NOVEMBER 2012

# FINAL ENVIRONMENTAL IMPACT STATEMENT AND PROPOSED CALIFORNIA DESERT CONSERVATION AREA PLAN AMENDMENT FOR THE WEST CHOCOLATE MOUNTAINS RENEWABLE ENERGY EVALUATION AREA

BLM/CA/ES-2013-001+1793

BLM

El Centro Field Office

**VOLUME 2**

# List of Appendices
## (Volume 2)

*This page intentionally left blank.*

# Appendix A

## Geothermal
## Reasonably Foreseeable
## Development Scenario

# GEOTHERMAL
# REASONABLY FORESEEABLE DEVELOPMENT SCENARIO
# WEST CHOCOLATE MOUNTAINS

*This page intentionally left blank.*

# GEOTHERMAL REASONABLY FORESEEABLE DEVELOPMENT SCENARIO WEST CHOCOLATE MOUNTAINS

## 1. Introduction

This Reasonably Foreseeable Development (RFD) scenario has been prepared as a basis for analyzing environmental impacts resulting from future leasing and development of federal geothermal resources within the West Chocolate Mountains Renewable Energy Evaluation Area (West Chocolate REEA, or the REEA). As the term "Reasonably Foreseeable Development" implies, the RFD scenario is a tool the Bureau of Land Management (BLM) can use to analyze the types of impacts that could be expected under an alternative being analyzed. A RFD is not a prediction of what would happen under a specific alternative.

For example, a RFD scenario could assume that all potentially productive areas for geothermal energy production, except areas determined to be not avoidable for development, would be leased: (1) subject to certain resource protection stipulations; or (2) subject to certain resource protection stipulations to each alternative. A RFD scenario would contain estimates for the number of wells and acres disturbed under each of the alternatives analyzed. This in no way is intended to imply that the BLM would be making decisions about development on lands not administered by the BLM or development of mineral estate that may underlie public lands. Those decisions are not exclusively the purview of the BLM. However, the RFD of those geothermal resources should be part of the RFD scenario analyzed because a cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 Code of Federal Regulations [CFR] § 1508.7).

In addition, geothermal leasing decisions would be related to the level and type of development of the geothermal resource occurring in subsequent stages of the process (exploration and development). The RFD scenario is intended to provide the information necessary to analyze potential cumulative impacts. The disturbance for the production facility and associated infrastructure (e.g., road, pipelines, transmission lines, etc.) would be based on the facilities typical in the surrounding area.

The foreseeable development described herein could occur on any land within the West Chocolate REEA, regardless of surface or mineral ownership. For this RFD, it is assumed that three 50-megawatt (MW) power plants would be constructed. The anticipated total surface disturbance for the area is summarized below (Table 1).

**Table 1 Surface Disturbance for Three 50-Megawatt Geothermal Projects in the West Chocolate REEA**

| | BLM Disturbance (acres) | Total Disturbance (acres)[1] |
|---|---|---|
| Initial | 380 | 1,026 |
| Final | 347 | 938 |

Source: BLM 2008 (RFD Updated 2009. The BLM refined the original RFD in the 2008 "Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States" [Geothermal PEIS] based on the specific characteristics of the Salton Sea area. These numbers are consistent with the range provided by the BLM in the Geothermal PEIS, which looked at an 11-state area).
Note: [1] Combination of disturbance for power plant and well field.

## 2. Available Data

Based on the available data and assumptions, including the "Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States (Geothermal PEIS) which used a variety of assumptions in development of their RFD and the original RFD initially developed and later refined by BLM to be specific to the Salton Sea, geothermal energy development could occur on any land within the West Chocolate REEA, regardless of surface or mineral ownership. Of the 64,058 acres, 32,729 acres are available for geothermal energy development on both private and BLM land (land withdrawn by the U.S. Bureau of Reclamation [USBR], acquisition lands not included). Of the 32,729 acres, BLM land allocated for geothermal energy development would be 11,962 acres of BLM subsurface mineral rights, with the remainder of the area being state or private land. An existing, noncompetitive lease application covers all of one section (about 640 acres) which is split estate (private surface/federal subsurface). Approved geothermal leases in the REEA cover 3,322 acres. To estimate the amount of anticipated development for the 32,729 acres which would potentially occur on BLM land, a simple ratio was developed to estimate the percentage of development that could occur on BLM-managed land. This ratio is based on the percentage of land within the REEA that is managed by the BLM for geothermal leasing (37 percent [11,962 acres BLM/32,729 acres total]).

Approximately 24 temperature-gradient (TG) wells have been drilled within the West Chocolate REEA with data that provide insight into the geothermal resource temperatures that may be encountered. Most of these TG wells have been plugged and abandoned, but information about the wells is available from geothermal databases maintained by various organizations, including the California Division of Oil, Gas, and Geothermal Resources; the United States Geological Survey (USGS); Southern Methodist University; and the Geo-Heat Center. The TG wells include one deep geothermal exploration well (MCR No. 1-15, drilled in 1979 to 9,800 feet in Section 15, Township 9S, Range 12E), which showed a gradient of 1.9 degrees Fahrenheit (°F) per 100 feet (essentially a background gradient indicating no commercial potential at that site).

Some TG wells drilled for geothermal exploration to depths ranging from several hundred to over 1,500 feet indicate gradients exceeding 5°F per 100 feet. That gradient, if maintained to greater depths, implies reservoir temperatures around 350°F at depths from 5,000 to 6,000 feet, and potentially exceeding 500°F at 9,000 feet. Since actual geothermal gradients may locally decrease or even reverse with depth, it is reasonable to estimate resource temperatures somewhere near 350°F at commercially drillable depths within the West Chocolate REEA.

In addition to the TG well data, the West Chocolate REEA's proximity to the Salton Sea geothermal field indicates the potential for geothermal development. The Salton Sea geothermal area is one of the most prolific geothermal areas in the world. The field is located in a geologic spreading center, where the Pacific Plate and the Continental Plate are being pulled away from each other. This pulling action results in abnormally thin crust, shallow magma, and high temperatures at relatively shallow depths. Temperatures in excess of 600°F have been encountered at depths as shallow as 3,500 feet below the surface, and single production wells can generate over 25 MW. The Salton Sea geothermal field has 10 operating geothermal power plants with a current capacity of 326 MW net.

At its closest point, the West Chocolate REEA is about 8 miles northeast of the developed portion of the Salton Sea field. Although decreasing resource temperatures on the northeast margin of the Salton Sea field are indicated by published temperature contours (CalEnergy 2003), there are spas with hot water wells adjacent to the northwest portion of the REEA (the Bashford, Lark, and Fountain of Youth spas), which suggests that geothermal resources suitable for electrical generation may be present within the REEA, itself. It is assumed that the productive areas would be less prolific than in the Salton Sea geothermal field and would require more production wells per MW than are required in the Salton Sea geothermal field.

## 3. Exploration

Geothermal exploration is carried out to help define the geothermal resource in terms of its geometry, boundaries, controls on permeability, temperature distribution, and fluid flow paths. Exploration is not only restricted to the pre-development phase, but may be undertaken after generation begins, perhaps in support of a capacity expansion, to identify locations for make-up production wells (drilled to maintain capacity) or to revise an injection strategy. Exploration programs are typically undertaken in stages, with lower-cost and logistically simpler activities undertaken first, gradually advancing to the more costly and complicated elements.

The activities described below may take place on any of the lands considered for leasing in the West Chocolate REEA.

Exploration typically begins with a geochemical survey, in which surface waters (if any) and ground waters (both thermal and non-thermal) are sampled and analyzed for their chemical content. This may involve creating access to areas with no roads or very poor roads (using four-wheel drive vehicles or on foot). In vegetated areas, some cutting of vegetation may be required for access; however, this is unlikely to be the case in the West Chocolate REEA, where the vegetation is generally low and sparse. Since there are no springs within the West Chocolate REEA, sampling of groundwater would entail either drilling monitoring wells or using existing production wells. Water samples are collected into sealed plastic bottles and taken off site for analysis. Small amounts of chemicals (such as NaOH) are often placed in the sample bottles prior to sampling to stabilize certain dissolved elements in the sampled water and avoid precipitation in the sample bottle.

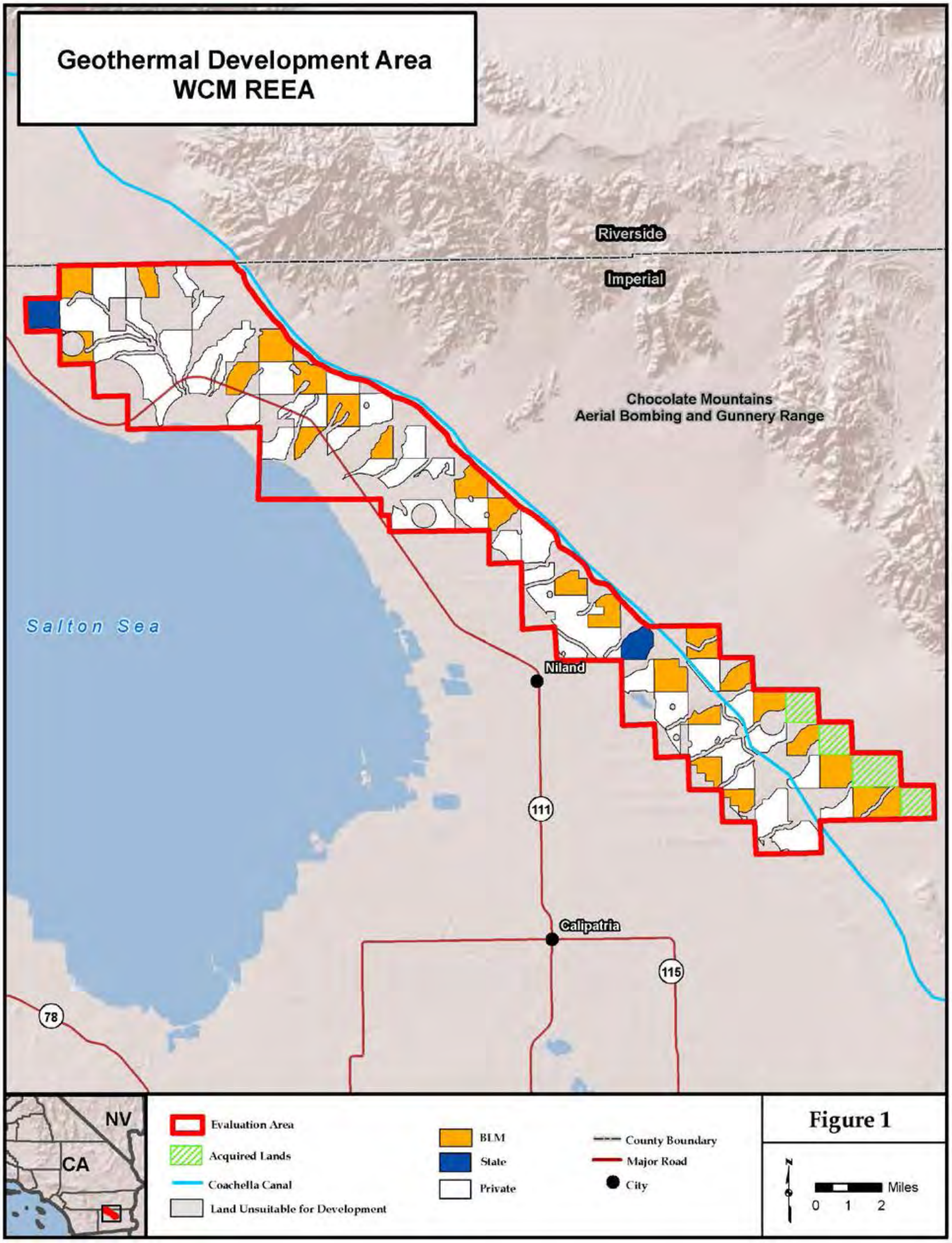
In addition, soil gases may be measured to determine their chemical makeup, which is an indicator of geothermal energy potential, by temporarily installing gas collectors. Soil gas sampling may result in minor disturbances to a number of small areas (less than 3 square feet) since the sensors are partially buried. The gas collectors are left for a few days before they are removed from the site. Other than this, chemical sampling generally creates no impact.

**Geologic mapping** is also a common geothermal exploration activity. While some mapping work involves evaluating maps, aerial photos, and satellite images, it is common for the geologist to make on-the-ground observations to obtain more geologic detail and to sample rock units for petrologic or other analyses. This involves obtaining access to the area by some means (often setting out on foot from existing roads or trails), but there is little if any impact on the area being mapped.

**Geophysical surveys** may also be undertaken, using one of several methods. Surveys that may be undertaken could include gravity, magnetic, seismic, resistivity, and measurements of ground temperature by one of several means. The process of and potential disturbances from these geophysical techniques are discussed below.

*Gravity and magnetic surveys* are passive (detecting naturally occurring events) measurements. A gravimeter or magnetometer is moved around the area, and measurements are taken at convenient locations, typically along roads. Where road access is limited, the measuring equipment must be carried to each measurement site. This is typically done either on foot or by using pack animals or all-terrain vehicles. The amount of disturbance to the land from such activities is minimal.

*Seismic surveys* are typically undertaken by setting up a monitoring array of geophones (with the data transmitted to a central location) and creating a pulse or series of pulses of seismic energy. The pulse is created either by detonating a charge below the ground surface or by a “thumper truck” that is driven through the area on established roads. The monitoring array may be deployed at the ground surface, in small excavations made specifically for burying the geophones, and/or at the bottom of existing wells. These surveys are typically undertaken over the course of just a few days, thus limiting the impacts associated with the movements of a thumper truck or detonation of a charge. The vibrations from the seismic sources are negligible and would not cause damage to existing structures. Longer term deployment of geophones is sometimes undertaken in areas where natural seismic activity occurs; this is a completely passive data collection method that records naturally occurring earthquakes.


Geothermal Development Area
WCM REEA
Riverside
Imperial
Chocolate Mountains
Aerial Bombing and Gunnery Range
Salton Sea
Niland
Calipatria
111
115
78
NV
CA
Evaluation Area
Acquired Lands
Coachella Canal
Land Unsuitable for Development
BLM
State
Private
County Boundary
Major Road
City
Figure 1
N
Miles
0 1 2

*This page intentionally left blank.*

*Resistivity surveys* are very common in geothermal exploration, because variation in the earth's resistivity can occur directly as a result of the presence (or absence) of geothermal fluids. Several possible methods may be used. Some involve laying out long lines (up to several hundred meters) of cable on the surface, typically along roads, although some convenient off-road areas may also be used for this purpose. Others, such as magneto-telluric (MT) surveys, involve setting up equipment repeatedly in small areas (a maximum of 20 or 30 square feet at each measurement site) and taking many measurements across the prospect. An MT survey is sometimes preferred because it evaluates conditions at greater depths than other resistivity methods (that is, at depths where the resource is likely to exist, rather than the overlying zone); therefore, it is quite possible that this method would be used within the REEA. In an MT survey, electrodes are buried just beneath the ground surface at each site, and measuring equipment is set up nearby. Each site is monitored for several hours, and the equipment is then moved to the next site. The only disturbance is associated with access to the area and with minor, temporary disturbance of the ground surface to bury the sensors. Each site is restored as closely as possible to its original condition before the next site is monitored.

*Shallow temperature measurements* are another geophysical exploration method. These can be made with a long thermal probe, which is inserted into the ground to a specified depth, allowed to stabilize, and removed after the temperature has been recorded. Alternatively, a hand auger may be used to drill short (less than 6 feet deep), narrow-diameter (a few inches at most) holes, into which the probe is temporarily placed. This type of survey is likely to be undertaken on foot in a prospective area.

## Temperature-Gradient Wells

TG drilling enables the investigation of temperatures at shallow depths in and around a geothermal system. These wells are drilled during the exploration phase of a project to help define the distribution of temperatures in the subsurface, and to extrapolate temperatures to different depths. It also provides valuable information on the shallow hydrology and may enable sampling of groundwater where the number of existing wells is limited. TG wells investigate conditions above the geothermal reservoir and, again, are not used for either production or injection. Their depth may range from perhaps 100 feet to 3,000 feet or more, depending on the potential characteristics of the geothermal resource, local hydrologic conditions, and other factors. The number of TG wells is also quite variable, depending on the system being investigated and the size of the anticipated power development. Samples are typically taken of any groundwater encountered during drilling. Then the wells are typically completed with sealed, water-filled tubing from surface to bottom, often with cement around the tubing. Later in the project, the tubing may be perforated to allow monitoring of groundwater pressure.

Drilling equipment for TG drilling is selected based on the depths and design of the wells to be drilled, and the physical and logistical conditions of the drilling sites. Most gradient wells are drilled with a small rotary rig (often truck-mounted) similar to that used for drilling water wells, or a diamond-coring rig, similar to that used for geologic sampling in civil works projects and mineral exploration. Neither requires much site preparation, but some auxiliary equipment is needed, including water trucks, tanks for mixing and holding drilling fluids, vehicles to transport supplies and personnel, and in some cases a backhoe to make minor excavations at the drilling site. After the wells are completed, temperature profiles are measured periodically in each well using a small downhole temperature probe, which is typically transported in a small truck.

Because only limited geothermal drilling has been conducted within the West Chocolate REEA, it is assumed that some level of exploration would occur prior to full-field development. Exploration may include one or more of the geophysical exploration methods above, and drilling of TG holes. The number of TG holes can vary considerably from project to project, but it is reasonable to expect that for a single project, between 10 and 30 TG holes would be drilled.

Seismic testing can be either passive (again, to detect naturally occurring events) or induced (typically by "thumper trucks" driven along established roads to create seismic pulses that can be detected by a geophone array). Alternatively, the seismic pulse may be created by detonating explosive charges placed in shallow holes (less than 100 feet deep). Geophones may be deployed at the ground surface, in small excavations made specifically to bury geophones, or downhole in existing wells. It is assumed that the total surface disturbance relating to seismic testing would be 5 acres. The area of surface disturbance would be linear, and might consist of up to a few (less than 10) line-miles.

TG drilling requires road access; therefore, some construction of new roads or improvement of existing ones (e.g., grading) may be required. At the well site itself, a small cellar (typically less than 3 feet square and less than 3 feet deep) may be excavated to allow the conductor casing to be set beneath the rig. In most cases, little or no leveling or grading is needed. Drilling may take up to several weeks. First, a hole is drilled to about 30 feet, and a conductor pipe (typically 8 to10 inches in diameter) is cemented into place. Next, a smaller-diameter hole (7 to 8.5 inches) is drilled to perhaps 300 feet, where a second casing is cemented. The final hole (commonly less than 6 inches in diameter) is then drilled to the final depth. A string of tubing (typically 3 inches in diameter or less) may be run from the surface to the bottom of the well ("downhole") and cemented in place. As discussed above, this tubing is sealed at the bottom to allow stable temperature gradients to be measured.

After drilling, the rig and other equipment are moved off the site and all materials and refuse are removed. If a cellar has been excavated, it is back-filled to restore the ground to its original level. The well is left with the inner tubing protruding slightly above the ground surface to allow access for later temperature logging; the outer casings are cut off near ground level. In the months after completion, the well site is likely to be visited several times for temperature measurements, until a completely stabilized profile is obtained. After this, the wells can be left for periodic monitoring, or they can be abandoned, which involves excavating the ground around the well to a depth of about 3 feet, cutting off the casing and tubing, plugging the tubing with cement, and back-filling and grading the site to restore the natural contour.

TG holes are small-diameter holes that do not, by definition, penetrate a geothermal resource. The purpose of these wells is to identify areas that have the greatest amount of heat flow, which would be the most probable targets for production wells. It is assumed that the total surface disturbance for each TG hole would be 3 acres, including the drilling location and the access road. It is likely that some of the drilling locations used for the TG holes would also be used for production wells.

However, for the purpose of this RFD, it is assumed that they would remain separate disturbances.

The total surface disturbance anticipated for exploration is 95 acres (Table 2).

**Table 2 Exploration Surface Disturbance For One, 50-Megawatt Power Plant**

| Description | Unit Surface Disturbance (acres) | Number | Total Surface Disturbance (acres) |
|---|---|---|---|
| Drilling TG holes | 3 | 30 | 90 |
| Seismic testing | 5 | 1 | 5 |
| **Total** | | | **95** |

The time required to drill and complete each well depends most on well depth, but also on the type of drilling equipment used. It is reasonable to expect a maximum of several weeks per well. The drilling rigs typically operate in a single-shift mode (10 to 12 hours each day), but occasionally operate around the clock. The number of vehicle trips per well may vary from 20 or 30 to a few hundred, depending primarily upon the well depth, but is unlikely to exceed 10 per day. The weight of the heaviest vehicles is unlikely to exceed 55,000 pounds; most trips to bring materials, as well as personnel trips, would be made with lighter vehicles. Exhaust from these vehicles and the rig engines would be controlled with standard air-pollution control equipment (such as catalytic converters) to maintain air quality. The rig engines may be as large as 600 horsepower (hp) and would operate continuously throughout the drilling shift. Water trucks are often used to control the dust generated by excavation, grading, or vehicle movements on unpaved roads.

Since the TG wells produce no geothermal fluids and generally do not directly contact the geothermal reservoir, no impact from discharge of geothermal fluids would be likely to occur. Artesian pressures may exist within the West Chocolate REEA, so any TG well drilled to a depth below the groundwater table would be drilled with blow-out prevention (BOP) equipment. If a gradient well did penetrate a geothermal zone, a significant release of geothermal fluids at the surface would be unlikely because of the use of BOP equipment and because of the relatively small diameter of the wells. If zones with artesian pressure are encountered during TG drilling, the well would be completed with cemented tubing to prevent cross-flow to shallower zones.

# 4. Drilling

The results of geologic mapping, geophysical surveys, and geochemical surveys are likely to define an area considered to be most prospective for drilling. The developer may choose to use temperature-gradient wells (TG wells) first and then use full-diameter (FD) wells, or may move directly to drilling FD wells. TG wells are smaller in diameter and usually shallower than FD wells, and cannot be used for either production or injection.

## Full-Diameter Wells

To support each 50-MW increment of net geothermal generation, it is estimated that up to 40 FD wells (16 production wells, 16 injection wells, and eight dry holes) would need to be drilled. This includes both the initial wells and make-up or replacement wells that would need to be drilled periodically during the life of the project. All wells on BLM-managed land would be permitted by BLM using standard review methods that ensure protection of ground water, public safety, and the environment. Typically, two to three FD wells are drilled during the early stages of the project. These wells discover and confirm the resource, and data from drilling, logging and testing areas used as a basis for making the decision about proceeding with the development (i.e., determining project feasibility).

### ***Surface Disturbance***

Each well is anticipated to be from 4,000 to 9,000 feet deep. However, these depths should not be considered a limiting factor when permitting, because there is no strong correlation between depth and environmental impacts. In other words, a 12,000-foot well could be drilled with only slightly more impacts than a 9,000-foot well. The difference in impacts is covered by the high-development bias of this RFD scenario.

The use of multi-well drill pads would depend on the depth of the resource that is encountered. Resource depths of less than 4,000 feet would make directional drilling difficult and require fewer wells per pad, whereas depths of 9,000 feet would allow five or more wells to be directionally drilled from a single pad. If there were more wells per pad, fewer pads would be required to achieve the same number of MWs, which would result in less overall surface disturbance. However, because little is known about the depth of potential resources within the West Chocolate REEA, rather than risk underestimating the potential surface disturbance, it is assumed that only one well would be drilled from each pad.

The potential impacts associated with drilling FD wells are similar to those for TG wells, although at a larger scale. The important differences for FD wells are as follows:

- The access roads need to meet higher standards than must roads needed for a TG-well-drilling rig, as the rig for a FD well is transported to the site by tractor-trailer trucks. It is highly likely that new roads would be needed for this activity in the West Chocolate REEA.
- The number of trips for both heavy and light vehicles would be significantly greater. Getting the rig and ancillary equipment to the site may require 15 to 20 trips by full-sized tractor-trailers; the same number would be required to de-mobilize the rig. The size of the material-supply trucks and water trucks would necessarily be larger than for a TG well, and the number of trips would be proportionally greater, given the greater well depth.

Well pads for a single well are typically on the order of 200 feet wide and 250 feet long. Thus, each FD well would require a well pad of approximately 2 acres, including cut and fill. As the topography is relatively flat, cut and fill would not contribute significantly to surface disturbance.

The length would increase if multiple wells are to be drilled from a single pad. The various constituents of the well pad include a reserve pit (or “sump”) for collection of drill cuttings and drilling fluids. Typically, the reserve pit is approximately 100 feet long by 60 feet wide. The depth varies according to the volume required and local soil conditions, but a typical depth is about 10 to 12 feet. The sides of the pit typically are sloped at approximately 45 degrees. A partition is typically constructed within the reserve pit to separate the drill cuttings and drilling fluids. The exact shape of the reserve pit at a specific drilling site will depend on the topography, and its holding capacity will vary with the requirements of the job, but a minimum capacity of a few hundred thousand gallons is typical. The base and sides of the pit are typically lined with an impermeable layer to prevent any infiltration of fluids into the subsurface. This can be a membrane material such as hypalon, or a clay liner may be used.

The reserve pit is used to receive fluids that come out of the well during the drilling process. Later, the reserve pit is used during testing operations. For example, during a brief discharge test, the reserve pit receives the produced fluids. If no well is available to inject the produced fluids (which is certainly the case for the first well drilled in a particular area), then the duration of the discharge test is limited by the capacity of the reserve pit. The reserve pit can also be used to store water for an injection test.

Each well location is assumed to need 1 mile of 30-foot-wide access road and 1 mile of pipeline. It is assumed that the pipelines would follow the access roads, thereby adding 10 feet to the total width. It is also assumed that all drilling locations would remain open for the life of the project.

While a temperature-gradient drilling operation can be run by about three onsite personnel and others traveling to the site periodically with materials and supplies, a FD drilling operation typically has from 10 to 15 people on site at all times, with more people coming and going periodically with equipment and supplies.

Rigs for FD wells typically operate around the clock. Noise control measures (such as the positioning of tanks and the use of baffling) may be employed to meet applicable noise limits.

The total foreseeable surface disturbance for new wells is summarized below (Table 3).

**Table 3 Well Site Surface Disturbance for 50-Megawatt Projects**

| Description | Unit Surface Disturbance | Number for One Project | Total Surface Disturbance for One Project (acres) | Number for Three Projects | Total Surface Disturbance for Three Projects (acres) |
|---|---|---|---|---|---|
| Well pads | 2 acres per well pad | 40 well pads | 80 | 120 well pads | 240 |
| Access roads | 3.6 acres/mile | 40 miles | 144 | 120 miles | 432 |
| Pipelines | 1.2 acres/mile | 40 miles | 48 | 120 miles | 144 |
| **Total** | | | **272** | | **816** |

## ***Noise***

Each well would be expected to take between 60 and 120 days to drill. During this time, high levels of noise would be generated by the diesel engines that power the drilling rig and air compressors/mud pumps, as well as by the draw-works, draw-works brake, racking of pipe, and well testing. The racking of pipe and draw-works brake are higher-pitched noises that typically travel further and are more difficult to mitigate than sources such as diesel engines. All diesel engines would use mufflers according to standard industry practice. All well testing would be done through mufflers or separators to reduce noise. Up to three drilling rigs could be in operation simultaneously, and drilling would be expected to take place 24 hours a day, 7 days per week.

## ***Water***

Water demand for dust suppression would be approximately 0.01 AF/acre (3,225 gallons/acre), for a total potential demand of 10.26 AF (3,308,850 gallons), a relatively small quantity of water, depending on the time of use. It is likely that this demand could be distributed over the entire duration of construction; the water would not be required at once, reducing potential water supply impacts; this represents less than 1 percent of the current Imperial Irrigation District (IID) allocation of imported surface water for non-industrial projects within its service area.

## ***Air Quality***

Diesel engine exhaust, reservoir gases produced during well testing, and dust are the primary impacts to air quality from the drilling of wells. Vented steam during a well test may contain non-condensable gases. Carbon dioxide ($CO_2$) comprises the major portion of the non-condensable gases (typically more than 90 percent). If present in the steam phase of the discharge, hydrogen sulfide emissions may be abated by injecting hydrogen peroxide and sodium hydroxide into the test line. Other non-condensable gases do not require abatement. Dust emissions from roads are mitigated by periodic watering.

## ***Ground Water***

It is unknown whether there are underground sources of drinking water in the West Chocolate REEA. Protection of groundwater from contamination by geothermal fluids is facilitated by the use of multiple casing strings, whose depths are specified partly on the basis of the depths of groundwater aquifers. In addition, redundant BOP equipment is used. For a 9,000-foot well, surface casing is normally set between 50 and 100 feet, an intermediate casing string is set between 300 and 1,000 feet, and a production casing string is set down to 4,000 feet or deeper, depending on the depth of the top of the anticipated zone of production or injection. If necessary to maintain hole stability, a slotted liner may be hung over the production or injection interval. Other than the slotted liner, all casing would be cemented in place using standard industry practice. In addition, all injection wells are required to be periodically tested for mechanical integrity. The testing protocol would depend on the nature of any aquifers and the type of resource encountered.

# 5. Power Plants

## 5.1 Construction

Power plant construction requires access via good-quality roads (those capable of accommodating large tractor-trailer trucks). Roads constructed to reach sites for FD wells could also be used to access the power plant site, if the plant were located near one or more of the wells. If topography allowed, the power plant could be positioned so as to be less visible from well-traveled roads; however, there are locations (such as Steamboat, Nevada) where power plants are visible from main roads. A site with reasonable air circulation (for example, not down in a gully) may be required for efficient operation of the plant's condensers.

Given the anticipated reservoir temperatures within the West Chocolate REEA, it is likely that geothermal power plants in this field would use binary conversion technology. The plants could use either air-cooled or water-cooled condensers to condense the binary working fluid after its transit through the turbines. Both water-cooled condensers and flash conversion technology with cooling towers (in which the geothermal fluid goes from a liquid to a vapor instantly when the pressure is dropped) can produce plumes of water vapor (sometimes incorrectly called "steam plumes"), which might be visible on cold days.

The amount of geothermal plant capacity to be installed within the West Chocolate REEA would depend on the resource capacity that is proven by drilling. Regardless of the total size of the resource, it is likely that power plants would be developed in increments of 20 to 50 MW of plant capacity, with separations of a mile or more between plants. A typical plant size of 30 MW would use a site area of up to 15 acres to accommodate all the needed equipment, which would include (in addition to the power plant itself) space for pipelines supplying the brine from the production wells and distributing the cooled brine back to the injection wells, a switch yard, space for moving and storing equipment, and buildings needed for various purposes (power plant control, fire control, maintenance shop, and so forth). The power plant itself would occupy approximately 25 percent of this area for a water-cooled plant, or about 50 percent for an air-cooled binary plant (more area is required for the cooling tower fans in an air-cooled plant). A 50-MW plant would require a larger footprint, on the order of 20 to 25 acres, depending on the conversion technology used.

The number of personnel required during construction varies widely, but at any one point there may be as many as 155 laborers and professionals on site, with attendant vehicle traffic.

After construction was complete, the area around the power plant that was no longer needed for access and maintenance would be regraded and revegetated with local species.

## 5.2 Wellfield Equipment

A geothermal power plant is typically supported by pipeline systems in the vicinity of the plant. These pipeline systems include a gathering system for produced geothermal fluids and an injection system for disposal of geothermal fluids after heat extraction by the plant. The pipeline routes are highly site-specific, but typically are located along access roads where possible.

Pipelines are usually less than 24 inches in diameter, and their lengths are minimized to the extent possible to reduce cost and heat loss. In some projects, new pipeline corridors across previously undisturbed areas may be chosen for logistical reasons. Since the pipelines are typically constructed on supports above ground, there is little if any impact to the surrounding area once construction and re-vegetation of the pipeline corridors are complete. Small animals can easily pass beneath the pipelines. The pipeline height is typically a few feet (less than five) above ground surface, and they are painted to blend in with the environment, thus minimizing their visual impact. Production pipelines are typically insulated, while injection pipelines (which are cooler) are usually left unclad. Pipeline expansion and contraction is accommodated by using expansion loops. These are large, U-shaped bends, with the contraction or expansion of the U being accommodated by slides or rollers mounted on the pipeline on either side of the U. These expansion loops are commonly horizontally oriented, but occasionally vertical (for example, where a road crosses a pipeline corridor).

A small shed (usually no more than 10 feet x 10 feet) may be constructed at each well site to house certain equipment (e.g., flow-metering equipment, electrical equipment, lubrication oil for the pump, and so forth). As for the pipeline, the sheds are painted to blend in with the environment.

## 5.3 Operations and Maintenance

### ***Operation of a Binary-Cycle Geothermal Power Plant***

In a binary-cycle geothermal power plant, which is the most likely type to be constructed within the West Chocolate REEA, the heat from the produced geothermal fluid is transferred to a working fluid that boils at a lower temperature than water. It is the working fluid (such as isobutane or n-pentane) that expands through a turbine to generate electricity, rather than the geothermal fluid itself. The geothermal fluid and the working fluid are maintained in separate, sealed loops to prevent them from mixing and/or escaping to the environment.

Geothermal wells supplying binary geothermal power plants are typically pumped (rather than self-flowing). Standard line-shaft pumps are the most commonly used downhole pumps. These are contained within their own casing and consist of several pump stages in a vertical arrangement. Lubricating oil is used to keep the bearings from seizing up. The production well system is maintained at a pressure greater than the “bubble point” (the pressure at which boiling would occur) to keep all gases in solution.

Hot water from the production wells is gathered in a series of pipelines and delivered to the power plant site, where it is then passed through several heat exchangers, which transfer heat from the geothermal fluid to the working fluid. After flowing through the heat exchanger, the cooled geothermal fluid enters the injection system to be returned to the reservoir via the injection wells. This type of system incurs no loss of geothermal fluid; only a portion of the heat (but no mass) is removed. No geothermal fluid or steam is emitted to the atmosphere.

The working fluid flashes into a vapor phase in the heat exchangers and is then passed through a condensing turbine. Electricity is created from a generator attached to the turbine shaft. After passing through the turbine, the working fluid is condensed into a liquid phase and the process is repeated. Like the geothermal fluid, the working fluid is also maintained in a closed loop, thus avoiding any leakage to the atmosphere or mixing with the geothermal fluid. Condensation of the working fluid in a binary power plant may be achieved either through air-cooling or water-cooling; however, given the high ambient summer temperatures in the West Chocolate REEA, water cooling would be the preferred option (if an adequate supply of cooling water is available), as it would result in greater generation efficiency. The cooling water could possibly be purchased from the IID for circulating through the cooling system. Some evaporative water loss is expected; the amount of loss increases during the hotter summer months.

The power plant itself requires electricity to operate, as do the production and injection pumps. This "parasitic power" may be purchased from the local utility or the plant may provide its own electricity, with less net power being available for sale. A source of outside power is required on site in any case for cold starts. The energy consumption of the plant and pumps varies significantly, but is typically no more than about 30percent of the gross generation. That is, if a plant is designed to produce 30 MW total, it may consume as much as 10 MW in supplying its own parasitic power needs and thus produce 20 MW net.

### ***Maintenance of a Binary Plant***

As discussed above, wells may periodically require some maintenance, which may or may not require the presence of a drilling rig. One of the most common maintenance tasks for pumped wells is removing and replacing the pump. This is done only as needed (on the order of once every several years), typically using a crane or boom truck.

The wells may be routinely sampled for changes in chemical composition via a port in the flow line. Periodic temperature and pressure surveys may be run in both the production and injection wells (for pumped production wells, this can only be done when the pump is out of the well) to evaluate how subsurface conditions are changing. Idle wells may be used for pressure monitoring, either at the wellhead (for artesian wells) or downhole. If the latter, an instrument is placed at a specified depth in the well, and the pressure readings are transmitted to the surface where they are recorded for a specified time period.

Tracer testing is another typical wellfield activity. In this type of test, a chemical is added to the injection stream, and samples are collected at each production well over a period of time. The tracers that are typically used in geothermal testing are non-toxic organic compounds (such as fluorescein) that reach only minute concentrations (usually less than 100 parts per million [ppm]) in reservoir fluids and degrade over several months at reservoir temperatures. The formations exposed to tracer testing are isolated from any potable groundwater by the configuration of well casings.

There are several reasons why a well may need to be worked over after it has been completed. It may experience a mechanical failure such as a casing collapse, which renders it unusable as a producer or injector. It may suffer a decline in productivity that could be remediated by some intervention, such as a scale clean-out. Since the wellfield represents a significant portion of the investment in a geothermal field, a diligent operator seeks to monitor its wells and maintain them in the best possible condition, within the constraints of operating budgets.

In some cases, a drilling rig may not be required for remediation. Sometimes a coiled-tubing unit can be mobilized for scale clean-outs or other activities. While a certain amount of disturbance comes with the mobilization of any equipment, coiled-tubing operations are typically much more compact and of shorter duration than those requiring a drilling rig.

If a well has a major problem, a drilling rig needs to be mobilized to the site. Depending on the nature of the problem, it may be possible to have a smaller rig than was used to originally drill the well. The impact of remediation operations is a function of the size of the rig, the duration of the operation, and the nature of the problem.

## ***Staffing***

The number of people required for routine operation of any kind of geothermal power plant is typically 37 using the ratio of 0.74 full-time employees per MW. For comparison, the Heber geothermal facility (which combines both binary and flash plants and has a total capacity of about 130 MW gross) in the southern part of the Imperial Valley had a staff of 47 people as of 2006, including both operating and administrative staff.

## ***Impacts***

### Noise

Power plant noise usually entails a constant low-level hum primarily created by the cooling tower fans.

### Air Quality

Binary plants use a closed-loop process in which the geothermal fluid is never exposed to the atmosphere, and there are no significant sources of air pollution.

A dual flash plant, on the other hand, would discharge any non-condensable gases that are produced with the steam including carbon dioxide, methane, ammonia, and hydrogen sulfide. However, local air quality districts typically have strict limits on hydrogen sulfide emissions. If it is necessary to mitigate hydrogen sulfide emissions, the non-condensable gases may be scrubbed using a “Stretford,” iron chelate, or burner process.

### Visual

Power plants would be sited using terrain to obstruct visual impacts to the extent possible. All facilities would also be painted a color that blends into the natural setting. If water cooling is used, steam plumes from the cooling towers can rise up to perhaps several hundred feet above the cooling towers on cold days. During the hot summer months, the steam plume would be minimal. Air-cooled binary plants would have no such steam plume.

### Seismic

Development of geothermal fields typically results in the creation of micro-seismic events that seem to be related to production and/or injection. These micro-seismic events are detectable by sensitive instrumentation but are usually too small for people to feel. Induced seismicity that is strong enough for people to feel is not typical of geothermal developments. In certain vapor-dominated reservoirs (such as at The Geysers geothermal field in northern California), concerns have been raised that injection has resulted in seismic activity that could be felt by local residents. However, the vapor-dominated conditions found in The Geysers geothermal field that may be associated with seismicity are rare and not expected to be encountered within the West Chocolate REEA. While environmental analysis at The Geysers suggests that seismic events are a result of geothermal activity, these events are not large enough to cause structural damage to homes or other improvements. Therefore, this potential has not been considered a significant impact for geothermal development within the REEA.

The West Chocolate REEA spans a region in which strike-slip motion along the San Andreas Fault system to the north transitions into divergent motion that pulls apart the Pacific and Continental plates at points further south (Lohman and McGuire 2007). Within this tectonically active area, felt earthquakes have often occurred in the past and are expected to occur in the future. However, it is not expected that geothermal development in the REEA would cause any increase in seismicity above naturally occurring levels. Within the Imperial Valley, several geothermal projects with liquid-dominated reservoirs similar to those potentially occurring within the REEA (for instance, the Salton Sea, Heber, and East Mesa projects) have had active production and injection since the 1980s with no increase in felt seismicity attributable to geothermal operations.

There is significant potential for the development of conventional hydrothermal projects in the West Chocolate REEA. However, it is possible that an enhanced geothermal systems (EGS) project may also be proposed by a developer, and therefore this possibility is discussed. In EGS projects, fluid injection is used to enhance rock permeability and recover heat from the rock. During the process of creating an underground heat exchanger by injection or the subsequent circulation of the system, stress patterns in the rock may change, resulting in seismic events.

In almost all cases, these events have been of relatively small magnitude, and by the time the released energy reaches the surface, the vast majority are rarely felt (Majer *et al.*, 2007). The impacts of a seismic event created by fluid injection can be significantly different from those associated with a natural earthquake: the former generally falls into the category of an annoyance, as with the passing of a rail transit vehicle or large truck, whereas the latter may cause damage in a moderate to large event. To date, there is no recorded instance of a significant danger or damage associated with induced seismicity related to geothermal energy production, including the event associated with the EGS project in Basel, Switzerland in late 2006. The introduction of EGS technology in populated areas could be regarded by some as an intrusion on the peace and tranquility of populated areas due to its potential "annoyance factor." For this reason, if an EGS project was proposed in the West Chocolate REEA, induced seismicity would be one of the issues to be covered by the project Environmental Impact Statement (EIS).

## Hazardous Materials

The power plant is maintained on a regular schedule, with major maintenance overhauls typically scheduled every two to five years. It is usually necessary either to reduce the output of the plant (for example, by shutting down one set of energy conversion units) or to shut down the entire plant for a few days while the equipment is inspected and serviced.

The routinely used chemicals that are specific to binary geothermal power plants include the hydrocarbon working fluid and the lubricating oil used in the downhole pumps. If a well's pressure falls below the "bubble point," it is possible that downhole scaling might occur. This would require either a mechanical clean-out with a drilling rig or coiled-tubing unit, or an "acid job," during which acid (typically HCl or less commonly HF) is injected into the wellbore to dissolve the scale. If scaling is persistent, the operator may choose to adopt routine injection of a scale-inhibitor chemical, such as polymaleic anhydride or polyacrylic acid, used in dosages of 1 to 10 ppm.

#### ***Water***

Water demand for dust suppression would be approximately 0.01 AF/acre (3,225 gallons/acre), for a total potential demand of 10.26 AF (3,308,850 gallons), a relatively small quantity of water, depending on the time of use.

#### ***Ground Water***

It is unknown whether there are underground sources of drinking water in the West Chocolate REEA. Protection of groundwater from contamination by geothermal fluids is facilitated by the use of multiple casing strings, whose depths are specified partly on the basis of the depths of groundwater aquifers. In addition, redundant BOP equipment is used. For a 9,000-foot well, surface casing is normally set between 50 and 100 feet, an intermediate casing string is set between 300 and 1,000 feet, and a production casing string is set down to 4,000 feet or deeper, depending on the depth of the top of the anticipated zone of production or injection. If necessary to maintain hole stability, a slotted liner may be hung over the production or injection interval. Other than the slotted liner, all casing would be cemented in place using standard industry practice. In addition, all injection wells are required to be periodically tested for mechanical integrity. The testing protocol would depend on the nature of any aquifers and the type of resource encountered.

In existing California binary geothermal power plants, fluid loss (usage) for operations ranges from 623 to 2,556 acre-feet/year. Fluid loss for existing California multi-stage flash geothermal power plants for operations ranges from 10,807 to 13,540 acre-feet/year. Despite the volumes of geothermal resource water that pass through a binary plant, the closed system ensures that little is consumed, but is reinjected into the same source reservoir.  This is not the case for a flash plant which is not a closed loop system.

## 5.4 Surface Disturbance

It is anticipated that up to three power plants would be built to use the resource from the West Chocolate REEA. Each power plant would be capable of generating 50 MW (net) of electricity. Given what is currently known about the resource, the power plants would likely use binary power generation to produce electricity. It is possible, however, that a flash generation system, in which the geothermal fluid goes from a liquid to a vapor instantly when the pressure is dropped, could be used, possibly in conjunction with the binary plants, to maximize the amount of energy produced. Until more information is gathered during the exploratory phase, the precise technology that would be used is unknown.

As described above, in a binary cycle, hot water from the wells is delivered to a heat exchanger at the power plant. The heat is transferred to a working fluid, and the cooled geothermal water is sent to injection wells and returned to the reservoir. This is a closed loop with no loss of water. The hot working fluid flashes into a vapor phase and is sent through a turbine (for binary generation, the working fluid flashes, while for flash generation, the geothermal fluid flashes). Electricity is created via a generator that is attached to the turbine shaft. After passing through the turbine, the secondary fluid is condensed into a liquid phase and the process is repeated. The secondary fluid is also maintained in a closed loop. Condensation of the working fluid in a binary power plant may be achieved either through air cooling or water cooling. Most plants in operation today are air-cooled, often because of the lack of sources of cooling water. Air-cooled binary plants have banks of cooling fans, beneath which the secondary fluid is circulated in a series of condensers. In areas where an outside source of water is available, the cooling water is circulated through a condenser.

Regardless of whether the plant uses binary or flash technology, each plant location would require about 25 acres, which would be 30 acres of total surface disturbance including cut and fill. Each plant would also require 1 mile of access road and 3 miles of new transmission line to intertie with an existing transmission line that runs through the middle of the West Chocolate REEA. It is assumed that the access road would require 30 feet of surface disturbance including cut and fill. Transmission intertie lines require 100 feet of initial surface disturbance; however, once the lines are constructed, all but a 20-foot access road would be reclaimed with native vegetation.

The total surface disturbance for power plants is summarized below (Tables 4 and 5).

**Table 4 Site Disturbance for One 50-Megawatt Power Plant**

| Description | Unit Surface Disturbance | Number | Total Surface Disturbance (acres) |
|---|---|---|---|
| Power plant location | 30 acres/50 MW | 1 50-MW | 30 |
| Access Roads | 3.6 acres/mile | 1 mile | 3.6 |
| Transmission lines initial | 12.1 acres/mile | 3 miles | 36.3 |
| Transmission lines final | 2.4 acres/mile | 3 miles | 7.2 |
| **Total** | | | **69.9 (initial)**<br>**40.8 (final)** |

**Table 5 Site Disturbance for Three 50-Megawatt Power Plants**

| Description | Unit Surface Disturbance | Number | Total Surface Disturbance (acres) |
|---|---|---|---|
| Power plant location | 30 acres/50 MW | 3 50-MW | 90 |
| Access Roads | 3.6 acres/mile | 3 mile | 10.8 |
| Transmission lines initial | 12.1 acres/mile | 9 miles | 108.9 |
| Transmission lines final | 2.4 acres/mile | 9 miles | 21.6 |
| **Total** | | | **209.7 (initial)**<br>**122.4 (final)** |

## 6. References

Bureau of Land Management 2008. Final Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States. October 2008.

CalEnergy. 2003. Testimony of CE Obsidian Energy LLC (an affiliate of CalEnergy Operating Corporation) before the California Energy Commission at a Notice-of-Intent hearing on the proposed Unit 6 project in the Salton Sea field.

Lohman, R. B. and J.J. McGuire. 2007. Earthquake swarms driven by a seismic creep in the Salton Trough, California. Journal of Geophysical Research 112 (B04405).

Majer, E.L., R. Baria, M. Stark, S. Oates, J. Bommer, B. Smith, and H. Asanuma. 2007. Induced seismicity associated with enhanced geothermal systems. Geothermics (36):185-222.

# Appendix B

## Solar
## Reasonably Foreseeable
## Development Scenario

# SOLAR
# REASONABLY FORESEEABLE DEVELOPMENT SCENARIO
# WEST CHOCOLATE MOUNTAINS

# SOLAR
# REASONABLY FORESEEABLE DEVELOPMENT SCENARIO
# WEST CHOCOLATE MOUNTAINS

## 1. Introduction

This Reasonably Foreseeable Development (RFD) scenario has been prepared as a basis for analyzing environmental impacts resulting from future development of federal lands for solar energy projects within the West Chocolate Mountains Renewable Energy Evaluation Area (West Chocolate REEA, or the REEA). This RFD scenario is a tool the Bureau of Land Management (BLM) can use to analyze the types of impacts that could be expected under an alternative being analyzed. A RFD is not a prediction of what would happen under a specific alternative.

The RFD scenario is intended to provide the information necessary to analyze potential cumulative impacts. The disturbance for a production facility and associated infrastructure (e.g., road, pipelines, transmission lines, etc.) would be based on the facilities typical in surrounding areas.

This RFD scenario assumes that two types of solar technologies could be developed: concentrated solar power (CSP), which is also referred to as solar thermal; and photovoltaic (PV).

CSP technologies use mirrors to reflect and concentrate sunlight onto receivers that collect the solar energy and convert it to heat. This thermal energy can then be used to produce electricity via a steam turbine or heat engine driving a generator. CSP technologies include parabolic trough technology, dish-engine technology, and power tower technology (U.S. Department of Energy [DOE] 2009a).

PV systems are based on the use of semiconductors, materials that can generate small amounts of electric current when exposed to sunlight. Semiconductors are materials that hold their bonding electrons tightly in covalent bonds (and therefore act as insulators in their pure state), but that have conducting properties when combined with small amounts of impurities called dopants. In most configurations, the solar cell material is present as a thin film. Silicon, the earth's most abundant material after oxygen, is the cheapest and most frequently used semiconductor. Boron and gallium are common dopants. Research is currently ongoing using different combinations of semiconductors and dopants to increase the efficiency of solar cells for capturing the energy in sunlight. Compound semiconductor materials such as cadmium telluride have also been used for solar cells. Currently, the silicon-based solar cells that have efficiencies of about 15% are likely to be used in utility-scale PV facilities built in the United States; however, multi-junction solar cells that contain two or more semiconductors and can increase efficiency to 30% or greater will likely be used in utility-scale PV facilities in the future. Another means of increasing efficiency is to use concentrating lenses (also known as concentrating PV technology [CPV]) and tracking systems to capture additional energy from the sun over longer periods of daylight.

## 1.1 Concentrated Solar Power Technologies

### ***Parabolic Trough***

Parabolic trough systems consist of a large field of single-axis tracking parabolic trough solar collectors. The solar field is modular and is composed of many parallel rows of solar collectors aligned on a north-south horizontal axis. Each solar collector has a linear trough or parabolic-shaped reflector that focuses the sun's direct beam radiation on a linear receiver located at the focus of the parabola. The collectors track the sun from east to west during the day to ensure that the sun is continuously focused on the linear receiver. A heat transfer fluid (HTF) is heated as it circulates through the receiver and returns to a series of heat exchangers in the power block where the fluid is used to generate high-pressure superheated steam. The superheated steam is then fed to a conventional reheat steam turbine/generator to produce electricity. The spent steam from the turbine is condensed in a standard condenser and returned to the heat exchangers via condensate and feed water pumps to be transformed back into steam, which is traditionally released into the atmosphere, hence the large amounts of water needed on an annual basis to keep the project going. After passing through the HTF side of the solar heat exchangers, the cooled HTF is re-circulated through the solar field (National Renewable Energy Laboratory [NREL] 2003).

Each plant includes thermal storage, consisting of a dual, two-tank molten salt system, sufficient to support approximately 3.5 full load hours of electricity production. The thermal energy storage (TES) system contains a “”hot” and a “cold” storage tank connected via two parallel trains of six oil to salt heat exchangers in series. For charging the storage, the salt is heated up to approximately 386 degrees Celsius (°C), and for discharging it is cooled down again to approximately 292°C. The salt freezes at approximately 221°C. Freezing of the salt must be avoided to prevent damage of components. The freeze protection system, which uses the hot HTF, keeps the salt at a minimum temperature of 260°C. To avoid freezing of the salt in nonworking periods, the heat exchangers are equipped with electrical heat tracing. The electric output of the plant would be supplied entirely with solar energy. No electricity is generated by the use of fossil fuel in this plant complex. A small gas-fired HTF heater is used for infrequent freeze protection of the HTF in the solar field. Gas for this purpose is supplied by truck.

The HTF is a synthetic hydrocarbon liquid – diphenyl/biphenyl oxide – that has a freezing point of about 13ºC. Freeze protection is routinely accomplished by circulating HTF at a very low flow rate through the solar field using hot HTF from the storage tank as a source. Performance model results indicate that the HTF heater may be required on very cold nights in the deep winter months (Solar Millennium 2008).

### ***Dish-Engine***

Dish-engine technology focuses sunlight from a large parabolic reflector onto a receiver above the dish. Each dish is independent and includes two major elements, the solar concentrator and the power conversion unit. The solar concentrator consists of many mirror facets attached to a frame by three point-adjusting mounts that are designed in five subassembly units for ease of transport and installation on site. Two small motors are attached to the pedestal and programmed to swivel the dish on two axes, following the sun's progression across the sky during the day. The power conversion unit consists of a Stirling engine, which includes a cylinder block that incorporates four sealed cylinder assemblies along with coolers, regenerators, and heater heads.

Concentrated solar energy heats up self-contained hydrogen gas in the power conversion unit, causing the gas to expand into the cylinders, moving the cylinders, and generating electricity. This cycle is repeated multiple times as the engine runs at a steady rate and power is generated by heat transfer from the concentrated solar energy to the working gas in the engine's heater head, which converts the heat energy into mechanical motion. The generator of each unit in a utility-scale project is connected by underground transmission line to a small substation where the power can be transformed into a higher voltage for more efficient transmission across the grid (BLM 2010).

### ***Power Tower***

Solar power towers generate electric power from sunlight by focusing concentrated solar radiation on a centralized tower-mounted heat exchanger or boiler (receiver). The receiver on the top of the tower is filled with a fluid, typically molten salt, which has the ability to hold large amounts of heat. The heat is transferred to water in the same way as the parabolic trough system to produce electricity. Some designs have eliminated the molten salt step and converted water directly into steam but these systems cannot produce electricity at night whereas the molten salt method can store heat in the salts and produce electricity at night (National Joint Apprentice and Training Committee for the Electrical Industry [NJATC] 2007). This technology uses hundreds to thousands of sun-tracking mirrors called heliostats to reflect the incident sunlight onto the receiver boiler at the top of the tower. Electricity is produced by the system's solar receiver boiler and a steam turbine generator. These plants are best suited for utility-scale applications in the 30- to 400-MW ranges (NREL 2003).

