CHAPTER 7 | SPATIAL IMPACTS

OVERVIEW

Many of the potential conflicts and benefits of the proposed solar facilities are spatial in nature. The location of a facility determines whether the benefits outweigh the costs, or vice versa. GIS can be used to understand the issues of siting solar facilities in the California desert. The spatial analyses we conducted allows for a visual and quantitative comparison across different variables, such as sensitive habitat and visual footprint, providing information and perspective that cannot be supplied by our other analyses.

Purpose of Spatial Analyses

We used spatial analyses to examine three potential development scenarios and the effects that these scenarios have on ecological and visual resources. The three potential development scenarios are:

1. Only proposed solar facilities labeled as "Fast Track" applications are built (10 projects total);
2. Only proposed solar facilities located in Solar Energy Study Areas (SESAs) are built (22 projects total);
3. All currently proposed solar facilities (as of March 2010) are built (54 projects total).

While it is unlikely that any of these three scenarios will manifest exactly as we analyzed them, they represent a wide range of possibilities that can be illustrative of likely impacts should any combination of facilities be built throughout the California desert landscape. The "Fast Track" application scenario was chosen because these applications are those that are most likely to be approved first, and may represent a first wave of development. The "SESA" application scenario was chosen because, pending adoption of the Solar PEIS, development will likely be actively promoted in these areas. The third scenario of full build-out of "All Proposed" facilities was chosen as a proxy for the maximum extent of development in the near future. In this analysis, facilities are identified using the serial number provided by the BLM because project names change fairly frequently whereas serial numbers do not. While results varied across individual facilities and the three scenarios, the SESA scenario and many individual SESA facilities were found to have the lowest ecological and visual impacts. A discussion of the analyses and results follow.

Ecological Impact Analyses

As discussed in Chapters 5 and 6, site engineering requirements, technological needs, and associated infrastructure could have significant impacts on site- and landscape-level ecology. To measure ecological impact, we conducted spatial analyses that would allow us to quantify the effects of solar development on California desert ecology and biodiversity:

- We utilized land management designations to identify and eliminate areas from our analysis that are legally incompatible or otherwise likely to conflict with solar development.
- We identified sensitive habitat using the presence of rare or endangered species.
- We used the distance of facilities to existing transmission lines and the slope of the proposed facility site as proxies for the amount of disturbance that a facility might have on the landscape.

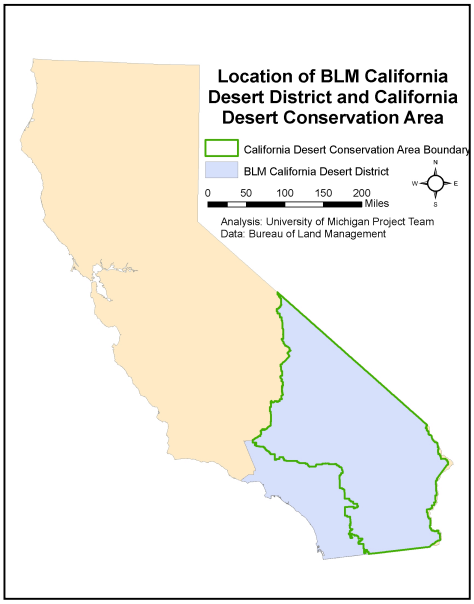
These three ecological impacts were analyzed separately because, for example, a score based on distance of a proposed facility to the nearest transmission line cannot be objectively compared to a score based on ecological impact. Therefore, layers were not added together to form a single analysis map. For the ecological impact analysis we analyzed 52 of the 54 proposed facilities. Two facilities, CACA 049490 and CACA 048728, are proposed for the same area and were only counted once. One facility, CACA 050379, is proposed for land that was excluded from our analysis by land management designation and so had no habitat calculations. In addition, facilities CACA 049490/048728 and CACA 050379 are all SESA facilities, so 20 out of 22 SESA facilities were analyzed for ecological impacts.

Visual Impact Analysis

The visual impact analysis sought to quantify how the construction of utility-scale solar facilities could affect the visual character of the California desert. The construction of multiple, utility-scale solar facilities, which can occupy several thousand acres and reach heights of 40 to over 600 feet, could have a significant impact on what the California desert landscape looks like. This is important because visual or scenic value is a defining characteristic of the desert and is important to residents and visitors alike. Significant changes to viewshed may be met by opposition from local residents. For example, attempts to install utility-scale wind power turbines off the coast of Cape Cod met strong resistance from local residents who were concerned about impacts that turbines would have on the view and indirectly on property values and quality of life.[1] Underscoring the importance of visual resources, the BLM is required to consider impacts to visual resources through an EIS under NEPA. We compared impacts to visual resources in the California desert under the three different development scenarios discussed above. For the visual impact analysis we analyzed 53 of the 54 proposed facilities. CACA 049490 and CACA 048728 are proposed for the same area and were only counted once. CACA 050379 is analyzed for visual impacts even though it was not analyzed in the ecological impact analysis. So, 21 out of 22 SESA facilities were analyzed for visual impacts.

Processing steps for all analyses can be found in Appendix E.

Study Area



Map 7.1 Spatial Analysis Study Area.

We used two different geographic boundaries for these analyses: the CDD and the CDCA (Map 7.1). The CDD is a BLM administrative area and is the functional unit for the management of the California desert ecosystem. It encompasses approximately the lower third of the State of California. The CDCA is the ecological boundary of the California desert landscape and represents the area where impacts from solar development could occur. Most data files were clipped to either the CDD or the CDCA depending on the type of data; because the CDD covers such a large area, data were sometimes clipped to the CDCA to reduce their file size. Both CDD and CDCA files were downloaded from the California State BLM GIS website (http://www.blm.gov/ca/gis). We used the North American Datum 1983 and Universal Transverse Mercator 11N projection for all data files.

Ecological Impact Analyses: Defining the Scope

We utilized land management designations to narrow the scope of our ecological impact analysis. By identifying areas that would conflict with solar development due to land management designations, we were able to define areas that are or should be excluded from solar development.

Data Sources

Publicly available data files were downloaded from the California State BLM GIS webpage (http://www.blm.gov/ca/gis/). These included wilderness areas, WSAs, national monuments, ACECs, and land ownership by agency, which was used to identify NPS, FWS, and DOD lands. Flat-tailed Horned Lizard Management Areas data were obtained directly from the El Centro Field Office. Critical habitat data files were obtained from the FWS critical habitat webpage. WSR data, which available on the California State BLM GIS website, were not used because all WSRs in the CDCA were designated after the last update of the data file, and are thus not included in the file. We were unable to obtain data files for Desert Wildlife Management Areas (DWMAs). Critical habitat for the desert tortoise was used instead, as DWMA boundaries generally correspond to desert tortoise critical habitat on BLM land in the CDCA. We were also unable to obtain data files for national trails, the Mohave Ground Squirrel Conservation Area, and areas with cultural or historic resources, so they are not included in this analysis. Data were gathered over the course of several months in late 2009 and early 2010. Any

updates that occurred to the data after a file was downloaded to represent a new or changed designation or a correction in the data file is not captured in the data we use in our analyses.

Excluding High Conflict Areas

We define "high conflict" areas as those areas that are or should be excluded from solar development. These include:

- Areas that are legally incompatible with solar energy development based on statute, regulation, or administrative designation.
- Areas that may be legally compatible, but where development of one or more solar facilities within such areas may hinder the ability for the BLM to manage the areas for their designated use.

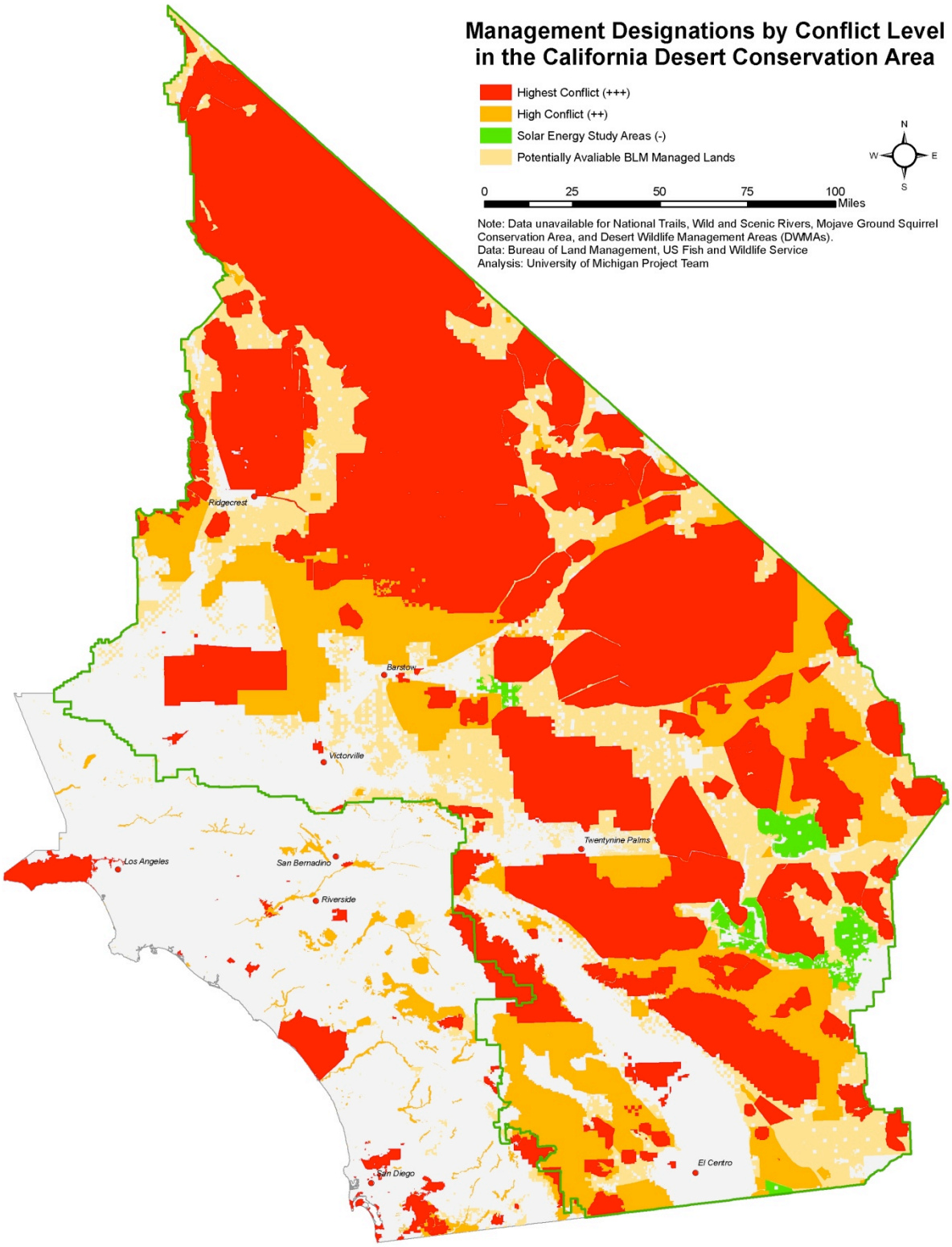
These high conflict areas include wilderness areas, WSAs, WSRs, national monuments, national trails, ACECs, DWMAs, critical habitat, special management areas, areas with cultural or historic resources, LTVAs, and OHV use areas (Table 7.1). Additionally, lands managed by the NPS, FWS, and DOD were included, as these lands are withdrawn from energy development (Map 7.2).[a] All other areas of BLM land in the California desert would thus be "potentially available", and these areas were chosen as the scope of our ecological impact analyses.

Table 7.1 BLM Land Management Designations with Conflict Ratings.

Designation	Conflict Level
Area of Critical Environmental Concern (ACEC)	++
Cultural and Historical Resources	++
Critical Habitat	++
Desert Wildlife Management Area (DWMA)	++
Long Term Visitor Area (LTVA)	+
National Monument	+++
National Trail	+
Off Highway Vehicle (OHV) Use Area	+
Solar Energy Study Area (SESA) (Under Solar PEIS)	-
Special Management Area	++
Wild and Scenic River (WSR)	+
Wilderness Area	+++
Wilderness Study Area (WSA)	+++

+++ designations of areas that are withdrawn from energy development or otherwise legally prohibit it. ++ areas of high conflict that may technically allow some level of surface disturbance, but where a solar facility may fill or breach any such cap or otherwise limit the ability of the BLM to manage the land for its designated purpose. + areas that may not have a limit on development or legal exclusion of energy development, but where energy development may preclude BLM from managing the area for its designated purpose. - areas specifically designated to be compatible with utility-scale solar development, though some site-level conflicts may still exist.

[a] Note: DOD may allow energy development on their lands if all the energy produced is used on DOD land. It has yet to be determined if energy development for sale to the grid is considered an authorized military use on BLM lands withdrawn for military purposes, which constitute many of the DOD lands in the California Desert.



Map 7.2 Management Areas by Conflict Level in the CDCA.

Results

After removing wilderness areas, WSAs, National Monuments, ACECs, critical habitat, and Flat-tailed Horned Lizard Management Areas, we determined that there are 4,299,064 acres of BLM land that are potentially available for solar development. Had we been able to access appropriate data for WSRs, National Trails, and Mohave Ground Squirrel Conservation Areas, this number would be smaller. We then determined the percent of potentially available BLM land that would be developed under the three development scenarios (Table 7.2). Under the Fast Track scenario, 1.15 percent of potentially available BLM lands would be developed. Under the SESA scenario, 4.26 percent would be developed, and 10.74 percent would be developed under the All Proposed scenario.

Table 7.2 Percent of Potentially Available BLM Acres Developed Under Three Development Scenarios.

Scenario	Acres of BLM Land Developed for Solar Production	Percentage of Potentially Available BLM Acres
Fast Track Facilities	49,441	1.15
SESA Facilities	183,251	4.26
All Proposed Facilities	461,890	10.74
Total Potentially Available BLM Land = 4,299,064 acres		

Ecological Impact Analyses: Sensitive Habitat

We sought to devise a method that would allow us to quantify the effects of solar development on California desert ecology and biodiversity. Because quantifying all potential ecological impacts, such as impacts to all landscape-level ecological processes or impacts to individual species, was neither practical nor feasible, the replacement of rare or endangered species habitat by solar development was used as an indicator for other potential ecological impacts. The effect of solar development on these habitats is just one of the possible ecological impacts. By developing a numerical scoring system that corresponds with established classification systems, we were able to quantify the ecological impact of individual facilities and each development scenario on rare or endangered species habitat.

