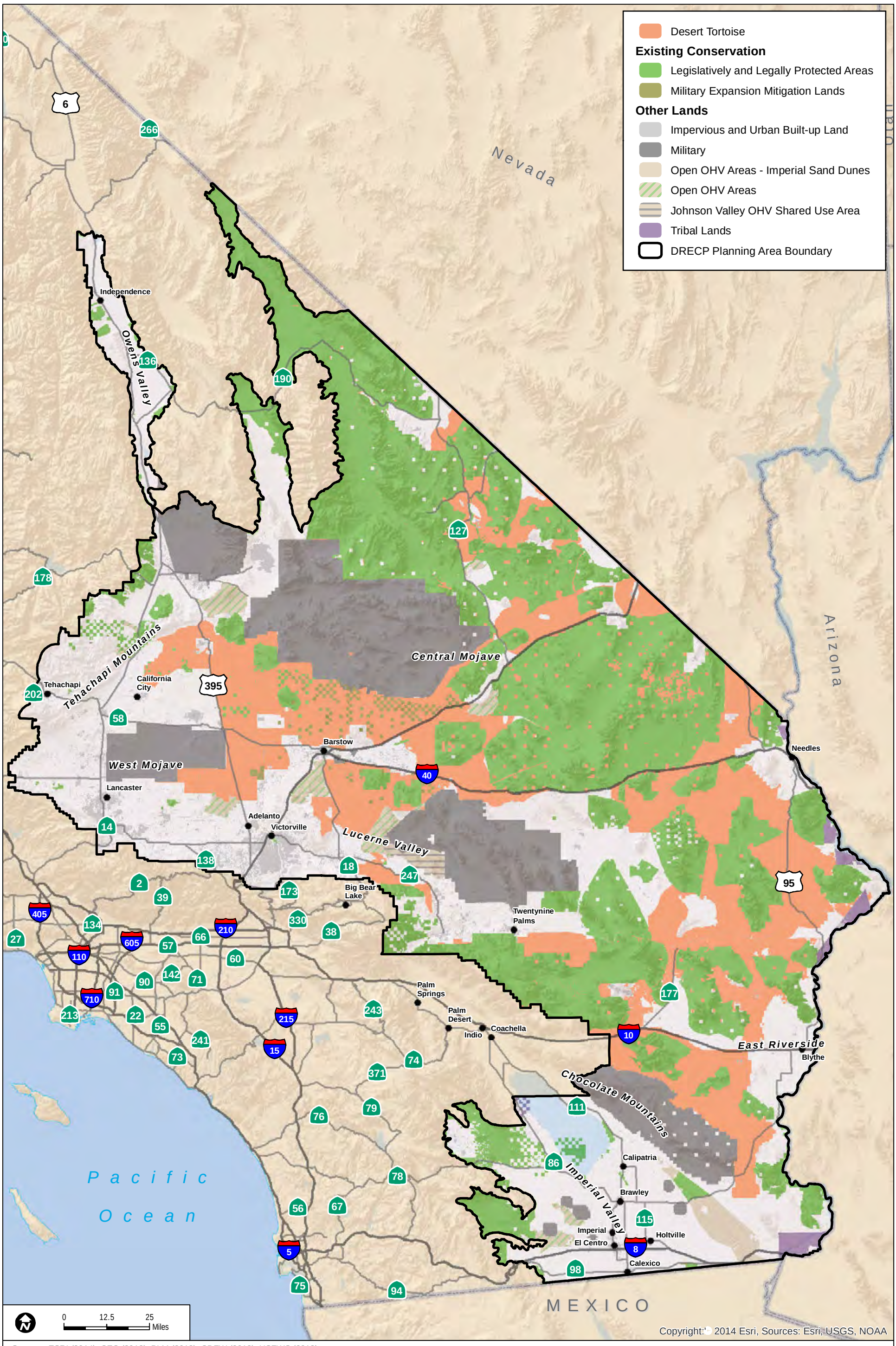
The following describes the evaluation and refinement process used to develop the reserve design envelope.

D.3.7.1 Collaborative Geographic Information System Mapping Sessions

Reserve design delineation and decisions in developing the reserve design envelope were made via web-based meetings facilitated by live GIS mapping sessions. Agency field experts and technical staff, including staff from the USFWS, BLM, CEC, CDFW, and Dudek, identified and mapped the draft reserve design envelope, guided by the DRECP BGOs (as described in Section D.2.1 and provided in Appendix C) and the reserve design principles (Section D.2.2). Exhaustive live GIS comparisons of early planning data; coarse-level approaches; disturbed lands mapping; intactness; the focal species, natural communities, and processes approach; and habitat models for all Covered Species, mapping for all natural communities, other habitat linkage data, environmental gradients, and other geospatial data layers were done in collaborative mapping sessions to develop the reserve design envelope.

Collaborative GIS mapping sessions focused on evaluating and refining the reserve design in 2012 occurred on January 24; February 21 and 29; March 1, 2, 6, 7, 8, 12, 13, and 15; and April 3. These sessions ultimately yielded an interim biological sensitivity map referred to as the Plan-Wide Biological Reserve Design Context Map. The interim Plan-Wide Biological Reserve Design Context Map was used for comparative analysis purposes in the Description and Comparative Evaluation of the Draft DRECP Alternatives (December 2012; http://www.drecp.org/documents/docs/alternatives_eval/index.php). Inputs into the development of this interim map included the existing planning and early coarse-level mapping, disturbed lands and intactness analyses, and early species distribution models and natural community mapping.

Collaborative GIS mapping sessions focused on evaluating and refining the reserve design in 2013 occurred on January 23, 25, and 29 and February 7. These sessions incorporated key updated biological datasets and the reserve driver layers from the focal species, natural communities, and processes approach (Section D.3.6). These were compared against the interim Plan-Wide Biological Reserve Design Context Map, other early mapping products, habitat models for all Covered Species, mapping for all natural communities, other habitat linkage data, environmental gradients, and other geospatial data layers to iteratively develop the draft reserve design envelope.



Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-4

Focal Species Approach: Desert Tortoise Reserve Driver Layer

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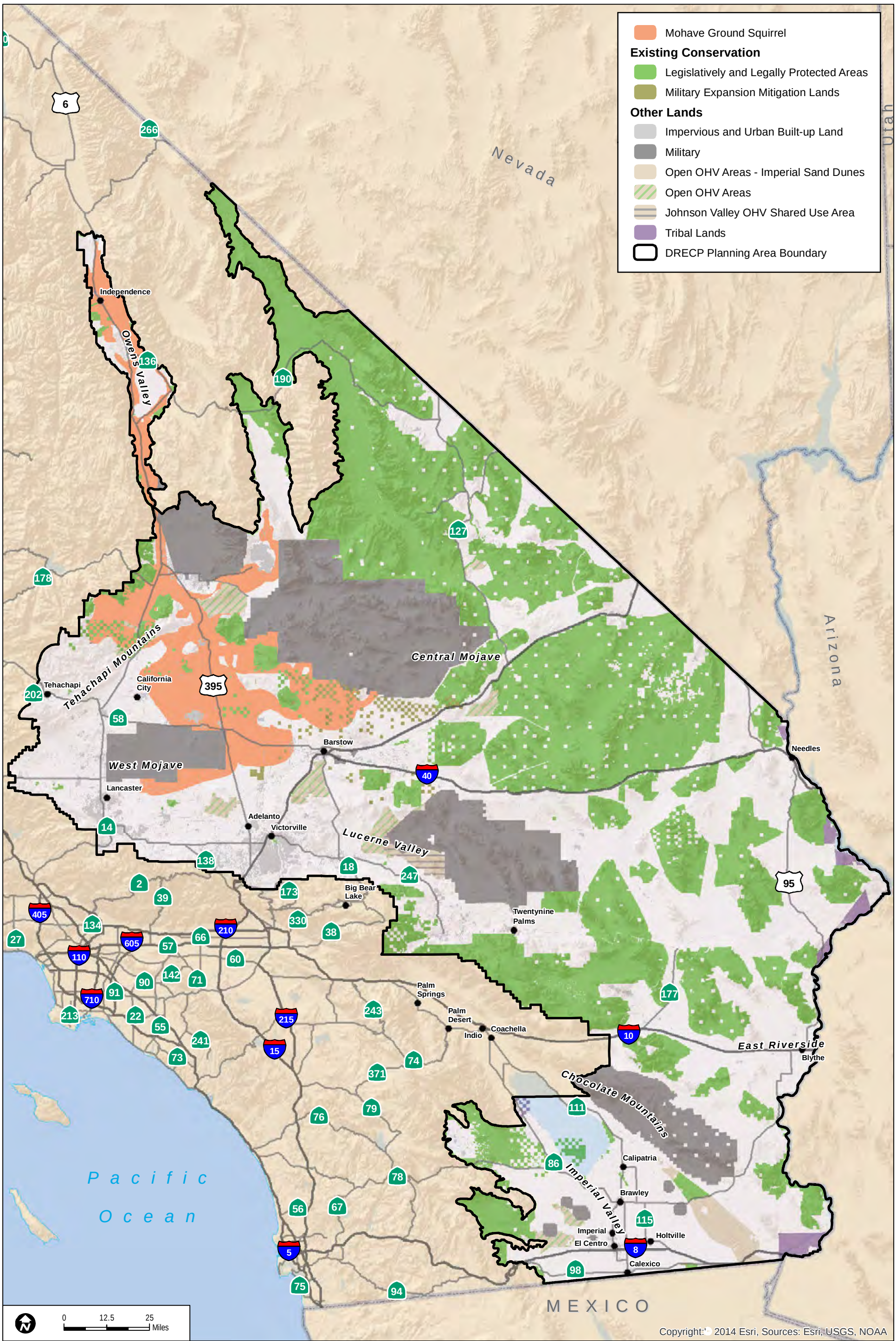

Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-5

Focal Species Approach: Mohave Ground Squirrel Reserve Driver Layer

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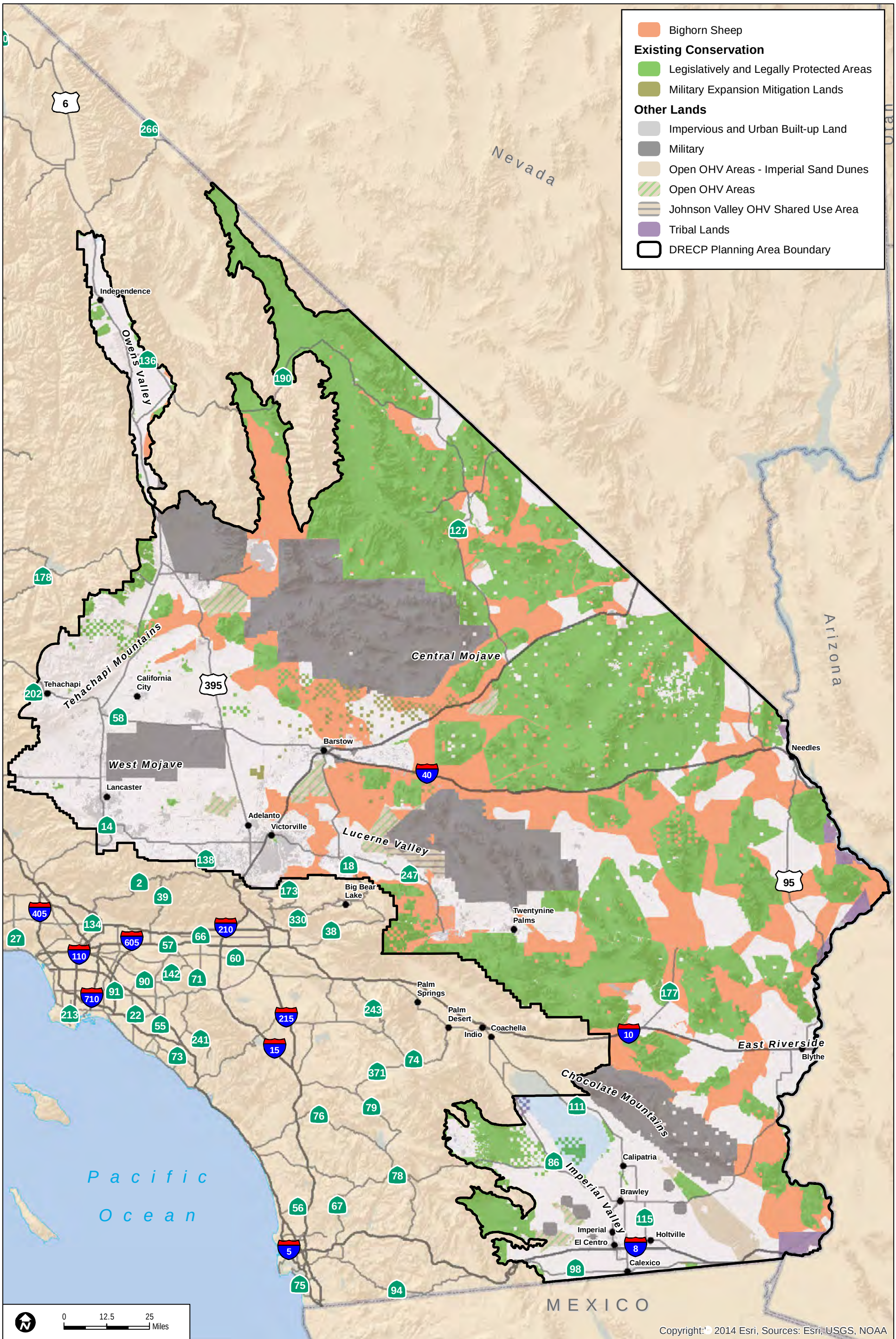

Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-6

Focal Species Approach: Desert Bighorn Sheep Reserve Driver Layer

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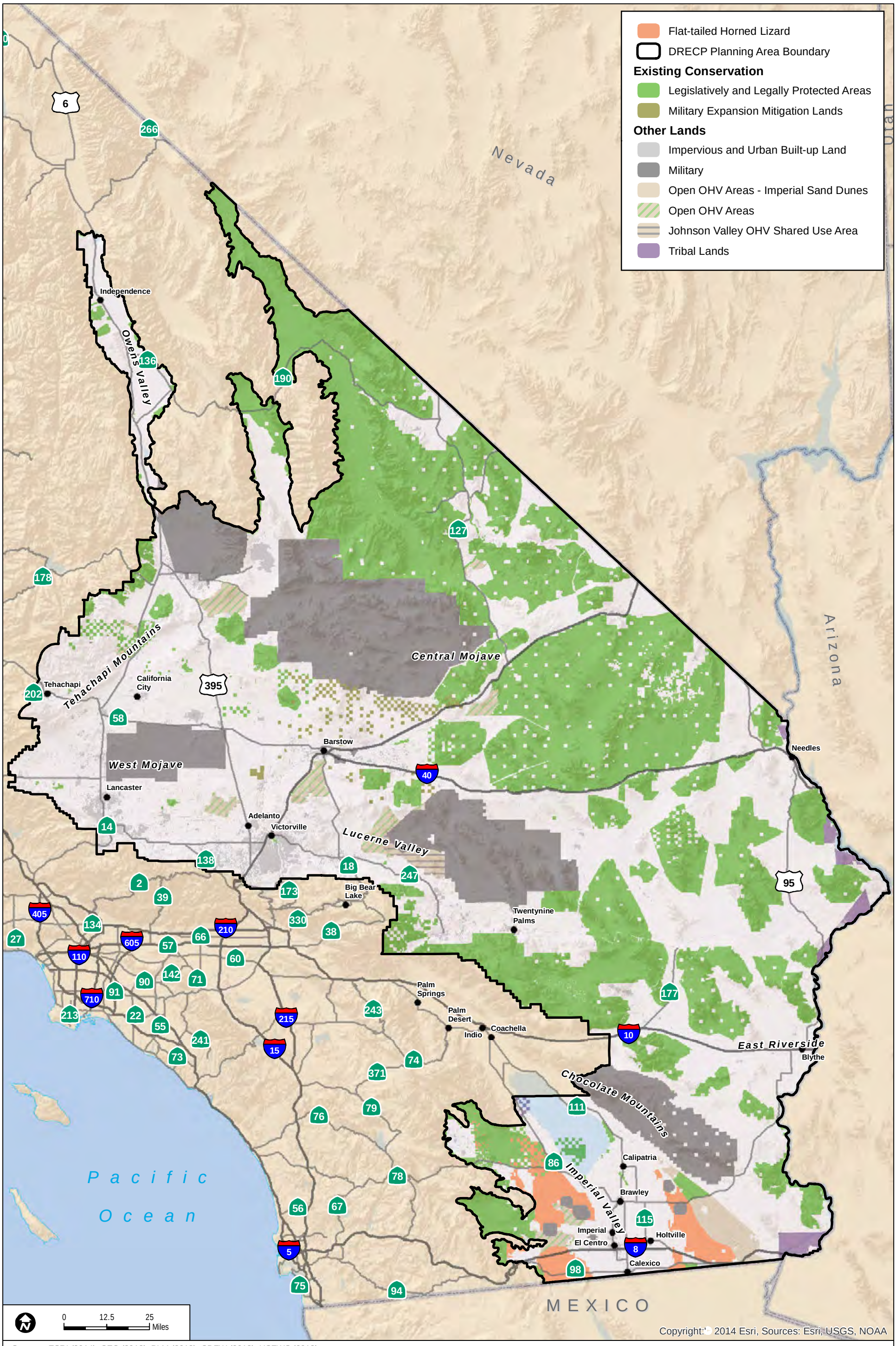

Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-7

Focal Species Approach: Flat-Tailed Horned Lizard Reserve Driver Layer

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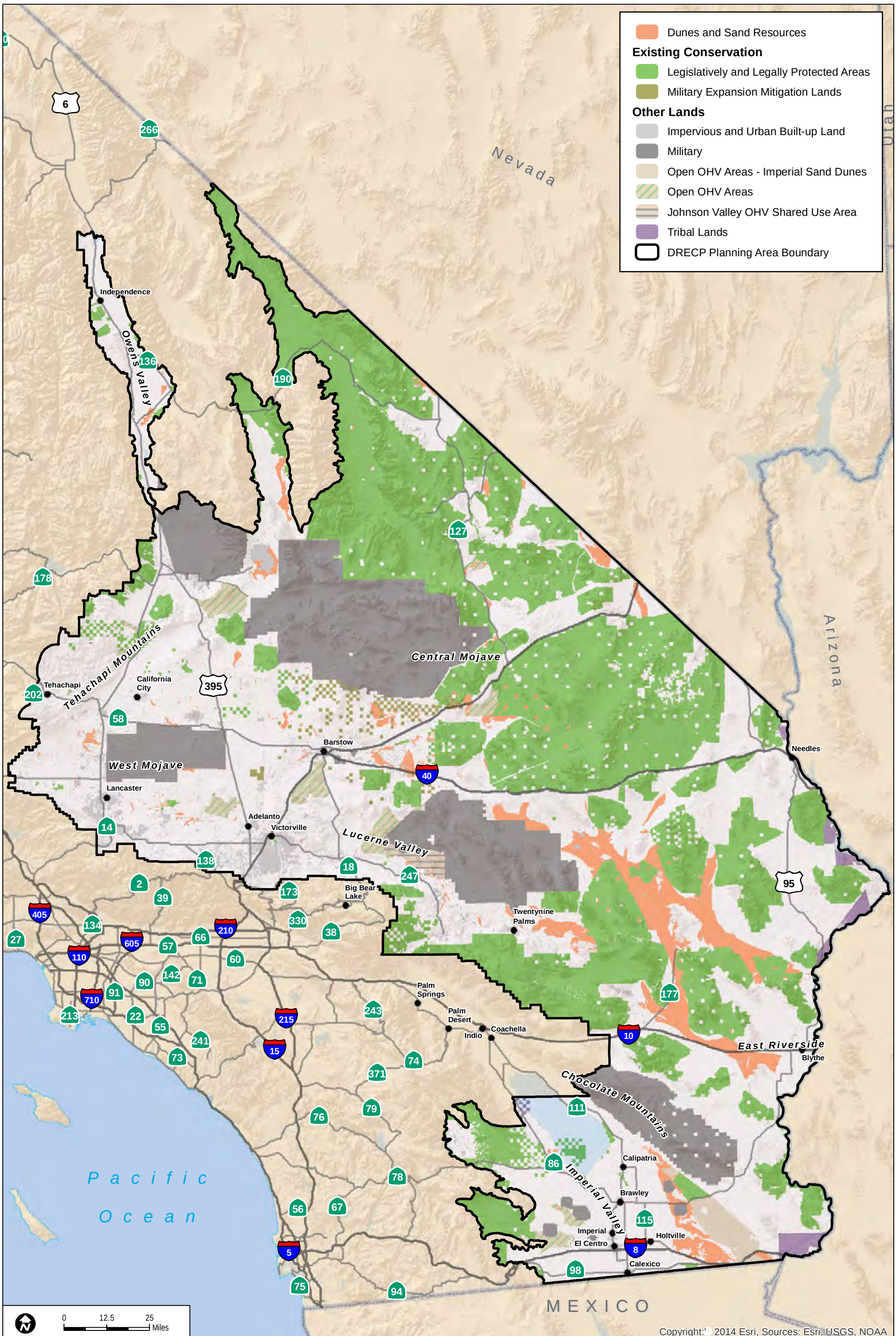

Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-8

Focal Species Approach: Dunes and Sand Resources Reserve Driver Layer

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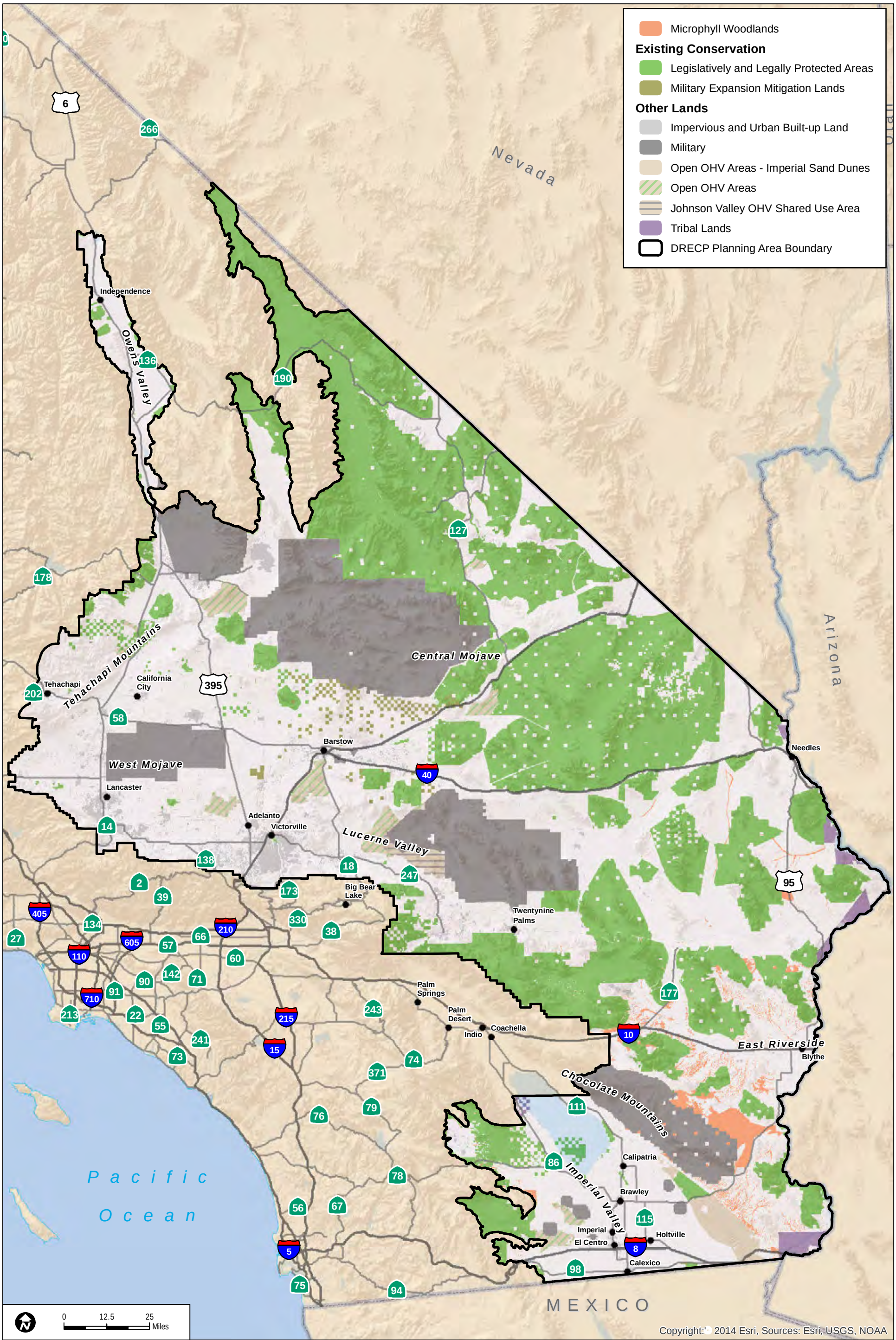

Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-9

Focal Species Approach: Microphyll Woodlands Reserve Driver Layer

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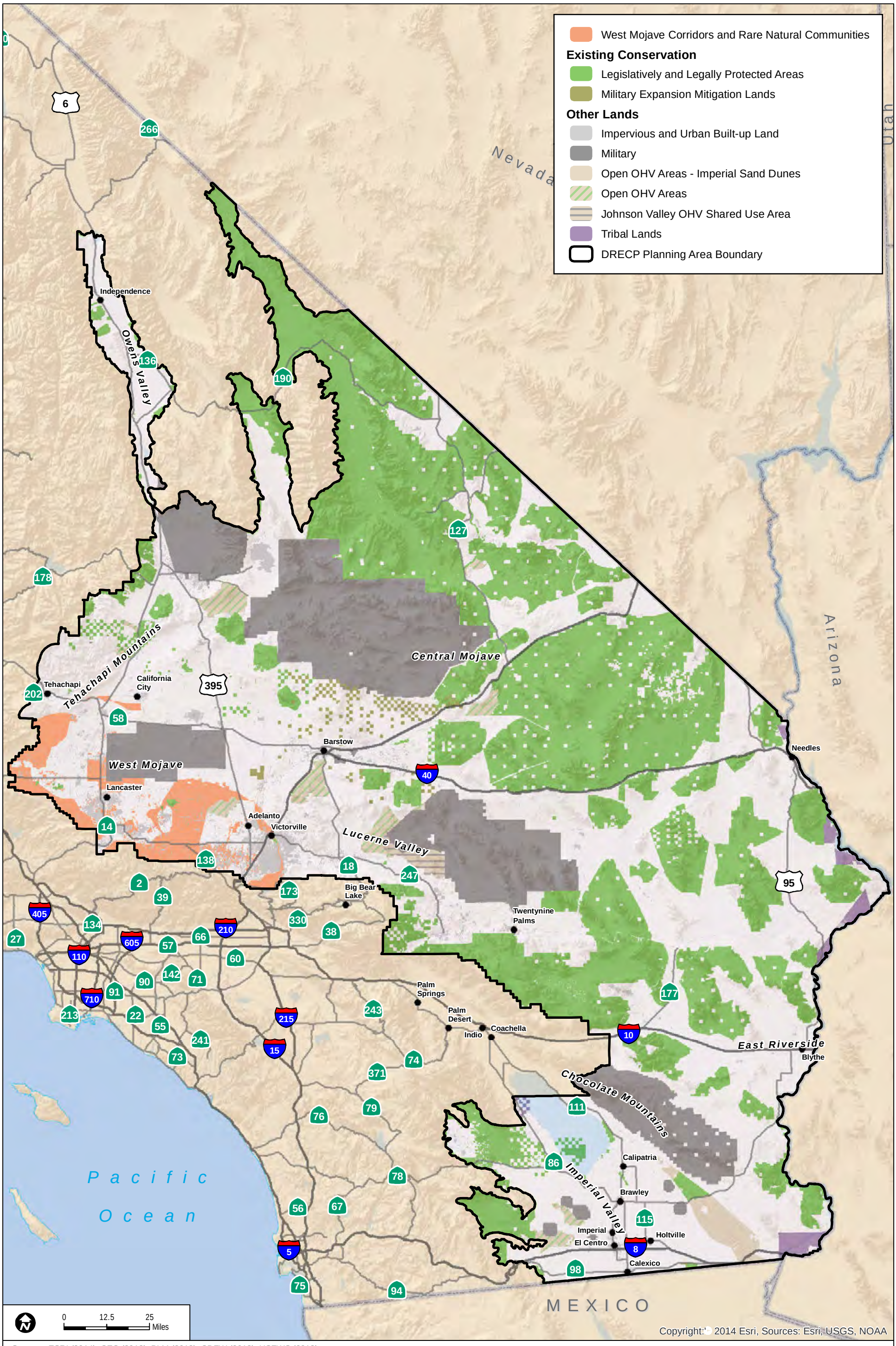

Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-10

Focal Species Approach: West Mojave Corridors and Rare Natural Communities Reserve Driver Layer

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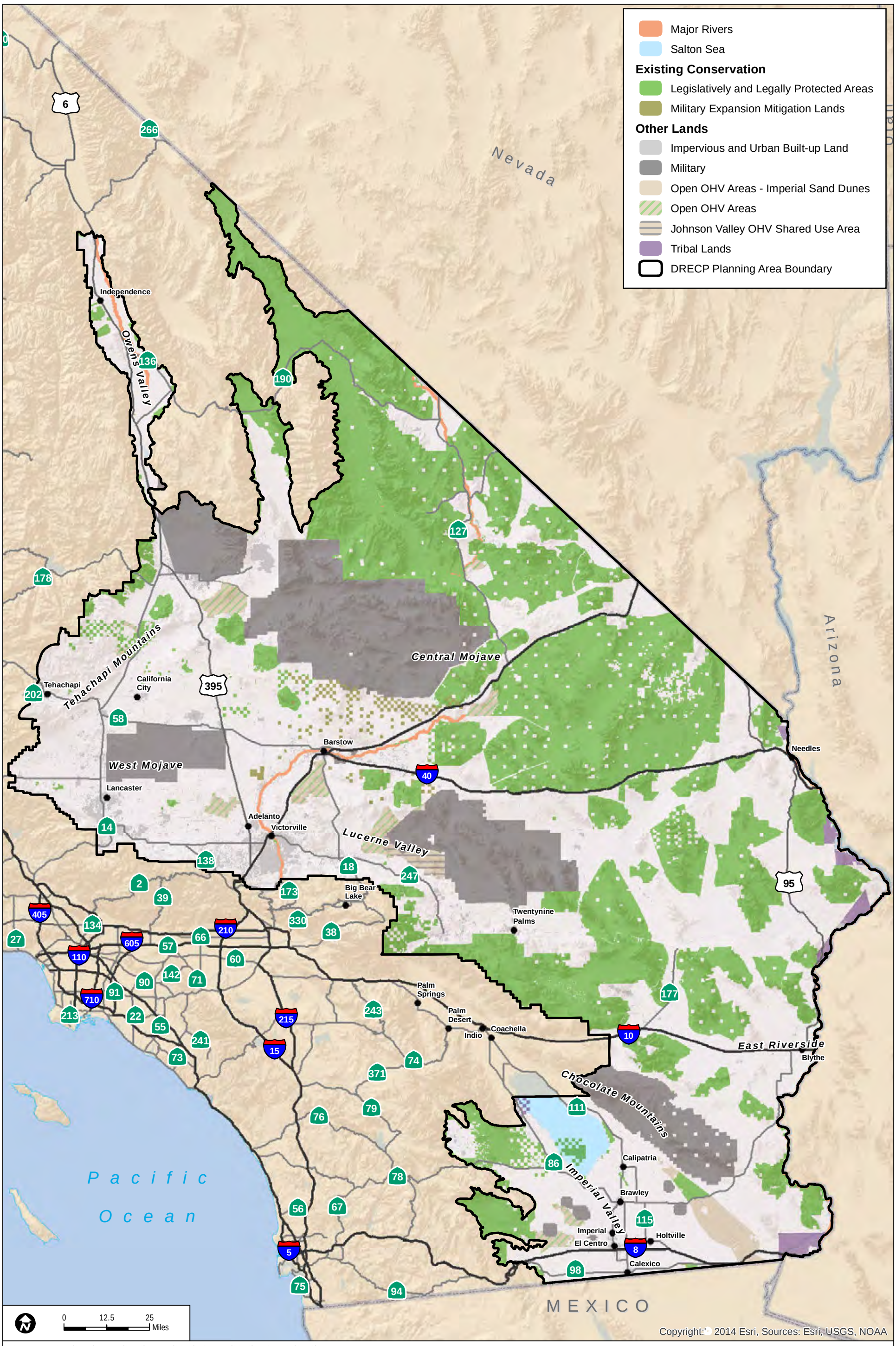

Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

FIGURE D-11

Focal Species Approach: Hydrologic Features Reserve Driver Layer

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D.3.7.2 Agency Expert Field Refinement

Additional refinement of the reserve design envelope resulted from input gathered by USFWS staff as they reviewed and conducted ground truthing in desert tortoise linkage habitat in the Ord-Rodman Linkages in the Stoddard Valley and Johnson Valley areas. This field reconnaissance and evaluation is provided in Attachment B.

D.3.7.3 Iterative Quantitative GIS Analyses

GIS analyses were conducted periodically throughout the evaluation and refinement process to quantitatively track and assess the capture of the species, natural communities, and landscape elements and processes. Early mapping approaches, interim maps, and draft versions of the reserve design envelope developed at various stages of the reserve design process were quantitatively assessed to determine the conservation levels of modeled species habitat for all Covered Species, mapping of all natural communities, and data for habitat linkages, environmental gradients and ecological processes. These quantitative analyses were stratified to assess representation of conserved resources by ecoregion subarea, county, and ownership class. These quantitative GIS evaluations provided a systematic way of comparing and evaluating various reserve design configurations and reserve design delineation decisions.

D.3.7.4 Comparisons to Newly Released Data and Models

New information is constantly being developed that could inform conservation in the Plan Area. New data and models developed now and in the future will be used through the Monitoring and Adaptive Management Program to manage the DRECP reserve during Plan implementation. As an example, the CBI has developed new information on climate refugia and climate velocity for the DRECP, as provided in Appendix P, Climate Change. This information was not available during the development of the reserve design envelope but would be a tool used for adaptive management during Plan implementation, as described in the MAMP (see Section II.3.1.3.5.1, Adaptive Management Framework – Plan). CBI also developed a terrestrial intactness layer for the Plan Area, which is a measure of landscape intactness such that high intactness has more potential conservation value and is less disturbed, whereas low intactness is more disturbed and has less potential conservation value (CBI 2013). Exhibit D-2 shows the percentage of terrestrial intactness value within the reserve design envelope. As this illustrates, at least 85% of the lands with positive intactness values (i.e., high terrestrial intactness) are in the reserve design envelope. Conversely, the reserve design envelope captures much lower percentages of lands with low terrestrial intactness.

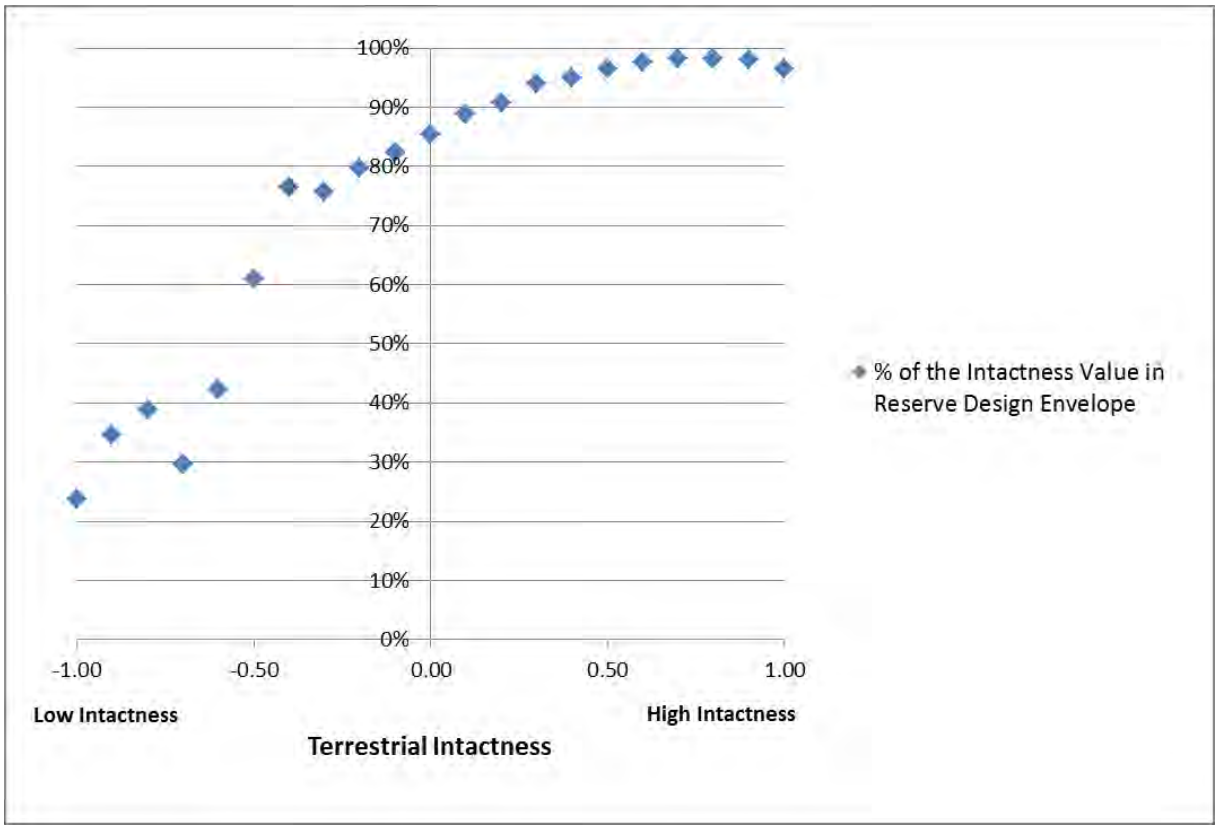
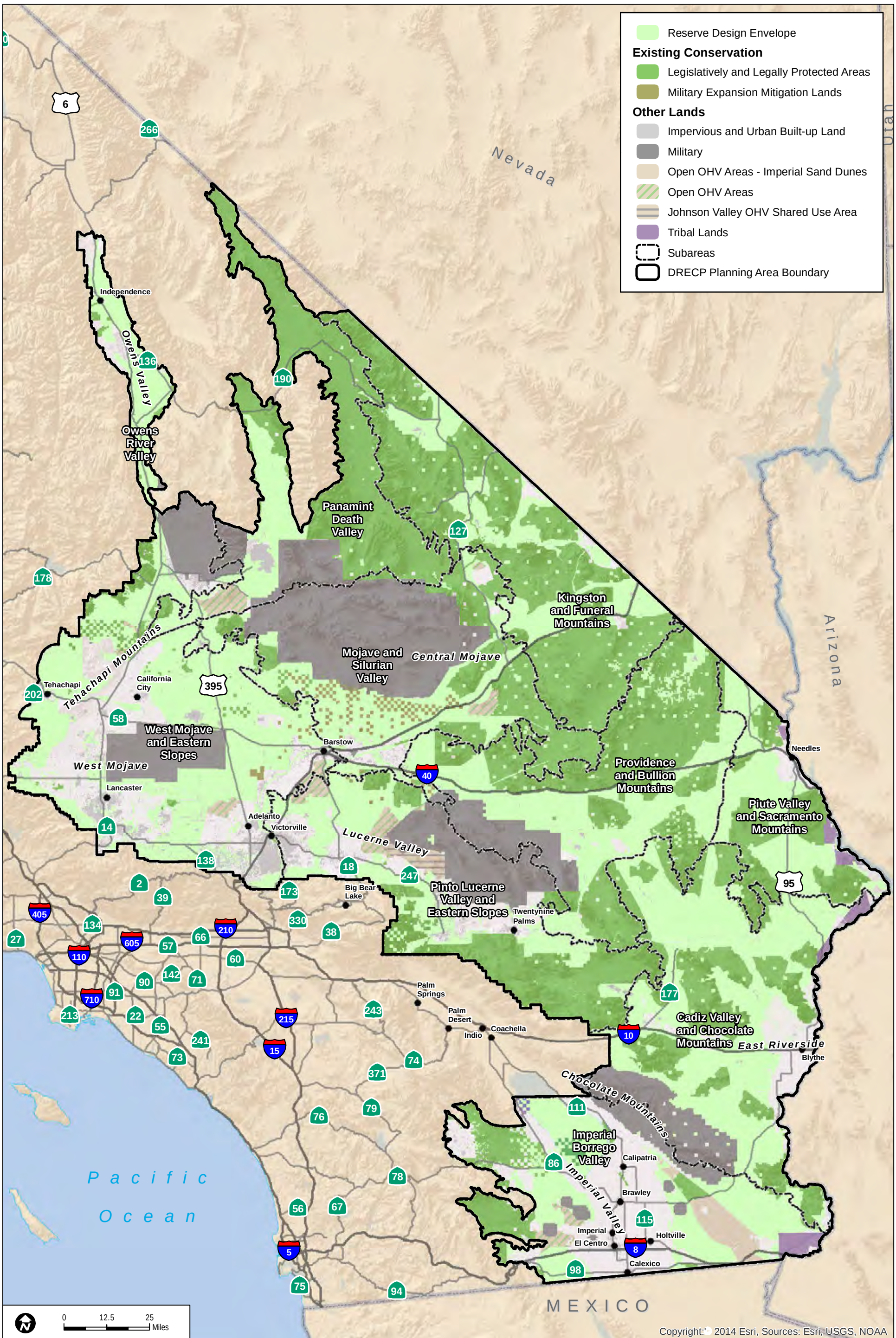


Exhibit D-2 Reserve Design Envelope Capture of the Terrestrial Intactness Values Across the Plan Area

D.4 Reserve Design Envelope Summary

Figure D-12 shows the reserve design envelope developed from the methods described in this appendix. The reserve design envelope covers approximately 8,365,000 acres, which is 44% of the approximately 19,013,000 acres reserve planning area. The reserve design envelope plus the existing protected areas (i.e., LLPAs and MEMLs) encompass 84% of the reserve planning area (approximately 16,027,000 acres).



Sources: ESRI (2014); CEC (2013); BLM (2013); CDFW (2013); USFWS (2013)

Figure D-12

Reserve Design Envelope

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As shown in Exhibit D-3, the reserve design envelope and existing protected areas combined cover at least 80% of the reserve design planning area in 7 out of 10 ecoregion subareas. This reflects the importance of these ecoregion subareas in the reserve design envelope as these ecoregion subareas are located in the most remote portions of the Plan Area, contain the most intact landscapes, and support important areas for Covered Species and natural communities. In the Imperial Borrego Valley, Pinto Lucerne Valley and Eastern Slopes, and West Mojave and Eastern Slopes ecoregion subareas, the reserve design envelope encompasses less area primarily due to more intensive land uses in these less-remote ecoregion subareas, which results in less intact landscapes and more degraded habitat not considered important for meeting the conservation needs of the Covered Species and natural communities.

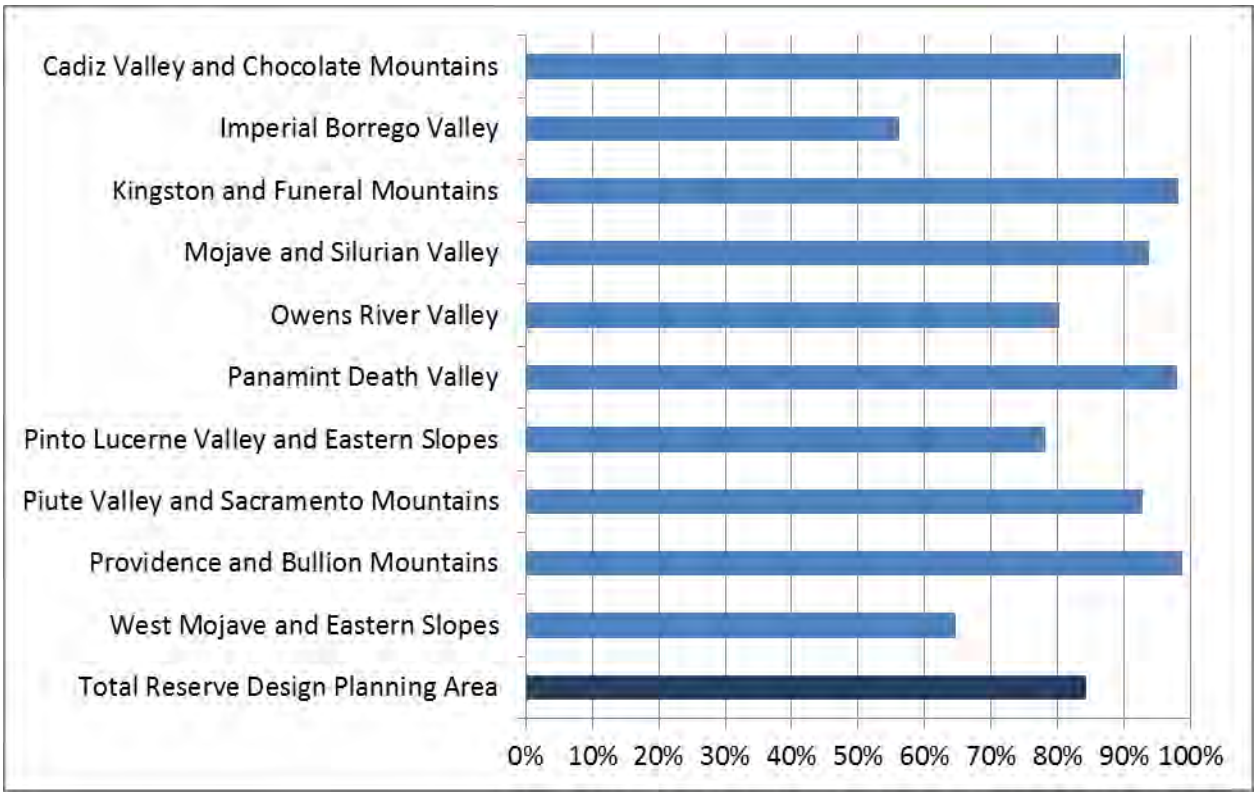

Exhibit D-3 Reserve Design Envelope and Existing Protected Areas Coverage of the Ecoregion Subareas within the DRECP Reserve Design Planning Area

D.5 DRECP Plan-Wide Reserve Design Envelope for Each Alternative

The reserve design envelope will not be implemented under any DRECP alternative. Instead, the reserve design envelope was used to guide the identification of the BLM LUPA conservation designations and Conservation Planning Areas, which together with the existing protected areas (i.e., LLPAs and MEMLs) comprise the DRECP Plan-Wide

Reserve Design Envelope for each alternative (i.e., the Preferred Alternative and Alternatives 1 through 4).

Additionally, the DRECP Plan-Wide Reserve Design Envelope for each alternative includes interagency Plan-wide Conservation Priority Areas, which are the basis for the NCCP Conceptual Plan-wide Reserve Design of each alternative. The NCCP Conceptual Plan-Wide Reserve Design reflects the highest priority areas for the creation and long-term management of habitat reserves for the conservation of the 37 proposed Covered Species and representative examples of the natural communities and processes that support them in the Plan Area (see Section I.3.2 for more information on the NCCP Planning Process). The interagency Plan-wide Conservation Priority Areas were designed to build off the existing conservation areas and include BLM LUPA conservation designation lands where durability tools and/or management agreements would be prioritized and Biological Conservation Priority Areas on non-BLM lands.