## 1.2 Photovoltaic Technologies

The most prevalent kind of solar technology is PV panels, and the vast majority of solar panels are silicon-based. About 90 percent of PV sales are made from silicon-based solar cells (Hasan 2007). The basic unit in a PV system is the solar cell. Silicon is crystallized to create a crystal column called an ingot, which is sliced thinly and processed into cells. PV cells are made of at least two layers of semiconductor material, one with a positive charge and the other with a negative charge. When sunlight enters the cell, some of the photons from the light are absorbed by the semiconductor atoms, freeing the electrons from the cell's negative layer to flow through a circuit and back into the positive layer, producing an electric current.

PV technology generates electric power by using solar cells to convert energy from the sun's direct and diffused solar radiations directly into electricity. Two categories of PV cells are used in most of today's commercial PV modules: crystalline silicon and thin film. Cells are arranged, interconnected, covered with tempered glass, and packaged into a structure called a panel. Dozens of individual cells can be arranged together in a sealed, weatherproof package to form a panel to produce additional energy. Panels can then be fitted into an array, which produces electricity based on the number and efficiency of the panels. A PV array is, thus, a set of panels arranged in frames for mounting on the ground, rooftops, or other locations. A PV array along with other components including inverters, mounting equipment, charge regulators, and sometimes batteries for storage make up large photovoltaic systems (Aruvian's Research 2010).

CPV systems use silicon solar cells or high-performance multi-junction solar cells (typically made of aluminum, gallium, indium, nitrogen, phosphorus, antimony) and use concentrating or reflecting optical devices to concentrate sunlight that strikes the solar cells. They also usually incorporate tracking devices. Because of their higher efficiency, CPV systems also generate excess heat; therefore, some require cooling systems to dissipate the heat. The cooling systems may be passive (e.g., cooling fins) or active (e.g., forced air cooling or water cooling).

The foreseeable development described here could occur on any land within the West Chocolate REEA (64,058 acres), regardless of surface ownership. Based on modeling performed by the NREL, the follow solar energy could be developed:

**Concentrated Solar Power Technology**

Trough – 1,327 MW

Dish – 737 MW

Power Tower – 737 MW

**Photovoltaic Technology**

1% Slope or less – 737 MW

3% Slope or less – 2,857 MW

5% Slope or less – 3,306 MW

The anticipated surface disturbance for the area is summarized below (Table 1).

**Table 1 Surface Disturbance for Solar Power Plants in the West Chocolate REEA***

| Technology Type | BLM Disturbance (acres) | Total Disturbance (acres) |
|---|---|---|
| Solar Trough | 1,574 | 6,637 |
| Dish – Engine | 1,574 | 6,637 |
| Power Tower | 1,574 | 6,637 |
| PV | | |
| 1% Slope or less | 1,574 | 6,637 |
| 3% Slope or less | 15,743 | 25,603 |
| 5% Slope or less | 16,954 | 29,758 |

Note:
*Within the BLM's Western Colorado (WECO) Desert Region.

## 2. Available Data and Assumptions

The West Chocolate REEA encompasses about 95 sections, or approximately 64,058 acres. Of this, 42 sections contain roughly 18,765 acres of surface land administered by the Bureau of Land Management (BLM: land withdrawn by the U.S. Bureau of Reclamation [USBR] not included), with the remainder being state or private land.

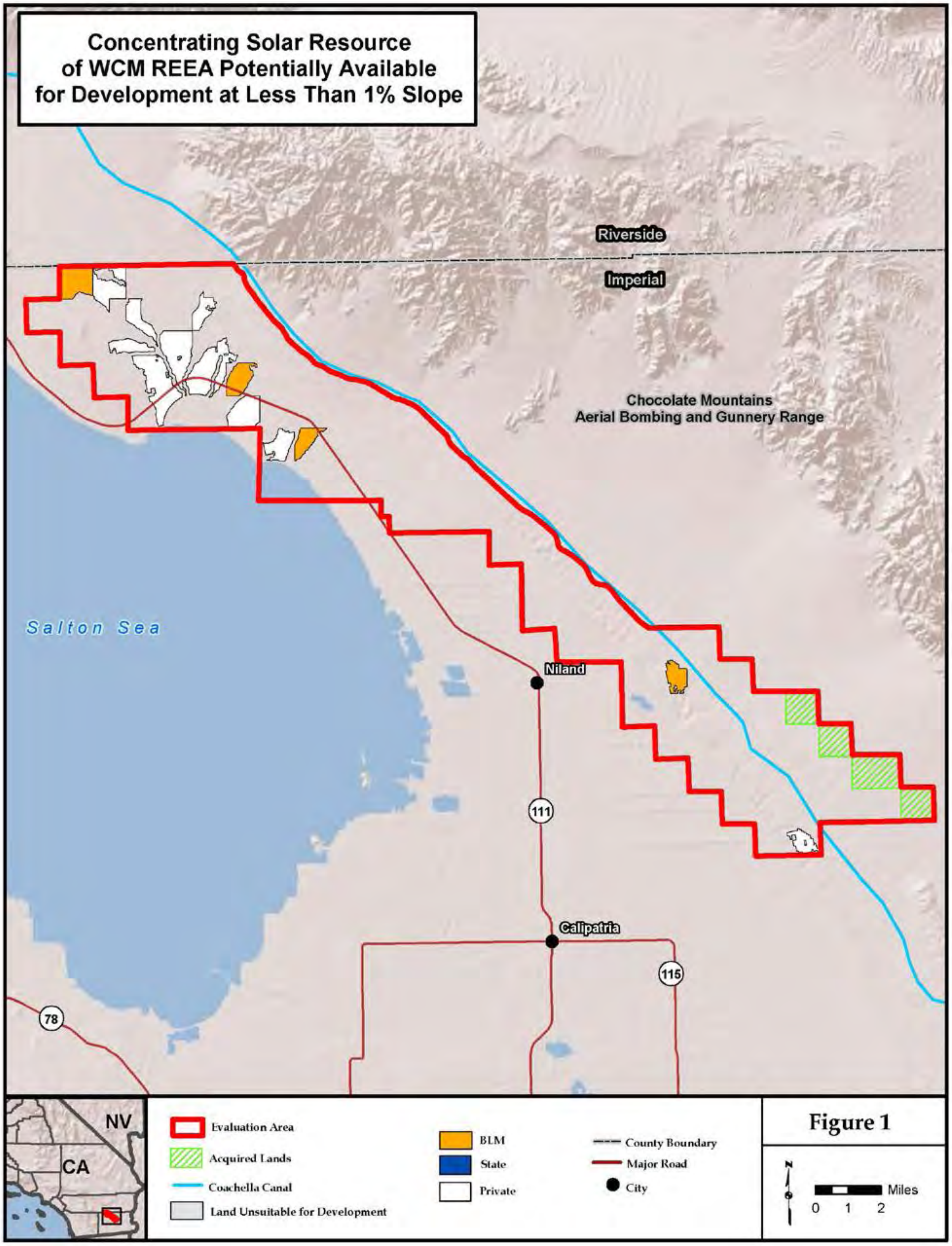
Of the 64,058 acres, 2010 modeling performed by the NREL using the above constraints revealed that only a maximum of 29,758 acres was developable for solar energy. Of the 29,758 acres, 46 sections contain roughly 9,066 acres of BLM surface land (land withdrawn by the USBR not included), with the remainder of the area being state or private land. The remainder was eliminated for reasons discussed previously in this section. To estimate the amount of anticipated development for the entire 29,758 acres which would potentially occur on BLM land, a simple ratio was developed to estimate the percentage of development that could occur on BLM-managed land. This ratio is based on the percentage of land within the West Chocolate REEA that is managed by the BLM and is available for solar ROW (30 percent [9,066 acres BLM/29,758 acres total]).

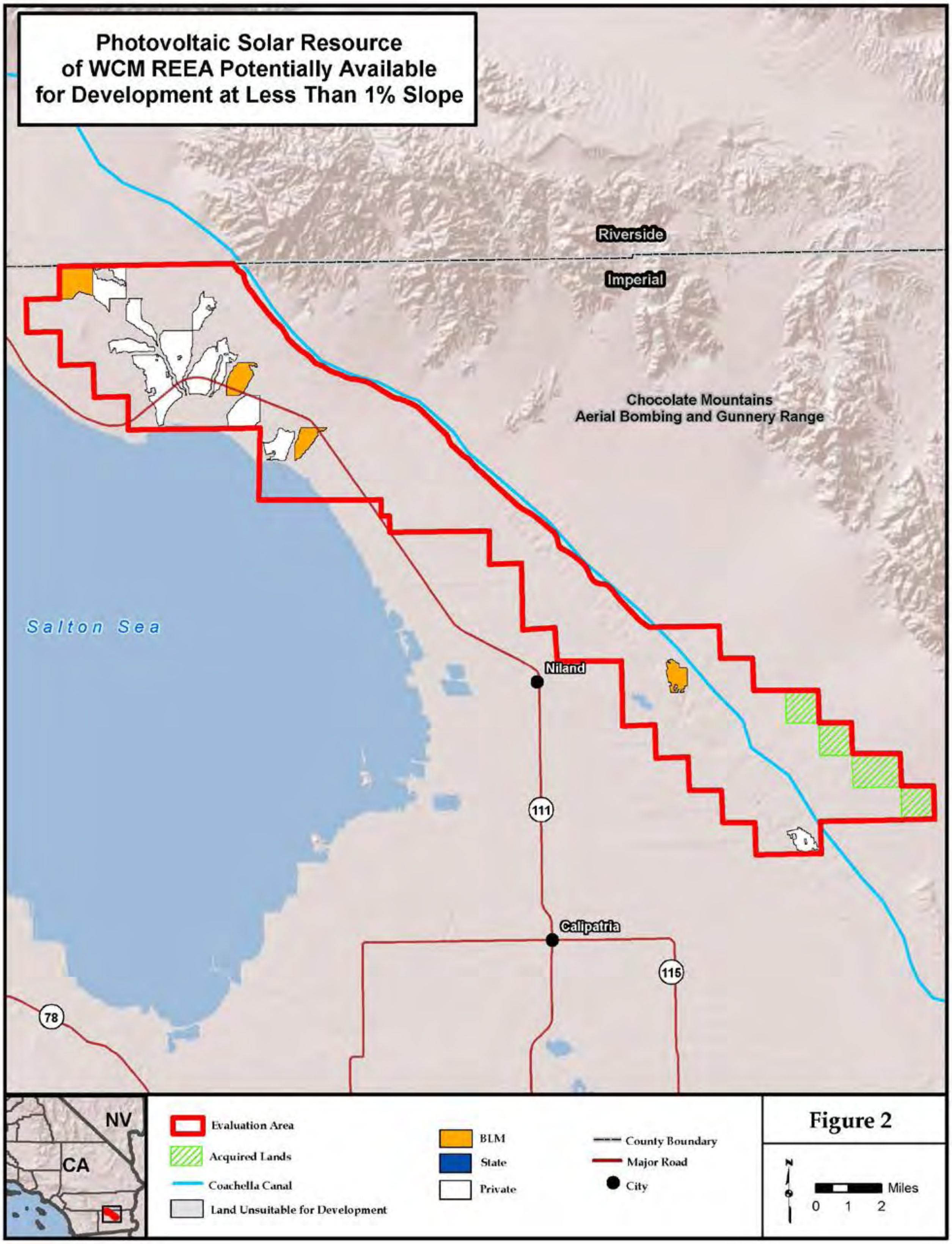
The NREL provides solar resource estimates in kilowatt hours per meter squared per day ($kWh/m^2$/day) for CSP and PV across the United States (Figures 1 through 4). Portions of the West Chocolate REEA are indicated as suitable land for CSP solar development and contain solar thermal resources estimated at 6.7 to 7.4 $kWh/m^2$/day on a scale ranging from 6 to 8.2, Portions of the REEA are indicated as suitable land for PV solar development and contain solar thermal resources estimated at 6.4 to 6.6 $kWh/m^2$/day on a scale ranging from 6 to 8.2.

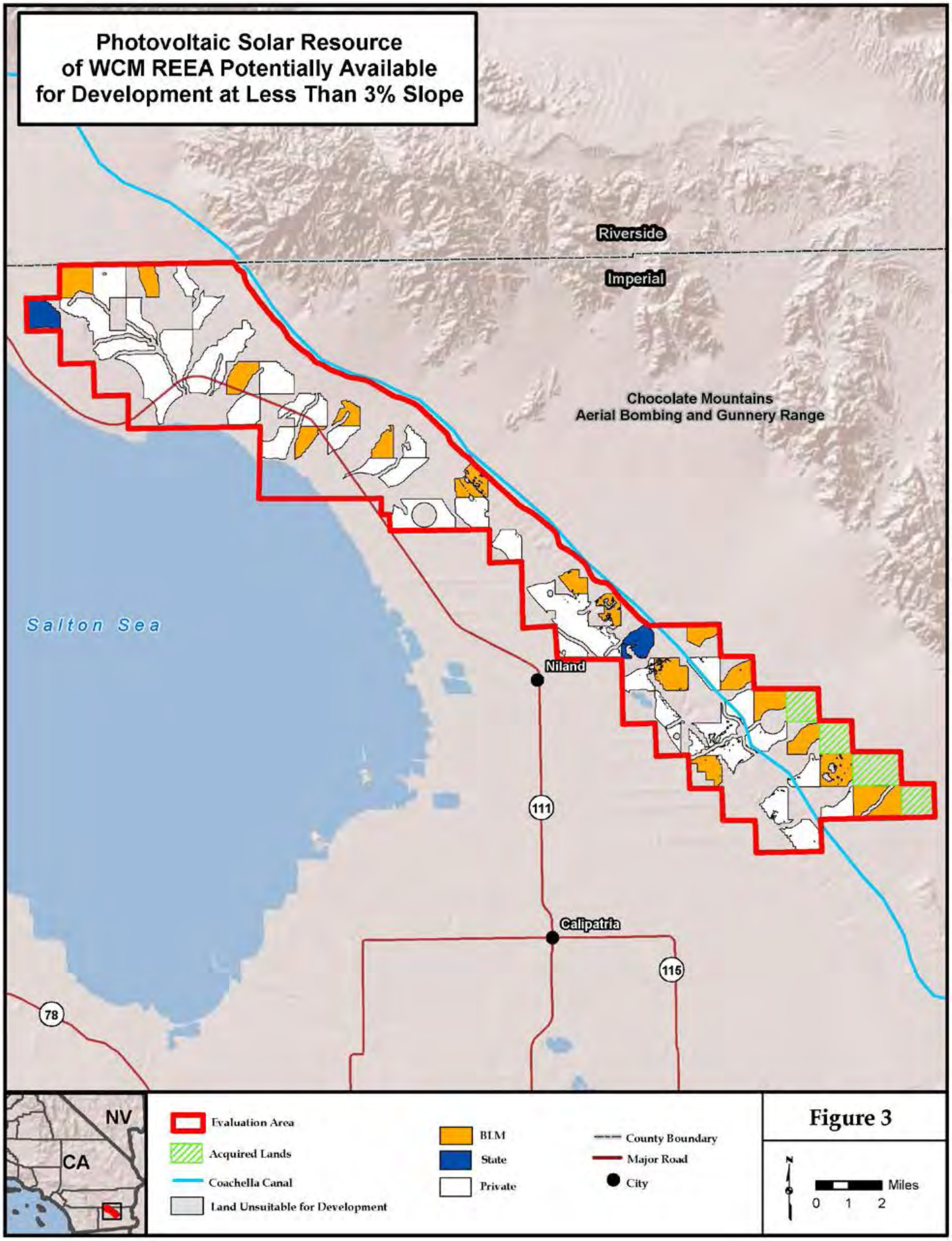
The model inputs are hourly visible irradiance from satellites and monthly average aerosol optical depth, precipitable water vapor, and ozone sampled at a 10 kilometer resolution. These factors are used to estimate the amount of solar radiation that would penetrate the atmosphere at a particular location. This 2010 NREL analysis used modeled direct normal solar radiation estimates at a 10 kilometer ground resolution. These results were further screened and results were also screened by BLM to eliminate areas subject to certain resource problems.

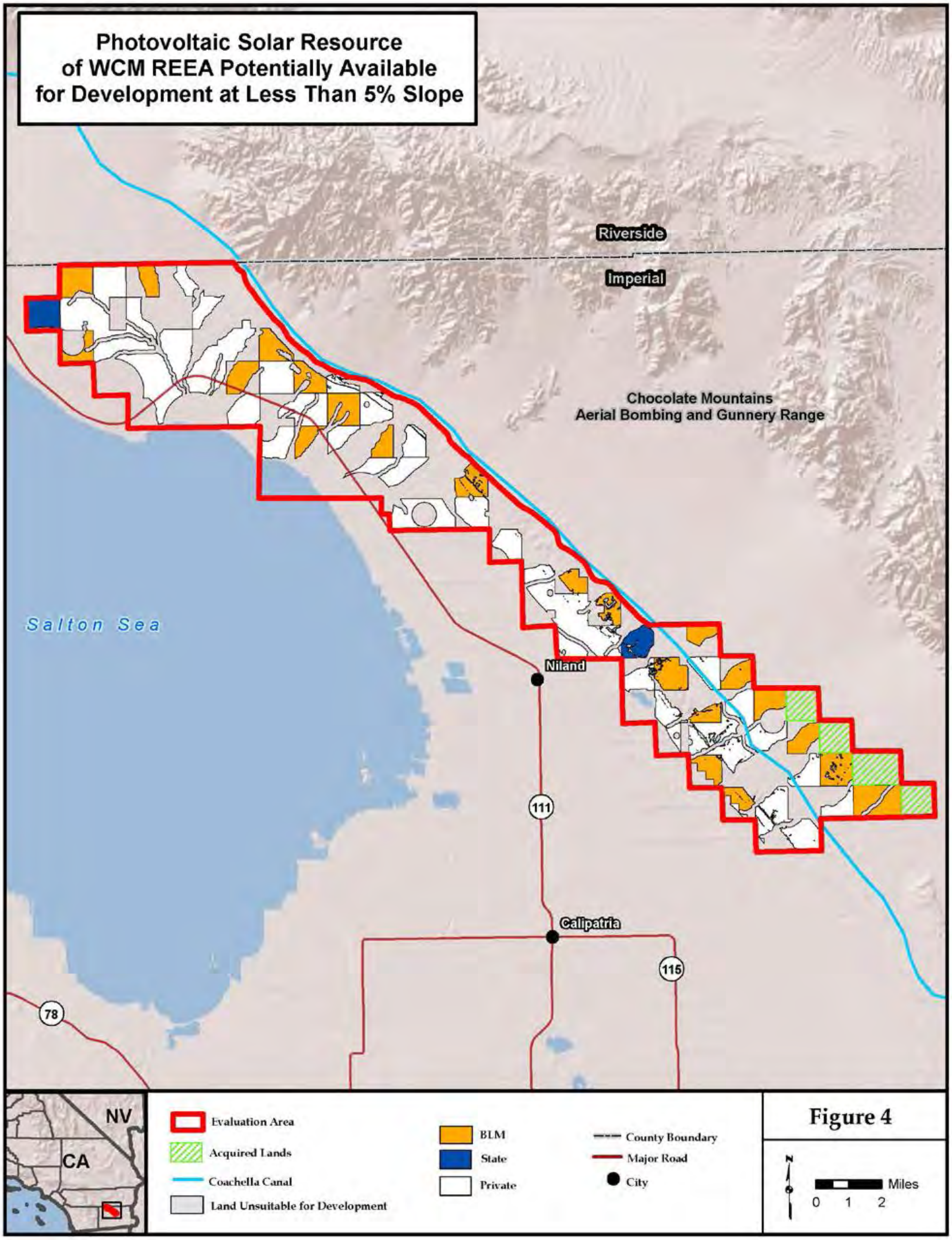
All projects located on BLM-managed land would be evaluated as part of the Federal Land Policy and Management Act (FLPMA) ROW application and National Environmental Policy Act (NEPA) processes.

*This page intentionally left blank.*


Concentrating Solar Resource of WCM REEA Potentially Available for Development at Less Than 1% Slope
Riverside
Imperial
Chocolate Mountains Aerial Bombing and Gunnery Range
Salton Sea
Niland
111
Calipatria
115
78
NV
CA
Evaluation Area
Acquired Lands
Coachella Canal
Land Unsuitable for Development
BLM
State
Private
County Boundary
Major Road
City
Figure 1
N
Miles
0 1 2


Photovoltaic Solar Resource of WCM REEA Potentially Available for Development at Less Than 1% Slope
Riverside
Imperial
Chocolate Mountains Aerial Bombing and Gunnery Range
Salton Sea
Niland
Calipatria
111
115
78
NV
CA
Evaluation Area
Acquired Lands
Coachella Canal
Land Unsuitable for Development
BLM
State
Private
County Boundary
Major Road
City
Figure 2
Miles
0 1 2


Photovoltaic Solar Resource of WCM REEA Potentially Available for Development at Less Than 3% Slope
Riverside
Imperial
Chocolate Mountains Aerial Bombing and Gunnery Range
Salton Sea
Niland
Calipatria
111
115
78
NV
CA
Evaluation Area
Acquired Lands
Coachella Canal
Land Unsuitable for Development
BLM
State
Private
County Boundary
Major Road
City
Figure 3
N
Miles
0 1 2


Photovoltaic Solar Resource of WCM REEA Potentially Available for Development at Less Than 5% Slope
Riverside
Imperial
Chocolate Mountains Aerial Bombing and Gunnery Range
Salton Sea
Niland
111
Calipatria
115
78
NV
CA
Evaluation Area
Acquired Lands
Coachella Canal
Land Unsuitable for Development
BLM
State
Private
County Boundary
Major Road
City
Figure 4
N
Miles
0 1 2

# 3. Activities Involved in Solar Development

Due to the wide range of solar development that could occur in the project area, the activities that could occur during solar development have been based on the development of a 50-MW PV project and a 500-MW solar trough project. These sizes were selected because of the availability of data related to development of these types of projects. PV and solar trough are the two technologies that have been fielded most widely in the United States and throughout the world.

## 3.1 Exploration

Because there has not been any actual development of a solar project in the area, it is assumed that some level of exploration would occur prior to full-field development. This exploration is typically limited to the placement of solar meters in the vicinity of a proposed solar project area. These meters record direct normal, global horizontal and diffuse horizontal irradiation. Temperature, humidity, wind speed, and wind direction are measured and then recorded in one minute increments. These meters are typically small, less than 1 square meter and can be installed using off highway vehicles (OHVs). They are commonly secured to a piece of concrete or other heavy object so they cannot be easily stolen. Ground disturbance is typically limited to 1 to 2 square meters.

## 3.2 Construction

### ***Concentrated Solar Power Technology***

Construction of a 500-MW solar trough project generally follows the sequence of site prep, grading, and road (180 days); installation of piers, solar field prep (180 days); assembly of solar collector elements (180 days); installation of the power block (180 days); and installation of buildings, evaporation ponds (180 days) (Solar Millennium 2008).

**Planning, Construction Workforce Numbers, Vehicles, Equipment, Timeframes**

Prior to mobilization for construction, a detailed construction plan would be developed to define the construction supervisory and technical field organizations and staffing levels required for the project. Approximately 2,100 people would be required during all phases of construction, although not all would be on site at any one time.

**Site Clearing, Grading, Excavation, Temporary Fencing and Parking, and Stormwater Systems**

Site work and solar field foundation preparation would include the following tasks:

- Earthwork, main entrance and construction personnel entrance roads, preparation of the solar collector assembly area, storage area, parking area and construction office area and installation of temporary and permanent site utilities.
- Construction of flood bypass channels.
- Installation of solar and piping drilled piers, sequenced with earthwork. Installation of underground piping and electrical systems would be sequenced consistent with orderly evacuation and placement of concrete foundations. Concrete foundations are

required throughout the solar field, for the turbine pedestal, for the control and maintenance buildings and for the cooling tower basins (Solar Millennium 2008).

### Solar Collector and Power Block Assembly and Construction

For construction of the solar collector element assembly an assembly line would be erected in the site fabrication and storage area. Assembly line fabrication consists of assembly of the solar collector element structural steel components and the mounting of the mirror panels. For field assembly the solar collector element assembly would be transported to the field by truck and trailer and lifted with a spreader bar and crane and set on end, middle, shared or drive pylons, and then aligned (if the wind speed is less than 12 kilometers/hour). The alignment takes approximately 2 to 3 hours. The heat collector element's (HCE's) are installed (three preassembled welded sections) in the field and the ends are welded to an adjacent solar collector element. Ball joint assembly and assembly of measuring equipment would follow (Solar Millennium 2008).

For solar field commissioning, the solar collector assembly (SCA) loops would be commissioned on an ongoing basis as they are completed during the installation of the solar collection field. Power block foundations would start shortly after the start of solar field drilled piers. The power blocks would be erected and commissioned in parallel with the solar collection field (Solar Millennium 2008).

### Facilities Outside the Solar Field Boundary

Construction of the evaporation pond, storm water retention pond, HV intertie, warehouse and gatehouse would run concurrent with construction of the power plants and would be commissioned to support the startup of the plants (Solar Millennium 2008).

### Cleanup and Reclamation

Temporary work areas would be cleaned up and reclaimed as necessary.

### Transmission Line

During construction of the transmission line there would be temporary pulling and tensioning sites, material staging sites, and concrete batch plants. There would be no grading at the pole site work areas or the pull and splicing site; rather, vegetation would be crushed (Solar Millennium 2008).

## ***Photovoltaic Technology***

Construction of a 50-MW solar PV project generally follows the sequence of planning, surveying/staking/flagging the perimeter of the project area (5 days); constructing security fencing (5 days) and access roads (5 days); clearing, grading, excavating, and installing temporary fencing and parking and stormwater systems (25 days); assembling and installing project facilities (360 days), cleaning up, and reclaiming any temporary work areas (20 days). In addition, some facilities are constructed outside the solar field boundary, and transmission lines are installed.

### Planning, Construction Workforce Numbers, Vehicles, Equipment, Timeframes,

Prior to mobilization for construction, a detailed construction plan would be developed to define the construction supervisory and technical field organizations and staffing levels required for any solar PV project. On average, 20 construction and supervisory personnel are required on site for approximately a 14-month period to construct one solar PV plant, with 40 personnel being required at the peak of construction. Approximately 400 personnel would be required during all phases of construction although not all would be on site at any one time.

### Surveying, Staking, and Flagging

Pre-construction survey work would consist of staking or flagging the site area boundaries, work areas (permanent and short term), cut and fill areas, access roads, transmission pole locations, and concrete pad and foundation areas.

### Fencing and Access Roads

Initial construction activities would include installation of security fencing and construction of access roads and maintenance tracks.

### Site Clearing, Grading, Excavation, Temporary Fencing and Parking, and Stormwater Systems

Site preparation consists of clearing, earthwork, and grading as required to construct the facility and achieve finished site grades. Grading is done to promote proper drainage and remove major scarring from previous drainage through the site. Cut and fill materials are typically in balance so that no material is either exported or imported to the site to achieve final grade. Rough site grading, excavation, and backfilling are performed using heavy-duty earth moving equipment.

Temporary fencing encloses material lay down and storage areas, and temporary parking areas are created to accommodate the construction workforce.

Typically, the solar panels would be mounted in a manner that follows the existing topography and, as a result, does not change the natural flow of water across the site. If necessary, hydraulic modeling would be completed during the design stage. Erosion control and storm drainage systems would be designed to promote sheet drainage, evenly distributing the flow of storm water across the site. A Site Grading and Erosion Control Plan would be developed and silt fences and fiber rolls would be used as necessary for drainage and to control erosion.

### Solar Array/Power Plant Assembly and Construction

In a PV plant, electrical power is produced directly by solar PV arrays, each comprised of several PV panels; one leading brand of panel is approximately 40 by 55 inches. Two of these panels are placed in portrait orientation on a south-facing rack tilted at approximately 20 to 25 degrees.

After a site is graded, underground conduit, overhead transmission lines, an inverter, and transformer pads are installed. Next, the PV panel supports and frames are installed. The support members are typically driven steel piles consisting of H beams or round pipe that are driven to a depth of 3 to 5 feet, depending on soil conditions. If the soil is exceptionally loose, corrosive, or too rocky to drive the supports, different support designs that could include augured holes with concrete fill could be required. The frame tables are then mounted to the support members. These tables consist of bolted or riveted steel members that are either built at the assembly point or fabricated in a factory and shipped preassembled to the construction site. The frame tables are aligned and fastened to the support members.

The PV panels are then set onto and secured to the frame tables. Three 135-watt (W), direct current (DC) photovoltaic panels are wired in series to a form a 1,000-volt (V) DC level string. Ten strings are then bound together in a wiring harness. Six groups of wiring harnesses are routed together into a row of panels. A single combiner box combines the electrical output of 180 panels. The output of 25 combiner boxes (4,500 PV panels) is collected at a 500-kilovolt (kV) inverter. Four 500-kV inverters and a 2-MW step-up transformer are co-located on a single concrete pad. The 480-V alternating current (AC) output of four 500-kV inverters is combined and stepped up to 33 kV in a single 2-MW transformer. Each 2-MW transformer handles the output of 18,000 PV panels. The 50-MW build out would use 180,000 PV panels.

A switchyard typically consists of a 10-foot x 12-foot concrete pad that accommodates the utility metering, the switchgear, and a protection breaker. Since the power is stepped up to utility line voltage at the solar field collector system, the switchyard does not require additional step-up transformers. From the step up transformers, the 33-kV collector system comprised of underground or overhead lines collects the output of the solar field and delivers it to the onsite switchyard, where it is metered and delivered to the 33-kV distribution system.

#### Cleanup and Reclamation

Temporary work areas would be cleaned up and reclaimed as necessary.

#### Facilities Outside the Solar Field Boundary

Construction of an electrical switchyard, communications, and a control/maintenance building would run concurrent with construction of the solar field. Even though some facilities are outside the solar field boundary, if they are located on public lands they would be authorized as part of the project ROW or authorized to the facility owner. Facilities such as power lines and switch/sub-stations are often within or near the solar field but not owned by the solar developer.

#### Transmission Line

A 33-kV collector system would aggregate power produced in the solar field and deliver it to an electrical switchyard. Since the electrical collector system operates at the same voltage at the transmission line, only a small switchyard meeting interconnection control and metering requirements is typically required. This equipment is located on a concrete pad approximately 10 by 12 feet.

## 3.3 Surface Disturbance

### ***Concentrated Solar Power Technology***

A typical ratio of land required for development of a solar trough project (solar arrays and ancillary facilities) is about 5 acres for every MW. Thus, a 500-MW solar CSP project would require approximately 2,500 acres of land. In an average solar trough energy project, approximately 90 percent of the project area is occupied by the parabolic trough solar field, and

10 percent is occupied by ancillary facilities, such as operation and maintenance (O & M) buildings, substations, access roads, and parking/laydown areas (Solar Millennium 2008). Each 500-MW solar trough development would need one or more 20-foot-wide interior access road, the placement of which would be determined by the solar field configuration.

Using this land use scenario as a model for the West Chocolate REEA, solar arrays for the development of one, 500-MW solar trough project would occupy approximately 2,000 acres, and development of related facilities would occupy 500 acres (Table 2).

**Table 2 Surface Disturbance for One 500-Megawatt CSP Project**

| Description | Unit Surface Disturbance (acres unless otherwise noted) | Number | Total Surface Disturbance (acres) |
|---|---|---|---|
| Solar troughs | 2,000 | 1 | 2,000 |
| Access roads within site area | 70 | 1 | 7 |
| Substation switchyard | 0.03 | 1 | 0.03 |
| O & M building | 0.06 | 1 | 0.06 |
| Parking laydown area | 50 | 1 | 50 |
| 230-kV transmission line | 5 acres/mile | 40 | 200 |
| 33-kV collector line | 5 acres/mile | 20 | 100 |
| Fencing and other discretionary facilities | 125 | 1 | 125 |
| **Total** | | | **2,482.09** |

Source: Solar Millennium 2008.

## ***Photovoltaic Technology***

A typical ratio of land required for development of a solar PV project (solar arrays and ancillary facilities) is about 9 acres for every MW. Thus, a 50-MW solar PV project would require approximately 450 acres of land. In an average solar PV energy project, approximately 90 percent of the project area is occupied by PV arrays, and 10 percent is occupied by ancillary facilities, such as operation and maintenance (O&M) buildings, substations, access roads, and parking/laydown areas (Chevron Energy Solutions 2009). Each 50-MW PV development would need one or more 20-foot-wide interior access road, the placement of which would be determined by the PV array configuration.

Using this land use scenario as a model for the West Chocolate REEA, solar arrays for the development of one 50-MW PV project would occupy approximately 400 acres, and development of related facilities would occupy 50 acres (Table 3).

**Table 3 Surface Disturbance for One 50-Megawatt PV Project**

| Description | Unit Surface Disturbance (acres unless otherwise noted) | Number | Total Surface Disturbance (acres) |
|---|---|---|---|
| PV arrays | 400 | 1 | 400 |
| Access roads within site area | 7 | 1 | 7 |
| Substation switchyard | 0.003 | 1 | 0.003 |
| O & M building | 0.006 | 1 | 0.006 |
| Parking laydown area | 0.5 | 1 | 0.5 |
| 230-kV transmission line | 5 acres/mile | 4 | 20 |
| 33-kV collector line | 5 acres/mile | 2 | 10 |
| Fencing and other discretionary facilities | 12.5 | 1 | 12.5 |
| **Total** | 500 | 1 | **450** |

Source: Chevron Energy Solutions 2009.

## 3.4 Total Amount of Solar Development

The solar energy RFD scenario generally identifies surface disturbance that either PV or CSP technology would cause if all land within the West Chocolate REEA is developed for solar energy, consistent with the Solar PEIS assumptions. It also generally describes the construction, maintenance and operations activities for both technologies.

While the West Chocolate REEA has significant solar energy potential, several factors would probably limit its full exploitation Therefore, in order to more accurately describe likely (i.e., reasonably foreseeable) development and associated impacts, this RFD scenario has been written to reflect real world activities. Because solar power in the West Chocolate REEA could be developed in a virtually unlimited number of ways, assumptions need to be made to allow for analysis.

Either CSP or PV technologies may be proposed, so the land requirements and construction and operational activities of each must be accurately described.

Proposals may be located only on BLM land, or may include participation of adjacent, non-BLM land to create larger or more logically arranged projects. If a project is proposed on both non-public and public lands, the project would be considered as being under a federal nexus and an environmental review including the private lands may be required.

Typical projects proposed in the region have historically been less that 50 MW in size (note: this is probably true for CSP projects on federal land because developers routinely stay below 50 MW to avoid California Energy Commission (CEC) involvement. While PV projects on federal land do not have a similar CEC nexus, these projects have tended to also be less than 50 MW in size.

Transmission would constrain future energy development, including solar, geothermal and wind. Large projects that have not entered the California Independent System Operator (CAISO) queue may not be built until new transmission capacity is built. Smaller projects may be able to fit within existing capacity. The Environmental Impact Statement (EIS) must include a thorough discussion of existing and currently planned transmission capacity to estimate when new or upgraded transmission would be needed to off-take additional power from the West Chocolate REEA.

Development would be constrained by buffers around sensitive resources, including hydrologic features, which have been incorporated into the existing RFD scenario.

Development would be constrained by slope. The RFD scenario currently includes lands that have slopes of 5 percent or less for PV and 1 percent for CSP.

The number and size of CSP projects may be limited by higher operational water requirements than PV.

CSP power tower technology may not be used in some locations due to airspace conflicts.

This RFD scenario identifies the maximum amount of land that could be developed for solar energy (CSP and/or PV) within the West Chocolate REEA. It does not take into account market factors and resource specific constraints (see above) that would likely result in a much smaller footprint in actual development. For the purpose of impact assessment across each alternative, the following assumptions would be used. Actual development may vary depending on future conditions.

The RFD scenario identifies a range of total disturbance of 13,473 acres to about 49,864 acres for PV energy. There would be approximately 13,480 acres within the West Chocolate REEA of surface disturbance for CSP technology. This includes use of adjacent, non-BLM lands for project development; BLM land usage would be considerably smaller. Using 9 acres per MW (PV) or 5 acres per MW (CSP), there could be as much as 5,540 MW (PV) or up to 2,696 MW (CSP) energy produced within the West Chocolate planning area, assuming full build out solely for solar energy. This would result in between 30 to 111 PV projects of 50 MW each and three to five, 500-MW CSP projects could be constructed. Thus, under the RFD scenario there could be a minimum of three, 500-MW projects to a maximum of 111, 50-MW PV projects or a combination thereof.

# 4. Operation and Maintenance Needs

## 4.1 Concentrated Solar Power Technology

Management and supervision of the plant would be centered within the solar field maintenance organization. Skilled personnel would be assigned to conduct expedient maintenance and mirror washing. The primary responsibility of “field operators” is to monitor, in considerable detail, the condition and repair needs of the solar fields. The O&M workforce is comprised of approximately 90 people. Equipment includes water trucks for cleaning mirrors and standard pickup trucks (Solar Millennium 2008).

## 4.2 Photovoltaic Technology

The operation and maintenance of a PV power plant is primarily automated. Scheduled and unscheduled maintenance activities require some staffing throughout the life of the power plant. The main operations and maintenance needs are panel washing and inverter inspection, as well as vegetation control and routine inspection of switchgear. Plants typically have a staff of only five full time staff during regular operations, including a security officer during non-business hours. The power components of PV solar power plants are turned on in the morning and off at night automatically.

Maintenance equipment includes all-terrain vehicles capable of going inside the array for physical inspection and parts replacement. PV solar power plants are well known for being almost maintenance-free, but there are some large maintenance tasks, such as panel washing, that require the presence of full-time personnel for the duration of the task. Outside contractors, in addition to the full time staff, are often used to conduct these activities. Panels are typically washed on a quarterly to semi-annual basis, depending on the long-term needs of the project owners. Inverter maintenance consists of inspection of intake air ducts, cooling fans, and refrigeration units and is conducted approximately monthly. Inspection of seals, connections, and enclosure are conducted yearly. Scheduled maintenance may involve the manufacturer of equipment such as the inverter.

### ***Scheduled Maintenance***

The following activities are conducted regularly:

- Solar panel cleaning (quarterly)
- Array visual and infrared inspection
- Vegetation mowing (as needed)
- Inverter maintenance
  - Inspection of intake air ducts, cooling fans, and refrigeration units (monthly)
  - Inspection of seals, electrical connections (torque setting), and transformer and/or inductor enclosure (yearly)
- Switchyard maintenance

### ***Unscheduled Maintenance***

Exposure to the elements and equipment failures require the following maintenance activities:

- Solar panel replacement
- Troubleshooting, repair, and eventual replacement for:
  - Inverters
  - Switchyard equipment
  - Digital Control Systems

## 4.3 Hazardous Materials

### ***Construction (CSP and PV)***

During construction, any necessary storage of diesel fuel, gasoline, motor oil, hydraulic fluid, and coolant are kept on site in above-ground tanks in a location with secondary containment and spill prevention countermeasures in place. These tanks are removed upon completion of construction and no permanent storage of these petroleum products occurs after construction is completed. A spill prevention control and countermeasure (SPCC) plan would be prepared, in accordance with all applicable BLM and California regulations.

### ***Operation***

**Concentrated Solar Power Technology**

- Typical chemicals on-site include the following:
- Diphenyl/biphenyl oxide
- Caustic (Sodium hydroxide)
- Acid (Sulfuric acid)
- Algaecide (Slimicide C-31) or chlorine equivalent
- Oxygen Scavenger (Powerline 1405)
- Liquid Propane Gas
- Lubricating Oil

*Oil-Filled Transformers*

Secondary containment structures would be provided around any oil-filled transformers located outdoors, STG lube oil tanks, HTF overflow and expansion vessels and any other oil containing tanks over 55 gallons without double walls or vendor supplied secondary containment. The containment would be sized to contain 125 percent of the fluid in the transformer or vessels with appropriate freeboard required per code. Additional equipment (such as HTF pumps, feedwater pumps, etc.) would be provided with 6 inch tall curbs as appropriate. Containment designs would be based on manual cleanup, with a portable sump pump (Solar Millennium 2008).

*Heat Transfer Fluid*

HTF, diphenyl/ biphenyl oxide (trade name Therminol or Dowtherm), requires periodic make-up due to the minor fluid degradation that occurs during the cyclic operation as well as due to the effects of vaporization (losses from pump seals, valve packings, and other mechanical joints), and unplanned spillage. The HTF make-up quantity projected is based on annualized losses of 2percent by volume (Solar Millennium 2008).

*Heat Transfer Fluid Spill Remediation*

The HTF fluid for the solar fields would be diphenyl/biphenyl oxide. Dowtherm A and Solutia VP-1 are commercial products that have been used in trough plants to date, and one of these products would be used in this project. The diphenyl/biphenyl oxide mixture (CAS numbers

101848 and 92524, respectively) is not classified as a hazardous material by the U.S. Dept. of Transportation, nor is it listed under U.S. Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations. However, this material, when discarded, may be a hazardous waste as that term is defined by the Resource Conservation and Recovery Act (RCRA), 40 CFR 261.24, due to its toxicity characteristic. Occasional small spills of HTF do occur, primarily due to equipment failures (Solar Millennium 2008).

**Photovoltaic Technology**

Solar PV projects do not typically generate, store, use, or release any toxic substances regulated under the federal Toxic Substances Control Act (TSCA) or similar state or local laws and regulations. No hazardous chemicals or extremely hazardous substances as defined by the Emergency Planning and Community Right to Know Act (EPCRA) are typically present at the project sites in excess of the quantities for which reporting is required under Section 312 of EPCRA. Stockpiles of petroleum products, coolants, antifreeze, diesel fuel, gasoline, cleaning solvents, and used petroleum products are housed and stored at the O&M facilities. Maintenance personnel are typically trained in the procedures of spill prevention and countermeasures, and keep spill kits on their service vehicles for immediate use in the event of a spill.

Solar panel towers provide secondary containment, in the event a leak occurs, no petroleum products escape the solar panel housing and tower. The transformer foundations are placed on grade and designed to provide containment of 125 percent of the volume of cooling oil in the transformer in case of a leak. No petroleum products containing polychlorinated biphenyls (PCBs) are used.

# 5. Decommissioning (CSP and PV)

The expected project life is 30 years. Given the unique and extreme levels of solar radiation at this site, it is highly plausible that new and improved solar power generating technology would be deployed at the site to continue clean and renewable power generation. However, should the site be removed from power generation service, the site would be made suitable for reclamation. All equipment, buildings, concrete foundations, and driven piles would be removed from the site. Consistent with BLM requirements, a detailed decommissioning plan would be developed in a manner that both protects public health and safety and is environmentally acceptable.

# 6. Potential Impacts

## 6.1 Noise

Significant increases in local noise levels could occur during the construction phase of solar projects due to truck traffic and noise resulting from the construction of the solar panels and ancillary structures. However, this increase in noise is short term, concluding at the end of construction. The operation phase does not produce significant noise impacts.

## 6.2 Air Quality

Diesel engine exhaust, dust from trucks, and dust generated during construction grading are the primary impacts to air quality from the construction of solar energy projects. Exhaust emissions can be controlled by approved emission control devices on each vehicle, and dust emissions can be mitigated by periodic watering of roads. Dust during grading can be minimized by watering the surface prior to grading. Commercially available bonding agents can be applied after grading is complete to prevent dust during periods of high winds.

## 6.3 Visual

Solar panels are typically sited using terrain to obstruct visual impacts to the extent possible.

## 6.4 Soils/Hydrology

Solar projects introduce a larger percentage of impermeable surfaces (e.g., solar panels) to project areas than do other renewable energy projects. Increased surface runoff results; however, with a drainage plan that meets all federal CWA standards, these impacts can be mitigated to a less than significant level.

## 6.5 Water Supply

In all thermal power plants (regardless of the energy source), heat is used to boil water into steam, which runs a steam turbine to generate electricity. The exhaust steam from the generator must be cooled prior to being heated again and turned back into steam. This cooling can be done with water (wet cooling) or air (dry cooling), or a combination of both (hybrid cooling). Water cooling is the most efficient. PV, concentrating PV, and dish-engine solar plants are not thermal cycle plants and therefore do not require water for cooling. CSP plants using parabolic trough, linear Fresnel, and power tower technologies must use one of the following forms of cooling:

### ***Wet Cooling***

Heat is dissipated from the power plant through evaporation, most often via a cooling tower. Wet cooling is the most common cooling method for power plants, as it is the most efficient and cheapest cooling method available. All CSP systems currently in operation use wet cooling.

### ***Dry Cooling***

Heat from the condenser is rejected using fans and ambient air. A significant temperature difference between the outside air and the exhaust steam is needed for an adequate heat exchange, limiting performance on hot summer days. Dry cooling systems have greater capital costs in comparison to wet cooling, but significantly reduce total water consumption.

### ***Hybrid Cooling***

The hybrid approach involves constructing both a wet and a dry cooling system. These systems can either operate in parallel or switch from dry cooling to wet cooling during the hottest hours of the day. Hybrid systems conserve less water than dry cooling but are more expensive than either alone (SEIA 2010).

### 6.6 Biological Resources

The West Chocolate REEA is within the southern extent of the habitat region for the federally listed desert tortoise. Mitigation measures approved by the U.S. Fish and Wildlife Service (USFWS) for desert tortoise would be required with any solar energy development in the area. Additionally, surveys for rare plants and other special status species such as the burrowing owl would be required prior to construction.

## 7. References

Aruvian's Research. 2010. Trends in the Global Solar Photovoltaics Industry. April 2010.

Black & Veatch. 2009. Renewable Energy Transmission Initiative (RETI) Phase 1B Final Report. January.

Bureau of Land Management (BLM) and California Energy Commission (CEC). 2010. Draft Project Description for the Ridgecrest Solar Power Project. February 28, 2010.

Chevron Energy Solutions. 2009. Lucerne Valley Solar Plant – File # CACA 49561 Plan of Development. Revision 4 submitted to United States Department of the Interior, Bureau of Land Management, Barstow Field Office, Barstow, California. June 23.

Department of Energy (DOE). 2009a. "Concentrating Solar Power." http://www1.eere.energy.gov/solar/csp_program.html (accessed August 17, 2010).

Hasan, Russell. 2007. "The Solar Silicon Shortage and Its Impact on Solar Power Stocks". http://www.solarhome.org/newsthesolarsiliconshortage.html (accessed September 3, 2010).

National Joint Apprentice and Training Committee for the Electrical Industry (NJATC). 2007. Photovoltaic Systems. American Technical Publishers, Inc. Homewood, Illinois.

National Renewable Energy Laboratory (NREL). 2003. Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts. Subcontractor Report from Sargent & Lundy LLC Consulting Group, Chicago, IL

______. 2010a. Concentrating Solar Power Prospects of West Chocolate Mountain Map. September.

______. 2010b. Photovoltaic Power Prospects 5 Percent Slope or Less Prospects of West Chocolate Mountain Map. September.

______. 2010c. Photovoltaic Power Prospects 3 Percent Slope or Less Prospects of West Chocolate Mountain Map. September.

______. 2010d. Photovoltaic Power Prospects 1 Percent Slope or Less Prospects of West Chocolate Mountain Map. September.

Solar Millennium, LLC. 2008. Updated Plan of Development, Amargosa – Farm Road Solar Project. BLM Land Use Application, File #NVN-84359. Revised Submission November 26, 2008.

*This page intentionally left blank.*

# Appendix C

## Wind
## Reasonably Foreseeable
## Development Scenario

# WIND
# REASONABLY FORESEEABLE DEVELOPMENT SCENARIO
# WEST CHOCOLATE MOUNTAINS

# WIND
# REASONABLY FORESEEABLE DEVELOPMENT SCENARIO
# WEST CHOCOLATE MOUNTAINS

## 1. Introduction

This Reasonably Foreseeable Development (RFD) scenario has been prepared as a basis for analyzing environmental impacts resulting from future leasing and development of federal lands for wind energy projects within the West Chocolate Mountains Renewable Energy Evaluation Area (West Chocolate REEA, or the REEA). As the term "Reasonably Foreseeable Development" implies, the RFD scenario is a tool the Bureau of Land Management (BLM) can use to analyze the types of impacts that could be expected under an alternative being analyzed. A RFD is not a prediction of what would happen under a specific alternative.

The RFD scenario is intended to provide the information necessary to analyze potential cumulative impacts. The disturbance for production facility and associated infrastructure (e.g., road, pipelines, transmission lines, etc.) would be based on the facilities typical in surrounding area.

The foreseeable development described here could occur on any land within the West Chocolate REEA, regardless of surface ownership. This RFD scenario assumes that one 45-megawatt (MW) wind energy power plant would be developed. The anticipated surface disturbance for the area is summarized below (Table 1).

**Table 1 Surface Disturbance for One 45-Megawatt Wind Energy Project in the West Chocolate REEA**

| | BLM Disturbance (acres) | Total Disturbance[1] (acres) |
|---|---|---|
| Initial | 23 | 76 |
| Final | 12 | 40 |

Note:
[1] BLM and non-BLM land.

## 2. Available Data and Assumptions

Based on the available data and assumptions, wind energy development could occur on any land within the REEA, regardless of surface ownership. Of the 64,058 acres 29,929 acres are available for wind energy development on both private and BLM land (land withdrawn by the UBSR not included). Of this, 42 sections contain roughly 9,162 acres of surface land administered by the BLM (land withdrawn by the U.S. Bureau of Reclamation [USBR] not included), with the remainder being state or private land. To estimate the amount of anticipated development for the entire 29,929 acres which would potentially occur on BLM land, a simple ratio was developed to estimate the percentage of development that could occur on BLM-managed land. This ratio is based on the percentage of land within the REEA that is managed by the BLM for geothermal leasing (31 percent [9,162 acres BLM/29,929 acres total]).

There are no direct data on which to base this RFD scenario. The amount of energy produced from wind energy development in the West Chocolate REEA would depend on the acreage devoted to such development and the MW output per wind turbine based on the model implemented. As part of the BLM study Final Programmatic Environmental Impact Statement (PEIS) on Wind Energy Development on BLM-Administered Lands in the Western United States (2005), the BLM and the U.S. Department of Energy (DOE) National Renewable Energy Laboratory (NREL) established a partnership to conduct assessments of wind energy on BLM-administered lands in the western United States. An initial assessment of renewable energy potential on BLM-administered lands was published in 2003. This assessment looked at an array of renewable resources, including wind. To determine where potential development might occur on the basis of land status and wind energy resources, NREL constructed a maximum potential development scenario (MPDS) using the same methodology used for the 2003 renewable energy assessment but using a different model, the Wind Deployment System (WinDS), to project the amount of wind power that might be generated over the next 20 years. Wind resource data, GIS data, and general screening criteria were used to identify the spatial distribution of the maximum possible extent of future wind energy development activities that might occur on BLM-administered lands. Maps depicting BLM-administered lands with low, medium, and high potential for wind energy development were constructed for each of the BLM Field Offices in the 11-state study area, including the El Centro Field Office. These maps were used to assess: (1) the distribution of BLM-administered lands on which wind energy development activities might be conducted; and (2) the total number of acres that might be impacted (BLM 2005).

Wind resources were assigned to seven different power classes on the basis of their resource potential, determined by a combination of wind power density and wind speed. Class 1 (Poor) had the lowest resource potential, and Class 7 (Superb) had the highest. The assembled wind resource data and GIS data, including major cities and towns, transmission lines, and major roads, were compiled and screened to construct the MPDS. The screening criteria were used to eliminate lands from the MPDS that were excluded from wind energy development by virtue of their status, classification, or some other administrative determination (BLM 2005).

Lands were then categorized into areas having a low, medium, or high potential for wind energy development over the next 20 years on the basis of their wind power classification (Table 2).

**Table 2 Wind Power Classification***

| Classification | Wind Potential | Economically Viable |
|---|---|---|
| 1 | Poor | No |
| 2 | Marginal | No |
| 3 | Fair | Yes in some instances. Will be fully viable upon development of low wind-speed turbines. |
| 4 | Good | Yes |
| 5 | Excellent | Yes |

**Table 2 Wind Power Classification***

| Classification | Wind Potential | Economically Viable |
|---|---|---|
| 6 | Outstanding | Yes |
| 7 | Superb | Yes |

*As wind technology develops areas that were determined to be poor or marginal may be upgraded and become an economically viable area for development.
Sources: BLM 2005, NREL 2007

The wind power estimates produced as part of the BLM's Wind Energy PEIS and based on NREL's wind power resource data (see Figure 1) show the West Chocolate REEA to have a wind potential of "Poor". These data were produced using the Mesomap system (a wind resource model) and historical weather data, and validated with available surface data by NREL and wind energy meteorological consultants (NREL 2007).

The 2009 Black & Veatch document "The Renewable Energy Transmission Initiative Phase 1B Final Report" (RETI report) identifies competitive renewable energy zones (CREZs) throughout western North America to help meet renewable energy production goals set by regions or states. The RETI report identifies the West Chocolate REEA of Imperial County as having no wind potential. The area in Imperial County closest to having viable wind energy potential is Imperial South, which has 45 MW of potential wind energy.

