Solar Energy, National Parks, and Landscape Protection in the Desert Southwest

NATIONAL PARKS CONSERVATION ASSOCIATION

CENTER FOR Park Research

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Executive Summary

Today's newspapers, television and internet news sites, and other media outlets broadcast stories about solar energy and solar energy development nearly every day. This represents a significant change from the recent past, when solar energy was decidedly not mainstream, and reflects a confluence of technological advancement and national policies. On the ground, this means rapidly increasing solar generating capacity, and projects, both currently under construction and proposed, will greatly increase the contribution of solar-generated electricity to the nation's power grid.

Because of the radiant energy it receives and the extensive acreage in public lands, the southwestern United States is currently under significant pressure for construction and operation of industrial-scale solar facilities. Lands managed by the Department of Interior's Bureau of Land Management (BLM) are currently available for solar development, and a number of projects have already been reviewed and approved.

BLM lands around three national parks (Death Valley National Park, Mojave National Preserve, Joshua Tree National Park) in the Mojave/Colorado desert region in California/Nevada have already had solar facilities approved and could face increased solar development in the future. Recently approved projects include: Amargosa Farm Road Solar Energy plant near Death Valley NP, Ivanpah Solar Electric Generating Station close to Mojave NPres, and Desert Sunlight Solar Farm practically abutting Joshua Tree NP. The approval processes for these three projects are examined, and those case studies demonstrate changes made to the project proposal to protect nearby national park resources as well as decisions made that will negatively impact resources of neighboring national parks.

Because of the expected increase in solar energy proposals on BLM lands in the Southwest, the BLM and the Department of Energy (DOE) have drafted a Programmatic Environmental Impact Statement (PEIS) outlining alternatives that will guide solar development across six states (California, Nevada, Arizona, Utah, Colorado, and New Mexico) going forward. The joint BLM/DOE document proposes several alternatives that cover available lands and resource protection issues, as well as other topics.

The decision on this PEIS will impact the character of the southwestern landscape for decades to come, and the current rush to develop must be replaced by a measured and cautious approach if we are going to minimize the impact to the desert landscape and protect resources held in public trust. Recommendations that allow "smart from the start" solar development in the desert Southwest and also protect the resources around and within our national parks include the following:

- Solar right-of-way applicants should consider all appropriate technology to minimize project footprint and impacts on water consumption.

- Regional land management agencies like NPS and FWS must be considered equal participants in the solar project approval process. In addition, BLM should routinely consult with other partners (State, Local, as well as NGOs, citizens groups, and other relevant stakeholders), because the resources at stake are shared resources.

- Information is the key to effective site decisions, so BLM should invest significant resources in thorough inventories to identify important natural and cultural resources that could be affected by siting decisions.

- To proceed cautiously in approving solar projects, projects should be confined to designated solar energy zones, and the lands currently considered as variance lands should be taken off the table for immediate solar energy development.

- The Department of the Interior should consider degraded lands (e.g., industrial brownfields) as potential sites for solar facilities and should bring other significant Federal landholders, including the Department of Defense, to the table when considering the future of solar energy production in the Southwest.

- Special status species, including federally listed, state listed and other rare plants and animals, should continue to be a focus because much of the land in question harbors endemic species or species with a restricted geographic range.

Part I. Solar energy tsunami headed for the American Southwest

Solar Energy: From the fringes and into the light

In the early 1980s, solar energy was considered as a fancy of only the geeks, science teachers, or other mavericks with grandiose dreams of powering specific everyday objects using the bountiful energy from Earth's closest star. The economies of scale just were not there: solar photovoltaic panels were expensive to produce and inefficient at converting sunlight into electricity. Through the remainder of the 1980s and into the 1990s, nothing really changed. If you were listening, you could hear chatter about new research on solar energy (and other renewable energy sources). There was an ongoing research push for solar applications to generate power for important instruments, like the Hubble telescope and the International Space Station, certainly high profile but generally way outside the orbit of everyday American experience.

In contrast, today's newspapers, television and internet news sites, and other media outlets broadcast stories about solar energy and solar energy development nearly every day. Why the change?

In the field of renewable energy, including solar energy, the landscape started to shift in the late 1990s and into the new millennium. Research on renewable energy continued, and the impact of that continued focus was a reduction in the cost to produce energy and the light at the end of the tunnel with respect to emerging economies of scale. Significant opportunities for large-scale renewable energy production now existed, particularly in Europe and Asia, but even within the United States. National policies were beginning to highlight the value and need for significant renewable energy production. Concerns about climate change, continued instability in oil-producing nations, and rapidly dropping costs for renewable energy production had finally shifted the energy landscape.

Today, around the globe, renewable energy has become an important means towards achieving several national policy ends (Muller et al. 2011):

- To improve energy security, emphasizing availability and affordability of domestic energy sources, and more recently overall sustainability and geopolitical security,
- To encourage economic development, particularly in rural and agricultural sectors, as well as development of high-tech sectors,

- To protect the climate and the wider environment from impacts of fossils fuels use, not only at the end of the smokestack, but also over the entire vertical integration (mining/extraction, transportation, etc) of energy production.

All three of these policy drivers were reflected in President George W. Bush's 2005 State of the Union Address. He orated: "To keep our economy growing, we also need reliable supplies of affordable, environmentally responsible energy. Nearly four years ago, I submitted a comprehensive energy strategy that encourages conservation, alternative sources, a modernized electricity grid and more production here at home, including safe, clean nuclear energy. . .And my budget provides strong funding for leading-edge technology - from hydrogen-fueled cars, to clean coal, to renewable sources such as ethanol. Four years of debate is enough - I urge Congress to pass legislation that makes America more secure and less dependent on foreign energy."

The data show that, around this time, the United States was encouraging the renewable energy sector. Muller et al. (2011) chart the patent shares (by country) for various renewable energy technologies from 2002 to 2006. Patent shares, according to Muller et al., indicate "a country's level of specialization in certain technologies and a measure of future potential for market share growth." In other words, patent shares reflect national strides in renewable energy technologies, and the United States over that period had the highest patent shares for solar photovoltaics of the countries presented (Germany, Denmark, Spain, France, United Kingdom, Italy, and Japan) and second behind Germany for patents in solar thermal energy production. These data, then, suggest that in the years leading up to the period reflected in this figure, the United States, relative to other countries, encouraged solar energy research and development.

It is one thing to create an environment where research and development spur technology advancement and lead to patents (or patent applications); it is another to have that research and development translate into energy production for public consumption. In 2005, the Energy Policy Act pushed to the forefront the need to generate and utilize renewable energy as part of a broader national strategy. Title II of Public Law 109-58, Section 211, states: "It is the sense of the Congress that the Secretary of the Interior should, before the end of the 10-year period beginning on the date of enactment of this Act, seek to have approved non-hydropower renewable energy projects located on the public lands with a generation capacity of at least 10,000 megawatts (MW) of electricity." [10,000 MW could power between 3 and 7.5 million homes.] This provision created a point of emphasis for policy going forward for the development of industrial-level renewable energy, including solar energy, on America's public lands.

From the national perspective, then, the confluence of better technologies and the Energy Policy Act of 2005 signaled a sea-change in the trajectory of solar energy. According to the Solar Energy Industries Association (SEIA), a trade association for the US solar energy industry, the amount of installed solar energy production capacity took a dramatic upward turn beginning in 2006. From 2000 to 2005, the installed solar capacity in the US slowly crept up to 100 MW, and this came almost exclusively from photovoltaic installations. However, since then, the rate of change has more closely approximated an exponential growth curve (Figure 1). The majority of production in the last five years has come from photovoltaic arrays (PV), but concentrating solar power (CSP) is beginning to contribute to overall solar production.

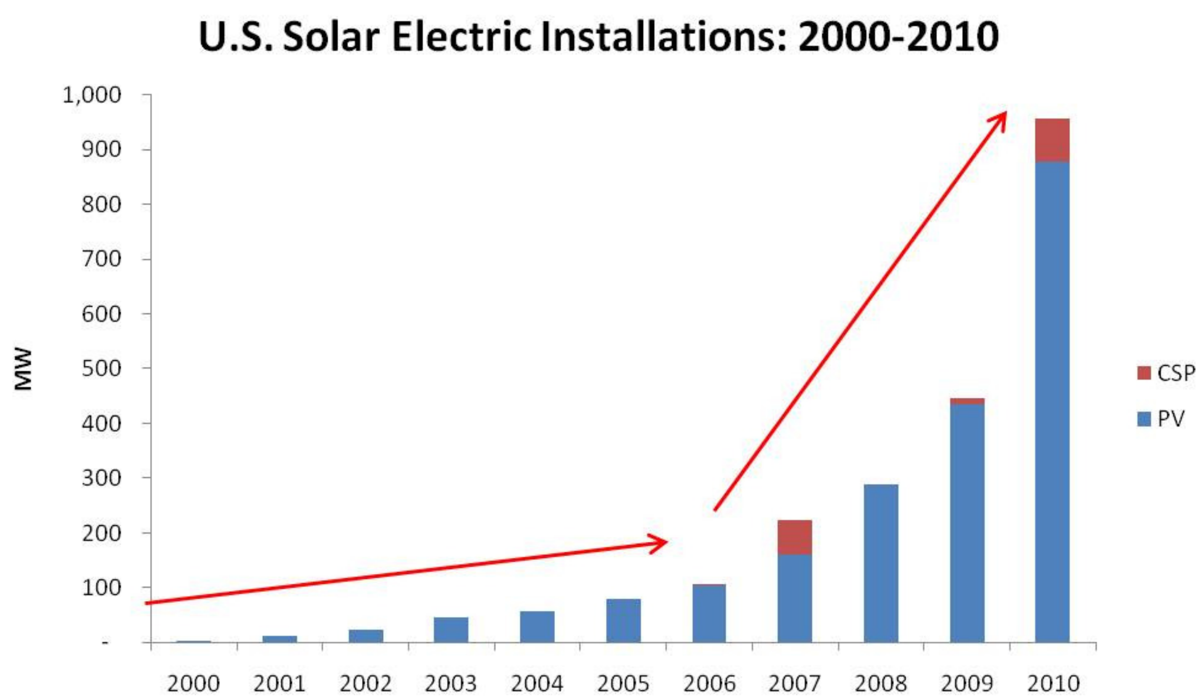

Figure 1. The total utility-scale (> 1 MW) installed solar electric energy generation in the United States (2000-2010). Courtesy of the SEIA (http://www.seia.org/cs/research/industry_data, accessed on 1/18/2012).

These solar technologies produce electricity via different processes. Photovoltaic arrays convert sunlight directly into electricity via the photoelectric effect. Basically, when sunlight hits a photovoltaic cell (sometimes called a solar cell), it excites electrons, causing them to jump between layers of the solar cell. This movement of electrons can be captured in an electric circuit as electricity. Concentrating solar power systems operate in a different way. They essentially replace the fossil fuel combustion process in traditional electricity generation. These concentrating systems focus the energy of the sun and transfer that heat to boil water. The steam, then, drives a turbine to produce electricity. As of 2012, the total MW of utility-scale (>1 MW) installed solar generation was 1,324 MW. Of this 61% was photovoltaic and 39% was concentrating solar power (SEIA 2012).

A photovoltaic panel installation (left) and a concentrating solar power system (right). ©Andrei Orlov/123rf and ©Paul Rommer/Shutterstock

While these trade association numbers reflect the recent rapid increase in installed utility-scale solar, they are, as they say, only the tip of the iceberg. SEIA (2012) reports that, across the nation, there are 4,611 MW of utility solar capacity currently under construction (as of 1/17/2012) and another 25,000 MW under development (pre-construction project development or application phase)! For comparison, the current residential and non-residential (commercial, non-profit, and government) solar energy production in the US totals almost 2,500 MW (SEIA 2012). Solar energy generation through utility-scale projects will soon greatly exceed residential and non-residential generation.

Not only is production expected to increase, but the location of that production is also expected to shift. According to SEIA (2012), most of the solar installations currently operating are on private land; of the 120 current utility-scale projects, 111 of them are on private lands while 3 (3%) are on public lands (6 have no classification). A shift from private lands to public lands is evident for projects under construction and under development. Of the 64 projects under construction, 47 are occurring on private lands and 11 (17%) are occurring on public lands (6 have no classification). For projects under development, 33 of the 199 (17%) listed are planned for public lands.

Industry data (SEIA 2012) also demonstrate one other trend: utility production capacity is increasing. Generating capacity of currently operating projects is generally small. Current private land projects generate between 1 and 80 MW, and current public land projects generate only between 10 and 19 MW (SEIA 2012). Projects currently under construction can generate up to 550 MW. Some projects under development are expected to generate that much, or more! These trends indicate both increasing number of facilities and generating capacity for utility-scale solar. Because of the increased size and generating capacity, many people invoke the term 'solar farm' to describe these facilities.

In 2010, Secretary of the Interior Ken Salazar issued a Secretarial Order (SO 3285A1) that made facilitating production, development, and delivery of renewable energy on public lands a top priority for the DOI. And within DOI, the Bureau of Land Management administers over 250 million acres of public land in the US. This effort by the Department of Interior to open lands for renewable energy development mirrors the broader White House policy effort to encourage electricity generation from a diverse portfolio of renewable sources, including solar, wind, and biomass, as well as other "clean technologies", including nuclear, efficient natural gas, and clean coal (White House 2011). According to "Blueprint for a Secure Energy Future," a White House white paper on energy, President Obama has set a goal of producing 80 percent of our electricity from renewable and other "clean" energy by 2035. This would essentially double the contribution of clean sources to electricity production (White House 2011), but the policy statement does not provide any guidance on how electricity generation will be allocated across that "clean" portfolio. And using public lands, whether they are offshore sites or BLM lands in the Southwest, is a critical part of this overall energy strategy through permitting "environmentally responsible development of renewable energy on public lands" (White House 2011).

The rapid growth in renewable energy development, including solar, projects, observed since 2008 has been further encouraged by the financial stimulus included in the Recovery Act, which made a historic $90 billion investment in clean energy. One aspect of the stimulus, the Section 1603 grant program, converted tax credits into grant payments and made it easier for private companies to initiate clean energy projects and job creation. This grant program was extended by another year through the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010, but is set to expire at the end of 2012.

At the same time that the Federal Government was developing policies to encourage, and even require, solar development, states were doing the same thing (McIntyre and Duane 2011). For example, the State of Nevada has established a Renewable Portfolio

Standard, in which all public utilities must invest, partner to purchase, or co-develop renewable projects. In practice, this means that a certain percentage of retail power sales from these public utilities must come from renewable resources: 15% by 2011-2012, 18% by 2013-2014, 20% by 2015-2019, 22% by 2020-2024, and 25% by 2025. In California, a set of policy statements has spurred the state's drive for renewable energy. California's 2002 Renewable Portfolio Standards established a target of 20% for energy sold to retail customers to come from renewable sources by 2010. (In 2010, 17% of retail electricity sold to customers came from renewable sources. Source: http://www.cpuc.ca.gov/PUC/energy/Renewables/index.htm, accessed 4/19/2012). By 2020, this was supposed to reach 33% (Bare et al. 2009). In 2008, then Governor Schwarzenegger issued an executive order that requires one-third of California's energy production (regardless of the retail destination) to come from renewable resources by 2020 (Bare et al. 2009).

Another facet of the reinvigorated interest in solar energy is the emerging economies-of-scale and the cheaper cost of power generation. Solar technologies have advanced to the point where the production cost for solar power is on a similar level to coal or natural gas production. In fact, a new study by Branker et al. (2011) indicates that the cost decrease of photovoltaic (PV) technology, as well as rapidly reducing installation costs, puts solar energy production on a very equal playing field in certain locations. Costs are coming down (and production costs for other electricity generation are, to some extent, going up), thus removing a cost disparity that was once viewed as insurmountable for general public consumption. A great example of this comes from northern Colorado. The Poudre Valley Rural Electric Association's Board of Directors just announced that consumer prices for renewable energy have been reduced again (NCBR 2012). This year, customers will pay 7.5 cents per 100 kilowatt-hours (kWh) to use renewable energy supplied by Tri-State Generation and Transmission. The price just last year was 9 cents per 100 kWh. Back in 1999, adding power produced by renewable sources was $2.50 per 100 kWh. In effect, a household using 1,000 kWh/month can add renewable energy to its bill for an additional $0.75 today; back in 1999, it would have cost that household 25 additional dollars per month. While this applies to renewable energy in general (likely a mix of wind, solar, and biomass), it indicates the greatly reduced cost of renewable energy for consumers.

In a few decades' time, solar energy has gone from the shadows to the bright lights of the national and international stage. In other words, solar energy has arrived! Technological advances, economies-of-scale, and state- and national-level policies have initiated a seismic shift in the energy production landscape. And the resulting solar tsunami is headed directly for the American Southwest.

The Southwest: Regional Geography and Environmental Features

To state the obvious, solar electricity generation requires sunlight. According to the National Renewable Energy Laboratory based in Golden, CO, the premier location in the US regarding solar irradiance is the Southwest. Over an annual period, seven US states (California, Nevada, Utah, Arizona, Colorado, New Mexico, and Texas) receive the highest levels of solar irradiance that can currently be captured by two different solar technologies (photovoltaic panels and concentrating solar technology), as indicated in Figures 2 and 3.

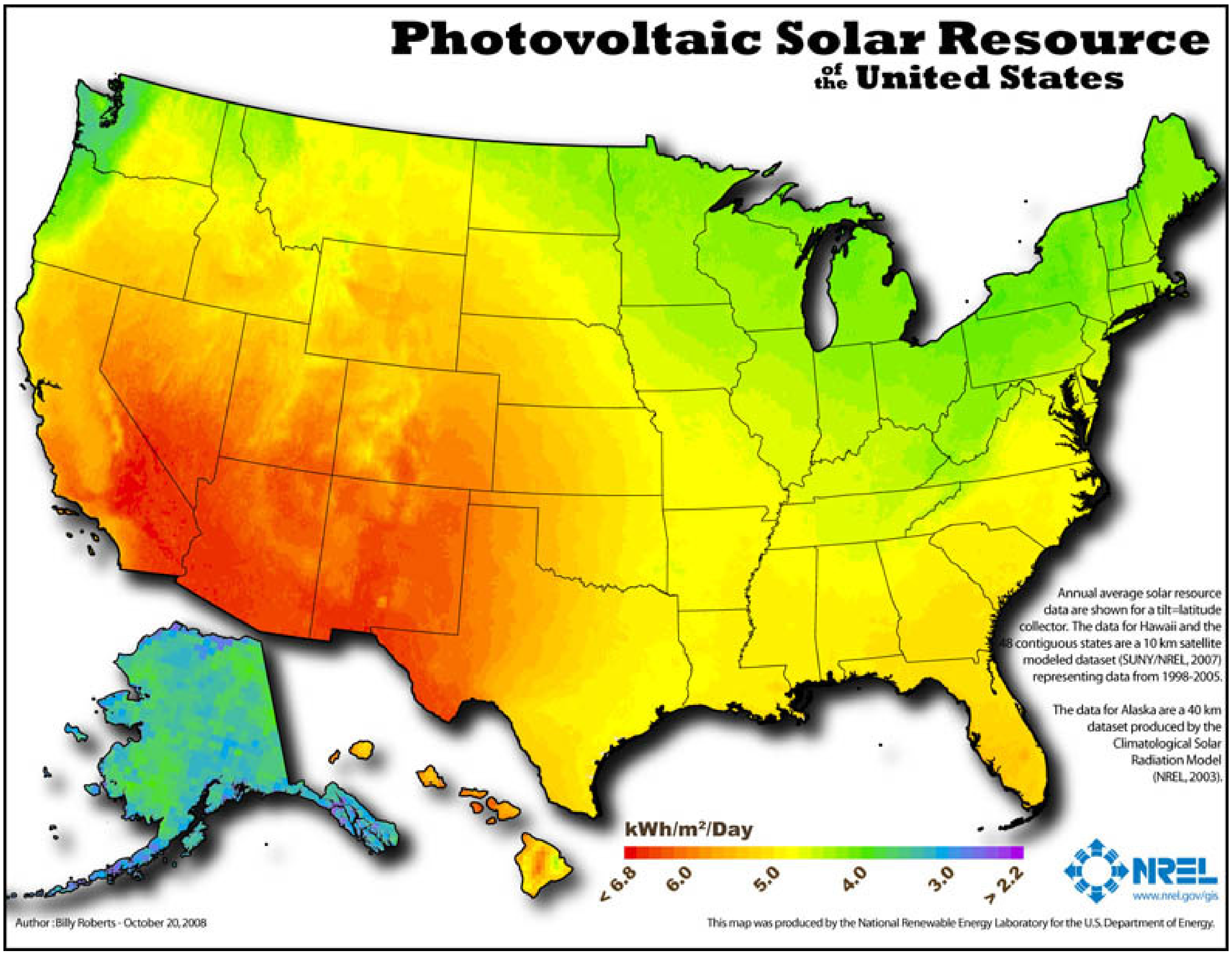

Figure 2. Annual solar irradiance across the United States (expressed as energy per unit area per day) available for capture by photovoltaic panels. Map courtesy of the National Renewable Energy Laboratory (http://www.nrel.gov/gis/solar.html, accessed 1/25/12).