The following standards and criteria were used to develop the interagency Plan-wide Conservation Priority Areas (and Conceptual Plan-wide NCCP Reserve Design):

- Conserve representative landscapes and natural communities to maintain the ecological integrity of large habitat blocks, ecosystem function, and biological diversity.
    - LLPAs and MEMLs were considered existing conservation areas that are and would continue to be protected and managed for natural resources, including Covered Species and the natural communities and processes that support them. The LLPAs and MEMLs formed building blocks of the interagency Plan-wide Conservation Priority Areas.
    - Ecoregional subareas were used to subdivide the Plan Area into ecological units to ensure the capture of representative landscapes across the Plan Area.
- Conserve critical habitat areas that also provide habitat linkages for the movement and interchange of organisms within the Plan Area and to areas outside the Plan Area.
    - Critical habitat linkage areas were included in the interagency Plan-wide Conservation Priority Areas using species-specific linkage information for key Covered Species, including desert tortoise, Mohave ground squirrel, and desert bighorn sheep.
    - Landscape-scale, multispecies habitat linkage information was used to identify movement corridors between habitat blocks inside and outside the Plan Area.
    - Species-specific threats and stressor information was incorporated to identify the critical linkage areas.

- Maintain habitat areas large enough and of appropriate quality to support sustainable populations and contribute to the recovery of declining or vulnerable Covered Species.
    - Resource-specific conservation strategies were developed for logical groupings of Covered Species
        - Species-Specific Conservation Strategies
        - Riparian and Wetland Conservation Strategy
        - Dune Conservation Strategy
        - Plant Covered Species Conservation Strategy
        - Wide-Ranging Covered Species Conservation Strategy
        - Agricultural Species Conservation Strategy
    - Species-specific conservation factors were considered for each of the 37 Covered Species to identify the interagency Plan-wide Conservation Priority Areas, including:
        - Species' population trends
        - Species' stressors and threats
        - Species' distribution and density
        - Terrestrial habitat intactness
        - Climate refugia
- Include conservation of environmental gradients and areas of high habitat diversity.

The DRECP Plan-Wide Reserve Design Envelopes described in Volume II for the Preferred Alternative and Alternatives 1 through 4 were developed through the integrated planning process described in this appendix and the Plan integration described in Section I.3.6. A Plan-wide and subarea analysis of the landscape, natural community, and Covered Species conservation provided by the reserve design for each alternative is provided in Volume IV, Environmental Consequences/Effects Analysis.

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ATTACHMENT A

REAT Agency Renewable Energy Study Area
Field Reconnaissance

ATTACHMENT A – REAT AGENCY RENEWABLE ENERGY STUDY AREA FIELD RECONNAISSANCE

The following provides a summary of the Renewable Energy Action Team (REAT) agency field reconnaissance of the Renewable Energy Study Areas (RESAs) conducted in late 2011 and early 2012. The purpose of this field reconnaissance was to identify areas of lower biological resource conflict and areas of high biological conflict in order to refine the mapping within the RESAs. Detailed GIS data and metadata from this analysis were used to inform the mapping of Development Focus Areas and potential reserve areas.

Table G.A-1
REAT Agency 2011-2012 RESA Field Reconnaissance Summary

RESA Region	Lower Biological Conflict Areas Identified	High Biological Conflict Areas Identified
Barstow RESA	• Harper Lake historical agriculture areas • Disturbed areas north of I-15 • Agricultural lands and disturbed areas between I-15 and I-40	• Harper Lake migratory bird areas • BLM DWMAs • BLM ACEC, Mojave fringe-toed lizard areas • Mojave River • Eastern edge of RESA desert tortoise critical habitat and linkage habitat
Eastern Riverside County RESA	• Disturbed Areas around Desert Center • I-10 corridor • Disturbed areas and agricultural lands around Blythe	• Chuckwalla Bench • Lower bajadas in the Eastern Chuckwalla DWMA • Chuckwalla Valley dune thicket • Pinto Wash and Big Wash connectivity areas between Joshua Tree National Park and the Chuckwalla DWMA • Palen Dunes • McCoy Wash and Upper McCoy Valley
Imperial County RESA	• Agricultural lands	• Dune systems • New, Alamo, and Colorado River corridors • San Felipe Creek and Carrizo Wash • Flat-tailed horned lizard Range-wide Management Strategy areas. • Microphyll woodlands east of the Coachella Canal • Desert tortoise and burro deer habitat south of the Chocolate Mountains

Table G.A-1
REAT Agency 2011-2012 RESA Field Reconnaissance Summary

RESA Region	Lower Biological Conflict Areas Identified	High Biological Conflict Areas Identified
Owens Valley RESA	• General area south of Lone Pine along Hwy 395	• Lower Owens River riparian areas • Areas east of Owens Lake and Owens River • Owens Lakebed
West Mojave RESA (Kern County)	• North of California City east of Hwy 14 • Disturbed and fragmented areas around Mojave • Agricultural lands and disturbed lands in Antelope Valley. • Fallow croplands east of Koehne Lake	• Desert Tortoise Natural Area (DTNA) • Cache Creek • Tehachapi Mountains and foothills
West Mojave RESA (Los Angeles County)	• Disturbed areas and agricultural lands of Antelope Valley • Disturbed areas and agricultural lands around and east of Lancaster	• Alkali Mariposa lily areas west and south of Edwards AFB. • Transitional habitat along base of San Gabriel Mountains • Big Rock Wash • Linkage and intact habitat along eastern LA County line
West Mojave RESA (San Bernardino County)	• Disturbed and fragmented areas around Victorville, Phelan, and Apple Valley. • Fragmented habitat and agricultural lands in the Lucerne Valley	• Mojave River corridor • Granite, Sidewinder, and Fairview Mountains • Juniper Flats • Rare and endemic plant areas at Rabbit Springs, Cushenbury Springs, and Box S Springs. • Intact desert tortoise habitat south of Hwy 247 in the Johnson Valley area.

ATTACHMENT B

Desert Tortoise Linkage Evaluations – Ord-Rodman Linkages

October 25, 2013

DESERT RENEWABLE ENERGY CONSERVATION PLAN – DESERT TORTOISE LINKAGE EVALUATIONS – ORD-RODMAN LINKAGES

Brian Croft - U.S. Fish and Wildlife Service, 602 South Tippecanoe Avenue, San Bernardino, California

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Desert Renewable Energy Conservation Plan – Desert Tortoise Linkage Evaluation – Ord-Rodman Linkages

Brian Croft - U.S. Fish and Wildlife Service, 602 South Tippecanoe Avenue, San Bernardino, California

Introduction

Conservation strategies for the Mojave desert tortoise rely on intensive management of designated Tortoise Conservation Areas (TCAs) that are of sufficient size and suitability to support long-term growth in population size and distribution (Service 2011). TCAs consist of desert tortoise critical habitat, Bureau of Land Management (BLM) Areas of Critical Environmental Concern (ACEC), and National Park Service units (Service 2011). For each TCA to support long-term population viability a minimum reserve size of 2,590 km^2 is needed (Service 1994). However, to conserve desert tortoises within these areas, management must focus not only on TCAs, but also on the matrix of habitat within linkages that connect TCAs (Averill-Murray et al. 2013). Management of populations within this matrix is critical for maintenance of gene flow, to protect against demographic consequences of small population size, and to allow for climate change adaptation. Linkage management is especially critical for TCAs that do not meet the minimum reserve size threshold.

Within the Western Mojave Recovery Unit, the Fremont-Kramer, Superior-Cronese, and Ord-Rodman Desert Wildlife Management Areas (DWMAs - i.e. BLM ACECs), as well as Joshua Tree National Park comprise the key Tortoise Conservation Areas. Of these, all meet the required minimum reserve size threshold with the exception of the Ord-Rodman DWMA, which is 1015 km^2 (BLM 2005) and not completely within Federal ownership and management control. In addition, central portions of the Ord-Rodman DWMA are mountainous and have low habitat potential (Nussear et. al 2009), which further constrains the effective area available to meet minimum reserve size (see Figure 1). Areas to the east, west, and south of the Ord-Rodman DWMA currently contain desert tortoise populations in continuity with the populations within the DWMA, so the DWMAs small size is not likely to result in loss of population viability within this TCA in the near term. However, these areas also contain off-highway vehicle use to the west and south and military training to the east that are not conducive to long-term desert tortoise occupancy and conservation (see Figure 2).

To address these issues, the Desert Renewable Energy Conservation Plan (DRECP) incorporated desert tortoise linkage modeling (Averill-Murray et al. 2013) in development of biological goals and objectives, reserve design planning, development focus area (DFA) siting, and development of conservation management actions. In applying this linkage modeling to the DRECP planning process, we performed more detailed analysis of the linkages connecting the Ord-Rodman DWMA to Joshua Tree National Park and the Fremont-Kramer DWMA to map the condition of habitat within the linkages and to assess proposed DFAs and ACEC locations.

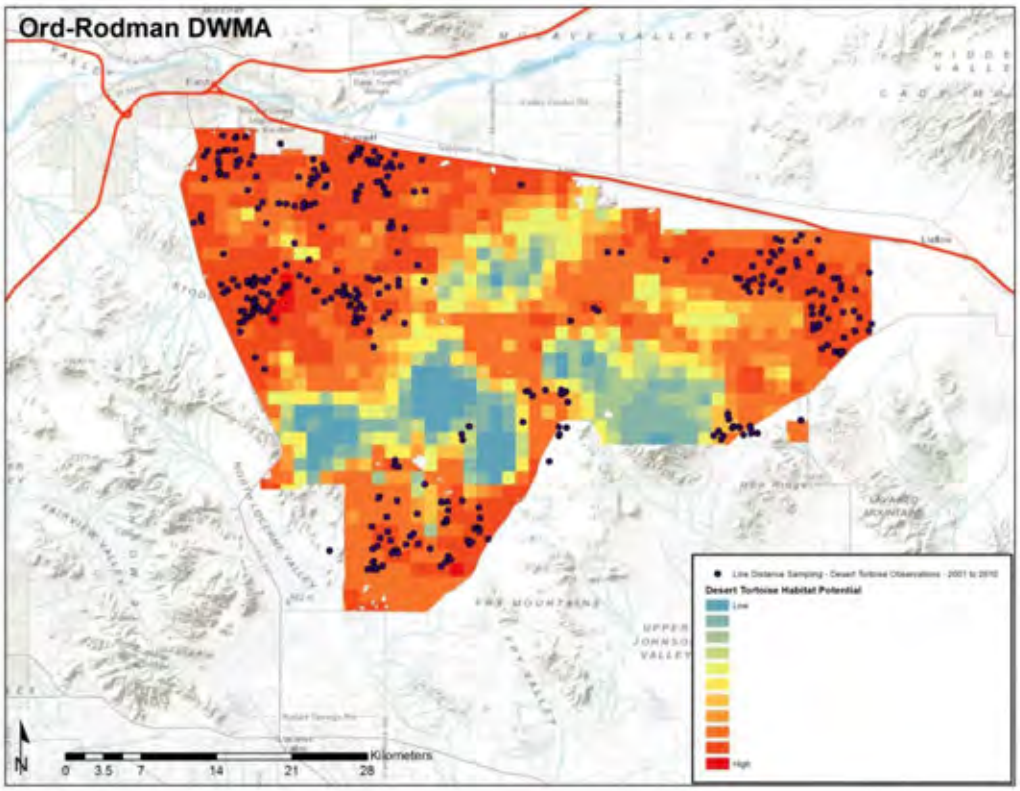

Figure 1. Desert tortoise habitat potential (Nussear et al. 2009) within the Ord-Rodman DWMA.

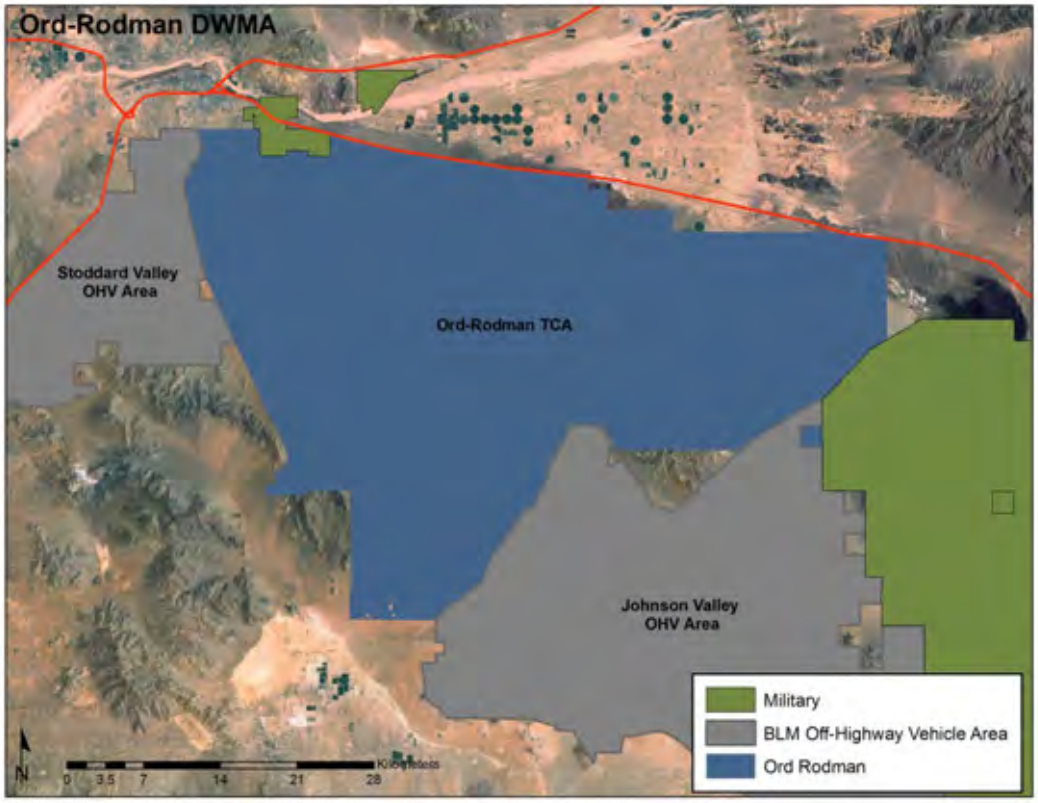

Figure 2. Ord-Rodman TCA, BLM OHV areas, and military lands

Figure 3. Ord-Rodman TCA and desert tortoise linkages. Linkages connecting the Ord-Rodman DWMA to the Fremont-Kramer DWMA and to Joshua Tree National Park are from Averill-Murray et al. 2013.

Methods

We analyzed the linkages connecting the Ord-Rodman DWMA to Joshua Tree National Park and the Fremont-Kramer DWMA using a combination of aerial photography analysis and field reconnaissance surveys. We focused this analysis on: 1) identifying large areas of intact habitat within the linkage, 2) identifying highly fragmented or developed areas that would be unsuitable for reserve design, 3) identifying areas of unsuitable habitat (e.g. playas, dunes), and 4) identifying areas of degraded habitat. We used this analysis in making recommendation on DFA boundary adjustments, conservation management actions, and ACEC modifications.

Aerial Photography Analysis

We performed analysis of aerial photography using the imagery base layer available from ArcMap. Analysis consisted of viewing this layer at a 1:10,000 scale and performing virtual transects across all portions of the two linkages. During these transects, we created a point feature layer depicting structures, bare areas, and agricultural areas within the linkage. Each structure generally received a single point, while larger bare areas and agricultural fields received multiple points meant to cover a representative portion of their extent. We also created a “non-habitat” layer by combining available GIS

layers of playas with our own digitized polygons of the Mojave River corridor and other playas not included in the available data layers (see Figure 4).

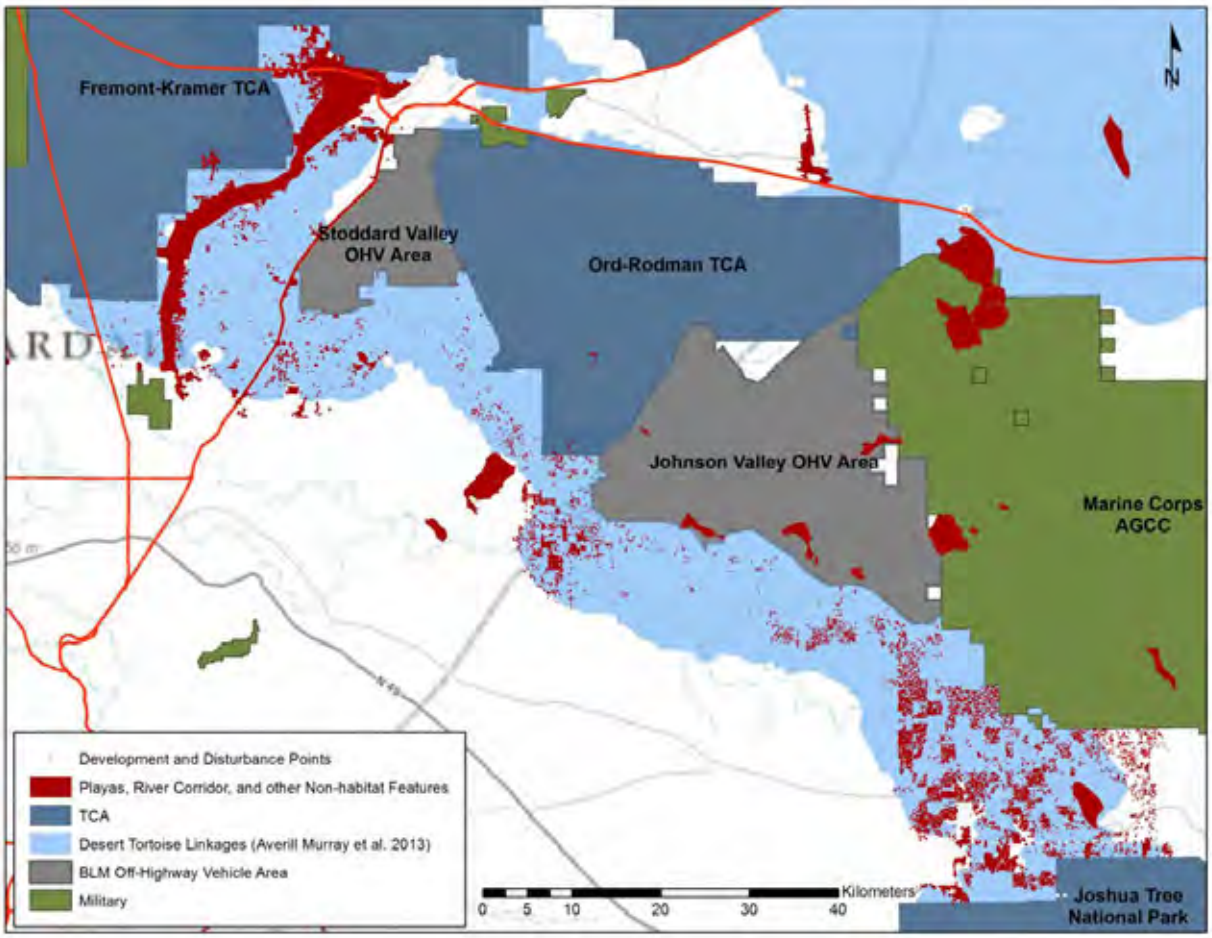

Figure 4. Development and disturbance points and non-habitat features identified through aerial photography analysis and use of available GIS layers prior to field reconnaissance surveys.

Following the development of this map, we created a kernel density layer using the point features described above to better depict where high density of disturbance and fragmentation was likely to occur in the linkage. We selected a threshold in this kernel layer by adjusting the symbology within the layer while looking at the underlying aerial photography to obtain an estimate of where more intact portions of the linkage occurred. In the Brisbane Valley area, we did not use this threshold method because of the desire to use the nearest section lines or other easily identifiable features to mark the edges of intact habitat. Both methods resulted in a rough estimate of what portions of the linkages contained relatively continuous intact habitat versus more fragmented or developed areas. We then used these rough maps in the field to help guide the routes taken during reconnaissance surveys.

Field Reconnaissance Surveys

We performed one field reconnaissance survey of the Ord-Rodman to Joshua Tree Linkage on March 12, 2013 and two surveys of the Ord-Rodman to Fremont-Kramer Linkage on March 19 and October 29, 2013. We used field maps to record notes (see Figure 5 and Appendix 2) during surveys and focused on: 1) areas of linkage constriction, 2) areas of potential off-highway vehicle impacts, 3) areas of DFA overlap with the linkage, and 4) areas containing the rough boundaries that we mapped between our intact and fragmented areas. Because of our limited field time and the size of the areas within the linkage, we extensively used high points (e.g., mountain peaks) to obtain a better vantage for assessing the level of development, road density, and other disturbances. Sufficient time was not available to visit all portions of the linkages, so we placed special emphasis on areas of DFA and ACEC overlap with the linkage. Areas that we definitively identified through aerial photography as too fragmented for reserve inclusion (e.g. Yucca Valley area) or clearly intact (e.g. areas south of Highway 247 in southern Johnson Valley) were not visited. We extensively documented all vantage points using photo points that provide a representative depiction of the area surveyed (see Figure 6 and Appendix 1).

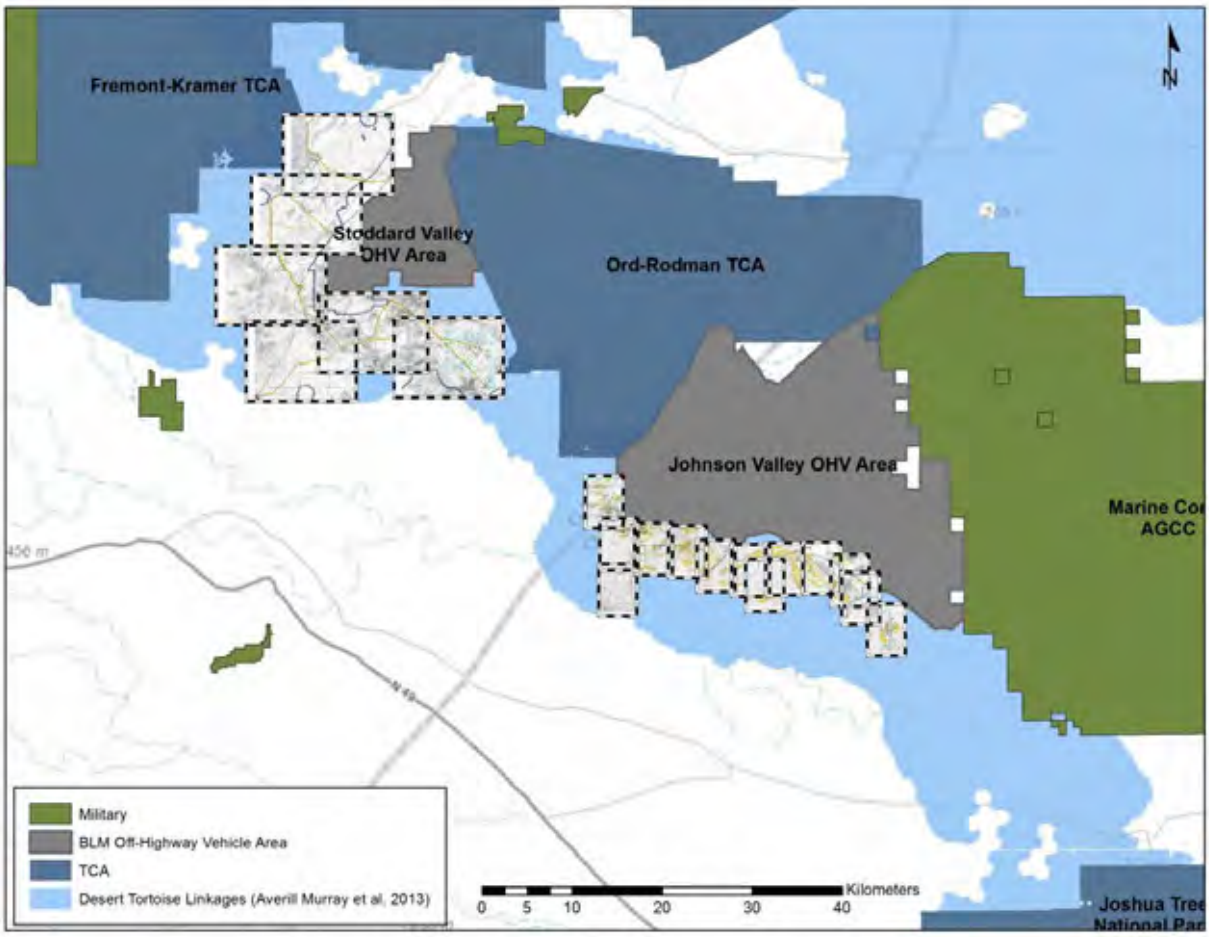

Figure 5. Coverage of field reconnaissance survey maps within analyzed linkages. Refer to Appendix 2 for field reconnaissance maps.