It is assumed that one 45-MW wind energy project would be developed. All projects on BLM-managed land are permitted by BLM using standard review methods that ensure protection of public safety and the natural environment, and are evaluated as part of the Federal Land Policy and Management Act (FLPMA) right-of-way (ROW) application and National Environmental Policy Act (NEPA) processes.

# 3. Activities Involved in Wind Energy Development

## 3.1 Exploration

As common practice, it is anticipated that meteorological (MET) towers would need to be constructed by wind energy developers on BLM-managed lands to gather meteorological and climatological data, thus determining the feasibility of wind energy development in the West Chocolate REEA.

Typically, one to three MET towers would be installed in a given area to measure the wind resource. These towers would likely be less than 200 feet in height, supported by three to four arrays of guy wires to keep them erect. The base of the MET tower is typically a concrete foundation or an anchor. MET towers are usually in place for three years recording data. The ground footprint of a MET tower would be very small—less than 1 acre for an entire site.

## 3.2 Wind Farm Construction

Construction generally follows the sequence of planning; surveying and staking, construction of temporary use areas, and road building (30 days); foundation development and trenching for underground electrical lines (60 days); tower and turbine delivery and placement (120 days); electrical line installation (30 days); and cleanup and reclamation (30 days).

### ***Planning Construction Workforce Numbers, Vehicles, Equipment, Timeframes***

Prior to mobilization for construction, a detailed plan is usually developed to define the supervisory and technical field organizations and staffing levels required for any wind project. The number of persons on site during construction is expected to be approximately 50. Equipment anticipated during various stages of construction would include bulldozers, backhoe/loaders, tracked excavators, trenchers, concrete mixers, compactors, cable trucks and trailers, delivery trucks, tractor/trailers, boom trucks, tracked cranes, rubber tired cranes, water trucks, and other miscellaneous trucks and passenger vehicles.

### ***Surveying, Staking, and Road Building***

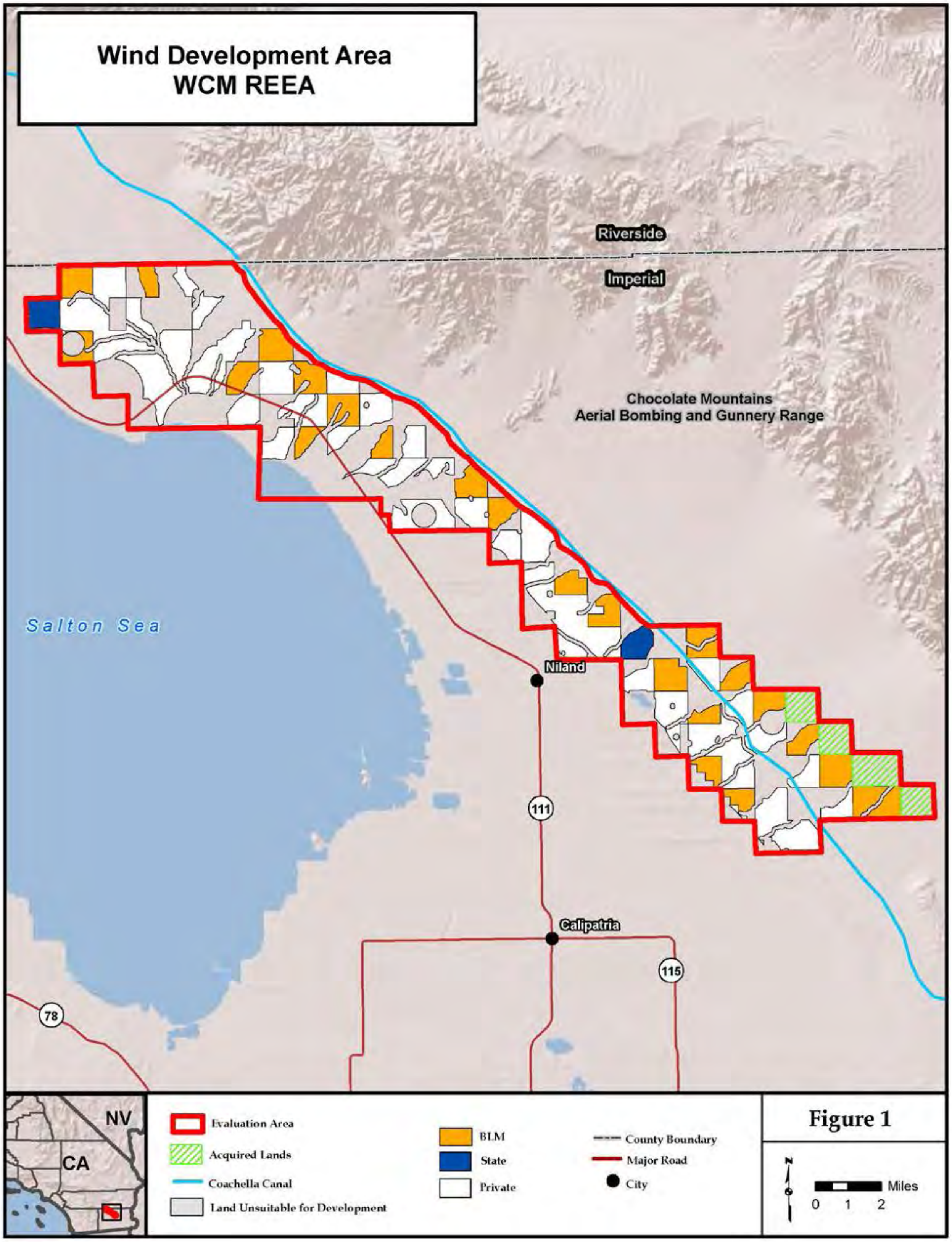
The first construction activities are typically surveying and staking, construction of temporary use areas, and building access roads to and throughout the site. The project perimeter would usually not be fenced; however, to minimize vandalism and theft, locked tower access doors would be installed on the turbines. Chain link fencing with concertina barbed wire may be installed at electrical substations and maintenance yards for security.

#### Site Plan

The layout would typically consist of roughly parallel rows of laterally spaced wind turbines, each with an adjacent pad-mounted transformer. Each row of wind turbines would be accessed by a network of new gravel roads whose alignments were chosen to minimize site grading and disturbance, while also avoiding very steep grades so that construction and operation of the site can be feasible. The alignment of the roads and turbines would follow the alignment of the topography on the site. The spacing of the wind turbines would vary somewhat from turbine to turbine, but always meet minimum spacing requirements of the turbine manufacturer so that harmful turbulence effects caused by adjacent wind turbines are minimized. This varying spacing and alignment somewhat would provide some relief from the rigid, regular spacing found at many wind projects.

#### Construction Temporary Use Areas Needed

During construction, staging and temporary storage of construction equipment, cable, foundation parts, components, towers, blades and nacelles would occur on small areas around the site. Construction trailers would be used at the maintenance yard during construction for contractor’s management and temporary storage of parts and equipment. The maintenance yard would be fenced for security and safety purposes. The construction staging areas would be compacted and a soil stabilizer applied to prevent soil erosion and control dust. At areas outside the staging areas the ground surface and any vegetation would be protected by wooden frames, pallets or straw bales, which would be placed on the ground while the turbine components are unloaded, pre-assembled or inspected. Components, tower sections, nacelles and blades, would be delivered to the points of installation and would be placed on wooden frames, pallets or straw bales while they are awaiting installation.


Wind Development Area
WCM REEA
Riverside
Imperial
Chocolate Mountains
Aerial Bombing and Gunnery Range
Salton Sea
Niland
111
Calipatria
115
78
NV
CA
Evaluation Area
Acquired Lands
Coachella Canal
Land Unsuitable for Development
BLM
State
Private
County Boundary
Major Road
City
Figure 1
N
Miles
0 1 2

*This page intentionally left blank.*

In this RFD scenario, there would be approximately six miles of new roads. On private land approximately 4.5 miles of new gravel roads will be constructed, and 1.5 miles of new gravel roads will be constructed on BLM land. Typical proposed roads would be approximately 16 feet in width plus ten feet cleared shoulders on both sides, unless topography does not permit this width. The roads would consist of 4 inches to 6 inches of gravel over compacted native material. The majority of roads would be constructed at-grade, except where roads must be elevated or lowered to provide access to turbine sites or where steeper cut slopes must be used to minimize depths of cut to blend the road into the surroundings. Crossings at low spots would be at-grade, with no culverts or extensive fill except at a few limited locations. Upon completion of construction, the on-site roads would be smoothed where low spots and ruts have occurred, and 4 inches to 6 inches of gravel would be applied. This design would facilitate movement of wildlife around the site by minimizing barriers caused by abrupt changes in grade.

Locked tower access doors would be installed on the turbines to discourage theft and vandalism, and to minimize vehicular risk to biological resources. No restriction of existing BLM Open Roads or power line access roads would occur from development of access roads.

### *Foundation Development and Trenching for Underground Electrical Lines*

Foundation development and trenching of underground electrical lines would typically follow in an overlapping schedule. Excavation of the foundations would be completed by large tracked excavators, to a depth of approximately 10 to 25 feet, depending on foundation design and soil conditions at the turbines. Steel reinforced concrete foundations with long bolts to hold the tower would be formed and poured at each turbine site. Conduits for the electrical lines would be installed prior to pouring concrete. For the transformers, a pad mount would be installed at each turbine site. The pad also provides storage in case of a transformer leak. Blasting would not be typically required.

### *Tower and Turbine Delivery and Placement*

Tower and turbine components would be delivered to the site by truck and trailer. The towers would be assembled and hoisted into place by cranes. The nacelle would then be placed on the tower, and the blades would be attached to the rotor hub and hoisted into place. Alternatively, the hub would be mounted on the turbine and the blades would be installed individually.

### *Electrical Line Installation*

Electrical lines would be typically installed in trenches parallel to the roads. The electrical lines would be connected to the transformers and turbines, and a fiber optic communication system would be typically installed.

### *Cleanup and Reclamation*

After construction, all the temporary construction and staging areas would be cleaned up and revegetated.

### 3.3 Spill Prevention and Hazardous Maintenance

During construction, above-ground tanks of diesel fuel, gasoline, motor oil, hydraulic fluid, and coolant would be kept on site in a location with secondary containment. The tanks would be removed and petroleum products would not be stored after construction is completed. A spill prevention control and countermeasure (SPCC) plan would be prepared and implemented in accordance with all applicable regulations.

## 4. Surface Disturbance

To support 45 MW of net wind generation, fifteen 3-MW wind turbine generators would need to be erected within an approximately 1,300-acre footprint. The wind turbines would have dimensions and characteristics as shown in Table 3. These specifications would be subject to modification by the turbine manufacturer.

**Table 3 Wind Turbine Characteristics**

| | |
|---|---|
| Rated Output | 2.3 to 3.0 MW |
| Tower Height (Hub) | 262.5 feet |
| Rotor Diameter | 328.1 to 331.4 feet |
| Total Height | 426.6 to 428.5 feet |
| Number of Blades per Turbine | 3 |
| Tower Type | Steel monopole |

Source: Daggett Ridge Wind Energy POD 2009.

The development would occur on approximately 390 acres on BLM-administered land (approximately 30 percent of the site's 1,300 acres). The project's permanent footprint on BLM land would be 40 acres (0.03 percent of the total site area). Large areas of open, vacant desert exist between the individual turbines, rows of turbines, and the boundaries of the BLM parcels that could be developed for wind energy generation. Unobstructed open space is necessary for the free flow of wind, which results in efficient, safe, long-term operation of the wind turbine generators. Other uses would be compatible with the project on the site, provided those uses would not impede the flow of wind across the site, increase turbulence to the wind turbine rotors, or block access for maintenance of the wind turbines. Fiber optic line may be located within existing disturbed areas on existing rights-of-way; the disturbance footprint for these lines would be approximately 0.5 acre.

Total foreseeable surface disturbance for wind energy development is summarized below (Table 4).

**Table 4 Surface Disturbance for Wind Energy Development**

| | BLM Property | Total Area[2] |
|---|---|---|
| Project Site Area | 390 acres | 1,300 |
| Temporary Total Disturbance Area | 10.8 acres | 36 |
| Permanent Total Project Footprint | 12 acres | 40 |
| Total Disturbance Area (temporary plus permanent) | 22.8 acres | 76 |
| Acreage of Access Roads | 3.33 acres | 9 |
| Length of Project Roads & Access Roads | 1.53 miles | 4.5 miles |

Source: Daggett Ridge Wind Energy POD 2009.
Notes:
[1] All numbers adjusted from the Daggett Ridge Wind Energy POD for a 50-MW project.
[2] BLM and Non BLM Land.

# 5. Operation and Maintenance

Routine operations and maintenance for a project this size are typically conducted by approximately four staff, using three 1½-ton pick-up trucks.

## 5.1 Road Maintenance

Roads would be inspected at least twice annually. Periodic blading or smoothing and application of gravel would be performed to maintain road quality. Maintenance of roads would be scheduled during times of low wind to minimize airborne dust. Vehicle speed limits of 20 mph on site would typically be posted and required of all operation and maintenance personnel to minimize airborne dust and erosion of roads and to minimize risk to desert tortoises that may be crossing roads.

## 5.2 Fire Protection and Site Security

All site facilities except wind turbine nacelles and blades are metal-contained, non-flammable structures. Habitable structures would not typically be built on site. Consequently, no fire protection equipment would be necessary except hand-held fire extinguishers, which are usually housed in the electrical substation utility building, maintenance yard (in a locked container), and on maintenance personnel trucks. Wind turbines, transformers, MET towers, and underground electrical facilities would be made with fire-resistant materials and are not expected to be damaged by brush fires or to increase the risk of fires in the area.

Individual wind turbines and transformers include heavy gauge steel locked doors equipped with anti-tamper locks and are very difficult to access without keys. Consequently, it would not be necessary to fence the perimeter of the site. Consequently, unauthorized trash dumping, vandalism and theft, and vehicle risk to desert tortoise would be minimized in those areas where project turbine roads are proposed. Other areas of the site would not be fenced or gated, and existing BLM Open Routes and existing power line access roads would remain open. Periodic site clean-up would be performed on an annual basis or more frequently. When routine daily maintenance is performed, the site would also be cleaned up by the maintenance personnel.

Fencing, except at substations and maintenance yards, would be designed to permit free movement of desert tortoise and other wildlife across the site. Approximately 100 to 300 feet of four-strand barbed wire fence would be placed adjacent to gated project entrances to discourage driving around gates. This type of fence is intended to allow movement of wildlife including desert tortoise. Fencing of the entire site would not be needed for site security.

# 6. Spill Prevention and Hazardous Materials on Site

## 6.1 Operation

Wind projects do not typically generate, store, use, or release any toxic substances regulated under the federal Toxic Substances Control Act (TSCA) or similar state or local laws and regulations. No hazardous chemicals or extremely hazardous substances as defined by the Emergency Planning and Community Right to Know Act (EPCRA) are present at wind projects in excess of the quantities for which reporting is required under Section 312 of EPCRA. All stockpiles of petroleum products, coolants, antifreeze, diesel fuel, gasoline, cleaning solvents, and used petroleum products would be housed and stored at the operation and maintenance facility.

Undetermined quantities of used hydraulic fluid, gear oil, and grease are typically generated annually from scheduled and unscheduled wind turbine maintenance. The used oil and grease would be collected on site and transported for recycling by a third-party contractor. The used oil would be expected to be non-hazardous and is not mixed with other substances prior to being picked up for recycling. Maintenance personnel would be trained in the procedures of spill prevention and countermeasures, and keep spill kits on their service vehicles for immediate use in case of a spill.

## 6.2 Secondary Containment of Oil

Wind turbine foundations and towers provide secondary containment so that if a leak occurs no petroleum products escape. Transformer foundations would be placed on grade and designed to provide containment of 125 percent of the volume of cooling oil in the transformer in the case of a leak. No petroleum products containing PCBs would be used.

# 7. Impacts

## 7.1 Noise

Possible significant increases in local noise levels could occur during the construction phase due to truck traffic to and from wind energy projects and noise resulting from the construction of the wind turbines and ancillary structures (e.g., operations and maintenance [O&M] buildings and substations). However, this increase in noise would be short term, concluding at the end of construction. The operation phase would not produce significant noise impacts.

## 7.2 Air Quality

Diesel engine exhaust and dust from trucks are the primary impacts to air quality from the construction of wind energy projects. Exhaust emissions can only be controlled by approved emission control devices on each vehicle, and dust emissions can be mitigated by periodic watering of roads.

## 7.3 Visual

Ideally, wind turbines would be sited using terrain to obstruct visual impacts to the extent possible. However, since wind turbines are tall, they are hard to conceal visually, especially in a topographically flat area. A BLM Visual Resource inventory would be performed in the West Chocolate REEA, and an interim Visual Resource Management (iVRM) class or classes would be assigned to the entire area. After iVRM class(es) are established, project-induced visual impacts would be assessed.

The project would include red lights approved by the Federal Aviation Administration (FAA) that would activate only from dusk until dawn. These lights would be synchronized to turn on and off in unison approximately once every three seconds, thereby substantially reducing the total number of times they turn on per minute and also minimizing the number of lights required. Only every third wind turbine would be lighted, and only one light would be installed per turbine. Using red lights and synchronizing the lights would greatly reduce the night sky impact of the lights. Security lights would be required at the substation; however, these lights would be hooded or directed downward to minimize stray light dispersion toward surrounding property. No other lights would be needed.

## 7.4 Biological Resources

Bird and bat species sustain the most significant impacts from wind energy projects, due primarily to interference with migration patterns. Special-status species of raptors, bats, and migratory birds tend to be particularly vulnerable to wind turbines, and mitigation measures (e.g., raptor ultraviolet reflectors, post construction mortality surveys) would be implemented as part of a Plan of Development (POD) at the request of the BLM. Additionally, special-status plant surveys would be necessary prior to clearing and grading activities to determine possible mitigation measures for impacts to those species.

## 7.5 Airspace

Wind turbines cause a particular hazard to military and civilian aeronautical activities. Consultation with the FAA would be necessary prior to construction to select a turbine layout that would mitigate potential impacts to all local aviation routes and activities.

The FAA would review the proposed project wind turbines prior to construction. Form 7460-1 would be prepared for the project and submitted to FAA to notify them that the proposed structures would exceed 200 feet in height. This action would result in a determination by FAA as to whether or not the project would constitute an obstruction or safety hazard to air navigation.

# 8. References

Black & Veatch. 2009. Renewable Energy Transmission Initiative (RETI) Phase 1B Final Report. January.

Bureau of Land Management (BLM). 2005. Wind Energy Final Programmatic Environmental Impact Statement (EIS), Appendix B: National Renewable Energy Laboratory Estimates Of Wind Energy Resources on BLM-Administered Lands. June.

National Renewable Energy Laboratory (NREL). 2007. 50m Wind Power Resource Map. September 25.

Plan of Development and Plan of Operation. 2009. Daggett Ridge Wind Energy Project. R/W GRANT CACA – 43088. Amended April 27.

# Appendix D

## Air Emissions Summaries

**GEOTHERMAL RFDS - EMISSION SUMMARIES**

**Year 1: Exploratory Drilling**

| | Annual Emissions (T/Yr) | | | | | GHG Emissions (MT/year) | |
|---|---|---|---|---|---|---|---|
| Type | PM-10 | NOX | VOC | SO2 | CO | CO2 | CO2e |
| Well Drilling - Fugitive | 0.02 | --- | --- | --- | --- | --- | --- |
| Well Drilling - Combustion | 0.47 | 17.55 | 2.97 | 2.77 | 24.30 | 1553 | 1553 |
| Construction | 31.76 | 52.39 | 4.22 | 3.48 | 11.34 | 1278 | 1278 |
| On-road vehicles | 5.08 | 0.09 | 0.01 | 0.00 | 0.10 | 19 | 19 |
| **Totals** | **37.33** | **70.04** | **7.21** | **6.25** | **35.74** | **2850** | **2850** |

**Year 2: Full Diameter Drilling and First Power Plant (50MW)**

| | Annual Emissions (T/Yr) | | | | | GHG Emissions (MT/year) | |
|---|---|---|---|---|---|---|---|
| Type | PM-10 | NOX | VOC | SO2 | CO | CO2 | CO2e |
| Well Drilling - Fugitive | 0.03 | --- | --- | --- | --- | --- | --- |
| Well Drilling - Combustion | 0.63 | 23.40 | 3.96 | 3.69 | 32.40 | 2070 | 2070 |
| Construction | 113.41 | 226.28 | 18.24 | 15.05 | 48.97 | 931 | 931 |
| On-road vehicles | 15.30 | 1.12 | 0.15 | 0.00 | 0.95 | 210 | 211 |
| **Totals** | **129.36** | **250.80** | **22.34** | **18.74** | **82.32** | **3212** | **3212** |

**Year 3: Full Diameter Drilling and Second Power Plant (50MW)**

| | Annual Emissions (T/Yr) | | | | | GHG Emissions (MT/year) | |
|---|---|---|---|---|---|---|---|
| Type | PM-10 | NOX | VOC | SO2 | CO | CO2 | CO2e |
| Well Drilling - Fugitive | 0.03 | --- | --- | --- | --- | --- | --- |
| Well Drilling - Combustion | 0.63 | 23.40 | 3.96 | 3.69 | 32.40 | 2070 | 2070 |
| Construction | 113.41 | 226.28 | 18.24 | 15.05 | 48.97 | 931 | 931 |
| On-road vehicles | 15.29 | 1.00 | 0.13 | 0.00 | 0.87 | 211 | 211 |
| **Totals** | **129.36** | **250.68** | **22.33** | **18.74** | **82.24** | **3212** | **3212** |

**Year 4: Full Diameter Drilling and Third Power Plant (50MW)**

| | Annual Emissions (T/Yr) | | | | | GHG Emissions (MT/year) | |
|---|---|---|---|---|---|---|---|
| Type | PM-10 | NOX | VOC | SO2 | CO | CO2 | CO2e |
| Well Drilling - Fugitive | 0.03 | --- | --- | --- | --- | --- | --- |
| Well Drilling - Combustion | 0.63 | 23.40 | 3.96 | 3.69 | 32.40 | 2070 | 2070 |
| Construction | 113.41 | 226.28 | 18.24 | 15.05 | 48.97 | 931 | 931 |
| On-road vehicles | 15.29 | 0.89 | 0.12 | 0.00 | 0.80 | 211 | 211 |
| **Totals** | **129.35** | **250.57** | **22.32** | **18.74** | **82.17** | **3212** | **3212** |

**Operational Emissions (On-road vehicles)**

| | Annual Emissions (T/Yr) | | | | | GHG Emissions (MT/year) | |
|---|---|---|---|---|---|---|---|
| Type | PM-10 | NOX | VOC | SO2 | CO | CO2 | CO2e |
| On-road vehicles - Engine | 0.003 | 0.021 | 0.024 | 0.000 | 0.219 | 36 | 36 |
| On-road vehicles - Fugitive dust | 4.271 | --- | --- | --- | --- | --- | --- |
| **Totals** | **4.27** | **0.02** | **0.02** | **0.00** | **0.22** | **36** | **36** |

**Table 1: Fugitive Emissions From Drilling Exploratory Wells (Year 1)**

| Activity | No. of Wells | Emission Factor[1] PM-10 (lb/hole) | Total Emissions[2] PM-10 (Tons/Project) |
|---|---|---|---|
| Drilling Wells | 30 | 1.3 | **0.0195** |

Notes:

1. Emission Factor from AP-42, Table 11.9-4 (5th Edition).
2. Total Emissions = No. of wells x Emission Factor/(2000 lb/Ton).

**Table 2: Emissions from Drilling Rig Engines for Initial Wells (Year 1)**

| | | | |
|---|---|---|---|
| Average Power Rating (hp) | 500 | 30 | Number of Wells |
| Fuel Type | Diesel | 12 | Operating Hours per day/drill rig |
| Total Operating Hours (hr/yr)[1] | 7,200 | 20 | Drilling days per well |
| Load Factor | 0.75 | | |

| | POLLUTANTS | | | | | GHG |
|---|---|---|---|---|---|---|
| | PM-10 | NOX | SO2 | CO | VOC | CO2 |
| Emission Factor (lb/hp-hr)[2,3] | 0.00035 | 0.013 | 0.00205 | 0.01800 | 0.0022 | 1.15000 |
| **Total Emissions (Tons/Project)[4]** | **0.47** | **17.55** | **2.77** | **24.3** | **2.97** | **1552.50** |

Notes:

1. Total operating hours of all drill rigs.
2. Emission Factors from "Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines," EPA420-F-97-014, Sept 1997, Nonroad CI Engines.
3. Emission Factor for SO2 from AP-42, Table 3.3-1 (5th Edition).
4. Total emissions = Average Power Rating x Total Operating Hours x Load Factor x Emission Factor/(2000 lb/ton).

**Construction Emissions: Vehicle Engine Exhaust From Grading and Material Hauling Activities (Year 1)**

| **Input Parameters/Assumptions:** | | |
|---|---|---|
| Total Building Area: | 0 | $ft^2$ |
| Total Paved Area: | 0.00 | $ft^2$ |
| Total Disturbed Area: | 95.00 | acres |
| Construction Duration: | 0.50 | years |
| Annual Construction Activity: | 250 | days/yr |
| Total Demolition: | 0 | $ft^2$ |

**Area for Year 1: Exploratory Drilling Disturbance: 95 acres;**

**Table 3 Summary of Input Parameters**

| | ROG[1] | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Total new acres disturbed: | 95 | 95 | 95 | 95 | 95 |
| Total new building space, $ft^2$: | 0 | 0 | 0 | 0 | 0 |
| Total years: | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Area graded, acres: | 95 | 95 | 95 | 95 | 95 |

**Emission Factors For Equipment Engine Exhaust From Construction Activities**

| | SMAQMD Emission Factor | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity** | ROG[1] | | $NO_x$ | | $SO_2$ [2] | | CO [2] | | $PM_{10}$ | |
| Grading Equipment[3] | 2.91E-01 | lbs/acre/day | 2.75E+00 | lbs/acre/day | 0.18 | lbs/acre/day | 0.60 | lbs/acre/day | 2.32E-01 | lbs/acre/day |
| Material Hauling[4] | 4.20E-01 | lbs/acre/day | 6.07E+00 | lbs/acre/day | 0.40 | lbs/acre/day | 1.31 | lbs/acre/day | 4.30E-01 | lbs/acre/day |

Reference: *Air Quality Thresholds of Significance* , Sacramento Metropolitan Air Quality Management District (SMAQMD), 1994 and *Compilation of Air Pollutant Emission Factors* (USEPA AP-42).

1 ROG = VOC.

2 Factors for grading equipment are calculated from AP-42 for diesel engines using ratios with the NOx factors.

3 Grading Activities assumes the use of one tracked loader, one wheeled loader, and one motor grader for each 10 acres of disturbed area, used 8 hours per day.

4 Material Hauling Activities assumes the use of one loader and one haul truck for each 10 acres of disturbed area, used 8 hours per day.

**Table 4 Total Daily Equipment Engine Exhaust Emissions From Construction Actitivies[1]**

| | ROG | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment | 27.7 | 261.7 | 17.4 | 56.6 | 22.0 |
| Material Hauling | 39.9 | 576.7 | 38.3 | 124.8 | 40.9 |
| **Total Emissions (lbs/day):** | **67.6** | **838.3** | **55.7** | **181.4** | **62.9** |

1 Total Emissions (lbs/day) = Emission Factor * Affected Acres

**Table 5 Total Emissions from Construction Activities[1]**

| | ROG | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment | 1.73 | 16.35 | 1.09 | 3.54 | 1.38 |
| Material Hauling | 2.49 | 36.04 | 2.40 | 7.80 | 2.55 |
| Fugitive Emissions (from page 2) | | | | | 27.83 |
| **Total Emissions(tons/yr)** | **4.22** | **52.39** | **3.48** | **11.34** | **31.76** |

1 Total emissions (TPY) = Total emissions (lbs/day) * days of construction / 2000 lbs per ton

## Construction Emissions: Fugitive Emissions From Construction Activities (Year 1)

**Input Parameters / Assumptions**

| | | | |
|---|---|---|---|
| Acres affected: | 95.0 | acres/yr | **Exp.Drilling: 95 acres** |
| Grading days/yr: | 21 | days/yr | |
| Exposed days/yr: | 21 | days/yr graded area is exposed | |
| Grading Hours/day: | 8 | hr/day | |
| Soil percent silt, s: | 15 | % | |
| Soil percent moisture, M: | 2 | % | |
| Fraction of TSP, J: | 0.5 | (SCAQMD recommendation) | |
| Mean vehicle speed, S: | 5 | mi/hr | (On-site) |
| Dozer path width: | 5 | ft | |
| Qty construction vehicles: | 3 | vehicles | |
| On-site VMT/vehicle/day: | 5 | mi/veh/day | (Excluding bulldozer VMT during grading) |

Reference: *CEQA Air Quality Handbook* , SCAQMD, April 1993.

### Equation Used To Calculate Operation Parameters

| Operation Parameter | Emission Factor | Units | Equation |
|---|---|---|---|
| Grading duration per acre | 1.8 | hr/acre | Grading days * hours per day / acres affected |
| Bulldozer mileage per acre | 1.7 | VMT/acre | Miles traveled by bulldozer, based on dozer path width |
| Construction VMT per day | 15 | VMT/day | Number of vehicle * VMT per vehicle per day |
| Construction VMT per acre | 3.3 | VMT/acre | Construction VMT * days of construction / acres affected |
| | | | (Travel on unpaved surfaces within site) |

### Equations Used To Calculate Mass/Unit Emission Factors (Corrected for $PM_{10}$)

| Operation | Empirical Equation | Units | AP-42 Section (4th Edition) |
|---|---|---|---|
| Bulldozing | 0.75(s^1.5)/(M^1.4) | lbs/hr | 8.24, Overburden |
| Grading | (0.60)(0.051)S^2.0 | lbs/VMT | 8.24, Overburden |
| Vehicle Traffic | (3.72/(M^4.3))*.6 | lbs/VMT | 8.24, Overburden |

Reference: *Compilation of Air Pollutant Emission Factors,* USEPA AP-42:
Section 8.24, Western Surface Coal Mining (4th Edition)

### Emission Factors For Fugitive Emissions From Construction Activities[1]

| Operation | Emission Factor (mass/ unit) | | Operation Parameter | | Emission Factor (lbs/acre) |
|---|---|---|---|---|---|
| Bulldozing | 16.51 | lbs/hr | 1.8 | hr/acre | 29.7 lbs/acre |
| Grading | 0.77 | lbs/VMT | 1.7 | VMT/acre | 1.3 lbs/acre |
| Vehicle Traffic | 0.11 | lbs/VMT | 3.30 | VMT/acre | 0.4 lbs/acre |

1 Emission Factor (lbs/acre) = Emission Factor (lbs per hour or VMT) * Operation Parameter (hours of VMT per acre)

### Table 6 Calculation of Annual Fugitive Emissions from Construction Activities

| Source | Emission Factor | | Graded Acres/yr | Exposed days/yr | Emissions lbs/yr | Emissions tons/yr |
|---|---|---|---|---|---|---|
| Bulldozing[1] | 29.7 | lbs/acre | 95.00 | NA | 2,822 | 1.41 |
| Grading[1] | 1.3 | lbs/acre | 95.00 | NA | 124 | 0.06 |
| Vehicle Traffic[1] | 0.4 | lbs/acre | 95.00 | NA | 38 | 0.02 |
| Erosion of Graded Surface[2] | 26.4 | lbs/acre/day[3] | 95.00 | 21 | 52,668 | 26.33 |
| **TOTAL** | | | | | **55,651** | **27.83** |

1 Total annual emissions (TPY) = Emission Factor (lbs/acre) * affected acres * 2000 lbs per ton
2 Total annual emissions (TPY) from erosion = Emission Factor (lbs/acre) * days of construction * 2000 lbs per ton
3. Reference: CEQA Air Quality Handbook, SCAQMD, April 1993.

**Projected Annual Emissions During Construction from On-Road Vehicles (Year 1)**

**On-Road Vehicles Emission Factors**

| Scenario Year | Vehicle Type | EPA Category | Emission Factor (pounds/mile) CO | NOx | ROG | SOx | PM10 | PM2.5 | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | Cars | LDGV | 0.00765 | 0.00078 | 0.00080 | 0.00001 | 0.00009 | 0.00006 | 1.10153 | 0.00007 |
| | Pickups | LDGT1 | 0.00765 | 0.00078 | 0.00080 | 0.00001 | 0.00009 | 0.00006 | 1.10153 | 0.00007 |
| | Heavy Trucks | HDDV | 0.01022 | 0.03092 | 0.00253 | 0.00004 | 0.00150 | 0.00129 | 4.21591 | 0.00012 |
| | Trucks (3 axles) | LDDT | 0.01546 | 0.01732 | 0.00224 | 0.00003 | 0.00065 | 0.00055 | 2.76628 | 0.00011 |

Source: SCAQMD 2010. Highest (Most Conservative) EMFAC2007 (version 2.3). Emission Factors for On-Road Vehicles and Heavy-Heavy-Duty Diesel Trucks

Key:

LDGV = Light-duty gasoline-fueled vehicles designated for transport of up to 12 people.

LDGT1 = Light-duty gasoline-fueled trucks with a gross vehicle weight (GVW) rating of 6,000 pounds or less.

LDDT = Light-duty diesel-powered trucks with a GVW of 8,500 pounds or less.

HDDV = Heavy-duty diesel-powered vehicles with a GVW exceeding 8,500 pounds.

**Table 7-a Projected Criteria Air Pollutant Emissions From On-Road Vehicles**

| Group | Vehicle Type | Daily Vehicles (/day) | Daily Travel - Per Vehicle At Plant (VMT) | Off-Plant (VMT) | Total (VMT) | Travel Days (days/yr) | Annual Travel (VMT/yr) | Annual Emissions (lb/yr)[1] CO | NOx | ROG | SOx | PM10 | PM2.5 | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | 10.0 | 4.0 | 0.0 | 4.0 | 180.0 | 7,200.0 | 55.1 | 5.6 | 5.7 | 0.1 | 0.6 | 0.4 | 7,931.0 | 0.5 |
| | Pickups/Light Trucks | 10.0 | 4.0 | 0.0 | 4.0 | 180.0 | 7,200.0 | 55.1 | 5.6 | 5.7 | 0.1 | 0.6 | 0.4 | 7,931.0 | 0.5 |
| | Trucks | 5.0 | 4.0 | 0.0 | 4.0 | 180.0 | 3,600.0 | 36.8 | 111.3 | 9.1 | 0.1 | 5.4 | 4.7 | 15,177.3 | 0.4 |
| Vehicle Trips/Day | Heavy Trucks | 5.0 | 4.0 | 0.0 | 4.0 | 180.0 | 3,600.0 | 55.6 | 62.4 | 8.1 | 0.1 | 2.3 | 2.0 | 9,958.6 | 0.4 |
| 30 | **Total** | **30.0** | - | - | - | - | - | **202.65** | **184.9** | **28.6** | **0.4** | **9.0** | **7.5** | **40,997.9** | **1.8** |
| | | | | | | | **TOTAL TPY[2]** | **0.1013** | **0.092** | **0.014** | **0.000** | **0.005** | **0.004** | **18.602** | **0.001** |

Notes:

1. Annual Emissions (lb/yr) = Emission Factor x Annual Travel/(453.6 g/lb)

2. Total TPY = Annual Emissions/(2000 lb/t). CO2 and CH4 are expressed as metric tones per year = Annual Emisisons/(2204 lb/MT)

**Table 7-b Road Fugitive Emissions**

| Group | Vehicle Type | Daily Vehicles (/day) | Daily Travel - Per Vehicle At Plant (VMT) | Off-Plant (VMT) | Total (VMT) | Travel Days (days/yr) | Annual Travel (VMT/yr) |
|---|---|---|---|---|---|---|---|
| | Cars | 10.0 | 4.0 | 0.0 | 4.0 | 180.0 | 7,200.0 |
| | Pickups/Light Trucks | 10.0 | 4.0 | 0.0 | 4.0 | 180.0 | 7,200.0 |
| | Trucks | 5.0 | 4.0 | 0.0 | 4.0 | 180.0 | 3,600.0 |
| Vehicle Trips/Day | Heavy Trucks | 5.0 | 4.0 | 0.0 | 4.0 | 180.0 | 3,600.0 |
| 30 | **Total** | **30.0** | - | - | - | - | - |

**Table 8: Fugitive Emissions From Drilling Secondary Wells (Year 2)**

| Activity | No. of Wells | Emission Factor[1] PM-10 (lb/hole) | Total Emissions[2] PM-10 (Tons/Project) |
|---|---|---|---|
| Full Diameter Wells | 40 | 1.3 | **0.0260** |

Notes:

1. Emission Factor from AP-42, Table 11.9-4 (5th Edition).
2. Total Emissions = No. of wells x Emission Factor/(2000 lb/Ton).

**Table 9: Emissions from Drilling Rig Engines for Secondary Wells (Year 2)**

| | | | |
|---|---|---|---|
| Average Power Rating (hp) | 500 | 40 | Number of Wells |
| Fuel Type | Diesel | 12 | Operating Hours per day/drill rig |
| Total Operating Hours (hr/yr)[1] | 9,600 | 20 | Drilling days per well |
| Load Factor | 0.75 | | |

| | POLLUTANTS | | | | | GHG |
|---|---|---|---|---|---|---|
| | PM-10 | NOX | SO2 | CO | VOC | CO2 |
| Emission Factor (lb/hp-hr)[2,3] | 0.00035 | 0.013 | 0.00205 | 0.01800 | 0.0022 | 1.15000 |
| **Total Emissions (Tons/Project)[4]** | **0.63** | **23.4** | **3.69** | **32.4** | **3.96** | **2070.0** |

Notes:

1. Total operating hours of all drill rigs.
2. Emission Factors from "Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines," EPA420-F-97-014, Sept 1997, Nonroad CI Engines.
3. Emission Factor for SO2 from AP-42, Table 3.3-1 (5th Edition).
4. Total emissions = Average Power Rating x Total Operating Hours x Load Factor x Emission Factor/(2000 lb/ton).

## Construction Emissions: Vehicle Engine Exhaust From Grading and Material Hauling Activities (Year 2)

**Input Parameters/Assumptions:**

| | | |
|---|---|---|
| Total Building Area: | 1,306,800 | $ft^2$ |
| Total Paved Area: | 156,816 | $ft^2$ |
| Total Disturbed Area: | 341.90 | acres |
| Construction Duration: | 0.60 | years |
| Annual Construction Activity: | 250 | days/yr |
| Total Demolition: | 0 | $ft^2$ |

**Area for Year 2: Wellfield (50-MW): 272 acres; Power Plant: 69.9**

**Table 10 Summary of Input Parameters**

| | ROG[1] | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Total new acres disturbed: | 341.9 | 341.9 | 341.9 | 341.9 | 341.9 |
| Total new building space, $ft^2$: | 1306800.0 | 1306800.0 | 1306800.0 | 1306800.0 | 1306800.0 |
| Total years: | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Area graded, acres: | 341.9 | 341.9 | 341.9 | 341.9 | 341.9 |

**Emission Factors For Vehicle Engine Exhaust From Construction Activities**

| Activity | SMAQMD Emission Factor | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ROG[1] | | $NO_x$ | | $SO_2$ [2] | | CO [2] | | $PM_{10}$ | |
| Grading Equipment[3] | 2.91E-01 | lbs/acre/day | 2.75E+00 | lbs/acre/day | 0.18 | lbs/acre/day | 0.60 | lbs/acre/day | 2.32E-01 | lbs/acre/day |
| Material Hauling[4] | 4.20E-01 | lbs/acre/day | 6.07E+00 | lbs/acre/day | 0.40 | lbs/acre/day | 1.31 | lbs/acre/day | 4.30E-01 | lbs/acre/day |

Reference: *Air Quality Thresholds of Significance* , Sacramento Metropolitan Air Quality Management District (SMAQMD), 1994 and *Compilation of Air Pollutant Emission Factors* (USEPA AP-42).

1 ROG = VOC.

2 Factors for grading equipment are calculated from AP-42 for diesel engines using ratios with the NOx factors.

3 Grading Activities assumes the use of one tracked loader, one wheeled loader, and one motor grader for each 10 acres of disturbed area, used 8 hours per day.

4 Material Hauling Activities assumes the use of one loader and one haul truck for each 10 acres of disturbed area, used 8 hours per day.

**Table 11 Total Daily Vehicle Engine Exhaust Emissions From Construction Actitivies[1]**

| | ROG | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment | 99.6 | 941.7 | 62.6 | 203.8 | 79.3 |
| Material Hauling | 143.6 | 2075.3 | 138.0 | 449.2 | 147.0 |
| **Total Emissions (lbs/day):** | **243.2** | **3017.1** | **200.6** | **653.0** | **226.3** |

1 Total Emissions (lbs/day) = Emission Factor * Affected Acres

**Table 12 Total Vehicle Engine Exhaust Emissions from Construction Activities[1]**

| | ROG | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment | 7.47 | 70.63 | 4.70 | 15.29 | 5.95 |
| Material Hauling | 10.77 | 155.65 | 10.35 | 33.69 | 11.03 |
| Fugitive Emissions (from page 2) | | | | | 96.43 |
| **Total Emissions(tons/yr)** | **18.24** | **226.28** | **15.05** | **48.97** | **113.41** |

1 Total emissions (TPY) = Total emissions (lbs/day) * days of construction / 2000 lbs per ton

**Construction Emissions: Fugitive Emissions From Construction Activities (Year 2)**

| Input Parameters / Assumptions | | | Drilling and Power Plant (One 50-MW Project) |
|---|---|---|---|
| Acres affected: | 341.9 | acres/yr | **Full Drilling: 272; Plant: 69.9** |
| Grading days/yr: | 21 | days/yr | |
| Exposed days/yr: | 21 | days/yr graded area is exposed | |
| Grading Hours/day: | 8 | hr/day | |
| Soil percent silt, s: | 15 | % | |
| Soil percent moisture, M: | 2 | % | |
| Fraction of TSP, J: | 0.5 | (SCAQMD recommendation) | |
| Mean vehicle speed, S: | 5 | mi/hr | (On-site) |
| Dozer path width: | 5 | ft | |
| Qty construction vehicles: | 3 | vehicles | |
| On-site VMT/vehicle/day: | 5 | mi/veh/day | (Excluding bulldozer VMT during grading) |

Reference: *CEQA Air Quality Handbook* , SCAQMD, April 1993.

**Equation Used To Calculate Operation Parameters**

| Operation Parameter | Emission Factor | Units | Equation |
|---|---|---|---|
| Grading duration per acre | 0.5 | hr/acre | Grading days * hours per day / acres affected |
| Bulldozer mileage per acre | 1.7 | VMT/acre | Miles traveled by bulldozer, based on dozer path width |
| Construction VMT per day | 15 | VMT/day | Number of vehicle * VMT per vehicle per day |
| Construction VMT per acre | 0.9 | VMT/acre | Construction VMT * days of construction / acres affected |
| | | | (Travel on unpaved surfaces within site) |

**Equations Used To Calculate Mass/Unit Emission Factors (Corrected for $PM_{10}$)**

| Operation | Empirical Equation | Units | AP-42 Section (4th Edition) |
|---|---|---|---|
| Bulldozing | 0.75(s^1.5)/(M^1.4) | lbs/hr | 8.24, Overburden |
| Grading | (0.60)(0.051)S^2.0 | lbs/VMT | 8.24, Overburden |
| Vehicle Traffic | (3.72/(M^4.3))*.6 | lbs/VMT | 8.24, Overburden |

Reference: *Compilation of Air Pollutant Emission Factors,* USEPA AP-42:
Section 8.24, Western Surface Coal Mining (4th Edition)

**Emission Factors For Fugitive Emissions From Construction Activities[1]**

| Operation | Emission Factor (mass/ unit) | | Operation Parameter | | Emission Factor (lbs/acre) |
|---|---|---|---|---|---|
| Bulldozing | 16.51 | lbs/hr | 0.5 | hr/acre | 8.3 lbs/acre |
| Grading | 0.77 | lbs/VMT | 1.7 | VMT/acre | 1.3 lbs/acre |
| Vehicle Traffic | 0.11 | lbs/VMT | 0.90 | VMT/acre | 0.1 lbs/acre |

1 Emission Factor (lbs/acre) = Emission Factor (lbs per hour or VMT) * Operation Parameter (hours of VMT per acre)

**Table 13 Calculation of Annual Fugitive Emissions from Construction Activities**

| Source | Emission Factor | | Graded Acres/yr | Exposed days/yr | Emissions lbs/yr | Emissions tons/yr |
|---|---|---|---|---|---|---|
| Bulldozing[1] | 8.3 | lbs/acre | 341.90 | NA | 2,838 | 1.42 |
| Grading[1] | 1.3 | lbs/acre | 341.90 | NA | 444 | 0.22 |
| Vehicle Traffic[1] | 0.1 | lbs/acre | 341.90 | NA | 34 | 0.02 |
| Erosion of Graded Surface[2] | 26.4 | lbs/acre/day[3] | 341.90 | 21 | 189,549 | 94.77 |
| **TOTAL** | | | | | **192,866** | **96.43** |

1 Total annual emissions (TPY) = Emission Factor (lbs/acre) * affected acres * 2000 lbs per ton
2 Total annual emissions (TPY) from erosion = Emission Factor (lbs/acre) * days of construction * 2000 lbs per ton
3. Reference: CEQA Air Quality Handbook, SCAQMD, April 1993.

## Projected Annual Emissions During Construction from On-Road Vehicles (Year 2)

### On-Road Vehicle Emission Factors

| | | | Emission Factor (pounds/mile) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Scenario Year | Vehicle Type | EPA Category | CO | NOx | ROG | SOx | PM10 | PM2.5 | CO2 | CH4 |
| 2013 | Cars | LDGV | 0.00709 | 0.00071 | 0.00075 | 0.00001 | 0.00009 | 0.00006 | 1.10087 | 0.00007 |
| | Pickups | LDGT1 | 0.00709 | 0.00071 | 0.00075 | 0.00001 | 0.00009 | 0.00006 | 1.10087 | 0.00007 |
| | Heavy Trucks | HDDV | 0.00932 | 0.02743 | 0.00226 | 0.00004 | 0.00134 | 0.00115 | 4.21519 | 0.00010 |
| | Trucks (3 axles) | LDDT | 0.01408 | 0.01577 | 0.00206 | 0.00003 | 0.00060 | 0.00050 | 2.78163 | 0.00010 |

Source: SCAQMD 2010. Highest (Most Conservative) EMFAC2007 (version 2.3). Emission Factors for On-Road Vehicles and Heavy-Heavy-Duty Diesel Trucks

Key:

LDGV = Light-duty gasoline-fueled vehicles designated for transport of up to 12 people.

LDGT1 = Light-duty gasoline-fueled trucks with a gross vehicle weight (GVW) rating of 6,000 pounds or less.

LDDT = Light-duty diesel-powered trucks with a GVW of 8,500 pounds or less.

HDDV = Heavy-duty diesel-powered vehicles with a GVW exceeding 8,500 pounds.

### Table 14 Projected Criteria Air Pollutant Emissions From On-Road Vehicles

| Group | Vehicle Type | Daily Vehicles (/day) | Daily Travel - Per Vehicle At Plant (VMT) | Off-Plant (VMT) | Total (VMT) | Travel Days (days/yr) | Annual Travel (VMT/yr) | Annual Emissions (lb/yr)[1] CO | NOx | ROG | SOx | PM10 | PM2.5 | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | 20.0 | 4.0 | 10.0 | 14.0 | 180.0 | 50,400.0 | 357.5 | 35.9 | 37.6 | 0.5 | 4.6 | 2.9 | 55,484.1 | 3.4 |
| | Pickups/Light Trucks | 20.0 | 4.0 | 10.0 | 14.0 | 180.0 | 50,400.0 | 357.5 | 35.9 | 37.6 | 0.5 | 4.6 | 2.9 | 55,484.1 | 3.4 |
| | Trucks | 20.0 | 4.0 | 10.0 | 14.0 | 180.0 | 50,400.0 | 469.6 | 1,382.4 | 114.1 | 2.1 | 67.4 | 57.8 | 212,445.4 | 5.3 |
| Vehicle Trips/Day | Heavy Trucks | 20.0 | 4.0 | 10.0 | 14.0 | 180.0 | 50,400.0 | 709.5 | 795.0 | 104.0 | 1.4 | 30.2 | 25.3 | 140,194.4 | 4.9 |
| 80 | **Total** | **80.0** | - | - | - | - | - | **1894.04** | **2,249.1** | **293.2** | **4.5** | **106.7** | **88.9** | **463,607.9** | **16.9** |
| | | | | | | | **TOTAL TPY[2]** | **0.9470** | **1.125** | **0.147** | **0.002** | **0.053** | **0.044** | **210.348** | **0.008** |

Notes:

1. Annual Emissions (lb/yr) = Emission Factor x Annual Travel/(453.6 g/lb)

2. Total TPY = Annual Emissions/(2000 lb/t). CO2 and CH4 are expressed as metric tones per year = Annual Emisisons/(2204 lb/MT)

### Table 14-b Road Fugitive Emissions

| Group | Vehicle Type | Daily Vehicles (/day) | Daily Travel - Per Vehicle At Plant (VMT) | Off-Plant (VMT) | Total (VMT) | Travel Days (days/yr) | Annual Travel (VMT/yr) |
|---|---|---|---|---|---|---|---|
| | Cars | 20 | 4 | 10 | 14 | 180 | 50,400 |
| | Pickups/Light Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| | Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| Vehicle Trips/Day | Heavy Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| 80 | **Total** | **80.0** | - | - | - | - | - |

**Table 15: Fugitive Emissions From Drilling Secondary Wells (Year 3)**

| Activity | No. of Wells | Emission Factor[1] PM-10 (lb/hole) | Total Emissions[2] PM-10 (Tons/Project) |
|---|---|---|---|
| Drilling Wells | 40 | 1.3 | **0.0260** |

Notes:

1. Emission Factor from AP-42, Table 11.9-4 (5th Edition).
2. Total Emissions = No. of wells x Emission Factor/(2000 lb/Ton).

**Table 16: Emissions from Drilling Rig Engines for Secondary Wells (Year 3)**

| | | | |
|---|---|---|---|
| Average Power Rating (hp) | 500 | 40 | Number of Wells |
| Fuel Type | Diesel | 12 | Operating Hours per day/drill rig |
| Total Operating Hours (hr/yr)[1] | 9,600 | 20 | Drilling days per well |
| Load Factor | 0.75 | | |

| | POLLUTANTS | | | | | GHG |
|---|---|---|---|---|---|---|
| | PM-10 | NOX | SO2 | CO | VOC | CO2 |
| Emission Factor (lb/hp-hr)[2,3] | 0.00035 | 0.013 | 0.00205 | 0.01800 | 0.0022 | 1.15000 |
| **Total Emissions (Tons/Project)[4]** | **0.63** | **23.4** | **3.69** | **32.4** | **3.96** | **2070.0** |

Notes:

1. Total operating hours of all drill rigs.
2. Emission Factors from "Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines," EPA420-F-97-014, Sept 1997, Nonroad CI Engines.
3. Emission Factor for SO2 from AP-42, Table 3.3-1 (5th Edition).
4. Total emissions = Average Power Rating x Total Operating Hours x Load Factor x Emission Factor/(2000 lb/ton).

**Construction Emissions: Vehicle Engine Exhaust From Grading and Material Hauling Activities (Year 3)**

| **Input Parameters/Assumptions:** | | |
|---|---|---|
| Total Building Area: | 1,306,800 | $ft^2$ |
| Total Paved Area: | 156,816 | $ft^2$ |
| Total Disturbed Area: | 341.90 | acres |
| Construction Duration: | 0.60 | years |
| Annual Construction Activity: | 250 | days/yr |
| Total Demolition: | 0 | $ft^2$ |

**<u>Area for Year 3</u>: Wellfield (50-MW): 272 acres; Power Plant: 69.9**

**Table 17 Summary of Input Parameters**

| | ROG[1] | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Total new acres disturbed: | 341.9 | 341.9 | 341.9 | 341.9 | 341.9 |
| Total new building space, $ft^2$: | 1306800.0 | 1306800.0 | 1306800.0 | 1306800.0 | 1306800.0 |
| Total years: | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Area graded, acres: | 341.9 | 341.9 | 341.9 | 341.9 | 341.9 |

**Emission Factors For Vehicle Engine Exhaust From Construction Activities**

| | SMAQMD Emission Factor | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Activity** | **ROG[1]** | | **$NO_x$** | | **$SO_2$ [2]** | | **CO [2]** | | **$PM_{10}$** | |
| Grading Equipment[3] | 2.91E-01 | lbs/acre/day | 2.75E+00 | lbs/acre/day | 0.18 | lbs/acre/day | 0.60 | lbs/acre/day | 2.32E-01 | lbs/acre/day |
| Material Hauling[4] | 4.20E-01 | lbs/acre/day | 6.07E+00 | lbs/acre/day | 0.40 | lbs/acre/day | 1.31 | lbs/acre/day | 4.30E-01 | lbs/acre/day |

Reference: *Air Quality Thresholds of Significance* , Sacramento Metropolitan Air Quality Management District (SMAQMD), 1994 and *Compilation of Air Pollutant Emission Factors* (USEPA AP-42).

1 ROG = VOC.

2 Factors for grading equipment are calculated from AP-42 for diesel engines using ratios with the NOx factors.

3 Grading Activities assumes the use of one tracked loader, one wheeled loader, and one motor grader for each 10 acres of disturbed area, used 8 hours per day.

4 Material Hauling Activities assumes the use of one loader and one haul truck for each 10 acres of disturbed area, used 8 hours per day.