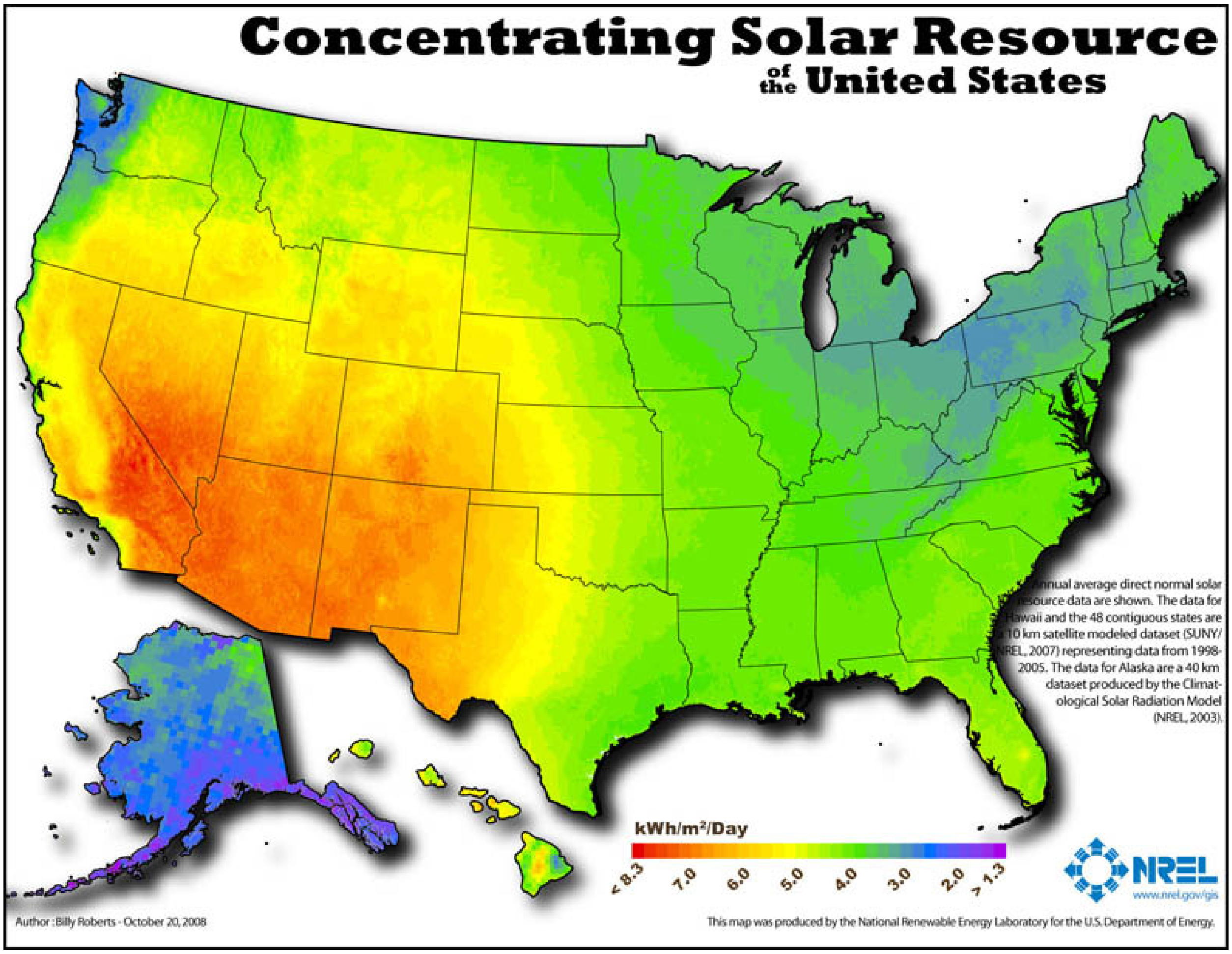

Figure 3. Annual solar irradiance across the United States (expressed as energy per unit area per day) available for capture by concentration solar technologies. Map courtesy of the National Renewable Energy Laboratory (http://www.nrel.gov/gis/solar.html, accessed 1/25/12).

Even within the US Southwest, though, not all areas are equally suited for solar energy production. With today's technology, the best sites for solar energy generation are relatively flat and even surfaces, and the flat areas that intersperse the many small chains of mountains throughout the Southwest are prime candidates for solar energy generation. Much of this report focuses on two specific areas in the California-Nevada-Arizona region: the Mojave and Sonoran Deserts. These deserts receive abundant sunshine, have acres and acres of relatively flat surfaces, generally have low human population densities, and are in large part managed as Federal lands. While they are targets for a strong Federal push to increase renewable energy (particularly solar) production on public lands, there are significant resource values associated with these regions as well.

Contrary to popular opinion, deserts are not wastelands; they are strongholds for biological diversity, including unique plants and animals, and they serve as crucial habitat for natural populations. These deserts are collections of rich ecosystems, and development of any kind (including urban areas or industrial energy facilities) will have some consequence to desert resource values (Lovich and Bainbridge 1999). First, a brief introduction to the deserts of this region and a few of their resource highlights.

Mojave Desert

The Mojave Desert, encompassing more than 32 million acres (Bunn et al. 2007), stretches across parts of California, Arizona, Nevada, and Utah. The Sonoran Desert is south and east, while the Great Basin Desert is north. To the west are the Tehachapi, San Gabriel, and San Bernardino ranges, as well as the Sierra Nevada mountains (Bare et al. 2009).

Figure 4. The location of the Mojave Desert ecoregion is indicated by the dark beige shape, and the 4 national park units are in green. Map courtesy of http://digital-desert.com/regions/ (accessed 2/27/2012).

The Mojave region (within California) ranges in elevation from 11,000 foot mountains down to the nadir of Death Valley, at 282 feet below sea level. While the elevation ranges over 2 miles, most of the desert is a plateau between 2000 and 3000 feet (Bunn et al. 2007). The vegetation in this dry region is characterized by creosote bush scrub, desert saltbush, Joshua tree scrub, desert wash, alkali scrub, and juniper-pinyon woodlands (Bunn et al. 2007). The Mojave region is sprinkled with aquatic habitats, including springs, seeps, and even perennial lotic habitats (e.g., Amargosa and Mojave rivers). While small in area, these aquatic habitats, as you would expect, play a critical role in plant and animal ecologies.

Mojave National Preserve, California. ©Jason Ross/123rf

While some people consider desert ecosystems as wastelands, these areas represent crucial stores of biodiversity. Bunn et al. (2007), utilizing the California Natural Diversity Database in the 3 years preceding the publication of their report, reported that 439 vertebrate species (252 bird, 101 mammal, 57 reptile, 10 amphibian, and 19 fish species) inhabit the Mojave Desert region at some point in their lifecycles. Thirty-one of these species are state endemic special status vertebrates, and 14 of them are endemic to the Mojave region (Table 1).

Table 1. List of the 14 vertebrate species endemic to the Mojave Desert region within California (from Bunn et al. 2007). Group refers to taxonomic grouping (B=bird, A=amphibian, F=fish, M=mammal).

Group	Common Name	Scientific Name
B	Eagle Mountain scrub-jay	*Aphelocoma californica cana*
B	Inyo California towhee	*Pipilo crissalis eremophilus*
A	Black toad	*Bufo exsul*
F	Saratoga Springs pupfish	*Cyprinodon nevadensis nevadensis*
F	Shoshone pupfish	*Cyprinodon nevadensis shoshone*
F	Cottonball Marsh pupfish	*Cyprinodon salinus milleri*
F	Salt Creek pupfish	*Cyprinodon salinus salinus*
F	Mohave tui chub	*Gila bicolor mohavensis*
M	Earthquake Merriam's kangaroo rat	*Dipodomys merriami collinus*
M	Panamint kangaroo rat	*Dipodomys panamintinus anamintinus*
M	Mohave River vole	*Microtus californicus mohavensis*
M	Amargosa vole	*Microtus californicus scirpensis*
M	No common name	*Perognathus longimembris salinensis*
M	Kingston Mountain chipmunk	*Tamias panamintinus acrus*

Complementing these endemic vertebrates are the 22 invertebrate species known to be endemic to the Mojave region (Bunn et al. 2007, Table 7.2). While this seems like a lot of endemic species (and it is), it is not surprising in a broader ecological context. Regions like the Mojave with a significant range in elevation, as well as the number of micro-climates and –habitats that form due to the complex geography (mountain faces, flat interspersing valleys, small aquatic habitats), often demonstrate large numbers of endemic species. Far from a wasteland, then, the Mojave region is a biological oasis.

At the same time, many species of concern residing in the Mojave are not endemic species (with an often narrow habitat requirement), but are instead widely dispersed species that range as individuals across fairly large areas. Some authors refer to these as "flagship" species (Bare et al. 2009, citing the California Department of Fish and Game), especially as a symbol of the desert natural community. One such flagship species is the desert bighorn sheep (*Ovis canadensis nelsoni*). Because the geography of the region is comprised of mountains interspersed with flat valley regions, the desert bighorn sheep has a naturally discrete distribution. According to Bare et al. (2009), the region of the Mojave desert within California is home to 69 populations (typically with less than 50 individuals per population, Epps et al. 2005), and there is evidence that individuals from these populations interchange and may create a metapopulation (Bleich et al. 1990, Epps et al. 2007). A metapopulation is a collection of geographically discrete populations connected by migration. Because of this population structure, there is significant conservation concern that changes in the landscape will impact the exchange between desert bighorn metapopulation units (Bare et al. 2009). Epps et al. (2005) have demonstrated that roads and highways that crisscross sheep habitat have, in fact, reduced gene flow between discrete population units. The consequences of further landscape modification, including locating and building solar generation facilities, for this species are unclear.

Desert bighorn sheep, a flagship desert species. ©David Lamfrom

The other flagship species is the desert tortoise. In fact, Bunn et al. (2007) refer to the desert tortoise (*Gopherus agassizii*) as THE flagship species of the Mojave Desert. [As an aside, the widely distributed desert tortoise has recently been split into two subspecies based on genetic evidence. The tortoise had up until last year been considered and managed as a widely distributed species with two distinct populations separated by the Colorado River. Now, scientists consider these two populations to be two distinct species. The Mojave population is now known as the Agassiz's desert tortoise (*Gopherus agassizi*). Tortoises east and south of the Colorado River are now known as Morafka's desert tortoise (*Gopherus morafkai*). For the purposes of this report, information on desert tortoise will specifically address Agassiz's desert tortoise found in the Mojave and Sonoran region.] Listed as threatened and protected under the Endangered Species Act since 1990, the desert tortoise inhabits the creosote scrubs common throughout this region and eats grasses (especially spring annuals). While desert tortoises do not move quickly, they do move extensively and have home ranges up to 100 acres (Marlow 2000, cited in Bare et al. 2009). Like bighorn sheep, changes in the landscape have impacted the desert tortoise. Increased anthropogenic changes to the landscape (including urban development and road construction) have reduced individual survival (Esque et al. 2010) and altered gene flow (Latch et al. 2011) within tortoises of the Mojave region. Furthermore, associated landscape changes like invading exotic grasses and increased abundance of tortoise predators (e.g., common raven) also threaten the tortoise (Boarman 2002). Potential impacts of solar energy development on the desert tortoise in this region are another central topic of consideration throughout this report.

Agassiz's desert tortoise, a federally listed threatened species. ©David Lamfrom

Randall et al. (2010) use an ecoregional approach to identify conservation targets for the Mojave Desert region. Using a combination of species-level information, along with information on ecological systems and all-important seep/spring and aquatic habitats, the study identified landscape segments and ranked them according to their value for protecting the ecological integrity of the Mojave region. Lands with the highest value include lands considered ecologically core regions; these are relatively undisturbed and, more importantly, unfragmented landscapes deemed critical for long-term conservation efforts in the Mojave (Randall et al. 2010). The next tier in conservation priority is referred to as ecologically intact, lands that are today relatively intact and unfragmented and also tend to buffer the core areas from other disturbed lands. Moderately degraded and highly converted lands offer the lowest conservation value. The analysis by Randall et al. (2010) demonstrated that much of the area around the national parks in this region (Death Valley National Park, Mojave National Preserve, and Joshua Tree National Park—often collectively referred to in this report as the California desert parks) is classified as either ecologically core or ecologically intact (Randall et al. 2010).

Due to the inclement conditions and generally low human population densities across this region, much of the Mojave Desert region is considered intact and in relatively good condition (Randall et al. 2010). It would be hard, though, to characterize this region as pristine, as many parts of this desert have been significantly altered by human activity (Lovich and Bainbridge 1999). Historic activities, like mining, livestock grazing, military operations, and agriculture (Lovich and Bainbridge 1999), and more modern impacts, like urban growth and development, groundwater pumping, and inappropriate off-road vehicle use (Bunn et al. 2007), have impaired or currently threaten the integrity of the Mojave region. Interestingly, in the Bunn et al. (2007) report, there was no mention of potential impacts of energy development for the Mojave region. Many other threats are highlighted, including many landscape changes correlated with solar energy development, but solar energy was not mentioned. This highlights the fact that this has been a very recent and rapidly developing concern in this region.

Colorado Desert

The Sonoran Desert ecoregion, over 55 million acres in area (Marshall et al. 2000) extends from south of the Mojave Desert down into Mexico and Baja California and eastward into much of southern Arizona. The majority (40.4%) of this ecoregion is in Arizona, and the next largest fraction (39.8%) is in the Mexican state of Sonora. Over 6 million acres (11.4% of the larger ecoregion) is within California. This section within California is often referred to as the Colorado Desert (Bunn et al. 2007). The Colorado Desert region is shown in Figure 5.

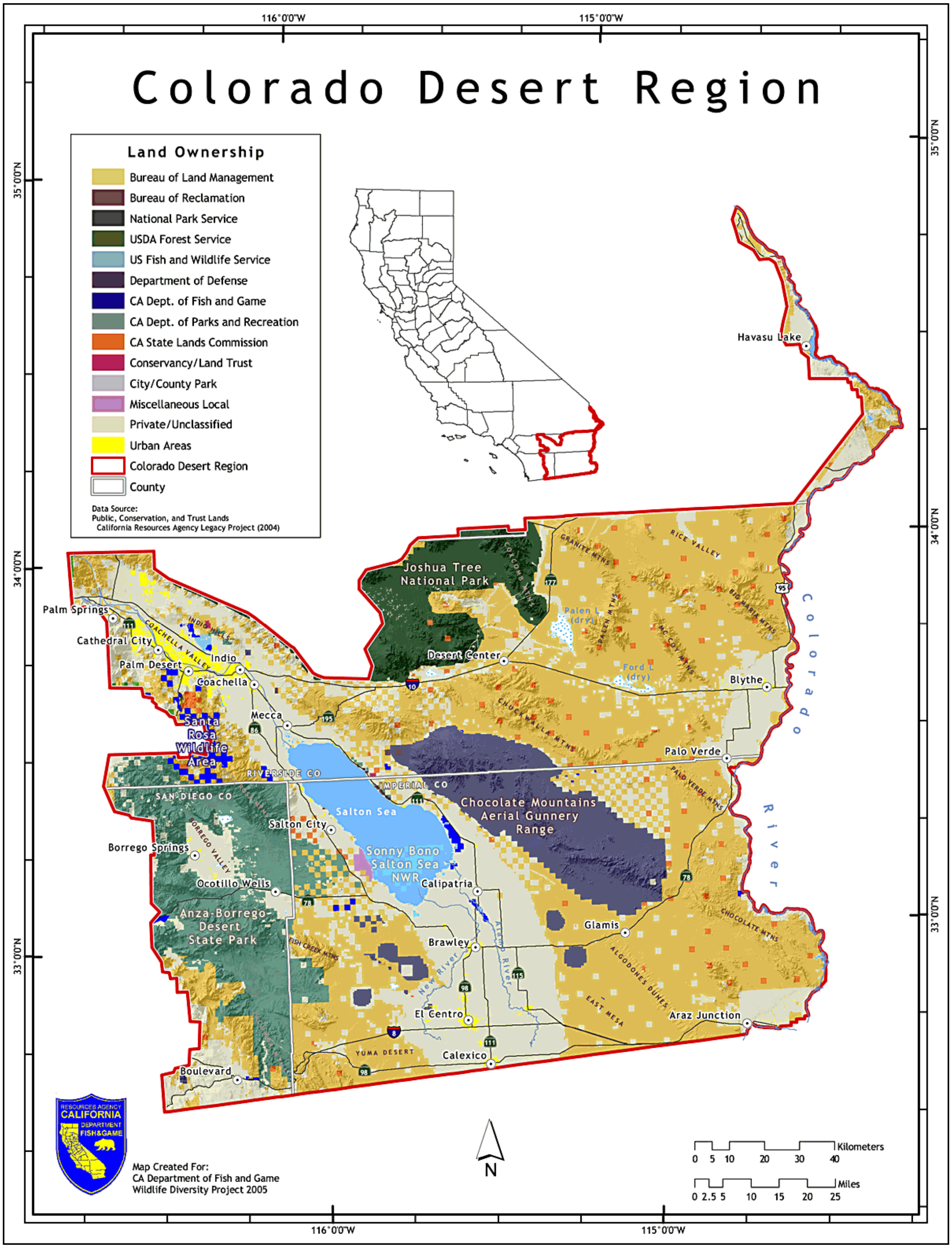

Figure 5. The Colorado Desert in southern California. Map courtesy of http://www.dfg.ca.gov/wildlife/WAP/region-colorado.html (accessed 2/27/2012).

Much of the Colorado Desert sits below 1000 feet in elevation and experiences greater summer daytime temperatures than higher elevation deserts (e.g. Mojave Desert). What scant precipitation it receives comes in the form of both winter and late summer (monsoonal) rains (Bunn et al. 2007). Similar to the Mojave, the vegetation is characterized by scrub habitat, including creosote bush and desert saltbush. Mixed scrub vegetation here also means yucca and cholla cactus. Higher elevations are characterized by pinyon pine and California juniper (Bunn et al. 2007).

Like the Mojave region to the north, many in the general public have a mental image of the Sonoran region as a dusty wasteland. This is not an accurate depiction. The Sonoran Desert ecoregion has a high proportion of endemic species, including plants, reptiles, and fish (Marshall et al. 2000). The region contains an exceptional diversity of pollinators, including the highest known diversity of bee species in the world (Marshall et al. 2000). Over 500 bird species utilize this area, either as a permanent residence, breeding grounds, or as a migratory stopover (Marshall et al. 2000). Bunn et al. (2007) list 4 endemic vertebrate species within the Colorado Desert (Table 2). There are also 8 endemic invertebrate species in the Colorado Desert.

Table 2. Endemic vertebrates of the Colorado Desert (from Bunn et al. 2007). Group refers to taxonomic grouping (A=amphibian, M=mammal, R=reptile).

Group	Common Name	Scientific Name
A	Desert slender salamander	*Batrachoseps major aridus*
M	Palm Springs pocket mouse	*Perognathus longimembris bangsi*
R	Coachella Valley fringe-toed lizard	*Uma inornata*
R	Sandstone night lizard	*Xantusia gracilis*

Like the Mojave, the Sonoran ecoregion as a whole is threatened by habitat loss (through land use conversion by urbanization and agriculture), overuse of surface water and groundwater resources, increasing recreational use, and improper livestock management (Marshall et al. 2000). Specifically, within the Colorado Desert section, the listed threats are very similar: water management conflicts, inappropriate off-road vehicle use, loss and degradation of dune habitats, growth and development, and invasive species (Bunn et al. 2007). Despite the climate, or perhaps because of the climate, the human population is expected to increase throughout the next decade. Population in the nine cities of the Coachella Valley (Figure 5) is projected to increase 50% over the 20 years following 2000 (Bunn et al. 2007).

Common wildlife of the Colorado Desert region includes mule deer, bobcat, Gambel's quail, and red-diamond rattlesnake. Wildlife species considered sensitive include the flat-tailed horned lizard, Coachella Valley fringe-toed lizard, desert tortoise, prairie falcon, Andrews' dune scarab beetle, Peninsular bighorn sheep (a distinct population segment of the desert bighorn sheep), and the California leaf-nosed bat (Bunn et al. 2007).

Within the Colorado Desert, several vegetation communities are considered of high value for conservation purposes (CBI 2009). Desert dry wash woodlands, higher elevation pinyon-juniper woodlands, and creosote bush scrub and desert mixed scrub are all considered vegetation communities of high value primarily for their biodiversity. CBI (2009) noted that, from a modeling perspective, these vegetation communities provided a first-level filter by which to delineate conservation priorities based on the assumption that protecting these habitats would protect priority species. For example, since desert tortoises rely on desert wash and flat creosote scrub habitats (among others), using this priority habitat as an indicator for the priority desert tortoise provided a useful approach. The habitat approach was also necessary because, for the most part, high resolution data for biological resources simply were not available (CBI 2009). This is a theme that the report will return to many times: much of the decision-making regarding site selection for renewable energy projects (including solar) is made in a general absence of detailed information.

Like the Mojave Desert area, the area of the Colorado Desert south and east of Joshua Tree NP is an area threatened by renewable energy development, including solar, wind, and geothermal energy. CBI (2009) mapped the relative probabilities of renewable energy development in the Colorado Desert, and solar energy development posed a consistent significant threat across the region. Figure 5.2 in CBI (2009) shows that significant acreage adjacent or proximate to Joshua Tree NP is threatened by industrial-scale solar energy development.

One last point needs to be made, as it has implications for any and all decisions made about land use changes in both the Mojave and Colorado deserts. As Lovich and Bainbridge (1999) argue, these desert systems have a history of anthropogenic impacts. The published literature on restoration efforts and ecosystem recovery times suggests that these fragile habitats are very slow to recover. Indeed, times to recover to pre-disturbance plant cover and biomass levels can take between 50 and 300 years. Land use decisions in these regions should not be made lightly, as we may find ourselves living with those consequences for decades or even centuries.

Regional Stakeholders and Shared Resources

Most of the lands in the Mojave Desert and Colorado Desert regions are under Federal land management. In the Mojave Desert ecoregion, the Bureau of Land Management manages over 14.5 million acres (45.6%) of land, and the next two largest Federal managers are the National Park Service (managing nearly 6.5 million acres, 20.1%) and the Department of Defense (DoD, 3.8 million acres, 11.8%; Randall et al. 2010). Within this ecoregion, over 4.7 million acres (14.7%) are under private ownership. Considering the Mojave region contained only within California, the relative proportions of managed lands are fairly similar; within California, the BLM manages 41% of the land, while NPS and DoD manage 26% and 13%, respectively. Eighteen percent of California's Mojave region is held in private hands (Bunn et al. 2007).

Within the Colorado Desert, the BLM is the largest land manager, managing over 43.1% of the region's 7 million acres (Figure 5). The DoD manages approximately 7% of the land. Nearly 9% of this area is protected as the Anza Borrego Desert State Park. The National Park Service is a relatively minor land manager in the Colorado Desert. Slightly less than half (~340,000 acres, 43%) of Joshua Tree NP sits within the Colorado Desert (Bunn et al. 2007, also see Figure 5).

On the Federal side, the BLM and the NPS are major land managers throughout the southern California desert region (both Mojave and Colorado Deserts), but they are guided by different missions that can result in conflicts over desert resource management (Randall et al. 2010). The 1976 Federal Land Policy and Management Act (FPLMA) that guides the BLM directs that "public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals." The National Park Service Organic Act (1916) from 60 years earlier generally mirrors the FLPMA resource protection angle: the "purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Where the agency missions diverge, though, is with respect to human use and resource extraction. The FLPMA allows management "that will provide for outdoor recreation and human occupancy and use." More specifically, the California Desert Conservation Area Plan (BLM 1999) directs the BLM to "provide for the immediate and future protection and administration of the public lands in the California Desert within the framework of a program of multiple use and sustained yield, and the maintenance of environmental quality.” On the other hand, the national park units in the region all endeavor for higher levels of resource protection. Death Valley National Park “dedicates itself to protecting significant desert features that provide world class scenic, scientific, and educational opportunities for visitors and academics to explore and study.” (NPS 2002). At Joshua Tree NP, the NPS “preserves and protects the scenic, natural, and cultural resources representative of the Colorado and Mojave deserts’ rich biological and geological diversity, cultural history, wilderness, recreational values, and outstanding opportunities for education and scientific study” (NPS 2011). Mojave, being a national preserve, has a focus on resource protection but slightly less so than at national parks. “Mojave National Preserve was created to protect the area’s diverse natural and cultural resources and to perpetuate the sense of discovery, solitude, and adventure that has existed for generations (NPS 2007, cited in Randall et al. 2010). However, all three of these park units are required to be managed for the high level of resource protection required by the National Park Organic Act.