Data Sources

We utilized the California Natural Diversity Database (CNDDB), a database managed by the DFG. The CNDDB compiles the status and locations of rare plants and animals for the entire state of California.[2] Rare or endangered species and communities in the CNDDB are referred to as “elements,” and an “element occurrence” is a site which contains a population of an “element.”[3] The data are not systematic surveys of the state, but instead are provided to the CNDDB by independent researchers, federal land management agency biologists (e.g. BLM, USFS), other agency biologists, biological consultants, and others.[4] Therefore, the CNDDB (and consequently our analysis) cannot be considered comprehensive because it is subject to a number of inherent limitations. Note that while the CNDDB

contains species data for the entire State of California, our analysis was limited to species within the CDCA.

Potential general limitations:

- Charismatic megafauna might be more heavily surveyed.
- Data availability is weighted heavily towards areas that are of particular interest to researchers (e.g. national parks and certain ecosystem types).
- Data availability is dependent on researchers knowing about the CNDDB and choosing to share their survey data.
- Private land might not be well surveyed due to issues of access to land for research.

Potential desert-related limitations[5]:

- Most botanical surveys are conducted in the spring in favored wildflower areas. Plants that grow or flower at other times of year are not well-surveyed.
- Old collection data might need to be re-surveyed to determine if species are still present.
- Surveys tend to occur on lands scheduled for some type of land use change, leaving many natural areas under-represented in the CNDDB.
- Once areas are developed or an area is degraded, usually no follow-up survey is conducted. Species may no longer be present in areas that have been developed, but have not been removed from the database.
- Survey data may be concentrated around roads since those areas are easier to access.
- Large areas have not been surveyed.

We acknowledge that the data used to create this tool is far from complete. It has been impressed upon us by several interviewees[6] that the desert is not well-studied relative to other ecosystems and that current and/or complete data is sorely lacking. Nevertheless, we believe that the overall results are useful even with these data issues and hope that users will take the following ideas and associated techniques, and expand on them to improve the accuracy and completeness of analysis.

Classification Systems

We utilized established classification systems to determine the sensitivity of habitat to development. Established classifications systems have proved useful in determining conservation priorities. Of the attributes provided with each CNDDB element occurrence, we decided that Global Rank, State Rank, listing under the Endangered Species Act (ESA), listing under the California State Endangered Species Act (CESA), and listing under the California Native Plant Society (CNPS) List would best capture how sensitive a species would be to anthropogenic disturbance. These scores were used as proxies for sensitive habitat, under the assumption that the more rare or endangered the species, the more likely it is that the species would be sensitive to habitat disturbance from solar development.

Global Rank and State Rank

Global Rank and State Rank are classifications used by NatureServe, a non-profit conservation organization that works with its network of natural heritage programs to provide information about rare and endangered species and threatened ecosystems.[7] Both Global Rank (GRank) and State Rank (SRank) are conservation status ranks that are assessed and determined by NatureServe scientists and its collaborators.[8] GRank uses a numbered status rank, 1 to 5, to reflect a species' risk of extinction. These numbered ranks include:

1 = critically imperiled
2 = imperiled
3 = vulnerable
4 = apparently secure
5 = secure

GRank refers to a species "global" status, while SRank refers to a species' status within a particular state or province.[9] These different geographic focuses can result in different GRank and SRank for a particular species. For example, the desert tortoise (*Gopherus agassizii*) has a GRank of G4, but in California it has a SRank of S2.

State Ranks in California are comprised of two parts. The number directly following the "S" indicates the number of element occurrences, individuals, or habitat; the number after the decimal is a threat designation. The first numbers indicate the following:

S1 = Less than 6 element occurrences OR less than 1,000 individuals OR less than 2,000 acres
S2 = 6 to 20 element occurrences OR 1,000 to 3,000 individuals OR 2,000 to 10,000 acres
S3 = 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 10,000 to 50,000 acres
S4 = Apparently secure within California, but there is some threat or somewhat narrow habitat
S5 = Demonstrably secure to ineradicable in California

The threat designations are the following:

0.1 = very threatened
0.2 = threatened
0.3 = no current threats known

The ranks S4 and S5 do not have a threat ranks associated with them. For the purposes of this study, we will refer to "element occurrences" of a species as "sensitive habitat" of a species from here onward.

Federal Endangered Species Act

The ESA is the primary species protection law in the nation. The stated purpose of the act is the "protect and recover imperiled species and the ecosystems on which they depend."[10] Under the ESA,

which lists both plants and animals, species may be listed as "Endangered" (the species is in danger of extinction throughout all or a significant portion of its range) or "Threatened" (the species is likely to become endangered within the foreseeable future).[11] The following categories are used in the CNDDB:

1. Federally listed as Endangered
2. Federally listed as Threatened
3. Proposed for federal listing as Endangered
4. Proposed for federal listing as Threatened
5. Candidate for federal listing
6. Species of Concern
7. None – no federal status
8. Delisted – previously listed

California State Endangered Species Act

The CESA generally follows the main provisions of the Federal ESA.[12] Under the CESA, which lists native plants and animals, a species can be listed as "Endangered" (a species or subspecies in serious danger of becoming extinct throughout all or a significant portion of its range),[13] "Threatened" (a species or subspecies not presently threatened with extinction but is likely to become an endangered species in the foreseeable future in the absence of special protection and management),[14] "Rare" (a species or subspecies not presently threatened with extinction, but is in such small numbers throughout its range that it may become endangered if its present environment worsens),[15] "Candidate" (a species or subspecies that is under review by the California Department of Fish and Game for listing).[16] The following categories are used in the CNDDB:

1. State listed as Endangered
2. State listed as Threatened
3. State listed as Rare
4. Candidate for state listing
5. None – no state status
6. Delisted – previously listed

Listing under the ESA is not a prerequisite for listing under the CESA, and vise-versa. A species may have a different listing category under each Act.

California Native Plant Society

The CNPS is a statewide non-profit organization that seeks to increase understanding of and preserve California's native flora for future generations.[17] The CNPS tracks the conservation status of hundreds of rare and endangered plant species in California and shares this information with the CNDDB.[18] Species undergo a rigorous, science-based review process before being placed on the CNPS *Inventory of*

Rare and Endangered Plants of California; the *Inventory* is widely regarded as the standard for information on the rarity and endangerment status of plants in California.[19] List categories include:

1A = Plants presumed extinct in California

1B = Plants rare, threatened, or endangered in California and elsewhere; AND

- 1B.1 = …seriously threatened in California
- 1B.2 = …fairly threatened in California
- 1B.3 = …not very threatened in California

2 = Plants rare, threatened, or endangered in California, but more common elsewhere; AND

- 2.1 = …seriously threatened in California
- 2.2 = …fairly threatened in California
- 2.3 = …not very threatened in California

3 = Plants about which we need more information

- 3.1 = …seriously threatened in California
- 3.2 = …fairly threatened in California
- 3.3 = …not very threatened in California

4 = Plants of limited distribution

- 4.1 = …seriously threatened in California
- 4.2 = …fairly threatened in California
- 4.3 = …not very threatened in California

Limitations of Established Classification Systems

Despite the fact that all five of these classification systems are well-established, relied upon methods for assessing a species' level of rarity or endangerment, they still face some limitations. Population estimates and trends for many species remain unstudied or have not been updated in many years, resulting in an inaccurate or unspecified assessment of rarity or endangerment. The ESA or CESA lists may be disproportionately weighted towards charismatic megafauna or inherently biased towards species that have social and cultural value, not necessarily biological value.[20] This is not to say that these classification systems should not be used, but that users need to be aware of the potential limitations of this tool.

Creating a Scoring System

Each classification system (GRank, SRank, ESA, CESA, CNPS) was assigned a numerical scoring system on a scale of 0-60, with a score of 0 reflecting low sensitivity and a score of 60 reflecting high sensitivity. For example, a GRank of "G1" was given a score of 60 while a GRank of "G5" was given a score of 20. For GRank and SRank, species were occasionally given two ranks (such as "G3G4") in which case the average numerical score was taken. For a full list of all the numerical scores given to each classification system see Appendix E3.

Species in the CNDDB were given scores under each of the five classification systems. For example, the Coachella Valley fringe-toed lizard (*Uma inornata*) is rated at G1 (critically imperiled globally) under the GRank classification system and was given a score of 60. The lizard also was given scores under the SRank, ESA, and CESA classification systems: 30, 50, and 60 respectively. Since only plants are scored under the CNPS system, the lizard was given a score of zero. In the map created for the GRank classification system, the lizard's habitat was given its score of 60. In the SRank map, those same areas of land were given its SRank score of 30. The same method was used for the ESA, CESA, and CNPS maps.

A map of numerical scores was created for each individual classification system: GRank (Map 7.3), SRank (Map 7.4), ESA (Map 7.5), CESA (Map 7.6), CNPS (Map 7.7). Where habitat of multiple species overlapped, the numerical scores were added together. Natural breaks in the resulting scores were used to categorize sensitive habitat into different colors on the maps. Areas with a high concentration of overlapping sensitive habitat had higher numerical scores. An example of overlapping habitat is provided by Figure 7.1.

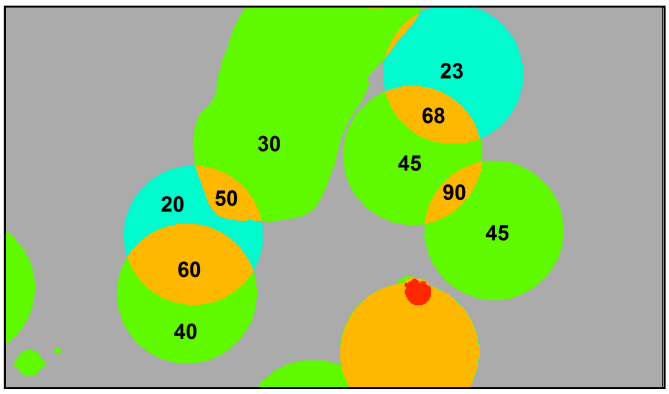
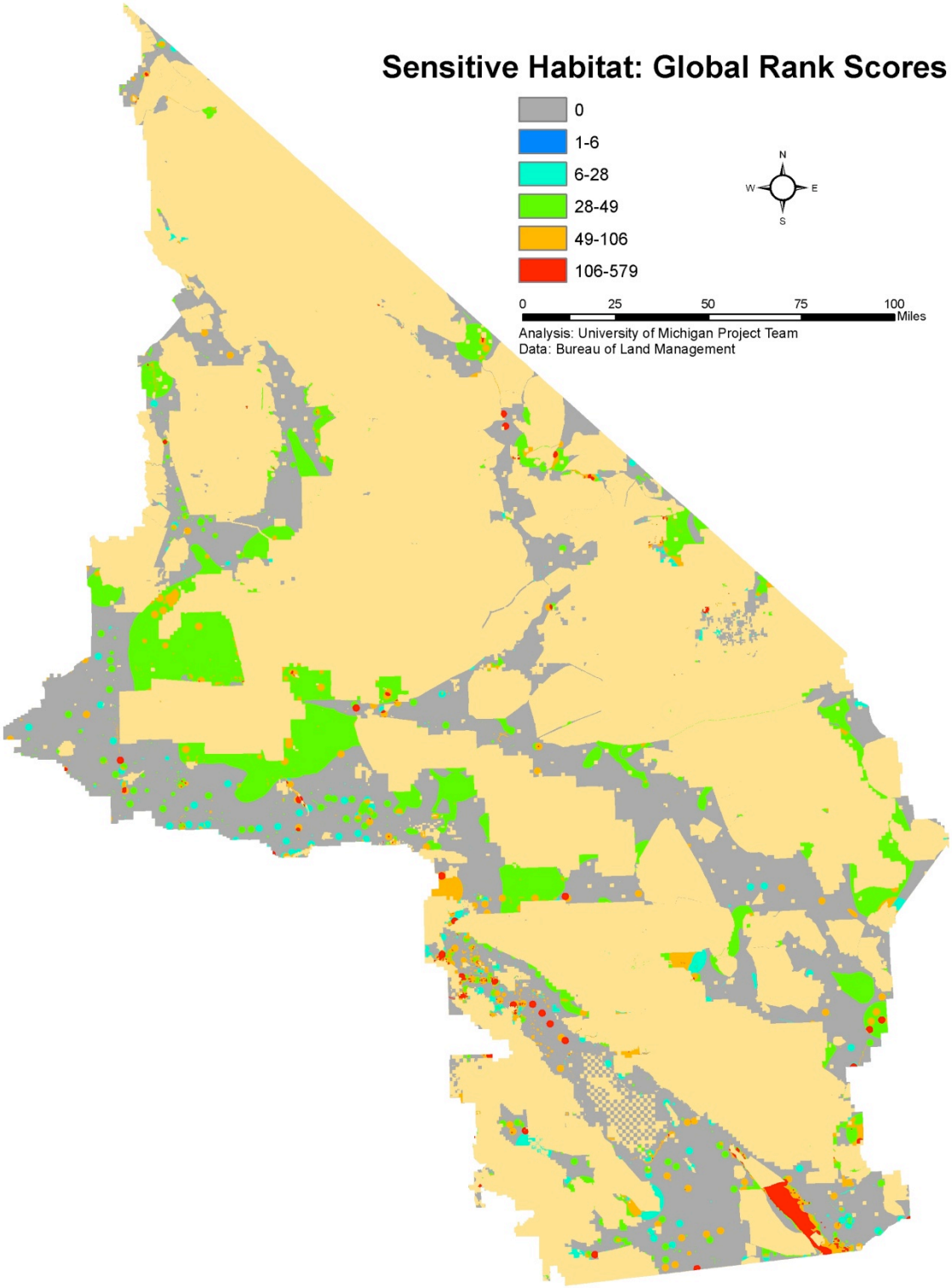
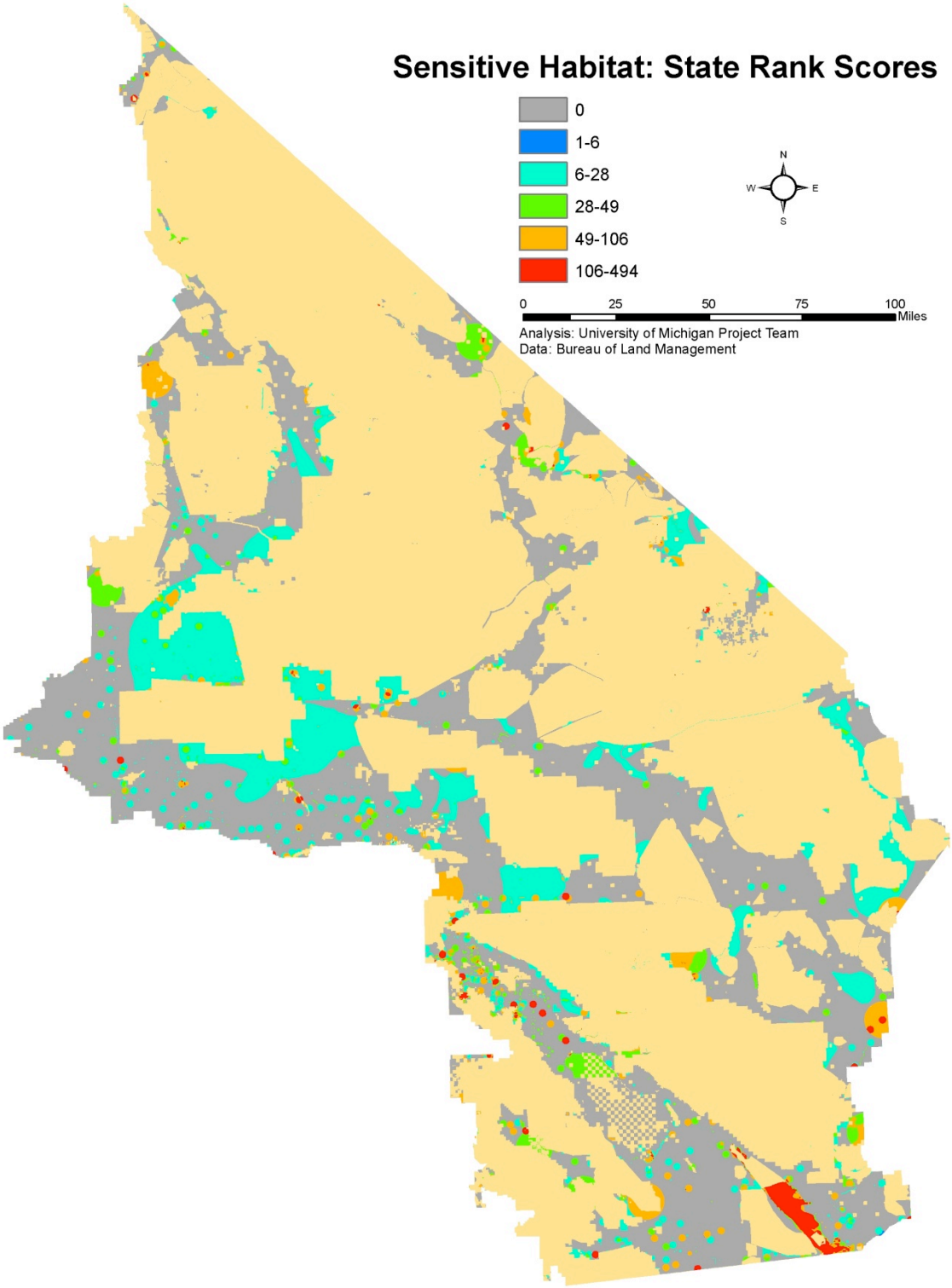