**Table 18 Total Daily Vehicle Engine Exhaust Emissions From Construction Actitivies[1]**

| | ROG | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment | 99.6 | 941.7 | 62.6 | 203.8 | 79.3 |
| Material Hauling | 143.6 | 2075.3 | 138.0 | 449.2 | 147.0 |
| **Total Emissions (lbs/day):** | **243.2** | **3017.1** | **200.6** | **653.0** | **226.3** |

1 Total Emissions (lbs/day) = Emission Factor * Affected Acres

**Table 19 Total Vehicle Engine Exhaust Emissions from Construction Activities[1]**

| | ROG | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment | 7.47 | 70.63 | 4.70 | 15.29 | 5.95 |
| Material Hauling | 10.77 | 155.65 | 10.35 | 33.69 | 11.03 |
| Fugitive Emissions (from page 2) | | | | | 96.43 |
| **Total Emissions(tons/yr)** | **18.24** | **226.28** | **15.05** | **48.97** | **113.41** |

1 Total emissions (TPY) = Total emissions (lbs/day) * days of construction / 2000 lbs per ton

**Construction Emissions: Fugitive Emissions From Construction Activities (Year 3)**

| Input Parameters / Assumptions | | | |
|---|---|---|---|
| Acres affected: | 341.9 | acres/yr | |
| Grading days/yr: | 21 | days/yr | |
| Exposed days/yr: | 21 | days/yr graded area is exposed | |
| Grading Hours/day: | 8 | hr/day | |
| Soil percent silt, s: | 15 | % | |
| Soil percent moisture, M: | 2 | % | |
| Fraction of TSP, J: | 0.5 | (SCAQMD recommendation) | |
| Mean vehicle speed, S: | 5 | mi/hr | (On-site) |
| Dozer path width: | 5 | ft | |
| Qty construction vehicles: | 3 | vehicles | |
| On-site VMT/vehicle/day: | 5 | mi/veh/day | (Excluding bulldozer VMT during grading) |

Reference: *CEQA Air Quality Handbook* , SCAQMD, April 1993.

**Equation Used To Calculate Operation Parameters**

| Operation Parameter | Emission Factor | Units | Equation |
|---|---|---|---|
| Grading duration per acre | 0.5 | hr/acre | Grading days * hours per day / acres affected |
| Bulldozer mileage per acre | 1.7 | VMT/acre | Miles traveled by bulldozer, based on dozer path width |
| Construction VMT per day | 15 | VMT/day | Number of vehicle * VMT per vehicle per day |
| Construction VMT per acre | 0.9 | VMT/acre | Construction VMT * days of construction / acres affected |
| | | | (Travel on unpaved surfaces within site) |

**Equations Used To Calculate Mass/Unit Emission Factors (Corrected for $PM_{10}$)**

| Operation | Empirical Equation | Units | AP-42 Section (4th Edition) |
|---|---|---|---|
| Bulldozing | 0.75(s^1.5)/(M^1.4) | lbs/hr | 8.24, Overburden |
| Grading | (0.60)(0.051)S^2.0 | lbs/VMT | 8.24, Overburden |
| Vehicle Traffic | (3.72/(M^4.3))*.6 | lbs/VMT | 8.24, Overburden |

Reference: *Compilation of Air Pollutant Emission Factors,* USEPA AP-42:
Section 8.24, Western Surface Coal Mining (4th Edition)

**Emission Factors For Fugitive Emissions From Construction Activities[1]**

| Operation | Emission Factor (mass/ unit) | | Operation Parameter | | Emission Factor (lbs/acre) |
|---|---|---|---|---|---|
| Bulldozing | 16.51 | lbs/hr | 0.5 | hr/acre | 8.3 lbs/acre |
| Grading | 0.77 | lbs/VMT | 1.7 | VMT/acre | 1.3 lbs/acre |
| Vehicle Traffic | 0.11 | lbs/VMT | 0.90 | VMT/acre | 0.1 lbs/acre |

1 Emission Factor (lbs/acre) = Emission Factor (lbs per hour or VMT) * Operation Parameter (hours of VMT per acre)

**Table 20 Calculation of Annual Fugitive Emissions from Construction Activities**

| Source | Emission Factor | | Graded Acres/yr | Exposed days/yr | Emissions lbs/yr | Emissions tons/yr |
|---|---|---|---|---|---|---|
| Bulldozing[1] | 8.3 | lbs/acre | 341.90 | NA | 2,838 | 1.42 |
| Grading[1] | 1.3 | lbs/acre | 341.90 | NA | 444 | 0.22 |
| Vehicle Traffic[1] | 0.1 | lbs/acre | 341.90 | NA | 34 | 0.02 |
| Erosion of Graded Surface[2] | 26.4 | lbs/acre/day[3] | 341.90 | 21 | 189,549 | 94.77 |
| **TOTAL** | | | | | **192,866** | **96.43** |

1 Total annual emissions (TPY) = Emission Factor (lbs/acre) * affected acres * 2000 lbs per ton
2 Total annual emissions (TPY) from erosion = Emission Factor (lbs/acre) * days of construction * 2000 lbs per ton
3. Reference: CEQA Air Quality Handbook, SCAQMD, April 1993.

**Projected Annual Emissions During Construction from On-Road Vehicles (Year 3)**

**On-Road Vehicles Emission Factors**

| | | | Emission Factor (pounds/mile) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Scenario Year** | **Vehicle Type** | **EPA Category** | **CO** | **NOx** | **ROG** | **SOx** | **PM10** | **PM2.5** | **CO2** | **CH4** |
| 2014 | Cars | LDGV | 0.006604 | 0.000655 | 0.000702 | 0.000011 | 0.000092 | 0.000059 | 1.102572 | 0.000063 |
| | Pickups | LDGT1 | 0.006604 | 0.000655 | 0.000702 | 0.000011 | 0.000092 | 0.000059 | 1.102572 | 0.000063 |
| | Heavy Trucks | HDDV | 0.008464 | 0.024180 | 0.002016 | 0.000041 | 0.001185 | 0.001006 | 4.212793 | 0.000093 |
| | Trucks (3 axles) | LDDT | 0.012843 | 0.014252 | 0.001896 | 0.000028 | 0.000549 | 0.000455 | 2.798455 | 0.000088 |

Source: SCAQMD 2010. Highest (Most Conservative) EMFAC2007 (version 2.3). Emission Factors for On-Road Vehicles and Heavy-Heavy-Duty Diesel Trucks

Key:

LDGV = Light-duty gasoline-fueled vehicles designated for transport of up to 12 people.

LDGT1 = Light-duty gasoline-fueled trucks with a gross vehicle weight (GVW) rating of 6,000 pounds or less.

LDDT = Light-duty diesel-powered trucks with a GVW of 8,500 pounds or less.

HDDV = Heavy-duty diesel-powered vehicles with a GVW exceeding 8,500 pounds.

**Table 21-a Projected Criteria Air Pollutant Emissions From On-Road Vehicles**

| | | | Daily Travel - Per Vehicle | | | | | Annual Emissions (lb/yr)[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **Vehicle Type** | **Daily Vehicles (/day)** | **At Plant (VMT)** | **Off-Plant (VMT)** | **Total (VMT)** | **Travel Days (days/yr)** | **Annual Travel (VMT/yr)** | **CO** | **NOx** | **ROG** | **SOx** | **PM10** | **PM2.5** | **CO2** | **CH4** |
| | Cars | 20 | 4 | 10 | 14 | 180 | 50,400 | 332.8 | 33.0 | 35.4 | 0.5 | 4.6 | 3.0 | 55,569.6 | 3.2 |
| | Pickups/Light Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 | 332.8 | 33.0 | 35.4 | 0.5 | 4.6 | 3.0 | 55,569.6 | 3.2 |
| | Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 | 426.6 | 1,218.7 | 101.6 | 2.1 | 59.7 | 50.7 | 212,324.8 | 4.7 |
| Vehicle Trips/Day | Heavy Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 | 647.3 | 718.3 | 95.6 | 1.4 | 27.7 | 22.9 | 141,042.1 | 4.4 |
| 80 | **Total** | **80** | - | - | - | - | - | **1739.54** | **2,003.0** | **268.0** | **4.5** | **96.6** | **79.6** | **464,506.2** | **15.5** |
| | | | | | | | **TOTAL TPY[2]** | **0.8698** | **1.001** | **0.134** | **0.002** | **0.048** | **0.040** | **210.756** | **0.007** |

Notes:

1. Annual Emissions (lb/yr) = Emission Factor x Annual Travel/(453.6 g/lb)

2. Total TPY = Annual Emissions/(2000 lb/t). CO2 and CH4 are expressed as metric tones per year = Annual Emisisons/(2204 lb/MT)

**Table 21-b Road Fugitive Emissions**

| | | | Daily Travel - Per Vehicle | | | | |
|---|---|---|---|---|---|---|---|
| **Group** | **Vehicle Type** | **Daily Vehicles (/day)** | **At Plant (VMT)** | **Off-Plant (VMT)** | **Total (VMT)** | **Travel Days (days/yr)** | **Annual Travel (VMT/yr)** |
| | Cars | 20 | 4 | 10 | 14 | 180 | 50,400 |
| | Pickups/Light Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| | Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| Vehicle Trips/Day | Heavy Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| 80 | **Total** | **80.0** | - | - | - | - | - |

**Table 22: Fugitive Emissions From Drilling Secondary Wells (Year 4)**

| Activity | No. of Wells | Emission Factor[1] PM-10 (lb/hole) | Total Emissions[2] PM-10 (Tons/Project) |
|---|---|---|---|
| Drilling Wells | 40 | 1.3 | **0.0260** |

Notes:

1. Emission Factor from AP-42, Table 11.9-4 (5th Edition).
2. Total Emissions = No. of wells x Emission Factor/(2000 lb/Ton).

**Table 23: Emissions from Drilling Rig Engines for Secondary Wells (Year 4)**

| | | | |
|---|---|---|---|
| Average Power Rating (hp) | 500 | 40 | Number of Wells |
| Fuel Type | Diesel | 12 | Operating Hours per day/drill rig |
| Total Operating Hours (hr/yr)[1] | 9,600 | 20 | Drilling days per well |
| Load Factor | 0.75 | | |

| | POLLUTANTS | | | | | GHG |
|---|---|---|---|---|---|---|
| | PM-10 | NOX | SO2 | CO | VOC | CO2 |
| Emission Factor (lb/hp-hr)[2,3] | 0.00035 | 0.013 | 0.00205 | 0.01800 | 0.0022 | 1.15000 |
| **Total Emissions (Tons/Project)[4]** | **0.63** | **23.4** | **3.69** | **32.4** | **3.96** | **2070.0** |

Notes:

1. Total operating hours of all drill rigs.
2. Emission Factors from "Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines," EPA420-F-97-014, Sept 1997, Nonroad CI Engines.
3. Emission Factor for SO2 from AP-42, Table 3.3-1 (5th Edition).
4. Total emissions = Average Power Rating x Total Operating Hours x Load Factor x Emission Factor/(2000 lb/ton).

**Construction Emissions: Vehicle Engine Exhaust From Grading and Material Hauling Activities (Year 4)**

**Input Parameters/Assumptions:**

| | | |
|---|---|---|
| Total Building Area: | 1,306,800 | $ft^2$ |
| Total Paved Area: | 156,816 | $ft^2$ |
| Total Disturbed Area: | 341.90 | acres |
| Construction Duration: | 0.60 | years |
| Annual Construction Activity: | 250 | days/yr |
| Total Demolition: | 0 | $ft^2$ |

**Area for Year 4: Wellfied (50 MW): 272 acres; Power Plant: 69.9 acres**

**Table 24 Summary of Input Parameters**

| | ROG[1] | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Total new acres disturbed: | 341.9 | 341.9 | 341.9 | 341.9 | 341.9 |
| Total new building space, $ft^2$: | 1306800.0 | 1306800.0 | 1306800.0 | 1306800.0 | 1306800.0 |
| Total years: | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Area graded, acres: | 341.9 | 341.9 | 341.9 | 341.9 | 341.9 |

**Emission Factors For Vehicle Engine Exhaust From Construction Activities**

| Activity | SMAQMD Emission Factor | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ROG[1] | | $NO_x$ | | $SO_2$ [2] | | CO [2] | | $PM_{10}$ | |
| Grading Equipment[3] | 2.91E-01 | lbs/acre/day | 2.75E+00 | lbs/acre/day | 0.18 | lbs/acre/day | 0.60 | lbs/acre/day | 2.32E-01 | lbs/acre/day |
| Material Hauling[4] | 4.20E-01 | lbs/acre/day | 6.07E+00 | lbs/acre/day | 0.40 | lbs/acre/day | 1.31 | lbs/acre/day | 4.30E-01 | lbs/acre/day |

Reference: *Air Quality Thresholds of Significance* , Sacramento Metropolitan Air Quality Management District (SMAQMD), 1994 and *Compilation of Air Pollutant Emission Factors* (USEPA AP-42).

1 ROG = VOC.

2 Factors for grading equipment are calculated from AP-42 for diesel engines using ratios with the NOx factors.

3 Grading Activities assumes the use of one tracked loader, one wheeled loader, and one motor grader for each 10 acres of disturbed area, used 8 hours per day.

4 Material Hauling Activities assumes the use of one loader and one haul truck for each 10 acres of disturbed area, used 8 hours per day.

**Table 25 Total Daily Vehicle Engine Exhaust Emissions From Construction Actitivies[1]**

| | ROG | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment | 99.6 | 941.7 | 62.6 | 203.8 | 79.3 |
| Material Hauling | 143.6 | 2075.3 | 138.0 | 449.2 | 147.0 |
| **Total Emissions (lbs/day):** | **243.2** | **3017.1** | **200.6** | **653.0** | **226.3** |

1 Total Emissions (lbs/day) = Emission Factor * Affected Acres

**Table 26 Total Vehicle Engine Exhaust Emissions from Construction Activities[1]**

| | ROG | $NO_x$ | $SO_2$ | CO | $PM_{10}$ |
|---|---|---|---|---|---|
| Grading Equipment | 7.47 | 70.63 | 4.70 | 15.29 | 5.95 |
| Material Hauling | 10.77 | 155.65 | 10.35 | 33.69 | 11.03 |
| Fugitive Emissions (from page 2) | | | | | 96.43 |
| **Total Emissions(tons/yr)** | **18.24** | **226.28** | **15.05** | **48.97** | **113.41** |

1 Total emissions (TPY) = Total emissions (lbs/day) * days of construction / 2000 lbs per ton

**Construction Emissions: Fugitive Emissions From Construction Activities (Year 4)**

| Input Parameters / Assumptions | | |
|---|---|---|
| Acres affected: | 341.9 | acres/yr |
| Grading days/yr: | 21 | days/yr |
| Exposed days/yr: | 21 | days/yr graded area is exposed |
| Grading Hours/day: | 8 | hr/day |
| Soil percent silt, s: | 15 | % |
| Soil percent moisture, M: | 2 | % |
| Fraction of TSP, J: | 0.5 | (SCAQMD recommendation) |
| Mean vehicle speed, S: | 5 | mi/hr (On-site) |
| Dozer path width: | 5 | ft |
| Qty construction vehicles: | 3 | vehicles |
| On-site VMT/vehicle/day: | 5 | mi/veh/day (Excluding bulldozer VMT during grading) |

Reference: *CEQA Air Quality Handbook*, SCAQMD, April 1993.

**Equation Used To Calculate Operation Parameters**

| Operation Parameter | Emission Factor | Units | Equation |
|---|---|---|---|
| Grading duration per acre | 0.5 | hr/acre | Grading days * hours per day / acres affected |
| Bulldozer mileage per acre | 1.7 | VMT/acre | Miles traveled by bulldozer, based on dozer path width |
| Construction VMT per day | 15 | VMT/day | Number of vehicle * VMT per vehicle per day |
| Construction VMT per acre | 0.9 | VMT/acre | Construction VMT * days of construction / acres affected |
| | | | (Travel on unpaved surfaces within site) |

**Equations Used To Calculate Mass/Unit Emission Factors (Corrected for $PM_{10}$)**

| Operation | Empirical Equation | Units | AP-42 Section (4th Edition) |
|---|---|---|---|
| Bulldozing | 0.75(s^1.5)/(M^1.4) | lbs/hr | 8.24, Overburden |
| Grading | (0.60)(0.051)S^2.0 | lbs/VMT | 8.24, Overburden |
| Vehicle Traffic | (3.72/(M^4.3))*.6 | lbs/VMT | 8.24, Overburden |

Reference: *Compilation of Air Pollutant Emission Factors,* USEPA AP-42:
Section 8.24, Western Surface Coal Mining (4th Edition)

**Emission Factors For Fugitive Emissions From Construction Activities[1]**

| Operation | Emission Factor (mass/ unit) | | Operation Parameter | | Emission Factor (lbs/acre) |
|---|---|---|---|---|---|
| Bulldozing | 16.51 | lbs/hr | 0.5 | hr/acre | 8.3 lbs/acre |
| Grading | 0.77 | lbs/VMT | 1.7 | VMT/acre | 1.3 lbs/acre |
| Vehicle Traffic | 0.11 | lbs/VMT | 0.90 | VMT/acre | 0.1 lbs/acre |

1 Emission Factor (lbs/acre) = Emission Factor (lbs per hour or VMT) * Operation Parameter (hours of VMT per acre)

**Table 27 Calculation of Annual Fugitive Emissions from Construction Activities**

| Source | Emission Factor | | Graded Acres/yr | Exposed days/yr | Emissions lbs/yr | Emissions tons/yr |
|---|---|---|---|---|---|---|
| Bulldozing[1] | 8.3 | lbs/acre | 341.90 | NA | 2,838 | 1.42 |
| Grading[1] | 1.3 | lbs/acre | 341.90 | NA | 444 | 0.22 |
| Vehicle Traffic[1] | 0.1 | lbs/acre | 341.90 | NA | 34 | 0.02 |
| Erosion of Graded Surface[2] | 26.4 | lbs/acre/day[3] | 341.90 | 21 | 189,549 | 94.77 |
| **TOTAL** | | | | | **192,866** | **96.43** |

1 Total annual emissions (TPY) = Emission Factor (lbs/acre) * affected acres * 2000 lbs per ton
2 Total annual emissions (TPY) from erosion = Emission Factor (lbs/acre) * days of construction * 2000 lbs per ton
3. Reference: CEQA Air Quality Handbook, SCAQMD, April 1993.

**Projected Annual Emissions During Construction from On-Road Vehicles (Year 4)**

**On-Road Emission Factors**

| Scenario Year | Vehicle Type | EPA Category | Emission Factor (pounds/mile) CO | NOx | ROG | SOx | PM10 | PM2.5 | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | Cars | LDGV | 0.006141 | 0.000602 | 0.000664 | 0.000011 | 0.000093 | 0.000060 | 1.101928 | 0.000059 |
| | Pickups | LDGT1 | 0.006141 | 0.000602 | 0.000664 | 0.000011 | 0.000093 | 0.000060 | 1.101928 | 0.000059 |
| | Heavy Trucks | HDDV | 0.007669 | 0.021227 | 0.001786 | 0.000041 | 0.001047 | 0.000880 | 4.209022 | 0.000084 |
| | Trucks (3 axles) | LDDT | 0.011694 | 0.012850 | 0.001739 | 0.000027 | 0.000503 | 0.000413 | 2.812477 | 0.000081 |

Note:

Emission factors from Calculation Methods for Criteria Air Pollutant Emission Inventories (Armstrong Laboratory,1994).

Key:

LDGV = Light-duty gasoline-fueled vehicles designated for transport of up to 12 people.

LDGT1 = Light-duty gasoline-fueled trucks with a gross vehicle weight (GVW) rating of 6,000 pounds or less.

LDDT = Light-duty diesel-powered trucks with a GVW of 8,500 pounds or less.

HDDV = Heavy-duty diesel-powered vehicles with a GVW exceeding 8,500 pounds.

**Table 28-a Projected Criteria Air Pollutant Emissions From On-Road Vehicles**

| Group | Vehicle Type | Daily Vehicles (/day) | Daily Travel - Per Vehicle At Plant (VMT) | Off-Plant (VMT) | Total (VMT) | Travel Days (days/yr) | Annual Travel (VMT/yr) | Annual Emissions (lb/yr)[1] CO | NOx | ROG | SOx | PM10 | PM2.5 | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | 20 | 4 | 10 | 14 | 180 | 50,400 | 309.5 | 30.3 | 33.4 | 0.5 | 4.7 | 3.0 | 55,537.2 | 3.0 |
| | Pickups/Light Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 | 309.5 | 30.3 | 33.4 | 0.5 | 4.7 | 3.0 | 55,537.2 | 3.0 |
| | Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 | 386.5 | 1,069.8 | 90.0 | 2.1 | 52.8 | 44.3 | 212,134.7 | 4.2 |
| Vehicle Trips/Day | Heavy Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 | 589.4 | 647.7 | 87.6 | 1.4 | 25.4 | 20.8 | 141,748.8 | 4.1 |
| 80 | **Total** | **80.0** | - | - | - | - | - | **1594.93** | **1,778.2** | **244.5** | **4.5** | **87.5** | **71.2** | **464,957.9** | **14.3** |
| | | | | | | | **TOTAL TPY[2]** | **0.7975** | **0.889** | **0.122** | **0.002** | **0.044** | **0.036** | **210.961** | **0.006** |

Notes:

1. Annual Emissions (lb/yr) = Emission Factor x Annual Travel/(453.6 g/lb)
2. Total TPY = Annual Emissions/(2000 lb/t). CO2 and CH4 are expressed as metric tones per year = Annual Emisisons/(2204 lb/MT)

**Table 28-b Road Fugitive Emissions**

| Group | Vehicle Type | Daily Vehicles trips (/day) | Daily Travel - Per Vehicle At Plant (VMT) | Off-Plant (VMT) | Total (VMT) | Travel Days (days/yr) | Annual Travel (VMT/yr) |
|---|---|---|---|---|---|---|---|
| | Cars | 20 | 4 | 10 | 14 | 180 | 50,400 |
| | Pickups/Light Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| | Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| Vehicle Trips/Day | Heavy Trucks | 20 | 4 | 10 | 14 | 180 | 50,400 |
| 80 | **Total** | **80.0** | - | - | - | - | - |

**Projected Annual Emissions from On-Road Vehicles During Operations**

**On-Road Emission Factors**

| Scenario Year | Vehicle Type | EPA Category | Emission Factor (pounds/mile) CO | NOx | ROG | SOx | PM10 | PM2.5 | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | Cars | LDGV | 0.006141 | 0.000602 | 0.000664 | 0.000011 | 0.000093 | 0.000060 | 1.101928 | 0.000059 |
| | Pickups | LDGT1 | 0.006141 | 0.000602 | 0.000664 | 0.000011 | 0.000093 | 0.000060 | 1.101928 | 0.000059 |
| | Heavy Trucks | HDDV | 0.007669 | 0.021227 | 0.001786 | 0.000041 | 0.001047 | 0.000880 | 4.209022 | 0.000084 |
| | Trucks (3 axles) | LDDT | 0.011694 | 0.012850 | 0.001739 | 0.000027 | 0.000503 | 0.000413 | 2.812477 | 0.000081 |

Note:

Emission factors from Calculation Methods for Criteria Air Pollutant Emission Inventories (Armstrong Laboratory,1994).

Key:

LDGV = Light-duty gasoline-fueled vehicles designated for transport of up to 12 people.

LDGT1 = Light-duty gasoline-fueled trucks with a gross vehicle weight (GVW) rating of 6,000 pounds or less.

LDDT = Light-duty diesel-powered trucks with a GVW of 8,500 pounds or less.

HDDV = Heavy-duty diesel-powered vehicles with a GVW exceeding 8,500 pounds.

**Table 29-a Projected Criteria Air Pollutant Emissions From On-Road Vehicles**

| Group | Vehicle Type | Daily Vehicles (/day) | Daily Travel - Per Vehicle At Plant (VMT) | Off-Plant (VMT) | Total (VMT) | Travel Days (days/yr) | Annual Travel (VMT/yr) | Annual Emissions (lb/yr)[1] CO | NOx | ROG | SOx | PM10 | PM2.5 | CO2 | CH4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cars | 59.5 | 4.0 | 10.0 | 14.0 | 60.0 | 49,980.0 | 306.9 | 30.1 | 33.2 | 0.5 | 4.6 | 3.0 | 55,074.4 | 3.0 |
| | Pickups/Light Trucks | 25.5 | 4.0 | 10.0 | 14.0 | 60.0 | 21,420.0 | 131.5 | 12.9 | 14.2 | 0.2 | 2.0 | 1.3 | 23,603.3 | 1.3 |
| | Trucks | 0.0 | 4.0 | 10.0 | 14.0 | 60.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vehicle Trips/Day | Heavy Trucks | 0.0 | 4.0 | 10.0 | 14.0 | 60.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 85 | **Total** | **85.0** | - | - | - | - | - | **438.47** | **43.0** | **47.4** | **0.8** | **6.6** | **4.3** | **78,677.7** | **4.2** |
| | | | | | | | **TOTAL TPY[2]** | **0.2192** | **0.021** | **0.024** | **0.000** | **0.003** | **0.002** | **35.698** | **0.002** |

Notes:

1. Annual Emissions (lb/yr) = Emission Factor x Annual Travel/(453.6 g/lb)
2. Total TPY = Annual Emissions/(2000 lb/t).

**Table 29-b Road Fugitive Emissions**

| Group | Vehicle Type | Daily Vehicles trips (/day) | Daily Travel - Per Vehicle At Plant (VMT) | Off-Plant (VMT) | Total (VMT) | Travel Days (days/yr) | Annual Travel (VMT/yr) |
|---|---|---|---|---|---|---|---|
| | Cars | 60.0 | 4.0 | 10.0 | 14.0 | 60.0 | 50,400.0 |
| | Pickups/Light Trucks | 25.0 | 4.0 | 10.0 | 14.0 | 60.0 | 21,000.0 |
| | Trucks | 0.0 | 4.0 | 10.0 | 14.0 | 60.0 | 0.0 |
| Vehicle Trips/Day | Heavy Trucks | 0.0 | 4.0 | 10.0 | 14.0 | 60.0 | 0.0 |
| 85 | **Total** | **85.0** | - | - | - | - | - |

**Table 1**

**Summary of Daily Emissions**

**45-MW Wind Energy Project**

| Activity | Emission Source | Daily Emissions (lb/day) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | NOx | SO2 | PM10 (Exh) | PM2.5 (Exh) | PM10 (Dust) | PM2.5 (Dust) | CO2 |
| Site Preparation | Exhaust Emissions - Nonroad Equipment | 6.7 | 22 | 53 | 0.05 | 2.4 | 2.4 | - | - | 4,820 |
| | Exhaust Emissions - Onroad Vehicles | 1.8 | 17 | 2 | 0.04 | 0.03 | 0.03 | - | - | 721 |
| | Fugitive Dust Emissions - Roads | - | - | - | - | - | - | 13 | 1.3 | - |
| | **Subtotal** | **8.5** | **39** | **55** | **0.09** | **2.4** | **2.4** | **13** | **1.3** | **5,541** |
| Foundation Construction / Electrical | Exhaust Emissions - Nonroad Equipment | 3.3 | 15 | 27 | 0.027 | 1.4 | 1.4 | - | - | 2,530 |
| | Exhaust Emissions - Onroad Vehicles | 9.9 | 93 | 8.9 | 0.117 | 0.075 | 0.072 | - | - | 3,206 |
| | Fugitive Dust Emissions - Roads | - | - | - | - | - | - | 56 | 5.7 | - |
| | **Subtotal** | **13** | **108** | **36** | **0.144** | **1.5** | **1.5** | **56** | **5.7** | **5,737** |
| Turbine Installation and Delivery | Exhaust Emissions - Nonroad Equipment | 11 | 36 | 96 | 0.094 | 4.2 | 4.2 | - | - | 8,781 |
| | Exhaust Emissions - Onroad Vehicles | 7.5 | 71 | 7.7 | 0.108 | 0.077 | 0.075 | - | - | 2,607 |
| | Fugitive Dust Emissions - Roads | - | - | - | - | - | - | 46 | 4.6 | - |
| | **Subtotal** | **18** | **107** | **104** | **0.20** | **4.3** | **4.3** | **46** | **4.6** | **11,388** |
| Electrical Trenching | Exhaust Emissions - Nonroad Equipment | 2.6 | 9.7 | 22 | 0.023 | 1.1 | 1.1 | - | - | 2,031 |
| | Exhaust Emissions - Onroad Vehicles | 3.0 | 28 | 3.29 | 0.0474 | 0.0356 | 0.0348 | - | - | 1,071 |
| | Fugitive Dust Emissions - Roads | - | - | - | - | - | - | 19 | 1.9 | - |
| | **Subtotal** | **5.6** | **38** | **26** | **0.070** | **1.2** | **1.2** | **19** | **1.9** | **3,101** |
| All Activities | Fugitive Dust Emissions - Earth Moving Activities | **-** | **-** | **-** | **-** | **-** | **-** | **75** | **11** | **-** |
| **TOTAL** | | **45** | **292** | **221** | **0.51** | **9.3** | **9.3** | **208** | **24** | **25,767** |

**Table 2**
**Summary of Total Emissions**
**45-MW Wind Energy Project**

| Activity | Emission Source | Emissions (tons) | | | | | | | | | GHG Emissions (metric tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ (Exh) | $PM_{2.5}$ (Exh) | $PM_{10}$ (Dust) | $PM_{2.5}$ (Dust) | $CO_2$ | $CO_2$ |
| Site Preparation | Exhaust Emissions - Nonroad Equipment | 0.055 | 0.18 | 0.42 | 0.00042 | 0.020 | 0.020 | - | - | 39 | 35 |
| | Exhaust Emissions - Onroad Vehicles | 0.016 | 0.15 | 0.02 | 0.0003 | 0.0003 | 0.0003 | - | - | 6 | 6 |
| | Fugitive Dust Emissions - Roads | - | - | - | - | - | - | 0.1 | 0.01 | - | - |
| | **Subtotal** | **0.071** | **0.33** | **0.45** | **0.0008** | **0.02** | **0.02** | **0.11** | **0.01** | **45** | **41** |
| Foundation Construction / Electrical | Exhaust Emissions - Nonroad Equipment | 0.11 | 0.50 | 0.90 | 0.00091 | 0.046 | 0.046 | - | - | 85 | 77 |
| | Exhaust Emissions - Onroad Vehicles | 0.47 | 4.5 | 0.43 | 0.0056 | 0.00358 | 0.00346 | - | - | 154 | 140 |
| | Fugitive Dust Emissions - Roads | - | - | - | - | - | - | 2.7 | 0.3 | - | - |
| | **Subtotal** | **0.58** | **5.0** | **1.3** | **0.0065** | **0.05** | **0.05** | **2.7** | **0.27** | **238** | **216** |
| Turbine Installation and Delivery | Exhaust Emissions - Nonroad Equipment | 0.14 | 0.48 | 1.3 | 0.0012 | 0.054 | 0.054 | - | - | 118 | 107 |
| | Exhaust Emissions - Onroad Vehicles | 0.23 | 2.1 | 0.23 | 0.0032 | 0.00232 | 0.00226 | - | - | 78 | 71 |
| | Fugitive Dust Emissions - Roads | - | - | - | - | - | - | 1.4 | 0.1 | - | - |
| | **Subtotal** | **0.36** | **2.6** | **1.5** | **0.0045** | **0.06** | **0.06** | **1.4** | **0.14** | **197** | **178** |
| Electrical Trenching | Exhaust Emissions - Nonroad Equipment | 0.093 | 0.34 | 0.78 | 0.00080 | 0.039 | 0.039 | - | - | 71 | 64 |
| | Exhaust Emissions - Onroad Vehicles | 0.112 | 1.1 | 0.123 | 0.00178 | 0.00133 | 0.00130 | - | - | 40 | 36 |
| | Fugitive Dust Emissions - Roads | - | - | - | - | - | - | 0.7 | 0.1 | - | - |
| | **Subtotal** | **0.20** | **1.4** | **0.90** | **0.0026** | **0.04** | **0.04** | **0.70** | **0.07** | **111** | **101** |
| All Activities | Fugitive Dust Emissions - Earth Moving Activities | **-** | **-** | **-** | **-** | **-** | **-** | **1** | **0.2** | **-** | **-** |
| **TOTAL** | | **1.2** | **9.3** | **4.2** | **0.0143** | **0.17** | **0.17** | **6** | **0.7** | **592** | **537** |

**Table 3**
**Nonroad Equipment Exhaust Emission Factors**
**45-MW Wind Energy Project**

| Equipment Type | Fuel Type | Engine Size Range | Emission Factor[a] (g/hp-hr) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $CO_2$ |
| Rubber Tire Dozers | Diesel | 0<hp≤175 | 0.622 | 2.251 | 4.635 | 0.004 | 0.269 | 335.598 |
| | Diesel | 250<hp≤500 | 0.458 | 2.198 | 4.059 | 0.003 | 0.173 | 335.598 |
| Graders | Diesel | 120<hp≤175 | 0.489 | 2.075 | 3.794 | 0.004 | 0.220 | 346.974 |
| | Diesel | 250<hp≤500 | 0.325 | 1.135 | 3.205 | 0.003 | 0.122 | 346.974 |
| Scrapers | Diesel | 175<hp≤250 | 0.511 | 1.438 | 4.854 | 0.005 | 0.196 | 409.544 |
| | Diesel | 250<hp≤500 | 0.464 | 1.928 | 4.361 | 0.004 | 0.176 | 409.544 |
| Excavators | Diesel | 175<hp≤250 | 0.297 | 0.803 | 3.056 | 0.004 | 0.106 | 324.222 |
| Cranes | Diesel | 120<hp≤175 | 0.369 | 1.486 | 2.834 | 0.003 | 0.164 | 244.589 |
| | Diesel | 175<hp≤250 | 0.271 | 0.754 | 2.700 | 0.003 | 0.102 | 244.589 |
| | Diesel | 250<hp≤500 | 0.247 | 0.898 | 2.406 | 0.002 | 0.093 | 244.589 |
| Off-Highway Trucks | Diesel | 250<hp≤500 | 0.297 | 0.897 | 2.762 | 0.003 | 0.104 | 324.222 |
| Rough Terrain Forklifts | Diesel | 50<hp≤120 | 0.664 | 2.431 | 4.007 | 0.004 | 0.370 | 341.286 |
| | Diesel | 120<hp≤175 | 0.449 | 1.996 | 3.523 | 0.004 | 0.205 | 341.286 |
| Tractors/Loaders/Backhoes | Diesel | 120<hp≤175 | 0.377 | 1.815 | 2.982 | 0.004 | 0.174 | 312.846 |
| | Diesel | 175<hp≤250 | 0.259 | 0.735 | 2.827 | 0.004 | 0.095 | 312.846 |
| Rollers | Diesel | 120<hp≤175 | 0.436 | 1.847 | 3.544 | 0.004 | 0.194 | 318.534 |

Notes:

a. Emission factors from Sacramento Metro AQMD Roadway Construction Model for Year 2010.

**Table 4**
**Nonroad Equipment Exhaust Emissions**
**45-MW Wind Energy Project**

| Phase | Equipment Type | No of Units | Equipment Engine Size (hp) | Fuel Type | Daily Operation of All Units (hrs/day) | Load Factor[a] | Total Working Days per Unit (days) | Daily Emissions (lb/day) | | | | | | | Emissions (tons) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ |
| Site Preparation | 16H Motor Grader | 1 | 275 | Diesel | 9 | 0.61 | 18 | 2.1 | 6.0 | 9.9 | 0.012 | 0.6 | 0.6 | 1,041 | 0.018 | 0.054 | 0.089 | 0.0001 | 0.005 | 0.005 | 9.4 |
| | 613 Scraper | 1 | 181 | Diesel | 18 | 0.59 | 18 | 2.2 | 6.1 | 20.6 | 0.020 | 0.8 | 0.8 | 1,736 | 0.020 | 0.055 | 0.185 | 0.0002 | 0.007 | 0.007 | 15.6 |
| | 623 Scraper | 1 | 330 | Diesel | 9 | 0.56 | 12 | 1.7 | 7.1 | 16.0 | 0.015 | 0.6 | 0.6 | 1,502 | 0.010 | 0.042 | 0.096 | 0.0001 | 0.004 | 0.004 | 9.0 |
| | CP563C Roller | 1 | 153 | Diesel | 9 | 0.56 | 18 | 0.7 | 3.1 | 6.0 | 0.006 | 0.3 | 0.3 | 542 | 0.007 | 0.028 | 0.054 | 0.0001 | 0.003 | 0.003 | 4.9 |
| | **Subtotal** | | | | | | | **6.67** | **22.3** | **52.5** | **0.052** | **2.39** | **2.39** | **4,820** | **0.05** | **0.2** | **0.4** | **0.0004** | **0.02** | **0.02** | **39** |
| Foundation Construction / Electrical | 65 Ton Rough Terrain Crane | 1 | 152 | Diesel | 5 | 0.43 | 20 | 0.3 | 1.1 | 2.0 | 0.002 | 0.1 | 0.1 | 176 | 0.003 | 0.011 | 0.020 | 0.00002 | 0.001 | 0.001 | 1.8 |
| | 330L Excavator | 2 | 222 | Diesel | 16 | 0.07 | 60 | 0.2 | 0.4 | 1.7 | 0.002 | 0.1 | 0.1 | 178 | 0.005 | 0.013 | 0.050 | 0.0001 | 0.002 | 0.002 | 5.3 |
| | 966C Loader | 1 | 140 | Diesel | 8 | 0.68 | 80 | 0.6 | 3.0 | 5.0 | 0.006 | 0.3 | 0.3 | 525 | 0.025 | 0.122 | 0.200 | 0.0002 | 0.012 | 0.012 | 21.0 |
| | D6H Dozer | 1 | 275 | Diesel | 8 | 0.59 | 60 | 1.3 | 6.3 | 11.6 | 0.009 | 0.5 | 0.5 | 960 | 0.039 | 0.189 | 0.348 | 0.0003 | 0.015 | 0.015 | 28.8 |
| | CAT Forklists | 2 | 153 | Diesel | 20 | 0.3 | 80 | 0.9 | 4.0 | 7.1 | 0.008 | 0.4 | 0.4 | 691 | 0.036 | 0.162 | 0.285 | 0.0003 | 0.017 | 0.017 | 27.6 |
| | **Subtotal** | | | | | | | **3.28** | **14.9** | **27.5** | **0.027** | **1.38** | **1.38** | **2,530** | **0.11** | **0.5** | **0.9** | **0.0009** | **0.05** | **0.05** | **85** |
| Turbine Installation and Delivery | 75 Ton Rough Terrain Crane | 2 | 250 | Diesel | 18 | 0.43 | 14 | 1.2 | 3.2 | 11.5 | 0.012 | 0.4 | 0.4 | 1,043 | 0.008 | 0.023 | 0.081 | 0.0001 | 0.003 | 0.003 | 7.3 |
| | 90 Ton Rough Terrain Crane | 5 | 250 | Diesel | 40 | 0.43 | 14 | 2.6 | 7.1 | 25.6 | 0.026 | 1.0 | 1.0 | 2,319 | 0.018 | 0.050 | 0.179 | 0.0002 | 0.007 | 0.007 | 16.2 |
| | Manitowoc 777 Crane | 2 | 330 | Diesel | 11 | 0.43 | 55 | 0.9 | 3.1 | 8.3 | 0.008 | 0.3 | 0.3 | 842 | 0.023 | 0.085 | 0.228 | 0.0002 | 0.009 | 0.009 | 23.1 |
| | Manitowoc 2250 Crane | 2 | 450 | Diesel | 12 | 0.43 | 55 | 1.3 | 4.6 | 12.3 | 0.012 | 0.5 | 0.5 | 1,252 | 0.035 | 0.126 | 0.339 | 0.0003 | 0.013 | 0.013 | 34.4 |
| | CAT Forklists | 3 | 60 | Diesel | 60 | 0.03 | 40 | 0.2 | 0.6 | 1.0 | 0.001 | 0.1 | 0.1 | 81 | 0.003 | 0.012 | 0.019 | 0.00002 | 0.002 | 0.002 | 1.6 |
| | 14G Motor Grader | 2 | 165 | Diesel | 10 | 0.61 | 20 | 1.1 | 4.6 | 8.4 | 0.009 | 0.5 | 0.5 | 770 | 0.011 | 0.046 | 0.084 | 0.0001 | 0.005 | 0.005 | 7.7 |
| | D6H Dozer | 2 | 140 | Diesel | 20 | 0.59 | 20 | 2.3 | 8.2 | 16.9 | 0.014 | 1.0 | 1.0 | 1,222 | 0.023 | 0.082 | 0.169 | 0.0001 | 0.010 | 0.010 | 12.2 |
| | LR 1400 Crane | 2 | 450 | Diesel | 12 | 0.43 | 25 | 1.3 | 4.6 | 12.3 | 0.012 | 0.5 | 0.5 | 1,252 | 0.016 | 0.057 | 0.154 | 0.0002 | 0.006 | 0.006 | 15.7 |
| | **Subtotal** | | | | | | | **10.61** | **36.0** | **96.3** | **0.094** | **4.23** | **4.23** | **8,781** | **0.14** | **0.5** | **1.3** | **0.0012** | **0.05** | **0.05** | **118** |
| Electrical Trenching | 14G Motor Grader | 2 | 165 | Diesel | 9 | 0.61 | 70 | 1.0 | 4.1 | 7.6 | 0.008 | 0.4 | 0.4 | 693 | 0.034 | 0.145 | 0.265 | 0.0003 | 0.015 | 0.015 | 24.3 |
| | D6H LGP Dozer | 1 | 140 | Diesel | 9 | 0.59 | 70 | 1.0 | 3.7 | 7.6 | 0.006 | 0.4 | 0.4 | 550 | 0.036 | 0.129 | 0.266 | 0.0002 | 0.015 | 0.015 | 19.3 |
| | 966C Loader | 1 | 210 | Diesel | 8 | 0.68 | 70 | 0.7 | 1.9 | 7.1 | 0.009 | 0.2 | 0.2 | 788 | 0.023 | 0.065 | 0.249 | 0.0003 | 0.008 | 0.008 | 27.6 |
| | **Subtotal** | | | | | | | **2.65** | **9.7** | **22.3** | **0.023** | **1.12** | **1.12** | **2,031** | **0.09** | **0.3** | **0.8** | **0.001** | **0.04** | **0.04** | **71** |
| **TOTAL** | | | | | | | | **23.21** | **82.94** | **199** | **0.20** | **9.12** | **9.12** | **18,162** | **0.4** | **1.5** | **3.4** | **0.003** | **0.2** | **0.2** | **312.81** |

**Table 5**
**Onroad Vehicle Activity**
**45-MW Wind Energy Project**

| Activity | Vehicle | No. of Units[a] | Round Trips per Day | Travel Distance per Roundtrip | | Total Working Days per Unit | VMT per Day | | | Total VMT for Construction Period | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Paved Roads | Unpaved Roads | | Paved Roads | Unpaved Roads | Total | Paved Roads | Unpaved Roads | Total |
| Site Preparation | Trucks | 2 | 2 | 14 | 2 | 18 | 56 | 8 | 64 | 1,008 | 144 | 1,152 |
| | **Diesel Vehicle - Subtotal** | | | | | | **56** | **8** | **64** | **1,008** | **144** | **1,152** |
| | Worker Vehicles | 9 | 1 | 58 | 2 | 18 | 522 | 18 | 540 | 9,396 | 324 | 9,720 |
| | **Gasoline Vehicle - Subtotal** | | | | | | **522** | **18** | **540** | **9,396** | **324** | **9,720** |
| | **Total** | | | | | | **578** | **26** | **604** | **10,404** | **468** | **10,872** |
| Foundation Construction / Electrical | Trucks | 3 | 2 | 14 | 2 | 96 | 84 | 12 | 96 | 8,064 | 1,152 | 9,216 |
| | **Diesel Vehicle - Subtotal** | | | | | | **84** | **12** | **96** | **8,064** | **1,152** | **9,216** |
| | Worker Vehicles | 50 | 1 | 58 | 2 | 96 | 2,900 | 100 | 3,000 | 278,400 | 9,600 | 288,000 |
| | **Gasoline Vehicle - Subtotal** | | | | | | **2,900** | **100** | **3,000** | **278,400** | **9,600** | **288,000** |
| | **Total** | | | | | | **2,984** | **112** | **3,096** | **286,464** | **10,752** | **297,216** |
| Turbine Installation and Delivery | Trucks | 4 | 2 | 14 | 2 | 60 | 112 | 16 | 128 | 6,720 | 960 | 7,680 |
| | **Diesel Vehicle - Subtotal** | | | | | | **112** | **16** | **128** | **6,720** | **960** | **7,680** |
| | Worker Vehicles | 38 | 1 | 58 | 2 | 60 | 2,204 | 76 | 2,280 | 132,240 | 4,560 | 136,800 |
| | **Gasoline Vehicle - Subtotal** | | | | | | **2,204** | **76** | **2,280** | **132,240** | **4,560** | **136,800** |
| | **Total** | | | | | | **2,316** | **92** | **2,408** | **138,960** | **5,520** | **144,480** |
| Electrical Trenching | Trucks | 2 | 2 | 14 | 2 | 75 | 56 | 8 | 64 | 4,200 | 600 | 4,800 |
| | **Diesel Vehicle - Subtotal** | | | | | | **56** | **8** | **64** | **4,200** | **600** | **4,800** |
| | Worker Vehicles | 15 | 1 | 58 | 2 | 75 | 870 | 30 | 900 | 65,250 | 2,250 | 67,500 |
| | **Gasoline Vehicle - Subtotal** | | | | | | **870** | **30** | **900** | **65,250** | **2,250** | **67,500** |
| | **Total** | | | | | | **926** | **38** | **964** | **69,450** | **2,850** | **72,300** |

Notes:
a. It was assumed that the number of worker vehicles was based on a 50% carpool/vanpool rate for workers.

**Table 6**
**Onroad Vehicle Exhaust Emission Factors**
**45-MW Wind Energy Project**

| Equipment Type | Fuel Type | Emission Factor[a] (g/VMT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $NO_x$ | ROG | CO | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ |
| Gasoline Vehicles | Gasoline | 1.09 | 1.49 | 14.05 | 0.0127 | 0.0059 | 0.0055 | 440 |
| Diesel Vehicles | Diesel | 8.06 | 0.28 | 1.10 | 0.158 | 0.17 | 0.17 | 1,400 |

Notes:

a. Emission factors for gasoline worker vehicles from "Emission Facts: Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks (EPA420-F-05-22, EPA 2005). It was assumed that the vehicle make-up included 50% cars and 50% light-duty trucks/SUVs. SO2 emission factor calculated from gasoline consumption rate and a sulfur content of 80 ppm.

b. Emission factors for diesel worker and delivery vehicles (except SO2 and CO2) from "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level- Final Report" (U.S. Federal Highway Administration 2005).

c. $CO_2$ and $SO_2$ emission factors for diesel worker and delivery vehicles from "Greenhouse Gas Protocol - Corporate Accounting and Reporting Standard / Mobile Guide" (World Resources Institute/World Business Council for Sustainable Development 2005). SO2 emission factor calculated from diesel consumption rate and a sulfur content of 348 ppm.

d. HAP emission factors based on fractions presented in "Documentation for the Oonroad National Emissions Inventory (NEI) for Base Years 1970-2002" (EPA 2004).

## Table 7
## Onroad Vehicle Exhaust Emissions
### 45-MW Wind Energy Project

| Activity | Description | Fuel Type | Daily Mileage (VMT) | Total Mileage (VMT) | Emissions (lbs/day) | | | | | | | Emissions (tons) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ROG | CO | NOx | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | ROG | CO | NOx | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ |
| Site Preparation | Onroad Vehicles | Gasoline | 540 | 9,720 | 1.77 | 16.73 | 1.29 | 0.02 | 0.01 | 0.01 | 523.81 | 0.02 | 0.2 | 0.01 | 0.0001 | 0.0001 | 0.0001 | 5 |
| | Onroad Vehicles | Diesel | 64 | 1,152 | 0.04 | 0.16 | 1.14 | 0.02 | 0.02 | 0.02 | 197.53 | 0.000 | 0.001 | 0.01 | 0.0002 | 0.0002 | 0.0002 | 2 |
| | **Total** | | | | **1.81** | **16.9** | **2.43** | **0.037** | **0.031** | **0.030** | **721** | **0.02** | **0.2** | **0.02** | **0.000** | **0.0003** | **0.0003** | **6** |
| Foundation Construction / Electrical | Onroad Vehicles | Gasoline | 3,000 | 288,000 | 9.82 | 92.92 | 7.18 | 0.08 | 0.039 | 0.036 | 2910.05 | 0.47 | 4.5 | 0.34 | 0.0040 | 0.0019 | 0.0017 | 140 |
| | Onroad Vehicles | Diesel | 96 | 9,216 | 0.06 | 0.23 | 1.71 | 0.03 | 0.036 | 0.036 | 296.30 | 0.003 | 0.01 | 0.1 | 0.0016 | 0.0017 | 0.0017 | 14 |
| | **Total** | | | | **9.88** | **93.2** | **8.9** | **0.1171** | **0.075** | **0.072** | **3206** | **0.47** | **4.5** | **0.43** | **0.0056** | **0.0036** | **0.0035** | **154** |
| Turbine Installation and Delivery | Onroad Vehicles | Gasoline | 2,280 | 136,800 | 7.46 | 70.62 | 5.45 | 0.06 | 0.029 | 0.027 | 2211.64 | 0.224 | 2.12 | 0.164 | 0.0019 | 0.0009 | 0.0008 | 66 |
| | Onroad Vehicles | Diesel | 128 | 7,680 | 0.08 | 0.31 | 2.27 | 0.04 | 0.048 | 0.048 | 395.06 | 0.0024 | 0.009 | 0.07 | 0.0013 | 0.0014 | 0.0014 | 12 |
| | **Total** | | | | **7.543** | **70.93** | **7.73** | **0.1082** | **0.077** | **0.075** | **2607** | **0.226** | **2.13** | **0.23** | **0.0032** | **0.0023** | **0.0023** | **78** |
| Electrical Trenching | Onroad Vehicles | Gasoline | 900 | 67,500 | 2.95 | 27.88 | 2.15 | 0.03 | 0.012 | 0.011 | 873.02 | 0.11 | 1.0 | 0.08 | 0.0009 | 0.0004 | 0.0004 | 33 |
| | Onroad Vehicles | Diesel | 64 | 4,800 | 0.04 | 0.16 | 1.14 | 0.02 | 0.024 | 0.024 | 197.53 | 0.001 | 0.006 | 0.04 | 0.0008 | 0.0009 | 0.0009 | 7 |
| | **Total** | | | | **2.99** | **28.0** | **3.29** | **0.047** | **0.036** | **0.035** | **1071** | **0.11** | **1.1** | **0.12** | **0.0018** | **0.0013** | **0.0013** | **40** |

## Table 8
## Road Fugitive Dust Emissions from Onroad Vehicles
### 45-MW Wind Energy Project

| Activity | Road Type | Daily Mileage (VMT) | Total Mileage (VMT) | Emission Factor[a] (lb/VMT) | | Uncontrolled Daily Emissions (lb/day) | | Uncontrolled Emissions (tons) | | Controlled Daily Emissions (lb/day) | | Controlled Emissions (tons) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ |
| Site Preparation | Paved Roads | 578 | 10,404 | 0.0068 | 0.0007 | 4.0 | 0.43 | 0.036 | 0.0038 | 2.0 | 0.21 | 0.018 | 0.0019 |
| | Unpaved | 26 | 468 | 0.82 | 0.082 | 21 | 2.1 | 0.19 | 0.019 | 11 | 1.07 | 0.10 | 0.010 |
| | **Subtotal** | | | | | **25** | **2.6** | **0.23** | **0.023** | **13** | **1** | **0.11** | **0.012** |
| Foundation Construction / Electrical | Paved Roads | 2,984 | 286,464 | 0.0068 | 0.0007 | 20.43 | 2.20 | 0.98 | 0.11 | 10.2 | 1.10 | 0.490 | 0.053 |
| | Unpaved | 112 | 10,752 | 0.82 | 0.082 | 92 | 9.2 | 4.4 | 0.44 | 46 | 4.6 | 2.2 | 0.22 |
| | **Subtotal** | | | | | **112** | **11.4** | **5.4** | **0.55** | **56** | **5.7** | **2.7** | **0.273** |
| Turbine Installation and Delivery | Paved Roads | 2,316 | 138,960 | 0.0068 | 0.0007 | 15.9 | 1.71 | 0.48 | 0.051 | 7.9 | 0.85 | 0.24 | 0.026 |
| | Unpaved | 92 | 5,520 | 0.82 | 0.082 | 75 | 8 | 2.3 | 0.23 | 38 | 3.8 | 1.1 | 0.11 |
| | **Subtotal** | | | | | **91** | **9** | **2.7** | **0.28** | **46** | **4.6** | **1.4** | **0.14** |
| Electrical Trenching | Paved Roads | 926 | 69,450 | 0.0068 | 0.0007 | 6.3 | 0.68 | 0.238 | 0.0256 | 3.17 | 0.34 | 0.12 | 0.013 |
| | Unpaved | 38 | 2,850 | 0.82 | 0.082 | 31 | 3.1 | 1.17 | 0.117 | 16 | 1.6 | 0.58 | 0.058 |
| | **Subtotal** | | | | | **38** | **3.8** | **1.41** | **0.142** | **19** | **1.9** | **0.70** | **0.071** |

Notes:
a. See emission factor derivation table below.