Joshua Tree National Park. ©David Lamfrom

As will become apparent later in this report, different land management agencies with differing missions can result in land management conflicts. The management missions of the NPS and BLM differ, but these agencies are neighbors throughout the region. Conflict emerges when management approaches (e.g. vehicular access, hunting) or decisions (e.g. permitting renewable energy projects) by one body affect the other agency's ability to meet its mission. For solar energy development, decisions made by BLM affect NPS resources, from wildlife species that have home or foraging ranges extending across jurisdictional to scenic vistas from a mountain top across the valley (and many other examples). The story to be told on solar development in the California desert region, then, is a story about how resources are protected across the landscape through planning and decision-making.

Competing agency missions and interests become crucial in considering the potential resource impacts of the solar energy boom in the southwestern United States. The major reason for this is that the land area under consideration for solar energy generation is significant. Figure 6 shows the size ranges for solar projects approved or under consideration on BLM lands in California, Nevada, and Arizona. These are significant chunks of land, and decisions made have consequences (i.e., acres converted equals habitat lost) for the resources both within and near those places. Furthermore, the impacts to resources are not exclusive to BLM lands alone; instead, the resource impacts will be spread across the landscape and across other management jurisdictions.

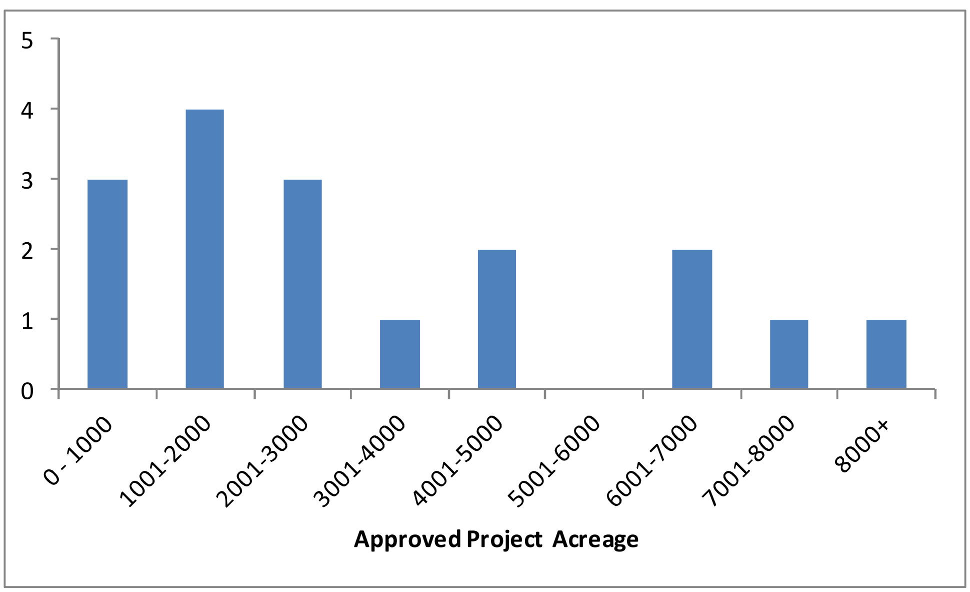

Figure 6. Acreage approved by BLM for already-processed solar right-of-way applications or requested for upcoming priority solar projects. Data from BLM websites.

With respect to industrial solar energy development on Federal lands, the BLM's philosophy is one of "smart from the start" and has led to the larger programmatic effort to analyze solar energy zones as one way to be "smart from the start." This is certainly a good first step, but is only one step in a long journey. Other land managers, like NPS and Fish and Wildlife Service, must be included from the very beginning in the planning and decision-making process because of the shared resources at risk. Community groups and other local stakeholders must also be included in the process to insure that the rush to develop energy resources does not cut from the process those most likely to be impacted by those decisions. For example, the communities of Yucca Valley, Landers, Joshua Tree, Twentynine Palms, Flamingo Heights, and Wonder Valley comprise the Morongo Basin Open Space Group and advocate for open space throughout the Morongo Basin (http://morongobasinopenspacegroup.camp7.org/Default.aspx?pageId=392235, accessed 1/31/2012). For this group, wildlife connectivity and habitat linkages (e.g. Penrod et al. 2008) are a crucial consideration for land use decisions. Because of this, decisions made by BLM in siting or permitting a solar energy plant may have significant implications for this citizen's group. Including these perspectives in comprehensive land use decisions will be critical for local buy-in.

The next section of this report will highlight three case studies from recently approved industrial solar energy projects on BLM lands. Two of the projects (Ivanpah SEGS, Desert Sunlight Solar Farm) are currently under construction; construction on the third project (Amargosa Farm Road) has not yet begun. This section will provide an overview of the decision made, the proposed solar technology, and some of the major resource issues considered during the environmental impact statement process. All three of these projects resulted from BLM's newly authorized "fast-track" process. The examples will show that, in some respects, resource protection concerns were addressed in spite of that rapid approval process and, in other respects, resource protection issues fell by the wayside.

These three case studies are not intended as an exhaustive review of all potential resource issues; instead, they serve to highlight three resource classes: water, wildlife, and visual resources. Other resource topics, including cultural resources, are referenced only generally. That is not to say those other topics are unimportant, but instead to say they are out of the purview of this report.

Part II. Case Studies of Approved Solar Energy Facilities

Amargosa Farm Road Solar Energy Plant Near Death Valley National Park: Preserving Water Resources to Protect Critically Endangered Species

Geographic Overview

The first case study under consideration in this report is the Amargosa Farm Road (AFR) Solar Energy Project, located in the Mojave Desert region in Nye County, Nevada. Solar Millennium, LLC proposed this project, a concentrated solar power technology, and petitioned BLM to approve the industrial facility on BLM lands in this part of Nevada. Nye County (area 47,091 km2), as of the 2010 Census, contained only 43,946 people (http://quickfacts.census.gov/qfd/states/32/32023.html, accessed 2/2/2012). Nearby cities include Pahrump and Beatty. The Nevada National Security Site (formerly known as the Nevada Test Site), a 3,500 km^2 area once used extensively as a land-based nuclear proving ground, is only a few miles northeast of the Amargosa facility. The Las Vegas urban area is 85 miles east-southeast.

The approved AFR project is only 5 miles from Death Valley National Park, the largest park (3,372,402 acres) in the continental United States. Over 98% of the land within the park boundary is federally owned. Most of the park is within California, but a small piece of the park extends into Nevada and so does the 40 acre Devils Hole detached unit located in Nevada's Ash Meadows National Wildlife Refuge. Death Valley NP includes all of Death Valley, a 156-mile valley wedged between the Panamint and Amargosa Ranges on the west and east, respectively (NPS 2002). This park contains the lowest point in the Western Hemisphere (282 feet below sea level) and preserves and interprets the Mojave Desert, its diversity of animal and plant life, and the human history in this region. In addition to these natural and cultural park values, other park assets include the vast open spaces and overwhelming silence (NPS 2002). Nearly 95% of the park is designated wilderness, and the park provides a unique opportunity to experience the Mojave Desert in all its physical grandeur. And people do visit. From 1995 to 2001, Death Valley's annual visitation topped the 1 million mark. Since then, and up to 2010, the visitation has declined a bit. Visitation in 2010 (the last year for which park statistics are available on http://www.nature.nps.gov/stats/, accessed 2/13/2012) was estimated at 984,775.

NPCA's Center for State of the Parks published a resource assessment on Death Valley National Park in 2005. The park's natural and cultural resources rated 'fair', scoring 67 and 71 out of 100, respectively, during the resource condition assessment. On the natural resources side, some resource highlights from that assessment included retiring historic grazing allotments within the park and careful managing of the 40 acre detached Devils Hole unit. Resource threats highlighted included non-native invasive plants and animals, air pollution driven by adjacent development and population growth, and groundwater depletion. Assessed cultural resources were generally strong, including a strong ethnography program, museum and archival collections, and archaeology program. Interestingly, at the time of the assessment, there were no concerns cited regarding industrial solar development outside the park.

Project Approval Timeline

The Bureau of Land Management published in the July 13, 2009 Federal Register (Vol. 74, No. 132, pg 33458) a Notice of Intent (NOI) announcing the preparation of an Environmental Impact Statement (EIS) regarding a proposed solar energy plant in Nye County, NV (Figure 7). Solar Millennium, LLC, submitted a right-of-way application to the BLM, and this NOI was the first public announcement and the beginning of a public process designed to explore alternatives, evaluate direct and cumulative potential resource impacts, solicit stakeholder responses for the proposed actions, and render a decision regarding the project. Those familiar with the EIS process across many government agencies know that this can be a long, deliberate, and sometimes drawn-out effort. However, Executive Order 13212 (Actions to Expedite Energy-related Projects), dated May 18, 2001, which ordered government agencies to act to "expedite projects that will increase the production, transmission, or conservation of energy" (BLM 2010c) and President Obama's own administration priorities, fast-tracked and expedited this review. The subsequent timeline shows that the review and approval process were relatively fast indeed.

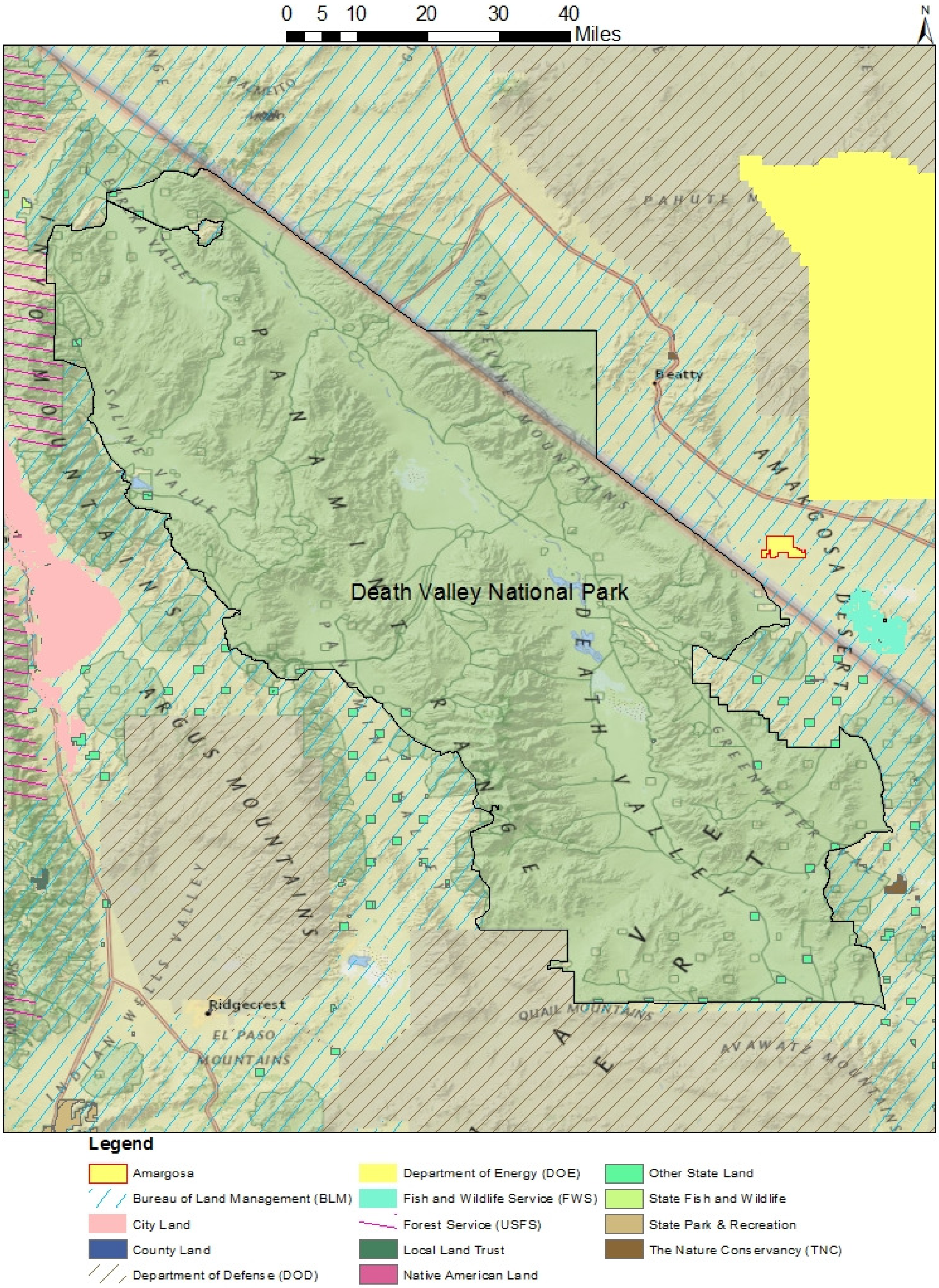

Figure 7. Death Valley National Park and the location of the approved Amargosa Farm Road Solar Facility. Map produced in collaboration with USGS (Reston, VA). Boundary

depictions and spatial data for location and footprint of the proposed Amargosa Farm facility were provided to USGS by NPCA.

The timeline of the review and approval process, then, went as follows. The July NOI initiated a series of public meetings beginning in August 2009, and into September. BLM considered the public comments and published in the Federal Register (Vol. 75, No. 53, pg 13301-13302) the Notice of Availability (NOA) for the Draft Environmental Impact Statement (BLM 2010c). The release of the DEIS in March 2010, was followed by public meetings in April 2010. Six months later, the October 15, 2010, issue of the Federal Register (Vol 75, No. 199, pg. 63503-63504) announced the availability of the final EIS (FEIS), with its finalized impact assessment and recommended action alternative. The Secretary of the Interior approved the Record of Decision on November 15, 2010, only 4 weeks after the FEIS was announced.

The BLM's efforts to expedite the process are evident. All told, the EIS process (at least the public part, of which there is a formal record) lasted from July 2009, to November 2010, approximately 16 months. This is not to imply that streamlining the process is at odds with resource protection; in fact, the case study shows that several decisions were made to the expected benefit of the resources in question.

Proposed Project and Technology

Solar Millennium, LLC, proposed constructing an industrial solar facility that used parabolic mirrors and solar thermal technology to produce electricity. Generally speaking, a plant using this technology would consist of three main parts: the solar field with the heat transfer circuit (Figure 8, left), the storage system (Figure 8, middle), and the power plant block with turbine, generator, and cooling circuit (Figure 8, right; Solar Millennium AG nd). During the day, the thermal field directs and concentrates solar radiation to absorber tubes that run along the focal point of the collector. Within those absorber tubes, a heat-transfer fluid (HTF) transfers the thermal energy to the heat exchanger. The heat exchanger generates steam, which drives a turbine to generate electricity. If the sun's energy is sufficiently intense, not only does the heated fluid generate steam (and thus electricity) but also heats up a storage tank of liquid salts. This tank serves to "store" some of the sun's energy for use after the sun goes down. This is one of the great technical advances provided by this solar thermal technology: it addresses the question of what you do when the sun goes down. The residual heat in the storage fluid can provide heat to continue generating steam for hours after the sun sets. Indeed, a properly scaled plant can provide energy during the day and then throughout the night using the stored heat (Solar Millennium AG nd). Thermal storage allows more energy production out of one day's sunshine. Over an annual period, the additional production of electricity past sundown can dramatically increase plant production capacity—up to 70% or more (http://www.nrel.gov/csp/troughnet/thermal_energy_storage.html#heat, accessed 2/2/2012).

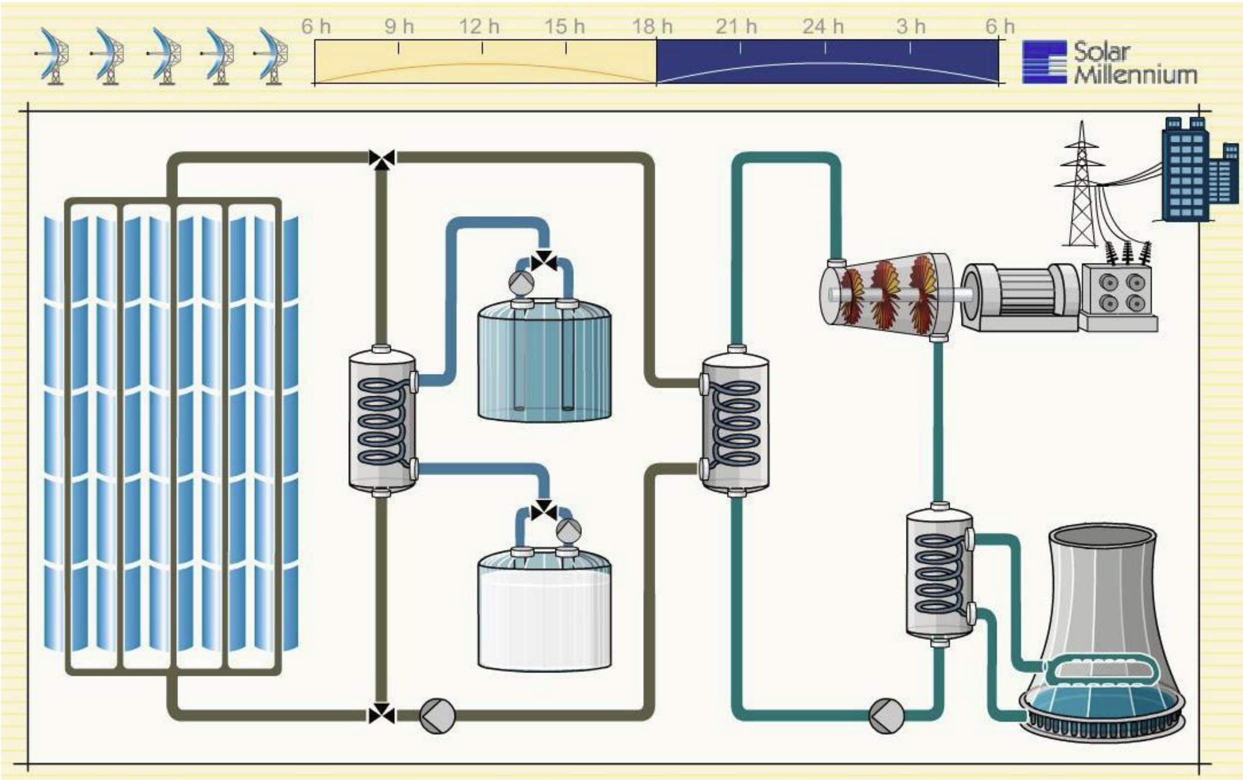

Figure 8. Schematic of a solar thermal plant using parabolic trough mirrors in the solar field. Figure taken from Solar Millennium AG (nd).

Solar Millennium, LLC, proposed using this type of technology for AFR. Specifically, Solar Millennium's plant would consist of two 250-MW solar plants and the associated infrastructure on 6,320 acres, of which the project facilities would be on 4,350 acres of that land. Each plant would have a solar field, numerous parallel rows of solar collectors, arranged along the north-south axis, which focus the sun's rays on a receiver tube using parabolic mirrors of silver-coated glass to heat temperature-stable synthetic oil (which can be heated to 400 °C). The proposed plant's specifications estimated that the storage capacity of the plant would continue to generate power up to 4.5 hours after sundown (BLM 2010d).

Within the context of the proposed technology, two alternatives were considered during the initial BLM review. One option utilized a wet-cooled system, where the superheated fluid would be cooled by water. This design requires significant water resources, with an estimated annual requirement of 4,400 acre-feet per year (AFY; 1 acre-foot is 325,851 gallons). [As a point of comparison, annual household use in selected US cities can range between 50,000 and 200,000 gallons/year, or 0.15 to 0.61 AFY (Rockaway et al. 2011)]. Not only does the process use higher amounts of water, but this used water has to be stored on site in detention ponds in order for it to cool sufficiently. Other water needs for the wet-cooled option include water for mirror washing and dust suppression, but these consumptive totals are relatively small compared to the water needs for cooling (BLM 2010c). The other option, a dry-cooled system uses forced air to cool the system. The dry-cooled system requires only 400 AFY, and 245 acre-feet of this is needed for mirror washing and dust suppression (BLM 2010c).

Water-related concerns were a main point of contention during the review and public comment period. A September 30, 2009, article in the New York Times ("Alternative Energy Projects Stumble on a Need for Water") highlighted the issues between these two alternative technologies. The wet-cooled system was Solar Millennium's preferred technology; it is cheaper and more efficient than the dry cooled technology (BLM 2010d). But water use became a major issue, from the perspective of available water (a wet-cooled plant would use an estimated ~20% of the Amargosa Valley's available water (NYT 2009) for people and for wildlife, in particular the wildlife that rely on groundwater at the Ash Meadows NWR. This will be detailed in the Water Resources section below.

After concluding its review and necessary consultations, the BLM and DOI issued the Record of Decision (ROD), granting Solar Millennium, LLC, to construct and operate the Amargosa Farm Road Solar Facility (BLM 2010e) as a dry-cooled facility. The decision included the following text: "The BLM, after careful consideration of the potential effects of the proposed project, has decided to authorize Solar Millennium, LLC to construct a 500-MW concentrated solar power generation facility as described in the Proposed Action. . .The BLM considered several key factors including visual resource management, social economics, and water use, in its decision to authorize the project. The Solar Millennium dry-cooled alternative allows for the least amount of water use among the . . .proposed alternatives. In addition. . . a stipulated agreement between BLM, USFWS, NPS, and Solar Millennium provides that Solar Millennium will acquire 236 acre-feet per year as mitigation water, to ensure that any potential effects to groundwater levels in the vicinity of Devils Hole and the Ash Meadows National Wildlife Refuge are mitigated."

<u>Resource Impacts</u>

Vegetative Communities and Plants

The Amargosa Farm Road project sits in the Amargosa Valley, the broad flat valley east of the Funeral Mountains, which form the eastern rim of Death Valley, and the Yucca

Mountains to the north. The Amargosa Valley is part of the Mojave Desert ecoregion, and as such, the project site is characterized as creosote desert scrub (Tierra Data 2009). Within the project area, creosote (*Larrea tridentata*) is the sole dominant plant (40% of project area); in other areas, codominant species include burrobush (*Ambrosia dumosa* in 38% of project area) or saltbush (*Atriplex* spp. in 17% of project area). In between the shrub canopies, the land is essentially barren desert pavement. Invasive plants are not well-established or common in the project area (Tierra Data 2009). In general, the soils in the area are well-drained and alluvial in origin.