Figure 7.1 Close-Up of the GRank Map with Labeled Habitat Scores.

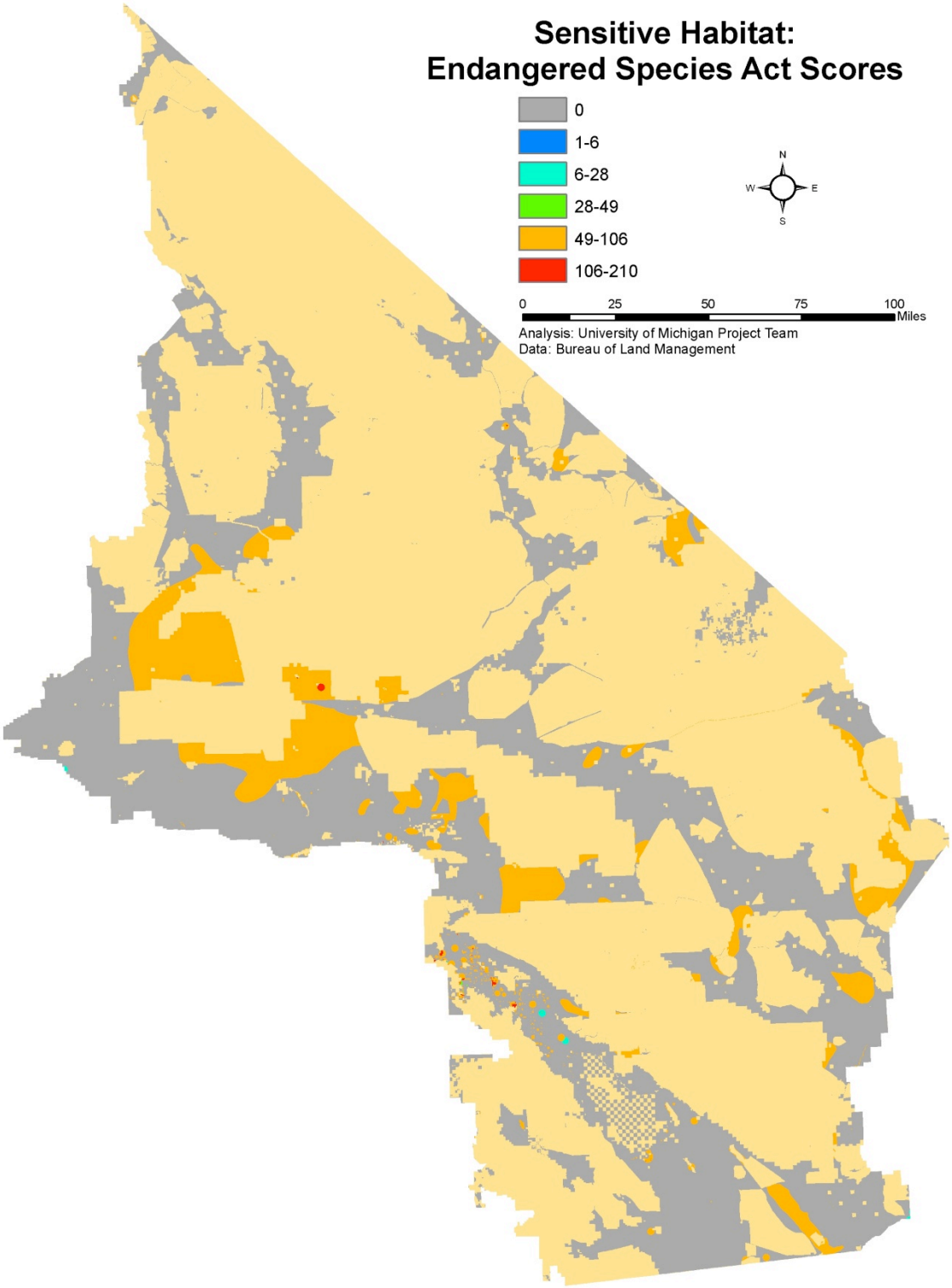
The circles and large, irregular green shape in Figure 7.1 indicate the habitat of several different species. In this figure, the gray areas have a score of zero, dark blue areas have scores of 1 to 6, light blue areas have scores of 6 to 28, green areas have scores of 28 to 49, orange areas have scores of 49 to 106, and red areas have scores higher than 106. Where two green circles, each with scores of 45, overlap the resulting score is the sum, 90. Overlapping species habitats are prevalent throughout our study area, as seen in Maps 7.3 to 7.7.



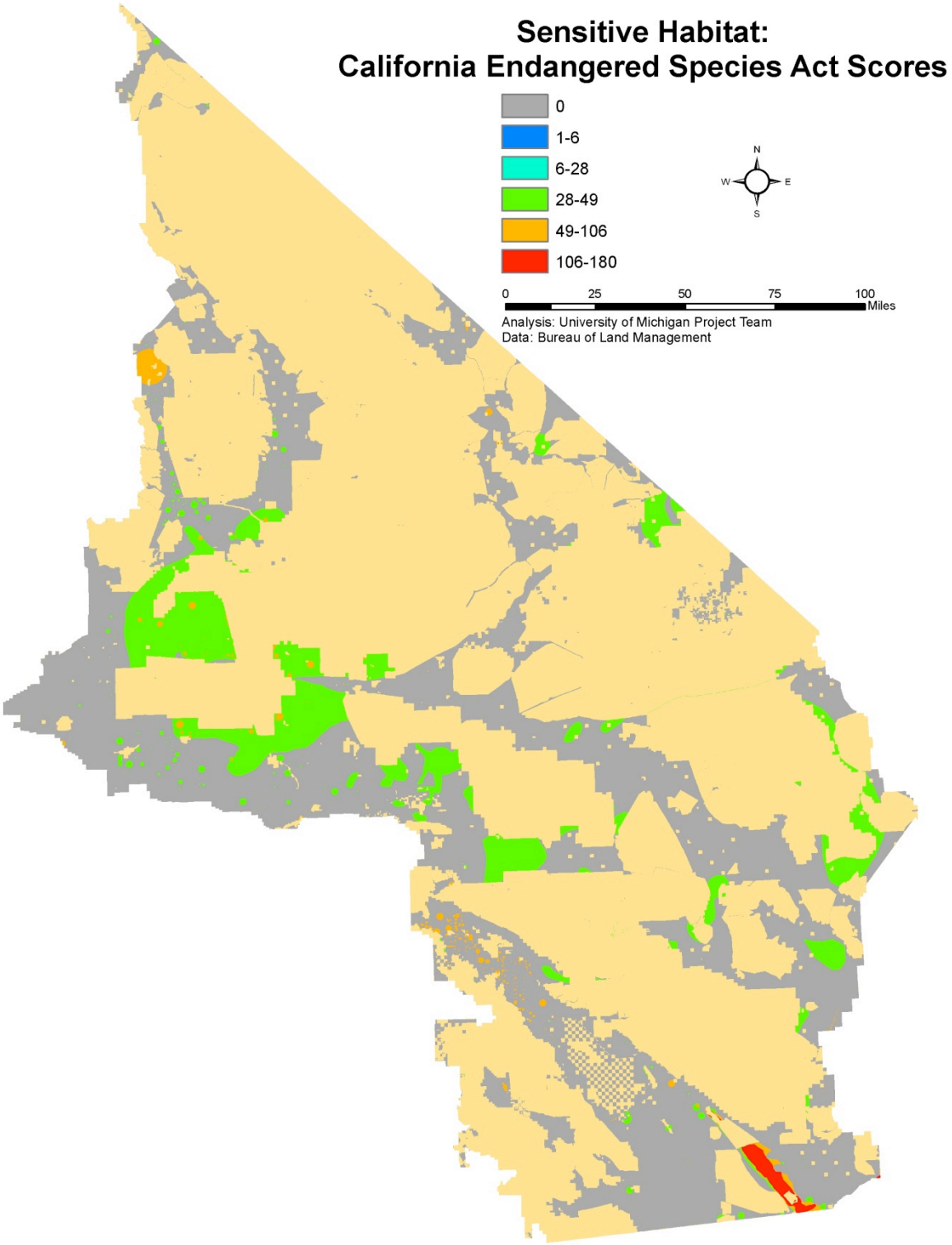
Map 7.3 Sensitive Habitat: Global Rank Scores. Tan areas represent excluded land.



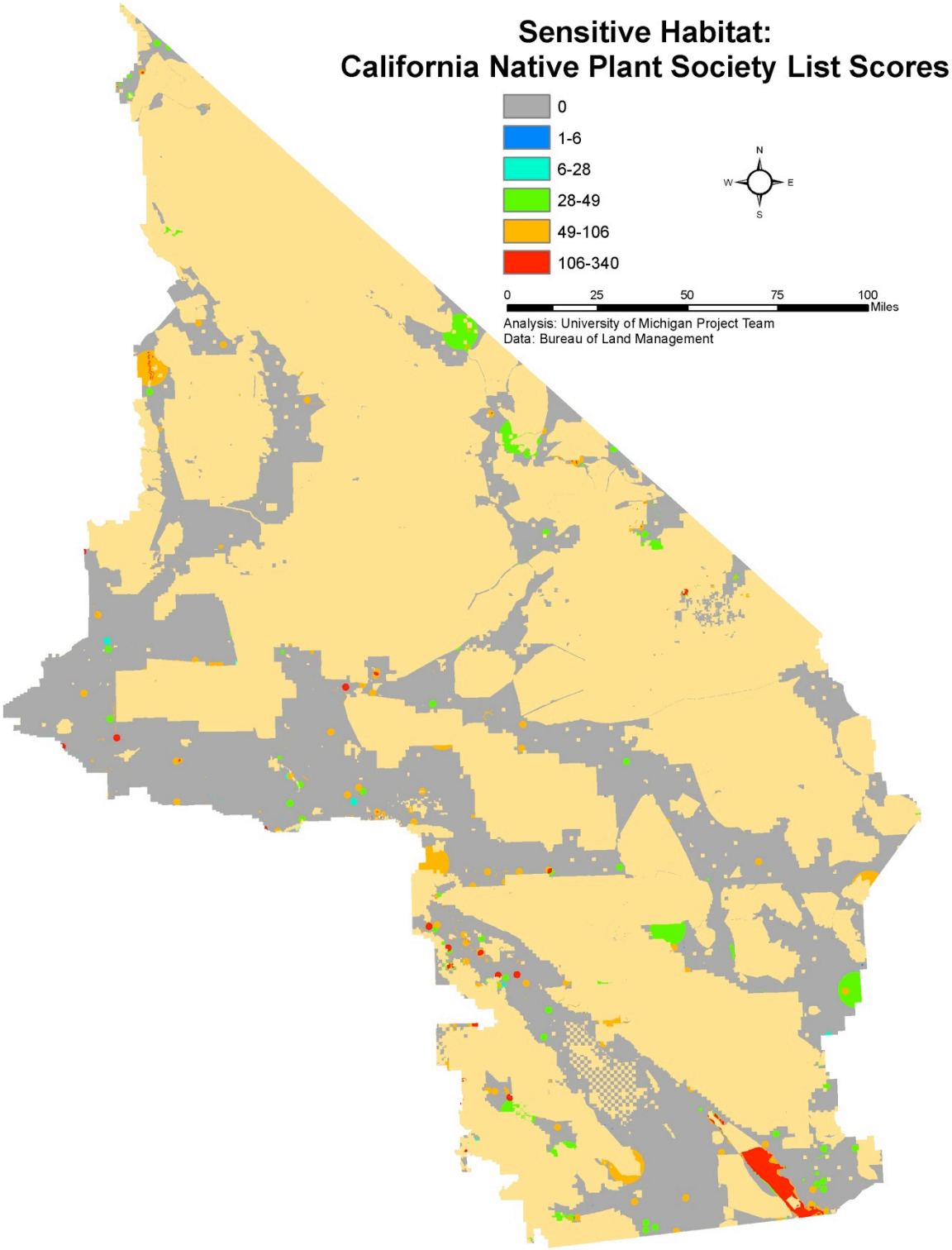
Map 7.4 Sensitive Habitat: State Rank Scores. Tan areas represent excluded land.