**Paved Roads - Emission Factor Derivation Table**

$E = (k(sL/2)^{0.65}(W/3)^{1.5}-C)$ AP-42 Section 13.2.1 (11/06 version)

where:
- E = particulate emission factor (lb/VMT)
- k = particle size multiplier
- sL = road surface silt loading ($g/m^2$)
- W = average vehicle weight (tons)
- C = emission factor for 1980's vehicle fleet exhaust, break wear and tire wear

| Parameter | Units | $PM_{10}$ | $PM_{2.5}$ | Reference |
|---|---|---|---|---|
| Mean Vehicle Weight | tons | 3 | 3 | Assumption |
| k factor | lb/VMT | 0.016 | 0.0024 | Table 13.2-1.1 |
| Silt Loading, sL | $g/m^2$ | 0.6 | 0.6 | Table 13.2.1-3 |
| Emission factor, C | lb/VMT | 0.00047 | 0.00036 | Table 13.2.1-2 |

**Unpaved Roads - Emission Factor Derivation**

$E = k(s/12)^a(W/3)^b$ AP-42 Section 13.2.2 (11/06 version)

Controlled E = E * ((100-CE)/100)

where:
- E = particulate emission factor (lb/VMT)
- k, a, b = empirical constants for industrial roads
- s = surface material silt content (%)
- W = average vehicle weight (tons)

| Parameter | Units | $PM_{10}$ | $PM_{2.5}$ | Reference |
|---|---|---|---|---|
| Mean Vehicle Weight | **tons** | 4.25 | 4.25 | Assumption |
| Constant, k | lb/VMT | 1.8 | 0.18 | Table 13.2.2-2 (worst case) |
| Constant, a | | 1 | 1 | Table 13.2.2-2 (worst case) |
| Constant, b | | 0.45 | 0.45 | Table 13.2.2-2 (worst case) |
| Silt content, s | % | 8.5 | 8.5 | Table 13.2..2-1 (construction sites) |
| Control Efficiency, CE | **%** | 45 | 45 | Assumption based on regular watering |

**Table 9**
**Fugitve Dust Emissions from Earth Moving Activities**
**45-MW Wind Energy Project**

| Construction Activity | Disturbance[a] (acres/day) | Duration of Activity (months) | Controlled Emission Factor[a] (ton/acre/month) | | Controlled Daily Emissions[c] (lbs/day) | | Controlled Emissions (tons) | |
|---|---|---|---|---|---|---|---|---|
| | | | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ |
| All Activities | 5 | 6 | 0.2 | 0.0 | 450.0 | 63.0 | 1.4 | 0.2 |

Notes:

a. Area of disturbance is listed as average disturbance area for a typical work day, considering 2 acres/day and 3 additional acres of disturbance for other activities

b. See emisison factor derivation table below

Emission Factor Derivation Table

| Parameter | Units | TSP[1] | $PM_{10}$[(2)] | $PM_{2.5}$[(3)] |
|---|---|---|---|---|
| Uncontrolled Emission Factor[1] (based on 30 days/month) | ton/acre/month | 1.2 | 0.9 | 0.126 |
| Controlled Emission Factor[5] (based on 24 days/month) | ton/acre/month | 0.3 | 0.225 | 0.0315 |

Notes:

1. Emission factor from AP-42 Section 13.2.3 for TSP.
2. $PM_{10}$ emission factor calculated by multiplying TSP emission factor by 0.75 (AP-42 Section 11.9, Table 11.9-1)
3. $PM_{2.5}$ emission factor calculated by multiplying TSP emission factor by 0.105 (AP-42 Section 11.9, Table 11.9-1)
4. Calculated by multiplying 30-day emission factor by 0.8 (24 days/ 30 days).
5. Conservatively assumed dust 75% control factor based on maximum control measures. Actual dust control effectiveness TBD based on consultation with local APCD (may be

*This page intentionally left blank.*

**Appendix B**
**Emission Calculations for Construction Activities**
**West Chocolate Mountains Solar PV Development**

| Table No. | Table Description |
|---|---|
| Table B1-a | Total Construction Emissions - Phase I (25 MW) |
| Table B1-b | Total Construction Emissions - Phase II (Additional 25 MW) |
| Table B2-a | Summary of Daily Construction Emissions - Phase I |
| Table B2-b | Summary of Daily Construction Emissions - Phase II |
| Table 3 | Non-Road Diesel Equipment Exhaust Emission Factors |
| Table 4-A | Total Emissions for Diesel Non-Road Equipment - Phase I |
| Table 4-B | Total Emissions for Diesel Non-Road Equipment - Phase II |
| Table 5-A | Daily Emissions for Diesel Non-Road Equipment - Phase I |
| Table 5-B | Daily Emissions for Diesel Non-Road Equipment - Phase II |
| Table 6 | On-Road Vehicle Usage Phases I and II |
| Table 7 | On-Road Vehicle Exhaust Emission Factors |
| Table 8-A | Total and Daily Exhaust Emissions for On Road Vehicles - Phase I |
| Table 8-B | Total and Daily Exhaust Emissions for On Road Vehicles - Phase II |
| Table 9-A | Fugitve Dust Emissions - Construction Site - Phase I |
| Table 9-B | Fugitve Dust Emissions - Construction Site - Phase II |
| Table 10 | Fugitive Dust Emission Factors - Roads |
| Table 11-A | Fugitive Dust Emissions from Road (Site and Off-Site) - Phase I |
| Table 11-B | Fugitive Dust Emissions from Road (Site and Off-Site) - Phase II |

**Table B1-a**

**Total Construction Emissions - Phase I (25 MW)**

**West Chocolate Mountains Solar PV Development**

| Emission Type | Source | Emissions (tons) | | | | | | GHG Emissions (metric tons) |
|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2e$ |
| Exhaust Emissions | Non Road Equipment | 0.57 | 2.29 | 4.90 | 0.01 | 0.25 | 0.25 | 537 |
| | On Road Vehicles | 0.09 | 0.36 | 1.17 | 0.00 | 0.06 | 0.05 | 117 |
| Fugitive Dust Emissions | Construction Activities | - | - | - | - | 0.54 | 0.08 | - |
| | Roads (Site and Off-Site) | - | - | - | - | 5.80 | 0.64 | - |
| **Subtotal** | | **0.66** | **2.65** | **6.06** | **0.01** | **6.64** | **1.02** | **653** |

**Table B1-b**

**Total Construction Emissions - Phase II (Additional 25 MW)**

**West Chocolate Mountains Solar PV Development**

| Emission Type | Source | Emissions (tons) | | | | | | GHG Emissions (metric tons) |
|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2e$ |
| Exhaust Emissions | Non Road Equipment | 0.57 | 2.29 | 4.90 | 0.01 | 0.25 | 0.25 | 537 |
| | On Road Vehicles | 0.09 | 0.36 | 1.17 | 0.001 | 0.06 | 0.05 | 117 |
| Fugitive Dust Emissions | Construction Activities | - | - | - | - | 0.74 | 0.08 | - |
| | Roads (Site and Off-Site) | - | - | - | - | 5.80 | 0.10 | - |
| **Subtotal** | | **0.66** | **2.65** | **6.06** | **0.01** | **6.84** | **0.48** | **653** |

**Table B2-a**

**Summary of Daily Construction Emissions - Phase I**

**West Chocolate Mountains Solar PV Development**

| Emission Type | Source | Emissions (lbs/day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| Exhaust Emissions | Non Road Equipment | 7.8 | 30.2 | 63.0 | 0.1 | 3.5 | 3.5 | 6,886 | 0.7 |
| | On Road Vehicles | 0.8 | 3.0 | 9.7 | 0.01 | 0.5 | 0.4 | 1,070 | 0.04 |
| Fugitive Dust Emissions | Construction Activities | - | - | - | - | 43 | 6 | - | - |
| | Roads (Site and Off-Site) | - | - | - | - | 48 | 5 | - | - |
| **Subtotal** | | **9** | **33** | **73** | **0.1** | **95** | **15** | **7,957** | **1** |

**Table B2-b**

**Summary of Daily Construction Emissions - Phase II**

**West Chocolate Mountains Solar PV Development**

| Emission Type | Source | Emissions (lbs/day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| Exhaust Emissions | Non Road Equipment | 7.8 | 30.2 | 63.0 | 0.1 | 3.5 | 3.5 | 6,886 | 0.7 |
| | On Road Vehicles | 0.8 | 3.0 | 9.7 | 0.01 | 0.5 | 0.4 | 1,070 | 0.04 |
| Fugitive Dust Emissions | Construction Activities | - | - | - | - | 58 | 8 | - | - |
| | Roads (Site and Off-Site) | - | - | - | - | 48 | 5 | - | - |
| **Subtotal** | | **9** | **33** | **73** | **0.1** | **110** | **17** | **7,957** | **1** |

**Table B3**
**Non-Road Diesel Equipment Exhaust Emission Factors**
**West Chocolate Mountains Solar PV Development**

| Equipment | Maximum Operating Range (hp) | Composite Emission Factor (lb/hr) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | PM | $CO_2$ | $CH_4$ |
| Vibratory Post Driver / Drill Rig | Composite | 0.1052 | 0.5146 | 1.1331 | 0.0017 | 0.0498 | 165 | 0.0095 |
| Crawler Tractors | Composite | 0.1861 | 0.6409 | 1.3854 | 0.0013 | 0.0854 | 114 | 0.0168 |
| Excavators | Composite | 0.1483 | 0.5581 | 1.1502 | 0.0013 | 0.0638 | 120 | 0.0134 |
| Forklifts | Composite | 0.0686 | 0.2319 | 0.5161 | 0.0006 | 0.0281 | 54.4 | 0.0062 |
| Generator Set | 15 | 0.0172 | 0.0726 | 0.1154 | 0.0002 | 0.0069 | 10.2 | 0.0016 |
| Graders | Composite | 0.1723 | 0.6314 | 1.4338 | 0.0015 | 0.0753 | 133 | 0.0155 |
| Rollers | Composite | 0.1176 | 0.4212 | 0.7749 | 0.0008 | 0.0547 | 67.1 | 0.0106 |
| Scrapers | Composite | 0.3202 | 1.2424 | 2.9078 | 0.0027 | 0.1256 | 262 | 0.0289 |
| Tractors/Loaders/Backhoes | Composite | 0.1021 | 0.3930 | 0.6747 | 0.0008 | 0.0521 | 66.8 | 0.0092 |
| Plate Compactor | Composite | 0.0050 | 0.0263 | 0.0317 | 0.0001 | 0.0015 | 4.3 | 0.0005 |

Source: South Coast Air Quality Management District (SCAQMD). 2008. Off-road Mobile Source Emission Factors (Scenario Years 2007 – 2025).

Notes:

Composite emission factors have horsepower rating and load factors already built into the emission factors. SCAQMD recommends using composite factors if the CEQA practitioner does not know these two parameters when calculating off-road mobile source emissions

**Table 4-A**
**Total Emissions for Diesel Non-Road Equipment - Phase I**
**West Chocolate Mountains Solar PV Development**

| Construction Phase | Equipment Type | Equipment Engine Size (hp) [a] | Fuel Type | Total Hourly Usage for All Units (hrs) | Criteria PollutantsTotal Emissions (tons) | | | | | GHG Total Emissions (metric tons) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ROG | CO | $NO_x$ | $SO_2$ | PM | $CO_2$ | $CH_4$ | $CO_2e$ |
| All Construction Activities | Vibratory Post Driver | 100-175 | Diesel | 4,050 | 0.213 | 1.042 | 2.295 | 0.004 | 0.101 | 302.8 | 0.0 | 303.2 |
| | Crawler Tractors/Dozer | 100-175 | Diesel | 500 | 0.047 | 0.160 | 0.346 | 0.000 | 0.021 | 25.9 | 0.0 | 25.9 |
| | Excavators | 175-300 | Diesel | 200 | 0.015 | 0.056 | 0.115 | 0.000 | 0.006 | 10.8 | 0.0 | 10.9 |
| | Forklifts/Aerial Lifts/ Booms | 50-100 | Diesel | 6,000 | 0.206 | 0.696 | 1.548 | 0.002 | 0.084 | 148.0 | 0.0 | 148.4 |
| | Generator/Compressor | 5-15 | Diesel | 4,000 | 0.034 | 0.145 | 0.231 | 0.000 | 0.014 | 18.5 | 0.0 | 18.6 |
| | Graders | 175-300 | Diesel | 80 | 0.007 | 0.025 | 0.057 | 0.000 | 0.003 | 4.8 | 0.0 | 4.8 |
| | Rollers/Compactors | 100-175 | Diesel | 500 | 0.029 | 0.105 | 0.194 | 0.000 | 0.014 | 15.2 | 0.0 | 15.3 |
| | Scrapers | 175-300 | Diesel | 40 | 0.006 | 0.025 | 0.058 | 0.000 | 0.003 | 4.8 | 0.0 | 4.8 |
| | Tractors/Loaders/Backhoes | 100-175 | Diesel | 160 | 0.008 | 0.031 | 0.054 | 0.000 | 0.004 | 4.8 | 0.0 | 4.9 |
| | Vibratory Plate (hand held) | 10 -- 15 | Diesel | 40 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.1 | 0.0 | 0.1 |
| | **TOTAL** | | | | **0.566** | **2.286** | **4.899** | **0.006** | **0.250** | **536** | **0.046** | **537** |

Notes:
(a) Composite emission factors recommended by the South Coast Air Management District were used per equipment, except for Generator/Compressor (maximum hp 15).

**Table 4-B**
**Total Emissions for Diesel Non-Road Equipment - Phase II**
**West Chocolate Mountains Solar PV Development**

| Construction Phase | Equipment Type | Equipment Engine Size (hp) [a] | Fuel Type | Total Hourly Usage for All Units (hrs) | Criteria PollutantsTotal Emissions (tons) | | | | | GHG Total Emissions (metric tons) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ROG | CO | $NO_x$ | $SO_2$ | PM | $CO_2$ | $CH_4$ | $CO_2e$ |
| All Construction Activities | Vibratory Post Driver | 100-175 | Diesel | 4,050 | 0.213 | 1.042 | 2.295 | 0.004 | 0.101 | 303 | 0.0 | 303 |
| | Crawler Tractors/Dozer | 100-175 | Diesel | 500 | 0.047 | 0.160 | 0.346 | 0.000 | 0.021 | 26 | 0.0 | 26 |
| | Excavators | 175-300 | Diesel | 200 | 0.015 | 0.056 | 0.115 | 0.000 | 0.006 | 11 | 0.0 | 11 |
| | Forklifts/Aerial Lifts/ Booms | 50-100 | Diesel | 6,000 | 0.206 | 0.696 | 1.548 | 0.002 | 0.084 | 148 | 0.0 | 148 |
| | Generator/Compressor | 5 -- 15 | Diesel | 4,000 | 0.034 | 0.145 | 0.231 | 0.000 | 0.014 | 19 | 0.0 | 19 |
| | Graders | 175-300 | Diesel | 80 | 0.007 | 0.025 | 0.057 | 0.000 | 0.003 | 5 | 0.0 | 5 |
| | Rollers/Compactors | 100-175 | Diesel | 500 | 0.029 | 0.105 | 0.194 | 0.000 | 0.014 | 15 | 0.0 | 15 |
| | Scrapers | 175-300 | Diesel | 40 | 0.006 | 0.025 | 0.058 | 0.000 | 0.003 | 5 | 0.0 | 5 |
| | Tractors/Loaders/Backhoes | 100-175 | Diesel | 160 | 0.008 | 0.031 | 0.054 | 0.000 | 0.004 | 5 | 0.0 | 5 |
| | Vibratory Plate (hand held) | 10-15 | Diesel | 40 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0 | 0.0 | 0 |
| | **TOTAL** | | | | **0.57** | **2.29** | **4.90** | **0.01** | **0.25** | **536** | **0.046** | **537** |

Notes:
(a) Composite emission factors recommended by the South Coast Air Management District were used per equipment, except for Generator/Compressor (maximum hp 15).

**Table 5-A**

**Daily Emissions for Diesel Non-Road Equipment - Phase I**

**West Chocolate Mountains Solar PV Development**

| Construction Phase | Equipment Type | Equipment Engine Size (hp) [a] | Fuel Type | Total Hourly Usage for All Units (hrs) | Estimated daily usage [b] (hrs/day) | Criteria PollutantsTotal Emissions (lbs/day) | | | | | GHG Total Emissions (lbs/day) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ROG | CO | $NO_x$ | $SO_2$ | PM | $CO_2$ | $CH_4$ |
| All Construction Activities | Vibratory Post Driver | 100-175 | Diesel | 4,050 | 17 | 1.776 | 8.684 | 19.122 | 0.029 | 0.841 | 2782 | 0.160 |
| | Crawler Tractors/Dozer | 100-175 | Diesel | 500 | 2 | 0.388 | 1.335 | 2.886 | 0.003 | 0.178 | 238 | 0.035 |
| | Excavators | 175-300 | Diesel | 200 | 1 | 0.124 | 0.465 | 0.958 | 0.001 | 0.053 | 100 | 0.011 |
| | Forklifts/Aerial Lifts/ Booms | 50-100 | Diesel | 6,000 | 25 | 1.714 | 5.798 | 12.902 | 0.015 | 0.702 | 1360 | 0.155 |
| | Generator/Compressor | 5 -- 15 | Diesel | 4,000 | 17 | 0.287 | 1.209 | 1.923 | 0.003 | 0.115 | 170 | 0.026 |
| | Graders | 175-300 | Diesel | 80 | 3 | 0.551 | 2.020 | 4.588 | 0.005 | 0.241 | 425 | 0.050 |
| | Rollers/Compactors | 100-175 | Diesel | 500 | 20 | 2.353 | 8.424 | 15.497 | 0.015 | 1.094 | 1341 | 0.212 |
| | Scrapers | 175-300 | Diesel | 40 | 2 | 0.512 | 1.988 | 4.653 | 0.004 | 0.201 | 420 | 0.046 |
| | Tractors/Loaders/Backhoes | 100-175 | Diesel | 160 | 1 | 0.068 | 0.262 | 0.450 | 0.001 | 0.035 | 45 | 0.006 |
| | Vibratory Plate (hand held) | 10 -- 15 | Diesel | 40 | 2 | 0.008 | 0.042 | 0.051 | 0.000 | 0.002 | 7 | 0.001 |
| | **TOTAL** | | | | | **7.8** | **30.2** | **63.0** | **0.1** | **3.5** | **6,886** | **0.702** |

Notes:

(a) Composite emission factors recommended by the South Coast Air Management District were used per equipment, except for Generator/Compressor (maximum hp 15).

(b) Daily usage is estimated per a composite number of equipment and based on a 240 days of total construction period.

Exception on daily usage assumption includes graders, scrapers, vibratory plates and roller/compactors, since the grading activities are intended to have a 25-day duration.

**Table 5-B**
**Daily Emissions for Diesel Non-Road Equipment - Phase II**
**West Chocolate Mountains Solar PV Development**

| Construction Phase | Equipment Type | Equipment Engine Size (hp) [a] | Fuel Type | Total Hourly Usage for All Units (hrs) | Estimated daily usage [b] (hrs/day) | Criteria PollutantsTotal Emissions (lbs/day) | | | | | GHG Total Emissions (lbs/day) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ROG | CO | $NO_x$ | $SO_2$ | PM | $CO_2$ | $CH_4$ |
| All Construction Activities | Vibratory Post Driver | 100-175 | Diesel | 4,050 | 17 | 1.776 | 8.684 | 19.122 | 0.029 | 0.841 | 2781.90 | 0.160 |
| | Crawler Tractors/Dozer | 100-175 | Diesel | 500 | 2 | 0.388 | 1.335 | 2.886 | 0.003 | 0.178 | 237.54 | 0.035 |
| | Excavators | 175-300 | Diesel | 200 | 1 | 0.124 | 0.465 | 0.958 | 0.001 | 0.053 | 99.65 | 0.011 |
| | Forklifts/Aerial Lifts/ Booms | 50-100 | Diesel | 6,000 | 25 | 1.714 | 5.798 | 12.902 | 0.015 | 0.702 | 1359.89 | 0.155 |
| | Generator/Compressor | 5-15 | Diesel | 4,000 | 17 | 0.287 | 1.209 | 1.923 | 0.003 | 0.115 | 170.13 | 0.026 |
| | Graders | 175-300 | Diesel | 80 | 3 | 0.551 | 2.020 | 4.588 | 0.005 | 0.241 | 424.78 | 0.050 |
| | Rollers/Compactors | 100-175 | Diesel | 500 | 20 | 2.353 | 8.424 | 15.497 | 0.015 | 1.094 | 1341.05 | 0.212 |
| | Scrapers | 175-300 | Diesel | 40 | 2 | 0.512 | 1.988 | 4.653 | 0.004 | 0.201 | 419.998 | 0.046 |
| | Tractors/Loaders/Backhoes | 100-175 | Diesel | 160 | 1 | 0.068 | 0.262 | 0.450 | 0.001 | 0.035 | 44.54 | 0.006 |
| | Vibratory Plate (hand held) | 10-15 | Diesel | 40 | 2 | 0.008 | 0.042 | 0.051 | 0.000 | 0.002 | 6.902 | 0.001 |
| | **TOTAL** | | | | | **7.8** | **30.2** | **63.0** | **0.1** | **3.5** | **6,886** | **0.702** |

Notes: Construction of Phase II is assumed to have the same duration and equipment/vehicle list as Phase I
(a) Composite emission factors recommended by the South Coast Air Management District were used per equipment, except for Generator/Compressor (maximum hp 15).
(b) Daily usage is estimated per a composite number of equipment and based on a 240 days of total construction period, except for gradind equipment (25 days).
Exception on daily usage assumption includes graders, scrapers, vibratory plates and roller/compactors.

**Table 6**
**On-Road Vehicle Usage Phases I and II**
**West Chocolate Mountains Solar PV Development**

**Phase I**

| Vehicle Type | Construction Phase | Vehicle Description | Vehicle Class | Total Working Hours | Total Working Days | Working hours per day | Estimated speed (mph) | Total Daily VMT All Units (VMT/day) | | | Total Overall VMT of All Units (VMT) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Unpaved Roads | Paved Roads | TOTAL | Unpaved Roads | Paved Roads | TOTAL |
| Heavy Duty Diesel Truck | All | Dump Truck | HDDV6 | 120 | 240 | 0.5 | 25 | 2.5 | 10 | 13 | 600 | 2,400 | 3,000 |
| | | Concrete Truck | HDDV6 | 120 | 240 | 0.5 | 25 | 2.5 | 10 | 13 | 600 | 2,400 | 3,000 |
| | | Tender Truck | HDDV6 | 120 | 240 | 0.5 | 25 | 2.5 | 10 | 13 | 600 | 2,400 | 3,000 |
| | | Highway Tractor | HDDV6 | 80 | 240 | 0.3 | 25 | 1.7 | 7 | 8 | 400 | 1,600 | 2,000 |
| | | Flatbed Truck | HDDV3 | 1000 | 240 | 4.2 | 25 | 20.8 | 83 | 104 | 5,000 | 20,000 | 25,000 |
| | | Water Truck | HDDV6 | 1000 | 240 | 4.2 | 25 | 20.8 | 83 | 104 | 5,000 | 20,000 | 25,000 |
| | **Subtotal** | - | | - | - | - | - | **51** | **203** | **254** | **12,200** | **48,800** | **61,000** |

**Phase II**

| Vehicle Type | Construction Phase | Vehicle Description | Vehicle Class | Total Working Hours | Total Working Days | Working hours per day | Estimated speed (mph) | Total Daily VMT All Units (VMT/day) | | | Total Overall VMT of All Units (VMT) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Unpaved Roads | Paved Roads | TOTAL | Unpaved Roads | Paved Roads | TOTAL |
| Heavy Duty Diesel Truck | All | Dump Truck | HDDV6 | 120 | 240 | 0.5 | 25 | 2.5 | 10 | 13 | 600 | 2,400 | 3,000 |
| | | Concrete Truck | HDDV6 | 120 | 240 | 0.5 | 25 | 2.5 | 10 | 13 | 600 | 2,400 | 3,000 |
| | | Tender Truck | HDDV6 | 120 | 240 | 0.5 | 25 | 2.5 | 10 | 13 | 600 | 2,400 | 3,000 |
| | | Highway Tractor | HDDV6 | 80 | 240 | 0.3 | 25 | 1.7 | 7 | 8 | 400 | 1,600 | 2,000 |
| | | Flatbed Truck | HDDV3 | 1000 | 240 | 4.2 | 25 | 20.8 | 83 | 104 | 5,000 | 20,000 | 25,000 |
| | | Water Truck | HDDV6 | 1000 | 240 | 4.2 | 25 | 20.8 | 83 | 104 | 5,000 | 20,000 | 25,000 |
| | **Subtotal** | - | | - | - | - | - | **51** | **203** | **254** | **12,200** | **48,800** | **61,000** |

Notes: Construction of Phase II is assumed to have the same duration and equipment/vehicle list as Phase I

**Table 7**

**On-Road Vehicle Exhaust Emission Factors**

**West Chocolate Mountains Solar PV Development**

| Equipment Type | Emission Factor[a] (pounds/VMT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ROG | CO | NOx | SOx | PM10 | PM2.5 | CO2 | $CH_4$ |
| Heavy Duty Diesel Trucks | 0.003042 | 0.011955 | 0.038221 | 0.000041 | 0.001831 | 0.001601 | 4.211206 | 0.000142 |
| Light Duty Trucks | 0.002590 | 0.01844 | 0.02062 | 0.0000270 | 0.0007512 | 0.0006243 | 2.732 | 0.0001258 |
| Gasoline Passenger Vehicles | 0.0009140 | 0.00826 | 0.0009181 | 0.00001077 | 0.00008698 | 0.00005478 | 1.096 | 0.00008146 |
| ATVs | 0.0046270 | 0.10146 | 0.0009048 | 0.00010582 | 0.00014550 | 0.00014550 | 0.517 | 0.00000000 |

Notes:

a. Emission Factors for On-Road Heavy-Heavy-Duty Diesel Trucks. SCAQMD (Scenario Year: 2010).

**Table 8-A**

**Total and Daily Exhaust Emissions for On Road Vehicles - Phase I**

**West Chocolate Mountains Solar PV Development**

**Total Emissions**

| Vehicle Type | Total Overall Miles Travelled (VMT) | Total Emissions (tons) | | | | | | Total Emissions (metric tons) | |
|---|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| Heavy Duty Diesel Trucks | 61,000 | 0.09 | 0.36 | 1.17 | 0.00 | 0.06 | 0.05 | 117 | 0 |
| **Total** | **-** | **0.09** | **0.36** | **1.17** | **0.00** | **0.06** | **0.05** | **117** | **0** |

**Daily Emissions**

| Vehicle Type | Total Overall Miles Travelled (VMT) | Total Emissions (lbs/day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| Heavy Duty Diesel Trucks | 61,000 | 1 | 3 | 10 | 0.01 | 0.5 | 0.4 | 1070 | 0.04 |
| **Total** | **-** | **1** | **3** | **10** | **0.01** | **0.5** | **0.4** | **1070** | **0.04** |

**Table 8-B**

**Total and Daily Exhaust Emissions for On Road Vehicles - Phase II**

**West Chocolate Mountains Solar PV Development**

**Total Emissions**

| Vehicle Type | Total Overall Miles Travelled (VMT) | Total Emissions (tons) | | | | | | Total Emissions (metric tons) | |
|---|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| Heavy Duty Diesel Trucks | 61,000 | 0.09 | 0.36 | 1.17 | 0.00 | 0.06 | 0.05 | 117 | 0 |
| **Total** | **-** | **0.09** | **0.36** | **1.17** | **0.00** | **0.06** | **0.05** | **117** | **0** |

**Daily Emissions**

| Vehicle Type | Total Overall Miles Travelled (VMT) | Total Emissions (lbs/day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2$ | $CH_4$ |
| Heavy Duty Diesel Trucks | 61,000 | 1 | 3 | 10 | 0 | 0 | 0 | 1070 | 0 |
| **Total** | **-** | **1** | **3** | **10** | **0** | **0** | **0** | **1070** | **0** |

Notes: Construction of Phase II is assumed to have the same duration and equipment/vehicle list as Phase I

**Table 9-A**
**Fugitve Dust Emissions - Construction Site - Phase I**
**West Chocolate Mountains Solar PV Development**

| Construction Activity | Average Daily Disturbance (acres) | Duration of Activity (months) | Emission Factor[a] (ton/acre/month) | | Emissions (tons) | | Daily Emissions (lbs/day) | |
|---|---|---|---|---|---|---|---|---|
| | | | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ |
| Site Clearing and Grading | 7.2 | 0.83 | 0.090 | 0.0126 | 0.54 | 0.08 | 43 | 6 |
| Access Roads | 1.4 | 0.17 | 0.090 | 0.0126 | 0.02 | 0.00 | 8.4 | 1.2 |
| Switchyard | 0.0006 | 0.17 | 0.090 | 0.0126 | 0.00 | 0.00 | 0.0 | 0.0 |
| Underground Power Line | 0.1667 | 1 | 0.090 | 0.0126 | 0.02 | 0.00 | 1.0 | 0.1 |
| Control/Maintenance Building | 0.0001 | 4 | 0.090 | 0.0126 | 0.00 | 0.00 | 0.00 | 0.00 |
| Parking / Laydown Area | 0.1 | 0.17 | 0.090 | 0.0126 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | - | - | - | - | **0.58** | **0.08** | **53** | **7** |

Notes:
a. See emission factor derivation table below.
b. Total site area for Phase I: 516 acres. Total duration of grading: 25 days.

Emission Factor Derivation Table

| Parameter | Units | TSP[1] | $PM_{10}$ [(2)] | $PM_{2.5}$ [(3)] |
|---|---|---|---|---|
| Uncontrolled Emission Factor[1] (based on 30 days/month) | ton/acre/month | 0.2 | 0.15 | 0.021 |
| Controlled Emission Factor[5] (based on 24 days/month) | ton/acre/month | 0.12 | 0.090 | 0.0126 |

Notes:
1. Emission factor from AP-42 Section 13.2.3 for TSP.
2. $PM_{10}$ emission factor calculated by multiplying TSP emission factor by 0.75 (AP-42 Section 11.9, Table 11.9-1)
3. $PM_{2.5}$ emission factor calculated by multiplying TSP emission factor by 0.105 (AP-42 Section 11.9, Table 11.9-1)
4. Calculated by multiplying 30-day emission factor by 0.8 (24 days/ 30 days).
4. Assume dust 40% duct control factor based on as-needed watering. Does not include any control for winter conditions.

**Table 9-B**
**Fugitve Dust Emissions - Construction Site - Phase II**
**West Chocolate Mountains Solar PV Development**

| Construction Activity | Average Daily Disturbance (acres) | Duration of Activity (months) | Emission Factor[a] (ton/acre/month) | | Emissions (tons) | | Daily Emissions (lbs/day) | |
|---|---|---|---|---|---|---|---|---|
| | | | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ |
| Site Clearing and Grading | 9.6 | 0.83 | 0.090 | 0.0126 | 0.72 | 0.10 | 58 | 8 |
| Switchyard | 0.0006 | 0.17 | 0.090 | 0.0126 | 0.00 | 0.00 | 0.0 | 0.0 |
| Underground Power Line | 0.1667 | 1 | 0.090 | 0.0126 | 0.02 | 0.00 | 1.0 | 0.1 |
| Parking / Laydown Area | 0.1 | 0.17 | 0.090 | 0.0126 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | - | - | - | - | **0.74** | **0.10** | **59** | **8** |

Notes:
a. See emission factor derivation table below.
b. Total solar array area for Phase II: 140 acres (Per POD description). Total duration of grading: 25 days.

Emission Factor Derivation Table

| Parameter | Units | TSP[1] | $PM_{10}$[(2)] | $PM_{2.5}$[(3)] |
|---|---|---|---|---|
| Uncontrolled Emission Factor[1] (based on 30 days/month) | ton/acre/month | 0.2 | 0.15 | 0.021 |
| Controlled Emission Factor[5] (based on 24 days/month) | ton/acre/month | 0.12 | 0.090 | 0.0126 |

Notes:
1. Emission factor from AP-42 Section 13.2.3 for TSP.
2. $PM_{10}$ emission factor calculated by multiplying TSP emission factor by 0.75 (AP-42 Section 11.9, Table 11.9-1)
3. $PM_{2.5}$ emission factor calculated by multiplying TSP emission factor by 0.105 (AP-42 Section 11.9, Table 11.9-1)
4. Calculated by multiplying 30-day emission factor by 0.8 (24 days/ 30 days).
4. Assume dust 40% duct control factor based on as-needed watering. Does not include any control for winter conditions (frozen ground)

**Table 10**
**Fugitive Dust Emission Factors - Roads**

**Unpaved Roads - Emission Factor Derivation**

$E = k(s/12)^a(W/3)^b$ AP-42 Section 13.2.2 (11/06 version)

where:

E = particulate emission factor (lb/VMT)
k, a, b = empirical constants for industrial roads
s = surface material silt content (%)
W = average vehicle weight (tons)

| Parameter | Units | $PM_{10}$ | $PM_{2.5}$ | Reference |
|---|---|---|---|---|
| Mean Vehicle Weight | **tons** | 12 | 12 | Assumption |
| Constant, k | lb/VMT | 1.5 | 0.15 | Table 13.2.2-2 (worst case) |
| Constant, a | | 0.9 | 0.9 | Table 13.2.2-2 (worst case) |
| Constant, b | | 0.45 | 0.45 | Table 13.2.2-2 (worst case) |
| Silt content, s | % | 8.5 | 8.5 | Table 13.2..2-1 (construction sites) |
| **Uncontrolled Emission factor, E** | **lb/VMT** | **2.05** | **0.205** | **Calculation** |
| Control Efficiency for Watering | % | 0.65 | 0.65 | Assumption |
| **Controlled Emission factor, E** | **lb/VMT** | **0.72** | **0.072** | **Calculation** |

**Paved Roads - Emission Factor Derivation Table**

$E = (k(sL/2)^{0.65}(W/3)^{1.5}-C)$ AP-42 Section 13.2.1 (11/06 version)

where:

E = particulate emission factor (lb/VMT)
k = particle size multiplier
sL = road surface silt loading ($g/m^2$)
W = average vehicle weight (tons)
C = emission factor for 1980's vehicle fleet exhaust, break wear and tire wear

| Parameter | Units | $PM_{10}$ | $PM_{2.5}$ | Reference |
|---|---|---|---|---|
| Mean Vehicle Weight | tons | 12 | 12 | Assumption |
| k factor | lb/VMT | 0.016 | 0.0024 | Table 13.2-1.1 |
| Silt Loading, sL | $g/m^2$ | 0.6 | 0.6 | Table 13.2.1-3 |
| Emission factor, C | lb/VMT | 0.00047 | 0.00036 | Table 13.2.1-2 |
| **Uncontrolled Emission factor, E** | **lb/VMT** | **0.05805** | **0.008419** | **Calculation** |

**Table 11-A**
**Fugitive Dust Emissions from Road (Site and Off-Site) - Phase I**

**Total Emissions**

| Fuel Type | Total Overall VMT (VMT) | | Emissions (tons) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Unpaved Roads | | Paved Roads | | All Roads | |
| | Paved Roads | Unpaved Roads | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ |
| Heavy Duty Diesel Trucks | 12,200 | 48,800 | 4.382 | 0.438 | 1.42 | 0.205 | 5.80 | 0.644 |
| **Total** | **-** | **-** | **4.4** | **0.4** | **1.4** | **0.21** | **5.8** | **0.64** |

**Daily Emissions**

| Fuel Type | Total Overall VMT (VMT) | | Emissions (lbs/day) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Unpaved Roads | | Paved Roads | | All Roads | |
| | Paved Roads | Unpaved Roads | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ |
| Heavy Duty Diesel Trucks | 12,200 | 48,800 | 36.5 | 3.7 | 11.8 | 1.7 | 48.3 | 5.4 |
| **Total** | **-** | **-** | **36.7** | **3.7** | **11.9** | **1.7** | **48.5** | **5.4** |

**Table 11-B**
**Fugitive Dust Emissions from Road (Site and Off-Site) - Phase II**

**Total Emissions**

| Fuel Type | Total Overall VMT (VMT) | | Emissions (tons) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Unpaved Roads | | Paved Roads | | All Roads | |
| | Paved Roads | Unpaved Roads | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ |
| Heavy Duty Diesel Trucks | 12,200 | 48,800 | 4.382 | 0.438 | 1.42 | 0.205 | 5.80 | 0.644 |
| **Total** | **-** | **-** | **4.4** | **0.4** | **1.4** | **0.21** | **5.8** | **0.64** |

**Daily Emissions**

| Fuel Type | Total Overall VMT (VMT) | | Emissions (lbs/day) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Unpaved Roads | | Paved Roads | | All Roads | |
| | Paved Roads | Unpaved Roads | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ |
| Heavy Duty Diesel Trucks | 12,200 | 48,800 | 36.5 | 3.7 | 11.8 | 1.7 | 48.3 | 5.4 |
| **Total** | **-** | **-** | **36.7** | **3.7** | **11.9** | **1.7** | **48.5** | **5.4** |

*This page intentionally left blank.*

## SCAB Fleet Average Emission Factors (Diesel)

**EF-OFFROAD**

| Air Basin | SC |
|---|---|

| | | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| **Equipment** | **MaxHP** | **ROG** | **CO** | **NOX** | **SOX** | **PM** | **CO2** | **CH4** |
| Aerial Lifts | 15 | 0.0104 | 0.0529 | 0.0662 | 0.0001 | 0.0037 | 8.7 | 0.0009 |
| | 25 | 0.0210 | 0.0577 | 0.1013 | 0.0001 | 0.0065 | 11.0 | 0.0019 |
| | 50 | 0.0756 | 0.1937 | 0.1984 | 0.0003 | 0.0189 | 19.6 | 0.0068 |
| | 120 | 0.0702 | 0.2501 | 0.4502 | 0.0004 | 0.0361 | 38.1 | 0.0063 |
| | 500 | 0.1506 | 0.5801 | 1.9198 | 0.0021 | 0.0598 | 213 | 0.0136 |
| | 750 | 0.2803 | 1.0486 | 3.5605 | 0.0039 | 0.1096 | 385 | 0.0253 |
| Aerial Lifts Composite | | 0.0670 | 0.2093 | 0.3600 | 0.0004 | 0.0248 | 34.7 | 0.0060 |
| Air Compressors | 15 | 0.0144 | 0.0513 | 0.0838 | 0.0001 | 0.0061 | 7.2 | 0.0013 |
| | 25 | 0.0325 | 0.0847 | 0.1397 | 0.0002 | 0.0098 | 14.4 | 0.0029 |
| | 50 | 0.1163 | 0.2813 | 0.2386 | 0.0003 | 0.0265 | 22.3 | 0.0105 |
| | 120 | 0.1014 | 0.3351 | 0.5977 | 0.0006 | 0.0545 | 47.0 | 0.0091 |
| | 175 | 0.1274 | 0.5113 | 1.0082 | 0.0010 | 0.0568 | 88.5 | 0.0115 |
| | 250 | 0.1225 | 0.3413 | 1.3983 | 0.0015 | 0.0462 | 131 | 0.0111 |
| | 500 | 0.1943 | 0.6778 | 2.2062 | 0.0023 | 0.0752 | 232 | 0.0175 |
| | 750 | 0.3054 | 1.0476 | 3.5002 | 0.0036 | 0.1179 | 358 | 0.0276 |
| | 1000 | 0.5203 | 1.8591 | 6.0195 | 0.0049 | 0.1809 | 486 | 0.0469 |
| Air Compressors Composite | | 0.1120 | 0.3613 | 0.7320 | 0.0007 | 0.0526 | 63.6 | 0.0101 |
| Bore/Drill Rigs | 15 | 0.0120 | 0.0632 | 0.0754 | 0.0002 | 0.0031 | 10.3 | 0.0011 |
| | 25 | 0.0196 | 0.0660 | 0.1257 | 0.0002 | 0.0065 | 16.0 | 0.0018 |
| | 50 | 0.0545 | 0.2505 | 0.2820 | 0.0004 | 0.0194 | 31.0 | 0.0049 |
| | 120 | 0.0722 | 0.4812 | 0.6155 | 0.0009 | 0.0456 | 77.1 | 0.0065 |
| | 175 | 0.0930 | 0.7543 | 0.9148 | 0.0016 | 0.0481 | 141 | 0.0084 |
| | 250 | 0.0957 | 0.3460 | 1.1847 | 0.0021 | 0.0384 | 188 | 0.0086 |
| | 500 | 0.1488 | 0.5566 | 1.7054 | 0.0031 | 0.0614 | 311 | 0.0134 |
| | 750 | 0.2996 | 1.0997 | 3.4821 | 0.0062 | 0.1231 | 615 | 0.0270 |
| | 1000 | 0.5360 | 1.7074 | 8.3092 | 0.0093 | 0.2078 | 928 | 0.0484 |
| Bore/Drill Rigs Composite | | 0.1052 | 0.5146 | 1.1331 | 0.0017 | 0.0498 | 165 | 0.0095 |
| Cement and Mortar Mixers | 15 | 0.0079 | 0.0388 | 0.0505 | 0.0001 | 0.0029 | 6.3 | 0.0007 |
| | 25 | 0.0346 | 0.0942 | 0.1633 | 0.0002 | 0.0107 | 17.6 | 0.0031 |
| Cement and Mortar Mixers Composite | | 0.0101 | 0.0434 | 0.0599 | 0.0001 | 0.0035 | 7.2 | 0.0009 |
| Concrete/Industrial Saws | 25 | 0.0200 | 0.0678 | 0.1279 | 0.0002 | 0.0063 | 16.5 | 0.0018 |
| | 50 | 0.1231 | 0.3210 | 0.3070 | 0.0004 | 0.0301 | 30.2 | 0.0111 |
| | 120 | 0.1342 | 0.4976 | 0.8601 | 0.0009 | 0.0719 | 74.1 | 0.0121 |
| | 175 | 0.1927 | 0.8786 | 1.6459 | 0.0018 | 0.0864 | 160 | 0.0174 |
| Concrete/Industrial Saws Composite | | 0.1270 | 0.4273 | 0.6566 | 0.0007 | 0.0552 | 58.5 | 0.0115 |
| Cranes | 50 | 0.1284 | 0.3166 | 0.2547 | 0.0003 | 0.0289 | 23.2 | 0.0116 |
| | 120 | 0.1117 | 0.3723 | 0.6542 | 0.0006 | 0.0602 | 50.1 | 0.0101 |
| | 175 | 0.1211 | 0.4880 | 0.9302 | 0.0009 | 0.0538 | 80.3 | 0.0109 |
| | 250 | 0.1243 | 0.3464 | 1.2372 | 0.0013 | 0.0470 | 112 | 0.0112 |
| | 500 | 0.1821 | 0.6625 | 1.7722 | 0.0018 | 0.0685 | 180 | 0.0164 |
| | 750 | 0.3082 | 1.1113 | 3.0564 | 0.0030 | 0.1166 | 303 | 0.0278 |
| | 9999 | 1.0894 | 4.1317 | 12.1879 | 0.0098 | 0.3792 | 971 | 0.0983 |
| Cranes Composite | | 0.1594 | 0.5431 | 1.4515 | 0.0014 | 0.0642 | 129 | 0.0144 |
| Crawler Tractors | 50 | 0.1446 | 0.3520 | 0.2780 | 0.0003 | 0.0320 | 24.9 | 0.0131 |
| | 120 | 0.1551 | 0.5018 | 0.9038 | 0.0008 | 0.0819 | 65.8 | 0.0140 |
| | 175 | 0.1941 | 0.7597 | 1.4788 | 0.0014 | 0.0856 | 121 | 0.0175 |
| | 250 | 0.2051 | 0.5743 | 1.9440 | 0.0019 | 0.0784 | 166 | 0.0185 |

## SCAB Fleet Average Emission Factors (Diesel)

**EF-OFFROAD**

| | |
|---|---|
| **Air Basin** | **SC** |

| | | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| **Equipment** | **MaxHP** | **ROG** | **CO** | **NOX** | **SOX** | **PM** | **CO2** | **CH4** |
| | 500 | 0.2913 | 1.1931 | 2.7255 | 0.0025 | 0.1101 | 259 | 0.0263 |
| | 750 | 0.5240 | 2.1290 | 4.9881 | 0.0047 | 0.1989 | 465 | 0.0473 |
| | 1000 | 0.7980 | 3.3726 | 8.5998 | 0.0066 | 0.2810 | 658 | 0.0720 |
| Crawler Tractors Composite | | 0.1861 | 0.6409 | 1.3854 | 0.0013 | 0.0854 | 114 | 0.0168 |
| Crushing/Proc. Equipment | 50 | 0.2271 | 0.5592 | 0.4700 | 0.0006 | 0.0520 | 44.0 | 0.0205 |
| | 120 | 0.1760 | 0.5956 | 1.0382 | 0.0010 | 0.0960 | 83.1 | 0.0159 |
| | 175 | 0.2367 | 0.9736 | 1.8607 | 0.0019 | 0.1068 | 167 | 0.0214 |
| | 250 | 0.2243 | 0.6225 | 2.5465 | 0.0028 | 0.0841 | 245 | 0.0202 |
| | 500 | 0.3091 | 1.0542 | 3.4510 | 0.0037 | 0.1187 | 374 | 0.0279 |
| | 750 | 0.4956 | 1.6226 | 5.6506 | 0.0059 | 0.1900 | 589 | 0.0447 |
| | 9999 | 1.3820 | 4.8014 | 16.0752 | 0.0131 | 0.4812 | 1,308 | 0.1247 |
| Crushing/Proc. Equipment Composite | | 0.2152 | 0.7260 | 1.4394 | 0.0015 | 0.0935 | 132 | 0.0194 |
| Dumpers/Tenders | 25 | 0.0108 | 0.0336 | 0.0645 | 0.0001 | 0.0036 | 7.6 | 0.0010 |
| Dumpers/Tenders Composite | | 0.0108 | 0.0336 | 0.0645 | 0.0001 | 0.0036 | 7.6 | 0.0010 |
| Excavators | 25 | 0.0199 | 0.0677 | 0.1261 | 0.0002 | 0.0057 | 16.4 | 0.0018 |
| | 50 | 0.1131 | 0.3145 | 0.2638 | 0.0003 | 0.0276 | 25.0 | 0.0102 |
| | 120 | 0.1398 | 0.5318 | 0.8402 | 0.0009 | 0.0781 | 73.6 | 0.0126 |
| | 175 | 0.1465 | 0.6701 | 1.1143 | 0.0013 | 0.0663 | 112 | 0.0132 |
| | 250 | 0.1451 | 0.3934 | 1.4935 | 0.0018 | 0.0519 | 159 | 0.0131 |
| | 500 | 0.1984 | 0.6161 | 1.9285 | 0.0023 | 0.0711 | 234 | 0.0179 |
| | 750 | 0.3313 | 1.0196 | 3.3023 | 0.0039 | 0.1198 | 387 | 0.0299 |
| Excavators Composite | | 0.1483 | 0.5581 | 1.1502 | 0.0013 | 0.0638 | 120 | 0.0134 |
| Forklifts | 50 | 0.0666 | 0.1824 | 0.1530 | 0.0002 | 0.0163 | 14.7 | 0.0060 |
| | 120 | 0.0601 | 0.2243 | 0.3497 | 0.0004 | 0.0342 | 31.2 | 0.0054 |
| | 175 | 0.0738 | 0.3306 | 0.5540 | 0.0006 | 0.0337 | 56.1 | 0.0067 |
| | 250 | 0.0652 | 0.1707 | 0.7163 | 0.0009 | 0.0227 | 77.1 | 0.0059 |
| | 500 | 0.0868 | 0.2343 | 0.8909 | 0.0011 | 0.0307 | 111 | 0.0078 |
| Forklifts Composite | | 0.0686 | 0.2319 | 0.5161 | 0.0006 | 0.0281 | 54.4 | 0.0062 |
| Generator Sets | 15 | 0.0172 | 0.0726 | 0.1154 | 0.0002 | 0.0069 | 10.2 | 0.0016 |
| | 25 | 0.0300 | 0.1033 | 0.1705 | 0.0002 | 0.0107 | 17.6 | 0.0027 |
| | 50 | 0.1117 | 0.2904 | 0.3070 | 0.0004 | 0.0284 | 30.6 | 0.0101 |
| | 120 | 0.1395 | 0.5054 | 0.9075 | 0.0009 | 0.0714 | 77.9 | 0.0126 |
| | 175 | 0.1672 | 0.7471 | 1.4780 | 0.0016 | 0.0721 | 142 | 0.0151 |
| | 250 | 0.1618 | 0.5018 | 2.0720 | 0.0024 | 0.0618 | 213 | 0.0146 |
| | 500 | 0.2305 | 0.8858 | 2.9974 | 0.0033 | 0.0917 | 337 | 0.0208 |
| | 750 | 0.3838 | 1.4300 | 4.9646 | 0.0055 | 0.1502 | 544 | 0.0346 |
| | 9999 | 1.0080 | 3.6008 | 12.1384 | 0.0105 | 0.3600 | 1,049 | 0.0909 |
| Generator Sets Composite | | 0.0961 | 0.3293 | 0.6440 | 0.0007 | 0.0396 | 61.0 | 0.0087 |
| Graders | 50 | 0.1400 | 0.3584 | 0.2961 | 0.0004 | 0.0323 | 27.5 | 0.0126 |
| | 120 | 0.1553 | 0.5459 | 0.9268 | 0.0009 | 0.0849 | 75.0 | 0.0140 |
| | 175 | 0.1743 | 0.7409 | 1.3532 | 0.0014 | 0.0783 | 124 | 0.0157 |
| | 250 | 0.1761 | 0.4934 | 1.7904 | 0.0019 | 0.0662 | 172 | 0.0159 |
| | 500 | 0.2149 | 0.7523 | 2.1198 | 0.0023 | 0.0807 | 229 | 0.0194 |
| | 750 | 0.4580 | 1.5877 | 4.6098 | 0.0049 | 0.1729 | 486 | 0.0413 |
| Graders Composite | | 0.1723 | 0.6314 | 1.4338 | 0.0015 | 0.0753 | 133 | 0.0155 |
| Off-Highway Tractors | 120 | 0.2457 | 0.7439 | 1.4200 | 0.0011 | 0.1255 | 93.7 | 0.0222 |
| | 175 | 0.2326 | 0.8561 | 1.7665 | 0.0015 | 0.1014 | 130 | 0.0210 |