Two other noteworthy habitat types comprise a small fraction of the project area. Creosote-saltbush sandy flats occur on 22.3 acres (0.3% of the project area). These habitats occur along the edges of Amargosa Farm Road, where sands and finer sediments are more common (Tierra Data 2009). Sparsely vegetated desert washes occur on 95.6 acres (1.2% of the project area), and generally run in a northeast-southwest direction across the western side of the project area. Unlike desert washes in other areas, these do not have the typical desert wash vegetation (desert willows), and instead may only have sparse representation of cheesebush (*Hymonoclea salsola*).

During field surveys for plants, a total of 61 species were found within the proposed project area. None of these species were considered special status species by either Federal or Nevada (Tierra Data 2009).

The AFR project would clear and grade up to 4,350 acres for the solar facility for the life of the project, thus destroying these vegetative communities and habitats over that acreage.

Animal Wildlife

Surveys indicated direct or indirect evidence of 18 mammal species, 27 bird species, and 13 reptile species in the project area (Tierra Data 2009, Table 3).

Table 3. Wildlife species observed directly or indirectly during field surveys of the Amargosa Farm Road Solar Energy Project. Data from Tierra Data (2009). Group refers to taxonomic grouping (B=bird, R=reptile, M=mammal).

Group	Common name	Scientific Name	Status
M	Deer Mouse	*Peromyscus maniculatus*	
	Little Pocket Mouse	*Perognathus longimembris*	
	Long-tailed Pocket Mouse	*Perognathus formosus*	
	Merriam's Kangaroo Rat	*Dipodomys merriami*	
	White-tailed Antelope Squirrel	*Ammospermophilus leucurus*	
	Desert Cottontail	*Sylvilagus audubonii*	

	Black-tailed Jackrabbit	*Lepus californicus*	
	California Myotis	*Myotis californicus*	BLM
	Yuma Myotis	*Myotis yumanensis*	BLM, NV
	Western Paratrelle	*Parastrellus Hesperus*	BLM, NV
	Townsend's Big-eared Bat	*Corynorhinus townsendii townsendii*	BLM
	Pallid Bat	*Antrozonous pallidus*	BLM, NV
	Brazilian Free-tailed Bat	*Tadarida brasiliensis*	BLM, NV
	Domestic Dog	*Canis familiaris*	
	Coyote	*Canis latrans*	
	Kit Fox	*Vulpes velox*	
	Burro	*Equus asinus*	
	Bighorn Sheep	*Ovis canadensis*	
B	Great Egret	*Ardea alba*	
	White-faced Ibis	*Plegadis chihi*	NV
	Turkey Vulture	*Cathartes aura*	
	Cooper's Hawk	*Accipiter cooperii*	
	Swainson's Hawk	*Buteo swainsoni*	BLM, NV
	Red-tailed Hawk	*Buteo jamaicensis*	
	American Kestrel	*Falco sparverius*	
	Prairie Falcon	*Falco mexicanus*	BLM, NV
	Eurasian Collared Dove	*Streptopelia decaocto*	
	Mourning Dove	*Zenaida macroura*	
	Greater Roadrunner	*Geococcyx californianus*	
	Burrowing Owl	*Athene cunicularia*	BLM, NV
	Lesser Nighthawk	*Chordeiles acutipennis*	
	Ash-throated Flycatcher	*Myiarchus cinerascens*	
	Western Kingbird	*Tyrannus verticalis*	
	Common Raven	*Corvus corax*	
	Horned Lark	*Eremophila alpestris*	
	LeConte's Thrasher	*Toxostoma lecontei*	BLM, NV
	Phainopepla	*Phainopepla nitens*	BLM, NV
	Wilson's Warbler	*Wilsonia pusilla*	
	Chipping Sparrow	*Spizella passerina*	
	Black-throated Sparrow	*Amphispiza bilineata*	
	Lincoln's Sparrow	*Melospiza lincolnii*	
	Black-headed Grosbeak	*Pheucticus melanocephalus*	
	Great-tailed Grackle	*Quiscalus mexicanus*	
	House Finch	*Carpodacus mexicanus*	
	House Sparrow	*Passer domesticus*	
R	Desert Tortoise	*Gopherus agassizii*	F(T)
	Desert Iguana	*Dipsosaurus dorsalis*	
	Long-nosed Leopard Lizard	*Gambelia wislizenii*	
	Zebra-tailed Lizard	*Callifsaurus draconoides*	

	Side-blotched Lizard	*Uta stansburiana*	
	Desert Horned Lizard	*Phyrnosoma platyrhinos*	
	Great Basin Whiptail	*Aspidocelis tigris*	
	Spotted Leaf-nosed Snake	*Phyllorhynchus decutatus*	
	Red Racer	*Masticophis flagellum*	
	Glossy Snake	*Arizona elegans eburnata*	
	Long-nosed Snake	*Rhinocheilus lecontei*	
	Nevada Shovel-nosed Snake	*Chionactis occipitalis talpina*	
	Mojave sidewinder	*Crotalus cerastes*	

F(T)=federally listed threatened, BLM= BLM sensitive species, NV=protected under Nevada state law

Habitat loss could affect several bird species. Old burrowing owl burrows were found in the project area, and site construction and operation will likely eliminate future potential nesting habitat. Similarly, the LeConte's thrasher will also lose some potential nesting habitat.

Burrowing owl habitat is at risk due to solar developments. ©David Lamfrom

Habitat loss could affect several reptile species. Desert tortoises were not directly observed in the project area (only 4 old burrows were found in the northwestern section [Tierra Data 2009]). While not prime tortoise habitat, this habitat will be destroyed and fenced to exclude other desert tortoises. The desert iguana and the Nevada shovel-nosed snake are two other reptile species that were found in the project area and will lose habitat.

Indirect impacts to wildlife, likely leading to population declines, could include altered hunting and foraging patterns resulting from habitat fragmentation and changes to movement patterns due to both fencing and changes to the Fortymile Wash corridor. According to the FEIS, "removal of vegetation, alteration of Fortymile Wash, and placement of fencing around perimeter of the solar fields *could* impede travel opportunities for wildlife." (italics mine) The operative word here is 'could', as not much is known about how wildlife move through this area (BLM 2010d; for a general perspective, see Lovich and Ennen 2011). Tortoise likely move along the wash corridor, but they will be excluded from the project area by fencing. Fencing may also change the movement of bighorn sheep, which typically move from mountainous region to mountainous region through low, flat areas, like the project area. Not much is known about sheep movement through this project area, though.

Much of the concern regarding plant and wildlife impacts focused on the potential impact to the inhabitants of the Ash Meadows NWR, located 10 miles southeast of the project area. These concerns will be detailed in the water resources section for two reasons: 1) plants and animals of concern are not located within the direct project area, and habitat destruction due to this facility will not directly impact these species, and 2) any potential effects on the species of Ash Meadows are likely to be offset by decisions regarding water resources, in particular groundwater resources.

Cultural Resources

Surveys of the project area and some adjacent lands (Area of Project Effect, APE) did identify 13 prehistoric or historic cultural resource sites, but only 1 of those sites has been determined to be eligible for listing on the National Register of Historic Places (BLM 2010d). This site "could yield important information regarding prehistory in southern Nevada" (BLM 2010d). Furthermore, "given the low density of sites in this large Project area, the potential for unanticipated discoveries is low" (BLM 2010d).

Mitigation measures for that eligible site have been considered, and a Historic Properties Treatment Plan has been prepared, including formal data recovery prior to construction or other ground-disturbing activities. BLM (2010d) also indicates that Tribal representatives consulted on this issue agree with the reported cultural assessment.

Water Resources

Surface waters in this part of the country are rare, but ephemeral systems that flow during and after periods of rain are an important feature of the project area. The western side of the project area is criss-crossed by desert wash channels including Fortymile Wash. Flow in Fortymile Wash originates in the mountains of the Nevada Test Site and then merges with the Amargosa River as it flows through the valley. The Amargosa River, then, ultimately wraps around and flows into and terminates within Death Valley (Tierra Data 2009). The washes in the project area are basically shallow swales, and do not have much associated vegetation (BLM 2010c). Constructing a solar energy facility in this area will require the section of Fortymile Wash to be rechanneled and rerouted to convey large floods to the south of the project site.

Groundwater is a key resource in and around the project site. Not only would groundwater provide the necessary water resources for use during construction and operation of the plant, but groundwater is the water resource that plays a key role in the nearby spring- and seep-fed wetlands of the Ash Meadows National Wildlife Refuge as well as the Devils Hole detached unit of Death Valley National Park.

Ash Meadows NWR is the home of 7 federally listed plant species: Amargosa niterwort (*Nitrophila mohavensis*), Ash Meadows milkvetch (*Astragalus phoenix*), Spring-loving Centaury (*Centaurium namophilum*), Ash Meadows sunray (*Enceliopsis naudicaulis corrugate*), Ash Meadows gumplant (*Grindelia fraxinopratensis*), Ash Meadows ivesia (*Ivesia eremica*), and Ash Meadows blazing star (*Mentzelia leucophylla*). All of these plants are endemic to Ash Meadows and federally listed as Threatened, with the exception of the Amargosa niterwort, which is listed Endangered (BLM 2010d). All are considered Endangered by the State of Nevada, and all are BLM listed sensitive species (BLM 2010d). While these are all different species with slightly different habitat requirements, one major threat to them all include future changes in the amount and quality of groundwater that feeds Ash Meadows. Such changes could come from overall regional water availability, but the species are more likely to be directly affected by groundwater pumping.

Ash Meadows NWR is also home to 5 federally listed animal species: Devils Hole pupfish (*Cyprinodon diabolis*), Ash Meadows Amargosa pupfish (*Cyprinodon nevadensis mionectes*), warm springs pupfish (*Cyprinodon nevadensis pectoralis*), Ash Meadows speckled dace (*Rhyinichthys osculus nevadensis*), and the invertebrate Ash Meadows naucorid (*Ambrysus amargosus*). All of the fish are considered endangered by the USFWS, and the naucorid is threatened. All species are considered sensitive species by BLM; all the fish are protected by the State of Nevada.

Protecting the water resources that feed Ash Meadows NWR and support the rare and unique fauna and flora found there became one major consideration throughout the Amargosa Farm approval process. A fundamental question became: how will operating the solar facility, with its proposed groundwater use, affect the local aquifer, and how might that impact Ash Meadows? From the perspective of NPS, how would this facility impact the Devils Hole pupfish, the endangered resident of the Devils Hole detached unit of Death Valley National Park?

The perennial yield (the amount of usable water from a groundwater aquifer that can be withdrawn economically and consumed each year for an indefinite period) of the Amargosa Valley hydrographic basin is estimated at 24,000 AFY (BLM 2010c). Currently, groundwater use in the basin (25,260 AFY) slightly exceeds the perennial yield, and the majority of that goes to irrigation (18,930 AFY). The wisdom of allocating groundwater resources in excess of the perennial yield notwithstanding, the decision on the solar technology would have real impacts on the basin groundwater allocation and, more importantly with respect to this report, the plants and wildlife at Ash Meadows that rely on groundwater resources.

A third-party contractor (GeoTrans, Inc) was contracted to develop a groundwater flow model to evaluate the potential impacts of future pumping (under the dry-cooled alternative [the wet-cooled alternative was never examined] on water levels in Devils Hole (BLM 2010d). The study used the Death Valley Regional Flow System (DVRFS) Model, a model published in 2004 and is, at this time, the only model of groundwater dynamics for this region. While the details are fairly messy, the overall conclusion of the study showed that an additional pumping for groundwater to be used in a dry-cooling system will only decrease the water levels within Devils Hole an additional 0.05 feet (beyond the expected background reduction in the habitat due to the other groundwater allocation) over a 200 year model scenario (BLM 2010d).

There are a couple of aspects of this modeling exercise that may raise concern over the validity of the study and its conclusions. First, the DVRFS model addresses larger regional-scale questions—the model grid size is 1.5 km x 1.5 km. The application of this model may then be too coarse to address a question at a specific site within one of those model cells (BLM 2010d). Furthermore, the model simplifies (by necessity) the local geology that might be important in driving groundwater dynamics. Lastly, model runs assumed no climatic changes and or any effects of varying future recharge rates. All these assumptions and limitations aside, the model study showed that the likely impact of the 400 AFY of the dry-cooled alternative would be minimal and would cause water levels within Devils Hole to decline a negligible amount and overall discharge rates into Ash Meadows to decline a similarly negligible amount (<7 AFY).

One aspect of groundwater use that was unexplored by the model (because the model was incapable of evaluating this aspect) and not adequately discussed within the EIS documents is the timing of the use. Under full operation, the dry-cooled facility is expected to use 400 AFY for mirror washing, dust suppression, etc. This use is not spread equally over the entire year, though, and water-related needs would instead be more intensive during the summer. How this would affect short-term flows is unexplored.

In the end, the evaluation process did not seem to seriously consider the wet-cooled option, but instead explored through modeling the impact of the dry-cooled option. While the scientific uncertainty associated with this model is significant, the results indicated that the groundwater use would not impact Ash Meadow NWR or (specifically with respect to NPS) Devils Hole. BLM thus made a very conservative decision regarding water impacts, and the aquatic fauna of Ash Meadow should benefit from that.

Visual Resources

In addition to expected short-term impacts to visual resources during the construction phase (construction activity and equipment, higher traffic, fugitive dust, and significant new sources of night lighting), the long-term impacts to visual resources from the objects in the project area are expected to result in moderate to strong visual contrast. These objects include the solar troughs, power block, transmission lines, and any buildings associated with the industrial site (BLM 2010d). A picture of a solar trough facility at Daggett, CA, is shown below (Figure 9).

Figure 9. Solar facility using parabolic mirror technology at Daggett, CA. Image courtesy of http://www.visualphotos.com/image/2x3872377/solar_power_via_parabolic_trough_mirrors_daggett (accessed 2/27/2012).

Visual resources analysis done as part of the EIS process considered some facets of the viewshed issue. Many of the locations considered during the analysis are relatively close to the project area or on adjacent BLM lands. For instance, the visual resources analysis considered BLM's Big Dunes Area of Critical Environmental Concern (ACEC), approximately 3.5 miles northwest of the project site, as well as the BLM-managed Funeral Mountains Wilderness, approximately 13 miles south of the project site. Other public lands considered in the analysis (not including state road or local access road or residential areas) were sites within USFWS's Ash Meadows NWR (10-15 miles) and sites within NPS's Death Valley National Park.

The results of this analysis suggest site-specific impacts to visual resources. From BLM's Big Dune there is only minimal to partial obstruction due to topography and vegetation, and the overall sensitivity of that area to visual impacts of the solar facility is considered moderate. Similarly, views from the Funeral Mountains Wilderness are almost completely unimpeded, and the visual impact is moderate. For NPS lands, the BLM analysis listed two sites, the Death Valley National Park and the park at Indian Pass. Both are considered completely obstructed from viewing the solar facility due to the Funeral Mountains in between. While this is true, and certainly is beneficial to the many people that access Death Valley NP via these routes, the analysis fails to consider the view from wilderness lands within Death Valley NP that are adjacent to the Funeral Mountains Wilderness and very close to the project area (BLM 2010d). The EIS documents suggest that BLM stopped short in fully considering National Park Service lands for visual impacts. These may not be highly visited lands, but the analysis does not fairly consider the shared resource aspect here.

Conclusion: Amargosa Farm Road Solar Facility

Through the EIS process, BLM addressed many resource issues, only some of which are covered here. The Amargosa project area is not a region of particularly high biological or cultural resources, and the EIS process documents these and identifies the potential impacts of clearing and grading the area, constructing the facility, and maintaining the physical plant for the life of the project.

The EIS process explored more carefully the off-site biological diversity associated with the Ash Meadows NWR and the potential effects of groundwater pumping on those resources. In the end and to its credit, BLM made a very conservative decision for those resources by approving only the dry-cooled plant design with its minimal groundwater needs. This decision, done primarily to protect the Devils hole pupfish, as well as other endemic fish and plants of Ash Meadows, stands as a significant victory on behalf of resource protection From the perspective of the water resources, approving the dry-cooled project puts less long-term stress on already scarce water resources and the plants and animals that depend on them. This is the significant success story associated with the Amargosa project.

With respect to visual resources, the EIS process considered viewshed impacts to roads, residential areas, BLM lands, and the Ash Meadows NWR. However, the potential impact to the viewshed from Death Valley NP was only casually considered. This represents a significant failure in this EIS process.

Ivanpah Solar Electric Generating System Near Mojave National Preserve: Protecting Endangered Desert Tortoises and Scenic Resources

Geographic Overview

The second case study under consideration in this report is the Ivanpah Solar Electric Generating System (ISEGS), located in the Mojave Desert region in San Bernardino County, California. Bright Source Energy, Inc. and several wholly-owned subsidiaries (Solar Partners I, LLC, Solar Partners II, LLC, Solar Partners IV, LLC, and Solar Partners VIII, LLC) proposed the project. The project, a 400 MW solar thermal power plant, was proposed for siting on public lands approximately 4.5 miles southwest of Primm, NV. The project is located in San Bernardino County, an area of over 20,000 square miles and over 2 million residents, as of the 2010 Census, http://quickfacts.census.gov/qfd/states/06/06071.html, accessed 2/3/2012).

The ISEGS nearly abuts the 1.6 million acre Mojave National Preserve (Figure 10). Mojave National Preserve, authorized in 1994 with the California Desert Protection Act, is mostly (95%) federal lands, and nearly 700,000 acres of the park is designated wilderness (NPS 2002). Mojave NPres seeks to "preserve and protect the natural and scenic resources. . . [and] cultural resources representing human use associated with Native American cultures and westward expansion" (NPS 2002). The park preserves and protects the significant natural resources of the Mojave Desert, and much of the park is designated critical habitat for the desert tortoise. Since 1997, visitation has increased nearly 40%, from 378,000 in 1997 to 600,000 in 2010 (the last year for which statistics are available). 2005 had the highest visitation during this period (632,000, http://www.nature.nps.gov/stats/viewReport.cfm, accessed 2/13/2012).

NPCA's Center for State of the Parks published its resource assessment for Mojave National Preserve in 2005. The assessment reported the condition of natural and cultural resources within the park as 'poor', having scored 59 and 50 out of 100, respectively. Natural resource highlights included retiring historic grazing allotments (from 1.3 to 0.2 million acres grazed) and the mapping of important seep and spring habitats within the park. Prominent natural resource concerns included past and (still) present grazing, off-road vehicle recreation, non-native species, and air and light pollution. The cultural resource program was noted as having accomplished much in the first decade of the park's existence, including significant work on many of the parks archaeological sites, but needed to bolster its museum and archive efforts as well as its ethnographic program. Threats from adjacent land development mentioned in the report include mining and airport development. Solar energy was not identified as a concern.

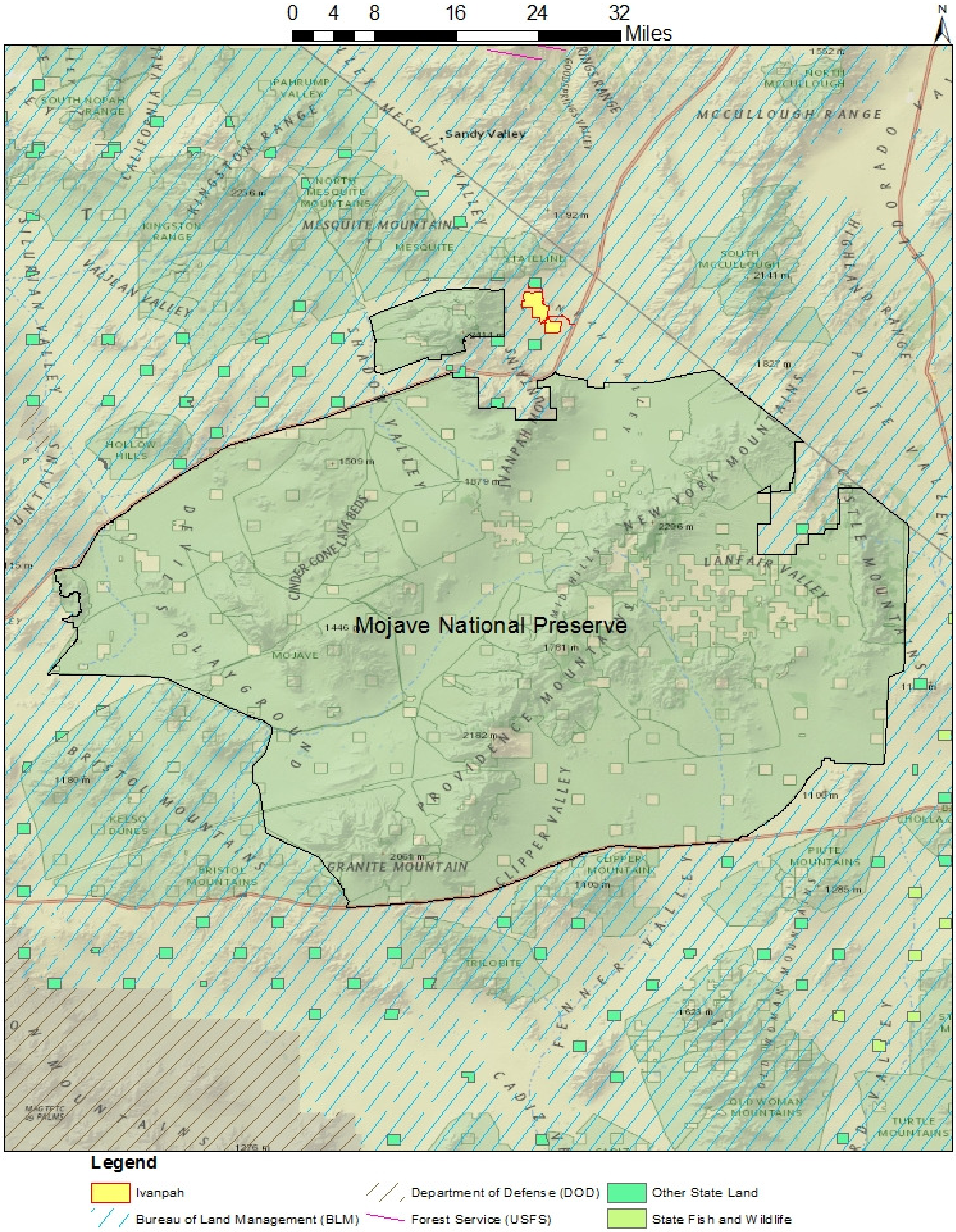
0 4 8 16 24 32
Miles
N
Mojave National Preserve
Sandy Valley
MESQUITE VALLEY
MCCULLOUGH RANGE
KINGSTON RANGE
MESQUITE MOUNTAINS
SHADOW VALLEY
IVANPAH MOUNTAINS
NEW YORK MOUNTAINS
LANFAIR VALLEY
DEVILS PLAYGROUND
CINDER CONE LAVA BEDS
PROVIDENCE MOUNTAINS
GRANITE MOUNTAIN
CLIPPER VALLEY
BRISTOL MOUNTAINS
FENNER VALLEY
PIUTE VALLEY
HIGHLAND RANGE
CASTLE MOUNTAINS
KELSO DUNES
HOLLOW HILLS
VALJEAN VALLEY
SILURIAN VALLEY
CALIFORNIA VALLEY
Legend
Ivanpah
Bureau of Land Management (BLM)
Department of Defense (DOD)
Forest Service (USFS)
Other State Land
State Fish and Wildlife

Figure 10. Mojave National Preserve and the location of the Ivanpah Solar Electric Generating Station (SEGS). Map produced in collaboration with USGS (Reston, VA). Boundary depictions and spatial data for location and footprint of the proposed Ivanpah facility were provided to USGS by NPCA.