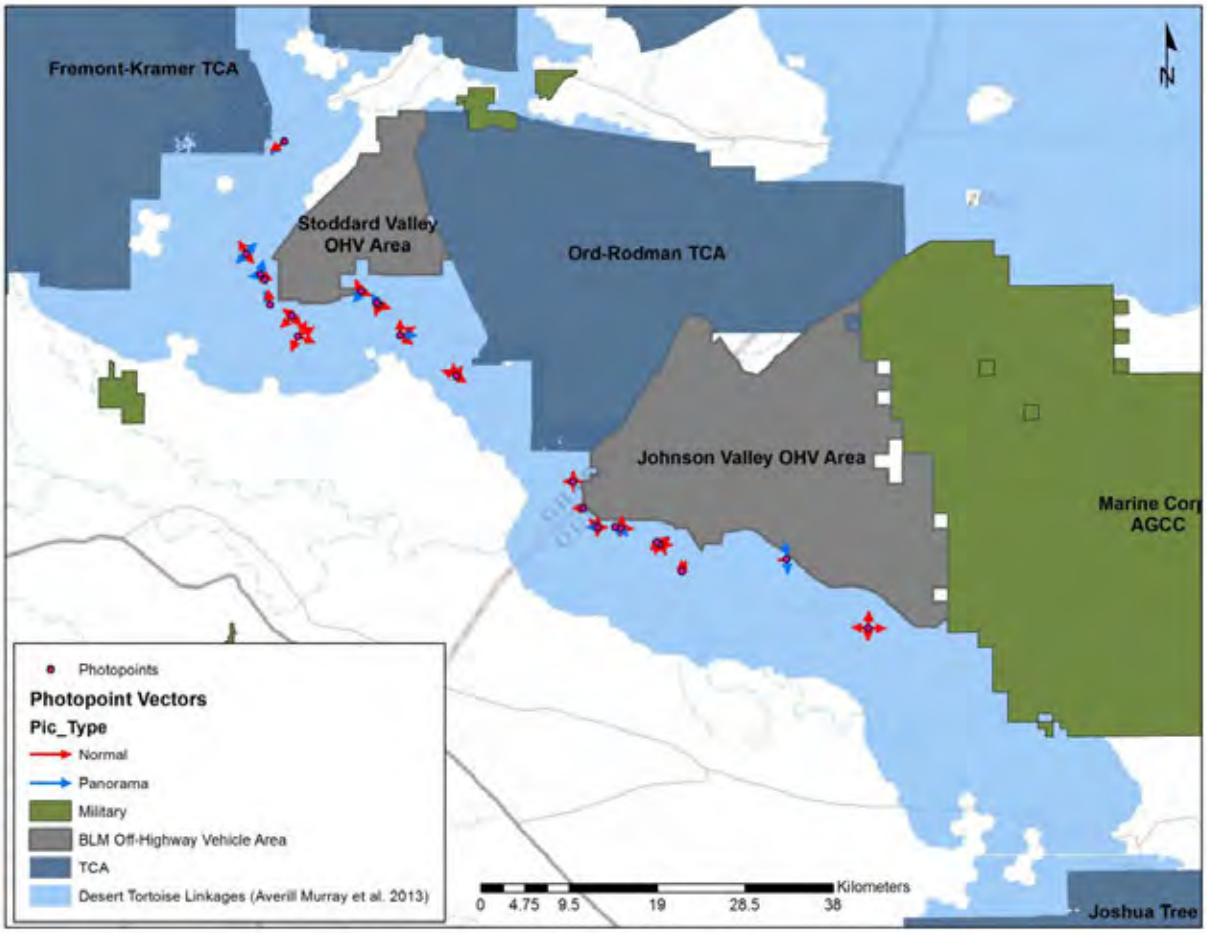

Figure 6. Location of photo points and photograph directions within linkages. Refer to Appendix 1 for images and descriptions.

Following completion of field reconnaissance surveys, we used our initial aerial photography analysis along with field notes and photographs to categorize the linkage into intact areas, fragmented areas, non-habitat, lost, developed, or severely disturbed habitat, and ohv-impacted habitat (see Figure 7). We then used these categories and their boundaries to inform U.S. Fish and Wildlife Service (Service) recommendations on adjustment of DFA and ACEC boundaries for analysis in various alternatives and to inform development of conservation management actions and biological goals and objectives for these two linkages.

Results and Recommendations

Figure 7 provides the categorization of the linkages as described above. In general, Brisbane Valley, Upper Lucerne Valley, and southern Johnson Valley contain large continuous tracts of intact habitat. All of these areas also contain high desert tortoise habitat potential (Nussear et al. 2009). Impacts to these areas would affect their function for the Ord-Rodman DWMA to varying degrees depending on the level of development and habitat degradation or fragmentation separating the intact linkage area from the

DWMA. For example, Upper Lucerne Valley may be relatively more important to the Ord-Rodman DWMA than Brisbane Valley because it is immediately adjacent to the DWMA and only separated by a two-lane highway, while Interstate 15 and large areas of ohv-impacted habitat separate Brisbane Valley from the DWMA. Our analysis supports the BLMs establishment of an ACEC south of Highway 247 in southern Johnson Valley. Based on this work we also added Conservation Planning Areas in the reserve system that would be immediately adjacent to this ACEC on the western end. We removed portions of the Johnson Valley DFA that were west of Bessemer Mine Road from the preferred alternative to improve the potential for maintaining a population connection between this ACEC and Ord-Rodman. All other areas of DFA overlap with the mapped intact portions of this linkage received stringent project analysis requirements and higher mitigation ratios during the development of conservation management actions.

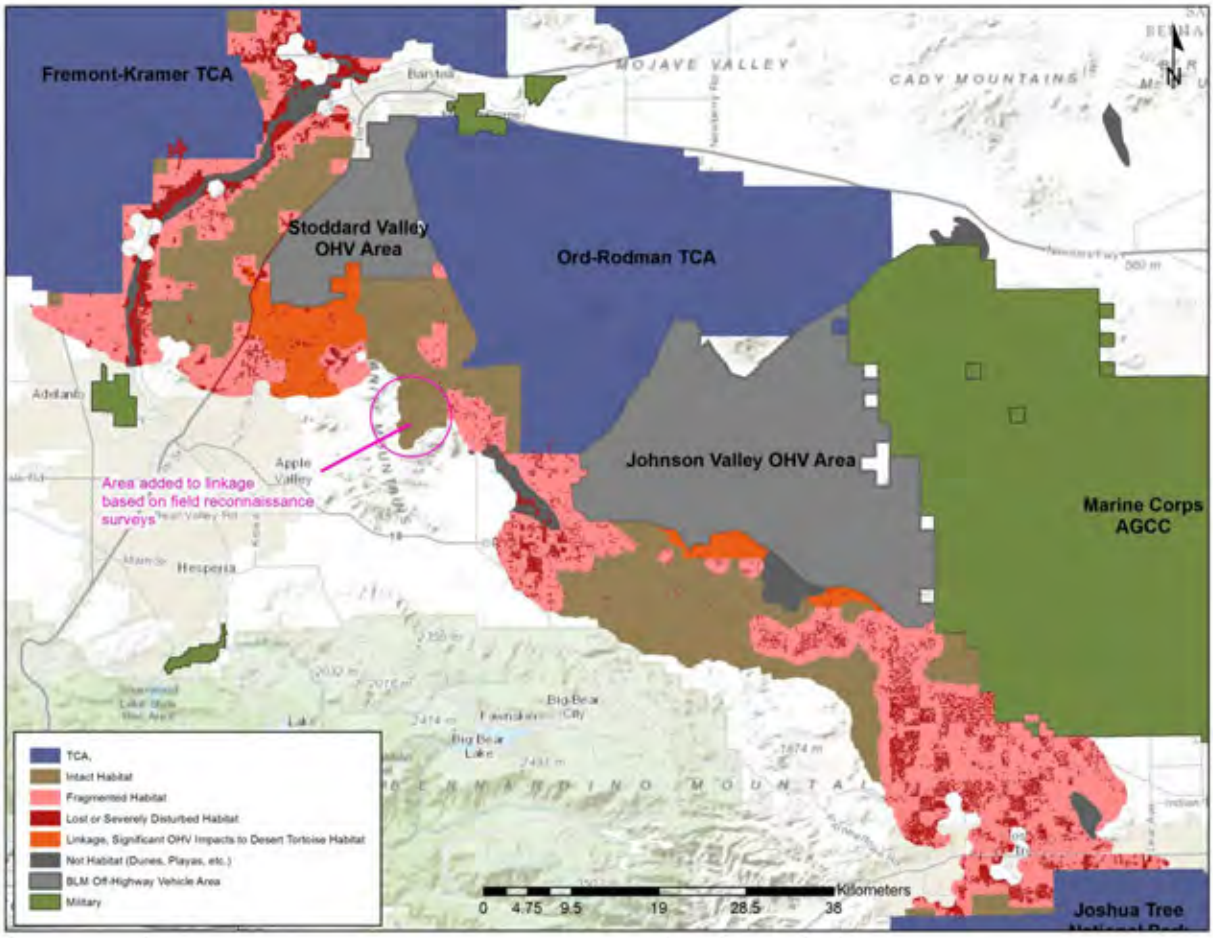

Figure 7. Categorization of habitat intactness and disturbance within linkages connecting the Ord-Rodman DWMA to the Fremont-Kramer DWMA and Joshua Tree National Park.

Areas immediately south of the Johnson Valley OHV area and south of the Stoddard Valley OHV area contain extensive unauthorized OHV damage, but would contain intact desert tortoise habitat otherwise. The ohv-impacted area south of the Stoddard Valley OHV Area is contained within a BLM

proposed ACEC, which will likely require extensive law enforcement and restoration to be effective. The ohv-impacted areas south of the Johnson Valley OHV area are within a DFA, so we recommended lower conservation management action requirements in these areas due to the likelihood of low desert tortoise density.

We categorized large portions of Landers, Yucca Valley, and Joshua Tree as highly fragmented in the southern portion of the Ord-Rodman to Joshua Tree National Park Linkage. While these areas continue to contain desert tortoises and likely contribute to gene flow, we believe they are too fragmented to serve as a functional part of the reserve system relative to desert tortoise conservation goals.

DFA Recommendations

The following map and list of recommendations provide more detailed information on specific areas of DFA overlap with the linkage. Each of these areas has undergone special consideration in the DRECP relative to conservation management action and compensation requirements.

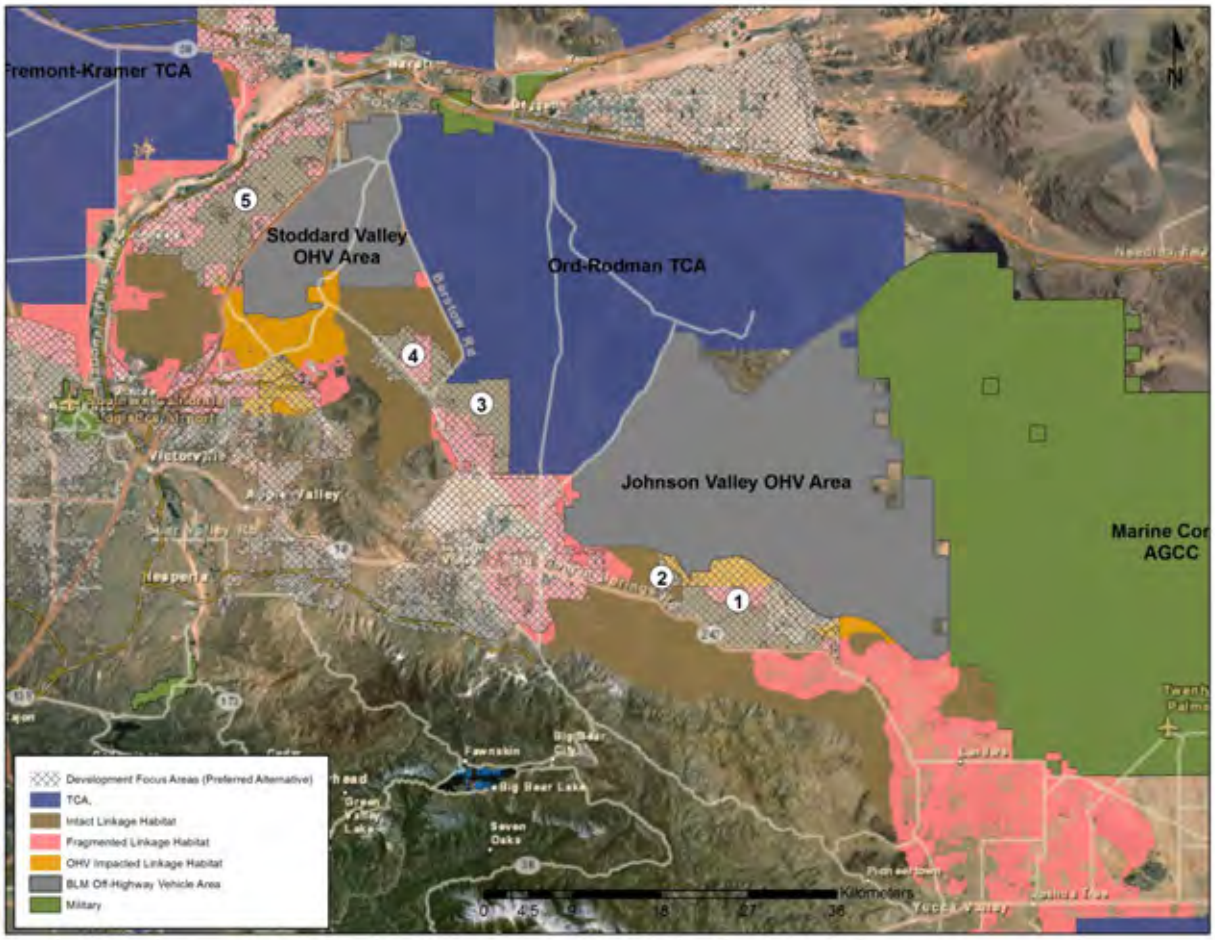

Figure 8. Overlap of DRECP DFAs with categorized linkage habitat. Numbers correspond to recommendation, detailed below, regarding DFAs.

The following numbered recommendations correspond to geographic areas labeled in Figure 8.

1. The DFA south of the Johnson Valley OHV Area contains a mixture of intact habitat, fragmented habitat, dune and sand transport areas (i.e., non-habitat areas), and areas heavily impacted by unauthorized off-highway vehicle use. Because desert tortoise are likely to be absent or occur in very low numbers in the OHV impacted areas and non-habitat areas, we recommended that the DRECP require fewer, more streamlined, conservation management actions and lower compensation requirements in these portions of the DFA. We recommended that the DRECP require high mitigation ratios (e.g., 5 to 1) and more stringent conservation management actions in portions of this DFA containing intact desert tortoise habitat.
2. We recommended that all portions of this proposed DFA, west of Bessemer Mine Road, be removed from the DFA and either added to the reserve system as part of BLMs ACEC or as part of a Conservation Planning Area in the proposed preferred alternative. These areas will help provide sufficient width to the north-south corridor that connects to the portions of the proposed Old Woman Springs ACEC, south of Highway 247.
3. The intact linkage habitat, south of Highway 247 (Barstow Road), and immediately adjacent to the Ord-Rodman DWMA are currently part of a Future Assessment Area. Because this area contains intact habitat, it is important for helping to maintain long-term viability of desert tortoise populations in the southern end of the DWMA. We recommended that this area not be opened to development.
4. The portion of Upper Lucerne Valley, north of Highway 247, within the DFA, comprises large areas of intact desert tortoise habitat that are contiguous with the Ord-Rodman DWMA and the Future Assessment Area identified in Item 3. In addition, the DFA portions of this intact linkage habitat comprise the areas of highest habitat potential. Other portions of the intact habitat north of Highway 247 are more marginal and include more mountainous areas like Stoddard Ridge that are likely to contain fewer desert tortoises than that found in the DFA itself. Based on this, we recommended stringent conservation management actions and high mitigation ratios in this portion of the DFA. All projects considered in this location must perform an analysis of effects on connectivity and effects on population viability within the Ord-Rodman DWMA. Projects that cannot show sufficient mitigation of their impacts on these factors are prohibited.
5. Brisbane Valley contains large areas of intact desert tortoise habitat, but its connection with the Ord-Rodman DWMA is tenuous due to Interstate 15 and intervening land uses that are not conducive to desert tortoise conservation (e.g., Stoddard Valley OHV Area and illegal OHV use south of Stoddard Valley OHV Area). However, desert tortoises continue to occupy the OHV areas and there are seven underpasses (Wild Wash Bridge and 6 passable culverts) under Interstate 15 that likely provide for some level of continued population connectivity. Based on this information, we recommended more stringent conservation management actions and high compensation ratios for projects in this DFA.

Reserve Recommendations

The following map and list of recommendations provide more detailed information on specific areas of ACEC overlap with the linkages.

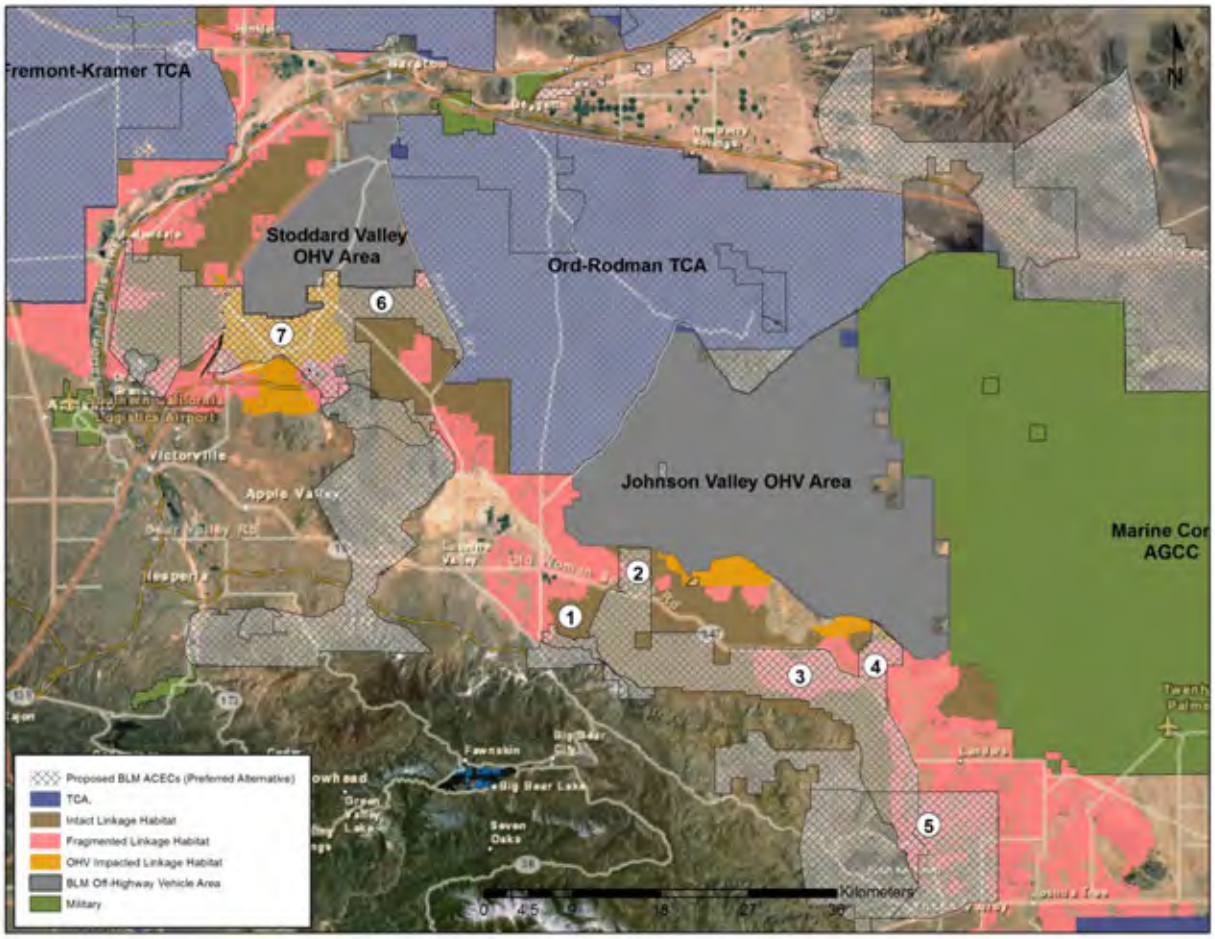

Figure 9. Overlap of BLMs proposed ACECs (preferred alternative) with categorized linkage habitat. Numbers correspond to recommendation made below.

1. Based on field reconnaissance surveys, we recommended that the intact linkage habitat in this location be added to the reserve as a Conservation Planning Area.
2. Field reconnaissance surveys support the inclusion of this north-south corridor in the reserve. However, we have recommended that the DRECP widen it to extend to Bessemer Mine Road by.
3. This portion of the proposed Old Woman Springs ACEC is relatively fragmented and contains numerous houses that may make consolidation and management difficult within the reserve.
4. This north-south linkage may be suitable for wildlife such as bighorn sheep, but it is likely to provide lower value for desert tortoise due to the fragmentation and development identified through our analysis.

5. This ACEC area contains large developed and fragmented portions of Yucca Valley. Consolidation and management of this area is likely to be infeasible.
6. This arm of the proposed Northern Lucerne Wildlife Linkage ACEC is comprised primarily of Stoddard Ridge, which is of lower habitat potential for desert tortoise due to mountainous terrain. As a linkage for other wildlife, such as bighorn sheep, or as a reserve for raptor breeding, it may still have beneficial value. However, as a linkage for desert tortoise it is of low value. Preservation of the intact habitat in the valley bottom areas of Upper Lucerne Valley would provide a more suitable linkage for desert tortoise through this area. This would require modification of the DFA in Upper Lucerne Valley.
7. This area contains high levels of unauthorized OHV use and extensive damage. BLM will need a large investment in law enforcement, land ownership consolidation, and habitat restoration for effective management. However, accomplishment of these things along with preservation of a suitable linkage through Upper Lucerne Valley (see Item 6 above) would allow connection of Ord-Rodman, under the Wild Wash Bridge to the ACEC in Brisbane Valley.

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Nussear, K.E., T.C. Esque, R.D. Inman, L. Gass, K.A. Thomas, C.S.A. Wallace, J.B. Blainey, D.M. Miller, and R.H.Webb. 2009. Modeling habitat of the desert tortoise (Gopherus agassizii) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona. U.S. Geological Survey Open-File Report 2009-1102.