## SCAB Fleet Average Emission Factors (Diesel)

**EF-OFFROAD**

| **Air Basin** | **SC** |
|---|---|

| | | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| **Equipment** | **MaxHP** | **ROG** | **CO** | **NOX** | **SOX** | **PM** | **CO2** | **CH4** |
| | 250 | 0.1881 | 0.5347 | 1.7050 | 0.0015 | 0.0735 | 130 | 0.0170 |
| | 750 | 0.7400 | 3.5496 | 6.8440 | 0.0057 | 0.2854 | 568 | 0.0668 |
| | 1000 | 1.1197 | 5.5155 | 11.4633 | 0.0082 | 0.4009 | 814 | 0.1010 |
| Off-Highway Tractors Composite | | 0.2368 | 0.8385 | 1.9897 | 0.0017 | 0.0974 | 151 | 0.0214 |
| Off-Highway Trucks | 175 | 0.1732 | 0.7625 | 1.2796 | 0.0014 | 0.0771 | 125 | 0.0156 |
| | 250 | 0.1639 | 0.4301 | 1.6150 | 0.0019 | 0.0574 | 167 | 0.0148 |
| | 500 | 0.2492 | 0.7542 | 2.3188 | 0.0027 | 0.0872 | 272 | 0.0225 |
| | 750 | 0.4069 | 1.2210 | 3.8814 | 0.0044 | 0.1436 | 442 | 0.0367 |
| | 1000 | 0.6440 | 2.0615 | 7.3260 | 0.0063 | 0.2219 | 625 | 0.0581 |
| Off-Highway Trucks Composite | | 0.2480 | 0.7429 | 2.3885 | 0.0027 | 0.0875 | 260 | 0.0224 |
| Other Construction Equipment | 15 | 0.0118 | 0.0617 | 0.0737 | 0.0002 | 0.0030 | 10.1 | 0.0011 |
| | 25 | 0.0162 | 0.0545 | 0.1039 | 0.0002 | 0.0053 | 13.2 | 0.0015 |
| | 50 | 0.1033 | 0.2930 | 0.2787 | 0.0004 | 0.0263 | 28.0 | 0.0093 |
| | 120 | 0.1320 | 0.5419 | 0.8649 | 0.0009 | 0.0740 | 80.9 | 0.0119 |
| | 175 | 0.1168 | 0.5901 | 0.9927 | 0.0012 | 0.0543 | 107 | 0.0105 |
| | 500 | 0.1705 | 0.6068 | 1.9821 | 0.0025 | 0.0678 | 254 | 0.0154 |
| Other Construction Equipment Composite | | 0.1056 | 0.4108 | 1.0117 | 0.0013 | 0.0442 | 123 | 0.0095 |
| Other General Industrial Equipmen | 15 | 0.0066 | 0.0391 | 0.0466 | 0.0001 | 0.0017 | 6.4 | 0.0006 |
| | 25 | 0.0186 | 0.0632 | 0.1177 | 0.0002 | 0.0054 | 15.3 | 0.0017 |
| | 50 | 0.1281 | 0.3073 | 0.2413 | 0.0003 | 0.0285 | 21.7 | 0.0116 |
| | 120 | 0.1459 | 0.4647 | 0.8218 | 0.0007 | 0.0795 | 62.0 | 0.0132 |
| | 175 | 0.1516 | 0.5816 | 1.1364 | 0.0011 | 0.0676 | 95.9 | 0.0137 |
| | 250 | 0.1400 | 0.3676 | 1.5016 | 0.0015 | 0.0509 | 136 | 0.0126 |
| | 500 | 0.2500 | 0.8031 | 2.6018 | 0.0026 | 0.0919 | 265 | 0.0226 |
| | 750 | 0.4153 | 1.3236 | 4.4083 | 0.0044 | 0.1538 | 437 | 0.0375 |
| | 1000 | 0.6374 | 2.2063 | 7.1530 | 0.0056 | 0.2212 | 560 | 0.0575 |
| Other General Industrial Equipmen Composite | | 0.1847 | 0.5948 | 1.6649 | 0.0016 | 0.0740 | 152 | 0.0167 |
| Other Material Handling Equipmen | 50 | 0.1773 | 0.4246 | 0.3355 | 0.0004 | 0.0395 | 30.3 | 0.0160 |
| | 120 | 0.1417 | 0.4524 | 0.8014 | 0.0007 | 0.0772 | 60.7 | 0.0128 |
| | 175 | 0.1914 | 0.7367 | 1.4429 | 0.0014 | 0.0856 | 122 | 0.0173 |
| | 250 | 0.1481 | 0.3917 | 1.6024 | 0.0016 | 0.0542 | 145 | 0.0134 |
| | 500 | 0.1782 | 0.5784 | 1.8750 | 0.0019 | 0.0660 | 192 | 0.0161 |
| | 9999 | 0.8390 | 2.9174 | 9.4509 | 0.0073 | 0.2912 | 741 | 0.0757 |
| Other Material Handling Equipment Composite | | 0.1773 | 0.5556 | 1.6150 | 0.0015 | 0.0715 | 141 | 0.0160 |
| Pavers | 25 | 0.0278 | 0.0845 | 0.1603 | 0.0002 | 0.0092 | 18.7 | 0.0025 |
| | 50 | 0.1624 | 0.3860 | 0.3110 | 0.0004 | 0.0356 | 28.0 | 0.0147 |
| | 120 | 0.1638 | 0.5223 | 0.9693 | 0.0008 | 0.0853 | 69.2 | 0.0148 |
| | 175 | 0.2049 | 0.7959 | 1.6028 | 0.0014 | 0.0903 | 128 | 0.0185 |
| | 250 | 0.2426 | 0.7011 | 2.3337 | 0.0022 | 0.0953 | 194 | 0.0219 |
| | 500 | 0.2622 | 1.1661 | 2.5319 | 0.0023 | 0.1023 | 233 | 0.0237 |
| Pavers Composite | | 0.1774 | 0.5644 | 0.9868 | 0.0009 | 0.0709 | 77.9 | 0.0160 |
| Paving Equipment | 25 | 0.0155 | 0.0521 | 0.0993 | 0.0002 | 0.0051 | 12.6 | 0.0014 |
| | 50 | 0.1384 | 0.3277 | 0.2654 | 0.0003 | 0.0303 | 23.9 | 0.0125 |
| | 120 | 0.1282 | 0.4084 | 0.7600 | 0.0006 | 0.0668 | 54.5 | 0.0116 |
| | 175 | 0.1599 | 0.6208 | 1.2577 | 0.0011 | 0.0704 | 101 | 0.0144 |
| | 250 | 0.1506 | 0.4363 | 1.4619 | 0.0014 | 0.0592 | 122 | 0.0136 |
| Paving Equipment Composite | | 0.1336 | 0.4478 | 0.8963 | 0.0008 | 0.0629 | 68.9 | 0.0121 |

## SCAB Fleet Average Emission Factors (Diesel)

**EF-OFFROAD**

| Air Basin | SC |
|---|---|

| Equipment | MaxHP | ROG (lb/hr) | CO (lb/hr) | NOX (lb/hr) | SOX (lb/hr) | PM (lb/hr) | CO2 (lb/hr) | CH4 (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| Plate Compactors | 15 | 0.0050 | 0.0263 | 0.0317 | 0.0001 | 0.0015 | 4.3 | 0.0005 |
| Plate Compactors Composite | | 0.0050 | 0.0263 | 0.0317 | 0.0001 | 0.0015 | 4.3 | 0.0005 |
| Pressure Washers | 15 | 0.0083 | 0.0348 | 0.0553 | 0.0001 | 0.0033 | 4.9 | 0.0007 |
| | 25 | 0.0122 | 0.0419 | 0.0691 | 0.0001 | 0.0043 | 7.1 | 0.0011 |
| | 50 | 0.0413 | 0.1143 | 0.1388 | 0.0002 | 0.0115 | 14.3 | 0.0037 |
| | 120 | 0.0388 | 0.1487 | 0.2674 | 0.0003 | 0.0193 | 24.1 | 0.0035 |
| Pressure Washers Composite | | 0.0199 | 0.0666 | 0.0989 | 0.0001 | 0.0070 | 9.4 | 0.0018 |
| Pumps | 15 | 0.0148 | 0.0528 | 0.0862 | 0.0001 | 0.0062 | 7.4 | 0.0013 |
| | 25 | 0.0439 | 0.1142 | 0.1884 | 0.0002 | 0.0133 | 19.5 | 0.0040 |
| | 50 | 0.1339 | 0.3428 | 0.3479 | 0.0004 | 0.0333 | 34.3 | 0.0121 |
| | 120 | 0.1441 | 0.5136 | 0.9216 | 0.0009 | 0.0744 | 77.9 | 0.0130 |
| | 175 | 0.1709 | 0.7489 | 1.4815 | 0.0016 | 0.0742 | 140 | 0.0154 |
| | 250 | 0.1593 | 0.4846 | 1.9941 | 0.0023 | 0.0609 | 201 | 0.0144 |
| | 500 | 0.2450 | 0.9411 | 3.1080 | 0.0034 | 0.0973 | 345 | 0.0221 |
| | 750 | 0.4167 | 1.5559 | 5.2721 | 0.0057 | 0.1631 | 571 | 0.0376 |
| | 9999 | 1.3269 | 4.8008 | 15.8590 | 0.0136 | 0.4723 | 1,355 | 0.1197 |
| Pumps Composite | | 0.0936 | 0.3096 | 0.5545 | 0.0006 | 0.0393 | 49.6 | 0.0084 |
| Rollers | 15 | 0.0074 | 0.0386 | 0.0461 | 0.0001 | 0.0019 | 6.3 | 0.0007 |
| | 25 | 0.0164 | 0.0551 | 0.1049 | 0.0002 | 0.0054 | 13.3 | 0.0015 |
| | 50 | 0.1270 | 0.3169 | 0.2753 | 0.0003 | 0.0292 | 26.0 | 0.0115 |
| | 120 | 0.1201 | 0.4177 | 0.7383 | 0.0007 | 0.0641 | 59.0 | 0.0108 |
| | 175 | 0.1478 | 0.6270 | 1.2022 | 0.0012 | 0.0659 | 108 | 0.0133 |
| | 250 | 0.1542 | 0.4540 | 1.6232 | 0.0017 | 0.0603 | 153 | 0.0139 |
| | 500 | 0.1987 | 0.7785 | 2.0882 | 0.0022 | 0.0783 | 219 | 0.0179 |
| Rollers Composite | | 0.1176 | 0.4212 | 0.7749 | 0.0008 | 0.0547 | 67.1 | 0.0106 |
| Rough Terrain Forklifts | 50 | 0.1590 | 0.4186 | 0.3558 | 0.0004 | 0.0377 | 33.9 | 0.0143 |
| | 120 | 0.1213 | 0.4447 | 0.7326 | 0.0007 | 0.0676 | 62.4 | 0.0109 |
| | 175 | 0.1640 | 0.7302 | 1.2875 | 0.0014 | 0.0749 | 125 | 0.0148 |
| | 250 | 0.1523 | 0.4270 | 1.6632 | 0.0019 | 0.0567 | 171 | 0.0137 |
| | 500 | 0.2097 | 0.6871 | 2.1987 | 0.0025 | 0.0788 | 257 | 0.0189 |
| Rough Terrain Forklifts Composite | | 0.1272 | 0.4766 | 0.7988 | 0.0008 | 0.0678 | 70.3 | 0.0115 |
| Rubber Tired Dozers | 175 | 0.2398 | 0.8686 | 1.7881 | 0.0015 | 0.1036 | 129 | 0.0216 |
| | 250 | 0.2776 | 0.7758 | 2.4482 | 0.0021 | 0.1071 | 183 | 0.0250 |
| | 500 | 0.3621 | 1.7411 | 3.2071 | 0.0026 | 0.1370 | 265 | 0.0327 |
| | 750 | 0.5457 | 2.6075 | 4.9024 | 0.0040 | 0.2071 | 399 | 0.0492 |
| | 1000 | 0.8464 | 4.1786 | 8.4813 | 0.0060 | 0.3018 | 592 | 0.0764 |
| Rubber Tired Dozers Composite | | 0.3379 | 1.4127 | 2.9891 | 0.0025 | 0.1288 | 239 | 0.0305 |
| Rubber Tired Loaders | 25 | 0.0206 | 0.0697 | 0.1314 | 0.0002 | 0.0064 | 16.9 | 0.0019 |
| | 50 | 0.1560 | 0.4005 | 0.3333 | 0.0004 | 0.0361 | 31.1 | 0.0141 |
| | 120 | 0.1206 | 0.4268 | 0.7227 | 0.0007 | 0.0660 | 58.9 | 0.0109 |
| | 175 | 0.1476 | 0.6326 | 1.1513 | 0.0012 | 0.0664 | 106 | 0.0133 |
| | 250 | 0.1493 | 0.4210 | 1.5357 | 0.0017 | 0.0563 | 149 | 0.0135 |
| | 500 | 0.2172 | 0.7648 | 2.1684 | 0.0023 | 0.0819 | 237 | 0.0196 |
| | 750 | 0.4484 | 1.5625 | 4.5660 | 0.0049 | 0.1700 | 486 | 0.0405 |
| | 1000 | 0.6154 | 2.2308 | 7.1368 | 0.0060 | 0.2156 | 594 | 0.0555 |
| Rubber Tired Loaders Composite | | 0.1440 | 0.5078 | 1.1537 | 0.0012 | 0.0651 | 109 | 0.0130 |
| Scrapers | 120 | 0.2236 | 0.7169 | 1.3034 | 0.0011 | 0.1177 | 93.9 | 0.0202 |

## SCAB Fleet Average Emission Factors (Diesel)

**EF-OFFROAD**

| **Air Basin** | **SC** |
|---|---|

| Equipment | MaxHP | ROG (lb/hr) | CO (lb/hr) | NOX (lb/hr) | SOX (lb/hr) | PM (lb/hr) | CO2 (lb/hr) | CH4 (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| | 175 | 0.2391 | 0.9290 | 1.8284 | 0.0017 | 0.1053 | 148 | 0.0216 |
| | 250 | 0.2618 | 0.7368 | 2.4818 | 0.0024 | 0.1006 | 209 | 0.0236 |
| | 500 | 0.3650 | 1.5182 | 3.4250 | 0.0032 | 0.1386 | 321 | 0.0329 |
| | 750 | 0.6328 | 2.6115 | 6.0373 | 0.0056 | 0.2413 | 555 | 0.0571 |
| Scrapers Composite | | 0.3202 | 1.2424 | 2.9078 | 0.0027 | 0.1256 | 262 | 0.0289 |
| Signal Boards | 15 | 0.0072 | 0.0377 | 0.0450 | 0.0001 | 0.0017 | 6.2 | 0.0006 |
| | 50 | 0.1492 | 0.3827 | 0.3689 | 0.0005 | 0.0364 | 36.2 | 0.0135 |
| | 120 | 0.1495 | 0.5380 | 0.9446 | 0.0009 | 0.0792 | 80.2 | 0.0135 |
| | 175 | 0.1907 | 0.8437 | 1.6203 | 0.0017 | 0.0846 | 155 | 0.0172 |
| | 250 | 0.2049 | 0.6138 | 2.5094 | 0.0029 | 0.0789 | 255 | 0.0185 |
| Signal Boards Composite | | 0.0224 | 0.0953 | 0.1615 | 0.0002 | 0.0091 | 16.7 | 0.0020 |
| Skid Steer Loaders | 25 | 0.0249 | 0.0700 | 0.1252 | 0.0002 | 0.0079 | 13.8 | 0.0022 |
| | 50 | 0.0785 | 0.2507 | 0.2463 | 0.0003 | 0.0217 | 25.5 | 0.0071 |
| | 120 | 0.0607 | 0.2822 | 0.4131 | 0.0005 | 0.0355 | 42.8 | 0.0055 |
| Skid Steer Loaders Composite | | 0.0692 | 0.2489 | 0.2919 | 0.0004 | 0.0252 | 30.3 | 0.0062 |
| Surfacing Equipment | 50 | 0.0589 | 0.1520 | 0.1451 | 0.0002 | 0.0142 | 14.1 | 0.0053 |
| | 120 | 0.1192 | 0.4334 | 0.7683 | 0.0007 | 0.0624 | 63.8 | 0.0108 |
| | 175 | 0.1071 | 0.4787 | 0.9169 | 0.0010 | 0.0472 | 85.8 | 0.0097 |
| | 250 | 0.1254 | 0.3883 | 1.3783 | 0.0015 | 0.0494 | 135 | 0.0113 |
| | 500 | 0.1854 | 0.7785 | 2.0517 | 0.0022 | 0.0741 | 221 | 0.0167 |
| | 750 | 0.2960 | 1.2171 | 3.2929 | 0.0035 | 0.1173 | 347 | 0.0267 |
| Surfacing Equipment Composite | | 0.1550 | 0.6164 | 1.5685 | 0.0017 | 0.0606 | 166 | 0.0140 |
| Sweepers/Scrubbers | 15 | 0.0124 | 0.0729 | 0.0870 | 0.0002 | 0.0033 | 11.9 | 0.0011 |
| | 25 | 0.0239 | 0.0808 | 0.1524 | 0.0002 | 0.0075 | 19.6 | 0.0022 |
| | 50 | 0.1508 | 0.3893 | 0.3297 | 0.0004 | 0.0355 | 31.6 | 0.0136 |
| | 120 | 0.1490 | 0.5329 | 0.8645 | 0.0009 | 0.0843 | 75.0 | 0.0134 |
| | 175 | 0.1856 | 0.8049 | 1.4276 | 0.0016 | 0.0854 | 139 | 0.0167 |
| | 250 | 0.1344 | 0.3643 | 1.5598 | 0.0018 | 0.0489 | 162 | 0.0121 |
| Sweepers/Scrubbers Composite | | 0.1548 | 0.5380 | 0.8473 | 0.0009 | 0.0686 | 78.5 | 0.0140 |
| Tractors/Loaders/Backhoes | 25 | 0.0214 | 0.0681 | 0.1317 | 0.0002 | 0.0072 | 15.9 | 0.0019 |
| | 50 | 0.1257 | 0.3548 | 0.3114 | 0.0004 | 0.0312 | 30.3 | 0.0113 |
| | 120 | 0.0910 | 0.3623 | 0.5664 | 0.0006 | 0.0515 | 51.7 | 0.0082 |
| | 175 | 0.1216 | 0.5881 | 0.9646 | 0.0011 | 0.0562 | 101 | 0.0110 |
| | 250 | 0.1418 | 0.4037 | 1.5493 | 0.0019 | 0.0523 | 172 | 0.0128 |
| | 500 | 0.2630 | 0.8495 | 2.7242 | 0.0039 | 0.0980 | 345 | 0.0237 |
| | 750 | 0.3986 | 1.2725 | 4.2276 | 0.0058 | 0.1496 | 517 | 0.0360 |
| Tractors/Loaders/Backhoes Composite | | 0.1021 | 0.3930 | 0.6747 | 0.0008 | 0.0521 | 66.8 | 0.0092 |
| Trenchers | 15 | 0.0099 | 0.0517 | 0.0617 | 0.0001 | 0.0023 | 8.5 | 0.0009 |
| | 25 | 0.0400 | 0.1355 | 0.2555 | 0.0004 | 0.0125 | 32.9 | 0.0036 |
| | 50 | 0.1837 | 0.4365 | 0.3620 | 0.0004 | 0.0405 | 32.9 | 0.0166 |
| | 120 | 0.1509 | 0.4840 | 0.9082 | 0.0008 | 0.0776 | 64.9 | 0.0136 |
| | 175 | 0.2254 | 0.8843 | 1.7973 | 0.0016 | 0.0990 | 144 | 0.0203 |
| | 250 | 0.2770 | 0.8161 | 2.6802 | 0.0025 | 0.1103 | 223 | 0.0250 |
| | 500 | 0.3468 | 1.6352 | 3.4013 | 0.0031 | 0.1373 | 311 | 0.0313 |
| | 750 | 0.6586 | 3.0677 | 6.5218 | 0.0059 | 0.2602 | 587 | 0.0594 |
| Trenchers Composite | | 0.1675 | 0.4907 | 0.7598 | 0.0007 | 0.0637 | 58.7 | 0.0151 |
| Welders | 15 | 0.0124 | 0.0441 | 0.0720 | 0.0001 | 0.0052 | 6.2 | 0.0011 |

## SCAB Fleet Average Emission Factors (Diesel)

**EF-OFFROAD**

| **Air Basin** | **SC** |
|---|---|

| | | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) | (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| **Equipment** | **MaxHP** | **ROG** | **CO** | **NOX** | **SOX** | **PM** | **CO2** | **CH4** |
| | 25 | 0.0254 | 0.0661 | 0.1091 | 0.0001 | 0.0077 | 11.3 | 0.0023 |
| | 50 | 0.1231 | 0.3025 | 0.2724 | 0.0003 | 0.0287 | 26.0 | 0.0111 |
| | 120 | 0.0807 | 0.2738 | 0.4899 | 0.0005 | 0.0428 | 39.5 | 0.0073 |
| | 175 | 0.1333 | 0.5515 | 1.0896 | 0.0011 | 0.0590 | 98.2 | 0.0120 |
| | 250 | 0.1052 | 0.3022 | 1.2367 | 0.0013 | 0.0400 | 119 | 0.0095 |
| | 500 | 0.1327 | 0.4823 | 1.5648 | 0.0016 | 0.0520 | 168 | 0.0120 |
| Welders Composite | | 0.0805 | 0.2246 | 0.2920 | 0.0003 | 0.0270 | 25.6 | 0.0073 |

AQMD

# Highest (Most Conservative) EMFAC2007 (version 2.3) Emission Factors for On-Road Heavy-Heavy-Duty Diesel Trucks

Projects in the SCAQMD (Scenario Years 2007 - 2026)
Derived from Peak Emissions Inventory (**Winter**, **Annual**, **Summer**)

**Vehicle Class:**
**Heavy-Heavy-Duty Diesel Trucks (33,001 to 60,000 pounds)**

The following emission factors were compiled by running the California Air Resources Board's EMFAC2007 (version 2.3) Burden Model and extracting the **Heavy-Heavy-Duty Diesel Truck (HHDT)** Emission Factors.

These emission factors can be used to calculate on-road mobile source emissions for the vehicle/emission categories listed in the tables below, by use of the following equation:

**Emissions (pounds per day) = N x TL x EF**

where N = number of trips, TL = trip length (miles/day), and EF = emission factor (pounds per mile)

The **HHDT-DSL** vehicle/emission category accounts for all emissions from heavy-heavy-duty diesel trucks, including start, running and idling exhaust. In addition, ROG emission factors account for diurnal, hot soak, running and resting emissions, and the PM10 & PM2.5 emission factors account for tire and brake wear.

The **HHDT-DSL, Exh** vehicle/emission category includes only the exhaust portion of PM10 & PM2.5 emissions from heavy-heavy-duty diesel trucks.

Scenario Year: **2007**
All model years in the range 1965 to 2007

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.01446237 |
| NOx | 0.04718166 |
| ROG | 0.00372949 |
| SOx | 0.00003962 |
| PM10 | 0.00230900 |
| PM2.5 | 0.00204018 |
| CO2 | 4.22184493 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00216752 |
| PM2.5 | 0.00199491 |

Scenario Year: **2008**
All model years in the range 1965 to 2008

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.01361368 |
| NOx | 0.04458017 |
| ROG | 0.00351579 |
| SOx | 0.00004136 |
| PM10 | 0.00215635 |
| PM2.5 | 0.00189990 |
| CO2 | 4.21067145 |
| CH4 | 0.00016269 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00201296 |
| PM2.5 | 0.00185303 |

Scenario Year: **2009**
All model years in the range 1965 to 2009

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.01282236 |
| NOx | 0.04184591 |
| ROG | 0.00329320 |
| SOx | 0.00004013 |
| PM10 | 0.00199572 |
| PM2.5 | 0.00175227 |
| CO2 | 4.21080792 |
| CH4 | 0.00015249 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00185393 |
| PM2.5 | 0.00170680 |

Scenario Year: **2010**
All model years in the range 1966 to 2010

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.01195456 |
| NOx | 0.03822102 |
| ROG | 0.00304157 |
| SOx | 0.00004131 |
| PM10 | 0.00183062 |
| PM2.5 | 0.00160083 |
| CO2 | 4.21120578 |
| CH4 | 0.00014201 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00168861 |
| PM2.5 | 0.00155435 |

# Highest (Most Conservative) EMFAC2007 (version 2.3)
# Emission Factors for On-Road Heavy-Heavy-Duty Diesel Trucks

Projects in the SCAQMD (Scenario Years 2007 - 2026)

Derived from Peak Emissions Inventory (**Winter**, **Annual**, **Summer**)

**Vehicle Class:**

**Heavy-Heavy-Duty Diesel Trucks (33,001 to 60,000 pounds)**

Scenario Year: **2011**

All model years in the range 1967 to 2011

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.01112463 |
| NOx | 0.03455809 |
| ROG | 0.00279543 |
| SOx | 0.00003972 |
| PM10 | 0.00166087 |
| PM2.5 | 0.00144489 |
| CO2 | 4.22045680 |
| CH4 | 0.00012910 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00151936 |
| PM2.5 | 0.00139772 |

Scenario Year: **2012**

All model years in the range 1968 to 2012

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.01021519 |
| NOx | 0.03092379 |
| ROG | 0.00252764 |
| SOx | 0.00004042 |
| PM10 | 0.00149566 |
| PM2.5 | 0.00129354 |
| CO2 | 4.21590774 |
| CH4 | 0.00011651 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00135537 |
| PM2.5 | 0.00124837 |

Scenario Year: **2013**

All model years in the range 1969 to 2013

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.00931790 |
| NOx | 0.02742935 |
| ROG | 0.00226308 |
| SOx | 0.00004086 |
| PM10 | 0.00133697 |
| PM2.5 | 0.00114629 |
| CO2 | 4.21518556 |
| CH4 | 0.00010441 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00119623 |
| PM2.5 | 0.00109863 |

Scenario Year: **2014**

All model years in the range 1970 to 2014

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.00846435 |
| NOx | 0.02418049 |
| ROG | 0.00201594 |
| SOx | 0.00004092 |
| PM10 | 0.00118458 |
| PM2.5 | 0.00100582 |
| CO2 | 4.21279345 |
| CH4 | 0.00009261 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00104243 |
| PM2.5 | 0.00096059 |

Scenario Year: **2015**

All model years in the range 1971 to 2015

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.00766891 |
| NOx | 0.02122678 |
| ROG | 0.00178608 |
| SOx | 0.00004082 |
| PM10 | 0.00104715 |
| PM2.5 | 0.00087977 |
| CO2 | 4.20902225 |
| CH4 | 0.00008369 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00090631 |
| PM2.5 | 0.00083282 |

Scenario Year: **2016**

All model years in the range 1972 to 2016

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | 0.00704604 |
| NOx | 0.01887374 |
| ROG | 0.00161035 |
| SOx | 0.00003952 |
| PM10 | 0.00094448 |
| PM2.5 | 0.00078443 |
| CO2 | 4.21063031 |
| CH4 | 0.00007508 |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | 0.00080419 |
| PM2.5 | 0.00073898 |

## Highest (Most Conservative) EMFAC2007 (version 2.3)
## Emission Factors for On-Road Heavy-Heavy-Duty Diesel Trucks

Projects in the SCAQMD (Scenario Years 2007 - 2026)

Derived from Peak Emissions Inventory (**Winter**, **Annual**, **Summer**)

**Vehicle Class:**

**Heavy-Heavy-Duty Diesel Trucks (33,001 to 60,000 pounds)**

Scenario Year: **2017**

All model years in the range 1973 to 2017

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00650533** |
| NOx | **0.01690387** |
| ROG | **0.00145203** |
| SOx | **0.00004033** |
| PM10 | **0.00084894** |
| PM2.5 | **0.00069721** |
| CO2 | **4.20820129** |
| CH4 | **0.00006722** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00070873** |
| PM2.5 | **0.00065111** |

Scenario Year: **2018**

All model years in the range 1974 to 2018

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00604721** |
| NOx | **0.01526414** |
| ROG | **0.00131697** |
| SOx | **0.00003934** |
| PM10 | **0.00076808** |
| PM2.5 | **0.00062383** |
| CO2 | **4.20756838** |
| CH4 | **0.00006182** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00062758** |
| PM2.5 | **0.00057700** |

Scenario Year: **2019**

All model years in the range 1975 to 2019

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00565433** |
| NOx | **0.01389113** |
| ROG | **0.00120235** |
| SOx | **0.00004032** |
| PM10 | **0.00070198** |
| PM2.5 | **0.00056085** |
| CO2 | **4.20637830** |
| CH4 | **0.00005499** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00056085** |
| PM2.5 | **0.00051320** |

Scenario Year: **2020**

All model years in the range 1976 to 2020

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00532242** |
| NOx | **0.01274755** |
| ROG | **0.00110621** |
| SOx | **0.00003957** |
| PM10 | **0.00064574** |
| PM2.5 | **0.00050904** |
| CO2 | **4.20541416** |
| CH4 | **0.00005216** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00050364** |
| PM2.5 | **0.00046227** |

Scenario Year: **2021**

All model years in the range 1977 to 2021

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00503726** |
| NOx | **0.01179977** |
| ROG | **0.00103095** |
| SOx | **0.00004033** |
| PM10 | **0.00059437** |
| PM2.5 | **0.00046287** |
| CO2 | **4.21495573** |
| CH4 | **0.00004734** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00045411** |
| PM2.5 | **0.00041729** |

Scenario Year: **2022**

All model years in the range 1978 to 2022

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00478830** |
| NOx | **0.01098794** |
| ROG | **0.00096142** |
| SOx | **0.00004106** |
| PM10 | **0.00055427** |
| PM2.5 | **0.00042597** |
| CO2 | **4.21520828** |
| CH4 | **0.00004448** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00041399** |
| PM2.5 | **0.00037807** |

## Highest (Most Conservative) EMFAC2007 (version 2.3)
## Emission Factors for On-Road Heavy-Heavy-Duty Diesel Trucks

Projects in the SCAQMD (Scenario Years 2007 - 2026)

Derived from Peak Emissions Inventory (**Winter**, **Annual**, **Summer**)

**Vehicle Class:**

**Heavy-Heavy-Duty Diesel Trucks (33,001 to 60,000 pounds)**

Scenario Year: **2023**

All model years in the range 1979 to 2023

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00457902** |
| NOx | **0.01031407** |
| ROG | **0.00090210** |
| SOx | **0.00004009** |
| PM10 | **0.00052122** |
| PM2.5 | **0.00039592** |
| CO2 | **4.21483461** |
| CH4 | **0.00004176** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00037922** |
| PM2.5 | **0.00034915** |

Scenario Year: **2024**

All model years in the range 1980 to 2024

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00444444** |
| NOx | **0.00974372** |
| ROG | **0.00084009** |
| SOx | **0.00003930** |
| PM10 | **0.00050766** |
| PM2.5 | **0.00038320** |
| CO2 | **4.19552935** |
| CH4 | **0.00003930** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00036682** |
| PM2.5 | **0.00033735** |

Scenario Year: **2025**

All model years in the range 1981 to 2025

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00431086** |
| NOx | **0.00932573** |
| ROG | **0.00080206** |
| SOx | **0.00004018** |
| PM10 | **0.00048541** |
| PM2.5 | **0.00036326** |
| CO2 | **4.19512979** |
| CH4 | **0.00003697** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00034397** |
| PM2.5 | **0.00031664** |

Scenario Year: **2026**

All model years in the range 1982 to 2026

| HHDT-DSL (pounds/mile) | |
|---|---|
| CO | **0.00420297** |
| NOx | **0.00898990** |
| ROG | **0.00077178** |
| SOx | **0.00003946** |
| PM10 | **0.00046717** |
| PM2.5 | **0.00034564** |
| CO2 | **4.19349747** |
| CH4 | **0.00003630** |

| HHDT-DSL, Exh (pounds/mile) | |
|---|---|
| PM10 | **0.00032670** |
| PM2.5 | **0.00029830** |

**Appendix C**
**Emission Calculations for Operation and Maintenance Activities**
**West Chocolate Mountains Solar PV Development**

| Table No. | Table Description |
|---|---|
| Table C1 | Summary of Operational Emissions per 50-MW Solar PV plant |
| Table C2 | Criteria Pollutants Emissions from Operations and Maintenance |
| Table C3 | Fugitive Dust Emission Factors - Roads |
| Table C4 | Fugitive Dust Emissions from Road |
| Table C5 | GHG Emissions from Operation and Maintenance Activities |

**Table C1**

**Summary of Operational Emissions per 50-MW Solar PV plant**

**West Chocolate Mountains Solar PV Development**

**Estimation per year**

| Emission Type | Source | Emissions (tons/year) | | | | | | GHG Emissions (metric tons/year) |
|---|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ | $CO_2e$ |
| Exhaust Emissions | Heavy Duty Diesel Truck | 0.000 | 0.001 | 0.001 | 0.005 | 0.000 | 0.000 | 0.5 |
| | ATVs | 17 | 371 | 3.312 | 0.387 | 0.533 | 0.533 | 0.9 |
| Fugitive Dust Emissions | Roads | - | - | - | - | 0.136 | 0.014 | - |
| **Subtotal** | | **16.9** | **371.3** | **3.3** | **0.4** | **0.7** | **0.5** | **1.3** |

**Estimation per day**

| Emission Type | Source | Emissions (tons/day) | | | | | |
|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ |
| Exhaust Emissions | Heavy Duty Diesel Truck | 0.0001 | 0.0004 | 0.0011 | 0.0000 | 0.0001 | 0.0000 |
| | ATVs | 0.0004 | 0.0091 | 0.0001 | 0.0000 | 0.0000 | 0.0000 |
| Fugitive Dust Emissions | Roads | - | - | - | - | 0.0104 | 0.0011 |
| **Subtotal per day** | | **0.001** | **0.009** | **0.001** | **0.000** | **0.011** | **0.001** |

**Estimation for the first year (125 days of operations)**

| Emission Type | Source | Emissions (tons/year) | | | | | |
|---|---|---|---|---|---|---|---|
| | | ROG | CO | $NO_x$ | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ |
| Exhaust Emissions | Heavy Duty Diesel Truck | 0.01 | 0.04 | 0.14 | 0.00 | 0.01 | 0.01 |
| | ATVs | 0.05 | 1.14 | 0.01 | 0.00 | 0.00 | 0.00 |
| Fugitive Dust Emissions | Roads | - | - | - | - | 1.31 | 0.13 |
| **Subtotal first yeat of operations** | | **0.06** | **1.19** | **0.15** | **0.00** | **1.31** | **0.14** |

**Table C2**
**Criteria Pollutants Emissions from Operations and Maintenance**
**West Chocolate Mountains Solar PV Development**

**Solar Panel Cleaning and Array Inspection (Quarterly)**

| Project Component | Vehicle Type | No. of Units | Weekly (days/wk) | Annual (wk/yr) | Vehicle Mileage: Daily per Vehicle (VMT/day) | Vehicle Mileage: Total Daily (VMT/day) | Vehicle Mileage: Total Annual (VMT/yr) |
|---|---|---|---|---|---|---|---|
| Solar PV Field | Water Truck | 1 | 1 | 4 | 60 | 60 | 240 |
| Solar PV Field | All-Terrain Vehicle | 2 | 1 | 4 | 60 | 120 | 480 |
| | | | | | - | - | - |

Notes:

Vehicles Mile Traveled estimated as 60 miles per roundtrip, considering an average distance from the closest cities (Barstow, Victorville and Hesperia) to the project site.

Number of Vehicles estimated based on similar Solar PV projects

**Inverter and Switchyard maintenance**

| Project Component | Vehicle Type | No. of Units | Weekly (days/wk) | Annual (wk/yr) | Vehicle Mileage: Vehicle (VMT/day) | Vehicle Mileage: Total Daily (VMT/day) | Vehicle Mileage: Total Annual (VMT/yr) |
|---|---|---|---|---|---|---|---|
| Mechanical Inspection | All-Terrain Vehicle | 1 | 1 | 52 | 60 | 60 | 3120 |
| Electrical Inspection | All-Terrain Vehicle | 1 | 1 | 1 | 60 | 60 | 60 |
| | | | | | - | - | - |

Notes:

The inverter mechanical maintenance is conducted monthly and consists of: inspection of intake air ducts, cooling fans, and refrigeration units.

Electrical inspections are conducted yearly and consists of: inspection of seals, electrical connections (torque setting), and transformer and/or inductor enclosure.

Number of Vehicles estimated based on similar Solar PV projects

**Emission Calculations**

| Pollutant | Water Truck Emission Factor[a] (lb/VMT) | ATV Emission Factor[b] (lb/VMT) | Daily Emissions (lbs/day): Truck Operations | Daily Emissions (lbs/day): ATV Operations | Daily Emissions (lbs/day): TOTAL | Annual Emissions (tons/yr): Truck Operations | Annual Emissions (tons/yr): ATV Operations | Annual Emissions (tons/yr): TOTAL |
|---|---|---|---|---|---|---|---|---|
| ROG | 0.003042 | 0.0046270 | 0.2 | 0.8 | 1.0 | 0.0004 | 16.9 | 16.9 |
| CO | 0.011955 | 0.10146 | 0.7 | 18.3 | 19.0 | 0.0014 | 371.3 | 371 |
| NOx | 0.038221 | 0.0009048 | 2.3 | 0.2 | 2.5 | 0.0046 | 3.3 | 3.3 |
| SOx | 0.000041 | 0.00010582 | 0.0 | 0.0 | 0.0 | 0.0000 | 0.4 | 0.4 |
| PM10 | 0.001831 | 0.00014550 | 0.1 | 0.0 | 0.1 | 0.0002 | 0.5 | 0.5 |
| PM2.5 | 0.001601 | 0.00014550 | 0.1 | 0.0 | 0.1 | 0.0002 | 0.5 | 0.5 |

Notes:

a. South Coast Air Quality Management District (SCAQMD). 2008. Spreadsheet onroadEF07_26.xls.

b. Emission factors for ATVs from EPA's NONROAD model.

**Table C3**
**Fugitive Dust Emission Factors - Roads**

**Unpaved Roads - Emission Factor Derivation**

$E = k(s/12)^a(W/3)^b$ AP-42 Section 13.2.2 (11/06 version)

where:

E = particulate emission factor (lb/VMT)
k, a, b = empirical constants for industrial roads
s = surface material silt content (%)
W = average vehicle weight (tons)

| Parameter | Units | $PM_{10}$ | $PM_{2.5}$ | Reference |
|---|---|---|---|---|
| Mean Vehicle Weight | **tons** | 2 | 2 | Assumption |
| Constant, k | lb/VMT | 1.5 | 0.15 | Table 13.2.2-2 (worst case) |
| Constant, a | | 0.9 | 0.9 | Table 13.2.2-2 (worst case) |
| Constant, b | | 0.45 | 0.45 | Table 13.2.2-2 (worst case) |
| Silt content, s | % | 8.5 | 8.5 | Table 13.2..2-1 (construction sites) |
| **Uncontrolled Emission factor, E** | **lb/VMT** | **0.92** | **0.092** | **Calculation** |
| Control Efficiency for Watering | % | 0.65 | 0.65 | Assumption |
| **Controlled Emission factor, E** | **lb/VMT** | **0.32** | **0.032** | **Calculation** |

**Paved Roads - Emission Factor Derivation Table**

$E = (k(sL/2)^{0.65}(W/3)^{1.5}-C)$ AP-42 Section 13.2.1 (11/06 version)

where:

E = particulate emission factor (lb/VMT)
k = particle size multiplier
sL = road surface silt loading ($g/m^2$)
W = average vehicle weight (tons)
C = emission factor for 1980's vehicle fleet exhaust, break wear and tire wear

| Parameter | Units | $PM_{10}$ | $PM_{2.5}$ | Reference |
|---|---|---|---|---|
| Mean Vehicle Weight | tons | 3 | 3 | Assumption |
| k factor | lb/VMT | 0.016 | 0.0024 | Table 13.2-1.1 |
| Silt Loading, sL | $g/m^2$ | 0.6 | 0.6 | Table 13.2.1-3 |
| Emission factor, C | lb/VMT | 0.00047 | 0.00036 | Table 13.2.1-2 |
| **Uncontrolled Emission factor, E** | **lb/VMT** | **0.00685** | **0.000737** | **Calculation** |

**Table C4**

**Fugitive Dust Emissions from Road**

**Annual Emissions**

| Fuel Type | Total VMT/year | | Emissions (tons/year) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Unpaved Roads | | Paved Roads | | All Roads | |
| | Paved Roads | Unpaved Roads | PM10 | PM2.5 | PM10 | PM2.5 | PM10 | PM2.5 |
| Heavy Duty Diesel Truck | 192 | 48 | 0.008 | 0.001 | 0.001 | 0.000 | 0.01 | 0.001 |
| ATVs | 2,928 | 732 | 0.12 | 0.012 | 0.010 | 0.001 | 0.13 | 0.01 |
| **Total** | **-** | **-** | **0.0077** | **0.0008** | **0.0007** | **0.0001** | **0.136** | **0.014** |

**Daily Emissions**

| Fuel Type | Total VMT/day | | Emissions (tons/day) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Unpaved Roads | | Paved Roads | | All Roads | |
| | Paved Roads | Unpaved Roads | PM10 | PM2.5 | PM10 | PM2.5 | PM10 | PM2.5 |
| Heavy Duty Diesel Truck | 48 | 12 | 0.002 | 0.0002 | 0.0002 | 0.000 | 0.002 | 0.000 |
| ATVs | 192 | 48 | 0.008 | 0.001 | 0.001 | 0.0001 | 0.008 | 0.001 |
| **Total** | **-** | **-** | **0.0019** | **0.0002** | **0.0002** | **0.0000** | **0.010** | **0.001** |

**Table C5**
**GHG Emissions from Operation and Maintenance Activities**
**Lucerne Valley Solar Project**

**GHG Emissions Estimation for Operation and Maintenance Activities**

| Emission Type | GHG | Emission Factors [a,b,c] | Emission Factor Units | Annual Emissions (lbs/yr) | Annual Emissions (tonnes/yr) | Global Warming Potential | Annual Emissions [as CO2-eq] (tonnes/yr) |
|---|---|---|---|---|---|---|---|
| Water Truck Emissions (Maintenance Activities) | CO2 | 4.211 | lb/VMT | 1,011 | 0.5 | 1 | 0.5 |
| | CH4 | 0.000142 | lb/VMT | 0.034 | 0.00002 | 23 | 0.0 |
| ATVs Emissions (Maintenance Activities) | CO2 | 0.516610 | lb/VMT | 1,891 | 0.9 | 1 | 0.9 |
| | CH4 | 0.000000 | lb/VMT | 0 | 0.0 | 23 | 0.0 |
| Electrical Consumption | CO2 | 0.724120 | lb/kWh | | | 1 | |
| | CH4 | 0.000030 | lb/kWh | | | 23 | |
| SF6 Leakage | SF6 | 0.50% | % per year per capacity | | | 23,900 | |
| Refrigerant Leakage | TBD | 0.50% | % per year per capacity | | | TBD | |
| **TOTAL** | **-** | **-** | **-** | **-** | **-** | **-** | **1.3** |

Notes:

a. South Coast Air Quality Management District (SCAQMD). 2008. Spreadsheet onroadEF07_26.xls: "Highest (Most Conservative) EMFAC2007 (version 2.3) Emission Factors for On-Road Passenger Vehicles & Delivery Trucks". Downloaded from SCAQMD Website.

c. Emission factors for ATVs from EPA's NONROAD model.

b. U.S. Environmental Protection Agency (EPA). 2009. eGrid2007 Version 1.1 Year 2005 GHG Annual Output Emission Rates (California). Downloaded from www.epa.gov/egrid

**Table C6**
**On-Road Vehicle Exhaust Emission Factors**

| Equipment Type | Emission Factor[a,b] (pounds/VMT) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ROG | CO | NOx | SOx | PM10 | PM2.5 | CO2 | CH4 |
| Heavy Duty Diesel Trucks | 0.003042 | 0.011955 | 0.038221 | 0.000041 | 0.001831 | 0.001601 | 4.211206 | 0.000142 |
| Light Duty Trucks | 0.002590 | 0.01844 | 0.02062 | 0.0000270 | 0.0007512 | 0.0006243 | 2.732 | 0.0001258 |
| Gasoline Passenger Vehicles | 0.0009140 | 0.00826 | 0.0009181 | 0.00001077 | 0.00008698 | 0.00005478 | 1.096 | 0.00008146 |
| ATVs | 0.0046270 | 0.10146 | 0.0009048 | 0.00010582 | 0.00014550 | 0.00014550 | 0.517 | 0.00000000 |

Notes:

a. Emission factors for trucks and vehicles from SCAQMD file "onroadEF07_26.xls".

b. Emission factors for ATVs from EPA's NONROAD model.

*This page intentionally left blank.*

# Appendix E

## Interim Visual Resource Management Classification West Chocolate Mountains Imperial County, California

This appendix is available in the DEIS.

It has been removed from the FEIS to save paper and due to the fact that it is unchanged from the DEIS.

*This page intentionally left blank.*

# Appendix F

## Water Resources Tables

**Named Surface Water Features Within the West Chocolate REEA**

| GNIS_ID | GNIS_Name | LengthKM | FTYPE |
|---|---|---|---|
| 240721 | Coachella Canal | 5.531 | CanalDitch |
| 241774 | East Highline Canal | 0.585 | CanalDitch |
| 243760 | I Lateral | 2.198 | CanalDitch |
| 243879 | Iris Wash | 1.853 | StreamRiver |
| 243945 | J Lateral | 2.437 | CanalDitch |
| 244189 | K Lateral | 3.353 | CanalDitch |
| 244379 | L Lateral | 3.483 | CanalDitch |
| 245332 | M Lateral | 4.109 | CanalDitch |
| 246422 | N Lateral | 12.967 | CanalDitch |
| 255665 | Niland Lateral Five | 3.186 | CanalDitch |
| 255664 | Niland Lateral Four | 5.508 | CanalDitch |
| 255663 | Niland Lateral Three | 6.326 | CanalDitch |
| 255662 | Niland Lateral Two | 3.479 | CanalDitch |
| 246693 | O Lateral | 11.777 | CanalDitch |
| 247059 | P Lateral | 4.194 | CanalDitch |
| 247843 | Q Drain | 10.924 | CanalDitch |
| 247844 | Q Lateral | 11.035 | CanalDitch |
| 247899 | R Side Main Canal | 0.855 | CanalDitch |
| 254268 | Siphon Five | 0.696 | StreamRiver |
| 254251 | Siphon Fourteen | 2.056 | StreamRiver |
| 254261 | Siphon Seven | 1.448 | ArtificialPath |
| 254266 | Siphon Three | 1.272 | ArtificialPath |
| 254265 | Siphon Two | 1.783 | ArtificialPath |
| 251121 | W Lateral | 0.869 | CanalDitch |
| 251834 | X Drain | 1.161 | CanalDitch |
| 251835 | X Lateral | 1.724 | CanalDitch |
| 251836 | Y Lateral | 5.865 | CanalDitch |
| 251897 | Z Lateral | 0.334 | CanalDitch |

**Geothermal Wells Located Within the West Chocolate REEA**

| APINUMBER | OPERATOR | WELL TYPE | STATUS | YEAR_DRILL | SECTION | TOWNSHIP | RANGE |
|---|---|---|---|---|---|---|---|
| 02590141 | Freeport-McMoRan Resource Partners | TG | ABDN | 1975 | 29 | 9S | 13E |
| 02590142 | Freeport-McMoRan Resource Partners | TG | ABDN | 1975 | 31 | 9S | 13E |
| 02590143 | Freeport-McMoRan Resource Partners | TG | ABDN | 1975 | 33 | 9S | 13E |
| 02590190 | MCR Geothermal Corp. | EWT | ABDN | 1979 | 15 | 9S | 12E |
| 02590300 | Freeport-McMoRan Resource Partners | TG | ABDN | 1980 | 6 | 11S | 15E |
| 02590358 | Chevron U.S.A. Inc. | TG | ABDN | 1981 | 28 | 10S | 14E |
| 02590395 | Chevron U.S.A. Inc. | TG | ABDN | 1981 | 26 | 11S | 15E |
| 02591183 | Imperial Spa | CLT | ACTV | 1938 | 2 | 9S | 12E |
| 02591184 | Imperial Spa | CLT | ACTV | 1962 | 2 | 9S | 12E |
| 02591206 | Fish Partners (was FPROD - Fish Partners | CLT | IDLE | 1992 | 12 | 11S | 14E |
| 02591249 | Fish Partners (was FPROD - Fish Partners | CLT | ACTV | 1995 | 12 | 11S | 14E |
| 02591250 | Fish Partners (was FPROD - Fish Partners | CLT | ACTV | 1995 | 12 | 11S | 14E |
| 02591200 | Trily, J. T. | TG | ACTV | 1979 | 13 | 9S | 13E |

**Summary of Wetlands Type and Acreage**

| Wetland Type | Acreage | % of Total |
|---|---|---|
| Lacustrine Limnetic/Littoral (L1/L2) | 1516.0 | 66 |
| Palustrine Aquatic Bed (PAB) | 1.4 | 0 |
| Palustrine Emergent (PEM) | 23.5 | 1 |
| Palustrine Scrub-Shrub (PSS) | 146.1 | 6 |
| Palustrine Unconsolidated Bottom (PUB) | 124.4 | 5 |
| Palustrine Unconsolidated Shore (PUS) | 28.4 | 1 |
| Riverine Lower Perennial (R2) | 288.5 | 13 |
| Riverine Intermittent (R4) | 158.5 | 7 |
| **TOTAL** | **2286.7** | **100** |

**Source: USFWS National Wetlands Inventory.**

*This page intentionally left blank.*

# Appendix G

## Stipulations and Lease Notices Exception, Modification, and Waiver Criteria

# APPENDIX G

# STIPULATIONS AND LEASE NOTICES
# EXCEPTION, MODIFICATION, AND WAIVER CRITERIA

The purpose of this appendix is to provide the stipulations and conditions of approval that apply to geothermal leases, or renewable energy rights of way, that would be applied within the West Chocolate Mountains Renewable Energy Evaluation Area under each proposed alternative. Any requests for exceptions, modifications, and waivers from the stipulations would be processed by the appropriate BLM office. The requests for exceptions must be initiated in writing by the operator near the time that the work is proposed to be initiated. This requirement is in place due to the unpredictability of weather, animal movement and condition, etc. The analysis of a request will typically include the review of potential mitigation measures and alternatives (traffic restrictions, alternative scheduling, staged activity, etc.). The request is considered as a unique action and is analyzed and documented individually for CDCA Plan and NEPA compliance.

The definitions for waivers, exceptions and modifications are as follows:

Exception - A one-time exemption for a particular site within the leasehold or right of way; exceptions are determined on a case-by-case basis; the stipulation continues to apply to all other sites within the leasehold or right of way. An exception is a limited type of waiver.

Modification - A change to the provisions of a lease or right of way stipulation, either temporarily or for the term of the lease. Depending on the specific modification, the stipulation may or may not apply to all sites within the leasehold, or right of way, to which the restrictive criteria are applied.

Waiver - A permanent exemption from a lease or right of way stipulation. The stipulation no longer applies anywhere within the leasehold or right of way.

**SPECIAL ADMINISTRATION (SA) STIPULATIONS**
Please see the table below:

**STANDARD STIPULATIONS**

**Resource: Cultural Resources**

**Stipulation:** "This geothermal lease may be found to contain historic properties and/or resources protected under the National Historic Preservation Act (NHPA), American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, E.O. 13007, or other statutes and executive orders. The BLM will not approve any ground disturbing activities that may affect any such properties or resources until it completes its obligations under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated."

Objective: This stipulation will be applied to all geothermal leases within the WCM REEA to protect cultural resources in accordance with BLM Instruction Memorandum No. 2005-003.

Exceptions, waivers, or modifications to this stipulation may not be approved unless, (1) the authorized officer determines that the factors leading to the stipulation's inclusion in the lease have changed sufficiently to make the protection provided by the stipulation no longer justified; or (2) the proposed operations would not cause unacceptable impacts. (43 CFR 3101.1-4)

**Resource: Geothermal.**

**Stipulation:** Parts of the lands contained in the parcel tract with serial number CACA 047196 may potentially be subject to drainage by offset wells which may be located adjacent to this parcel in sections 2, 12, and 14, T 9 S., R 12 E., SBB&M, Imperial County, California (on Federal Lease CACA 046142.) The lessee shall, within 6 months of the drilling and completion of any productive well on the adjacent federal lease, submit for approval by the authorized officer:

1) Plans for protecting the lease from drainage (43 CFR § 3210.16.) The plan must include either (a) a completed application for Geothermal Drilling Permit (GDP) for the necessary protective wells, or (b) a proposal for inclusion in an agreement for the affected portion of the lease. Any agreement should provide for an appropriate share of the production from the offending well to be allocated to the lease; or

2) Engineering, geologic and economic data to demonstrate to the authorized officer's satisfaction that no drainage has occurred or is occurring and/or that a new protective well(s) would have little or no chance of production sufficient to yield a reasonable rate of return in excess of the costs of drilling, completing and operating the well.

3) If no plan, agreement or data is submitted and drainage is determined to be occurring, compensatory royalty will be assessed. Compensatory royalty will be assessed on the first day following expiration of the 6-month period, and shall continue until a protective well has been drilled and placed into production status, or until the offending well ceases production, whichever occurs first. Failure to comply with this special leasing stipulation also may subject the lease to termination under the provisions of 43 CFR § 3213.17.

**Objective:** Drainage Protection. To protect the federal geothermal resource from being drained by development on adjacent non-federal lands.

An exception, waiver, or modification to this stipulation may not be approved unless, (1) the authorized officer determines that the factors leading to the stipulation's inclusion in the lease have changed sufficiently to make the protection provided by the stipulation no longer justified; or (2) the proposed operations would not cause unacceptable impacts. (43 CFR 3101.1-4).

**Stipulation:** The single non-competitive lease application (CACA 047196) within the REEA was pending on August 8, 2005. Therefore, the lease applicant must make their election and provide written notice to the BLM of their preference for payment of royalties on production before the lease may be issued.

**Objective:** Royalty Compliance in accordance with the revised geothermal regulations at 43 CFR 3200.8 (b)(1) and (b)(3).

No exception, waiver or modification to this stipulation will be authorized.

**Stipulation:** Potential geothermal lessees should be aware of the revised due diligence requirements contained in the federal regulations at 43 CFR § 3207. Leases are typically issued for an initial term of 10 years, and may be extended if diligent work requirements have been satisfied, and the BLM believes that the lessee has made satisfactory progress in complying with the lease terms and stipulations.

The BLM may, after giving you 30 days written notice, terminate your lease if we determine that you have violated any of the requirements of 43 CFR § 3200.4, including, but not limited to compliance with the terms and conditions of the lease, including any and all lease stipulations, the nonpayment of required annual rentals or royalties and fees (43 CFR § 3213.17.)

**Objective:** “Due Diligence” in compliance with the revised geothermal regulations at 43 CFR § 3207.

Exceptions, waivers, or modifications to this stipulation may not be approved unless, (1) the authorized officer determines that the factors leading to the stipulation’s inclusion in the lease have changed sufficiently to make the protection provided by the stipulation no longer justified; or (2) the proposed operations would not cause unacceptable impacts. (43 CFR 3101.1-4),

## Resource: Geothermal Features.

**Stipulation:** Requirement to Characterize Thermal Features. Prior to surface disturbing activities, a survey of surface expressions of the geothermal reservoir (hot springs) shall be conducted. Such surveys shall include identification of invertebrate species and water characteristics, as well as all available geologic information regarding their potential source. Monitoring of thermal features may also be required during exploration, development, and production to ensure that there are no impacts to water quality or quantity, or to protect the integrity of geothermal resource features. If it is determined that geothermal operations are reasonably likely to result in adverse effects to such a feature, significant additional restrictions may be imposed.

**Objective:** Areas within the West Chocolate Mountains REEA are known to contain thermal features (e.g., hot springs or surface expressions). Monitoring of the thermal features shall be required during exploration, development, and production to ensure that there are no impacts to water quality or quantity.

Exceptions, waivers, or modifications to this stipulation may not be approved unless, (1) the authorized officer determines that the factors leading to the stipulation’s inclusion in the lease have changed sufficiently to make the protection provided by the stipulation no longer justified; or (2) the proposed operations would not cause unacceptable impacts. (43 CFR 3101.1-4).