Project Approval Timeline

The Notice of Intent to develop alternatives regarding Bright Source Energy's right-of-way application was first published in the Federal Register in November, 2007, and the draft environmental impact statement was released in November, 2009. During the public comment period about the DEIS, there were several other alternatives suggested for BLM's consideration, so BLM developed those alternatives and published a supplemental DEIS in April, 2010. The supplemental DEIS introduced some new alternatives that became an important part of the final EIS proposal.

After a public review period, a final EIS was announced in the Federal Register (Vol 75, No. 151, pp 47619-47620) in August, 2010. Secretary Salazar signed the Record of Decision on October 17, 2010. So, while the initial application started the process in 2007, the first draft documents for public consideration did not emerge until November, 2009. The ROD was signed less than 1 year later.

Proposed Project and Technology

Like the AFR project in Nevada, solar thermal technology is the heart of the ISEGS. Unlike the AFR, the ISEGS project will rely on heliostat (mirror) technology to track the sunlight and focus that energy on 459-foot tall power towers (Figure 11). Heliostats consist of two mirrors, each 7.2' high by 10.5' wide (for a total reflective surface/heliostat of 151.2 ft^2). Arrays of these heliostats will concentrate the sun's rays on a boiler, and steam produced will generate electricity via the steam turbine in the power block. The steam is condensed back to water through an air-cooled condenser. The completed project would include power towers and associated heliostats. In total, the project is expected to use approximately 173,500 heliostats (BLM 2010f).

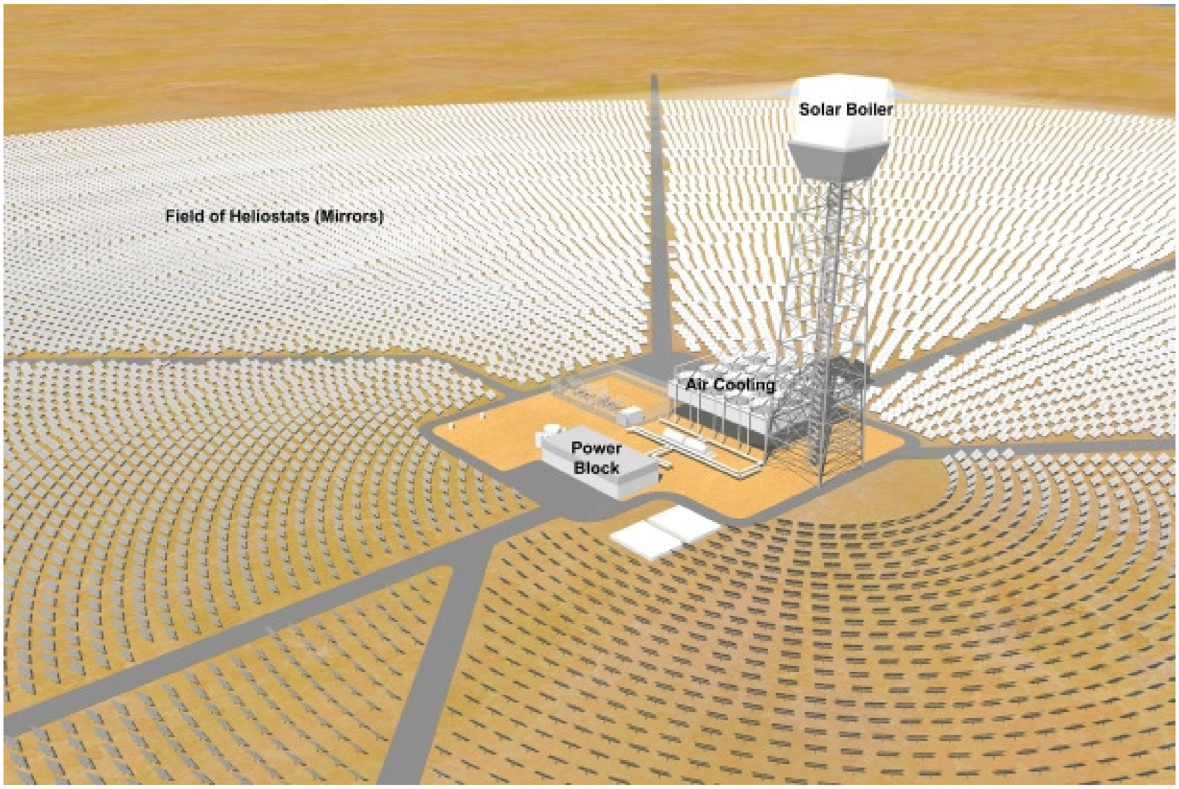

Figure 11. A schematic representation of the solar thermal technology proposed for the ISEGS. The image shows the circular configuration of heliostats to reflect light up to the boiler. Image courtesy of http://www.basinandrangewatch.org/IvanpahUpdate.html, accessed 2/3/2012

The project, as initially conceived, was projected in three phases. The first phase, Ivanpah 1 (the most southern of the solar fields), would stand on approximately 914 acres and provide 100 MW of electricity (BLM 2010b). At Ivanpah 1, the maximum number of heliostats under the optimized design is 55,000, all focused on one power tower. The second phase, Ivanpah 2, would also provide 100 MW of power from a nearly equivalent 921 acres, again using a maximum of 55,000 heliostats and one power tower. The third phase (Ivanpah 3, the northern most solar field) will require double the acreage (1,836 acres) to produce 200 MW power. The maximum number of heliostats for Ivanpah 3 is 104,000, and these would be focused across five power towers. The height of the tower is a function of the area across which the heliostats are spread. A higher tower allows a broad area of mirrors to efficiently focus their energy on the tower (BLM 2010b).

During the review process, several modifications were made to the site layout. In the end, the BLM approved a slightly modified layout (called the Mitigated Ivanpah 3 Alternative, BLM 2010g), which moved the northern boundary of Ivanpah 3 approximately 1900 feet south and reduced the overall acreage of Ivanpah 3 by 433 acres (BLM 2010g). This 433 acre region would serve as a rare plant mitigation area. Each heliostat field will have only one power tower. Ivanpah 1 will generate 120 MW, and Ivanpahs 2 and 3 will each generate 125 MW (for a total generating capacity of 370 MW for the whole facility). These three phased plants will, to a certain extent, rely on the same infrastructure, sharing an administrative building, an operation and maintenance building, and a substation. The total approved project footprint is 3,564 acres, of which 3,471 acres are under the jurisdiction of BLM (BLM 2010f).

The Record of Decision emphasized that the project, as authorized, would have all the socioeconomic and employment benefits identified during the review process and would minimize (relatively speaking) the environmental impacts, "especially in the areas of Biological Resources, Soil and Water Resources, and Visual Resources" (BLM 2010f).

<u>Resource Impacts</u>

Vegetation and Plant Resources

The Ivanpah Valley is bounded by several mountain ranges: to the east are the Lucy Gray Range and McCullough Mountains, to the south are the New York Mountains, the Clark Mountains are on the west. The proposed project area is generally alluvial fan sloping gradually to the east and southeast, dropping in elevation from 3,150 feet to 2,850 feet above sea level. Due to the topography, surface water from rainfall runs off these range faces and drains into the Ivanpah and Roach Dry Lakes (CH2MHill 2009). Runoff from the Clark Mountain range drains through the project area and into Ivanpah dry lake.

The Ivanpah project site is characterized by Mojave creosote bush scrub (CH2MHill 2009). Other co-dominant shrub species include burrobush, cheesebush, Nevada tea (*Ephedra nevadensis*) and Mojave yucca (*Yucca schidigera*). In addition to the Mojave creosote bush scrub, 2 other vegetation associations are present at the project site: Mojave Yucca-Nevada Ephedra Scrub and Mojave Wash Scrub. The wash scrub, located along the ephemeral washes, have an increased density of cheesebush.

During surveys in 2007 and 2008, no federally or state listed plant species were identified in the project area. However, 8 plant species considered to merit conservation concern by the California Native Plant Society were found during the two-year survey period (CH2MHill 2009).

Table 4. Listing of plant species found within the project area of the ISEGS during preliminary surveys. All species are considered by the California Native Plant Society to merit concern. Five of the 8 plant species (in bold) are also found in Mojave NPres.

Common name	Scientific Name
Small-flowered androstephium	*Androstephium breviflorum*
Mojave milkweed	***Asclepias nyctaginifolia***
Desert pincushion	*Coryphantha chlorantha*
Utah vine milkweed	***Cynanchum utahense***
Nine-awned pappus grass	***Enneapogon desvauxii***
Parish's club-cholla	*Opuntia parishii*
Utah mortonia	***Mortonia utahensis***
Rusby's desert mallow	***Sphaeralcea rusbyi eremicola***

In addition to these plant species found in the project site, several other special status species were found in the proposed fiber optic corridor. These included Mojave milkweed, nine-awned pappus grass, Parish's club-cholla, Aven Nelson's phacelia (*Phacelia anelsonii*), sky-blue phacelia (*Phacelia coerulea*), black grama (*Bouteloua eriopoda*) and Utah vine milkweed.

In addition, cacti found around the project site include California barrel cactus (*Ferocactus cylindraceus* var. *lecontei*) and clustered barrel cactus (*Echinocactus polycephauls* var. *polycephalus*), estimated at 1-2 mature barrel cacti per acre across the overall project site (BLM 2009f). Both cacti species are also found within Mojave NPres.

The Ivanpah Valley in this part of the Mojave Desert ecoregion is widely recognized as a center of plant biodiversity (Bunn et al. 2007).While the pre-project surveys found only a handful of special status plant species (CH2MHill 2009), the number of special status plant species known to or potentially occurring in the project area is much larger. Sixty-four plant species were listed by BLM (2010b) as potentially occurring in this area. None of these plants have official federal or state listing status, but all of them are considered by the California Native Plant Society to merit concern. As one might expect, given the proximity, there is significant overlap between the flora of the project area and the flora of Mojave National Preserve. A recent survey (Andre Botanical Consulting 2006) indicated that 51 of the 64 special status species (known to or potentially occurring in the Ivanpah project area) are found within the boundaries of Mojave NPres. While one might look at this as unnecessary redundancy, one can also view it as a shared biological resource. Impacts to this resource on BLM land may well affect the persistence of that resource on adjacent NPS lands.

The project will directly impact vegetation communities and any rare plants through mowing down to a height of 12-18 inches, which will keep plant biomass from interfering with heliostat movement (BLM 2010b). In addition, mowing will likely facilitate the spread of non-native invasive plants, like cheat grass (*Bromus tectorum*) and red brome (*Bromus rubens*).

Other indirect effects include habitat fragmentation impacts to pollinators, changes in soil moisture (due to shading from heliostats) and soil nutrient availability. Another interesting potential indirect effect is the impact to some desert-adapted plants, mediated through shading and thereby eliminating longer wavelengths of the visible spectrum (BLM 2010b). This will most dramatically affect crassulacean acid metabolism (CAM) plants (like Mojave yucca, barrel cactus, and cholla). Crassulacean acid metabolism, also known as CAM photosynthesis, evolved in some plants as an adaptation to arid condition. During the day, the plant stomata in the leaves remain shut to reduce water loss but open at night to collect carbon dioxide (CO_2). The CO_2 is stored as the four-carbon acid malate and then used for photosynthesis during the day. (http://en.wikipedia.org/wiki/Crassulacean_acid_metabolism, accessed 2/9/2012). It is an open question whether shading would change the energetic dynamics of CAM, and, if so, what the impacts on those plants might be.

Wildlife

In the Ivanpah area, there is significant wildlife diversity as well, and many of the species are special status species. While there are many species that are considered species of concern, either at the federal or state level, the only species that is officially listed as threatened (at both the federal and State of California levels) is the desert tortoise.

Table 5. Wildlife species observed directly or indirectly during field surveys of the Ivanpah Valley Solar Generating Station project. Data from CH2MHill (2009). Group refers to taxonomic grouping (B=bird, R=reptile, M=mammal).

Group	Common Name	Scientific Name	Status
M	Townsend's big-eared bat	*Corynorhinus townsendii*	CA(SC), BLM
	Pallid bat	*Antrozous pallidus*	CA(SC), BLM
	Long-legged myotis	*Myotis volans*	BLM
	Nelson's bighorn sheep	*Ovis canadensis nelson*	BLM
	American badger	*Taxidea taxus*	CA(SC)
B	Burrowing owl	*Athene cunicularia*	F(SC), CA(SC)
	Golden eagle	*Aquila chrysaetos*	F(SC), CA(SC), BLM
	Vaux's swift	*Chaetura vauxi*	F(SC)
	Gray-headed junco	*Junco hyemalis caniceps*	F(SC)
	Loggerhead shrike	*Lanius ludovicianus*	F(SC), CA(SC)

	Hepatic tanager	*Piranga flava*	F(SC)
	Summer tanager	*Piranga rubra*	CA(SC)
	Brewer's sparrow	*Spizella breweri*	
	Bendire's thrasher	*Toxostoma bendirei*	CA(SC), BLM
	Crissal thrasher	*Toxostoma crissale*	
	Le Conte's thrasher	*Toxostoma lecontei*	
	Virginia's warbler	*Vermivora virginiae*	
	Gray vireo	*Vireo vicinior*	CA(SC), BLM
R	Desert tortoise	*Gopherus agassizii*	F(T), CA(T)
	Banded gila monster	*Heloderma suspectum cinctum*	CA(SC), BLM

F(T) = federally listed threatened, F(SC)=federal species of concern, CA(T)= California threatened, CA(SC)=California state species of concern, BLM= BLM Sensitive species

BLM Manual §6840 defines sensitive species as"...those species that are (1) under status review by the FWS/NMFS; or (2) whose numbers are declining so rapidly that Federal listing may become necessary, or (3) with typically small and widely dispersed populations; or (4) those inhabiting ecological refugia or other specialized or unique habitats." <www.blm.gov/ca/pdfs/pa_pdfs/biology_pdfs/SensitiveAnimals.pdf>

Based on field surveys, many of these species use the habitat in the project area directly to nest and some use it as hunting areas. For instance, loggerhead shrikes have been observed at the project area year-round, using the site for nesting, foraging, and cover, as does the LeConte's thrasher. Golden eagles, however, do not nest on the project site (but instead in the nearby Clark Mountains) and use the habitats at the project area for hunting (BLM 2010b).

There is significant overlap between the bird species found in the project area (Table 5) and those found within Mojave NPres (NPS ndc). In fact, 11 of the 13 bird species found in the project area are found within Mojave NPres. Again, the species overlap suggests that birds are another resource shared at the landscape level.

While noted in the field surveys, Nelson's bighorn sheep do not reside in the Ivanpah valley area. Instead, these bighorn sheep reside in the Clark Mountains and other high elevation habitats and move between them through the broad flat valleys (Epps et al. 2007). BLM (2010b) states, "No studies are available that would confirm the presence of Nelson's bighorn sheep in the project area. Given the proximity of the Clark Mountains, it is likely that bighorn sheep move down into the upper elevations of the Ivanpah Valley, including the ISEGS project area, to forage." In particular, the alluvial areas near steep rocky terrain may be valuable forage habitats for gestating ewes. While no studies are available documenting bighorn use of the Ivanpah Valley as a movement corridor (BLM 2010b, Lovich and Ennen 2011), Epps et al. (2007) do report movement of sheep between Clark Mountains and Kingston mountains to the northwest. An NPS wildlife biologist also highlighted the fact that bighorn from the Clark Mountains move to the north or northwest, but they also move south to the Mohawk hills (R. Monello, pers. comm). While there currently are no documented studies of bighorn sheep moving east across the Ivanpah Valley from the Clark Mountains, it is still a potential movement corridor.

The Ivanpah Valley also provides high quality habitat (low levels of disturbance, high plant species diversity) for the desert tortoise. Indeed, this valley has always been known as a stronghold of the desert tortoise. When the 1994 desert tortoise recovery plan was published, tortoise densities in the southern Ivanpah Valley were some of the highest densities known (200-250 adults/mi^2, BLM 2010b). Tortoise densities in the northern part of the valley were typically less than 50 adults/mi^2 (BLM 2010b). Because of the high habitat value for desert tortoise in the southern Ivanpah Valley, a large critical habitat unit has been designated in this region. No critical habitat overlaps with the project area. The Ivanpah Valley also serves as an important connection linking two desert tortoise critical habitat units (Ivanpah Critical Habitat Unit and the Eldorado Critical Habitat Unit), and large scale projects like the ISEGS will fragment these important connecting links (USFWS 2011).

Field surveys done in 2007 and 2008 as part of the ROW application found desert tortoises throughout the solar project area. During the fieldwork, 25 live desert tortoises, over 200 burrows, and 20 other tortoise sign were noted. Within the project area, the density and sign of tortoise were greatest at the southern end of the project site and showed reduced density moving north-northwest along the project area towards the Clark Mountains. Survey data agreed with the general population gradient known from the Ivanpah Valley.

The US Fish and Wildlife Service provided formal consultation under Section 7 of the Endangered Species Act. These data collected prior to project approval, as well as additional data plus all the associated plans (e.g. translocation plans, raven management plans) fed into the USFWS Biological Opinion (USFWS 2010). In that opinion, USFWS estimated that the density of subadult/adult desert tortoises in the project area was 6-14 individuals/mi^2, but also noted that the actual density (not the estimated density) could be in the 20-30 individual/mi^2 range (USFWS 2010). USFWS also estimated the lost habitat would be <1% of the total potential habitat in the Northeastern Mojave Recovery Unit. Based on the project area tortoise population, the estimated habitat loss, and the mitigation proposals, the USFWS concluded: “After reviewing its status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the desert tortoise."

While the 2010 Biological Opinion allowed the project to move forward, additional information on the tortoise found during initial fencing, clearance, and construction activities reopened the issue. In essence, the initial field surveys significantly underestimated the likely numbers of desert tortoise in the project area (CH2MHill 2011). The hypothesis is that the extreme drought conditions during the initial work caused the surveys to significantly underestimate adult tortoises (CH2MHill 2011). Using newer survey information, the USFWS (USFWS 2011) estimated the number of larger (> 160 mm carapace length) desert tortoises to range from 51 to 141 (with the point estimate being 84) as well as a significant number of smaller tortoises.

Work was halted in order to re-evaluate the impact on desert tortoises. After analysis, the USFWS concluded the following: "After reviewing its status, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the desert tortoise." The conclusion was word-for-word the same as the initial biological opinion, but the reasons offered reflected the new data and the additional planning effort by the applicant.

The Ivanpah SEGS provides a significant opportunity to consider the issues at play when wildlife resources (in particular, T&E species) are considered. Several points merit mention.

Evaluating the impact of one solar facility on a widely distributed species is complicated. The desert tortoise has a very widely distributed population, historically extending throughout the desert Southwest (USFWS 2011). Even now, the critical habitat for the desert tortoise includes over 6 million acres of Mojave and Colorado desert habitat (USFWS 2011). Given this broad geographic range, it's hard to imagine a single solar energy proposal that will "jeopardize the continued existence of the desert tortoise." Even considering cumulative impacts to this T&E species, it still seems very easy to conclude that any particular project is "unlikely to jeopardize the continued existence of the desert tortoise." One is forced to wonder, however, how many small insults the species can withstand before population persistence becomes an issue. And by that point, will intervention be feasible and effective?

Translocation as a mitigation tool might soon need to be reconsidered. Translocation, the act of moving tortoises from the impact area to areas where they are expected to survive and thrive, is one of the most widely used mitigation techniques (Field et al.

2007). Recent research, though, suggests that the positive value of translocation may wane as the larger western landscape changes through time. A study by Esque et al. (2010) showed that translocated tortoises had reduced survivorship, and researchers hypothesized that the reduction in survivorship is because more of the landscape is impacted by human activity, and that tortoise survivorship is not as high in modified landscapes. Since the western landscape is changing (Leu et al. 2008), translocating tortoises may soon become an ineffective management tool as more and more of the landscape is tinged with the human footprint.

The value of a good environmental assessment cannot be overstated. From the resource perspective, pre-project assessments are crucial. The BLM manages millions of acres, and only a small proportion of that acreage has been evaluated and resources assessed. The biological assessment done as due diligence for the NEPA process provides potentially the only snapshot of resources--what's present, and what condition it might be in– for the project area. It is a fundamental assumption of the evaluative NEPA process that the assessment accurately reflects the resources in question. Unfortunately, the initial biological assessment done for the Ivanpah project was highly inaccurate with respect to desert tortoise population density in the project area. This was not a sloppy effort; unfortunately, though, it was an effort done during a period (intense drought) when a fair representation of the biological resources was unlikely to emerge. That is just bad luck. It also likely has some root in the expedited and streamlined project reviews. If federal agencies focus on the EIS timeline, there will always be a chance of basing agency decisions on an inaccurate or unrepresentative assessment. When those assessments are focused on T&E species, the potential consequences of faulty information are magnified.

Cultural Resources

According to the FEIS for the Ivanpah project, "The proposed project would have no direct or indirect adverse impacts on known or unknown, National Register of Historic Places (NRHP)-eligible archaeological, ethnographic, or built-environment resources. With the adoption and implementation of mitigation measures. . ., the cumulate effect of the proposed project on the one presently known NRHP-eligible listed resource, the Hoover Dam-to-San Bernardino transmission line, would be reduced." (BLM 2010b).

The project developer recognized the possibility of finding cultural resource sites during excavation and site development, and several mitigation measures were required as part of the approval. In addition, relevant expertise, including a cultural resources specialist and archaeological monitors, would be on hand to address cultural resource issues if they appeared (BLM 2010b).