Map 7.5 Sensitive Habitat: Federal Endangered Species Act Scores. Tan areas represent excluded land.



Map 7.6 Sensitive Habitat: California Endangered Species Act Scores. Tan areas represent excluded land.



Map 7.7 Sensitive Habitat: California Native Plant Society List Scores. Tan areas represent excluded land.

Results

General Habitat Impacts

With our first analysis, we were interested in the number of facilities that would have an effect on sensitive habitat and how much sensitive habitat would be affected by individual facilities. We compared the area of land within a facility that had a score of zero (indicating the absence of sensitive habitat) to the area within a facility that had a score greater than zero (indicating the presence of rare or endangered species habitat). If all of the land within a facility had a score of zero, the facility would not affect sensitive habitat, while scores other than zero within the facility boundary indicated that the facility would affect sensitive habitat. Of the 52 proposed facilities, we found that 31 of the facilities affected sensitive habitat, while 21 of the facilities had no effect on sensitive habitat (Table 7.3). The amount of sensitive habitat for each facility ranged from zero percent of the facility (no sensitive habitat was contained by that facility) to 100 percent (the entire facility area contained sensitive habitat). Table 7.3 lists the percent of sensitive habitat within a facility and the number of facilities that contain that proportion of habitat.

Table 7.3 Percent of Sensitive Habitat within a Facility.

Percent of Sensitive Habitat	Number of Facilities
0	21
>0 to 10	12
>10 to 20	5
>20 to 30	4
>30 to 40	3
>40 to 60	0
>60 to 80	2
>80 to 100	5

Of the 52 facilities, 21 of the facilities contained no sensitive habitat. For 12 facilities, 10 percent or less of the facility area contained sensitive habitat. For 12 facilities, 11 to 40 percent of the facility area contained sensitive habitat. For 7 facilities, over 60 percent of the facility area contained sensitive habitat.

We also examined the amount of sensitive habitat that would be affected by each of the three solar development scenarios relative to the total number of acres that would be developed in each scenario. Acres of sensitive habitat were added up for each scenario to give a total number of sensitive habitat acres affected (Table 7.4). Acres of sensitive habitat were divided by the total number of developed acres to determine percent of sensitive habitat affected by each scenario.

Table 7.4 Percent of Habitat Affected by Three Development Scenarios.

	Acres of Sensitive Habitat	Total Facility Acres	Percent of Sensitive Habitat
Fast Track	9,338	49,442	18.89
SESA	20,303	187,025	10.86
All Proposed	56,871	461,990	12.31

Of the three scenarios, the Fast Track scenario had the largest relative impact, with sensitive habitat occupying 18.89 percent of land in the scenario. The All Proposed scenario had the second largest relative impact with sensitive habitat occupying 12.31 percent of land in the scenario, and the SESA scenario had the smallest relative impact with sensitive habitat occupying 10.86 percent of land in the scenario (Table 7.4). However, it is important to note that the amount of sensitive habitat found within a facility site may depend on whether or not the proposed site has been surveyed for biological resources, when the site was surveyed, and for what species. Our results must be understood in the context of the data limitations we discussed earlier in this chapter.

Individual Facilities: Average Impacts

Next we compared the average impact of individual facilities. We calculated the weighted average of the scores within each proposed facility using the score and the number of acres occupied by that score. This resulted in five weighted averages for each facility. As an example, weighted averages for one facility are shown in Table 7.5

Table 7.5 Weighted Averages for Proposed Solar Facility CACA 049431.

Classification System	Score	Number of acres	Weighted Average
GRank	0	8290.48	5.31
	30	1760.44	
	33	20.68	
SRank	0	8290.48	4.41
	20	20.68	
	25	1760.44	
ESA	0	8311.16	8.74
	50	1760.44	
CESA	0	8311.16	7.87
	45	1760.44	
CNPS	0	45780	0
TOTAL Facility Impact (Sum of Weighted Averages)	--	--	26.33

The five weighted averages were added together to arrive at a total impact score for each facility. In Table 7.5, the total impact of facility CACA 049431 on sensitive habitat was calculated to be 26.33. We used the sum of the five weighted averages for each classification system to reach a total facility

impact score as the five classification systems provide different information on the rarity or endangerment of a particular species, and thus how sensitive the species would be to habitat disturbance. The total impact score was calculated for all proposed solar facilities and each facility was placed into one of three categories (Table 7.6). Facilities with total facility impact scores of zero to 10 were categorized as "low impact" facilities, facilities with scores of greater than 10 to 60 were categorized as "medium impact" facilities, and facilities with scores greater than 60 were categorized as "high impact" facilities. The scores 10 and 60 were chosen as cutoff points because 10 is the value at which a species reaches some level of rarity or endangerment in four of the five classifications systems, and 60 is the highest value that an individual species can receive.

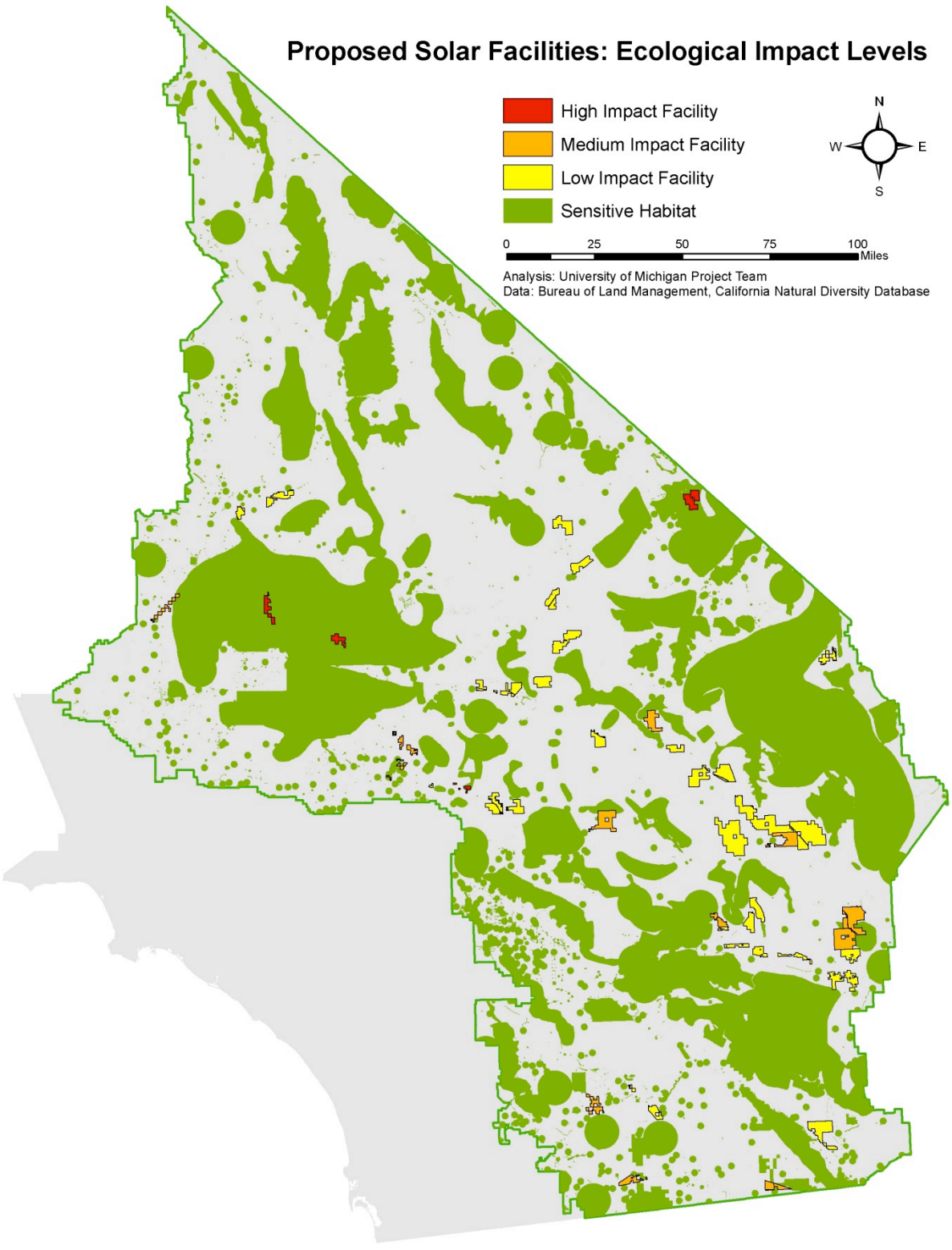
Table 7.6 Impact Categories and Number of Facilities in Each Category.

Category	Score Range	# of Facilities	# of Fast Track	# of Fast Track / SESA	# of SESA	Other
Low	0 to 10	34	2	5	9	18
Medium	>10 to 60	12	1	1	5	5
High	>60	6	1	0	0	5

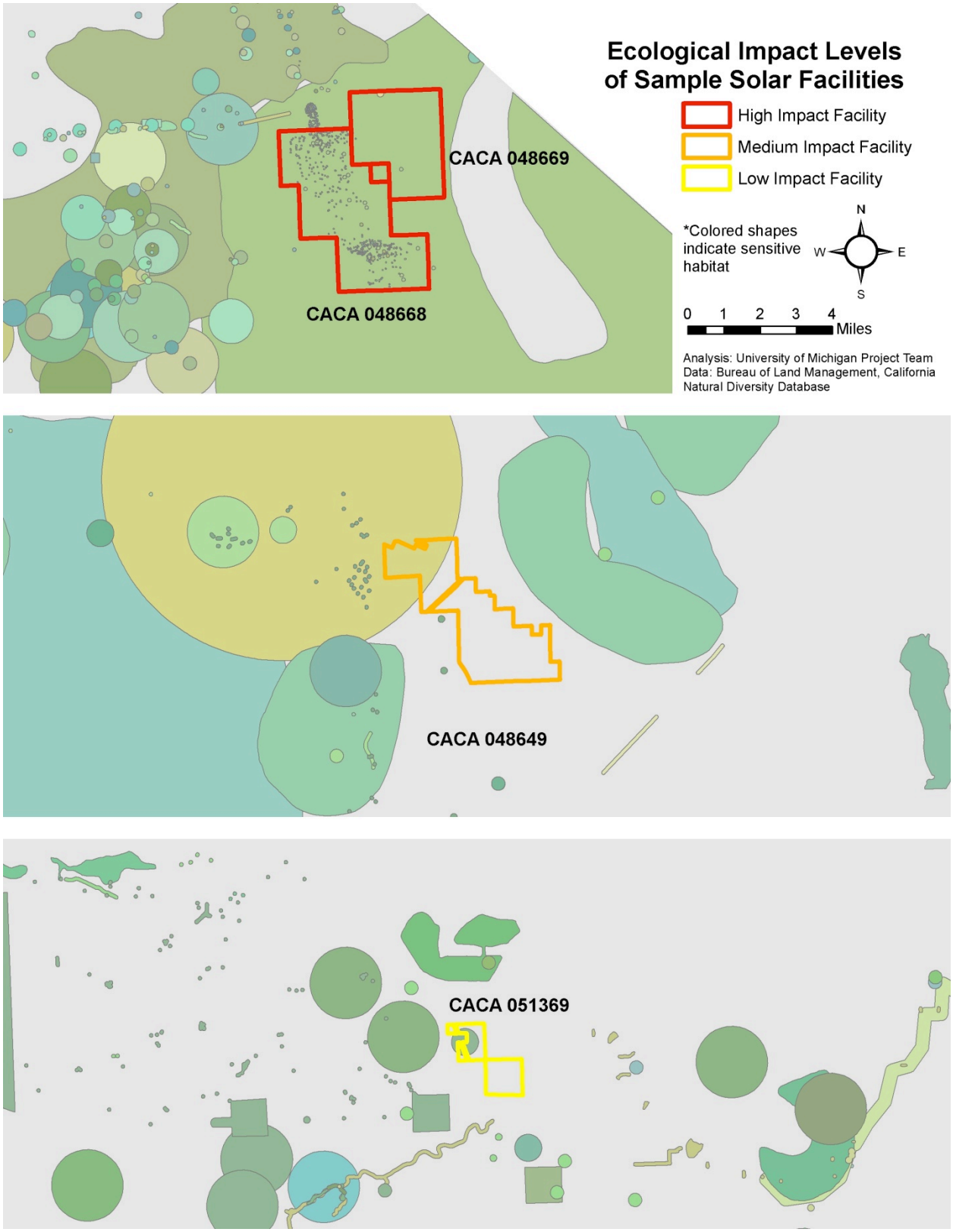
Note: some facilities are in both the Fast Track and SESA scenarios and are labeled as "Fast Track/SESA" in this table.

Of the 52 facilities, 34 were categorized as low impact facilities, 12 were categorized as medium impact facilities, and 6 were categorized as high impact facilities. Most facilities in either the Fast Track or SESA scenario fall into the low impact category, though one Fast Track facility (CACA 048668) falls into the high impact category. A complete list of facility total impact scores can be found in Appendix E7. The spatial arrangement of these facilities across the California desert landscape is shown in Map 7.8.

Map 7.9 zooms in on facilities in each of the impact categories to provide a better sense of why facilities received certain scores. For the two high impact facilities at the top of the map, high scores resulted from complete overlap with one species' habitat. In addition, facility CACA 048668 is situated over numerous smaller species occurrences. In the middle and bottom frame, less than half of the medium and low impact facilities overlap with species habitat, and so these facilities received lower scores. New off-site roads and transmission lines were not factored into the sensitive habitat analysis, but would also have an impact on the habitat surrounding the facilities. The high impact facility, and to some extent the medium impact facility, in Map 7.9 are surrounded by sensitive habitat, and construction of new roads or transmission lines would likely have negative effects on those habitats as well.



Map 7.8 Proposed Solar Facilities: Ecological Impact Levels.



Map 7.9 Ecological Impact Levels of Sample Solar Facilities.