*This page intentionally left blank.*

# Appendix H

## Legal Description for the West Chocolate Mountains REEA

West Chocolate REEA
BLM Surface Ownership
Imperial County, California

San Bernardino Meridian

T. 9 S., R., 12 E.,
section 2, E½SE¼SW¼,S½SE¼,S½NE¼SE¼ ;
section 4, lots 1 and 2 of the NE¼, lots 1 and 2 of the NW¼,SW¼,SE¼;
section 6, lots 1 and 2 of the NE¼, lots 1 and 2 of the NW¼; lots 1 and 2 of the SW¼, SE¼;
section 8,NE¼,SE¼ ;
section 10, entire section;
section 12, NW1/4, SW1/4, NW1/4SE1/4, NE1/4SE1/4, SE1/4SE1/4, NE1/4 with the exception of land east of the Coachella Canal;
section 14, E1/2NE1/4, NW1/4
section 18, lots 1 and 2 of the NW¼, lots 1 and 2 of the SW¼,NE¼,SE¼;
section 20, entire section;
section 24, entire section;
section 26, S½NW¼,SW¼,SE¼;
section 28, SE¼NW¼,E1/2,SW1/4;

T. 9 S., R. 13 E.,
section 18, lots 3-6 inclusive; E½NW¼,E½SW¼,SE¼;
section 20, SW¼NE¼,W1/2NW¼,S1/2,SE1/4NW1/4;
section 22, S½SW¼,
section 26, SW¼NW¼,SW¼,S½SE¼;
section 28, entire section;
section 30, E½SW¼,S½SE¼;
section 32, entire section;
section 34, entire section;

T. 10 S. R. 13 E.,
section 4, lots 6,7,14 of the NW¼,SW¼;
section 6, lots 5-8 inclusive of the NE¼, lots 11-14 inclusive of the NW¼; lots 2 and 15 of the SW¼,E½SW¼,SE¼;

T. 10 S., R. 14 E.,
section 6, lots 6, 7, 13, 14, 15 and 16,
E½SW¼,W½SE¼,SE¼SE¼;
section 8, SW¼NE¼,W1/2,SE¼;
section 22, SW¼NE¼,W1/2,SE¼;
section 26, S1/2N1/2SW1/4,N½NW¼,N½SE¼NW¼, ,S½SW¼, , E1/2;
section 28, NE1/4SE1/4;
section 34, E1/2

T. 10 S., R. 15 E.,
section 32, entire section;

T. 11 S., R. 15 E.,
section 4, entire section;
section 6, entire section ;
section 8, entire section;
section 10, entire section;
section 11, entire section;
section 13, entire section;
section 14, entire section;
section 18, E½ E½;
section 20, N1/2,N1/2SE¼,SE1/4SE¼,
section 22, entire section
section 24, entire section
section 28, N1/2,N1/2SE1/4,SE1/4SE¼;
section 34, SW¼;

T. 11 S., R. 16 E.,
section 19, lots 3-18 inclusive;
section 29, entire section;
section 30, entire section;

Recommendations:

- Have another Realty Specialist proof this document.
- Field Offices often use minor variations in legal descriptions it might be good to have a local person make sure this legal description matches El Centro FO and the District formats for consistency with past documents.
- The legal description contained here lists only those BLM lands on the ownership map from Chapter #1, page 1-9 of the ADEIS and does not include BLM lands with subsurface mineral estate.
- Maps in ADEIS are of a scale which limits verification of subsurface minerals and some boundaries. BLM minerals shop should be able to determine BLM subsurface mineral estate within the REEA and furnish that data.
- California State Lands commission should know or be able to determine which lands they hold within the REEA and furnish that data to the BLM rather than BLM advising them. There may be lands which passed from public domain to private then to the state, which do not appear on our MTPS and the mineral estate may have changed ownership at some time leaving the State with subsurface minerals under private and BLM probably will not have a record of this. This may need to be researched at the local courthouse by the California Lands Commission staff.
- Verify that ownership maps include correct information. There appear to be lands shown as State lands on the map that appear as private on BLM MTPS and lands shown as BLM or private that appears as State lands on BLM MTPs.
- Prepare a legal description of the entire REEA for clarity and for “the record”.

JGB 4-28-11

*This page intentionally left blank.*

# Appendix I

## Best Management Practices

I-A BMPs from the REAT Guidance Manual

I-B BMPs from the 2010 BLM Geothermal, Solar, and Wind PEISs

# I-A BMPs from the REAT Guidance Manual

The Renewable Energy Action Team (REAT) agencies (California Energy Commission [CEC], California Department of Fish and Game [CDFG], BLM, and U.S. Fish and Wildlife Service (USFWS) jointly prepared the Best Management Practices and Guidance Manual: Desert Renewable Energy Projects. The manual fulfills agency commitments in the State of California's Executive Order (EO) S-14-08, Secretary of the Interior Secretarial Order (S.O.) No. 3285, and related memoranda between California and the U.S. Department of Interior (DOI), and between the REAT agencies (signed in 2008 and 2009). This appendix presents the best management practices (BMPs) proposed in the guidance manual that have been adopted for the West Chocolate Mountains Renewable Energy Evaluation Area EIS and CDCA Plan Amendment.

The following BMPs will be considered at the time BLM reviews site-specific project development proposals. All relevant mitigation and BMPs will be incorporated in the analyses and those that are appropriate to prevent undue or unnecessary degradation to public lands will be approved in the respective RODs for EIS-level analyses or Decision Records for Environmental Assessment (EA) level analyses.

This appendix presents BMPs by individual resource, and is organized as follows:

I-A1: Air Quality

I-A2: Biological Resources

I-A3: Cultural and Historic Resources

I-A4: Hazardous Materials, Pesticides, and Waste Management

I-A5: Noise and Vibration

I-A6: Paleontological Resources

I-A7: Safety, Health, and Nuisances

I-A8: Soils, Drainage, Erosion, Stormwater, and Flooding

I-A9: Traffic and Transportation Roads

I-A10: Aviation

I-A11: Visual Resources

I-A12: Water Supply and Quality

*This page intentionally left blank.*

# I-A1: AIR QUALITY

## BEST MANAGEMENT PRACTICES

## GENERAL

An applicant will apply for, secure, and comply with all appropriate air quality permits for project construction and operations from the local Air Quality Management District and from the U.S. Environmental Protection Agency (EPA), if appropriate, prior to construction mobilization. The appropriate air quality permits should be valid and remain in force for the life of the project.

1. Use low sulfur and low aromatic fuel meeting California standards for motor vehicle diesel fuel.
2. For combustion emission sources, use emission controls.
3. Prepare a report outlining the sources and amounts of greenhouse gases (GHG) from the project construction, equipment transportation, operation, and maintenance activities and identify measures to reduce or mitigate greenhouse gas emissions, depending on attainment status.
4. Prepare and comply with a dust abatement plan in cooperation with the local air quality management district that addresses emissions of fugitive dust during construction and operation of the project. Provisions for monitoring fugitive dust should be part of the abatement plan and follow protocols established by the California Air Resource Board (CARB). Consider incorporating the following practices in the plan:
   a. Use dust suppressant applications or other suppression techniques to control dust emissions from on-site unpaved roads and unpaved parking areas, as well as to mitigate fugitive dust emissions from wind erosion on areas disturbed by construction activities. When considering use of water or chemical dust suppressants take into account water supply and chemical dust suppressant issues.
   b. Limit traffic speeds on all unpaved site areas to 10 miles per hour.
   c. Cover all trucks hauling soil, sand, and other loose materials or require all such trucks to maintain at least two feet of freeboard.
   d. Post and enforce speed limits on the project site and all project access roads.
   e. Inspect and clean, as necessary construction equipment vehicle tires so they are free of dirt prior to entering paved roadways.
   f. Provide gravel ramps of at least 20 feet in length at tire cleaning stations.
   g. Gravel or treat unpaved exits from construction sites to prevent track-out to public roadways.

h. Direct all construction vehicles to enter the construction site through gravel or treated entrance roadways, unless alternative routes are approved by the air quality management district.

i. Provide sandbags or other measures in areas adjacent to paved roadways, as specified in the Storm Water Pollution Prevention Plan (SWPPP), to prevent run-off to roadways.

j. Sweep paved roads to prevent accumulation of dirt and debris.

5. Ensure wind erosion control techniques (e.g., windbreaks, water, and vegetation) are used on all access and maintenance routes and materials stockpiles that may be disturbed during project maintenance and operation. Use of chemical dust suppressants should be avoided in and around areas occupied by special status species. Any windbreaks used should remain in place until the soil is stabilized or permanently covered with vegetation.
6. Ensure construction and maintenance vehicles and equipment comply with CARB and EPA emissions standards.
7. Use off-road construction diesel equipment that has a rating of 100 horsepower (hp) to 750 hp and that meets the Tier 3 California Emission Standards for Off-Road Compression-Ignition Engines as specified in Title 13, California Code of Regulations (CCR) Section 2423(b)(1). All construction diesel engines, which have a rating of 50 hp or more, should meet, at a minimum, the Tier 2 California Emission Standards for Off-Road Compression-Ignition Engines as specified in Title 13, CCR Section 2423(b)(1). All heavy earth moving equipment and heavy duty construction related trucks with engines meeting the requirements above should be properly maintained and the engines tuned to the engine manufacturer’s specifications. No diesel heavy construction equipment should idle for more than five minutes, to the extent practical.
8. When CARB Tier 4 regulations come into effect, where applicable, construction equipment should meet these standards as well.
9. Consider the use of vehicle and equipment exhaust filters and catalysts to reduce air emissions during construction and operation.
10. Consider using ultra low sulfur diesel with a 15 part per million (ppm) sulfur contact, biodiesel or alternative fuels to reduce project criteria and GHG pollutants.

## GEOTHERMAL ENERGY DEVELOPMENT

The following air quality BMPs include recommendations to reduce emissions of criteria or hazardous air pollutants and H2S. The EPA does not classify H2S as either a criteria air pollutant or a hazardous air pollutant. The State of California, however, adopted an Ambient Air Quality Standard for H2S to protect public health and decrease odor annoyance. Air pollution control/management districts may have short-term, maximum (for example, hourly) and annual average standards for stationary sources of H2S, including geothermal power plants. For example, the Imperial County Air Pollution Control District requires Best Available Control

Technology be applied to geothermal power plants with the potential to emit more than 55 pounds per day of $H_2S$ (County of Imperial 1999).

Develop an emissions inventory, a list of both long-term (annual) and short-term (generally hourly) emission rates for each relevant pollutant from each emission point source (such as well venting, drill rig diesel engines, fugitive dust, plant silencers, sulfur plant exhaust, cooling towers). Organize emissions inventory by project phase: well-field development (estimate number of wells to be drilled, vented each year); plant operations (estimate number of replacement wells to be drilled each year, and forced and planned outage rates.) Quantify the pollutants contained in the geothermal fluids and steam by testing well venting. Collect fluid and gas samples for every well using independent laboratory and air quality specialist for at least one round of sample collection and chemical analysis.

1. Own both the geothermal production and injection wells as well as the geothermal power plant, so that responsibility for H2S emission control is not lost between the steam producer and electricity generator.
2. As an integral part of an odor control program, implement an ambient monitoring program for $H_2S$ and meteorology. Continue to operate the meteorological station used to collect baseline data. Use an EPA reference sulfur dioxide monitor with an in-line sulfur dioxide ($SO_2$) scrubber and $H_2S$ to $SO_2$ oxidizer for real-time collection of less than 1 part per billion $H_2S$. Store hourly $H_2S$ and wind data for use whenever odor issues arise.
3. Remove $H_2S$ from condensate by directing the condensate to the cooling tower to which chelated iron and sodium sulfite has been added to the cooling-tower water. These chemicals will react with the H2S to form a water soluble chemical, which can be injected into the geothermal formation.
4. Remove $H_2S$ from both the condensate and noncondensible gas (NCG) stream by processing the NCG in a thermal oxidizer.
5. When present in small volumes in the NCG stream, remove H2S with liquid scavengers, rather than solid-based scavengers, so that the spent material can be injected into the geothermal formation for disposal rather than discarded in a landfill.
6. When present in large volumes in the NCG stream, remove $H_2S$ with a liquid redox system.
7. Inject hydrogen peroxide and sodium hydroxide into a well's test line to abate $H_2S$ emissions.

# I-A2: BIOLOGICAL RESOURCES

## BEST MANAGEMENT PRACTICES

## GENERAL

During the environmental review and regulatory decision-making processes, the BLM will be the lead agency consulting with USFWS and CDFG pursuant to the federal and state ESAs, NEPA, and California Environmental Quality Act (CEQA). The consultations and any determinations of effects on protected species will be based on the biological assessments (BAs) prepared for filling of applications to the lead agency. The consultation activities highlight impacts to protected species and mitigation that may or may not be addressed in the BAs or the following BMPs.

**General to Any Species of Interest**

1. Project-specific biological resource field studies must be conducted after development applications are accepted.
2. Minimize, to the extent practicable, the area disturbed by pre-construction site monitoring and testing activities and installations.
3. Use construction and installation techniques that minimize new site disturbance, soil erosion, and removal of vegetation.
4. Use maps that show the location of sensitive resources and the results of pre permitting studies to establish the layout of facilities, roads, fences, and other infrastructure.
5. Avoid or minimize site/project area disturbance to special status species and unique plant assemblages.
6. Utilize existing roads and utility corridors to the maximum extent feasible to minimize the number and length/size of new roads, lay-down areas, and borrow areas.
7. Install and maintain transmission line towers/poles, access roads, pulling sites and storage and parking areas to avoid special status species or unique plant assemblages adjacent to linear facilities, in consultation with permitting agencies.
8. Install and maintain facility lighting to prevent up and side casting of light towards wildlife habitat.
9. Bury electrical collector lines in a manner that minimizes additional surface disturbance (e.g., along roads or other paths of surface disturbance). Overhead lines can be considered in cases where burying lines would result in disturbance of important habitat, but must be balanced with the concern for creation of additional predatory bird perching opportunities.

10. Delineate the boundaries of all areas to be disturbed using temporary construction fencing and/or flagging prior to beginning construction activities, and confine all disturbances, project vehicles and equipment to the delineated project areas.
11. Ensure that vehicular traffic is confined to existing routes of travel to and from the project site, and prohibit cross country vehicle and equipment use outside of approved designated work areas.
12. Use road surfacing, road sealant, soil bonding, and stabilizing agents, if needed on non-paved surfaces that have been shown to be non-toxic to wildlife and plants.
13. If the application of water is needed to abate dust in construction areas and on dirt roads, use the least amount needed to meet safety and air quality standards and prevent the formation of puddles, which could attract wildlife to construction sites.
14. Minimize construction and operation related noise levels to minimize impacts to wildlife.
15. Use explosives only within agency approved specified times and at specified distances from sensitive wildlife and habitats.
16. Maintain all vehicles and equipment in proper working condition to minimize fugitive emissions and accidental spills from motor oil, antifreeze, hydraulic fluid, grease, or other fluids or hazardous materials. All fuel or hazardous waste leaks, spills, or releases should be stopped or repaired immediately and cleaned up at the time of occurrence. Project developers should be responsible for spill material removal and disposal to an approved offsite landfill and spill reporting to the permitting agencies. Service construction equipment should be stored at designated areas only. Service/maintenance vehicles should carry appropriate equipment and materials to isolate and remediate leaks or spills. A spill containment kit should be available onsite for all fueling, maintenance, and construction activities.
17. Dispose of all trash and food-related items in self-closing, sealable containers with lids that latch to prevent wind and wildlife from opening containers. Trash containers should be emptied daily and removed from the project site when construction activities are complete.
18. Prohibit workers or visitors from (1) feeding wildlife, (2) bringing domestic pets to the project site, (3) collecting native plants, or (4) harassing wildlife.
19. Designate a qualified biologist (approved by BLM, USFWS, and CDFG) who would be responsible for overseeing compliance with all biological resources BMPs during mobilization, ground disturbance, grading, construction, operation, and closure/decommissioning or project abandonment activities, particularly in areas containing or known to have contained sensitive biological resources, such as special status species and unique plant assemblages. The qualified biologist should be responsible for actions including, but not limited to, the following:
    a. Clearly marking sensitive biological resource areas and inspecting these areas at appropriate intervals for compliance with regulatory terms and conditions.
    b. Inspecting active construction areas where animals may have become trapped (e.g., trenches, bores and other excavation sites outside the permanently fenced

area that constitute wildlife pitfalls) prior to construction commencing each day. At the end of the day, inspect for the installation of structures that prevent entrapment or allow escape during periods of construction inactivity. Periodically inspect areas with high vehicle activity (e.g., parking lots) for animals in harm's way.

c. Overseeing cactus and yucca salvage operations.

d. Recording and reporting any hazardous spills immediately as directed in the project Hazardous Materials Management Plan.

e. Coordinating directly and regularly with representatives of the permitting agencies regarding any biological resources issues, including implementation of biological resource BMPs.

f. Maintaining written records regarding implementation of biological resource BMPs and providing a summary of these records periodically in a report to the appropriate agencies.

g. Notifying the project owner and appropriate agencies of any non-compliance with any biological resources BMPs.

20. Develop a project-specific Worker Environmental Awareness Program (WEAP) that meets the approval of the permitting agencies and would be implemented during all phases of the project (e.g., site mobilization, ground disturbance, grading, construction, operation, closure/decommissioning or project abandonment and restoration/reclamation activities). The purpose of the WEAP would be to identify sensitive biological resources and BMPs for minimizing impacts to resources. Interpretation should be provided for non-English speaking workers, and the same instruction should be provided for any new workers prior to their performing work onsite. The names of all onsite personnel (e.g., surveyors, construction engineers, employees, contractors, contractor's employees, subcontractors, etc.) who have participated in the education program should be kept on file at the project field construction office. The program should include but not be limited to the following:

    a. Photos and habitat descriptions for all special status species that may occur on the project site and information on their distribution, general behavior and ecology.

    b. The sensitivity of these species to human activities.

    c. Legal protections afforded these species.

    d. Project BMPs for protecting species.

    e. Penalties for violation of state and federal laws.

    f. Worker responsibilities for trash disposal and safe/ humane treatment of any special status species found on the project site, associated reporting requirements, and any specific measures required of workers to prevent take of threatened or endangered species.

    g. Handout materials summarizing all the contractual obligations and protective requirements specified in project permits and approvals.

h. Requirements and penalties regarding adherence to speed limits on the project site.

21. Develop and implement a project specific integrated weed management plan that meets the approval of the permitting agencies that would be implemented during all phases of the project (e.g., site mobilization, ground disturbance, grading, construction, operation, modification or expansion, closure/decommissioning or project abandonment, and restoration/reclamation activities). The plan should include, but not be limited to, the following to prevent the establishment, spread and propagation of noxious weeds:

    a. Limit the size of any vegetation and/or ground disturbance to the absolute minimum, and limit motorized ingress and egress to defined routes.

    b. Store project vehicles onsite in designated areas to minimize the need for multiple washings of vehicles that re-enter the project site.

    c. Maintain vehicle wash and inspection stations and closely monitor the types of materials brought onto the site.

    d. Thoroughly clean the tires and undercarriage of all vehicles entering or reentering the project site.

    e. Reestablish native vegetation quickly on disturbed sites.

    f. Monitor and quickly implement control measures to ensure early detection and eradication for weed invasions.

    g. Use certified weed-free straw or hay bales for sediment barrier installations.

    h. Train employees and contractors to carry out the WEAP and on their role in ensuring the effectiveness of their efforts in implementing the Plan.

22. Prepare a project specific restoration, revegetation and reclamation plan that meets the approval of the permitting agencies that would be implemented during all phases of the project. The plan should address, at a minimum:

    a. Minimizing natural vegetation removal and considering cutting or mowing vegetation rather than total removal whenever possible.

    b. Salvage and relocation of cactus and yucca from the site prior to the initiation of construction activities.

    c. Identification of protocols to be used for vegetation salvage.

    d. Reclamation of all areas of temporarily disturbed soil using certified weed free native vegetation and topsoil salvaged from all excavations and construction activities.

    e. Restoration and reclamation of all temporarily disturbed areas, including pipelines, transmission lines, staging areas, and temporary construction-related roads as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to facilitate the recovery to natural habitats.

f. Specifying proper seasons and timing of restoration and reclamation activities to ensure success.

23. Prepare a vector (such as mosquitoes or rodents) control plan for the facility, as appropriate, that meets the approval of the permitting agencies and would be implemented during all phases of the project.

24. Prepare a project-specific mitigation and monitoring plan in cooperation with and that meets the approval of the permitting agencies. The plan should be carried out during all phases of the project and in general, should identify appropriate levels of mitigation to compensate for significant direct, indirect, and cumulative impacts to, and loss of habitat for, special status plant and animal species and should include, but not be limited to, the following:

    All biological resource mitigation, monitoring, and compliance measures required by CDFG, BLM, USFWS, CEC, and/or other agencies including the 2003 revision of the Flat-Tailed Horned Lizard Range-Wide Management Strategy (USFWS 2003). This strategy provides guidance for the conservation and management of sufficient habitat to maintain existing populations of flat-tailed horned lizards within five management areas.

    a. All sensitive biological resources to be avoided, impacted, and mitigated by project construction, operation, and decommissioning.

    b. A detailed description of measures that should be taken to minimize or mitigate permanent and temporary disturbances from construction activities.

    c. Documentation of sensitive biological resources expected to be affected by all phases of the project.

    d. All locations on a map, at an approved scale, of sensitive biological resource areas subject to disturbance and areas requiring temporary protection and avoidance during construction.

    e. Aerial photographs, at an approved scale, of all areas to be disturbed during project construction activities.

    f. Duration for each type of monitoring and a description of monitoring methodologies and frequency.

    g. Performance standards and criteria to be used to determine if/when proposed mitigation is or is not successful.

    h. All standards and remedial measures to be implemented if performance standards and criteria are not met.

    i. A discussion of biological resources-related facility decommissioning measures including a description of funding mechanism(s).

25. To the greatest extent practicable, existing roads, substations, ancillary facilities and disturbed areas should be re-used in repower layouts.

26. For a repowering or retrofit project, roads and facilities that are no longer needed should be removed or stabilized and re-seeded with native plants appropriate for the

soil conditions and adjacent habitat. Plants should be derived from local seed sources where feasible. The term "local" in this context means seed sources with a genetic makeup that do not vary substantially from seeds or plants found at the disturbed location.

27. Prepare a project specific closure/decommissioning or abandonment plan that meets the approval of the permitting agencies. The plan should also be implemented in the event of project abandonment. The plan should include, but not be limited to, the following:

    a. Removal of transmission conductors, power lines, fencing when they are no longer used and useful.

    b. Removal of all above ground power plant site facilities and related facilities when they are no longer used or useful.

    c. If the site has been terraced or otherwise substantially altered from its natural contour, recontouring may be necessary.

    d. If the plan anticipates removal of topsoils, it should address storing and vegetation of the soils. Soil profiles should be restored so that topsoils will establish and maintain pre-construction native plant communities to the extent possible.

    e. Methods for restoring wildlife habitat and promoting the re-establishment of native plant and wildlife species.

    f. Methods for restoring vegetation cover, composition, and diversity to values commensurate with the natural ecological setting. The plan should call for use of local seed sources and identify those sources, where possible.

    g. Re-vegetation of the project site and other disturbed areas utilizing appropriate native seed mix.

    h. Criteria that would trigger implementation 1 of the plan (e.g., nonoperational for one year or more).

    i. A cost estimate to complete closure/decommissioning-related activities.

    j. A funding mechanism to ensure sufficient funds are available for revegetation, reclamation, and decommissioning.

28. Apply all management plans, BMPs, and stipulations prepared for the construction phase to similar activities during any project modifications or expansions and the closure/ decommissioning phase or upon project abandonment.

**Plants**

Follow BLM and CDFG guidance and requirements regarding mapping and surveying for presence of protected plants.

### Aquatic Species

Identification of aquatic resources using a combination of aerial photo interpretation, Global Positioning System (GPS) field verification, and other methods will be required for all proposed projects.

### Wetlands and Riparian Areas

It is assumed that all streams or aquatic resources located onsite within the West Chocolate Mountains REEA are jurisdictional, should be considered provisionally restricted from development, and the BLM would accept USACE mitigation requirements for permitting projects. Some of these streams may flow directly into the Salton Sea, or into canals and drainages prior to entering the Salton Sea; a Section 404 permit is likely required for any type of discharge of dredge or fill material in ephemeral streams within the West Chocolate Mountains REEA. The USACE would restrict from development all jurisdictional waters from high water mark to high water mark and impose strict conditions on the use of any lands within (such as road crossings). All washes identified by the USGS National Hydrography Dataset within the WCM REEA would be expected to have restrictions on development and/or significant stipulations based on Jurisdictional Delineation efforts by the USACE. Jurisdictional Delineation efforts for Section 404 of the CWA (consultation with USACE) would begin prior to publication of an NOI. Preliminary Jurisdictional Determinations have been suggested by the USACE to expedite the determination process. Obtainment of a Jurisdictional Determination by the applicant will establish the USACE's jurisdiction over aquatic resources on site. Washes would be a significant issue to deal with because the USACE Section 404 Permitting Requirements. Avoidance of project development in wetlands and setback stipulations would be strictly enforced.

### Avian Species [not applicable to common raven (*Corvus corax*)]

1. Conduct pre-construction nest surveys in accordance with BLM, USFWS, and CDFG guidelines, if construction activities are anticipated to occur from February 1 through August 31. Surveys should be conducted within all potential nesting habitat in the proposed plan site and within 500 feet of the boundaries of the site and linear facilities. Presence of larger bird species may require larger survey areas; check with the appropriate agencies for further information.
2. For active nests detected during the survey, retain an avian-qualified biologist to identify a buffer zone (protected area surrounding the nest) and develop a monitoring plan in coordination with BLM, CDFG, USFWS and/or other appropriate agencies.
3. Retain an avian qualified biologist to monitor the nest until he/she determines that nestlings have fledged and dispersed. Activities that might, in the opinion of an avian qualified biologist, disturb nesting activities should be prohibited within the buffer zone until such a determination is made.
4. Establish non-disturbance buffer zones to protect raptor nests, bat roosts, areas of high bird or bat use, or specials-status species habitat identified in pre-construction studies. Determine the extent of the buffer zone in consultation with the appropriate agencies.
5. Develop Bird and Bat Conservation Plan to protect migratory birds, while improving avian conservation and safety and reliability for utility customers. Consult guidance in the USFWS White Paper providing guidance for the development of Project-Specific Avian and Bat Protection Plans for Renewable Energy Facilities. This

document was published August 3, 2010. Also consult guidance in the California Guidelines and Avian Protection Plan Guidelines published by the Avian Power Line Interaction Committee (APLIC) and USFWS (APLIC and USFWS 2005).

6. Consult guidance in the BLM/USFWS Memorandum of Understanding (MOU) to Promote the Conservation of Migratory Birds signed April 10, 2010.
7. Place acoustic bat detectors on meteorological towers at a height near the theoretical rotor swept zone and also at suspected high-use areas near the ground with the goal of documenting pre-construction activity levels and species composition of bats.
8. Install and maintain transmission lines and all electrical components in accordance with the APLIC Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006 (APLIC 2006) to reduce the likelihood of electrocutions of raptors and other large birds.
9. Install and maintain transmission lines and all electrical components in accordance with the APLIC Mitigating Bird Collisions with power lines: The State of the Art in 1994 (Edison Electric Institute 2004) to reduce the likelihood of bird collisions.
10. If possible and not cost prohibitive, not seismic prohibited, and without causing greater impacts to avian species, wetlands, cultural sites, vegetation, and other area wildlife and flora, place a portion or portions of low voltage connecting power lines underground in to avoid attracting certain aviation prey for raptors and other large birds.
    a. Overhead lines may be acceptable if sited away from high bird crossing locations, such as between roosting and feeding areas or between lakes, rivers and nesting areas.
    b. Overhead lines may be acceptable for areas outside the range of the flat-tailed horned lizard or where populations of BUOW are low.
    c. Overhead lines may be acceptable when they parallel tree lines, or are otherwise screened so that collision risk is reduced.
11. Communication towers and permanent meteorological towers should not be guyed. If guy wires are necessary, bird flight diverters or high visibility marking devices should be used.
12. Install and maintain facility lighting to prevent upward and side casting of light towards wildlife habitat and propose use of motion sensors. If the Federal Aviation Administration (FAA) requires lighting to alert aircraft of turbines or towers, minimize risk of avian collisions by using red or white strobe lights on the structures. The strobes should be on for as brief a period as possible and the time between strobe or flashes should be the longest possible. Strobes should be synchronized so that a strobe effect is achieved and towers are not constantly illuminated.
13. Use lights with sensors and switches to keep lights off when not required.
14. Minimize use of high intensity lighting, steady-burning, or bright lights such as sodium vapor or spotlights.

15. If the use of open evaporation ponds is permitted for the project and especially if the water would be considered toxic to wildlife, design the ponds to discourage their use by birds and other wildlife.

**Species Specific: Burrowing Owl (*Athene cunicularia*)**

1. Retain a qualified biologist to complete a preconstruction survey for burrowing owls in any areas subject to disturbance from construction no less than 30 days prior to the start of initial ground disturbance activities. Preconstruction surveys should consist of four separate site visits conducted on different dates to maximize detection. If burrowing owls are present within 500 feet of the project site or linear facilities, then the CDFG burrowing owl guidelines (California Burrowing Owl Consortium 1993) should be implemented.
2. If burrowing owl relocation is determined to be an appropriate conservation measure, develop and implement a Burrowing Owl Mitigation and Monitoring Plan for approval by CDFG and other permitting agencies. The plan should outline the number of evictions necessary, new burrows to be created, their locations, and how any created burrows/individuals and compensation foraging habitat would be protected for the life of the project.

**Species Specific: Bald Eagle (*Haliaeetus leucocephalus*) and Golden Eagle (*Aquila chrysaetos*)**

1. Comply with the new authorization Eagle Permits; Take Necessary to Protect Interests in Particular Localities (Federal Register [FR] Vol. 74, No. 175, September 11, 2009), where proposed projects may result in take of bald or golden eagles. Where applicable, incorporate actions to avoid disturbance of eagles in accordance with the USFWS National Bald Eagle Management Guidelines, May 2007.
2. Consult Guidance in BLM IM 2010-156 Bald and Golden Eagle Protection Act (BGEPA) – Golden Eagle National Environmental Policy Act and Avian Protection Plan Guidance for Renewable Energy published July 13, 2010 on complying with the BGEPA discussed in No. 1 above.

**Species Specific: Desert Tortoise (*Gopherus agassizii*)**

1. Conduct project activities when desert tortoises are inactive (typically November 1 to March 14), to minimize impacts to roaming individuals.
2. Retain a desert tortoise Authorized Biologist approved by CDFG and USFWS who would be responsible for ensuring compliance with desert tortoise BMPs prior to the initiation of and during ground-disturbing activities. The Authorized Biologist should conduct clearance surveys, tortoise handling, artificial burrow construction, egg handling and other procedures in accordance with the *Guidelines for Handling Desert Tortoise during Construction Projects* (Desert Tortoise Council 1994) or the most current guidance provided by USFWS.
3. The Authorized Biologist should be present on-site from March 15 through October 31 (active season) during ground-disturbing activities in areas that have not been enclosed with tortoise exclusion fencing. The Authorized Biologist should be on-call

from November 1 to March 14 (inactive season) and should check construction areas that have not been enclosed with tortoise exclusion fencing immediately before construction activities begin at all times.

4. Incorporate desert tortoise exclusion fencing, approved by USFWS and CDFG, into any permanent fencing surrounding the proposed facility prior to the initiation of ground disturbing activities to avoid potential harm to desert tortoise in the project area. Tortoise exclusion fencing should be constructed in accordance with the *Desert Tortoise Exclusion Fence Specifications* (USFWS 2005) or the most current guidance provided by USFWS and CDFG.
5. Install desert tortoise exclusion fencing around temporary project areas such as staging areas, storage yards, excavations, and linear facilities during construction. Construct fences in late winter or early spring to minimize impacts to tortoises and accommodate subsequent tortoise surveys.
6. Within 24 hours prior to the initiation of construction of tortoise exclusion fence, the Authorized Biologist should survey the fence alignment to ensure it is cleared of desert tortoises. Following construction of the tortoise-exclusion fence, the Authorized Biologist should conduct clearance surveys within the fenced area to ensure as many desert tortoises as possible have been removed from the site.
7. Install and regularly maintain gates that remain closed, except for the immediate passage of vehicles, to prevent desert tortoise passage into the project area.
8. Heavy equipment should only be allowed to enter the project site following the completion of desert tortoise clearance surveys of the project area by the Authorized Biologist. The Authorized Biologist should monitor initial clearing and grading activities to ensure any tortoises missed during the initial clearance survey are moved from harm’s way.
9. Ensure that any damage to the permanent or temporary fencing is immediately blocked to prevent tortoise access and permanently repaired within 72 hours between March 15 and October 31, and within 7 days between November 1 and March 14. Following installation, the permanent fencing should be inspected quarterly and after major rainfall events to ensure fences are intact and there is no ground clearance under the fence that would allow tortoise to pass.
10. The Authorized Biologist should inspect any construction pipe, culvert, or similar structure with a diameter greater than 3 inches, stored less than 8 inches aboveground and within desert tortoise habitat (i.e., outside the permanently fenced area) for one or more nights, before the material is moved, buried or capped. As an alternative, all such structures may be capped before being stored outside the fenced area, or placed on pipe racks. These materials would not need to be inspected or capped if they are stored within the permanently fenced area after desert tortoise clearance surveys have been completed.
11. Ensure vehicular traffic does not exceed 25 miles per hour within the delineated project areas or on access roads in desert tortoise habitat. On unpaved roads the speed limit should be 10 miles per hour to suppress dust and protect air quality.

12. Any time a vehicle or construction equipment is parked in desert tortoise habitat outside the permanently fenced area, the Authorized Biologist or drivers of the vehicle should inspect the ground under the vehicle for the presence of desert tortoise before it is moved. If a desert tortoise is observed, it should be left to move on its own. If it does not move within 15 minutes, the Authorized Biologist may remove and relocate the animal to a safe location.
13. Design culverts to allow safe passage of tortoises.
14. If desert tortoise relocation is determined to be an appropriate conservation measure, develop and implement a Desert Tortoise Translocation Plan for approval by CDFG, USFWS, BLM and other permitting agencies. The Plan should designate a relocation site as close as possible to the disturbance site that provides suitable conditions for long term survival of the relocated desert tortoise and outline a method for monitoring the relocated tortoise. This area would be set aside in perpetuity for desert tortoise relocation.
15. If desert tortoises are observed within the West Chocolate REEA, consult with CDFG and USFWS to determine the need for and/or feasibility of conducting relocation or translocation as minimization or mitigation for project impacts. Development and implementation of a translocation plan may require, but not be limited to, additional surveys of potential recipient sites; disease testing and health assessments of translocated and resident tortoises; and consideration of climatic conditions at the time of translocation. Because of the potential magnitude of the impacts to desert tortoise from proposed renewable energy projects, CDFG and USFWS must evaluate translocation efforts on a project by project basis in the context of cumulative effects.

**Species Specific: American Badger (*Taxidea taxus*)**

1. Retain a qualified biologist, approved by the CDFG and other permitting agencies, to conduct preconstruction surveys for badger dens in the project area, including areas within 250 feet of all project facilities, utility corridors, and access roads. If badger dens are found, each den should be classified as inactive, potentially active, or definitely active. Inactive dens should be excavated by hand and backfilled to prevent reuse by badgers. Potentially and definitively active dens should be monitored for three consecutive nights using a tracking medium (such as diatomaceous earth or fire clay) at the entrance. If no tracks are observed in the tracking medium after three nights, the den should be excavated and backfilled by hand. If tracks are observed, the den should be progressively blocked with natural materials (rocks, dirt, sticks, and vegetation piled in front of the entrance) for the next three to five nights to discourage the badger from continued use. The den should then be excavated and backfilled by hand to ensure that no badgers are trapped in the den. Any excavation and filling activities should be performed by the qualified biologist and conducted outside of the breeding season to ensure young badgers are not affected.

**Species Specific: Flat-Tailed Horned Lizard (*Phrynosoma mcallii*)**

1. If appropriate, erect barrier fencing where long-term activities occur. Fencing can be used to exclude flat-tailed horned lizard after clearing the construction area of lizards. Applicants should coordinate with BLM to determine if fencing is appropriate.

2. The Designated Biologist will contact the BLM and the USFWS before ground disturbing activities, document compliance, and be present during operations and maintenance (O&M) activities that take place in flat-tailed horned lizard habitat.. The applicant's Designated Biologist or biological monitors will move any observed flat-tailed horned lizard out of harm's way. They will also map and report how many FTHLs have been encountered.

3. To fully mitigate for habitat loss and potential take of flat-tailed horned lizard, compensation funds will be allocated. These compensation funds will be used to acquire, protect, or restore flat-tailed horned lizard habitat within and contiguous with the flat-tailed horned lizard management areas in accordance with the Flat-Tailed Horned Lizard Rangewide Management Strategy.. The acquisition and management of compensation lands shall include the following elements:

   <u>Selection Criteria for Compensation Lands.</u> The compensation lands selected for acquisition should:

   a. Be within holdings of the nearest management area;

   b. Be in the Colorado Desert;

   c. Provide moderate to good quality habitat for flat-tailed horned lizard with capacity to regenerate naturally when disturbances are removed, though poor quality habitat is acceptable near protected flat-tailed horned lizard habitats;

   d. Be near larger blocks of lands that are either already protected or planned for protection, or which could feasibly be protected by a public resource agency or a non-governmental organization dedicated to habitat preservation; and

   e. Be connected to lands currently occupied by flat-tailed horned lizard, ideally with populations that are stable, recovering, or likely to recover.

   Other approved uses of the compensation funds, should acquisition opportunities be exhausted:

   a. Transfer funds to other management areas to purchase flat-tailed horned lizard habitat, especially habitat within or contiguous with management areas that are threatened with imminent impacts;

   b. Construct and maintain fences and signs around management areas to prevent off-highway vehicles (OHVs) from entering and degrading flat-tailed horned lizard habitat. In addition, these fences could be designed to physically prevent flat-tailed horned lizards from leaving the management areas and encountering nearby roads; and

   c. Restore degraded flat-tailed horned lizard habitat within or contiguous with management areas.

   The project owner shall implement a Raven Monitoring, Management, and Control Plan that is consistent with the most current USFWS-approved raven management guidelines, and which meets the approval of the USFWS, CDFG, and BLM, and CEC staff. The draft Raven Monitoring, Management, and Control Plan submitted by the applicant shall provide the basis for the final plan, subject to review and revisions from the BLM, USFWS, and CDFG, and the CEC staff.

Verification. At least 60 days prior to start of any project-related ground disturbance activities, the project owner shall provide the BLM's Authorized Officer, the CPM, USFWS, and CDFG with the final version of the Raven Monitoring, Management, and Control Plan that has been reviewed and approved by USFWS, CDFG, and BLM's Authorized Officer . The BLM would determine the plan's acceptability within 15 days of receipt of the final plan. All modifications to the approved Raven Monitoring, Management, and Control Plan must be made only after consultation with the BLM, CEC staff, USFWS, and CDFG. The project owner shall notify BLM's Authorized Officer and the CPM no less than five working days before implementing any BLM- and CPM-approved modifications to the Raven Monitoring, Management, and Control Plan. Within 30 days after completion of project construction, the project owner shall provide to BLM's Authorized Officer and the CPM for review and approval, a written report identifying which items of the Raven Monitoring, Management, and Control Plan have been completed, a summary of all modifications to BMPs made during the project's construction phase, and which items are still outstanding.

The Designated Biologist will verify for the BLM that all flat-tailed horned lizard impact avoidance, minimization, and compensatory measures have been implemented (Flat-Tailed Horned Lizard Interagency Coordinating Committee 2008).

**Species Specific: Nelson's Big Horn Sheep (*Ovis Canadensis nelsoni)***

1. Erect fences and gates to preclude large mammal access to the site and to contain construction equipment. Obtain CDFG approval of fence design plan before installation.
2. Cover excavated areas, slope trenches, or install wildlife escape ramps in the excavated areas to facilitate the escape of any sheep that wander on site.
3. Avoid or minimize impacts to drainage features in known bighorn sheep territory.
4. Avoid impacts to water sources identified as those utilized by bighorn sheep.
5. Avoid and minimize disturbance to wildlife corridors present in the REEA.

## WIND ENERGY DEVELOPMENT

1. Use flashing or strobe lights on heliostat towers to minimize risk of avian collisions, in consultation with the USFWS, CDFG, and the DoD.
2. Cut-in speeds of wind turbines will be maintained at 5.0 meters per second or higher during night hours or when it is determined that active bats may be at particular risk from turbines. This measure will reduce the number of bat mortalities (Arnett et al. 2010).
3. Keep lighting at both operation and maintenance facilities and substations located within 0.5 mile of the turbines to the minimum required to meet FAA guidelines and safety and security needs.

4. Locate turbines to avoid separating birds and bats from their daily roosting, feeding, or nesting sites if documented that the turbines' presence poses a risk to species.
5. Although it is unclear whether tubular or lattice towers pose less risk, it is recommended that tubular towers or best available technology be used to reduce ability of birds to perch on turbines.
6. Remove wind turbines when they are no longer cost effective to use or retrofit so they cannot present a collision hazard to birds and bats.

# I-A3: CULTURAL AND HISTORIC RESOURCES

## BEST MANAGEMENT PRACTICES

---

## GENERAL

### General Stipulations

1. Avoid and protect potentially significant cultural resources in the APE.
2. Construction and operations monitoring by an archaeologist listed on a BLM California Cultural Resources Use Permit (CRUP) at locations with known sensitivity for cultural resources.
3. Train construction personnel to identify, avoid, and report the presence of cultural resources.
4. Construction and operations monitoring by an archaeologist listed on a BLM California CRUP in areas of high sensitivity for buried cultural resources.
5. Construction and operations monitoring by an archaeologist listed on a BLM CRUP for properties eligible for listing in the NRHP.
6. Reduce adverse visual intrusions to historic built environment properties.
7. Properly treat human remains.

### Stipulations Specific to Geothermal, Solar, and Wind Energy Leases

1. <u>Complete Consultation with Native American and other Traditional Groups.</u>

   The BLM will consult with Native American tribal governments to identify tribal interests and traditional cultural resources or properties that may be affected by federal land leases and potential for geothermal, solar, or wind energy development. Tribal interests include economic rights such as Indian trust assets and resource uses and access guaranteed by treaty rights. Traditional cultural resources or properties include areas of cultural importance to contemporary communities, such as sacred sites or resource gathering areas. There may be issues related to the presence of cultural properties, access rights, disruption to traditional cultural practices, cultural use of hot springs and water sources and impacts to visual resources important to tribes. Areas proposed for leasing may include lands where there are tribal interests and traditional cultural resources that are not currently identified. Consultations on leases should include a full disclosure of the lease as a commitment of the land that may eventually involve future development that could preclude other tribal uses. Consideration and research should be directed to determine if there are other ethnic and social groups that may have traditional uses or ties to the lands proposed for leases.

   One of the defining characteristics of most proposed energy projects is their size and scale. Because of the large land areas involved, it is essential to effect the early identification and analysis of landscape level resources and issues that might normally not be identified in conventional cultural resources survey. As part of this analysis, it is extremely important to identify and contact Native American tribes and other interested parties that may have information on historic properties, sacred sites, traditional cultural properties, or other cultural resources that may be located within the APE or may be affected by the proposed undertaking. It is essential that rigorous and meaningful tribal consultation be carried out early in the application process to identify issues and concerns that may rise above and beyond specific archaeological or historic properties, which may involve sacred sites, traditional cultural landscapes or other issues that would not normally be identified.

Tribal consultation/contact should be focused on working with tribes at the earliest stages of the proposed undertaking to gather ethnographic information, property information, and other resource information to help identify significant properties or issues, especially information about traditional cultural properties, sacred sites, and cultural landscapes. This will assist in identifying significant issues and resources that are not identified through the course of normal cultural resources survey. The objective of consultation is to identify any potentially significant properties or issues that may pose difficulties for the proposed undertaking and future management decision-making. As this consultation will be conducted on a landscape level scale, it is imperative to provide information and maps that are easily understood by tribal members in the consultation process. Because of the number, size and scale of proposed energy projects in any given area, BLM offices should consider additional strategies for tribal consultation beyond consultation on project specific basis. BLM Field Offices should consider combining consultations on multiple projects or inviting tribes to meetings where multiple projects may be discussed and coordinated in order to facilitate coordination and information exchange, minimize confusion about the large number of projects, and provide for a more effective and productive process of tribal consultation.

2. <u>Cultural Resources Literature Review and Records Search.</u>

A records search and literature review is required with the objective of developing sufficient information and contexts for the purpose of identifying significant resources and issues that may be relevant to the assessment of effects for the undertaking. However, the records search and literature review may not necessarily require a full BLM Class I cultural overview and documentation as defined in the BLM 8100 Manual. Documentation sufficient for a records search and literature review may include records provided by information centers or other repositories, such as historical societies, museums, and BLM land records, and may include copies of site records, maps, historic maps, lists of reports, surveys, previous cultural resources overviews. The purpose of the records search and literature review is to identify any potentially significant properties or issues that may pose difficulties for the proposed undertaking and future management decision-making.

3. <u>Inventory and Evaluate all Cultural Resources in Final APE.</u>

Before any ROW or Lease Authorizations are issued, treatment of cultural resources will follow the procedures established by the Advisory Council on Historic Preservation for compliance with Section 106 of the National Historic Preservation Act. A pedestrian inventory will be undertaken of all portions that have not been previously surveyed or are identified by BLM as requiring inventory to identify properties that are eligible for the National Register of Historic Places (NRHP). Those sites not already evaluated for NRHP eligibility will be evaluated based on surface remains, subsurface testing, archival, and/or ethnographic sources. Subsurface testing will be kept to a minimum whenever possible if sufficient information is available to evaluate the site or if avoidance is an expected mitigation outcome. Recommendations regarding the eligibility of sites will be submitted to the BLM, and a treatment plan will be prepared to detail methods for avoidance of impacts or mitigation of effects.

4. <u>Eligibility Determinations</u>.

The BLM will make determinations of eligibility and effect and consult with SHPO as necessary based on each proposed lease application and project plans. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated. Avoidance of impacts through project design will be given priority over data recovery as the preferred mitigation measure. Avoidance measures include moving project elements away from site locations or to areas of previous impacts, restricting travel to existing roads, and maintaining barriers and signs in areas of cultural sensitivity. Any data recovery will be preceded by approval of a detailed research design, Native American Consultation, and other requirements for BLM issuance of a permit under the Archaeological Resources Protection Act.

5. <u>Develop and Implement Plan(s) for the Treatment, Management, and Protection of Cultural Resources.</u>

If cultural resources are present at the site, or if areas with a high potential to contain cultural material have been identified, a cultural resources management plan (CRMP) will be developed. This plan will address mitigation activities to be taken for cultural resources found at the site. Avoidance of the area is always the preferred mitigation option. Other mitigation options include archaeological survey and excavation (as warranted) and monitoring. If an area exhibits a high potential, but no artifacts were observed during an archaeological survey, monitoring by a qualified archaeologist could be required during all excavation and earthmoving in the high-potential area. A report will be prepared documenting these activities. The CRMP also will (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of artifacts and destruction of property on public land.

In addition to a CRMP, one or more of the following documents may be required by the BLM, in consultation with the SHPO and, possibly, the Advisory Council on Historic Preservation: Historic Properties Treatment Plan, Historic Properties Management Plan, Inadvertent Discoveries Plan, Tribal Participation Plan, Long Term Management Plan, Memorandum of Agreement, Memorandum of Understanding, or other document or agreement addressing the treatment and management of cultural resources.

## GEOTHERMAL ENERGY DEVELOPMENT

For geothermal leases, the BLM will apply the following stipulation to protect cultural resources, in accordance with BLM Instruction Memorandum No. 2005-003:

> "This lease may be found to contain historic properties and/or resources protected under the NHPA, American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Executive Order 13007, or other statutes and executive orders. The BLM will not approve any ground-disturbing activities that may affect any such properties or resources until it completes its obligations under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated."

# I-A4: HAZARDOUS MATERIALS, PESTICIDES, AND WASTE MANAGEMENT

## BEST MANAGEMENT PRACTICES

---

## GENERAL

1. Ensure that on-site workers are fully trained to properly handle and are informed about each of the hazardous materials that will be used on site.
2. Prepare a hazardous materials management plan addressing storage, use, transportation, and disposal of each hazardous material anticipated to be used, stored, or transported at the site. The plan should establish inspection procedures, storage requirements, storage quantity limits, inventory control, nonhazardous product substitutes, and disposition of excess materials and be implemented during all phases of the project. The plan should also identify requirements for notices to federal and local emergency response authorities and include emergency response plans. Project developers should contact the local certified unified program agency (CUPA) for requirements and enrollment in the CUPA's hazardous waste generator program. If the plan calls for treating hazardous waste onsite, consult with the CUPA on and obtain the required authorizations for the treatment activity from the state or local permitting agency.
3. If Environmental Site Assessments determine that remediation is necessary, ensure the remediation activities are conducted in accordance with the appropriate regulatory agency requirements and oversight. Demonstrate that the site has been cleaned up in accordance with all applicable laws, ordinances, regulations and standards.
4. Prepare a construction and operation waste management plan identifying the waste streams that are expected to be generated at the site and addressing hazardous waste determination procedures, waste storage locations, waste-specific management, recycling and disposal requirements, inspection procedures, inventory selection and control, and waste minimization procedures. The plan should be implemented during all phases of the project and address all solid and liquid wastes that may be generated at the site in compliance with the Clean Water Act requirements to obtain the project's NPDES permit. Consider, for example, the following in the plan:
    a. Identifying and controlling practices that produce wastes and wastewater, such as: metal fabrication, zero liquid discharge residue, grinding and finishing; storing and disposing of solid and liquid waste; vehicle and equipment refueling, maintenance service, washing, engine cleaning, and parking.
5. Prepare and implement a spill prevention and response plan identifying where hazardous materials and wastes are stored on site, spill prevention measures to be implemented, training requirements, appropriate spill response actions for each material or waste, the locations of spill response kits on site, a procedure for ensuring

that the spill response kits are adequately stocked at all times, and procedures for making timely notifications to authorities. Consider including the following practices, at a minimum, in the plan:

a. Place equipment and vehicle maintenance and repair areas under a roof.

b. Work on engines, transmissions, miscellaneous repairs, and changing automotive fluids (brake fluid, transmission fluid, gear oil, radiator fluids, and air conditioner Freon or refrigerant) should be conducted in a covered area using drip pans when there is a likelihood of leaks or spills. Use absorbent materials for spill prevention and cleanup.

c. Promptly cleaning up vehicle leaks, using a rag or absorbent material; properly disposing of used rags or spent sorbents.

d. Fueling vehicles should be done where spills or leaks will be contained and cleaned up quickly.

e. No vehicle refueling would occur within 100 feet of a perennial or mapped ephemeral watercourse.

6. Ensure secondary containment is provided for all on-site hazardous and extremely hazardous materials and waste storage, including fuel. In particular, fuel storage (for construction vehicles and equipment) should be a temporary activity occurring only for as long as is needed to support construction activities.

7. Ensure wastes are properly containerized, covered and removed periodically for disposal at appropriate off-site permitted disposal facilities.

8. In the event of an accidental hazardous waste release to the environment, document the event, including a root cause analysis, appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event should be provided to the permitting agencies and other federal and state agencies within 30 days, as required.

9. If pesticides are used on the site, prepare an integrated pest management plan to ensure that pesticide applications would be conducted within the framework of state and federal policies and entail only the use of EPA registered and state approved pesticides that permitting agencies have authorized. Pesticide use should be limited to non-persistent, immobile pesticides. Pesticides should only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications. All pesticides should be used, stored, and disposed of in accordance with their label. A pesticide use permit would be required from BLM before any pesticide can be applied.

10. If potentially contaminated soil (as evidenced by discoloration, odor, detection by handheld instruments, or other signs) is identified during site excavation grading, or construction at either the proposed site or linear facilities, a qualified Professional Civil Engineer, Professional Geologist or Registered Environmental Assessor should inspect the site. The inspection should determine the need for sampling to confirm the nature and extent of contamination, before continuing activities in the area of the suspected contamination. Project construction activities should not be allowed to

continue in the area until the suspected contamination is assessed and remediated as necessary to comply with applicable environmental and worker health and safety laws, ordinances, regulations, and standards.