On the negative side, the EIS failed to recognize the value of Clark Mountain to the Chemehuevi people as an integral part of their creation story. To this extent, then, the EIS process inadequately considered this important facet of cultural resources.

Visual Resources

Elements of the proposed project would be expected to greatly impact the viewsheds within and around the Ivanpah Valley, and the DEIS (BLM 2009) concludes just that. Thousand-acre arrays of mirrors focusing light on a 450 foot high tower located in the middle of those arrays would be expected to create significant visual contrast that would diminish landscape views within the valley. Also, since the project area sits within a broad valley, a superior viewpoint from the encircling mountain ranges (including both Park Service and BLM managed lands) could create significant visual contrast and degrade significant visual resources.

The FEIS analysis states that "the proposed project would results in direct adverse impact to existing scenic resource values, including. . .viewpoints in the Mojave National Preserve, throughout the east face of Clark Mountain and viewpoints in the Stateline Wilderness Area. . .The analysis establishes that the proposed project would represent a substantial change and impairment of a natural landscape that is largely intact" (BLM 2010b). BLM attempts to justify this, though, by saying "within an urban frame of reference, not all viewers would find the project disagreeable or unattractive; indeed, many viewers could find the project interesting to view due to its novelty." While it is true that "beauty is in the eye of the beholder," a fair analysis of the visual impacts cannot presume a monolithic frame of reference when evaluating impacts. Presumably, visitors to Mojave may have an urban mindset but do not want to see an industrial facility when away from the city.

Water Resources

The project area is characterized by ephemeral drainages that flow in direct response to precipitation. During pre-project assessments, over 1,900 ephemeral washes were mapped (BLM 2010b). These dry washes support many of the same hydrological and ecological functions that perennial streams support: landscape hydrologic connections; stream energy dissipation during high-water flows that reduces erosion and improves water quality; water supply and water-quality filtering; surface and subsurface water storage; groundwater recharge; sediment transport, storage, and deposition aiding in floodplain maintenance and development; nutrient cycling; wildlife habitat and movement/migration corridors; and support for vegetation communities that help stabilize stream banks and provide wildlife habitat (Levick et al. 2008 cited in BLM 2009).

Construction plans sought to maintain the natural sheet flow in the area that routed water through the project area and ultimately deposited it in Ivanpah Dry Lake to the east of the project site. All attempts would be made to maintain this natural stormwater runoff (except through the power block areas). Project construction, however, was expected to result in direct or indirect impacts to up to 198 acres of waters and water-related habitats (BLM 2010b).

This region of the Mojave Desert typically receives 4 to 7 inches of rain annually, although those precipitation totals can be variable (BLM 2010b). One impact of installing acres and acres of heliostats is that the distribution of rainfall across the project site will change. Normally, rainfall would be evenly distributed across the solar field. However, for safety reasons, the heliostats across the solar field will be placed in a flat horizontal position during rains. This will cause the rain to concentrate along the heliostat dripline and create a decidedly non-uniform distribution of rainfall on the ground (BLM 2010b). Mirror washing will have the same effect.

With respect to groundwater resources, the project is not expected to have a significant impact on groundwater dynamics. Water consumption for construction, operation, and decommissioning of the Ivanpah project is estimated at less than 100 AFY over the 50-year life of the project (BLM 2010b). Unlike other technologies, this solar thermal technology is not considered overly water-intensive. Primary water use will come from power plant needs (water for power block, fire suppression), human use, mirror washing, and dust suppression.

Conclusion: Ivanpah Solar Electric Generating Station

The vegetation and wildlife resource impacts of the Ivanpah facility have received the most publicity, largely because the Ivanpah Valley is widely regarded as an important locus of biodiversity within the Mojave Desert. The project area is known to contain or have potential habitat for 64 rare plant species, as well as many wildlife species of concern. Building this plant would destroy those habitats, fragment a relatively intact landscape, and potentially interrupt wildlife movement corridors. Of the wildlife considered, the predicted impacts to the desert tortoise were initially understated (because of inaccurate biological information). This has since become a significant problem in terms of facility construction, because unexpected tortoises in the project area have to be removed and additional surveys have to occur. Again, this underscores the need for accurate and thorough scientific information on which to base decisions.

From the perspective of visual resources, the impact analysis process did not give proper weighting to the impacts felt by visitors on adjacent lands. Specifically, the impacts to wilderness users in Mojave National Preserve and other nearby wilderness lands were underestimated.

All that said, the NEPA process did lead to modest changes to the facility design, which in the end reduced the direct footprint of the facility by ~10%. This highlights one of the few bright spots of this case study: a NEPA process that entertains multiple alternatives, including those that emerge during the public comment periods, will often result in a better selection, in this case leading to less habitat impacts on this important landscape.

Desert Sunlight Solar Farm Project Near Joshua Tree NP: Protecting Park Scenery from Adjacent Development

Geographic Overview

The last case study under consideration in this report is the Desert Sunlight Solar Farm (DSSF) Project, located in the Colorado Desert region in Riverside County, California. Riverside County, an area of over 7,200 square miles, had over 2 million residents (as of the 2010 Census, http://quickfacts.census.gov/qfd/states/06/06065.html, accessed 2/6/2012). First Solar Inc. applied for a right-of-way authorization to install a 550 MW solar photovoltaic array on BLM lands approximately 6 miles north of Desert Center, CA (Figure 12).

Just two miles to the north of the Desert Sunlight project is Joshua Tree National Park. Unlike the other highlighted parks adjacent to case study solar projects, Joshua Tree reflects the transition zone between the Mojave Desert ecoregion to the north and the Sonoran Desert ecoregion to the south. The purpose of the park is to preserve and protect "the scenic, natural, and cultural resources representative of the Colorado and Mojave deserts' rich biological and geological diversity, cultural history, wilderness, recreational values, and outstanding opportunities for educational and scientific study" (NPS 2011). The park is 793,520 acres, with 97% in federal ownership, and contains 595,000 acres of wilderness and more under wilderness study (NPS 2011). Known for its iconic Joshua trees, people come to Joshua Tree in increasing numbers every year. Since 1990, the annual visitation has topped 1 million each year, and 2010 had the highest recorded visitation (1,434,976) in that 2-decade stretch (http://www.nature.nps.gov/stats/, accessed 2/13/2012). Of the 3 California Desert parks included in this report, Joshua Tree has the highest visitation rates.

NPCA's Center for State of the Parks published a resource assessment for Joshua Tree National Park in 2005. The assessment reported the condition of natural resources within this park as 'fair', having scored 65 out of 100, while the condition of cultural resources was described as 'poor' (scoring 58 out of 100). One notable resource highlight from the assessment was the park's Center for Arid Lands Restoration, which serves as a plant nursery for the park and nearby adjacent lands. Prominent natural resource concerns included air pollution, diminishing water levels in park spring habitats, and non-native invasive grasses. The cultural resource program was decidedly short-staffed during the assessment period, and this indicated a variety of cultural resource shortcomings. However, the cultural resources program had been working on important cultural resource studies, including a traditional use study and cyclic historic structure maintenance. The major threat from adjacent land development mentioned in the report was the proposed Eagle Mountain landfill. Solar energy, again, was not identified as a concern.

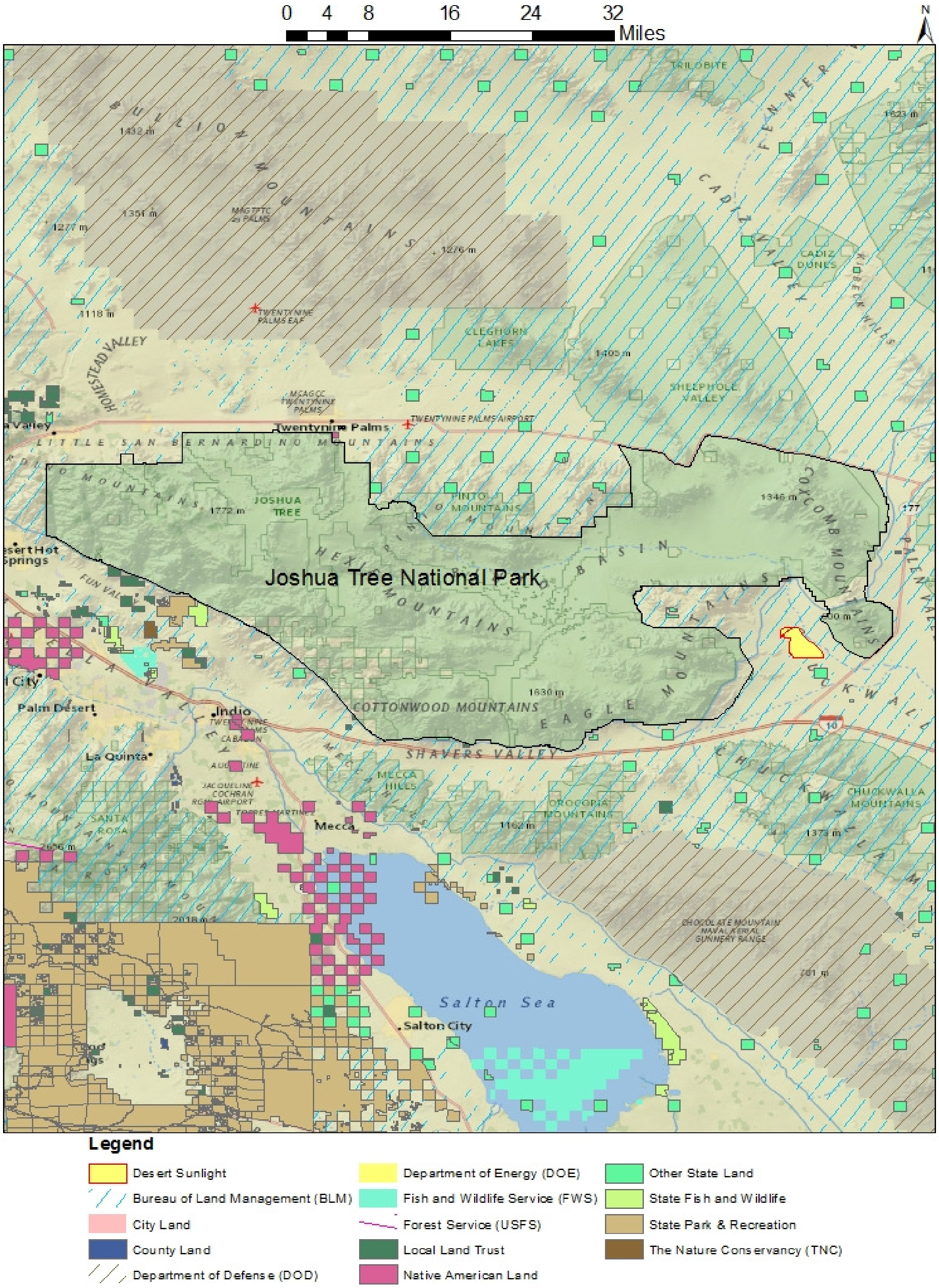

Figure 12. Joshua Tree National Park and the location of the Desert Sunlight Solar Farm. Map produced in collaboration with USGS (Reston, VA). Boundary depictions

and spatial data for location and footprint of the proposed Desert Sunlight Farm facility were provided to USGS by NPCA.

Project Approval Timeline

In response to First Solar Inc's request for a right-of-way authorization, the BLM published in the Federal Register (Vol 75, No. 8, pp 1802-1803) a notice of intent to prepare an environmental impact statement in January, 2010. The Bureau announced the DEIS on August 27, 2010, and opened the 90 day public comment period. The FEIS was completed and released on April 15, 2011. The Secretary of the Interior signed the Record of Decision on August 9, 2011, and the ROD was announced in the Federal Register on August 15, 2011 (Vol 76, No. 157, pp. 50493-50494). The overall process to develop alternatives, solicit public opinion, evaluate impacts, and approve the Desert Sunlight Solar Farm took 20 months.

Proposed Project and Technology

While the other two case studies were concentrating solar technologies, the approved DSSF utilizes arrays of photovoltaic (PV) panels to convert sunlight directly into electricity. Photovoltaic technology gets its name from the photovoltaic effect, discovered in 1954 at Bell Telephone when scientists discovered that silicon created an electric charge when exposed to sunlight (http://www.nrel.gov/learning/re_photovoltaics.html, accessed 2/6/12).

The project consists of three main components: the solar farm site, the 220 kV interconnection line (Gen-Tie Line), and the Red Bluff Substation. The solar farm site would encompass up to 3,912 acres and consist of several components: the main generation area, including the PV arrays, overhead lines, and access corridors; an operations and maintenance facility; a visitor center; an on-site substation, where the voltage generated by the PV array would be stepped up to 220 kV; and site security and fencing. The approved Gen-Tie Line would be up to 12.2 miles long. While the land area permanently disturbed for this line is only 92 acres, the right-of-way would total 256 acres. The Red Bluff Substation would connect the electricity produced at the solar array directly to Southern California Edison's (SCE) regional transmission system (BLM 2011a).

For this project, the applicant sought a location that fit a certain number of criteria. Ideally, the solar farm would be located in a site large enough for the 550 MW facility of suitable flat terrain (with minimal cut and fill), would avoid areas of significant environmental concern or sensitivity, including Wilderness Areas, Areas of Critical

Environmental Concern (ACEC), and Desert Wildlife Management Areas, avoid high quality habitat for listed species, avoid known cultural or historic sites and recreational areas, and be proximate enough to necessary infrastructure (roads, transmission lines, etc) to be economically feasible. Lastly, First Solar wanted to site this project in an area under study for the BLM/DOE Programmatic Solar EIS (BLM 2011a).

Originally, then, the study area for the DSSF focused on a large section of the southeast side of Joshua Tree National Park (Figure 13), as well as several potential corridor lines for the Gen-Tie Line and 2 potential sites for the Red Bluff Substation. Preliminary assessments for biological, cultural, hydrological, and geological resources further refined the proposed project site (BLM 2011d). This was the proposed project outlined in the DEIS. During the DEIS review period, an alternative was proposed that reduced the footprint of the proposed project. The initial review of the study area then ultimately changed into a proposal that tucked the DSSF into this space near Joshua Tree, but the proposed site is significantly smaller than the original study area, as well as further away from Joshua Tree's boundary (now, 1.4 miles away at the closest point). In the end, BLM authorized the project as it "provides the most public benefits and avoids the most cultural, biological and hydrological resources" (BLM 2011a).

Resource Impacts

Vegetative Communities and Plants

The land area proposed for siting the DSSF was described this way in the BLM final EIS: "The Project area is a largely vacant, undeveloped, and relatively flat area in the Chuckwalla Valley of the Sonoran Desert in eastern Riverside County" (BLM 2011a). This undeveloped, largely vacant area has many of the hallmarks of Colorado (Sonora) Desert vegetation. The two main vegetation classes found in the project study area are creosote desert scrub vegetation and desert dry wash woodland (Ironwood Consulting 2010). The majority of the study area supports the creosote desert scrub, and the dominant plants include creosote bush, burro bush, boxthorn (*Lycium* sp.), brittlebush (*Encelia farinose*), indigo bush (*Psorothamnus* spp.) and cheesebush. The other habitat type found within the project study area is the desert dry wash woodland. Plant species often associated with this habitat type include blue palo verde (*Cercidium floridum*), ironwood (*Olneya tesota*), smoke tree (*Psorothamnus spinosa*), and desert willow (*Chilopsis linearis*). The vegetation assemblage is also referred to as microphyll woodland, a community that offers shade, structure, shelter, and nutrient cycling important to deserts (BLM 1999). This habitat does not contain standing water, but instead receives mostly ephemeral wetting following storms. The trees, however, likely indicate a higher water table than in other nearby places (BLM 2011a). Because of its value, both as a channel through which water sporadically flows and as a high value habitat for wildlife for nesting and movement, this vegetation community is generally considered a high conservation target within the Colorado Desert ecosystem (CBI 2009).

Across the entire proposed project area (including the solar farm site, power line corridor, and new substation), the vast majority of the habitat is creosote desert scrub. For the Gen-Tie line and the proposed Red Bluff substation, the relative amount of desert dry wash woodland is higher (Ironwood Consulting 2010) in those places. The action alternatives (approving a solar facility in some form or other) explored by the DEIS would have resulted in the permanent removal of over 3,000 acres of creosote bush scrub. BLM's proposed alternative would have resulted in the permanent removal of 4,327 acres, while another alternative would have resulted in the loss of 4,295 acres of creosote habitat. A third alternative, the reduced footprint alternative, would have approved only 3,121 acres of creosote habitat for the project. For desert dry wash woodlands, all the action alternatives considered would have resulted in the permanent removal of between 51 and 67 acres of dry wash habitat (BLM 2011a). While the acreage of this specific habitat is not high (<2% of land area), the high habitat values are difficult to lose.

During the process leading up to the ROD, several changes were made to the action alternatives to ameliorate impacts to the vegetation. In general, the acreage under pressure was reduced to include only 3,761 acres for the solar panel array, 210 acres for the transmission line, and 172 acres for the substation. This represents ~14% decrease from the expected overall footprint of the proposed 4,391 acres facility. Since one of the major issues with solar energy development is the overall footprint of facility installation (Tsoutsos et al. 2005) which in some cases is on par with traditional coal-fired power plants (Muller et al. 2011), this is considered a beneficial change in the plan specifications that will save habitat and the associated plants and wildlife.

Based on surveys, special status plant species were considered to occur within the project area. None of the plants were federally-listed, but all of these plants were listed by the State of California (BLM 2011a). They include: foxtail cactus (*Coryptantha alversonii*), Emory's crucifixion thorn (*Castela emoryi*), Las Animas colubrina (*Colubrina californica*), California ditaxis (*Ditaxis serrata* var. *californica*), desert unicorn plant (*Proboscidea althaeifolia*), and slender-spined allthorn (*Koeberlinia spinosa* ssp. *tenuispina*). Many of these plants were located during surveys; most of these sightings were outside the project farm site, but many individuals of foxtail cactus and California ditaxis were found along one proposed Gen-Tie corridor. Few individuals of other special status plants (Crucifixion thorn, slender-spined allthorn, desert unicorn plant) were scattered around the project area.

Wildlife

Within the project area and surrounding ("largely vacant, undeveloped") lands, surveys showed a high level of wildlife diversity, some of which uses the creosote vegetation and others which are often associated with the desert dry wash habitats. Creosote habitat is frequented by reptiles (e.g., desert horned lizard (*Phrynosoma platyrhinos*), desert iguana (*Dipsosaurus dorsalis*), and sidewinder (*Crotalus cerastes*)), birds (e.g. turkey vulture (*Cathartes aura*), common raven (*Corvus corax*)); and mammals (e.g., coyote (*Canis latrans*), bobcat (*Lynx rufus*), and many small mammals like desert woodrat (*Neotoma lepida*)). The desert dry woodlands support these common birds plus ones that utilize wood habitats (blue-gray gnatcatcher (*Polioptila caerulea*)), amphibians (e.g. Couch's spadefoot toad (*Scaphiopus couchi*)) and foraging bats (pallid bat (*Antrozous pallidus*). Large mammals, including burro deer (*Odocoileus hemionus eremicus*) and bighorn sheep (*Ovis canadensis*) are also known to use dry wash habitats. Signs for burro deer were observed during surveys, while signs of bighorn sheep were not.

Not only do common wildlife use these habitats, but many special status species are either known to be there or expected to occur. These are shown in the Table 6.

Table 6. Wildlife species observed directly or indirectly during field surveys of the Desert Sunlight Solar Farm project. Data from Ironwood Consulting (2010) Group refers to taxonomic grouping (A=amphibian, B=bird, R=reptile, M=mammal). Bolded reptile and mammal species also occur within Joshua Tree NP (no comprehensive list of birds was available).

Group	Common Name	Scientific Name	Status
A	Couch's spadefoot toad	*Scaphiopus couchi*	CA (SC)
R	Desert tortoise	***Gopherus agassizii***	F(T), CA(T)
	Mojave fringe-toed lizard	***Uma scoparia***	CA(SC)
	Rosy boa	***Lichanura trivirgata***	
	Chuckwalla	***Saruomalus obesus***	
B	Golden eagle	*Aquila chrysaetos*	MBTA, CA(SC)
	Short-eared owl	*Asio flammeus*	MBTA, CA(SC)

	Long-eared owl	*Asio otus*	MBTA, CA(SC)
	Burrowing owl	*Athene cunicularia*	MBTA, CA(SC)
	Ferruginous hawk	*Buteo regalis*	MBTA, CA(SC)
	Prairie Falcon	*Falco mexicanus*	MBTA, CA(SC)
	Swainson's hawk	*Buteo swainsonii*	MBTA, CA(T)
	Vaux's swift	*Chaetura vauxi*	MBTA, CA(SC)
	Purple martin	*Progue subis*	MBTA, CA(SC)
	Northern harrier	*Circus cyaneus*	MBTA, CA(SC)
	Loggerhead shrike	*Lanius ludovicianus*	MBTA, CA(SC)
	Bendire's thrasher	*Taxostoma bendirei*	MBTA, CA(SC)
	LeConte's thrasher	*Taxostoma leconte*	MBTA, CA(SC)
M	Palm Springs round-tailed ground squirrel	*Spermophilus teriticaudus chlorus*	Fed candidate, CA(SC)
	Pallid bat	***Antrozous pallidus***	CA(SC)
	Townsend's big-eared bat	*Corynorhiunus townsendii*	CA(SC)
	Western mastiff bat	***Eumops perotis californicus***	CA(SC)
	California leaf-nosed bat	***Macrotus californicus***	CA(SC)
	Pocketed free-tailed bat	*Nyctinomops femorosaccus*	CA(SC)
	Mountain lion	***Puma concolor browni***	
	Colorado Valley woodrat	*Neotoma albigula venusta*	

	Nelson's bighorn sheep	***Ovis canadensis nelsoni***	
	Burro deer	*Odocoileus hemionus eremicus*	
	American badger	***Taxidea taxus***	CA(SC)

MBTA = covered under migratory bird treaty, F(T) = federally listed threatened, CA(T) = state listed threatened, CA(SC) = state species of concern

Of these special status species found in the DSSF project area, all of the reptile species and 6 of the mammal species are also found in Joshua Tree NP (NPS nda, NPS ndb). The significant overlap in species located in the project area and in the nearby national park is unsurprising given the proximity. More importantly, it indicates the broader distribution of these shared resources across the larger landscape.