Individual Facilities: A Closer Look at High Impact Facilities

A few facilities stood out as having higher impacts to sensitive habitat in both the analysis of the percent of sensitive habitat within a facility and in the analysis of average facility impacts. To better understand the negative ecological impacts of high impact facilities, the three facilities with the highest total impact scores were chosen. Relative to facilities in the All Proposed or Fast Track scenarios, the SESA facilities had lower total impact scores and lower percentages of sensitive habitat within the facilities. The SESA facility in Table 7.7 is used to highlight the contrast between the highest impact Fast Track and non-Fast Track/non-SESA facilities. The SESA facility was selected as an example because it had the highest percentage of sensitive habitat within the proposed facility site and one of the highest total impact scores of all the SESA facilities.

Table 7.7 Sample High Ecological Impact Facility.

Identification Number	Facility Status	Percent of the Facility that is Sensitive Habitat	Facility Total Impact Score
CACA 050528	None	92	179
CACA 048668	Fast Track	100	155
CACA 050103	None	100	153
CACA 050174	SESA	62	41

Of all the proposed facilities, CACA 050528 had the highest total impact score, with a score of 179, followed by CACA 048668 (score of 155), and CACA 050103 (score of 153). These scores were significantly higher than the scores of the majority of facilities, as six facilities have total impact scores above 90 (CACA 050528, 048668, 050103, 049017, 048669, 050150), with the next highest impact score falling to 52 (CACA 048728, CACA 049490) (Appendix E7). Sensitive habitat that could be affected by these four facilities is shown in Table 7.8.

The four facilities either completely overlap sensitive habitat (CACA 048668, CACA 050103), or almost completely overlap sensitive habitat (CACA 050528, CACA 050174) of rare and endangered species. The facility with the highest total impact score, CACA 050528, almost completely overlaps both purple-nerve cymopterus (*Cymopterus multinervatus*) and prairie falcon (*Falco mexicanus*) habitat. The Fast Track facility, CACA 048668, completely overlaps desert tortoise (*Gopherus agassizii*) habitat, as well as sensitive habitat for six different rare plant species. CACA 050103 completely overlaps desert tortoise (*G. agassizii*) habitat, and partially overlaps the habitat of the other two species. The SESA facility, CACA 050174, partially overlaps flat-tailed horned lizard (*Phrynosoma mcallii*) habitat and only slightly overlaps Yuma clapper rail (*Rallus longirostris yumanensis*) habitat.

Due to the effect that CACA 050528, CACA 048668, and CACA 050103 are likely to have on sensitive habitat, we encourage the BLM to fully analyze the possible ecological impacts of these and other high impact facilities. We are especially concerned about CACA 048668 because it is a Fast Track facility

Table 7.8 High Ecological Impact Facilities and Affected Sensitive Habitat Listed by Species.

Identification Number	Affected Sensitive Habitat (By Species)
CACA 050528	• Purple-Nerve Cymopterus (*Cymopterus multinervatus*) • Prairie Falcon (*Falco mexicanus*)
CACA 048668*	• Desert Pincushion (*Coryphantha chlorantha*) • Desert Tortoise (*Gopherus agassizii*) • Mojave Milkweed (*Asclepias nyctaginifolia*) • Nine-Awned Pappus Grass (*Ennaepogon desvauxii*) • Parish's Club-Cholla (*Grusonia parishii*) • Rusby's Desert Mallow (*Sphaeralcea rusbyi* var. *eremicola*) • Small-Flowered Androstephium (*Androstephium breviflorum*)
CACA 050103	• Burrowing Owl (*Athene cunicularia*) • Desert Tortoise (*Gopherus agassizii*) • Western Snowy Plover (*Charadrius alexandrinus nivosus*)
CACA 050174**	• Flat-tailed Horned Lizard (*Phrynosoma mcallii*) • Yuma Clapper Rail (*Rallus longirostris yumanensis*)

* = Fast Track Facility
** = SESA Facility

slated to be permitted and break ground before December 31, 2010 and we encourage the BLM to reconsider this proposed facility.

Development Scenarios: Average Impacts

Next we compared the average impact of each development scenario. Initially, we examined each classification system separately. Using the Fast Track scenario as an example, we took the mean of GRank weighted averages for all the Fast Track facilities by treating each facility as one unit (Table 7.9). The overall GRank score for the Fast Track facilities is 4.61.

Table 7.9 GRank Weighted Averages for Fast Track Facilities.

Fast Track	Weighted Average
CACA 047740	8.27
CACA 049539	1.67
CACA 048668	31.58
CACA 049537	0.28
CACA 049561	0
CACA 048810	0
CACA 048880	0
CACA 048811	0
CACA 048649	4.02
CACA 049016	0.31
Mean of Weighted Averages	4.61

Using this method, we calculated overall GRank, SRank, ESA, CESA, and CNPS scores for all three development scenarios. We then added the overall GRank, SRank, ESA, CESA, and CNPS scores for each scenario to achieve an average impact score for each scenario (Table 7.10). Since we used the mean of the weighted averages to determine impact scores for each classification system, average impact scores can be compared even though there are an unequal number of facilities in the three scenarios.

Table 7.10 Average and Total Impact Scores for Each Scenario and Classification System.

	GRank	SRank	ESA	CESA	CNPS	AVERAGE Impact of a Facility within each Scenario	TOTAL Scenario Score (Sum of Facility Scores)
Fast Track	4.61	4.08	5.12	4.61	1.05	19.47	195
SESA	3.74	2.84	1.90	1.69	0.85	11.02	220
All Proposed	6.02	5.35	5.96	5.36	1.93	24.62	1,280

Facilities in the All Proposed scenario have the greatest impact to rare and endangered species with an average facility score of 24.62, the Fast Track scenario has the second greatest impact with an average facility score of 19.47, and the SESA scenario has the least impact with an average facility score of 11.02. The sum of all facilities scores was also taken, resulting in a total score for each scenario. The Fast Track scenario had the lowest total scenario score, with a score of 195, followed by the SESA scenario (220), and the All Proposed scenario (1,280). It is understandable that the Fast Track scenario has the lowest score because it has the fewest number of facilities while the All Proposed scenario has the highest score because it has most number of facilities. However, considering that the SESA scenario has twice as many facilities as the Fast Track scenario, there is surprisingly little difference between the total scenario scores. The small difference between the Fast Track and SESA total scenario scores is supported by the average impact scores, because the average impact score of a SESA facility is lower than the average impact score of a Fast Track facility.

Ecological Impact Analyses: Transmission and Grading Disturbance

The installation of multiple utility-scale solar facilities across the California desert will have ecological impacts beyond sensitive habitat, such as impacts to landscape-scale ecological processes. We chose two variables as proxies for the amount of disturbance that a facility might have on the landscape:

- Distance to transmission was chosen because the farther away a facility is from existing transmission lines, more land will need to be disturbed when building new transmission lines and associated infrastructure to connect the facility to the grid. New transmission lines could interrupt ecological processes like migration by disrupting habitat connectivity.
- Slope of the proposed facility site was chosen as the second variable. Solar facilities require a relatively low slope, zero to six percent slope for most facilities, and therefore a higher slope

at the facility site will require more grading and site engineering to make the land flat. Changes to the slope over large areas could impact ecological processes like the movement of water across the landscape.

Other infrastructure-based disturbances are inherent in the installation of utility-scale solar facilities and addition of other variables would strengthen this analysis.

Data Sources

Transmission data in GIS form is protected for national security reasons. Thus, we were unable to obtain adequate data for this analysis. However, we were able to obtain one publicly available data file, downloaded from the California State BLM GIS webpage (http://www.blm.gov/ca/gis/). While this file does not contain complete transmission line data, it is used here as a proxy. Data for the slope analysis came from a digital elevation model (DEM) with 30 square meter resolution, obtained from the USGS National Map Seamless Server (http://seamless.usgs.gov).

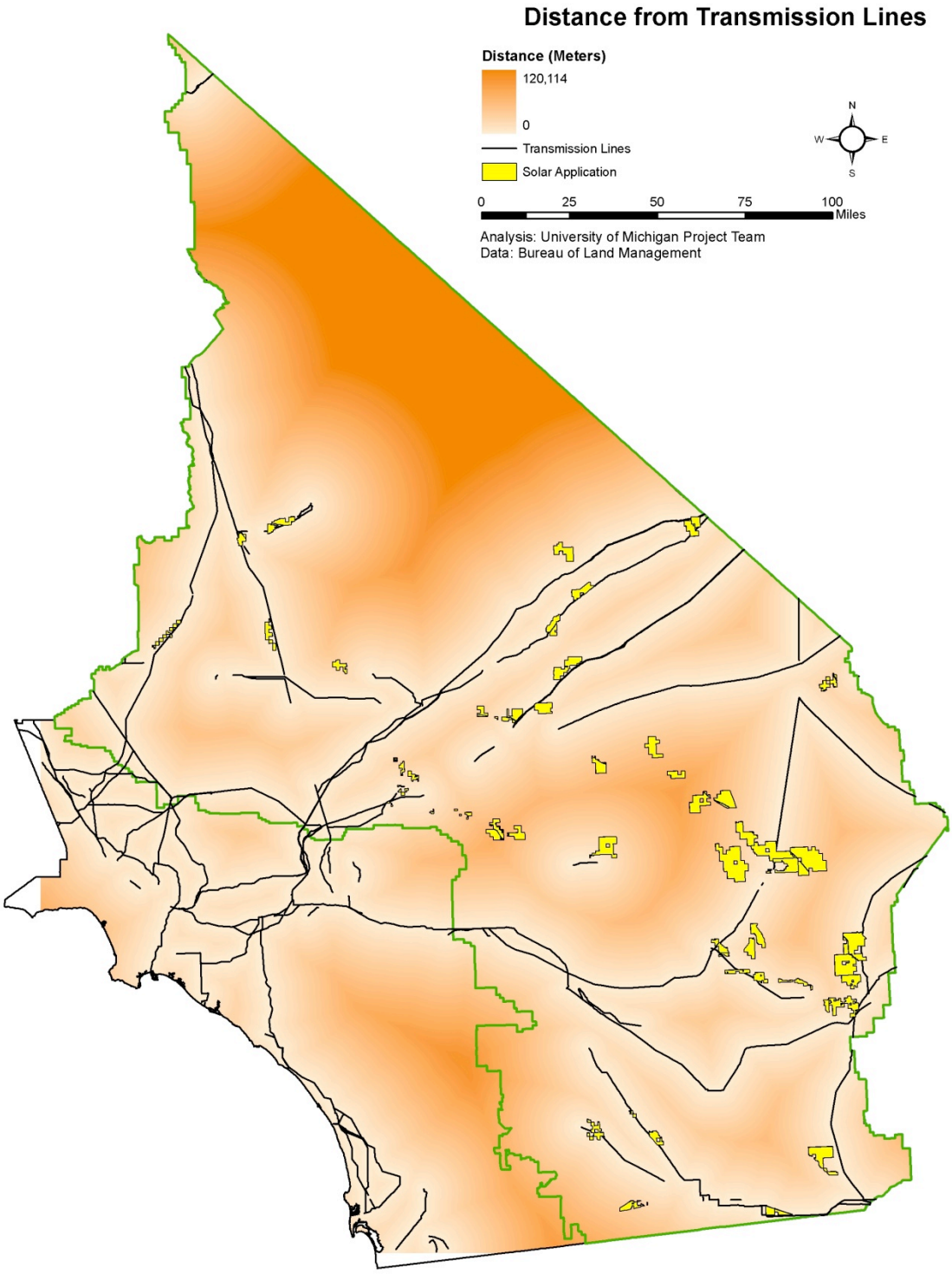
Creating a Scoring System

The transmission line data layer was used to create a raster data layer with each cell assigned a value of the straight line distance to the nearest transmission line. We used this data to calculate the minimum distance from each facility to the nearest transmission line. We calculated the average slope for each facility to compare the amount of grading and site engineering required relative to other facilities. We use the average slope as a method for comparing slopes across sites, though we recognize that average slope is not an accurate indicator of the amount of grading that will be performed on-site.

Results

Distance to Transmission

The minimum distance of a facility to the nearest transmission line ranges from zero meters (indicating that the facility is proposed to overlap an existing line) to 36,707 meters, or about 23 miles (Map 7.10). Looking at the average minimum distance to transmission for each scenario, the SESA scenario has the smallest average minimum distance at 1,558 meters, while the All Proposed scenario has the largest at 5,496 meters (Table 7.11). Table 7.11 also lists the minimum and maximum distances in our minimum distance to transmission calculation. The Fast Track scenario falls in the middle at 2,694 meters. Because some existing transmission lines are absent from the data used for this analysis, it is possible that some proposed facilities may be closer to transmission lines than our results suggest.



Map 7.10 Distance of Proposed Solar Facilities to Existing Transmission Lines.

Table 7.11 Results of the Minimum Distance to Transmission Analysis.

	Average Minimum Distance	Minimum Minimum Distance	Maximum Minimum Distance
Fast Track	2,694	0	12,098
SESA	1,558	0	6,936
All Proposed	5,966	0	36,707

Because one of the criteria for SESA locations was proximity to transmission, it makes sense that the SESA scenario has the lowest average distance to existing transmission lines. To understand how individual facilities contribute to the overall scenario, we placed individual facilities into four categories based on the minimum distance to transmission (Table 7.12).

Table 7.12 Distance to Transmission Categories and Number of Facilities in Each Category.