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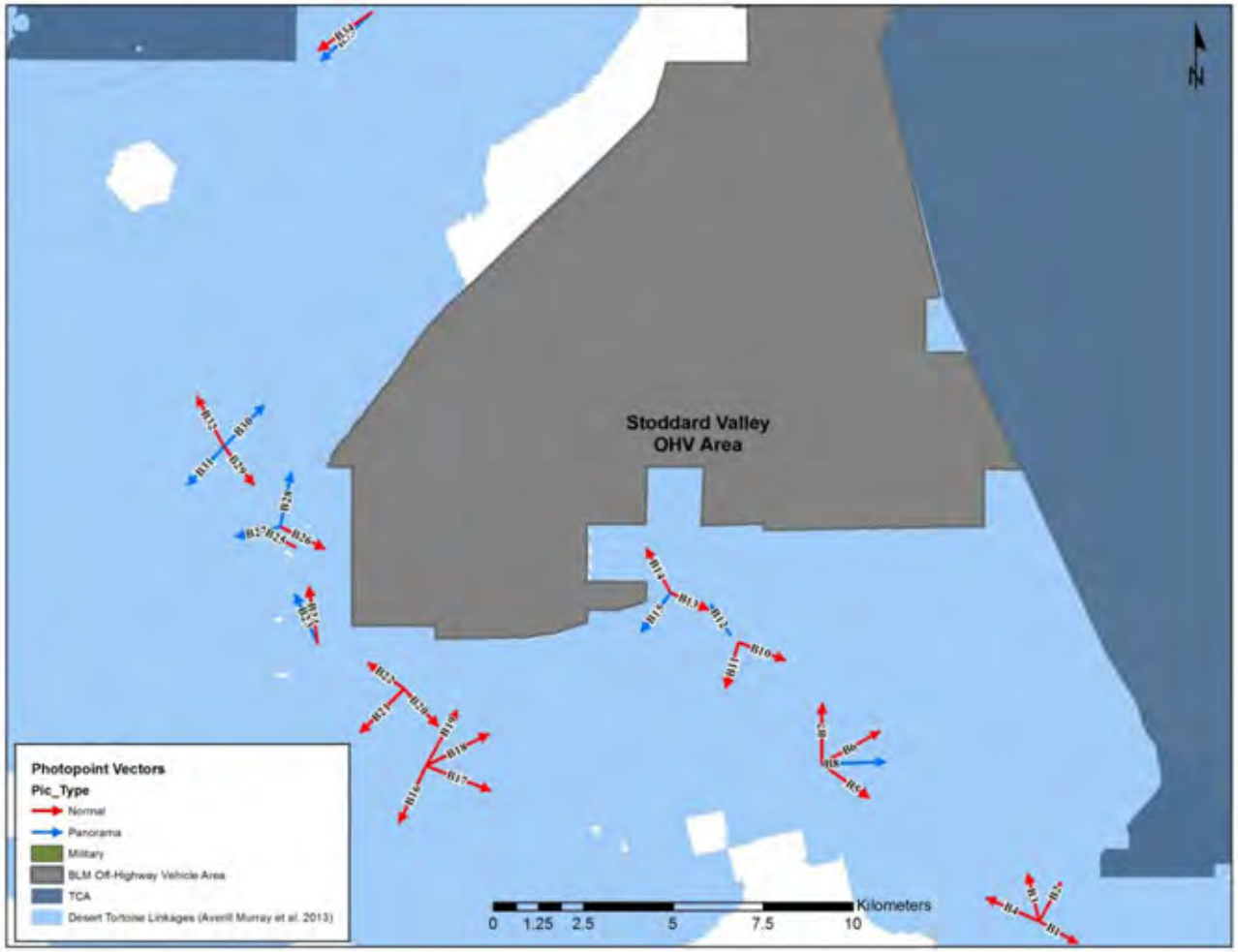
APPENDIX 1 – FIELD RECONNAISSANCE PHOTO POINTS

Field Reconnaissance Photo Points – Brisbane Valley, Upper Lucerne Valley, and Wild Wash Area



Note: Photo vector numbers in this map do not match those labeled on field reconnaissance maps. We have re-labeled for this report.

Picture B1. Taken from west side of Highway 247 looking to the southeast. Photo point on rock outcrop near the intersection of 247 and Lucerne Cutoff Road.

Picture B2. Taken from west side of Highway 247 looking to the northeast along the highway. Photo point on rock outcrop near the intersection of 247 and Lucerne Cutoff Road.

Picture B3. Taken from west side of Highway 247 looking to the north into Upper Lucerne Valley. Photo point on rock outcrop near the intersection of 247 and Lucerne Cutoff Road.

Picture B4. Taken from west side of Highway 247 looking to the northwest along the Lucerne Cutoff Road. Photo point on rock outcrop near the intersection of 247 and Lucerne Cutoff Road.

Picture B5. Taken from hill on west side of Lucerne Cutoff Road approximately 3 miles northwest of Highway 247 (T6N, R2W, Section 1). Photo looking southeast through Upper Lucerne Valley.

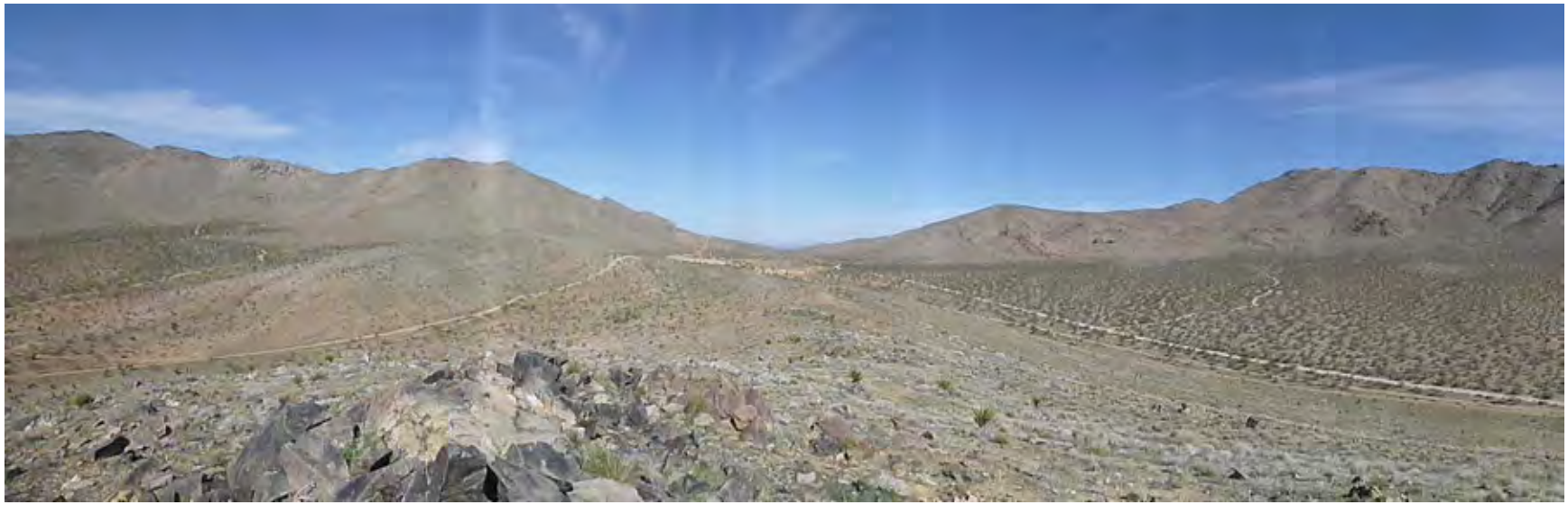
Picture B6. Taken from hill on west side of Lucerne Cutoff Road approximately 3 miles northwest of Highway 247 (T6N, R2W, Section 1). Photo looking northeast across Upper Lucerne Valley toward Stoddard Ridge.

Picture B7. Taken from hill on west side of Lucerne Cutoff Road approximately 3 miles northwest of Highway 247 (T6N, R2W, Section 1). Photo looking north across Upper Lucerne Valley.

Picture B8. Taken from hill on west side of Lucerne Cutoff Road approximately 3 miles northwest of Highway 247 (T6N, R2W, Section 1). Panorama photo across Upper Lucerne Valley.

Picture B10. Taken from hill on west side of Lucerne Cutoff Road approximately 3.5 miles northwest of Highway 247 (T7N, R2W, Section 35). Photo looking southeast through Upper Lucerne Valley.

Picture B11. Taken from hill on west side of Lucerne Cutoff Road approximately 3.5 miles northwest of Highway 247 (T7N, R2W, Section 35). Photo looking south.



Picture B12. Taken from hill on west side of Lucerne Cutoff Road approximately 3.5 miles northwest of Highway 247 (T7N, R2W, Section 35). Panorama photo looking northwest.

Picture B13. Taken from hill near intersection of Lucerne Cutoff Road and Stoddard Wells Road (T7N, R2W, Section 21). Photo looking southeast.

Picture B14. Taken from hill near intersection of Lucerne Cutoff Road and Stoddard Wells Road (T7N, R2W, Section 21). Photo looking northwest towards the Stoddard Valley OHV Area.

Picture B15. Taken from hill near intersection of Lucerne Cutoff Road and Stoddard Wells Road (T7N, R2W, Section 21). Panorama photo looking southwest.

Picture B16. Taken from hill near intersection of Wild Wash Road and Stoddard Wells Road (T6N, R3W, Section 2). Photo looking southwest towards Bell Mountain.

Picture B17. Taken from hill near intersection of Wild Wash Road and Stoddard Wells Road (T6N, R3W, Section 2). Photo looking southeast towards Black Mountain and large OHV staging areas at the intersection of Stoddard Wells Road and Wild Wash Road.

Picture B18. Taken from hill near intersection of Wild Wash Road and Stoddard Wells Road (T6N, R3W, Section 2). Photo looking northeast.

Picture B19. Taken from hill near intersection of Wild Wash Road and Stoddard Wells Road (T6N, R3W, Section 2). Photo looking northeast toward Stoddard Peak.

Picture B20. Taken from hill along east side of Wild Wash Road (T7N, R3W, Section 27). Photo looking southeast along Wild Wash Road.

Picture B21. Taken from hill along east side of Wild Wash Road (T7N, R3W, Section 27). Photo looking southwest across Wild Wash Road.

Picture B22. Taken from hill along east side of Wild Wash Road (T7N, R3W, Section 27). Photo looking northwest along Wild Wash Road towards Interstate 15.

Picture B23. Taken from hill along west side of Wild Wash Road (T7N, R3W, Section 28). Panorama photo looking north.

Picture B24. Taken from hill along west side of Wild Wash Road (T7N, R3W, Section 28). Photo looking north along Wild Wash toward Interstate 15.

Picture B25. Wild Wash, south of Interstate 15, looking north at Wild Wash bridge.

Picture B26. Taken from hill "2927" along south side of Wild Wash Road (T7N, R3W, Section 17). Photo looking southeast toward Wild Wash Bridge on Interstate 15.

Picture B27. Taken from hill "2927" along south side of Wild Wash Road (T7N, R3W, Section 17). Panorama photo looking west.

Picture B28. Taken from hill "2927" along south side of Wild Wash Road (T7N, R3W, Section 17). Panorama photo looking north across Brisbane Valley.

Picture B29. Taken from small hill along west side of Wild Wash Road (T7N, R3W, Section 6). Photo looking southeast toward Interstate 15.

Picture B30. Taken from small hill along west side of Wild Wash Road (T7N, R3W, Section 6). Panorama photo looking northeast across Brisbane Valley.

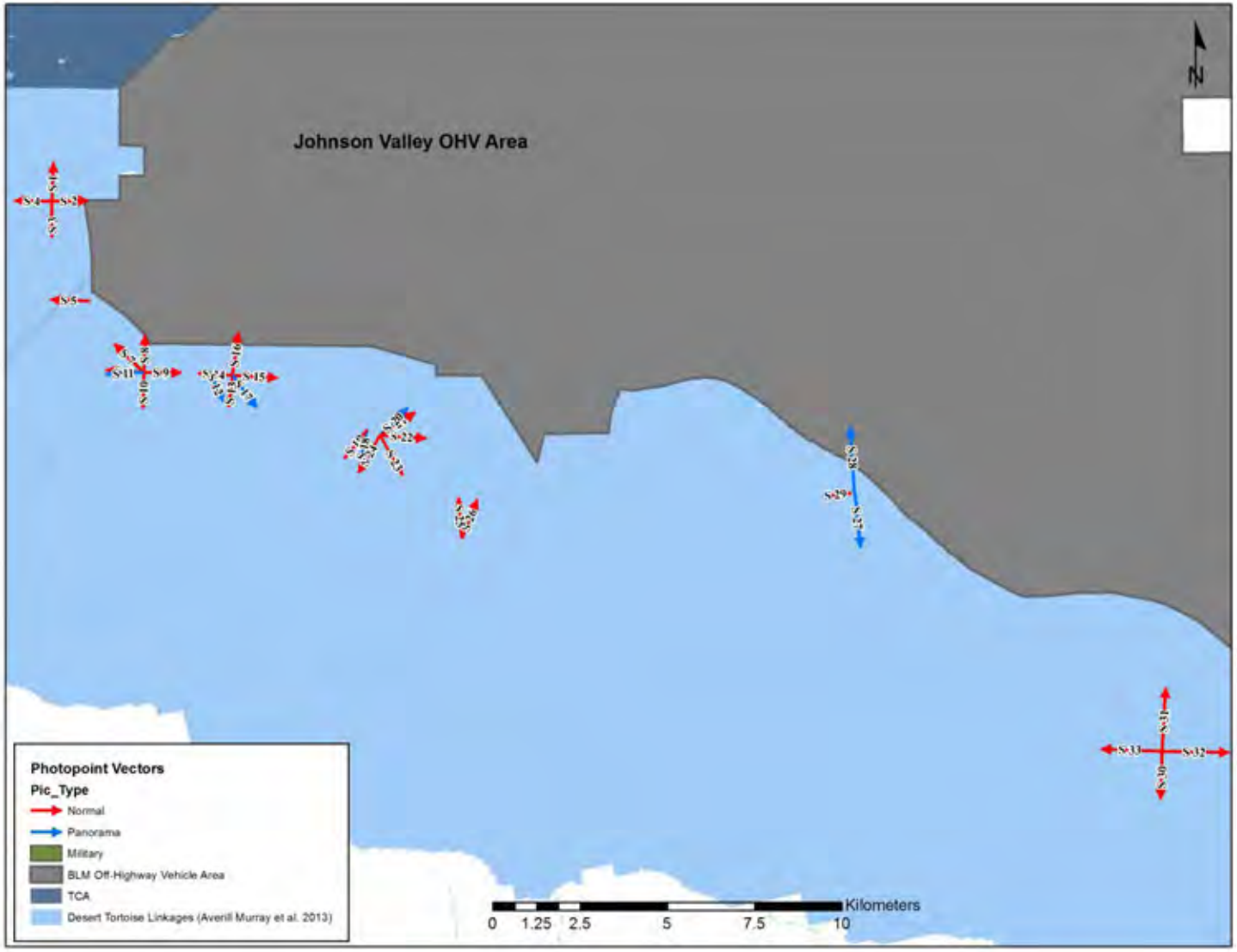
Picture B31. Taken from small hill along west side of Wild Wash Road (T7N, R3W, Section 6). Panorama photo looking southwest.

Picture B32. Taken from small hill along west side of Wild Wash Road (T7N, R3W, Section 6). Photo looking northwest across Brisbane Valley.

Picture B33. Taken from Hinkley Road, off of Route 66, near Johnston's Corner. Looking southwest toward the Mojave River.

Picture B34. Taken from Hinkley Road, off of Route 66, near Johnston's Corner. Looking southwest toward the Mojave River.

Field Reconnaissance Photo Points – Southern Johnson Valley and Lucerne Valley areas



Note: Photo vector numbers on this map and some coordinates in image captions do not match those labeled on field reconnaissance maps.

Picture S1. Taken along Granite Road, approximately 0.75 miles east of Camp Rock Road (T5N, R1E, Section 23). Looking north toward the Ord-Rodman DWMA/TCA.

Picture S2. Taken along Granite Road, approximately 0.75 miles east of Camp Rock Road (T5N, R1E, Section 23). Looking east toward the Johnson Valley OHV Area.

Picture S3. Taken along Granite Road, approximately 0.75 miles east of Camp Rock Road (T5N, R1E, Section 23). Looking south toward the San Bernardino Mountains.

Picture S4. Taken along Granite Road, approximately 0.75 miles east of Camp Rock Road (T5N, R1E, Section 23). Looking west toward Lucerne Lake and the Granite Mountains.

Picture S5. Taken along Meteor Way between Big Dipper Drive and Planet Road (T5N, R1E, Section 36). Looking west toward Lucerne Lake.

Picture S6. Taken from top of rock outcrop near corner of Rabbit Springs Road and Livingston Road (W 116° 48’ 53.5’’ N 34° 27’ 24.6”). Looking west along Rabbit Springs Road toward Lucerne Valley.

Picture S7. Taken from top of rock outcrop near corner of Rabbit Springs Road and Livingston Road (W 116° 48’ 53.5’’ N 34° 27’ 24.6”). Looking northwest; Cougar Buttes on right side of image.

Picture S8. Taken from top of rock outcrop near corner of Rabbit Springs Road and Livingston Road (W 116° 48’ 53.5’’ N 34° 27’ 24.6”). Looking north toward Cougar Buttes.

Picture S9. Taken from top of rock outcrop near corner of Rabbit Springs Road and Livingston Road (W 116° 48’ 53.5’’ N 34° 27’ 24.6”). Looking east.

Picture S10. Taken from top of rock outcrop near corner of Rabbit Springs Road and Livingston Road (W 116° 48’ 53.5’’ N 34° 27’ 24.6”). Looking south toward the San Bernardino Mountains.

Picture S11. Taken from top of rock outcrop near corner of Rabbit Springs Road and Livingston Road (W 116° 48’ 53.5’’ N 34° 27’ 24.6”). Panorama image looking west toward Lucerne Valley.

Picture S12. Taken from Rabbit Springs Road near intersection with Santa Fe Fire Road (W 116° 48’ 4.2” N 34° 27’ 27.6”). Panorama looking southeast towards San Bernardino Mountains.

Picture S13. Taken from top of hill east of the intersection of Rabbit Springs Road and Santa Fe Fire Road (W 116° 47’ 13.4” N 34° 27’ 23.0”). Looking south toward San Bernardino Mountains.

Picture S14. Taken from top of hill east of the intersection of Rabbit Springs Road and Santa Fe Fire Road (W 116° 47’ 13.4” N 34° 27’ 23.0”). Looking west toward Lucerne Valley along Rabbit Springs Road.

Picture S15. Taken from top of hill east of the intersection of Rabbit Springs Road and Santa Fe Fire Road (W 116° 47’ 13.4” N 34° 27’ 23.0”). Looking east toward southern Johnson Valley.

Picture S16. Taken from top of hill east of the intersection of Rabbit Springs Road and Santa Fe Fire Road (W 116° 47’ 13.4” N 34° 27’ 23.0”). Looking north toward the Johnson Valley OHV Area.

Picture S17. Taken from top of hill east of the intersection of Rabbit Springs Road and Santa Fe Fire Road (W 116° 47’ 13.4” N 34° 27’ 23.0”). Panorama image looking south toward the San Bernardino Mountains.

Picture S18. Taken from top of hill east of the intersection of East End Road and Road B (W 116° 44’ 51.6” N 34° 26’ 37”). Panorama looking south toward the San Bernardino Mountains.

Picture S19. Taken from top of hill east of the intersection of East End Road and Road B (W 116° 44’ 51.6” N 34° 26’ 37”). Looking southwest toward the San Bernardino Mountains.

Picture S20. Taken from top of hill east of the intersection of East End Road and Road B (W 116° 44’ 51.6” N 34° 26’ 37”). Panorama looking northeast toward Soggy Lake.

Picture S21. Taken from top of hill east of the intersection of East End Road and Road B (W 116° 44’ 51.6” N 34° 26’ 37”). Looking northeast toward Soggy Lake.

Picture S22. Taken from top of hill east of the intersection of East End Road and Road B (W 116° 44’ 51.6” N 34° 26’ 37”). Looking east.

Picture S23. Taken from top of hill east of the intersection of East End Road and Road B (W 116° 44’ 51.6” N 34° 26’ 37”). Looking southeast toward the San Bernardino Mountains.

Picture S24. Taken from top of hill east of the intersection of East End Road and Road B (W 116° 44’ 51.6” N 34° 26’ 37”). Looking southwest toward the San Bernardino Mountains.

Picture S25. Taken near the intersection of Bessemer Mine Road and Dune Road (W 116° 42’ 57.2” N 34° 24’ 50.6”). Looking north.

Picture S26. Taken near the intersection of Bessemer Mine Road and Dune Road (W 116° 42’ 57.2” N 34° 24’ 50.6”). Looking northeast along Bessemer Mine Road.

Picture S27. Taken from top of large mesquite hummock in dune field west of “3289” mountain (W 116° 35’ 35.7” N 34° 25’ 30.6”). Panorama looking south.

Picture S28. Taken from top of large mesquite hummock in dune field west of “3289” mountain (W 116° 35’ 35.7” N 34° 25’ 30.6”). Panorama looking north.

Picture S29. Large mesquite hummocks in dune field west of “3289” mountain (W 116° 35’ 35.7” N 34° 25’ 30.6”).

Picture S30. Taken near top of hill “3331” along west side of Ghost Road, 1.25 miles north of Highway 247 (W 116° 29’ 46.6” N 34° 21’ 24.5”). Looking south towards Highway 247.

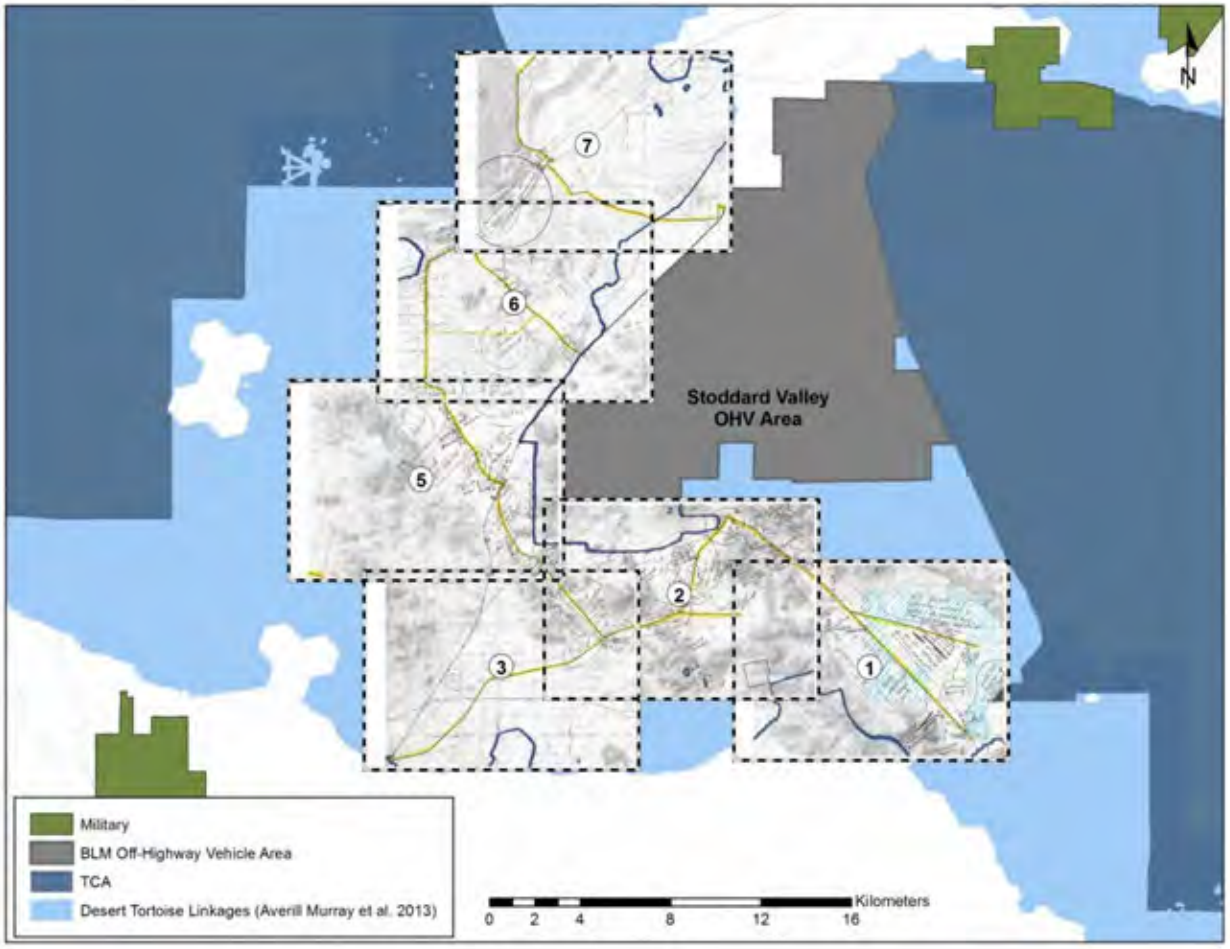
Picture S31. Taken near top of hill “3331” along west side of Ghost Road, 1.25 miles north of Highway 247 (W 116° 29’ 46.6” N 34° 21’ 24.5”). Looking north.