The project area, then, contains habitat for many important desert species, both in terms of important foraging, nesting, or burrowing habitats, and also in terms of larger wildlife movement patterns. According to Ironwood Consulting (2010), the lands proposed for the solar farm are relatively low-quality desert tortoise habitat. Just to the south of the proposed project area, though, the lands have special designation because of their habitat values for the tortoise. Much of the area is part of the Chuckwalla Desert Wildlife Management Area. Overlapping that is the desert tortoise Chuckwalla Critical Habitat Unit. Much of these designated lands are outside the proposed project area (with the exception of some part of the Gen-Tie line and a proposed substation). In addition to these, the project area may also serve as corridors for wildlife movement. Desert tortoises may utilize desert dry wash habitats to move. In addition, bighorn sheep, mountain lions, and burro deer likely move through the area as well. Wildlife might use this area to migrate between the Eagle Mountains and Coxcomb Mountains. In fact, Epps et al. (2007) cited a radio-telemetry study that showed recorded desert bighorn sheep movements between the Eagle and Coxcomb mountains.

Discussions with an NPS wildlife biologist (R. Monello, pers. Comm.) also indicated that bighorn sheep populations use the mountain ranges in and around Joshua Tree NP. In a region where movement between high-elevation herding sites keeps gene flow high, barriers to movement might have significant consequences to these localized sheep populations. This region is a focus of bighorn sheep conservation effort, because of the historic and ongoing fragmentation of the landscape by roads (Bleich et al. 1990) and other human developments. Development of the DSSR solar facility may further impede sheep movement and potentially impact long-term sheep population dynamics.

So, while the area was considered suitable for solar projects because it was undeveloped and largely vacant, biological surveys of this area show that it in fact represents the Colorado Desert systems and harbors significant plant and wildlife resources. To their credit, the biological surveys and subsequent decisions made by the applicant as well as the BLM indicate that several decisions were made to reduce the potential impact on wildlife.

All the BLM action alternatives resulted in loss of habitat acreage, and the loss of these habitats would directly impact the wildlife that utilize those habitats. Fortunately, while desert tortoise are known to inhabit the solar farm project area, the tract of land where the solar panels would be arrayed was not considered high quality tortoise habitat. On the other hand, the transmission corridor and the Red Bluff substation to the south of the panel array are closer to, and in some cases overlap, important habitats for the tortoise. The Chuckwalla Desert Wildlife Management Area and the Chuckwalla Critical Habitat Unit (designated critical habitat for the desert tortoise) would both lose nominal acreage under any of the action alternatives considered. In the end, BLM selected an alternative that overlapped 190 acres of the Chuckwalla DWMA and 187 acres of the Chuckwalla CHU (BLM 2011b).

Cultural Resources

Based on Class I surveys (surveys of the literature, records searches) indicated that <5% of the original project study area had been surveyed in the past, and less than 1% had been surveyed in the last 10 years (BLM 2011a). Class III surveys and observations however, suggested many potential cultural sites. Within the solar farm site, many cultural sites (more than 40, depending on the alternative) were identified, some of which may be CRHR eligible. The proposed transmission lines and the substation sites also were found to contain cultural sites, some of which could be eligible for protection.

Water Resources

With alterations to the desert dry wash woodland habitat, there might be some changes in surface water quality of the runoff. The main consideration, though, is the effect on overall groundwater quantity in this water-scarce region. All the action alternatives would require groundwater for construction, approximately 703 acre-feet / year for the 26 month construction period. BLM maintains that this is ~25% of surplus inflow to the basin (estimated at 2600 to 3300 AFY) and aquifer drawdown would be a maximum of 18 feet. Water requirements during operation were expected to be much smaller (0.2 AFY), mostly used for dust suppression and washing PV panels.

Visual Resources

Visual resources refer to the natural and man-made, moving and stationary physical features that compose the character of the landscape as visually observed from a given location (BLM 2011a). The region of influence (ROI) for visual resources is defined as the viewshed, or the area seen from a particular location to the visible horizon. Because of the geography of this region, the viewshed is generally less than 15 miles from the project area to the mountain ridgelines that encircle the Chuckwalla Valley.

BLM public lands are evaluated by their scenic quality and their sensitivity. Scenic quality is the "measure of the visual appeal of a tract of land" and is rated A, B, or C. The Chuckwalla valley (area of the project) received a low B for its scenic quality. The sensitivity measure is a measure of public concern for scenic quality, and the sensitivity level was classified as medium (BLM 2011). BLM classifies visual resources using a classification system ranging from Class I to Class IV. The objective for Class I resources is to preserve the character of the landscape and only minimally impact views. At the other end, Class IV objectives can include significant modification of the landscape and its views (http://www.blm.gov/wo/st/en/prog/Recreation/recreation_national/RMS/2.html, accessed 4/27/2012). The lands within the project area are classed as Visual Resource Class II and III, and the lands for the solar farm (closest to Joshua Tree) are classified as Class III. The management objective for these Class III lands is described in the DEIS as follows: "The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract a casual observer's attention. Any changes must repeat the basic elements of line, form, color, and texture found in the predominant natural features of the existing landscape." (BLM 2011a).

According to the DEIS, the viewer groups (the clients) include dispersed recreational users in the surrounding mountains and the valley floor, as well as residents in nearby communities and roadway traffic. From much of the BLM lands, the views of the project area are horizontal. The higher angle of the project area from the surrounding mountains (including Joshua Tree NP and Chuckwalla Mountain Wilderness) may be important to dispersed recreational viewers and is, in general, "very low" (BLM 2011a). "As a result, it is the views of the surrounding mountains from the valley, rather than the views from the surrounding mountains, that are more important." In essence, BLM develops their argument for resource impacts from a BLM centric viewpoint: if we can see out, it matters not what people see in. While this may be technically all they are expected to do, it ignores the views of the Chuckwalla Valley from adjacent Joshua Tree NP. In this respect, the proximity of the site and the potential resource values to people experiencing wilderness within JOTR makes the visual resource angle an important one in this EIS process. It is also an important consideration for the PEIS.

All of BLM's action alternatives would permanently disturb visual resources in the area, but these changes were expected to comply with the visual management class II and III objectives. There was text added to the FEIS that indicates a sea change in how visual resources were considered in this project (and in others going forward). The text shows the fact that usage of the surrounding areas is low does not diminish the importance of visual resources to those users. "Additionally, use of the surrounding mountains by dispersed recreational users is low *because of the general lack of facilities serving visitors, developed access, permanent natural water sources, and the steep terrain. While use levels in these areas are low, the remote and isolated character of the landscape and the access to unencumbered, panoramic views of the region are attributes that are highly valued by its users. As such, these users are likely to be highly sensitive to visual changes in adjacent landscapes that are visible from wilderness areas. (sec 3.16-9)*" (underlining from the original document to reflect change from DEIS).

Conclusion: Desert Sunlight Solar Farm

The majority of the Desert Sunlight facility is sited in areas that are generally considered low quality for desert tortoise and only peripheral habitat for rare plants. However, the major issue with respect to wildlife and other environmental values is the potential loss of connectivity and overall fragmentation of the larger landscape by locating this facility in the valley between the mountains of Joshua Tree NP. In particular, for species like the bighorn sheep that are known to move between mountain ranges, the Desert Sunlight facility may have impacts on sheep movements. In the end, the decision to reduce the footprint of the facility is a significant positive one.

The larger issue surrounding the Desert Sunlight facility, given its proximity to Joshua Tree NP, is the impact on visual resources. BLM initially downplayed the importance of considering the visual resources from adjacent areas looking down at the solar facility, citing the low numbers of people who use these national park wilderness lands as a factor. However, between the DEIS and the FEIS, the BLM position changed, and the agency acknowledged the important visual resources at risk here. While this perspective change did not seem to play a strong role in the decision regarding the DSSF, it signified an important change in the way visual resources were viewed in the solar energy process. This shift has carried forward into the PEIS process. To an extent, it makes sense to think of the visual resources story at Joshua Tree as a lost battle that may affect the overall war. This may be cold comfort for the nearby national park indeed.

Part III. The Department of Interior's Programmatic Solar Energy Environmental Impact Statement

Setting the Stage for Solar Development in Six States

The three case studies discussed in the last section provide a view of the BLM's solar energy (and likely other renewable energy projects as well) project review process up to this point. A company applies for a right-of-way to construct a solar facility on public lands, and the BLM reviews that plan, considers alternatives, makes modifications, and then renders a decision on the proposal. This case-by-case approach has resulted in the certification of many solar energy projects on public lands in both California and Nevada. In California, 7 solar projects (expected to generate over 3,500 MW of electricity) on nearly 28,000 acres of BLM land have already been approved. In addition to these, 5 other solar facilities are on private land but have transmission ROWs on BLM lands (http://www.blm.gov/ca/st/en/prog/energy/Approved_Projects.html, accessed 2/13/2012). In total, presently approved solar projects in California will use 28,383 acres of public land. In Nevada, only 2 solar projects have been approved for BLM lands thus far (Amargosa Farm Road Solar Energy Project and Silver State North Solar Project, http://www.blm.gov/nv/st/en/fo/lvfo/blm_programs/energy/approved_renewable.html, accessed 2/13/2012), with 2 priority projects slated for 2012 approval (Silver State South Solar Project and PSI Amargosa PV Solar Project, http://www.blm.gov/nv/st/en/fo/lvfo/blm_programs/energy.html, accessed 2/13/2012). Although these projects have been approved to move forward, the approval process has not been without its share of conflict and litigation.

In addition to these approved plans, there are many active applications. As of February, 2010, there were 127 applications for ROW authorizations for solar facilities on BLM lands. California had 55 active applications; both Nevada and Arizona had 34 active applications each (DOE/BLM 2010); the remaining four are in New Mexico.). A handful of these (14) are being processed as "fast-track" projects (DOE/BLM 2010 and Figure 13). Given the clustering of these proposed projects in the desert Southwest (Figure 13), one must wonder about the long-term, cumulative impacts to habitats across the landscape from this development.

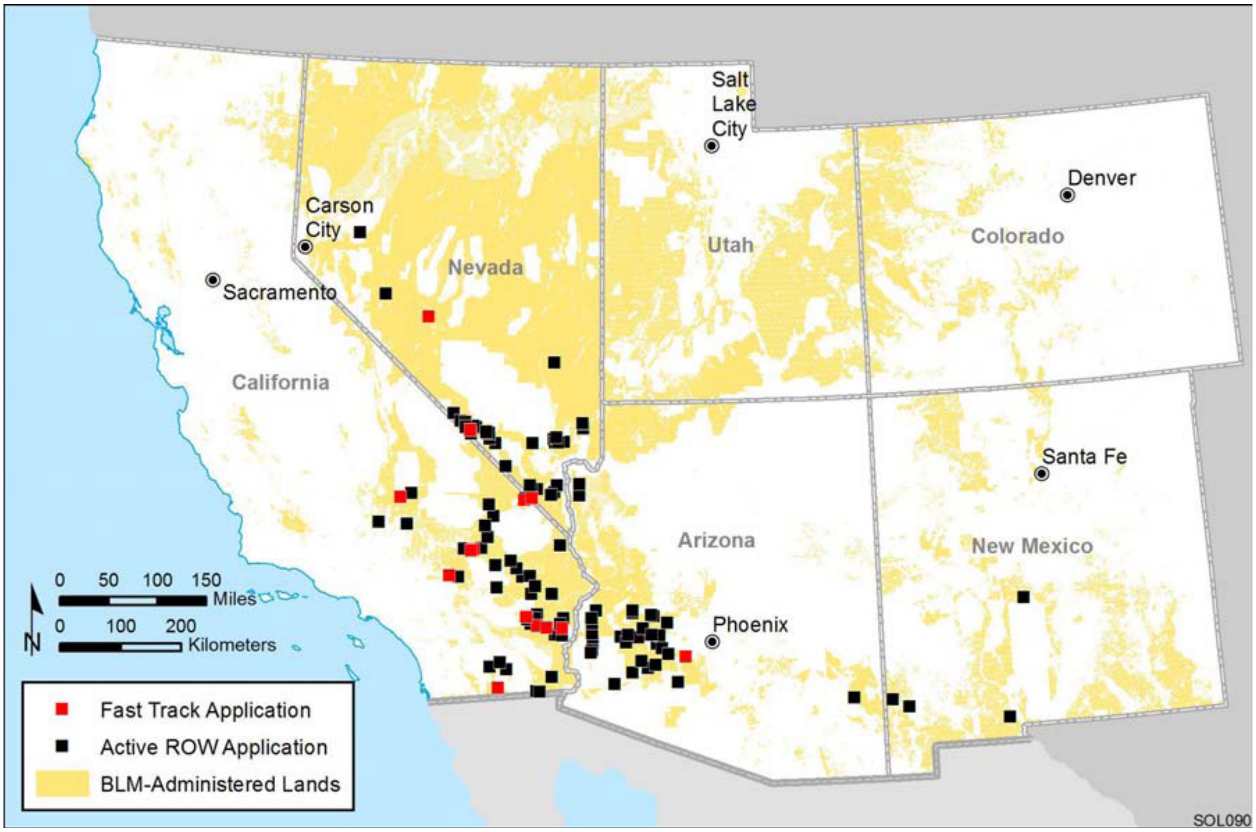

Figure 13. The active ROW applications and fast-track solar projects on BLM lands across six southwestern states. Figure from DOE/BLM 2010.

In order to create an overarching framework for evaluating upcoming solar energy projects, the Departments of Energy and Interior have embarked on a process to develop a programmatic environmental impact statement (PEIS). According to the website detailing this effort, the reasons for a PEIS are simple: the PEIS would develop programs to guide upcoming decisions on whether to fund solar projects or guarantee loans as well as set the stage for evaluating the potential impacts of those facilities on the resources and values associated with BLM lands (http://solareis.anl.gov/eis/why/index.cfm, accessed on 2/13/2012). This PEIS focuses only on 6 southwestern states (California, Nevada, Arizona, New Mexico, Utah, and Colorado) that have been identified as having the best potential solar resources for utility scale production in the next few decades (http://solareis.anl.gov/eis/what/index.cfm, accessed 2/13/2012). The PEIS will not assess site-specific issues but instead will only identify a range of potential impacts for any particular solar energy facility proposal. The site-specific issues would need to be resolved during the individual project review stage (DOE/BLM 2010). This is an important point: each solar project proposed under the PEIS will be reviewed and analyzed. The extent and nature of that review, though, will be determined by the PEIS.

The PEIS proposes several alternatives for consideration. The first, of course, is the no-action alternative. This alternative would continue the case-by-case approach to evaluating project proposals on the nearly 99 million acres of BLM lands in the 6-state region. The second alternative is the solar energy development program alternative (aka program alternative), which will do two things: identify a subset of BLM lands that would be available for solar energy production (approximately 22 million acres) and, within that acreage, create a series of solar energy zones where BLM could prioritize and encourage development. The program alternative is BLM's preferred alternative. The third alternative (SEZ alternative) would entail creating solar energy zones and restricting future applications to those lands. The initial DOE/BLM draft programmatic EIS identified 24 solar energy zones (3 each in Arizona, New Mexico, and Utah; 4 each in California and Colorado; 7 in Nevada; DOE/BLM 2010). California's proposed SEZs totaled 339,090 acres; Nevada and New Mexico had the next highest amount of SEZ acreage (171,265 acres for Nevada, 113,052 acres in New Mexico).

The draft programmatic EIS was released in December, 2010; a supplemental version was released in October, 2011. The supplemental DEIS (DOE/BLM 2011) made some significant modifications to the DEIS. The no-action alternative remained essentially the same, with solar applications on any eligible lands evaluated by BLM on a project-by-project basis. The second alternative (the solar energy development program alternative, aka the program alternative) was modified. The new alternative, known as the modified solar energy development program alternative, is still BLM's preferred alternative. From the PEIS website: "Under this alternative, the BLM proposes categories of lands to be excluded from utility-scale solar energy development and identifies specific locations well suited for utility-scale production of solar energy (i.e., SEZs) where the BLM would prioritize development. This alternative emphasizes and incentivizes development within SEZs and proposes a collaborative process to identify additional SEZs. The alternative also allows for utility-scale solar development in variance areas outside of SEZs in accordance with a proposed variance process" (http://solareis.anl.gov/eis/what/index.cfm, accessed 4/25/2012). The third alternative, the SEZ only alternative, was also modified through the Supplement. The following table summarizes the changes to the proposed solar energy zones.

Table 7. Proposed SEZs and the changes in size between the draft programmatic EIS (DOE/BLM 2010) and the supplemental PEIS (DOE/BLM 2011). An asterisk (*) indicates that a SEZ was eliminated, but the lands were reclassified as variance lands. See text for explanation.

State	SEZ	Initial Size (acres)	Current Proposed Size (acres)	Developable Area (acres)	Comments

AZ	Bullard Wash	7,239	eliminated*		
	Brenda	3,878	3,878	3,847	31 acres of Bouse Wash identified as non-development area
	Gillespie	2,618	2,618	2,618	some acreage identified for potential visual resource conflicts; permits only PV tech. no greater than 10 ft high
CA	Imperial East	5,722	5,722	5,717	5 acres of wetlands identified as non-development area
	Riverside East	202,896	159,457	147,910	43,439 acres (closest to Joshua Tree NP) excluded to future proposals; 11,547 acres listed as non-development; specific visual resource mitigation required
	Iron Mountain	106,522	excluded		The only SEZ taken completely off the table.
	Pisgah	23,950	eliminated*		
NV	Delamar Valley	16,552	eliminated*		
	East Mormon Mountain	8,968	eliminated*		
	Amargosa Valley	31,625	9,737	8,479	21,888 acres excluded, 1,258 acres in Amargosa River floodplain listed as non-development; solar technology should be low-water
	Dry Lake	15,649	6,186	5,717	9,463 acres eliminated to reduce impacts on desert tortoise and other wildlife, but retained as variances; 469 acres of floodplain and wetland considered non-development
	Dry Lake Valley North	76,874	28,726	25,069	48,148 acres eliminated to protect sage grouse and other wildlife but retained as variances; 3,657 acres of wetland and dry lake identified as non-development
	Gold Point	4,810	4,810	4,596	214 acres of intermittent stream identified as non-development
	Millers	16,787	16,787	16,534	253 acres of Ione Wash and small wetland identified as non-development
NM	Mason Draw	12,909	eliminated*		
	Red Sands	22,520	eliminated*		

	Afton	77,623	30,706	29,964	46,917 acres eliminated but retained as variances; 742 acres of floodplain and dry lake areas identified as non-development; approved technology should be low-water
UT	Escalante Valley	6,614	6,614	6,533	12 acres of dry lake and 69 acres of dune identified as non-development
	Milford Flats South	6,480	6,480	6,252	228 acres of Minersville Canal identified as non-development
	Wah Wah Valley	6,097	6,097	5,873	224 acreas of Wah Wah Wash identified as non-development
CO	Antonito Southeast	9,729	9,729	9,712	17 acres identified as non-development
	Los Mogotes East	5,918	2,650	2,650	3,268 acres excluded to reduce impacts to cultural resources, riparian habitats, grazing areas, and important wildlife
	Fourmile East	3,882	2,883	2,882	999 acres excluded to avoid impacts to known cultural resources; 1 acre wetland listed as non-development
	De Tilla Gulch	1,522	1,064	1,064	458 acres excluded from solar development because of concerns for Gunnison prairie dog colony and pronghorn range

The table indicates the significant modifications announced in the supplemental PEIS. These changes indicate that BLM acted on the comments provided by other federal and state agencies, as well as the non-governmental organizations and interested public, and made changes that would more effectively protect resources (or, at the very least, err on the conservative side in resource protection issues). Changes to the SEZs include the following:

- Over 175,000 acres of BLM land excluded from solar development, including the proposed Iron Mountain SEZ, 43,439 acres from the Riverside East SEZ closest to Joshua Tree NP, and 21,888 acres of the Amargosa Valley SEZ close to Death Valley NP.

- Over 18,000 acres of land within the proposed SEZs has been identified as non-development. Most of these acres (11,547) are within the Riverside East SEZ. Reasons for classifying as non-development included to protect wetlands or dry lake habitats, floodplains, and wash habitats.

- Specific technology requirements are associated with certain SEZs, and this is done to minimize future potential conflicts. Areas with visual resource concerns limit solar technology to PV or other low-lying generation technologies, and places with water concerns often specify no wet-cooled technology.

First off, the exclusion of over 175,000 acres of land is a significant and positive change. One of the main issues surrounding solar energy development is the solar footprint, that is the amount of land required to produce electricity. When capturing wind energy, for example, turbines can take advantage of spatial arrangements and different rotations to maximize energy generation within a specified area (Dabiri 2011). Solar energy relies on capturing sunlight, and the energy generation is directly proportional to the area covered. Thus, the footprint of solar energy is as large as other traditional means and higher than many renewable energy forms (Muller et al. 2011). The supplemental DEIS eliminates significant acreage from BLM lands (over 175,000 acres). All else being equal, less acreage means less impact (and less energy generated).

These changes show that BLM considered concerns expressed by NPS and others, and some of these changes should directly benefit national park resources. For example, the Amargosa Valley SEZ was modified to exclude areas within the floodplain of the Amargosa River. The Amargosa River, as stated in Section II, flows through the Amargosa Valley and ultimately terminates within Death Valley NP. The Amargosa pupfish (*Cyprinodon nevadensis amargosa*), a species endemic to the Mojave Desert, lives in the river within Death Valley NP; impacts to the Amargosa River could affect this fish. Also, the Saratoga pupfish (*Cyprinodon nevadensis nevadensis*), another Mojave endemic, inhabits Saratoga Springs, near the Amargosa River within Death Valley NP. These habitats are likely connected via groundwater flow, and again changes in the river could impact this native fish. In this case, then, the changes made in the supplemental PEIS (DOE/BLM 2011) should directly benefit national park resources.

Changes also suggest that BLM learned something from recent solar EIS evaluations and incorporated into this larger programmatic-level planning document some of those lessons. For example, the water issue was particularly central in the Amargosa Farm Road project review, specifically the impact of groundwater pumping on federally-listed plant, invertebrate, and fish species in Ash Meadows NWR. Going forward, the PEIS stipulates that, because of the concern, future projects in the Amargosa Valley and certain other SEZs must utilize low-water technologies (DOE/BLM 2011). Visual resources were also a big issue in some fast-tracked projects, including the Desert Sunlight Solar Farm outside Joshua Tree NP and the Ivanpah project outside Mojave NPres. There, it appeared that BLM was at first blindsided by the visual resources concerns expressed by NPS and others, as if it was a bit shocking that someone standing on adjacent land might be disheartened by looking down at acres and acres of PV panels or heliostats. Nonetheless, the supplemental DEIS (DOE/BLM 2011) more thoroughly analyzes the visual resource issue and acknowledges that this has to be a fundamental concern in the PEIS going forward.