Minimum Distance to Transmission (in meters)	Total Number of Facilities	Fast Track	Fast Track and SESA	SESA	Other
0	24	2	4	8	10
1 to 5,000	11	0	2	4	5
5,000 to 10,000	7	1	0	2	4
10,000 to 20,000	6	1	0	0	5
Greater than 20,000	4	0	0	0	4

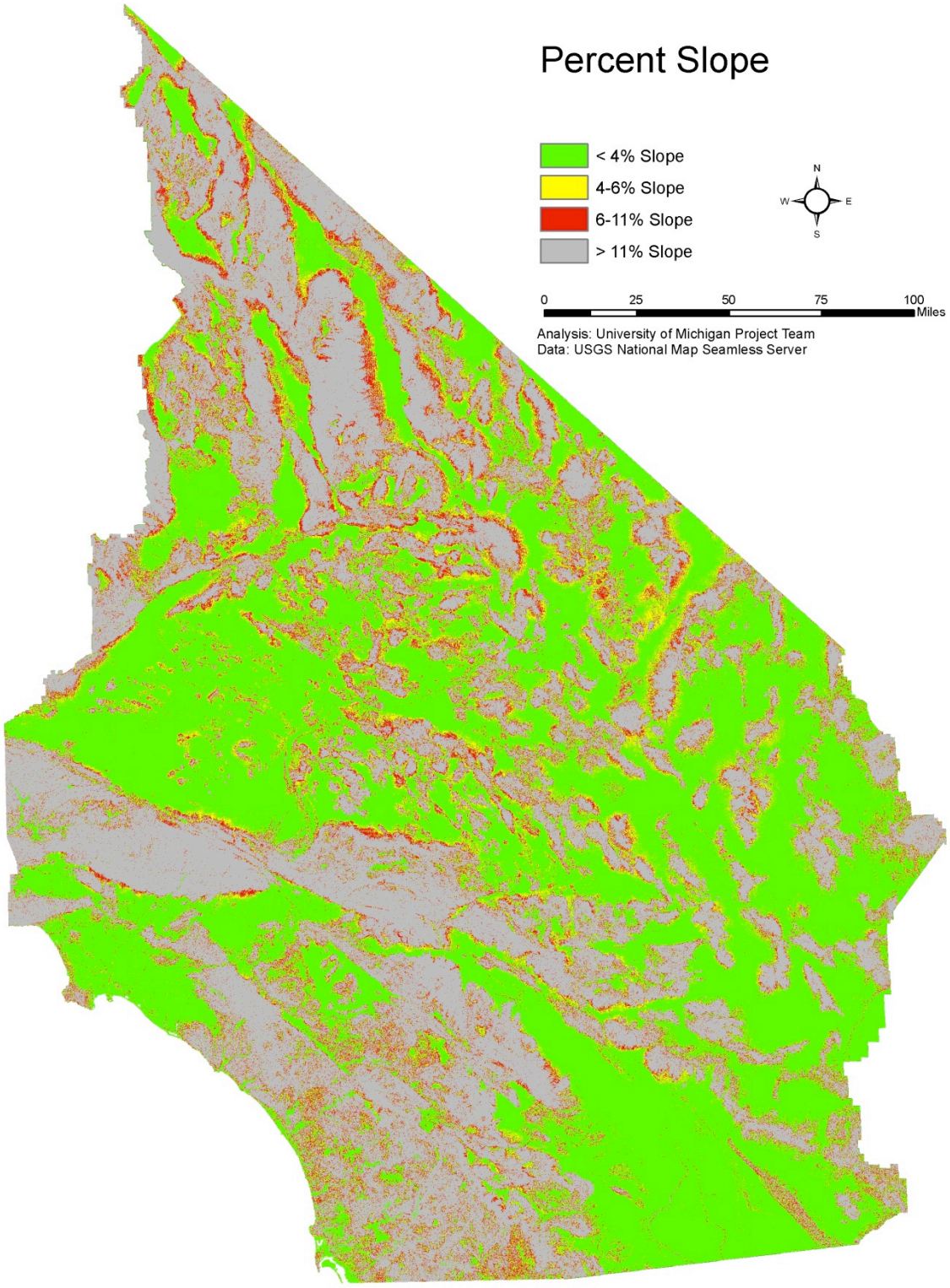
While one of the Fast Track facilities and nine of the All Proposed scenario facilities are over 10,000 meters from existing transmission lines, all SESA facilities are within 10,000 meters of existing transmission lines. Twelve of the 20 SESA facilities are directly on existing transmission lines.

Percent Slope

The California desert contains a range of percent slope (Map 7.11). The average percent slope of a facility ranges from one percent to 51 percent. Looking at the mean of the average percent slope for each scenario, the SESA scenario has the smallest mean average percent slope at 13.75 percent, while the All Proposed scenario has the largest at 17.68 percent (Table 7.13). The Fast Track scenario falls in the middle at 14.75 percent.

Table 7.13 Results of the Average Percent Slope Analysis.

	Average	Lowest	Highest
Fast Track	14.75	2	44
SESA	13.75	1	51
All Proposed	17.68	1	51



Map 7.11 Percent Slope of the California Desert.

Because one of the selection criteria for SESA locations was relatively low slope, it makes sense that the SESA scenario has the lowest average slope. To understand how individual facilities contribute to the overall scenario, we placed individual facilities into four categories based on average percent slope (Table 7.14).

Table 7.14 Average Percent Slope Categories and Number of Facilities in Each Category.

Average Percent Slope	Total Number of Facilities	Fast Track	Fast Track and SESA	SESA	Other
1 to 6	18	1	3	7	7
6 to 11	9	1	2	2	4
12 to 40	18	2	1	2	13
Greater than 40	7	0	0	3	4

Over half of the Fast Track facilities (seven of the 10) and SESA facilities (14 of the 20) have an average slope below 11 percent. However, of all 52 facilities, about half have an average slope below 11 percent and about half have a slope above 11 percent, contributing to the higher mean average percent slope for the All Proposed scenario.

Visual Impact Analysis

The visual impact analysis sought to identify the extent to which visual resources will be affected by solar development across the California desert landscape. For each of the three scenarios, we wanted to determine the number of visually-affected acres and the percentage of the CDCA these affected acres comprise. To get a sense of the magnitude of impact, we were interested in determining how many solar facilities could be seen from a particular place in the landscape. We also sought to compare scenarios to determine which scenario had a larger overall impact and which had a proportionately larger impact relative to the number of acres developed. Finally, we conducted a visual impact analysis of a viewshed from Mojave National Preserve as an example to demonstrate how solar development may affect areas valued for scenic views.

Data Sources

We obtained and downloaded proposed solar facility shapefiles from the California State BLM GIS webpage (http://www.blm.gov/ca/gis/). Data used by ArcGIS for the viewshed analysis came from a digital elevation model (DEM) obtained from the USGS National Map Seamless Server (http://seamless.usgs.gov).

Building Scenarios

A viewshed analysis was conducted for each of the 53 proposed solar facilities. There were 53 facilities in the All Proposed scenario, 21 facilities in the SESA scenario, and 10 facilities in the Fast Track

scenario. Each analysis was conducted using the solar facility as the observation point, under the assumption that the landscape visible from the facility would be the same as the locations on the landscape from which the facility was visible. The observation point was placed on the ground in the center of the facility. The Viewshed Analysis tool in ArcGIS outputs a single raster for each facility, indicating the land that is visible from the facility (i.e., the facility's visual footprint), and the land that is not visible from the facility. We overlayed the facilities included in each scenario to determine the overall visual footprint of the scenario.

The following assumptions are inherent in our analysis. We utilized a single observation point in the center of solar facilities ranging from several hundred to thousands of acres, which could underestimate a facility's visual footprint. Second, the observation point was placed on the ground even though some facility infrastructure may reach much greater heights. This could also result in underestimates. For example, dish/engines are about 40 feet tall, while the three proposed facilities that plan to utilize power tower technology provide tower, the tallest element of the facility, heights of 312, 459, and 653 feet tall. Last, the DEM under the facility was not modified in any way, even though developers are likely to make modifications to the landscape, such as grading to reduce the slope of the land. Whether this assumption over- or underestimates a facility's visual footprint is likely dependent on individual facility sites. Overall, our analysis most likely significantly underestimates the visual impact of the individual facilities and the three scenarios.

Results and Analysis

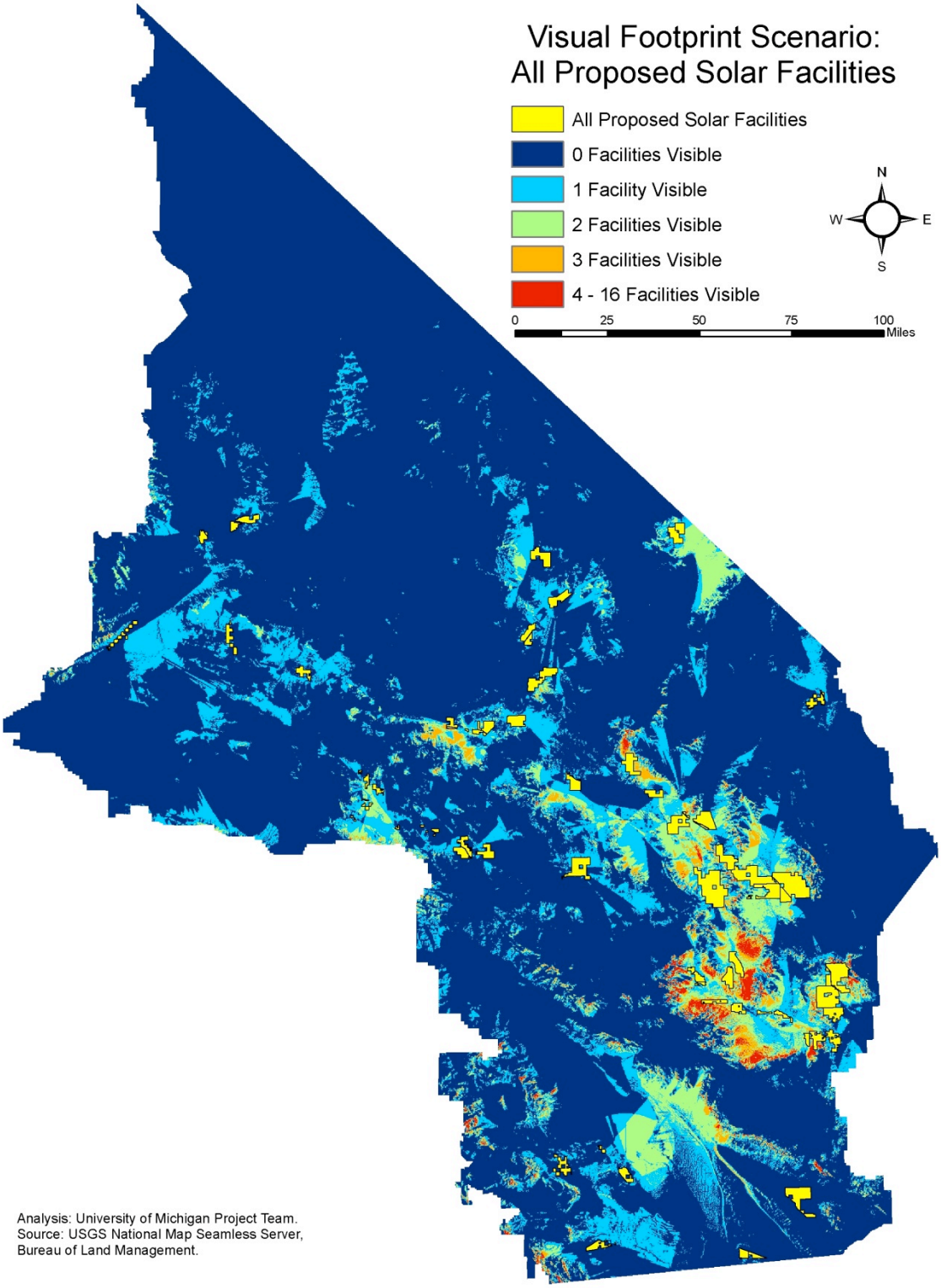
Table 7.15 displays the results of the viewshed analysis for each scenario. In the Fast Track scenario, almost 900,000 acres of land have a view of at least one solar facility while four facilities is the greatest number of facilities that can be seen at one time; in the SESA scenario, just over 1 million acres of land have a view of at least one solar facility while 13 facilities is the greatest number of facilities that can be seen at one time; in the All Proposed scenario, about 3.6 million acres of land have a view of at least one solar facility, while 16 facilities is the greatest number of facilities that can be seen at one time. To put the number of affected acres into perspective, we provided the percent of the CDCA for each visual footprint, with the CDCA being about 25.6 million acres of land.

Of the three scenarios, the All Proposed scenario has the largest visual impact (Map 7.12), with at least one solar facility visible to about 15 percent of the CDCA. The SESA scenario has the second largest impact, with at least one solar facility visible to about 4 percent of the CDCA (Map 7.13). The Fast Track scenario has the smallest impact, with only about 3.5 percent of the CDCA visually affected by solar facilities (Map 7.14).

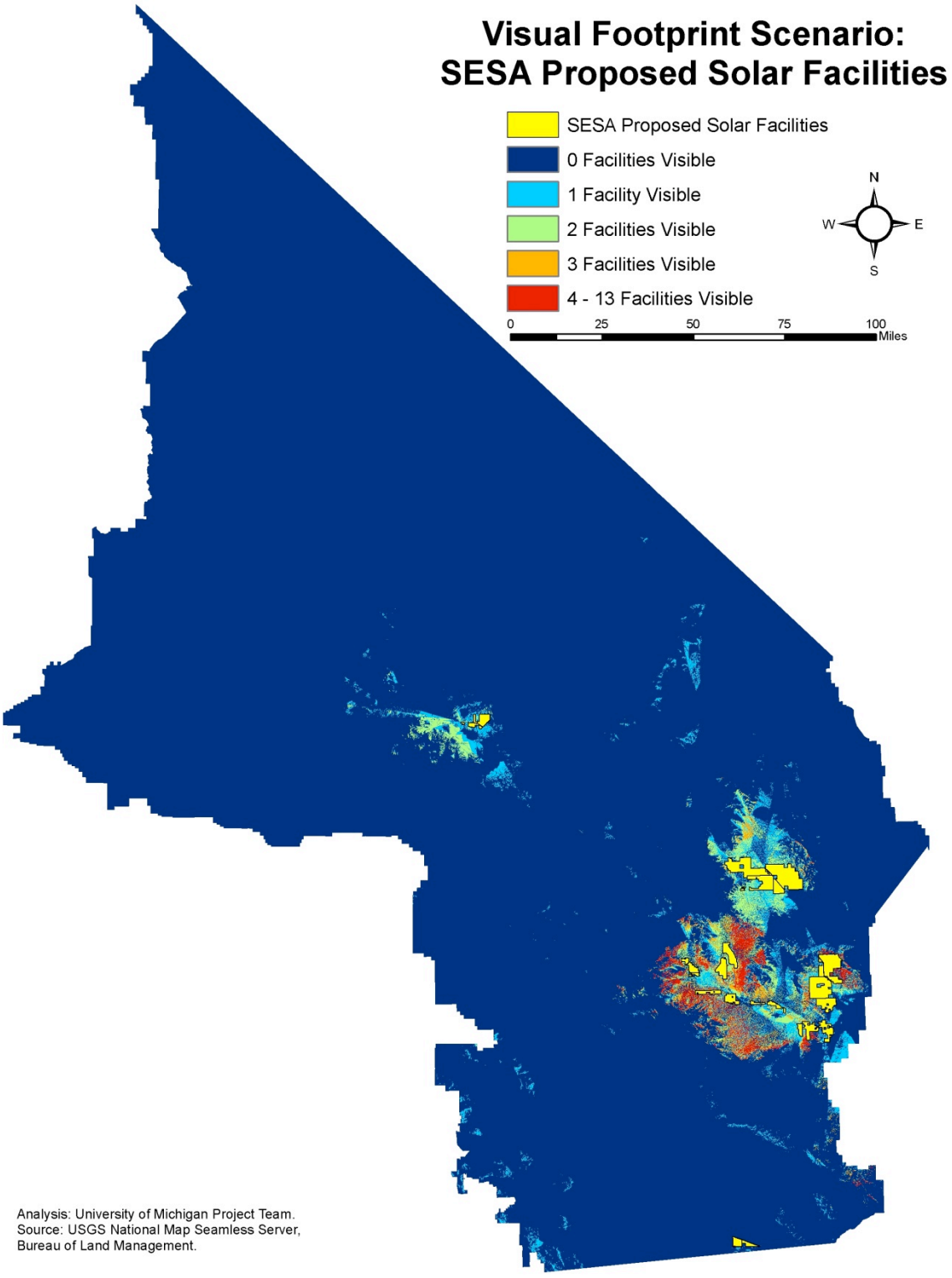
Table 7.15 Viewshed Analysis for Fast Track, SESA, and All Proposed Build-out Scenarios.