Picture S32. Taken near top of hill “3331” along west side of Ghost Road, 1.25 miles north of Highway 247 (W 116° 29’ 46.6” N 34° 21’ 24.5”). Looking east.

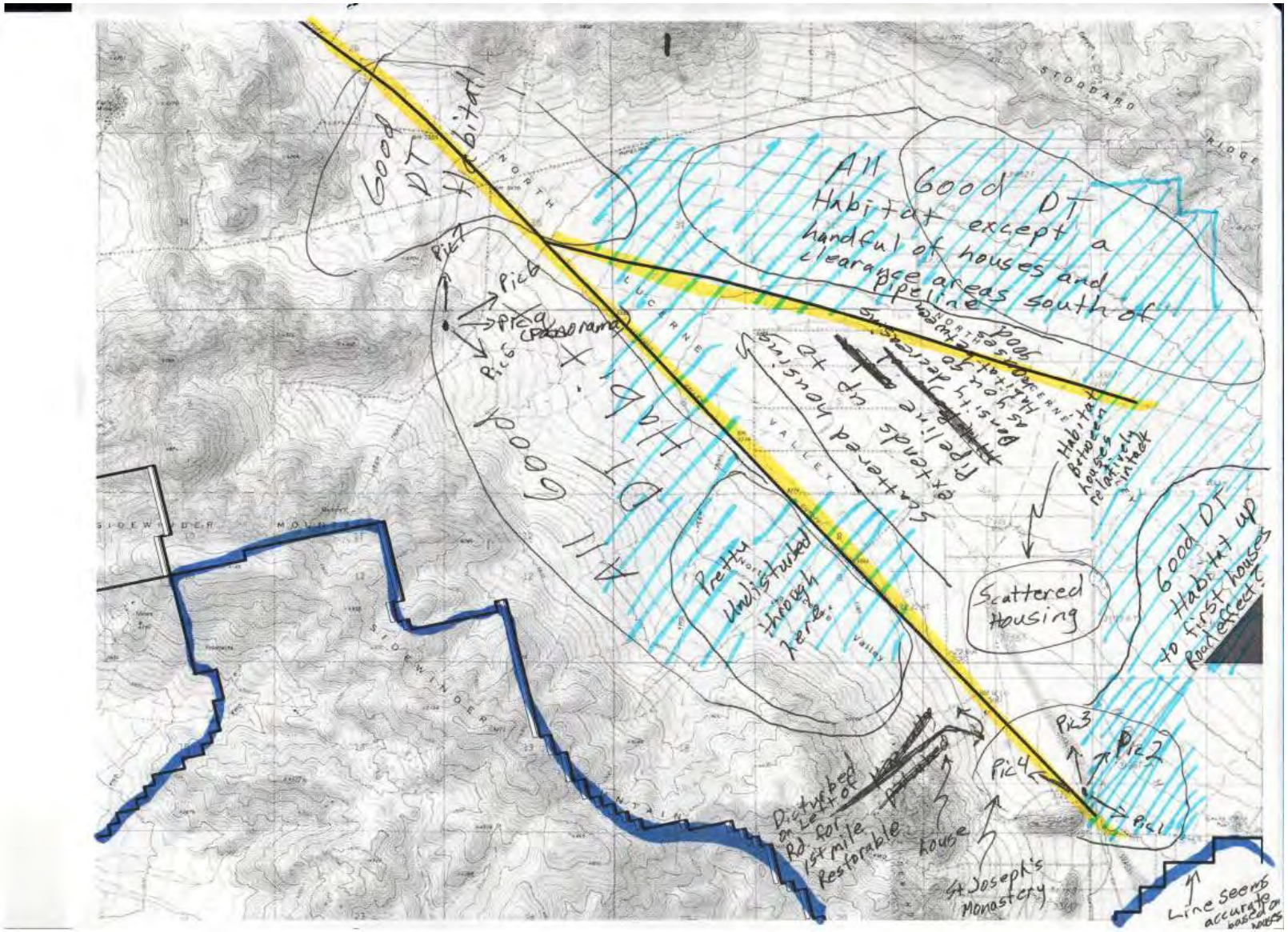
Picture S33. Taken near top of hill “3331” along west side of Ghost Road, 1.25 miles north of Highway 247 (W 116° 29’ 46.6” N 34° 21’ 24.5”). Looking north.

APPENDIX 2 – FIELD RECONNAISSANCE MAPS

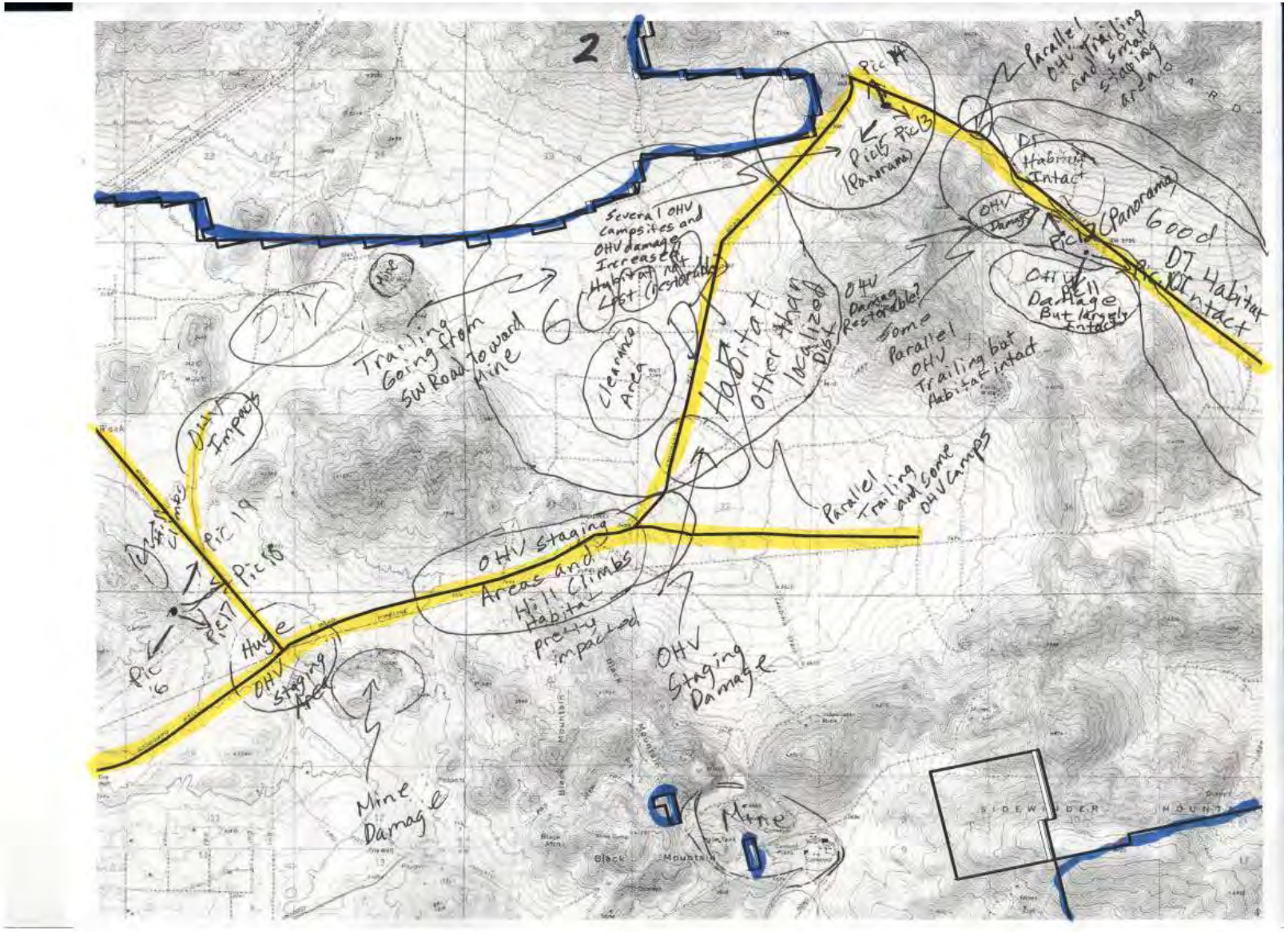
Field Reconnaissance Maps – Brisbane Valley, Upper Lucerne Valley, and Wild Wash Area



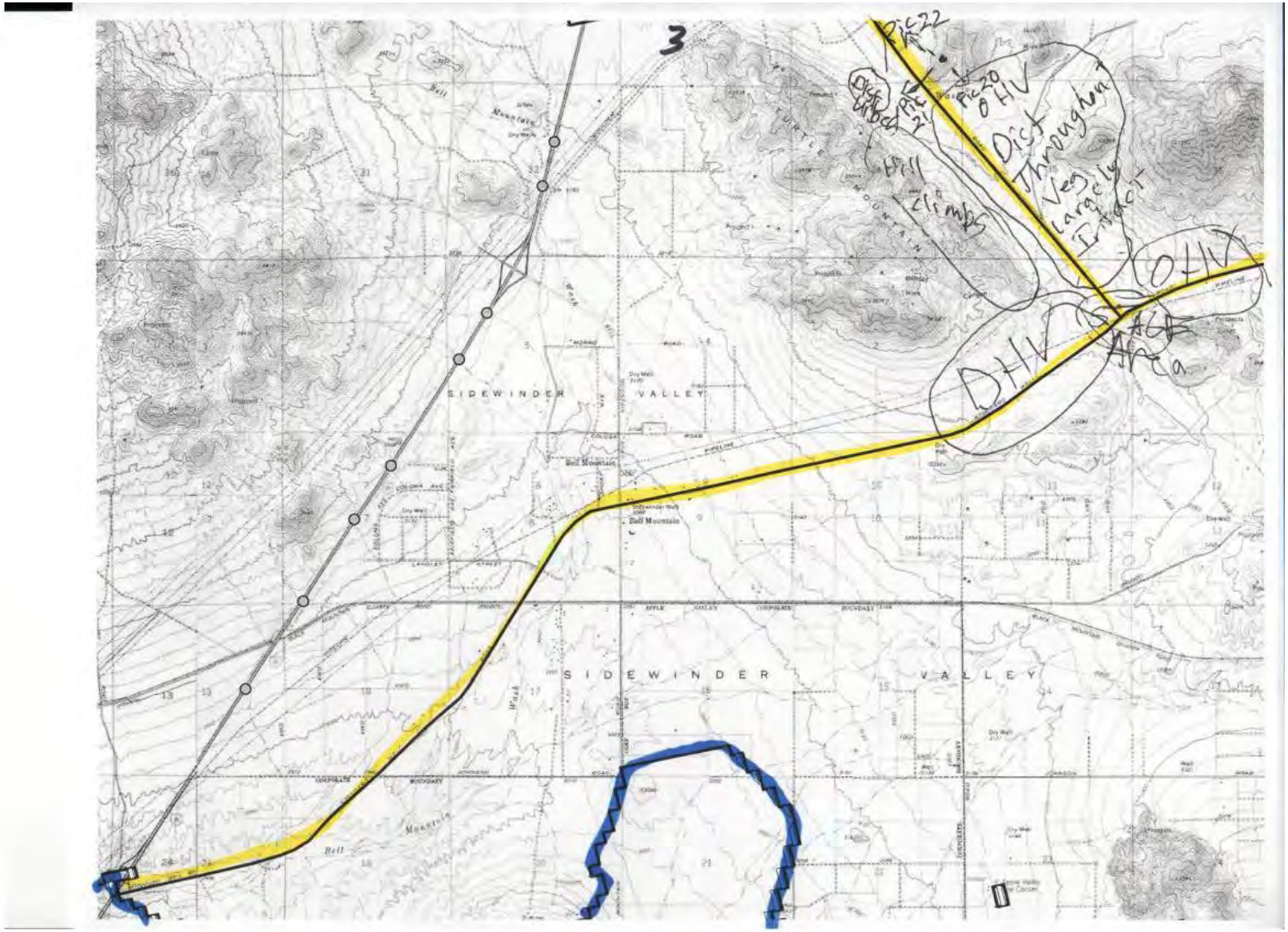
Key to Field Reconnaissance Maps - **Brisbane Valley, Upper Lucerne Valley, and the Wild Wash area**. Note that numbering is based on the field map numbers and is not sequential (e.g. Map 4 is skipped because the area we were going to cover in Map 4 was not visited)


Good DT Habitat
All Good DT Habitat except a handful of houses and clearance areas south of pipeline
Pic7
Pic6
Pic5
Pic4
Pic3
Pic2
Pic1
Pretty Undisturbed through here.
Scattered Housing
Good DT Habitat up to first houses Road effect?
Disturbed on Left of Rd for 1st mile Restorable
house
St Joseph's Monastery
Line seems accurate based on roads
STODDARD RIDGE
SIDEWINDER MOUNTAIN
SIDEWINDER
NORTH
VALLEY

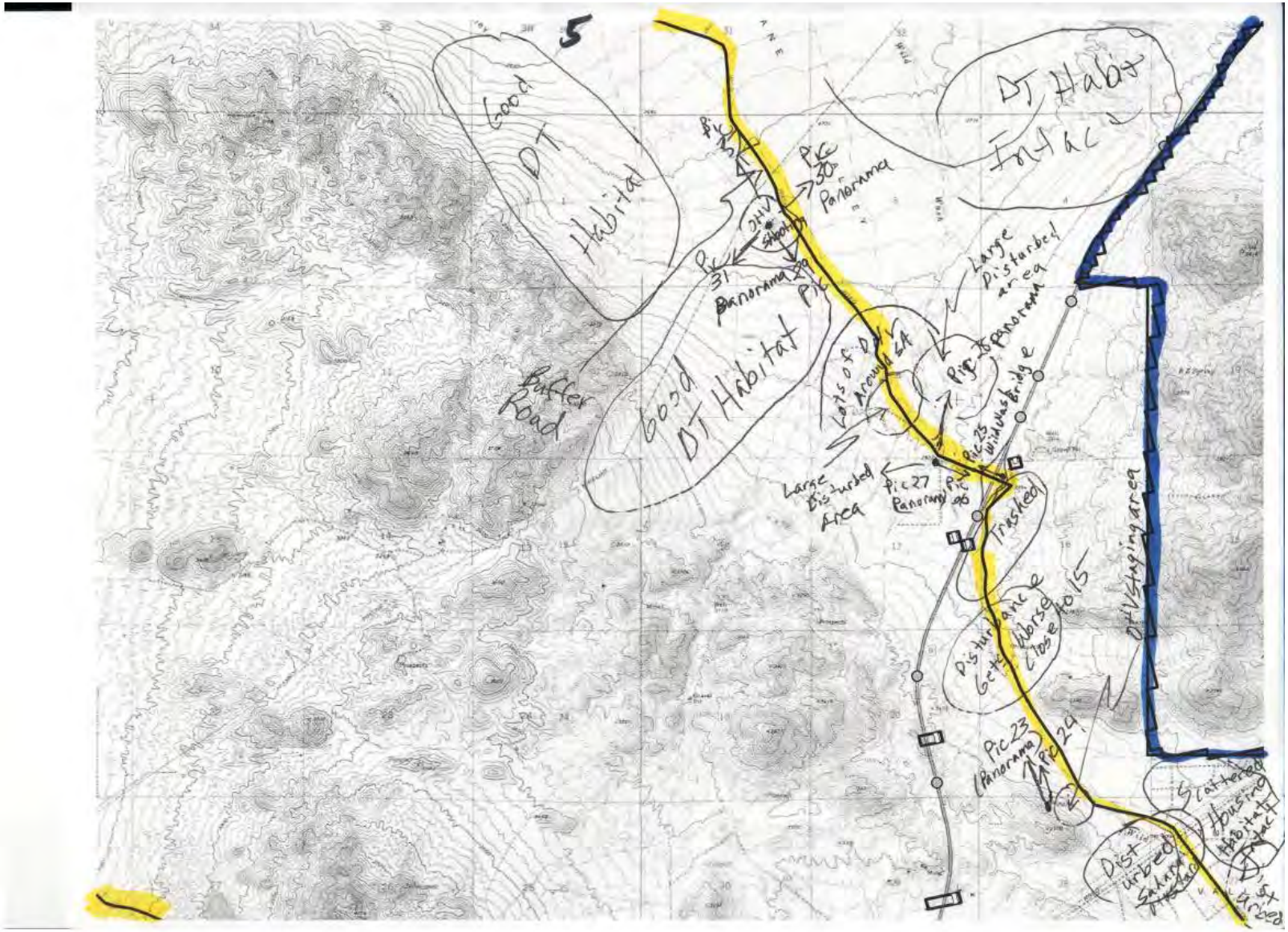
Map 1


2
Pic 14
Parallel OHV Trailing and small staging area
Pics Pic13 (Panorama)
DT Habitat Intact
OHV Damage
Pic 12 (Panorama)
Good DT Habitat Intact
OHV Damage But largely Intact
Several OHV campsites and OHV damage Increases Habitat not Lost (restorable)
OHV
Trailing Going from SW Road Toward Mine
Clearance Area
Habitat other than localized Disturbance
OHV Damage Restorable?
Some Parallel OHV Trailing but Habitat intact
Parallel Trailing and some OHV Camps
OHV Impacts
Pic 19
Pic 18
Pic 17
Pic 16
Huge OHV staging Area
OHV staging Areas and Hill Climbs Habitat pretty impacted
OHV Staging Damage
Mine Damage
Mine
Black Mountain
SIDEWINDER MOUNTAIN

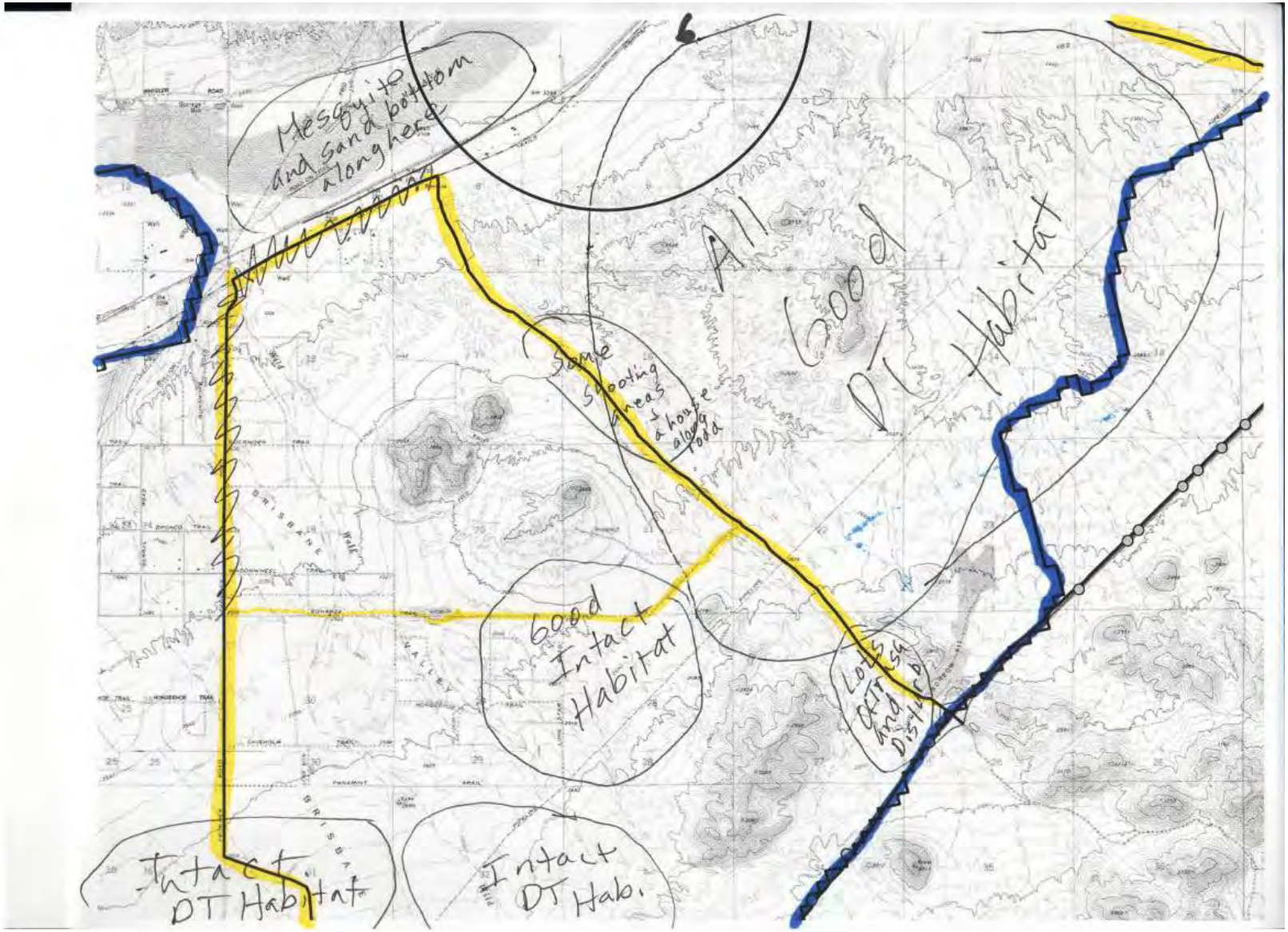
Map 2


3
SIDEWINDER VALLEY
SIDEWINDER VALLEY
Bell Mountain
Bell Mountain
Bell Mountain
Dist Through Veg Large Impact
Hill climbs
OHV
OHV

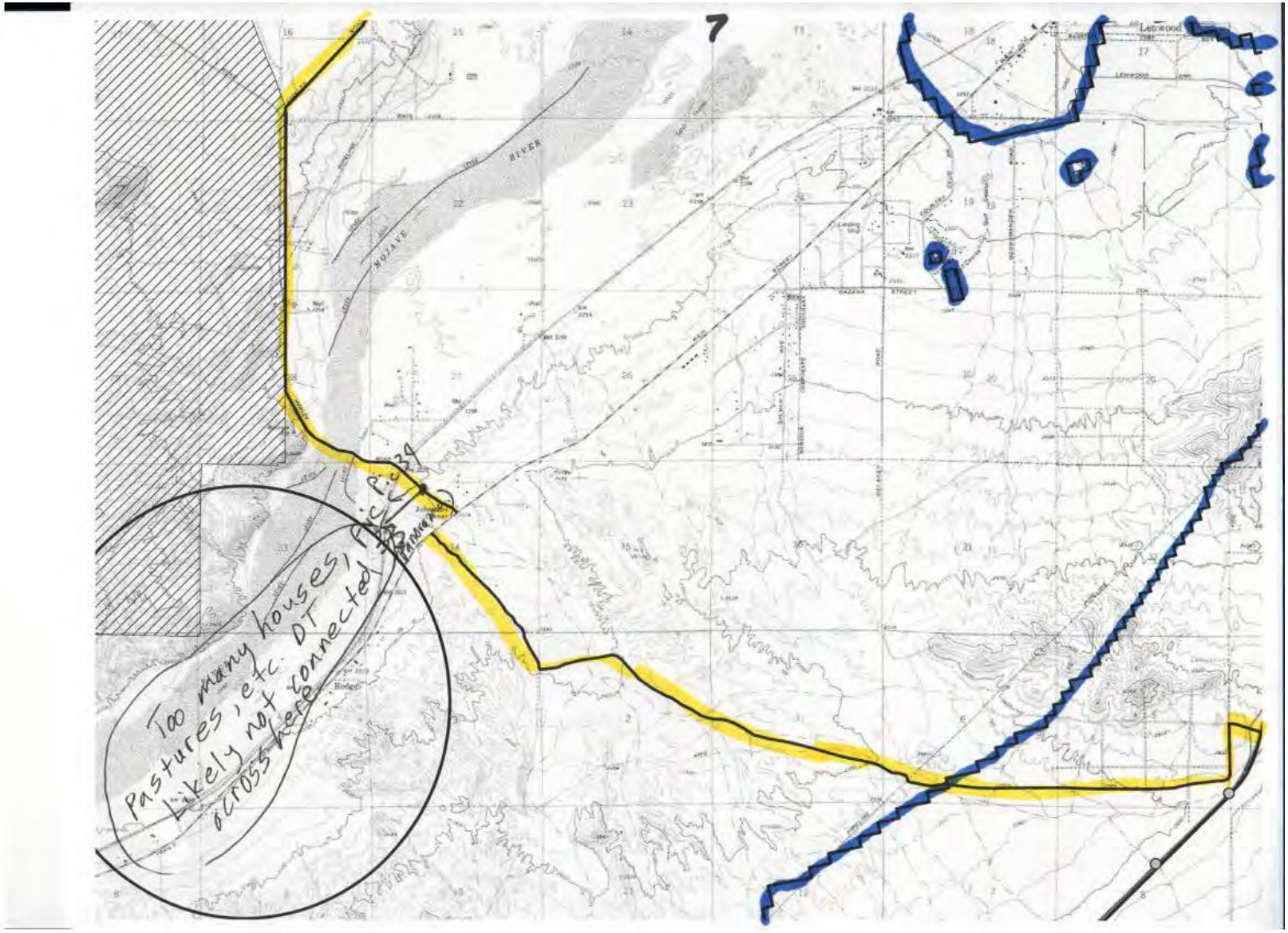
Map 3


5
Good DT Habitat
DT Habitat Frac
Pic 30 Panorama
Pic 31 Panorama
Large Disturbed area
Pic 28 Panorama
Lots of DIV Around GA
Good DT Habitat
Buffer Road
Pic 25 Wildhorse Bridge
Large Disturbed Area
Pic 27 Panorama
Trashed
Disturbance Get Horse Close to 15
OHV Staging area
Pic 23 (Panorama)
Pic 29
Scattered Housing Habitat Frac
Dist urbed Salary Trashed