Special status species, exemplified by the desert tortoise, play a central role in planning laid out by the supplemental DEIS. There was no doubt that this would always be the case, particularly under Section 7 of the Endangered Species Act. The supplemental DEIS, though, incorporates that process more fully than the DEIS by excluding some acreage, including the entire proposed Iron Mountain SEZ (important habitat and connectivity for the desert tortoise) and 458 acres of the DeTilla Gulch SEZ (CO) because of concerns for the Gunnison prairie dog (as of 2008, certain populations of Gunnison prairie dog in Colorado merit protection under the Endangered Species Act, but formal listing has not yet occurred). In some cases, acreage was eliminated from the proposed SEZ, ostensibly to address concerns about special status species (including the desert tortoise at Dry Lake SEZ and sage grouse at the Dry Lake Valley North SEZ, both in NV). Unfortunately, in these cases, the acreage was not excluded but only reclassified as a solar energy variance. This will be a key issue addressed later in this document.

Even concerns over cultural resources had a role in the supplemental DEIS revisions. Unknown cultural resource impacts were a contributing factor to excluding the Iron Mountain SEZ and were also cited for eliminating (but retaining as variance lands) the Pisgah SEZ. One concern regarding the East Mormon Mountain SEZ in Nevada is that plants and animals located there are traditionally important to Native Americans. While the relative importance of cultural resources to BLM's planning is outside the scope of this document, it is clear that the presence or unknown status of cultural resources in proposed SEZs played a role in BLM's revisions.

Another encouraging aspect of the supplemental DEIS is its acknowledgement that in all cases more information will be necessary to make sure that resource protection issues are central in processing permit applications within SEZs. A reading of the PEIS documents, including the supplemental, suggests that BLM did not have a very rigorous knowledge of the extent, distribution, and condition of many resources (natural or cultural) on their lands. [This is perhaps not surprising, considering the vast acreage of BLM lands in CA and NV, let alone the other 4 states considered here.] The DEIS review period allowed BLM to review comments and concerns about certain lands, and the way those concerns were acknowledged in the supplemental felt as if they were either not initially considered (bad) or straight-up unknown (also bad). By addressing this directly in the supplemental DEIS, the BLM acknowledges that up-to-date and accurate information regarding resources must play a central role in decision making within the proposed SEZs.

For example, the supplemental DEIS calls for data collection in the Amargosa Valley SEZ to get a better handle on vegetation and plant communities. Specifically, the plan calls to "map the location and areal extent of desert dry washes and playa habitats within the SEZ" as well as to "identify and map the location and areal extent of these habitats, as well as wetland, riparian, greasewood flat, desert chenopod scrub, and mesquite bosque habitats, and Amargosa River shrub communities, outside the SEZ that may be affected by hydrological changes" (DOE/BLM 2011, C-156). It also calls for "pre-disturbance surveys within the SEZ to determine the use of the SEZ as movement/migratory corridor or as important habitat for the mule deer" (DOE/BLM 2011, C-156). Other additional data needed include information on presence/absence of special status species and the suitability of potential habitats.

Critically, water resources also need more research in the Amargosa Valley SEZ. Some of it is needed to clarify the important habitats within the SEZ, but other research is needed to better understand the groundwater dynamics. Specifically, the DEIS calls for work to "modify the regional-scale Death Valley Regional Flow System (DVRFS) model" which was the groundwater model used to inform the ROD on the Amargosa Farm Road Solar Project regarding potential impacts of groundwater pumping on Ash Meadows NWR and the Devils Hole pupfish. As detailed in Part II, this model was the only one available but was considered generally inappropriate for scientific certainty because the model scale was significantly larger than the habitat (Devils Hole) in question.

The supplement also lists additional information required within the Riverside East SEZ. Like all places in the desert, water is a critical issue, so the plan calls for more information regarding water-dependent habitats (ephemeral stream channels, alluvial habitats) and the 100-year floodplain. The plan also calls for a modified groundwater model that will better evaluate potential impacts of pumping scenarios. For ecological resources, the supplemental DEIS indicates a need for more detailed information regarding the location and extent of woodlands, wetlands, and scrub habitats within the SEZ and also bush seep-weed habitats outside the SEZ (DOE/BLM 2011, C-63). Much more information is needed, as well, on special status wildlife (e.g., desert tortoise) and rare plants.

Heightened emphasis on visual resources, and the potential impacts of solar facilities to these resources, is evident in the Riverside East SEZ adjustment. Not only is the new SEZ further away from Joshua Tree NP, but the supplement recognizes the need for solar technologies that will be less disruptive to visual resources. [This marks a significant change from the permitting process associated with Desert Sunlight Solar Farm (detailed in Part II).]

For cultural resources, DOE/BLM (2011) identifies significant needs to better identify and delineate cultural resources, from significant historic sites or structures to cultural sensitivities and ethnographic resources. The Riverside SEZ falls in the traditional use of several Native American tribes. A recent news story (LA Times 2012) highlights the importance of thorough and accurate cultural resource data considered in all decision-making. Construction on the Genesis Solar Energy Project, an already approved fast-tracked project located within the proposed Riverside East SEZ, is threatened because activities uncovered significant evidence of prehistoric human settlement in the project area. The parent company, NextEra Energy Resources, stated that “the project could become uneconomical” if too many areas within the project area were put off limits because of new-found cultural sites.

The programmatic EIS identifies resource classes, like above, requiring more information to better evaluate the impacts of solar development within an SEZ. It also identifies areas where no additional data collection is needed. For instance, within the Riverside East SEZ, there is no need for additional information regarding rangeland resources, recreation, and air quality. This will allow BLM to “tier” future project authorizations (DOE/BLM 2011, 1-7) to the analysis in the final PEIS. Text from the supplement better explains this: “For example, if the water impacts associated with a proposed project were not covered by the SEZ analysis in the Solar PEIS and those water impacts are expected to be significant, a tiered EIS would be appropriate. . . tiered analyses for projects in SEZs are expected to be narrowly focused on those issues not already adequately analyzed in the Solar PEIS” (DOE/BLM 2011, 2-20). In this way, the process is streamlined and efficient for the applicant and for the agency (neither has to spend time detailing resources already identified as not significant, allowing both to focus on likely potential impacts).

From the perspective of resources protection, the tiered analysis laid out by the PEIS will go a significant way towards addressing many of the resource issues identified throughout this report. For instance, water and water-related habitats are so critical in desert ecosystems (and the natural resources often associated with those habitats are often unique, Desert Fish Habitat Partnership 2008), and the PEIS reiterates this by requiring more information and sufficient documentation on impacts to water resources by solar projects in SEZs. More information is needed for cultural resources, to comply with the law and avoid the situation happening at Genesis Solar. More information will also mitigate impairment to visual resources, or at the very least result in more thoughtful consideration of these resources (particularly from lands outside the SEZs).

The supplemental DEIS also indicates a real effort by BLM to address resource issues related to solar development on lands outside BLM. Many of the resources of concern are resources shared between places or cultures. The PEIS specifies many of those resources, whether they be special status species with a wide (or narrow) geographical distribution, viewsheds, traditional properties, or underground aquifer contents. This represents a significant step for land managers and sets the stage for real "smart from the start" development.

This concern for resources on adjacent lands means that the National Park Service should have a more central role in siting decisions. [This is something the NPS has consistently advocated for, given how close approved projects are to area national parks and how much nearby land is still under consideration for solar development (the variance lands, see next section).] Changes in the PEIS between the draft and supplemental suggest that BLM better acknowledges NPS's interests in the region and its different resource protection mission. This should increase the focus on resource protection on NPS lands adjacent to proposed solar facilities.

One concern, though, is that the tiering will preclude resource information on unknown but still important resources. For example, DOE/BLM (2011) lists many special status species which require significant field study to map the location and extent of these species. This is commendable, but it potentially ignores other species currently unknown in an SEZ and therefore not in BLM's list of species requiring further information. Informed decision-making is paramount in resource protection; only time will tell if the tiering approach is sufficient or tends to blind applicants and the agency to other resources in those areas.

Significant Issues Remain Unresolved

At this stage in the PEIS process, significant unresolved issues remain, the largest and most pressing of which is the status of BLM variance lands. Variance lands are lands outside of the proposed SEZs but still open for solar development (Figure 14). The no-action and the modified program alternatives (again, BLM's preferred alternative) would allow applicants to pursue solar development on these BLM lands.

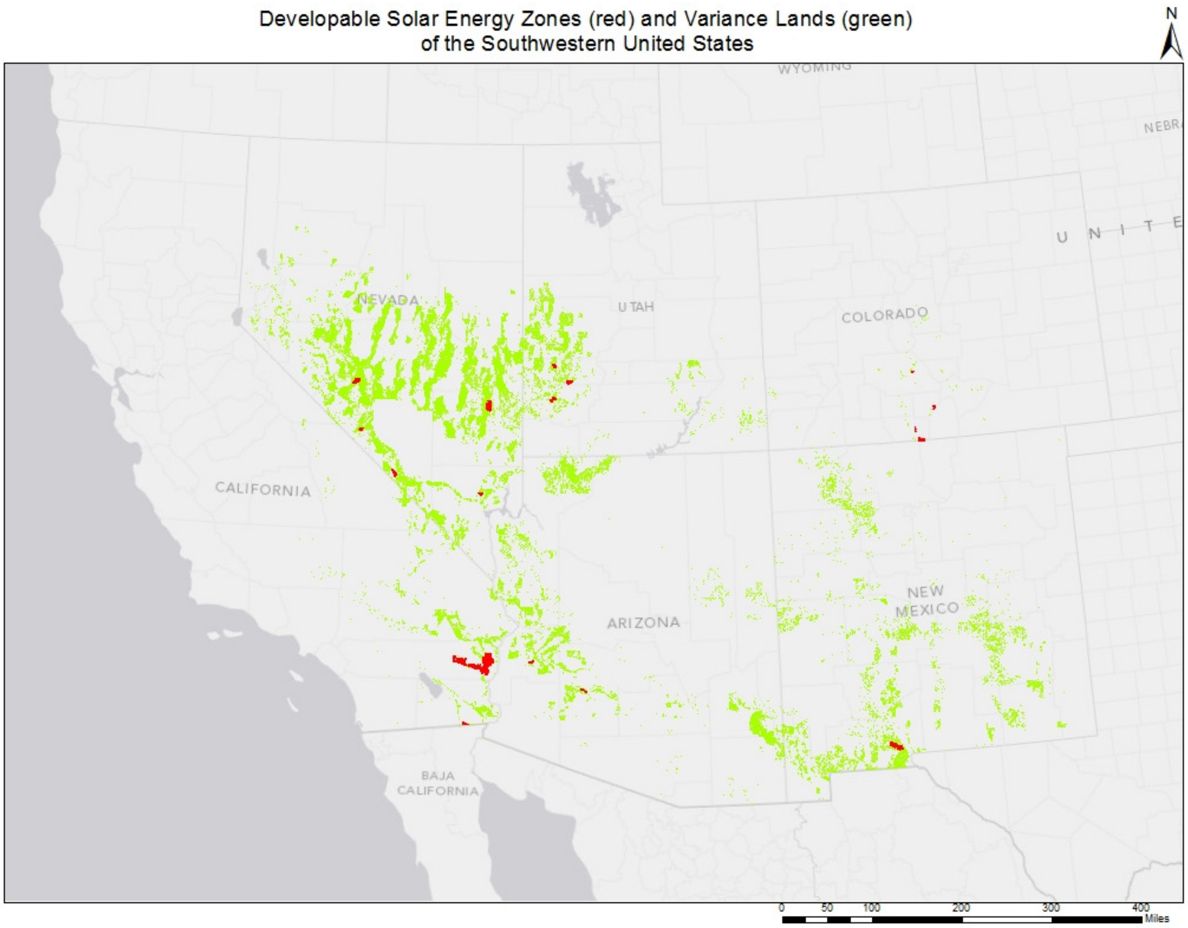

Figure 14. Lands currently proposed as Solar Energy Zones (SEZs, in red), as well as variance lands (in green). The current PEIS draft encourages solar development in the SEZs but will consider applications proposed for variance lands. Map produced in collaboration with USGS (Reston, VA).

From the perspectives of the region's national parks, allowing solar development on variance lands could be disastrous. Variance lands dot the California and southern Nevada desert region, including nearly 2 million acres that abut or are very proximate to the California desert national parks. All told, there are 934,135, 495,824, and 516,354 acres classified as variance lands in the 25 mile buffer regions around Death Valley, Mojave, and Joshua Tree, respectively (Table 8). Within 5 miles of these parks, over 499,000 acres are classified as variance lands (Table 8). In fact, the 179,828 acres of variance land within 5 miles of Death Valley exceeds any of the proposed SEZ areas (Table 7). There is currently nothing stopping a ROW application for these lands, and the evaluation of that application, while it might receive significant scrutiny by BLM and NPS and other agencies, may still be approved and impact the resource values within that park. The supplemental DEIS takes some steps to address potential future conflict, by encouraging early communication and consultation with the NPS and placing a greater burden on the applicant to demonstrate "need, project viability, and environmental appropriateness" (NPS 2012). NPS wants to see the policies covering variance lands strengthened, not to the point of automatic exclusion but so that the review bar is set particularly high. NPCA, in its January 27, 2012 comments on the supplemental PEIS, supported the solar energy zone alternative. If BLM's preferred alternative is selected, NPCA insists that certain measures be put in place to safeguard park resources (NPCA 2012). One suggestion is a 15 mile exclusion zone around national parks. For the California desert parks, this would take over 1 million acres off the table (Table 8).

Table 8. Area (in acres) around the California desert parks within 5-, 15-, and 25-mile buffer zones managed by BLM and classified as variance lands in the PEIS.

	5 Mile Zone		15 Mile Zone		25 Mile Zone	
	BLM (acres)	Variance (acres)	BLM (acres)	Variance (acres)	BLM (acres)	Variance (acres)
Mojave NPres	702,012	85,956	2,155,930	255,401	3,490,912	495,824
Joshua Tree NP	403,990	233,954	1,236,276	275,016	2,153,973	516,354
Death Valley NP	989,645	179,828	2,666,835	639,267	3,874,454	934,135

Speaking more generally, the lands formerly located within SEZs but now considered variance lands (Table 7) pose other resource protection concerns. Recall, 6 SEZs proposed by DOE/BLM (2010) were eliminated in the supplement (DOE/BLM 2011). But instead of being taken off the table, these lands were retained as variance lands. The text that BLM uses to describe this is interesting: "Although the area will be dropped from consideration as an SEZ, the lands that composed the proposed [eliminated] SEZ will be retained as solar right-of-way variance areas, because the *BLM expects that individual projects could be sited in this area to avoid and/or minimize impacts*. Any solar development within this area in the future would require appropriate environmental analysis" (italics mine).

From a resource perspective, this is of concern because it is not at all clear why some lands were excluded and some only eliminated from an SEZ. For example, the Iron Mountain SEZ was excluded from any solar development for the following resource considerations: impacts on nearby wilderness, impacts on soil resources, potential groundwater depletion, habitat or potential habitat for 43 special status species, concerns about strong visual contrasts, and unknown impacts to cultural resources

(DOE/BLM 2011, B-5 to B-8). Pisgah SEZ was eliminated (but retained as variance) for the following reasons: potential impact to wilderness, impacts on soil resources, potential groundwater depletion, habitat or potential habitat for 54 special status species, and unknown impacts to cultural resources (DOE/BLM 2011, B-11 to B-13). Why, ultimately, was one excluded while the other retained? BLM does not provide sufficient justification for this distinction, why precisely Iron Mountain gets a pardon from the Governor while Pisgah only gets a stay of execution.

Part of the justification for retaining variance lands is to meet potential demand. "Variances may be needed in the near-term because the lands identified as SEZs might be insufficient to accommodate demand for utility-scale solar development" (DOE/BLM 2011, 2-33). This reasoning is suspicious at best. Using the assumed acreage to MW generated conversion of 9 acres/MW generated, the available 285,000-plus acres currently listed as developable (Table 7) is sufficient to produce over 30,000 MW of electricity, far in excess of the legistatively-mandated 10,000 MW by 2015. To keep options open is understandable, but the justification that variance lands might be needed for demand is not sufficient or defensible.

Another concern emerges from trying to ferret out just exactly how BLM "expects that individual projects could be sited in this area to avoid and/or minimize impacts." What exactly would constitute this difference? It is possible that BLM simply means that the tiered analysis within SEZs is slightly less stringent and project analysis on variance lands would be more rigorous. This might imply that the tiered analysis may have sufficient weaknesses with respect to resource protection. It also might mean that BLM wants to both have cake and eat it too, by encouraging development in SEZs but ultimately retaining the option to pursue it on other lands. Any or all of these might be possible, but the ultimate consequences for resource protection are troubling. The resource impacts on variance lands could be extensive, and BLM seems to be pushing these concerns down the line. If the case study analysis presented in Part II shows anything, it shows that despite the critical review of each project, significant resource issues were overlooked or insufficiently addressed in the EIS process.

The programmatic EIS through both the original draft and supplement has accomplished several things thus far. First, it has advanced the national-level conversation about solar energy development on public lands, in terms of both the societal benefits and costs. This needed to happen, and DOI and DOE should be commended for their efforts. Second, it has structured that conversation around important resource concerns and issues: wilderness experience, groundwater use, visual resources, cultural resources, special status species, and recreational values, to name a few. Tying the process to these resource issues helps clarify potential costs to these decisions and makes stakeholder values a central part of the discussion. Third, it has attempted to streamline a very time- and labor-intensive process by establishing a tiered review process and encouraging ("incentivizing") development within SEZs.

There are still resource issues in question. The lands in and around the California Desert parks are not wastelands but instead are intricate ecosystems with unique flora and fauna. Decisions regarding solar energy production (or anything else, for that matter) should be made carefully.

Conclusions and Recommendations

<u>Conclusions</u>

1) Industrial solar energy is here to stay, and the discussion regarding solar energy production on public lands is the first phase of a new national dialogue.

2) The desert lands targeted for solar energy production are not wastelands. They are robust ecosystems, often rich in biodiversity, and exceedingly fragile. Not only are they fragile, but deserts often take a very long time to heal. Land use decisions, including industrial solar (and other renewable energy facilities), can and will negatively impact fragile desert ecosystems and should not be made lightly. If so, we will find ourselves living with those consequences for decades or even centuries.

3) Case studies of already approved solar energy projects on BLM lands show that, in some ways, the "fast track" review process did a reasonably good job in regards to resource protection. Plan modifications resulted in smaller footprints, slight alteration of project sites, and realistic technology with respect to water consumption--all in all highlighting resource protection concerns. In some cases these affected only BLM resources but in other cases benefitted the resources shared by BLM and other land managers, including the National Park Service.

4) On the other hand, some resource issues were handled rather sloppily, or inadequately addressed. For instance, visual resource issues were analyzed in a one-dimensional manner, and the impacts to people on nearby adjacent lands were downplayed (or not considered at all). Other critical resource issues, like the impact to desert tortoise populations, were miscalculated, leading to an underestimation of project impacts to project area populations.

5) The experience of BLM in these project-by-project evaluations seems to have been incorporated into the larger PEIS process. This is a good thing and suggests real learning about how to incorporate resource protection issues better into the overarching programmatic process.

6) Open questions remain, and these may provide fruitful opportunities for engaging in this emerging national dialogue on solar energy.

a. There is still the open question of the sheer acreage currently classified as variance lands (both eliminated from proposed SEZs and outside SEZs altogether). Not only does this potentially tie-up BLM staff in case-by-case evaluations, but it also may greatly impact park resources as many of these acres within the CA desert region and beyond abut national park lands and may lead to park resource impairment.
b. Even with the larger PEIS framework, there is still great uncertainty on the shared resources located within the SEZs. While the PEIS addresses this issue somewhat from its tiered evaluation, it's very clear that there is in many cases very little knowledge on what resources are where on these lands.

Recommendations

Solar energy should have a key role in a realistic modern energy policy. Development of solar energy technology and production should continue, and public lands can play a strong supporting role in that effort. That said, this is not something to be pursued haphazardly because of potential impacts to public lands including national parks and the resources shared across those lands and enjoyed by Americans as shared heritage.

Technology

1) The deserts of the American Southwest have lots of sun but very little water. **Proposed solar facilities should make every effort to minimize water consumption.** Wet-cooled technologies, though more efficient, are simply inappropriate for this region. In addition, water consumption should be minimized during the construction and operation phase as well.

2) Facility footprint is a major issue, so **BLM should encourage ROW applicants to consider all appropriate technologies and options to minimize project footprint.** Two of the three case studies considered in this report reduced project footprints (in terms of acreage) from the initial proposal, and the departmental PEIS also reduces SEZ acreage. This mindset must continue.

Facility Siting

3) **BLM should continue to consult with other partners (Federal, State, Local, as well as NGOs, citizens groups, and other relevant stakeholders), because the resources in question are, in most cases, landscape-level resources.** Specifically, the National Park Service because of its resource stewardship role should play an integral role in

proposal evaluation and siting decisions for facilities adjacent or near NPS-managed lands.

4) Because the acreage is so great and in some cases so close to NPS lands, **the lands currently considered as variance lands should be taken off the table for immediate solar energy development.**

5) Information is the key to effective site decisions, so **BLM should invest significant resources in thorough inventories to identify important natural and cultural resources that could be affected by siting decisions.** Information will also improve the discussion and evaluation of potential trade-offs between energy development benefits and resource costs. Revenues from leasing fees should support the resource work central to solid decision-making.

6) The **Department of the Interior should consider degraded lands (e.g., industrial brownfields) as potential sites for solar facilities and should bring other significant Federal landholders, including the Department of Defense, to the table when considering the future of solar energy production in the Southwest.**

7) To protect resources on adjacent Federal lands, **management agencies like NPS and FWS must be considered equal participants in this process. This must extend outside Washington, DC, to the BLM Field Offices, Parks, and Wildlife Refuges. Because of impacts to adjacent lands, BLM offices must fairly consider requested adjustments by NPS and FWS to benefit resources.**

Resource Impacts

8) **Many of the resources in question should be considered shared—shared across Federal lands, shared with local communities and stakeholders, a shared heritage for all Americans.** For example, this includes wildlife that move along corridors or between habitats, species with limited distributions, groundwater aquifers spanning large geographic areas, and many others. A spirit of cooperation should pervade this process to insure the protection of the region's shared resources.

9) **Special status species, including federally listed, state listed and other rare plants and animals, should continue to be a focus**

because much of the land in question harbors endemic species or species with a restricted geographic range.

10) **There should be a significant effort to document and/or model landscape connectivity.** Focusing on the connections across the landscape will preclude a monolithic view of resource issues (e.g., these plants are on my land, so it's my decision how to handle them) and facilitate a shared perspective.

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