	Fast Track		SESA		All Proposed	
Number of Visible Facilities	# of Acres	% of CDCA	# of Acres	% of CDCA	# of Acres	% of CDCA
1	**802,985**	**3.133**	**475,052**	**1.854**	**2,473,928**	**9.654**
2	**79,335**	**0.310**	**311,426**	**1.215**	**884,328**	**3.451**
3	**3,963**	**0.015**	**127,346**	**0.497**	**292,271**	**1.141**
4	**40**	**0.000**	**65,105**	**0.254**	**109,831**	**0.429**
5			**36,722**	**0.143**	**47,493**	**0.185**
6			**12,103**	**0.047**	**15,824**	**0.062**
7			**4,031**	**0.016**	**4,898**	**0.019**
8			**2,006**	**0.008**	**2,422**	**0.009**
9			**1,148**	**0.004**	**1,342**	**0.005**
10			**744**	**0.003**	**847**	**0.003**
11			**173**	**0.001**	**283**	**0.001**
12			**3**	**0**	**22**	**0**
13			**0.220**	**0**	**9**	**0**
14					**8**	**0**
15					**4**	**0**
16					**3**	**0**
At Least 1	886,323	3.459	1,035,859	4.042	3,833,512	14.959

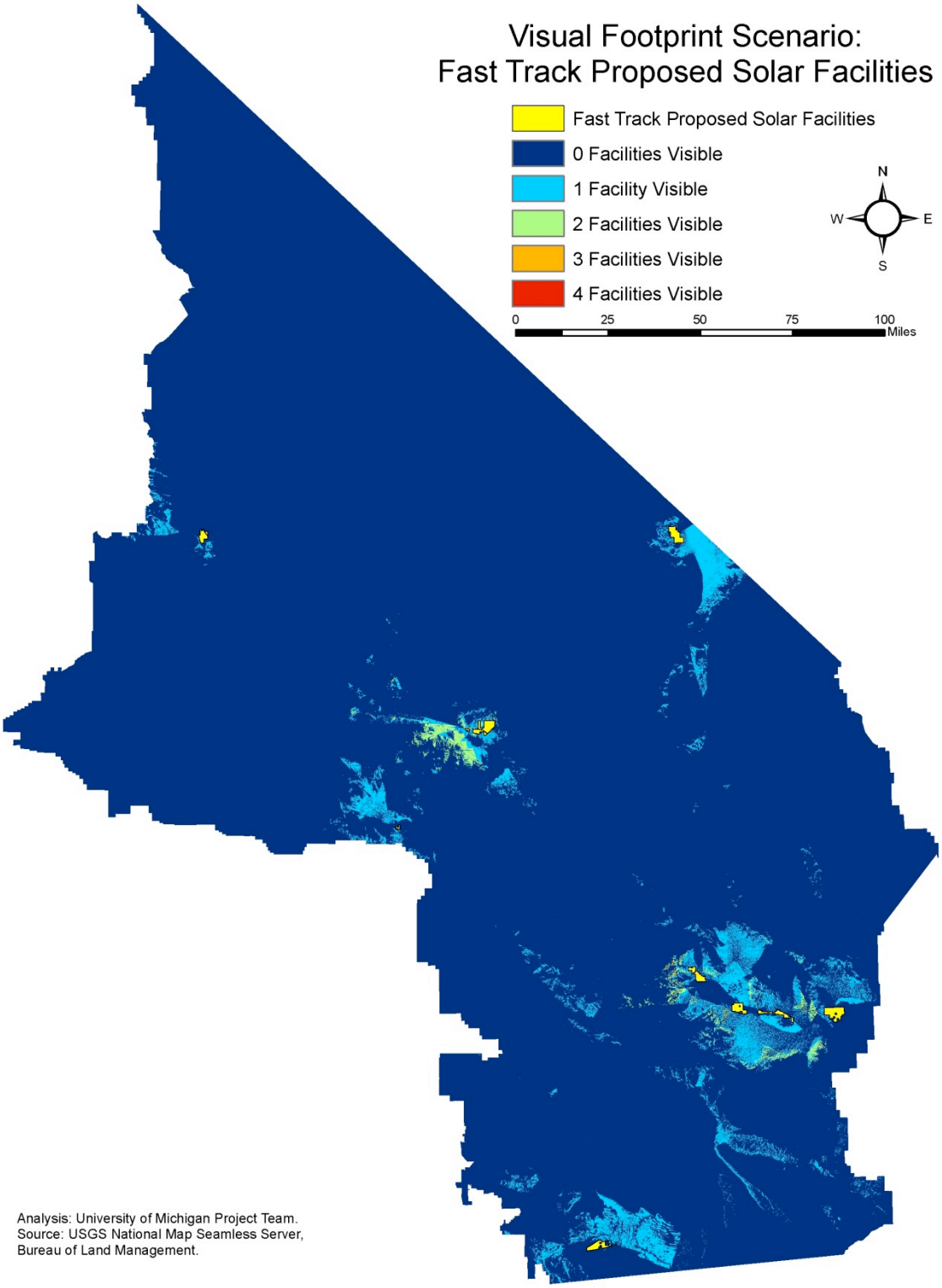
The numbers of acres in the table correspond to the number of facilities that are visible from those acres. The total number of visually affected acres for each scenario is calculated by adding up acres for each of the number of visible facility values, seen here as the numbers in the "At Least 1" row.



Map 7.12 Visual Footprint Scenario: All Proposed Solar Facilities.



Map 7.13 Visual Footprint Scenario: SESA Proposed Solar Facilities.



Map 7.14 Visual Footprint Scenario: Fast Track Proposed Solar Facilities.

Since the total number of acres of solar facilities differs across the scenarios, we compared the amount of land developed in each scenario with the size of the scenario's visual footprint. The total developed acres were calculated for each scenario by adding up the acreage for each proposed facility within that scenario (Table 7.15). The amount of land where at least one solar facility was visible was considered to be the scenario's visual footprint. The ratio of visual footprint acres to developed acres was calculated by dividing Visual Footprint acres by Total Developed Acres.

Table 7.15 Visual Footprint to Developed Acres Ratio.

	Total Developed Acres	Visual Footprint	Ratio
Fast Track	50,252	886,323	17.64
SESA	212,901	1,035,859	4.87
All Proposed	491,828	3,833,512	7.79

The Fast Track scenario has the largest visual footprint ratio, while the SESA scenario has the smallest. There are about 18 acres of visual footprint for every 1 acre of solar development in the Fast Track scenario, about 5 acres of visual footprint for every 1 acre of solar development in the SESA scenario, and about 8 acres of visual footprint for every 1 acre of solar development in the All Proposed scenario.

To understand how individual facilities contribute to the overall scenario footprint ratio, we placed individual facilities into four categories based on the size of the facility's visual footprint (Table 7.16).

Table 7.16 Visual Footprint Categories for Individual Solar Facilities and Number of Facilities in Each Category.

Visible Acres (in 1,000s)	Total Number of Facilities	Fast Track	Fast Track and SESA	SESA	Other
Less than 50	10	1	1	2	6
50 to 100	18	1	3	5	9
100 to 150	13	1	0	7	5
150 to 600	12	1	2	1	8

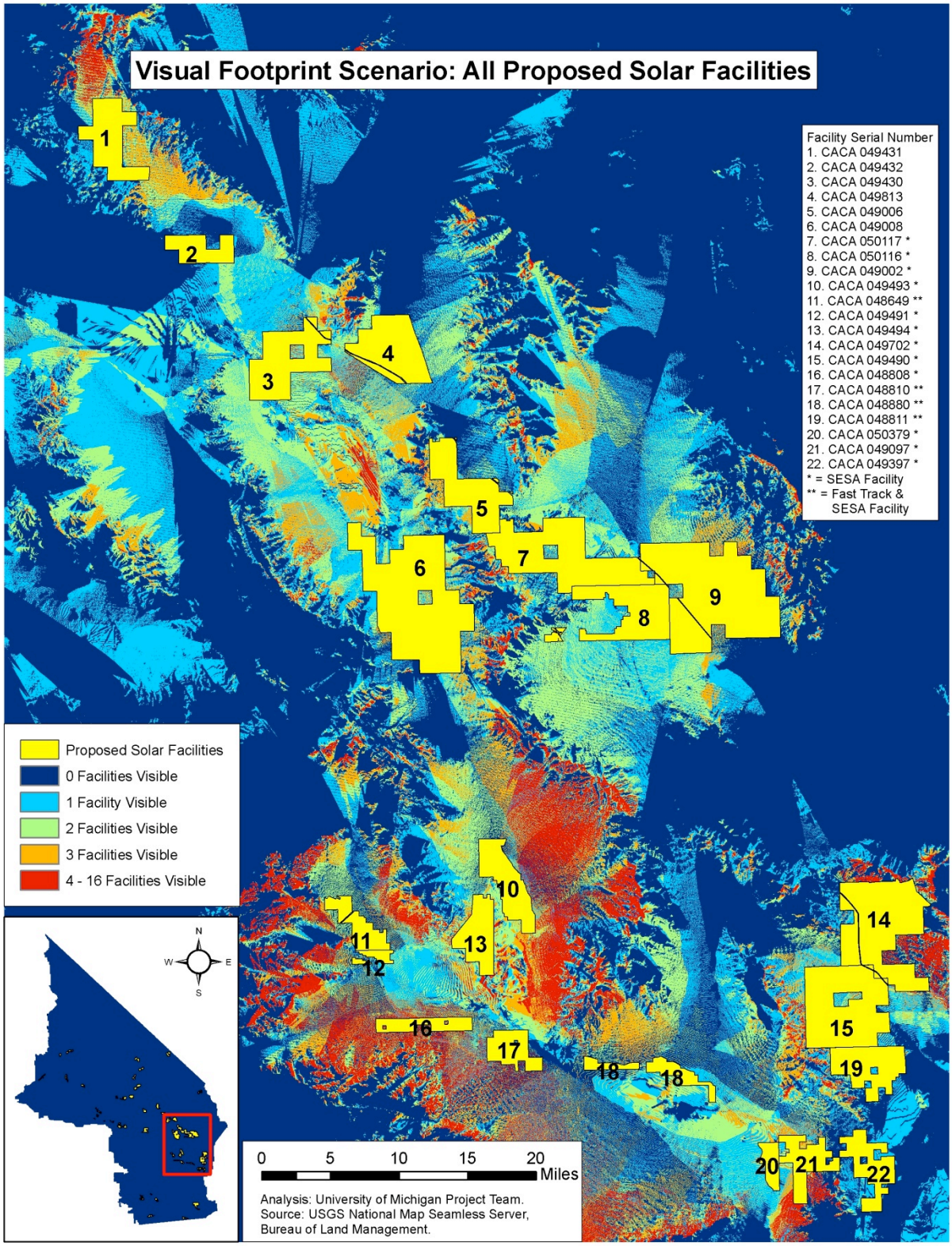
The majority of individual facilities, 43, affect fewer than 150,000 acres. Surprisingly, many SESA facilities were present in the higher impact categories: three facilities in the 150,000 to 600,000 acre category, seven facilities in the 100,000 to 150,000 acre category, and eight facilities in the 50,000 to 100,000 acre category. However, if visual footprints for multiple facilities overlap within a scenario, the number of acres that are visually affected by at least one facility will remain constant. Overlapping visual footprints likely contributes to the low visual footprint to developed acres ratio in the SESA scenario. It makes sense that the SESA scenario has the smallest visual footprint ratio because SESAs are meant to cluster facilities, which reduces the overall area by which they can be seen.