Map 5

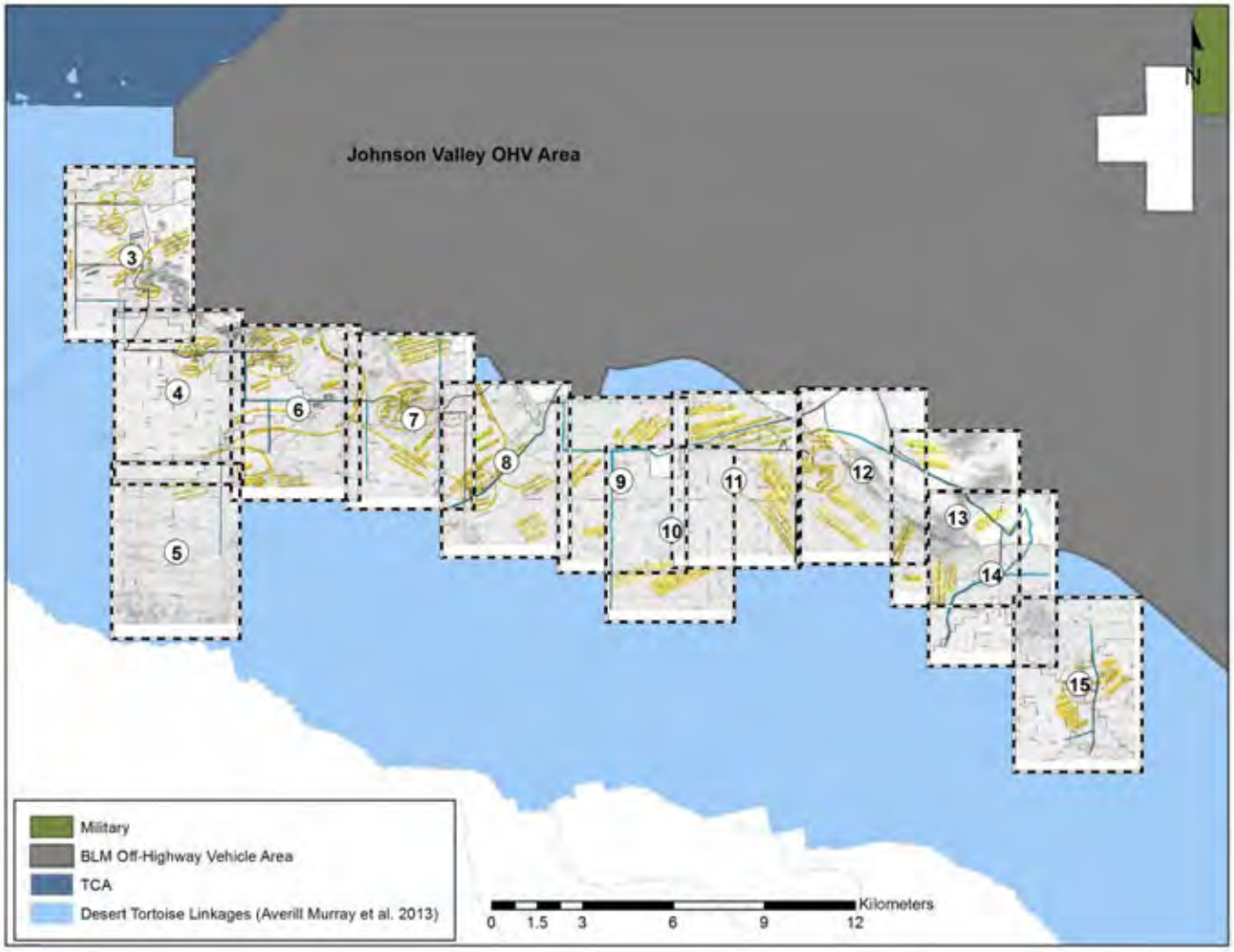

Mesquite and sand bottom along here
All Good DT Habitat
Some shooting areas
a house along road
Good Intact Habitat
Lots of ATV and Distrib
Intact DT Habitat
Intact DT Habi.

Map 6

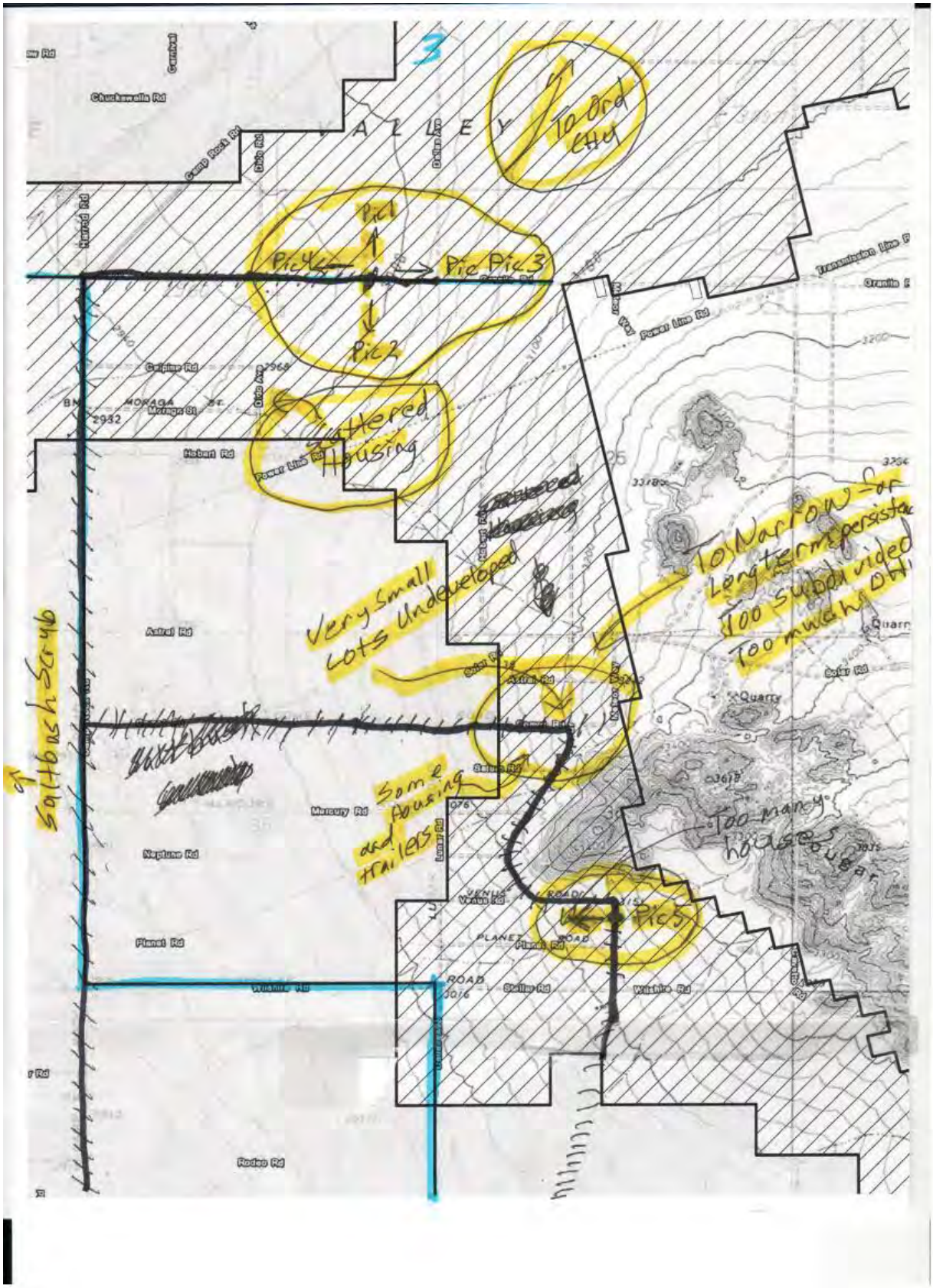

7
Leewood
RIVER
MOJAVE
Too many houses, pastures, etc. DT likely not connected across here

Map 7

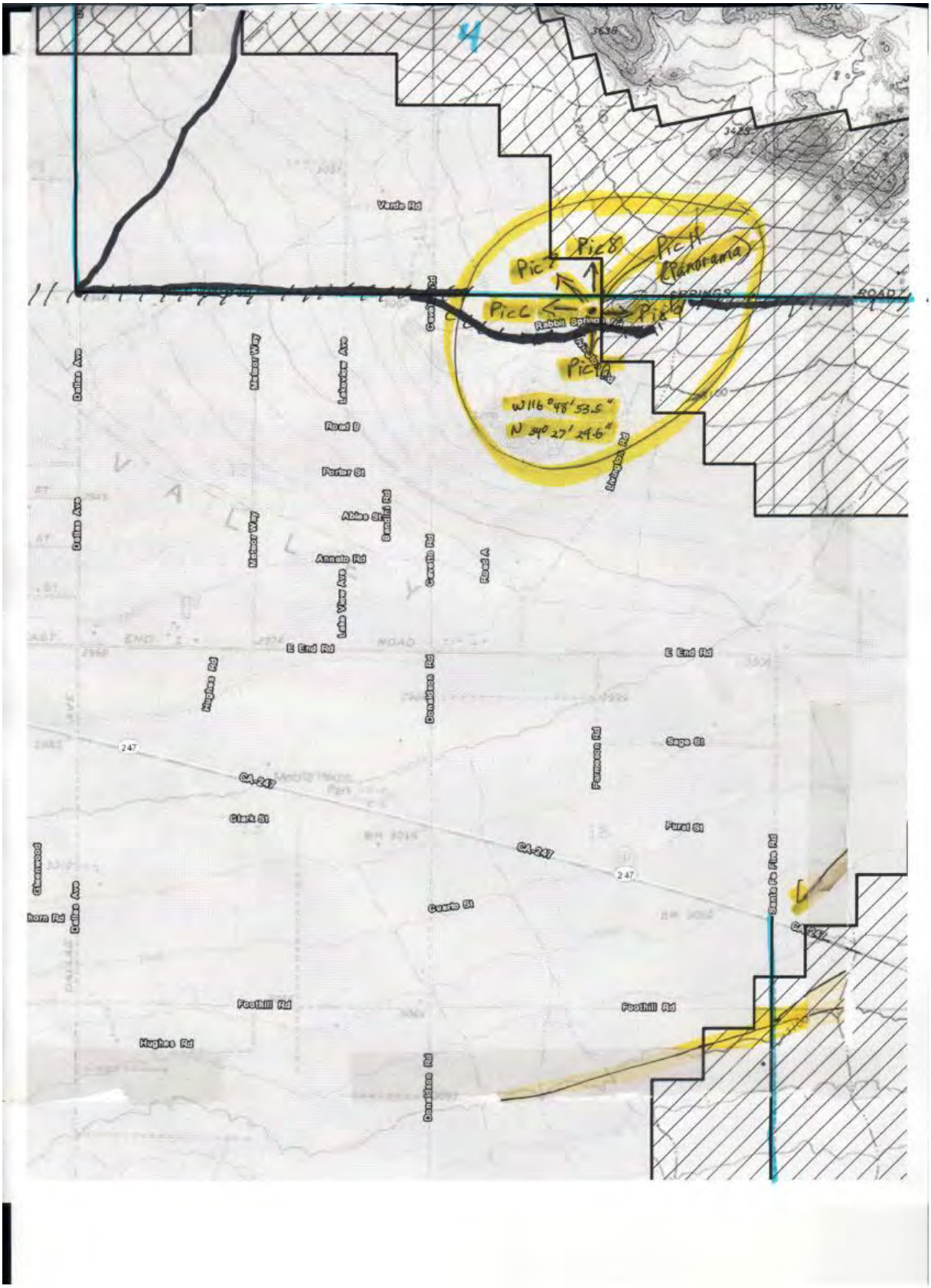
Field Reconnaissance Maps – Southern Johnson Valley and Lucerne Valley areas



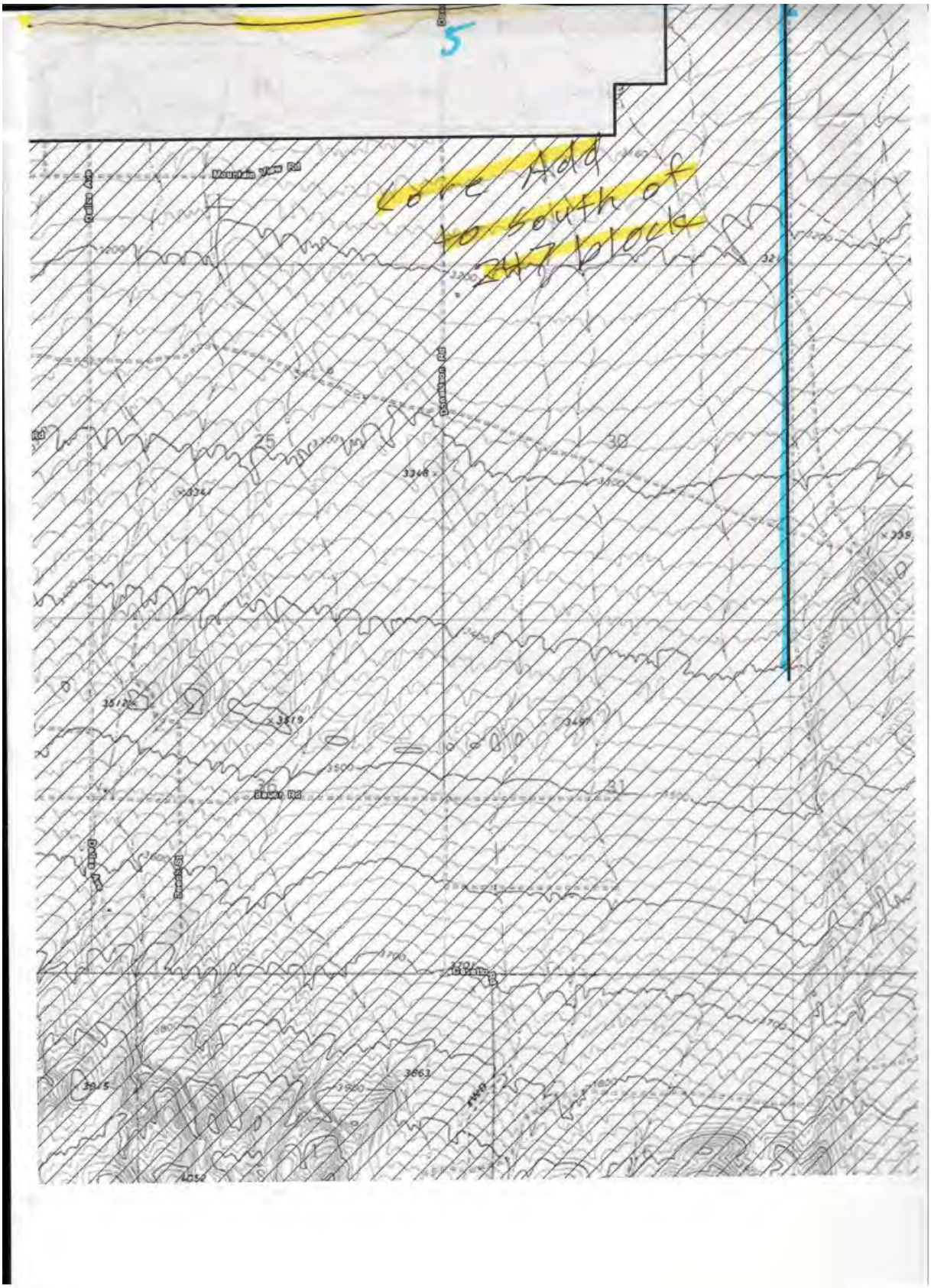
Key to Field Reconnaissance Maps – Southern Johnson Valley Area. Note that numbering is based on the field map numbers and is not sequential (e.g. Maps 1 and 2 are skipped because the area we were going to cover in Maps 1 and 2 was not visited)


3
VALLEY
To Ord CHU
Pic1
Pic4
Pic Pic3
Pic2
Scattered Housing
Very Small Lots Undeveloped
Too Narrow for Long term persistence
Too subdivided
Too much OHV
Some housing and trailers
Too many houses
Pic5
Chuckwalla Rd
Camp Rock Rd
Hatred Rd
Gilpin Rd
Hobart Rd
Astral Rd
Mercury Rd
Neptune Rd
Planet Rd
Rodeo Rd
Power Line Rd
Quarry
Southbound Scrub

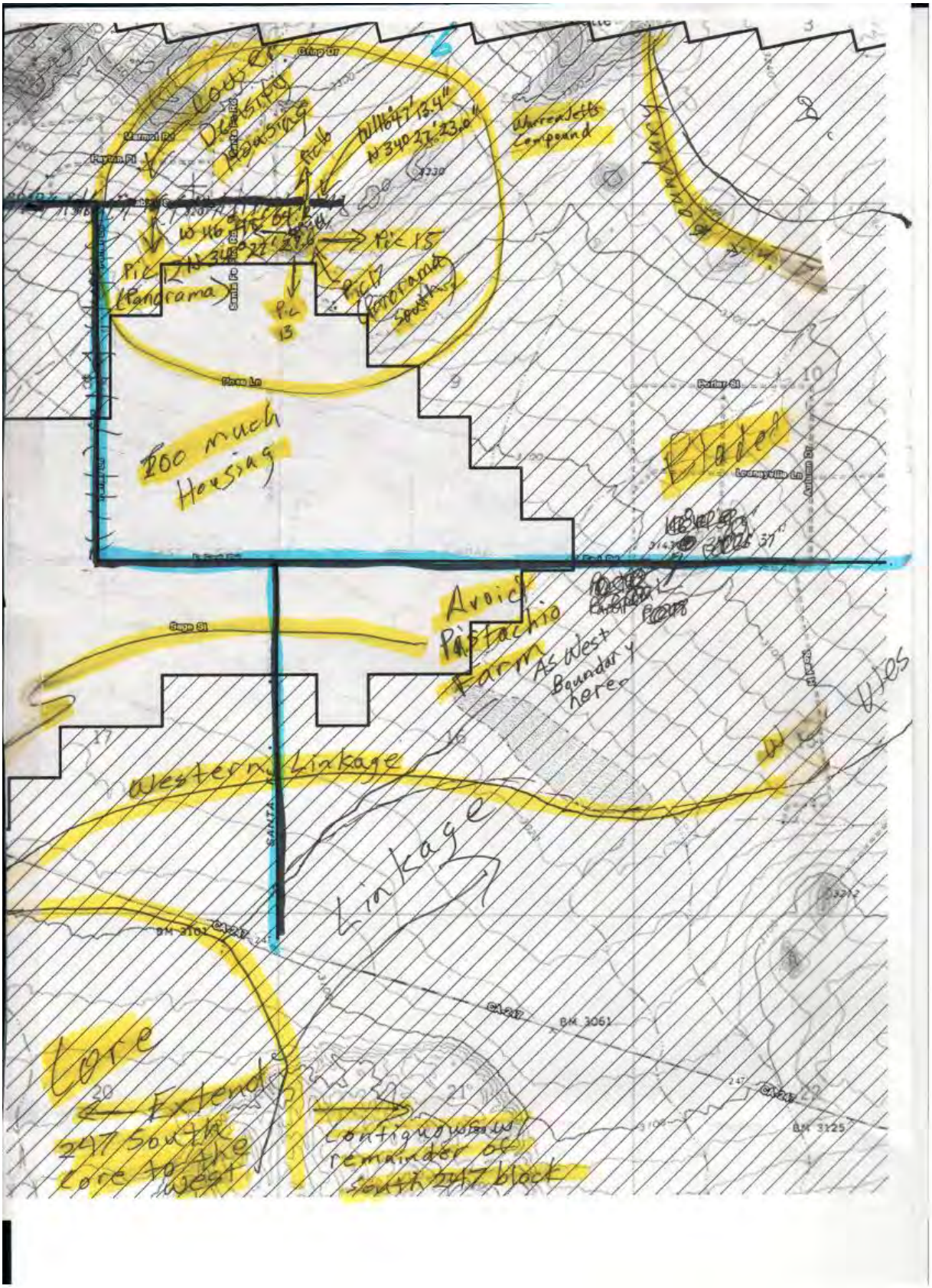
Map 3


4
Vando Rd
Pic7
Pic8
Pic11
(Panorama)
PicC
Pic9
Pic10
W116°48'53.5"
N 34°27'29.6"
Dallas Ave
Mohar Way
Lakeview Ave
Road B
Porter St
Abbas St
Annado Rd
Lake View Ave
Road A
E End Rd
Angelus Rd
Sage St
Pumacco Rd
Clark St
Purel St
Cuerto St
Foothill Rd
Hughes Rd
Santa Fe Flat Rd
CA-247
247

Map 4


5
Core Add
to south of
247 block
Mountain View Rd
Gulley Ave
Bonham Rd
Bowie Rd
25
30
3248
3319
3497
3663
3701

Map 5


Too much Housing
Avoid Pistachio Farm
As West Boundary here
Western Linkage
Linkage
Core
Extend 247 South
Core to the West
contiguous w/ remainder of south 247 block
Pic 15
Pic 17 (Panorama south)
Pic 13
Pic 12 (Panorama)
Warren Jetts Compound
Graded
Parker St
Loomyville Ln
Fage St
Place Ln
Carmel Rd
Santa Fe
BM 3061
BM 3125

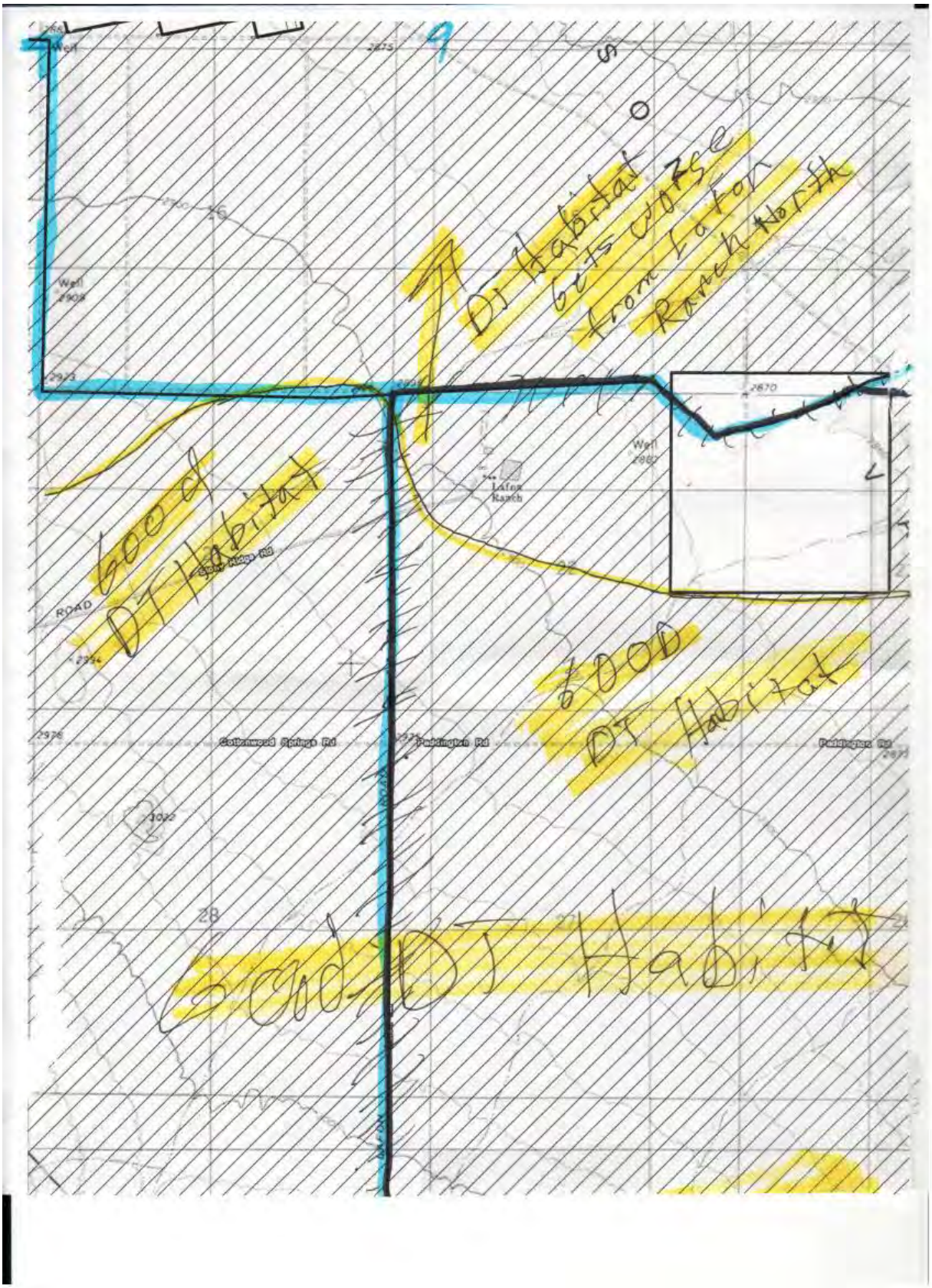
Map 6

Need to connect to Tortoise Concentration from HCABCC Surveys
Avoid Cougar Buttes Staging Area
Pic20
Pic21
Pic22
Pic23
Pic24
Pic16
Pic17
Panorama
Maximize link width (2.5 miles) & lifeline util. areas
Cimarron Rd
Cerbayo Ln
Furnace Rd
Sacto St
Dunn Rd
Gaskins Rd
Mine
BM 3141

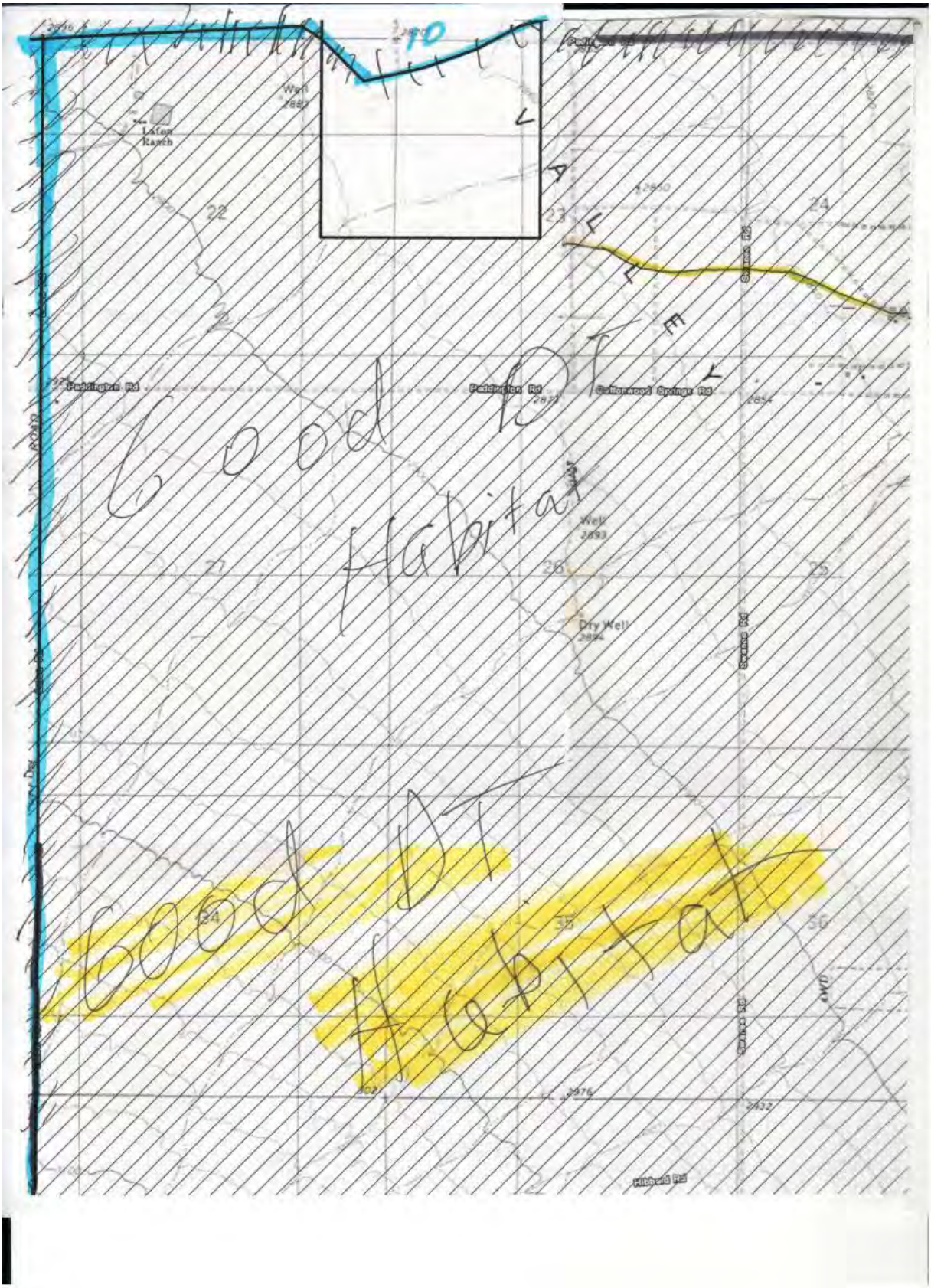
Map 7

Well
Forest St
Good DI Habitat
Trasked/Off in Buffer along Bessemer
Look at this Data
Bessemer as Western Boundary
Pic 26
116°49'61.6"
34°26'37.0"
Bessemer
Stony Ridge Rd
Cottonwood Springs Rd
STONY
RIDGE
Cottonwood Spring
BM 3149
Landing

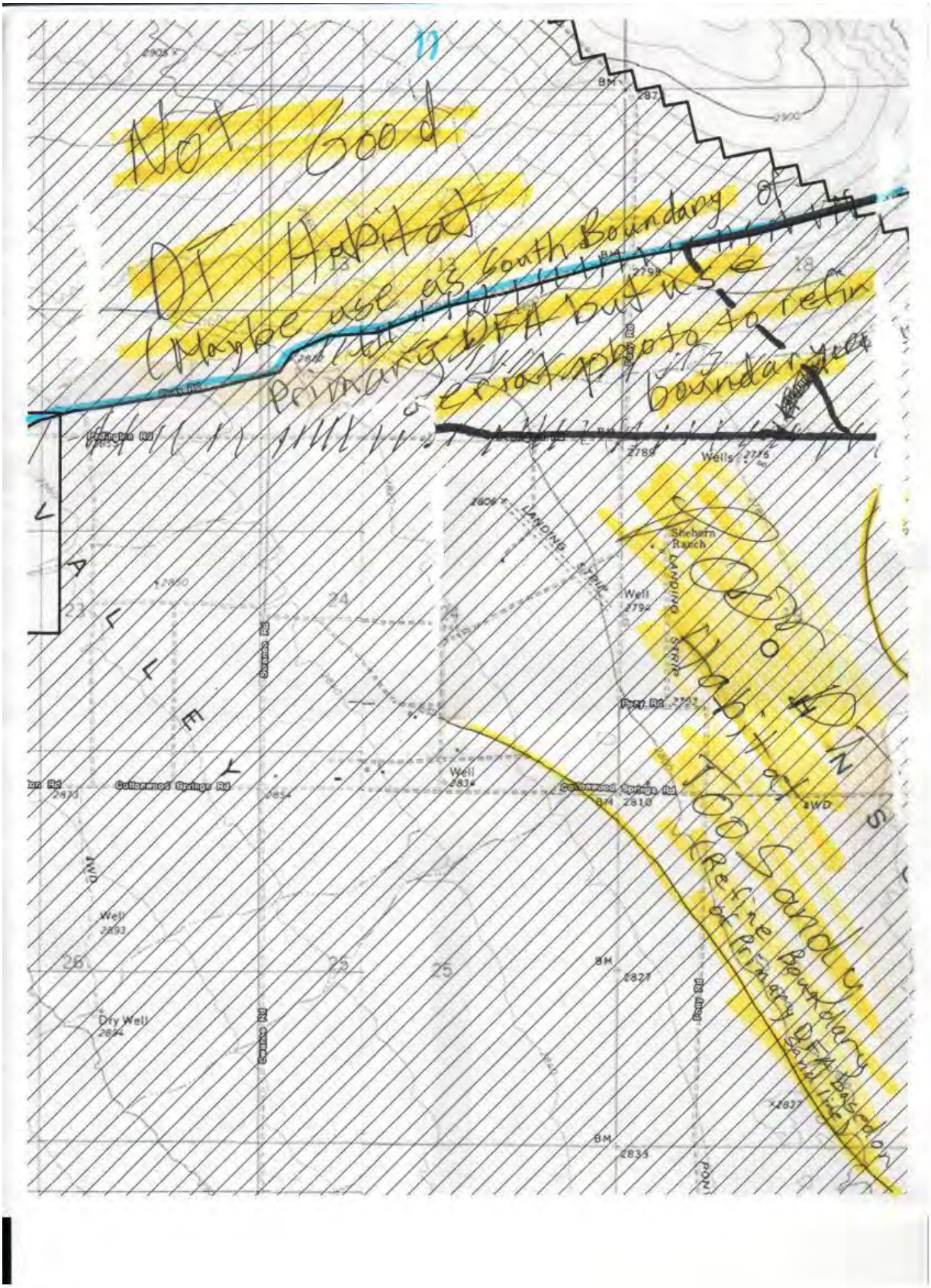
Map 8

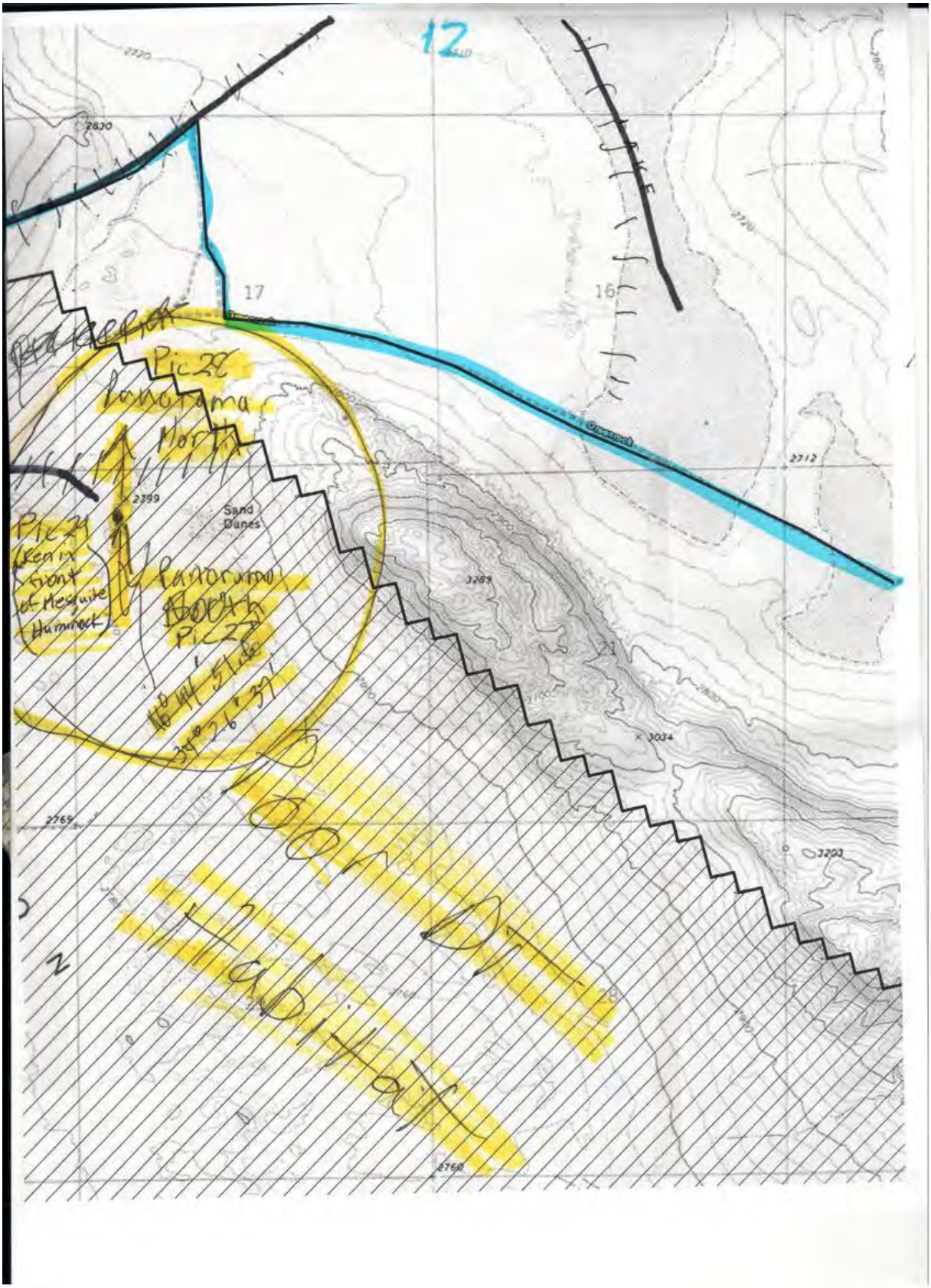

9
DT Habitat gets worse from Lafon Ranch North
Good DT Habitat
Good DT Habitat
Good DT Habitat
Lafon Ranch
Cottonwood Springs Rd
Paddington Rd
Well
ROAD
28

Map 9

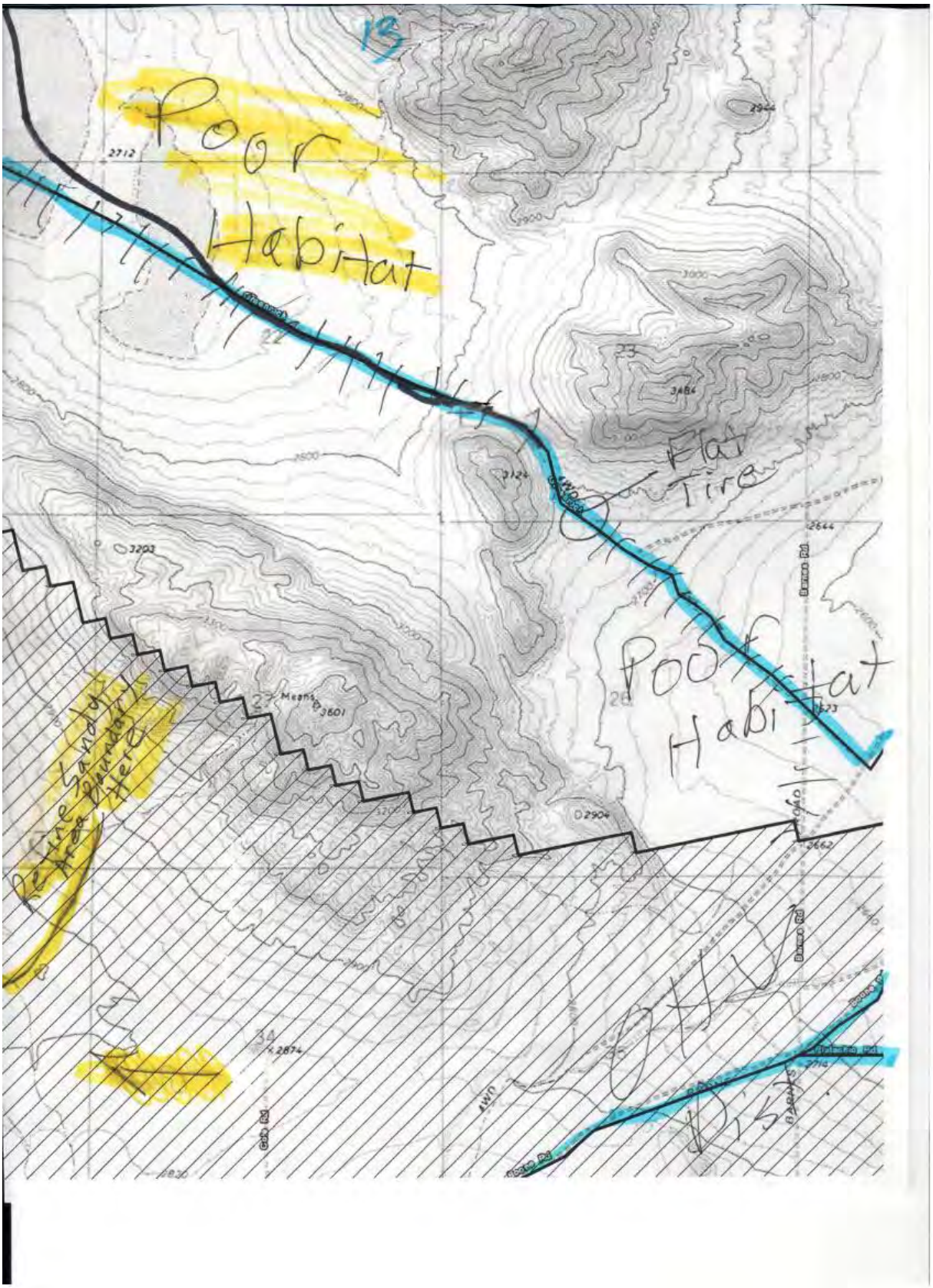

10
Well
Lafon Ranch
22
23
24
Paddington Rd
Paddington Rd
Cottonwood Springs Rd
Well
Dry Well
Springs Rd
Springs Rd
Hilliard Rd
Good Dr Habitat
Good Dr Habitat

Map 10

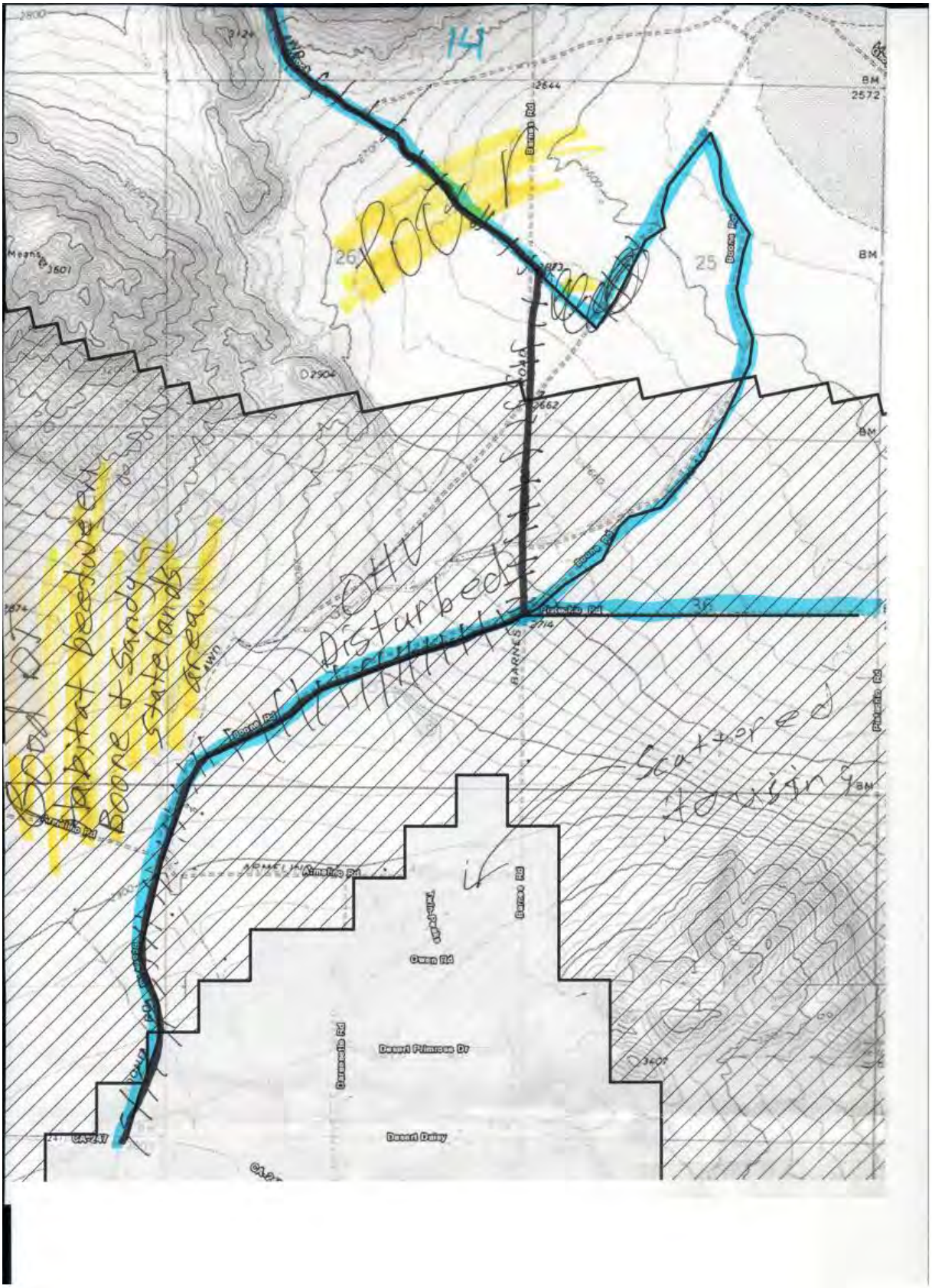

11
Not Good DF Habitat
(Maybe use as South Boundary of Primary DFA but use Ortho photo to refine boundary)
Good Habitat
100 Sound Refine Boundary based on Primary DFA Survey
Pierson Rd
Pierson Rd
Pierson Rd


12
17
16
Pic 22
Panorama
North
Pic 24
Panorama
South
Pic 23
Sand
Dunes
2799
2712
3269
3034
3203
2769
2760

Map 12


13
Poor Habitat
Flat Tire
Poor Habitat
Potential Landfill Area Here
Off Site
Mesa
Barron Rd
Gab Rd
UWD

Map 13


14
Poor
26
25
Good Habitat between Boone & Sandy State lands area
OHV Disturbed
Scattered Housing
Barnes Rd
Boone Rd
Amelia Rd
Ocean Rd
Desert Primrose Dr
Desert Daisy
Barnesville Rd
Pinyon Rd
BM
2572
2644
2714
2662
3601
2904
3407

Map 14

15
Wilsey Rd
Mustang Trl
100
Pic 3
116°29'46.6"
34°21'24.5"
Pic 2
Pic 1
Pic 30
Too
Joshua Tree Rd
Peach Tree
Sandoval Rd
Tow Rd
Zuno Rd
BM 3383
BM 3332

Map 15