If we examine the viewshed of several solar facilities more closely, we see how factors like clustering play a role in determining the magnitude and extent of impact to visual resources (Map 7.15). Impacts

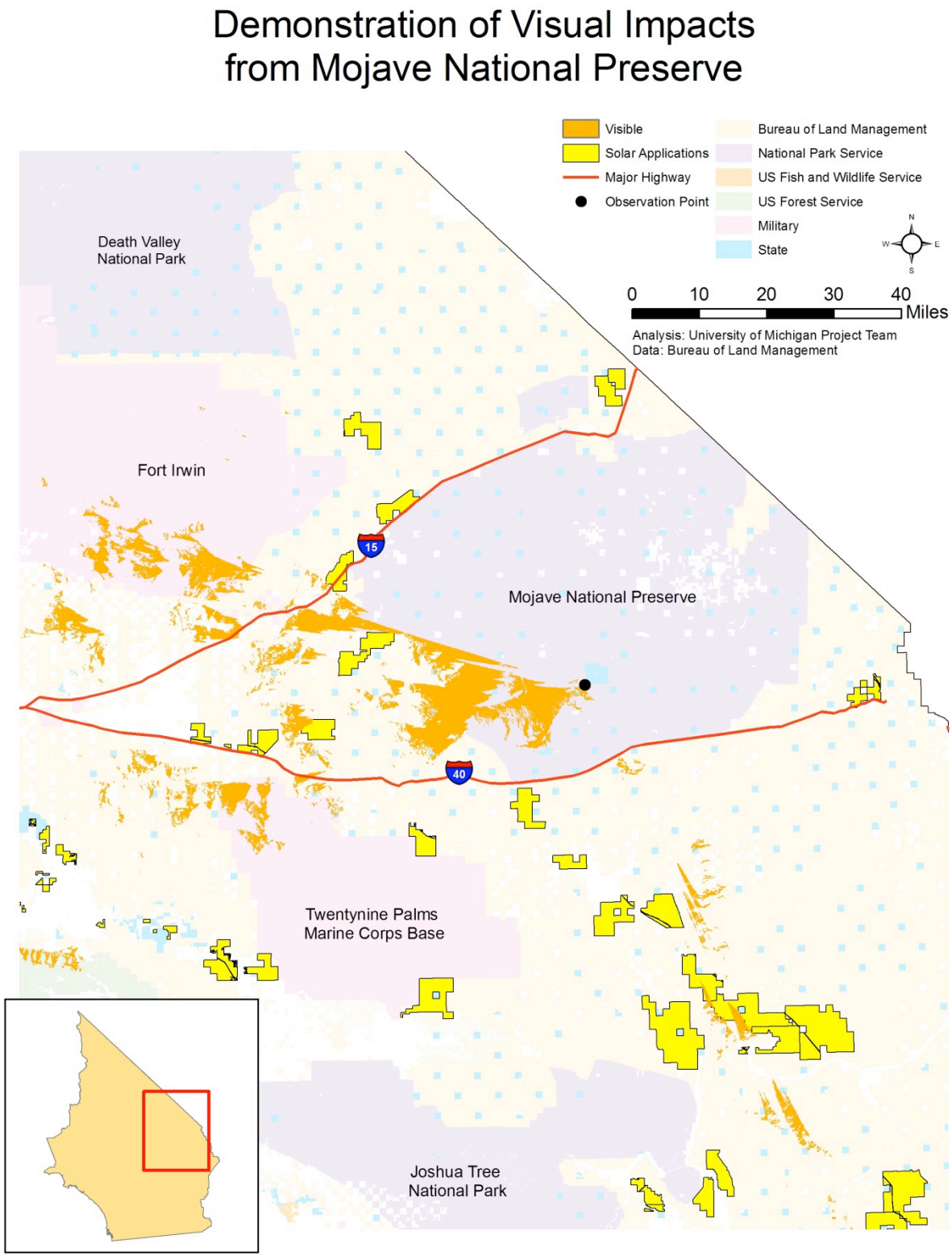
to visual resources are high in and around clusters of facilities and then dissipate as distance from the cluster of facilities increases (Map 7.13). Elevation plays a major role in determining the extent of facility visibility. A greater number of facilities are visible to higher elevation areas, such as mountaintops, and therefore views of the desert landscape from those areas are more heavily affected. However, higher elevation areas may also play a role in containing the visual impact of a facility because facilities are usually situated in low slope and low elevation areas. For example, facilities labeled 10 to 13, 16, and 17 in Map 7.15 are surrounded by higher elevations. The mountaintops surrounding these facilities sustain high impacts to visual resources and are denoted in red, indicating that four to 16 facilities may be seen from those areas. However, beyond these higher elevation areas (such as the northeast), the facilities are no longer visible. Facilities that are not bordered by higher elevation areas, including facilities one to nine, have a much wider area of impact. The extent of visual impacts in the SESA scenario are smaller and more concentrated (Map 7.13) than visual impacts in the Fast Track scenario (Map 7.14), despite a higher number of facilities in the SESA scenario. Thus, if land managers were interested in minimizing the visual impact of utility-scale solar development across the California desert landscape, siting facilities in SESAs or similarly clustered developments might be the most effective way to accomplish such a goal. Restricting visual impacts to a smaller area may also be accomplished by siting developments in lower elevation areas surrounded by mountains or other high-elevation landscape features.

Demonstration of Impacts from Mojave National Preserve

While mountain tops and high-elevation landscape features may sustain heavy impacts to visual resources, impacts to views experienced by desert residents and visitors could be better assessed by determining visual impacts from road corridors and highly trafficked areas. Stakeholder groups (e.g., local municipalities, private landowners, land management agencies, and environmental groups) interested in specific visual resources could select a series of points from which to conduct viewshed analyses of individual facilities or facility development scenarios. We were interested in seeing how solar development might affect views from national parks and other areas valued for their scenic qualities. We selected one observation point from a visitor use area in the Mojave National Preserve from which a few solar facilities are visible, to serve as an example of further analyses that can be conducted from towns, roads, trails, and visitor use areas throughout the desert to predict impacts of proposed solar facilities to visual resources (Map 7.16).



Map 7.15 Visual Footprint Scenario: A Closer Look at the All Proposed Solar Facilities Scenario.



Map 7.16 Demonstration of Visual Impacts from Mojave National Preserve.

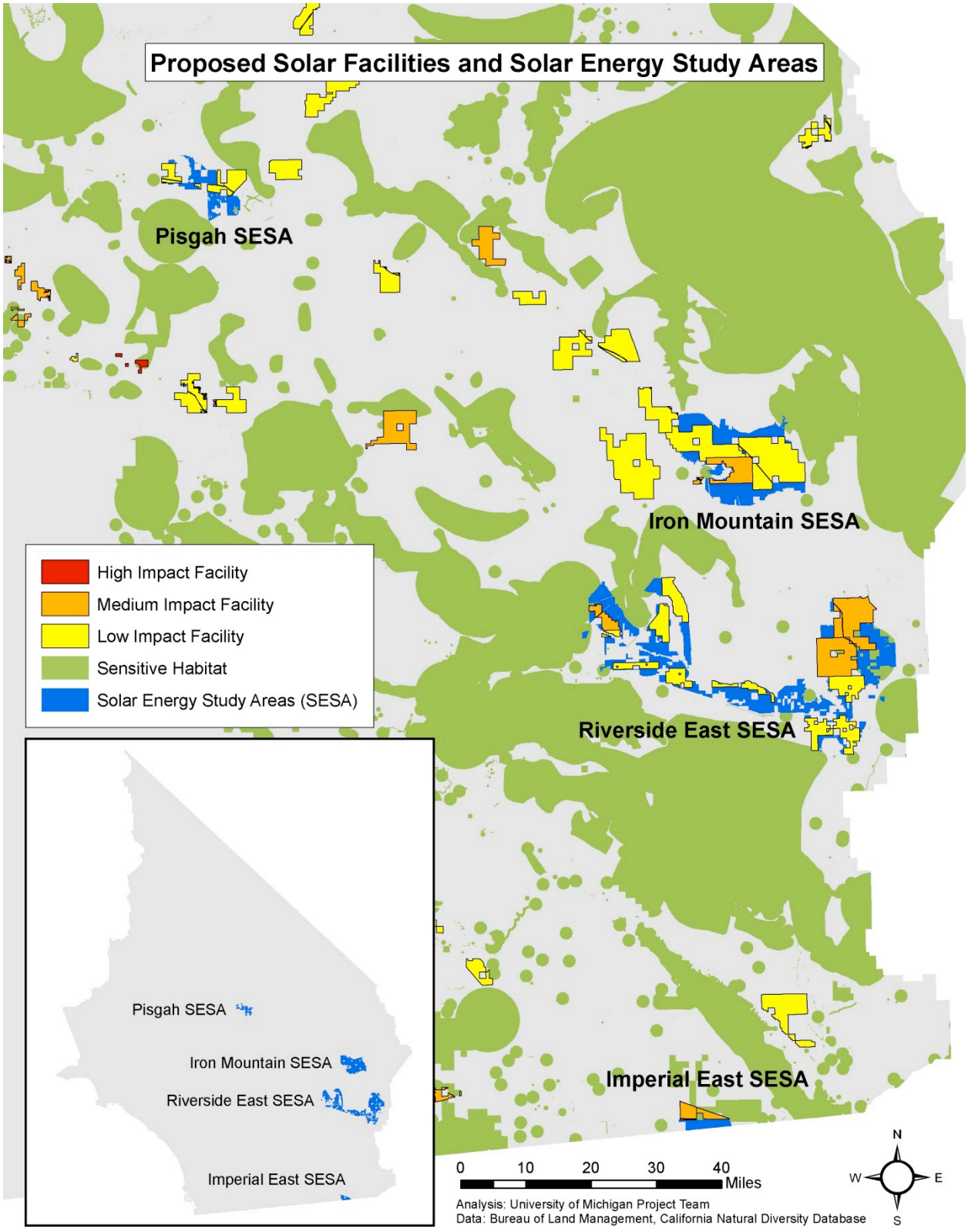
CONCLUSIONS

The four SESAs in the California desert were chosen under the Solar PEIS process for their high solar resources, suitable slope, proximity to roads and transmission, avoidance of areas with important visual resources, and avoidance of sensitive and wilderness lands, including threatened and endangered species designated critical habitat, ACECs, and wildlife movement corridors.[21,22] Based on the results of our spatial analyses, these selection criteria were effective in choosing areas for development that would minimize impacts to both ecological and visual resources.

Compared with the Fast Track and All Proposed scenarios, the SESA scenario has the lowest overall ecological impact, with the lowest amount of sensitive habitat within the scenario, the lowest total sensitive habitat impact score, and fewer individual high and medium impact facilities, based on the data used and the assumptions noted. Only 10.86 percent of land proposed for development in the SESA scenario contains sensitive habitat, compared to 12.31 percent for the All Proposed and 18.89 percent for the Fast Track scenarios. In addition, the SESA scenario has the lowest average facility impact score at 11.02, while the Fast Track (19.47) and All Proposed (24.62) scenarios have much higher average facility impact scores. Examining total impact scores for individual facilities, 14 of the SESA facilities are low impact, six are medium impact, and none are high impact. All four of the SESAs avoid major swaths of sensitive habitat and most of the facilities within SESAs are low impact facilities (Map 7.17).

Based on the data available to us, the SESA scenario will also require the least amount of disturbance to surrounding habitat because its facilities are, in general, closer to existing transmission lines and have lower slope. Concentrating facilities into limited areas like SESAs, may allow facilities to share new or existing transmission lines and reduce the amount of land that would need to be disturbed to connect new facilities to the grid. In our visual impact analysis for the three scenarios, we found that clustering facilities in low elevation areas surrounded by mountains or other high elevation landscape features helped to minimize the extent of impacts to visual resources. The SESA scenario was found to have the lowest visual impact compared to the amount of land actually developed, with a ratio of only 4.87 acres of land that are visually affected for every one acre of land developed, compared to the All Proposed (7.79) and the Fast Track (17.64) scenarios. Clustering of facilities may be crucial to reducing visual impacts of solar development across the landscape.

Based on our ecological and visual impact analyses and associated assumptions, we conclude that the SESA development scenario would have the least impact of the three scenarios. However, further analysis would be needed to determine whether SESAs are the optimal locations for solar development in the California desert. This scenario-based approach would be useful in future evaluations of landscape-level impacts from solar development.



Map 7.17 Ecological Impact Levels of Proposed Solar Facilities and SESA Locations.

CITATIONS

Chapter 7

[1] Wendy Williams and Robert Whitcomb, *Cape Wind: Money, Celebrity, Class, Politics, and the Battle for Our Energy Future on Nantucket Sound* (New York: PublicAffairs, 2007).
[2] California Department of Fish and Game, *California Natural Diversity Database*, http://www.dfg.ca.gov/biogeodata/cnddb/.
[3] California Natural Diversity Database, *How to Read* RareFind *3 Reports*, 2007 (Sacramento, CA).
[4] Roxanne Bittman, Lead Botanist, California Natural Diversity Database, Personal Communication, November 12, 2009.
[5] Roxanne Bittman, Lead Botanist, California Natural Diversity Database, Personal Communication, November 12, 2009.
[6] Jim Andre, Director, Sweeney Granite Mountain Desert Research Center; Roxanne Bittman, Lead Botanist, California Natural Diversity Database; Michael Connor, California Science Director, Western Watersheds Project; Frank Davis, Professor, University of California, Santa Barbara; Robert Fulton, Manager, CSU Desert Studies Center; Debra Hughson, Science Advisor, Mojave National Preserve; Kristeen Penrod, Conservation Director, Science and Collaboration for Connected Wildlands; Personal Communication, October – December 2009.
[7] NatureServe, *About Us*, http://www.natureserve.org/aboutUs/.
[8] NatureServe, *NatureServe Conservation Status*, http://www.natureserve.org/explorer/ranking.htm.
[9] NatureServe, *NatureServe Conservation Status*, http://www.natureserve.org/explorer/ranking.htm.
[10] U.S. Fish & Wildlife Service, *ESA Basics: More Than 30 Years of Conserving Endangered Species*, http://www.fws.gov/endangered/factsheets/ESA_basics.pdf.
[11] U.S. Fish & Wildlife Service, *ESA Basics: More Than 30 Years of Conserving Endangered Species*, http://www.fws.gov/endangered/factsheets/ESA_basics.pdf.
[12] California Environmental Resources Evaluation System, *California Wetlands Information System: California Endangered Species Act*, http://ceres.ca.gov/wetlands/permitting/cesa_summary.html.
[13] Legislative Counsel of California, *California Law: California Fish and Game Code Section 2062*, http://www.leginfo.ca.gov/cgi-bin/displaycode?section=fgc&group=02001-03000&file=2050-2068.
[14] Legislative Counsel of California, *California Law: California Fish and Game Code Section 2067*, http://www.leginfo.ca.gov/cgi-bin/displaycode?section=fgc&group=02001-03000&file=2050-2068.
[15] Legislative Counsel of California, *California Law: California Fish and Game Code Section 1901*, http://www.leginfo.ca.gov/cgi-bin/displaycode?section=fgc&group=01001-02000&file=1900-1913.
[16] Legislative Counsel of California, *California Law: California Fish and Game Code 2068*, http://www.leginfo.ca.gov/cgi-bin/displaycode?section=fgc&group=02001-03000&file=2050-2068.
[17] California Native Plant Society, *About CNPS*, http://www.cnps.org/cnps/about/.
[18] California Native Plant Society, *Rare Plant Program*, http://www.cnps.org/cnps/rareplants/.
[19] California Native Plant Society, *Rare Plant Program*, http://www.cnps.org/cnps/rareplants/.
[20] Amy Fesnock, Threatened and Endangered Species Lead, Bureau of Land Management, Personal Communication, December 8, 2009.
[21] U.S. Bureau of Land Management, *Solar Energy Study Areas,* http://www.blm.gov/wo/st/en/prog/energy/solar_energy/Solar_Energy_Study_Areas.html.
[22] Department of the Interior Bureau of Land Management, "Notice of Availability of Maps and Additional Public Scoping for Programmatic Environmental Impact Statement to Develop and Implement Agency-Specific Programs for Solar Energy Development; Bureau of Land Management Approach for Processing Existing and Future Solar Applications," *Federal Register* 74, no. 124 (June 2009): 31308.