11. Rinsing of herbicide/pesticide spray tanks should not occur in or near water bodies.
12. Minimize herbicide/pesticide treatment in areas that have a high risk for groundwater contamination.
13. Determine the risk of herbicide/pesticide contamination when such substances are used to control vegetation. Consider the weather, soil type, slope, and vegetation type.
14. Use appropriate herbicide-free/pesticide-free buffer zones for herbicides not labeled for aquatic use, based on BLM/U.S. Forest Service (USFS) risk assessment guidance. The guidance suggests minimum widths of 100 feet for aerial applications, 25 feet for applications dispersed by vehicle and 10 feet for hand-spray applications.
15. Project developers should provide a Debris Management Plan and a Performance Guarantee per the applicable county's Construction and Demolition Recycling Program and should ensure compliance with all of the county's diversion program requirements.
16. Hazardous product leaks and chemical releases that constitute a Recognized Environmental Condition should be remediated prior to completion of decommissioning.
17. Project developers should contact the USACE, as any streams or other aquatic resources located within the REEA, particularly those that are connected to the Salton Sea, are likely USACE jurisdictional waters of the U.S.
18. Section 404 permits are likely required for any type of discharge of dredge or fill material in ephemeral streams within the West Chocolate REEA because some of these streams may flow directly into the Salton Sea, or into canals and drainages prior to entering the Salton Sea.
19. Additional measures have been added that require a 300-foot buffer around riparian and wetlands features (distance from the edge of the water body) for renewable energy projects that would be developed in the West Chocolate REEA, east of the Coachella Canal. The 100-foot buffer should remain for lands west (and south) of the Coachella Canal. Any exclusion area or "buffer" for a water feature would use the "ordinary high water mark" as defined by the USACE. Project specific surveys will also be required to identify constraints to development (i.e., wetlands and riparian habitat) and to ensure protection of valuable aquatic resources in the REEA.
20. Establish setbacks or consider acquiring buffer lands to separate nearby residences and occupied buildings from the proposed facility to minimize impacts from sun reflection, low-frequency sound, electromagnetic fields (EMF), construction and operation noise, air pollution, and facility-related hazards and wastes. Design the project to reduce electromagnetic interference (EMI) (e.g., impacts to radar, microwave, television, and radio transmissions) and to comply with Federal Communications Commission (FCC) regulations. Conduct signal strength studies when proposed locations have the potential to affect FCC licensed transmissions. Reduce to nil potential or real interference with public safety communication systems (e.g., radio traffic related to emergency activities) or the amateur radio bands.

## GEOTHERMAL ENERGY DEVELOPMENT

1. Increase the pH of spent geothermal brine to keep silica in solution prior to reinjection.
2. Return spent geothermal brines, steam condensate, and cooling system blow-down to the geothermal resource via reinjection wells.
3. Assure that hazardous substances and wastes removed from surface impoundments are not leaked, spilled, or otherwise improperly released outside the surface impoundments and into the environment.
4. Remediate any contamination near and around surface impoundments, including the tops of berms and areas downwind from the impoundments, filter cake bay storage areas, hydroblast pads and adjacent areas, pipes containing hazardous waste scale and areas adjacent, and other areas where hazardous waste releases or disposals have occurred.
5. Minimize releases of filter cake into the environment by enclosing filter cake bays with doors or replace filter cake bays with containers or trailers capable of holding the waste material.
6. Prevent filter cake from being released or disposed of into the environment during the transfer to, from, or while stored at the filter cake bays or in end-dump trailers.
7. Ensure that all employees and contractors staff operating at any facility receive appropriate hazardous waste management and high pressure high temperature (HPHT) training prior to conducting any work involving hazardous waste, including hazardous waste treatment, storage, and disposal at the facility, or HPHT environments, including wellsite, pipeline, and power plant operations.
8. Conduct annual environmental audits to identify all hazardous waste streams and determine compliance with all applicable statutory and regulatory provisions of California’s Hazardous Waste Control Law and the Unified Hazardous Waste and Hazardous Materials Management Regulatory Program.
9. Maintain a minimum freeboard of two feet at all times within the geothermal brine surface impoundment. Ensure the fluids and brine precipitates discharged to and contained in the surface impoundment never overflow.
10. Install a leak detection system beneath the membrane liner of the geothermal brine surface impoundment. Inspect the system quarterly to ensure brine is not collecting due a membrane-liner breach.
11. Monitor groundwater wells to determine whether the geothermal brine surface impoundment is releasing hazardous waste into groundwater.
12. Clean conveyance systems regularly to prevent buildup of silica scale and the potential for release of solid materials from conveyance systems.
13. Perform pipe maintenance and de-scaling only in areas designated for these activities.
14. Construct hydro blasting areas so that the base is impermeable base and no wastewater can spray or run onto adjacent soil. For example, the hydro blasting area

should have 12-foot-high walls on three sides. Convey wastewater from the hydro blasting process to the brine surface impoundment for reinjection to the geothermal resource.

15. Containerize drilling mud and cuttings, when possible. Placing muds and cuttings in containers, such as Baker tanks, may not always be practical, but is a practice that avoids discharging such wastes to land.

# I-A5: NOISE AND VIBRATION

## BEST MANAGEMENT PRACTICES

### GENERAL

1. Ensure noisy construction activities (including truck and rail deliveries, pile driving and blasting) are limited to the least noise-sensitive times of day (i.e., weekdays only between 7 a.m. and 7 p.m.) for projects near residential or recreational areas.
2. Consider use of noise barriers such as berms and vegetation to limit ambient noise at plant property lines, especially where sensitive noise receptors may be present.
3. Ensure all project equipment has sound-control devices no less effective than those provided on the original equipment. All construction equipment used should be adequately muffled and maintained. Consider use of battery powered forklifts and other facility vehicles.
4. Ensure all stationary construction equipment (i.e., compressors and generators) is located as far as practicable from nearby residences.
5. If blasting or other noisy activities are required during the construction period, notify nearby residents and the permitting agencies 24 hours in advance.
6. Properly maintain mufflers, brakes and all loose items on construction and operation related vehicles to minimize noise and ensure safe operations. Keep truck operations to the quietest operating speeds. Advise about downshifting and vehicle operations in residential communities to keep truck noise to a minimum.
7. Use noise controls on standard construction equipment; shield impact tools. Consider use of flashing lights instead of audible back-up alarms on mobile equipment.
8. Install mufflers on air coolers and exhaust stacks of all diesel and gas-driven engines. Equip all emergency pressure relief valves and steam blow-down lines with silencers to limit noise levels.
9. Contain facilities within buildings or other types of effective noise enclosures.
10. Employ engineering controls, including sound-insulated equipment and control rooms, to reduce the average noise level in normal work areas.

### GEOTHERMAL ENERGY DEVELOPMENT

BLM regulations seek to "minimize noise," but set no measurable standard. BLM relies on noise criteria published in 1975 by the USGS in "Geothermal Resources Operational Order No. 4." The order is applicable to people occupying nearby homes, hospitals, schools, and libraries and wildlife, according to the 2008 PEIS and states that federal land lessees may:

> *"not exceed a noise level of 65 dB(A) for all geothermal-related activity including but not limited to, exploration, development, or production operations as*

*measured at the lease boundary line or 0.8 km (one-half mile) from the source, whichever is greater, using the A-weighted network of a standard Sound Level Meter. However, the permissible noise level of 65 dB(A) may be exceeded under emergency conditions or with [regulatory] approval if written permission is first obtained by the lessee from all residents within 0.8 km (one-half mile).”*

Geothermal resource exploration/testing involves well drilling and less invasive approaches such as geophysical remote sensing. Remote sensing can refine well targeting and reduce the number of wells drilled. The exploration/testing approach is generally identified in a reservoir management plan.

1. Use as few drill sites as is feasible so that fewer people are noise-impacted.
2. Locate the sites as far from residences as possible. In addition, use terrain, such as ridges, and plan the drill site so that noise is projected away from residences, to shield noise impacts to the greatest extent possible. Within two miles of existing, occupied residences, consider restricting geothermal well drilling or major facility construction activities to non-sleeping hours (7 a.m. to 10 p.m.).
3. To dampen drilling rig noise, install acoustical windows in structures occupied by affected parties.
4. Install adequate noise abatement equipment during construction and operation, and maintain it in good condition to reduce noise from any drilling or producing geothermal well located within 1,500 feet of a habitation, school or church. Examples of such equipment include temporary noise shields, cyclone silencers, rock wall mufflers, and sound insulation in pipes. Silencers slow the velocity of steam in the steam processing facility.

## WIND ENERGY DEVELOPMENT

Wind turbines produce noise generated primarily from mechanical and aerodynamic sources. Mechanical noise may be generated by machinery in the nacelle (the structure on the wind turbine that encloses the generation equipment). Aerodynamic noise emanates from the movement of air around the turbine blades and tower. The types of aerodynamic noise may include low frequency, impulsive low frequency, tonal, and continuous broadband. Preventing and controlling noise can be generally accomplished by appropriate siting and turbine design.

1. Site wind farms to avoid locations in close proximity to sensitive noise receptors (e.g. residences, hospitals, and schools).
2. Adhere to national or international acoustic design standards for wind turbines (e.g. International Energy Agency, International Electrotechnical Commission, and the American National Standards Institute).
3. Use variable speed turbines or pitched blades to lower rotational speed.

# I-A6: PALEONTOLOGICAL RESOURCES

## BEST MANAGEMENT PRACTICES

### GENERAL

1. Develop a protocol for unexpected paleontological discoveries. Unexpected discovery of paleontological resources during construction should be brought to the immediate attention of the appropriate permitting agencies. Work should be halted near the discovery to avoid further disturbance to the resources while they are being evaluated and appropriate BMPs are being developed.
2. Operators will determine whether paleontological resources exist in a project area on the basis of the sedimentary context of the area, a records search for past paleontological finds in the area, and/or, depending on the extent of existing information, a paleontological survey.
3. If paleontological resources are present at the site, or if areas with a high potential to contain paleontological material have been identified, a paleontological resources management plan (PRMP) will be developed. This plan will include a mitigation plan for avoidance, removal of fossils, or monitoring. If an area exhibits a high potential but no fossils were observed during survey, monitoring by a qualified paleontologist may be required during excavation and earthmoving in the sensitive area. The operator will submit a report to the agency documenting these activities. The paleontological resources management plan also will (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of fossils on public land.

# I-A7: SAFETY, HEALTH, AND NUISANCES

## BEST MANAGEMENT PRACTICES

### GENERAL

1. All developers will comply with all state and federal occupational health and safety regulations.

# I-A8: SOILS, DRAINAGE, EROSION, STORMWATER, AND FLOODING

## BEST MANAGEMENT PRACTICES

---

## GENERAL

1. Prepare and implement a Drainage, Erosion, and Sedimentation Control Plan that ensures proper protection of water quality and soil resources, demonstrates no increase in off-site flooding potential, and includes provisions for stormwater and sediment retention for the project site. The plan should also identify site surface water runoff patterns and develop BMPs that prevent excessive and unnatural soil deposition and erosion throughout, including areas downslope of the project site and related construction sites. The plan should be designed to minimize disturbance of the site during construction, operation, repowering/retrofit and decommissioning, and achieve the following:
   a. Stabilize disturbed areas that will not be covered with structures or pavement following grading and/or cut and fill operations by means such as moisturizing and compacting.
   b. Save removed topsoil for reuse, when possible, by segregating and stockpiling the material. Cover material to prevent erosion.
   c. Runoff from parking lots, roof, or other impervious surfaces should be directed to the immediate landscape or directed to retention basins prior to entering the storm drain.
   d. Minimize stormwater runoff contamination from vehicle refueling and repair areas by containing such activities to work areas where runoff is collected or controlled.
   e. Landscaping that requires little or no irrigation should be used and be recessed to create retention basins/areas to capture runoff.
   f. The amount of area covered by impervious surfaces should be reduced through use of permeable pavement or other pervious surfaces.
   g. Natural drainages and pre-project hydrographs for the area should be maintained.
   h. The expectation of an acceptable surface hydrology report, and roads, structures and other project accoutrements will be designed to withstand a 100year storm event.
2. Prepare a SWPPP for the site prior to construction mobilization to ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion.

3. Topsoil that is removed and stored should be spread in windrows to maximize viability of seedbank and soil biota.
4. Avoid using invasive species for seeding or planting for erosion control and soil stabilization purposes.
5. Conduct post-construction monitoring of areas that were disturbed during the construction phase, and apply appropriate mitigation as necessary in a timely manner.
6. Conduct regular inspections of permanent erosion control measures to ensure proper working order.
7. After decommissioning, erosion control measures should be installed in all disturbance areas where potential for erosion exists.

## GEOTHERMAL ENERGY DEVELOPMENT

1. Do not use geothermal fluids or exploratory well drilling muds for dust control on access roads, well pads, or within the facility area.

# I-A9: TRAFFIC AND TRANSPORTATION ROADS

## BEST MANAGEMENT PRACTICES

---

### GENERAL

1. Comply with the Circulation Element of the Imperial County General Plan.
2. Road construction and maintenance on BLM lands should follow established policy and guidelines within BLM Manual 9113 – Roads, state, local and/or other appropriate transportation agencies.
3. Roads that are no longer needed should be abandoned, recontoured and restored using weed-free native grasses, forbs, and shrubs based on BLM, USFWS, and/or CDFG recommendations.
4. Prepare a transportation plan for implementation during all phases of the project. Address methods for reducing construction worker traffic volumes and transport of project related equipment and materials.
    a. Consider providing a construction worker rideshare program.
    b. Consider scheduling shift changes and deliveries to avoid conflict with peak hour traffic patterns.
    c. Describe transport of facility hazardous and non-hazardous materials, components, main assembly cranes, and other large pieces of equipment.
    d. Consider specific object sizes, weights, origin, destination, peak hour traffic, and unique handling requirements and evaluate alternative transportation approaches.
5. Obtain vehicle oversize and overweight permits, as appropriate.
6. Obtain utility encroachment permits from appropriate agencies.
7. Conduct ongoing ground transportation planning to evaluate road use, minimize traffic volume, and ensure that roads are maintained adequately to minimize associated impacts.
8. Consult with local planning authorities regarding increased traffic during the construction phase, including an assessment of the number of vehicles per day, their size, and type.
9. Ensure signs are placed along construction roads to identify speed limits, travel restrictions, and other standard traffic control information. To minimize impacts on local commuters, consideration should be given to limiting construction vehicles traveling on public roadways during the morning and late afternoon commute times.
10. Restrict traffic to the roads specified for the project. Use of other unimproved roads should be restricted to emergency situations involving potential injury or loss of life.

11. Future specific project areas should only be accessed from existing county roads or a permitted highway access location. Any new access or additional trips to an existing access may require a focused traffic analysis, a traffic control plan, or other necessary studies.
12. Instruct project personnel and contractors to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and airborne dust. Consider requiring driver attendance at Traffic Safety Awareness training.
13. Vehicle tires should be inspected regularly to allow faulty tires to be replaced before they fail on the road.
14. Implement a program with truck owner/operators to cover loads per California Vehicle Code 23114(a); sweep, clean, or hose truck and trailers after loading and unloading and before entering a public road.
15. Repair or reconstruct to pre-project conditions project-related access roads that are damaged by project construction activities.
16. All structures crossing washes or streams should be located and constructed so that they do not decrease channel stability or increase water velocity, to avoid erosion and changes to surface water runoff.
17. Potential soil erosion from road building or use should be controlled at culvert outlets with appropriate structures. Catch basins, roadway ditches, and culverts should be cleaned and maintained regularly.

# I-A10: AVIATION

## BEST MANAGEMENT PRACTICES

---

### GENERAL

1. Mitigate impacts to air traffic safety. So that interference from electrical generation facilities can be quickly recognized by aircraft with onboard radar systems, work with the FAA to determine best practices for conveying warning information to the aircraft and mitigating the interference.
2. Notify the FAA of any construction or alteration of navigable airspace within 5,000 feet from a heliport or 20,000 feet of any airport runway more than 3,200 feet in length, via the filing of FAA Form 7460.
3. Mitigate impacts to DoD/military low fly zones. Work with local and/or appropriate military representatives to determine best practices for conveying warning information to aircraft and mitigating interference to address interference from electrical generation facilities. Notify the appropriate representatives of any proposed construction or alteration of navigable airspace in low fly zones.

# I-A11: VISUAL RESOURCES

## BEST MANAGEMENT PRACTICES

### GENERAL

1. Ensure the public is involved and informed about the visual site design elements of the proposed project. Possible approaches include conducting public participation forums for disseminating information, offering organized tours of operating solar developments, and using computer simulation and visualization techniques in public presentations.
2. Reduce visual impacts during construction by minimizing areas of surface disturbance, controlling erosion, using non-chemical dust suppression techniques, and restoring exposed soils as closely as possible to their original contour and vegetation.
3. Color and finish surfaces of all project structures and buildings visible to the public to ensure they minimize visual intrusion and contrast and minimize glare. Paint grouped structures the same color to reduce visual complexity and color contrast.
4. Establish a regular litter pick-up procedure within and around the perimeter of the project site.
5. Use perimeter berms and/or decorative landscape plantings, where appropriate for effective facility screening, on the perimeter of the project site, outside of security fencing. Use native, drought tolerant plants to the maximum extent possible.
6. Inspect landscaping regularly and replace dead plantings in a timely manner.

### WIND ENERGY DEVELOPMENT

Depending on the location and local public perception, wind farms, like other power plants, may impact visual resources. Visual impacts associated with wind energy projects typically concern the turbines themselves (e.g. color, height, and number of turbines) and impacts relating to their interaction with the character of the surrounding landscape. Carrying out the general visual resource BMPs and the following BMPs specific to wind farms will minimize visual impacts.

1. Maintain uniform size and design of turbines (e.g. direction of rotation, type of turbine and tower, and height).
2. Paint the turbines with a non-reflective coating and a uniform color, typically matching the sky (light gray or pale blue), while observing air navigational marking regulations.
3. Avoid lettering, company insignia, advertising, or graphics on the turbines.

## Shadow Flicker and Blade Glint

Shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow. As the rotor blades rotate, shadows pass over the same point causing an effect termed shadow flicker. Shadow flicker may become a problem when residences are located near or have a specific orientation to the wind farm. Most problems occur generally southwest and southeast of the turbines.

Similar to shadow flicker, blade or tower glint occurs when the sun strikes a rotor blade or the tower at a particular orientation. This can impact a community, as the reflection of sunlight off the rotor blade may be angled toward nearby residences. Blade glint is a temporary phenomenon for new turbines only, and typically disappears when blades have been soiled after a few months of operation.

Prevention and control measures to address these impacts include the following:

1. Use commercially available modeling software to identify a ‘zone’ of flicker. Site and orient wind turbines appropriately.
2. Paint wind turbine towers with non-reflective coating.

# I-A12: WATER SUPPLY AND QUALITY

## BEST MANAGEMENT PRACTICES

## GENERAL

1. Ensure that any wastewater generated in association with temporary, portable sanitary facilities is periodically removed by a licensed hauler and disposed into an existing municipal sewage treatment facility.
2. Temporary, portable sanitary facilities provided for construction crews should be adequate to support expected on-site personnel and should be removed at completion of construction activities.
3. Consider cleaning company vehicles at commercial car washes rather than washing vehicles on the company's property so that dirt, grease, and detergents are treated effectively at existing facilities designed to handle those types of wastes.
4. Comply with local requirements for permanent, domestic water use and wastewater treatment.

   Groundwater withdrawal may result in aquifer drawdown, potentially impacting hydrologically connected surface water bodies and riparian areas by reducing inflows. Historical groundwater data indicate that groundwater levels in the East Salton Sea Subbasin have been declining (USGS 2011). Long-term withdrawal of groundwater for the purpose of energy production may result in further localized groundwater drawdown. BMPs may include aquifer testing, groundwater level monitoring, and locating production wells outside of riparian areas to minimize inflow impacts to adjacent surface waters. Groundwater withdrawal should not exceed recharge to the reasonably defined sub-basin from which it is produced.

   Water and waste treatment facilities may be required for energy production facilities with long term operational water needs, including for drinking water and mirror/panel washing or dust suppression. Potable water needs may likely be met by a small package water treatment plant that would have a relatively small acreage footprint in the context of the entire facility. Additionally, any wastewater generated by operational uses may be treated and recycled for future use or evaporated. A similar package wastewater treatment system may be sufficient. Any discharge of wastes would require applicable permits.
5. Project developers should identify the source(s) of project water, and provide analysis proving that adequate quantity and quality of water are available from identified source(s).
6. Submittal of a Jurisdictional Determination for streams within the REEA, and submittal of a Preliminary Jurisdictional Determination form (PJD) required by the USACE to expedite the determination process. By obtaining a Jurisdictional

Determination, an applicant will establish USACE jurisdictionality for on-site aquatic resources.

7. All practicable steps will be taken to avoid and minimize impacts to aquatic resources; additionally, large mainstem streams will be avoided as much as practical.
8. Consultation with the USACE through pre-application meetings during the design phase of projects will be encouraged to avoid and minimize impacts to aquatic resources.
9. It is assumed that all streams or aquatic resources located on site within the West Chocolate Mountains REEA are jurisdictional, should be considered provisionally restricted from development, and the BLM would accept USACE mitigation requirements for permitting projects. Some of these streams may flow directly into the Salton Sea, or into canals and drainages prior to entering the Salton Sea; a Section 404 permit is likely required for any type of discharge of dredge or fill material in ephemeral streams within the West Chocolate Mountains REEA. The USACE would restrict from development all jurisdictional waters from high water mark to high water mark and impose strict conditions on the use of any lands within (such as road crossings). All washes identified by the USGS National Hydrography Dataset within the West Chocolate Mountains REEA would be expected to have restrictions on development and/or significant stipulations based on Jurisdictional Delineation efforts by the USACE. Jurisdictional Delineation efforts for Section 404 of the Clean Water Act (consultation with USACE) would begin prior to publication of an Notice of Intent. Preliminary Jurisdictional Determinations have been suggested by the USACE to expedite the determination process. Obtainment of a Jurisdictional Determination by the applicant will establish the USACE's jurisdiction over aquatic resources on site. Washes would be a significant issue due to USACE Section 404 permitting requirements. Avoidance of project development in wetlands and setback stipulations would be strictly enforced.

## GEOTHERMAL ENERGY DEVELOPMENT

### Water/Brine Injection and Water Supply

If geothermal power plants are properly designed and sited, water supply and well injection issues can be addressed. Flash geothermal power plants can satisfy up to 95 percent of their water supply needs, including cooling tower make-up water, by recycling steam condensed from produced geothermal brine (CE Obsidian Energy LLC 2009). Water-cooled binary power plants require an external source of cooling water because the brine remains within a closed-loop system until injected, according to Imperial County (County of Imperial, Department of Public Works, n.d.). The brine may include concentrated amounts of contaminants which would present problems to the cooling system and the environment. Use of dry cooling or non-potable or degraded surface or groundwater would protect potable water supplies. Dry cooling can reduce the efficiency or electrical energy output of the power plant by as much as 50 percent in hot weather.

The quality of underground sources of drinking water can be protected through careful well and casing design. Imperial County notes that contamination of groundwater aquifers could be caused by upflow through a fault or by leakage of the injected fluid behind the casing due to a poor cement bond or through a casing damaged by corrosion or mechanical causes.

Hydraulic fracturing, widely known as hydrofracking, is a well stimulation process that enhances subsurface fracture systems, to facilitate the movement of the underground energy source—in this case geothermal fluid—from rock pores to production wells. Hydraulic fluids, typically consisting of water and chemical additives, are pumped into geological formation at high pressures. Once pressure is sufficient, the hydraulic fluid, or flowback fluid, will rise to the surface. Potential impacts associated with hydrofracking include the use of high volumes of water, potentially impacting local water resources, and the discharge of hydraulic fluid containing chemical additives that may result in contamination of groundwater and surface waters. Flowback water is either discharged to surface waters, regulated under the National Pollutant Discharge Elimination System (NPDES) program, or injected into the ground, regulated by the EPA or state Underground Injection Control (UIC) program. Currently, EPA is preparing a new study to evaluate the potential impacts of hydrofracking on drinking water and public health. This purpose of the study is to address recent concerns related to hydrofracking fluid and to update the findings of an EPA study that resulted in the exemption of hydrofracking fluid from regulation under the Safe Drinking Water Act UIC program (EPA 2011). BMPs may include groundwater level and quality monitoring, as well as obtaining and complying with criterion set forth in applicable permits.

Geothermal operations may result in water loss through evaporation. Evaporative losses may vary from 5 to 33 percent (Clark 2010). Binary cycle geothermal power plants typically have lower evaporative losses (5 percent). To mitigate impacts associated with evaporative water losses, appropriate technologies, such as binary cycle, may be implemented.

### Water/Brine Injection Wells

1. Begin planning for injection early in the field development stage. Prepare a preliminary injection strategy as soon as the first few exploration and production wells have been drilled and tested.
2. Use tracer testing and numerical modeling of the reservoir to develop an optimum injection strategy (disappointing production wells should not necessarily be converted to injection wells).
3. Prevent injection pressure buildup with proper chemical treatment and/or filtering of the injection fluid to prevent scaling and/or plugging of injection wells.
4. Increase the spacing between injection wells or the number of injection wells to redistribute the total amount of injection over a larger area and, thereby, correct for ground heaving.
5. Avoid locating injection wells near known active faults and do not allow injection pressure to exceed original pore pressure to avert induced seismicity.
6. Design wells with casing that run from the surface to the depth below the underground source of drinking water. A well should have two casing strings; each sealed its entire length. Test casings, cements, and other materials before selecting them for use in construction at the specific well site.
7. At shallow depths, include multiple casing strings in geothermal wells.

8. If injecting under pressure, monitor injection pressures to avoid excessive pressure and minimize likelihood of injection-induced seismic activity from increased subsurface pressure and the stresses on the injection well equipment.
9. Inject at a rate that will not cause a pressure build-up in the formation or result in reduced fluid temperature at production wells. Monitor injection rates along with pressure monitoring to assess and ensure casing integrity.
10. Design and construct cellars around the casing wellhead. Keep these cellars dry or well drained to prevent corrosion of the casing at the soil-air-water interface.
11. Monitor well integrity to prevent unintended release from within the well to the surrounding formations and interzonal migration of fluids between the casing and the formation.
12. Observe surface conditions daily for casing leaks.
13. If an injection well penetrates an underground source of drinking water, perform mechanical integrity testing periodically to detect actual and potential leaks, casing failures, and cementing problems. Perform these tests prior to initial injection, after well workovers and repairs, and on a routine schedule during normal operations.

Water Supplies Best Management Practices

The use of surface or ground water for cooling a geothermal facility must be thoroughly evaluated and impacts mitigated. This assessment may result in lengthy delays of permitting timeframes.

1. For flash-steam cycle plants minimize the use of fresh water by using geothermal fluid as the major source of cooling water. Use high-efficiency fills in cooling towers to enhance air-to-water contact.
2. For binary geothermal plants, use air-cooled condensers, only, during fall, winter and spring (October through April). During the summer season (May through September), plant electrical efficiency can be improved by using one of the following pre-cooling strategies:
    a. Direct deluge cooling of the air-cooled condenser tubes. Add a purified water rinse to wash away new forming scale when the deluge system is shut down for the winter.
    b. Spray-cooling enhancement (that is, pre-cooling with spray nozzles capable of creating micron-sized water droplets).
    c. Honey-comb, porous evaporative-cooling media (for example, Munters media). Use degraded or reclaimed water sources for geothermal-source water supplies, as much as possible. Minimize use of fresh water supplies.
3. Submittal of a Jurisdictional Determination for streams within the REEA, and submittal of a Preliminary Jurisdictional Determination form (PJD) required by the USACE to expedite the determination process. By obtaining a Jurisdictional Determination, an applicant will establish USACE jurisdictionality for on-site aquatic resources.

4. All practicable steps will be taken to avoid and minimize impacts to aquatic resources; additionally, large mainstem streams will be avoided as much as practical.

Sufficient water supply (for construction, cooling, geothermal makeup water, etc.) must be guaranteed by an applicant before the lease can be approved. The Applicant may need a Conditional Use Permit (CUP) approved by Imperial County to present to BLM before the lease would be granted. Water use would be evaluated during the NEPA process at the project level.

## Proximity to Existing Plugged and Abandoned Wells

1. Given that there are existing plugged and abandoned oil and gas and geothermal wells within the REEA, all proposed drill sites should be accurately plotted on maps and cross checked with California Department of Oil, Gas and Geothermal Resources (CDOGGR) maps.
2. Operators must have a bond on file before certain well operations are undertaken.
3. Written approval from the CDOGGR supervisor will required prior to changing the physical condition of any well.
4. CDOGGR must be notified to witness or inspect all operations specified in the approval of any notice. This includes tests and inspections of blowout-prevention equipment, reservoir and freshwater protection measures, and well-plugging operations.
5. CDOGGR recommends that adequate safety measures be taken to prevent unauthorized access to equipment. Safety shut-down devices on wells and other oilfield equipment must be considered, when appropriate.
6. If any plugged and abandoned or unrecorded wells are damaged or uncovered during excavation or grading, remedial plugging operations may be required. If such damage or discovery occurs, CDOGGR's Cypress district office must be contacted to obtain information on the requirements for and approval to perform remedial operations.

# I-B BMPs from the 2010 BLM Geothermal, Solar, and Wind PEISs

The following BMPs will be considered at the time BLM reviews site-specific project development proposals.  All relevant mitigation and BMPs will be incorporated in the analyses and those that are appropriate to prevent undue or unnecessary degradation to public lands will be approved in the respective RODs for EIS-level analyses or Decision Records for Environmental Assessment (EA) level analyses.

This appendix presents BMPs by individual resource, and is organized as follows:

I-B1: Air Quality

I-B2: Biological Resources

I-B3: Cultural and Historic Resources

I-B4: Hazardous Materials, Pesticides, and Waste Management

I-B5: Noise and Vibration

I-B6: Paleontological Resources

I-B7: Safety, Health, and Nuisances

I-B8: Soils, Drainage, Erosion, Stormwater, and Flooding

I-B9: Traffic and Transportation Roads

I-B10: Aviation

I-B11: Visual Resources

I-B12: Water Supply and Quality

I-B13: Lands and Realty

I-B14: Special Management Areas

I-B15: Rangeland

I-B16: Recreation

I-B17: Socioeconomics

I-B18: Reclamation

*This page intentionally left blank.*

# I-B1: AIR QUALITY

## BEST MANAGEMENT PRACTICES

---

### COMMON TO ALL

- Dust abatement techniques should be used to minimize airborne dust and reduce air emissions. These techniques may include, but are not limited to, surfacing roads with aggregate materials, paving highly used roads, revegetating cleared areas, keeping soil moist, minimizing height of load drops, covering loads while traveling, particulate traps, oxidation catalysts, and using diesel fuel having sulfur content of 15 ppm or less.

### GEOTHERMAL ENERGY DEVELOPMENT

- The operator will coordinate with the [State Air Quality Division] to develop and implement an air quality monitoring plan.
- The operator will prepare and submit to the agency an Equipment Emissions Mitigation Plan for managing diesel exhaust, An Equipment Emissions Mitigation Plan will identify actions to reduce diesel particulate, carbon monoxide, hydrocarbons, and nitrogen oxides associated with construction and drilling activities. The Equipment Emissions Mitigation Plan will require that all drilling/construction related engines are maintained and operated as follows:
    - Are tuned to the engine manufacturer’s specification in accordance with an appropriate time frame.
    - Do not idle for more than five minutes (unless, in the case of certain drilling engines, it is necessary for the operating scope).
    - Are not tampered with in order to increase engine horsepower.
    - Include control devices to reduce air emissions. The determination of which equipment is suitable for control devices should be made by an independent Licensed Mechanical Engineer. Equipment suitable for control devices may include drilling equipment, work over and service rigs, mud pumps, generators, compressors, graders, bulldozers, and dump trucks.

### SOLAR ENERGY DEVELOPMENT

Most solar facilities would be located in desert environments. Fugitive dust emissions from vehicle traffic on unpaved roads and/or from soil-disturbing activities would be the greatest concern with respect to air quality impacts, especially during construction. These fugitive dust emissions and other combustion-related emissions would need to be controlled through stipulations included in the ROW authorization and other permitting processes. The emissions would need to comply with applicable laws, ordinances, regulations, and standards. Many of the BMPs recommended below have been adapted from those discussed in the following references:

BrightSource Energy, Inc. (2007), Beacon Solar, LLC (2008), and Stirling Energy Systems (SES) Solar Two, LLC (2008).

A project- and location-specific Dust Abatement Plan should be prepared for all solar facilities. Water spraying, which is widely used as a dust control measure, is sometimes not cost effective, for example, in water-deprived locations. Paving also is not justifiable for low-volume traffic roads within and around a solar facility. Gravel can be used to reduce fugitive dust from roads. Another solution for controlling dust is to apply a dust suppressant, although this is not a permanent solution. Currently, a wide variety of dust suppressants are commercially available. Selection of the proper dust abatement program should be based on road conditions, environmental impacts, and long-term cost. Primary factors for road conditions include number of vehicles, number of wheels, vehicle speed, vehicle weight, particle size distribution of road surface material, degree of road compaction, and meteorological conditions (e.g., wind speed, humidity, and precipitation) (Bolander and Yamada 1999). Dust palliatives could migrate due to careless application, runoff, leaching, and resuspension of loose materials after abrasion by vehicles, adhesion to tires, and so on. Environmental concerns associated with the application of dust palliatives include potential impacts on surface water and groundwater quality, the freshwater aquatic environment, and plant communities. Potential environmental impacts on these receptors would depend on soil permeability and depth of groundwater and on the composition, persistency, and toxicity of the chemicals. Bolander and Yamada (1999) discuss in detail the types of dust palliatives, dust palliative selection and application tips, and environmental impacts.

## General Multiphase Measures

- Access roads, on-site roads, and parking lots should be surfaced with aggregate with hardness sufficient to prevent vehicles from crushing the aggregate and thus causing dust or compacted soil conditions. Paving could also be used on access roads and parking lots. Alternatively, chemical dust suppressants or durable polymeric soil stabilizers should be used on these locations. The choice of dust suppression measures should consider the potential impacts on wildlife from the windborne dispersal of fugitive dust containing dust suppressants and the potential impact on future reclamation.
- All unpaved roads, disturbed areas (e.g., areas of scraping, excavation, backfilling, grading, and compacting), and loose materials generated during project activities should be watered as frequently as necessary to minimize fugitive dust generation. In water-deprived locations, water spraying should be limited to active disturbance areas only and non-water-based dust control measures should be implemented in areas with intermittent use or use that is not heavy, such as stockpiles or access roads.
- Machinery should use air emission-control devices as required by federal, state, and local regulations or ordinances.
- On-site vehicle use should be reduced to the extent feasible.
- Travel should be limited to stabilized roads.
- The main access road to the main power block and the main maintenance building area should be paved.

- Speed limits (e.g., 10 mph [16 km/h]) within the construction site should be posted with visible signs and enforced to minimize airborne fugitive dust.
- All vehicles that transport loose materials as they travel on public roads should be covered, and their loads should be sufficiently wet and kept below the freeboard of the truck.
- Workers should be trained to comply with the speed limit, use good engineering practices, minimize the drop height of materials, and minimize the number and extent of disturbed areas. The project developer should enforce these requirements.
- Wind fences should be installed around disturbed areas that could affect the area beyond the site boundaries (e.g., nearby residences).
- All soil disturbance activities and travel on unpaved roads should be suspended during periods of high winds. A critical site-specific wind speed should be established on the basis of soil properties determined during site characterization, and monitoring of the wind speed would be required at the site during construction, operation, and reclamation.
- Any stockpiles created should be kept on-site, with an upslope barrier in place to divert runoff. Stockpiles should be sprayed with water, covered with tarpaulins, and/or treated with appropriate dust suppressants, especially in preparation for high wind or storm conditions. Compatible native vegetative plantings may also be used to limit dust generation from stockpiles that will be inactive for a relatively long period. Chemical dust suppressants that emit VOCs should be avoided within or near ozone nonattainment areas.
- The idling time of diesel equipment should be limited to no more than 10 minutes unless idling must be maintained for proper operation (e.g., drilling, hoisting, and trenching).
- Potential environmental impacts from the use of dust palliatives should be minimized by taking all necessary measures to keep the chemicals out of sensitive soil and streams. In addition, the application of dust palliatives should comply with federal, state, and local laws and regulations. Dust palliatives must meet the requirements of the applicable transmission system operator (e.g., Western Area Power Administration construction standards prohibit the use of oil as a dust suppressant [Western 2008]).

## Construction

- Access to the construction site and staging areas should be limited to authorized vehicles only through the designated treated roads.
- Construction should be staged to limit the exposed area at any time, whenever practical.
- Tires of all construction-related vehicles should be inspected and cleaned as necessary so they are free of dirt before they enter paved public roadways.
- Visible trackout or runoff dirt on public roadways from the construction site should be cleaned (e.g., through street vacuum sweeping).
- Topsoil from all excavations and construction activities should be salvaged and reapplied during reclamation or, where feasible, used for interim reclamation by being reapplied to

construction areas not needed for facility operation as soon as activities in that area have ceased.

- Because of low winds and stable atmospheric conditions occurring in the early morning from late fall to early spring, the highest 24-hr concentrations of particulate matter during construction would be attributable to activities occurring during those hours. Thus, soil disturbance activities should be eliminated or minimized under these atmospheric conditions, particularly for construction activities occurring near facility boundaries.

- All soil-disturbing activities and travel on unpaved roads under high-wind events should be limited.

### Operations

Typically, a utility-scale solar facility would have few emission sources during normal operations, as discussed in Section 5.11.1.3. However, the following BMPs are appropriate:

- All combustion sources should comply with state emission standards (e.g., best available control technology requirements).
- For portions of facilities that are maintained to be free of vegetation during operations, the dust control BMPs that were used to limit fugitive dust emissions during the construction phase should be implemented to minimize fugitive dust emissions from bare surfaces and unpaved access roads.
- Alternative fuel, electric, or latest-model-year vehicles should be used, when available, as facility service vehicles.

### Decommissioning/Reclamation

Decommissioning activities are generally the reverse of construction activities, so the BMPs applied during construction should also be applied during decommissioning.

### Transmission Lines and Roads

Most BMPs applied to the construction, operation, and decommissioning activities discussed above also should be implemented during the entire life of transmission lines. An additional BMP would include accessing the transmission lines from public roads and designated routes to the maximum extent possible in order to minimize fugitive dust emissions.

## WIND ENERGY DEVELOPMENT

As discussed above, the potential for adverse air quality impacts during the site monitoring and testing and operation phases would be limited. The greatest potential impacts would occur during the construction and decommissioning phases. Generation of fugitive particulates from vehicle traffic and earthmoving activities would need to be controlled both through the permitting process and the application of BMPs. Typical measures

(ABC Wind Company, LLC undated; PBS&J 2002) that can be implemented to control particulates and other pollutants include these:

- BMPs for areas subject to vehicular travel

    - Speed limits should be posted (e.g., 25 mph [40 km/h]) and enforced to reduce airborne fugitive dust.

- BMPs for soil and material storage and handling
    - Workers should be trained to handle construction material to reduce fugitive emissions.
    - Construction materials and stockpiled soils should be covered if they are a source of fugitive dust.
    - Storage piles at concrete batch plants should be covered if they are a source of fugitive dust.
- BMPs for clearing and disturbing land
    - Disturbed areas should be minimized.
- BMPs for earthmoving
    - Disturbed areas should be revegetated as soon as possible after disturbance.
- BMPs for soil loading and transport
    - Soil loads should be kept below the freeboard of the truck.
    - Gate seals should be tight on dump trucks.

# I-B2: BIOLOGICAL RESOURCES

## BEST MANAGEMENT PRACTICES

### COMMON TO ALL

- All pre-disturbance surveys should be conducted by qualified biologists following accepted protocols established by the USACE, BLM, USFWS, or other federal or state regulatory agencies, as determined appropriate by the managing agency, to identify and delineate the boundaries of important, sensitive, or unique habitats in the project vicinity including waters of the United States, wetlands, springs, seeps, ephemeral streams, intermittent streams, 100-year floodplains, ponds and other aquatic habitats, riparian habitat, remnant vegetation associations, rare or unique natural communities, and habitats supporting special status species populations.
- Projects shall be sited and designed to avoid direct and indirect impacts on important, sensitive, or unique habitats in the project vicinity, including, but not limited to, waters of the United States, wetlands (both jurisdictional and nonjurisdictional), springs, seeps, streams (ephemeral, intermittent, and perennial), 100-year floodplains, ponds and other aquatic habitats, riparian habitat, remnant vegetation associations, rare or unique biological communities, crucial wildlife habitats, and habitats supporting special status species populations (including designated and proposed critical habitat). For cases in which impacts cannot be avoided, they shall be minimized and mitigated appropriately. Project planning shall be coordinated with the appropriate federal and state resource management agencies.
- If trucks and construction equipment are arriving from locations with known invasive vegetation problems, a controlled inspection and cleaning area will be established to visually inspect construction equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces.
- Fill materials and road surfacing materials that originate from areas with known invasive vegetation problems will not be used.
- Revegetation, habitat restoration and weed control activities will be initiated as soon as possible after construction activities are completed.
- Use of pesticides must be approved by the agency. Pesticide use will be limited agency approved pesticides and will only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- The operator shall prepare a habitat restoration plan to avoid (if possible), minimize, or mitigate negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. The plan will identify revegetation, soil stabilization, and erosion reduction measures that will be implemented to ensure that all temporary use areas are restored. The plan will require that restoration occur as soon as possible after

completion of activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.

- The collection, harassment, or disturbance of plants, wildlife, and their habitats (particularly special status species) should be reduced through employee and contractor education about applicable state and federal laws. In addition, the following measures should be implemented: (1) all personnel should be instructed to avoid harassment and disturbance of local plants and wildlife; (2) personnel should be made aware of the potential for wildlife interactions around facility structures; (3) food refuse and other garbage should be placed in closed containers so it is not available to scavengers; and (4) workers should be prohibited from bringing firearms and pets to project sites.

## GEOTHERMAL ENERGY DEVELOPMENT

- The operator will conduct surveys for plant and animal species that are listed or proposed for listing as threatened or endangered and their habitats in areas proposed for development where these species could potentially occur, following accepted protocols and in consultation with the USFWS or NMFS, as appropriate. Particular care should be taken to avoid disturbing listed species during surveys in any designated critical habitat. The operator will monitor activities and their effects on ESA-listed species throughout the duration of the project.
- The operator will identify important, sensitive, or unique habitat and biota in the project vicinity and site and should design the project to avoid (if possible), minimize, or mitigate potential impacts on these resources. The design and siting of the facilities will follow appropriate guidance and requirements from the BLM, FS, and other resource agencies, as available and applicable.

### Noxious Weeds and Pesticides

- If pesticides are used on the site, an integrated pest management plan will be developed to ensure that applications would be conducted within the framework of all Federal, State, and local laws and regulations and entail only the use of EPA-registered pesticides.

### Wild Horses and Burros

- The operator will ensure employees, contractors, and site visitors avoid harassment and disturbance of wild horses and burros, especially during reproductive (e.g., breeding and birthing) seasons. In addition, any pets will be controlled to avoid harassment and disturbance of wild horses and burros.
- Observations of potential problems regarding wild horses or burros, including animal mortality, will be immediately reported to the agency.

### Wildlife

- Ponds, tanks and impoundments (including but not limited to drill pits) containing liquids can present hazards to wildlife. Any liquids contaminated by substances which may be harmful due to toxicity, or fouling of the fur or feathers (detergents, oils), should be excluded from wildlife access by fencing, netting or covering at all times when not in active use. Liquids at excessive temperature should likewise be excluded. If exclusion is not feasible, such as a large pond, a hazing program based on radar or visual detection, in conjunction with formal monitoring, should be implemented. Clean water impoundments can also present a trapping hazard if they are steep-sided or lined with smooth material. All pits, ponds and tanks should have escape ramps functional at any reasonably anticipated water level, down to almost empty. Escape ramps can take various forms depending on the configuration of the impoundment. Earthen pits may be constructed with one side sloped 3:1 or greater lined ponds can use textured material; straight-sided tanks can be fitted with expanded metal escape ladders.

- Pipelines constructed above ground due to thermal gradient induced expansion and contraction will rest on cradles above ground level, allowing small animals to pass underneath. Projects should be analyzed to ensure adequate passage for all wildlife species. The pipeline will be raised higher to allow wildlife passage where needed. Because pipeline corridors through certain habitat types can alter local predator-prey dynamics by providing predators with lines of sight and travel corridors, large projects should be analyzed to ensure there will be no significant changes to predator-prey balance.
- Underground utilities will be installed to minimize the amount of open trenches at any given time, keeping trenching and backfilling crews close together. Avoid leaving trenches open overnight. Where trenches cannot be back-filled immediately, escape ramps should be constructed at least every 100 feet.

### Livestock and Grazing

- The operator will coordinate with livestock operators to minimize impacts to livestock operations.

## SOLAR ENERGY DEVELOPMENT

Many BMPs are similar for the different types of ecological resources (plant communities and habitats, wildlife, aquatic resources, and special status species). Many of the BMPs are applicable for ecological resources in general. The more general measures are presented first for each phase and then by more specific measures for specific resource types.

### Siting and Design

- To the extent practicable, projects should be sited on previously disturbed lands close to energy load centers to avoid and minimize impacts on remote, undisturbed lands.
- Existing access roads, utility corridors, and other infrastructure should be used to the maximum extent feasible.
- As practical, staging and parking areas should be located within the site of the utility-scale solar energy facility to minimize habitat disturbance in areas adjacent to the site.
- Appropriate agencies (e.g., the BLM, the USFWS, and state resource management agencies) should be contacted early in the planning process to identify potentially sensitive ecological resources, including but not limited to aquatic habitats, wetland habitats, unique biological communities, crucial wildlife habitats, and special status species locations and habitats, as well as designated critical habitat, that might be present

in the area proposed for a solar energy facility and associated access roads and ROWs. This coordination should be used to identify the need for and scope of pre-disturbance surveys of the project area and vicinity.

- Projects should not be sited in designated critical habitat, ACECs, or other specially designated areas that are considered necessary for special status species and habitat conservation.
- Projects should be designed to avoid, minimize, and mitigate impacts on wetlands, waters of the United States, and other special aquatic sites.
- Project facilities and activities, including associated roads and utility corridors, should not be located in or near occupied habitats of special status animal species. Buffer zones should be established, (e.g., identified in the land use plan or substantiated by best available information or science), around these areas to prevent any destructive impacts associated with project activities.
- Buffer zones should be established around sensitive habitats, and project facilities and activities should be excluded or modified within those areas (e.g., identified in the land use plan or substantiated by best available information or science).
- Habitat loss, habitat fragmentation, and resulting edge habitat due to project development should be minimized to the extent practicable. Habitat fragmentation could be reduced by consolidating facilities (e.g., access roads and utilities could share common ROWs, where feasible), reducing the number of access roads to the minimum amount required, minimizing the number of stream crossings within a particular stream or watershed, and, locating facilities in areas where habitat disturbance has already occurred. Individual project facilities should be located and designed to minimize disruption of animal movement patterns and connectivity of habitats.
- Locating solar power facilities near open water or other areas known to attract a large number of birds should be avoided.
- Plant species that would attract wildlife should not be planted along high speed or high-traffic roads.
- Tall structures should be located to avoid known flight paths of birds and bats.
- Transmission line conductors should span important or sensitive habitats within limits of standard structure design.
- If cattle guards are identified for the design for new roads, they should be wildlife friendly. To the extent practicable, improvements should be made to existing ways and trails that require cattle to pass through existing fences, fence-line gates, new gates, and standard wire gates alongside them.
- Fences should be built (as practicable) to exclude livestock and wildlife from all project facilities, including all water sites.
- Project developers should identify surface water runoff patterns at the project site and develop mitigation that prevents soil deposition and erosion throughout and downhill from the site.

- Developers should avoid the placement of facilities or roads in drainages and make necessary accommodations for the disruption of runoff.
- Any necessary stream crossings should be designed to provide instream conditions that allow for and maintain uninterrupted movement and safe passage of fish during all project periods. Section 5.9.3 presents mitigation recommendations to minimize impacts on water quality associated with stream crossings.
- Projects should avoid surface water or groundwater withdrawals that affect sensitive habitats (e.g., aquatic, wetland, and riparian habitats) and any habitats occupied by special status species. Applicants should demonstrate, through hydrologic modeling, that the withdrawals required for their project are not going to affect groundwater discharges that support special status species or their habitats.
- The capability of local surface water or groundwater supplies to provide adequate water for the operation of proposed solar facilities should be considered early in the project siting and design. Technologies that would result in large withdrawals that would affect water bodies that support special status species should not be considered.
- New roads should be designed and constructed to meet the appropriate BLM road design standards, such as those described in BLM Manual 9113 (BLM 1985), and be no larger than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles). Roads internal to solar facility sites should be designed to minimize ground disturbance.
- Pipelines that transport hazardous liquids (e.g., oils) that will pass through aquatic or other habitats containing sensitive species should be designed with block or check valves on both sides of the waterway or habitat to minimize the amount of product that could be released as a result of leaks. Such pipelines should be constructed of double-walled pipe at river crossings.

## General Multiphase Measures

General BMPs for eliminating or reducing impacts on plant communities and habitats, wildlife resources, aquatic resources, and special status species that apply to all or nearly all of the project phases include the following:

- Project developers should designate a qualified biologist who will be responsible for overseeing compliance with all BMPs related to the protection of ecological resources throughout all project phases, particularly in areas requiring avoidance or containing sensitive biological resources, such as special status species and important habitats. Additional qualified biological monitors may be required on-site during all project phases as determined by the authorizing federal agency, the USFWS, and appropriate state agencies.
- All personnel should be instructed on the identification and protection of ecological resources (especially for special status species), including knowledge of BMPs required by federal, state, and local agencies. Workers must be aware that only qualified biologists are permitted to handle listed species according to specialized protocols approved by the USFWS. Workers should not approach wildlife for photographs or feed wildlife.

- Projects should maintain native vegetation cover and soils to the extent possible and minimize grading to reduce flooding, maintain natural infiltration rates, maintain wildlife habitat, maintain soil health, and reduce erosion potential. All short (i.e., less than 7-in. [18-cm] tall) native vegetation should be retained to the maximum extent possible. Blading within the project site should be minimized to the maximum extent possible. Where necessary and feasible, shrub cover may be mowed and/or raked to smooth out the surface. Retention of native root structure and seeds within the project area would help retain soil stability, minimize soil erosion, and minimize fugitive dust pollution. Retention of native seed and roots within the project site will also facilitate recovery of vegetative cover. Use of native plant species will minimize the need to water the vegetation because native species are already adapted to the local climate and moisture regime of the area.
- Plants, wildlife, and their habitats should be protected from fugitive dust. See Section 5.11.3 for recommended dust abatement practices.
- Activities should be timed to avoid, minimize, or mitigate impacts on wildlife. For example, crucial winter ranges for elk, deer, pronghorn, and other species should be avoided especially during their periods of use. If activities are planned during bird breeding seasons, a nesting bird survey should be conducted first. If active nests are detected, the nest area should be flagged, and no activity should take place near the nest (at a distance determined in coordination with the USFWS) until nesting is completed (i.e., nestlings have fledged or the nest has failed) or until appropriate agencies agree that construction can proceed with the incorporation of agreed-upon monitoring measures. The timing of activities should be coordinated with the authorizing federal agency, USFWS, and appropriate state agencies.
- Noise reduction devices (e.g., mufflers) should be employed to minimize the impacts on wildlife and special status species populations. Explosives should be used only within specified times and at specified distances from sensitive wildlife or surface waters as established by the managing agency or other federal and state agencies. Operators should ensure that all equipment is adequately muffled and maintained in order to minimize disturbance to wildlife.
- BMPs for hazardous materials and waste management regarding refueling, equipment maintenance, and spill prevention and response should be applied to reduce the potential for impacts on ecological resources.
- Low-water crossings (fords) should be used only as a last resort and then during the driest time of the year. Rocked approaches to fords should be used. The pre-existing stream channel, including bed and banks, should be restored after the need for a low-water ford has passed.
- The number of areas where wildlife could hide or be trapped (e.g., open sheds, pits, uncovered basins, and laydown areas) should be minimized. For example, an uncovered pipe that has been placed in a trench should be capped at the end of each workday to

prevent animals from entering the pipe. If a special status species is discovered inside a component, that component must not be moved or, if necessary, moved only to remove the animal from the path of activity, until the animal has escaped.

- During all project phases, buffer zones should be established around sensitive habitats, and project facilities and activities should be excluded or modified within those areas, to the extent practicable.
- Project activities should not be located in or near occupied habitats of special status animal species. Buffer zones should be established around these areas (e.g., identified in the land use plan or substantiated by best available information or science), to prevent any destructive impacts associated with project activities.
- If any federally listed threatened and endangered species are found during any phase of the project, the USFWS should be consulted as required by Section 7 of the ESA, and an appropriate course of action should be determined to avoid or mitigate impacts.
- Access roads should be appropriately constructed, improved, maintained, and provided with signs to minimize potential wildlife/vehicle collisions and facilitate wildlife movement through the project area.
- Project vehicle speeds should be limited in areas occupied by special status animal species. Appropriate speed limits should be determined through coordination with federal and state resource management agencies. Traffic should stop to allow wildlife to cross roads. Shuttle vans or carpooling should be used where feasible to reduce the amount of traffic on access roads.
- Unless authorized, personnel should not attempt to move live, injured, or dead wildlife off roads, ROWs, or the project site. Honking horns, revving engines, yelling, and excessive speed are inappropriate and considered a form of harassment. If traffic is being unreasonably delayed by wildlife in roads, personnel should contact the project biologist and security, who will take any necessary action.
- Road closures or other travel modifications (e.g., lower speed limits, no foot travel) should be considered during crucial periods (e.g., extreme winter conditions, calving/fawning seasons). Personnel should be advised to minimize stopping and exiting their vehicles in the winter ranges of large game while there is snow on the ground.
- Any vehicle-wildlife collisions should be immediately reported to security. Observations of potential wildlife problems, including wildlife mortality, should be immediately reported to the BLM or other appropriate agency authorized officer. Procedures for removal of wildlife carcasses on-site and along access roads should be addressed in the Nuisance Animal and Pest Control Plan, to avoid vehicle-related mortality of carrion-eaters.
- A Nuisance Animal and Pest Control Plan should be developed that identifies management practices to minimize increases in nuisance animals and pests in the project area, particularly those individuals and species that would affect human health and safety or that would have the potential to adversely affect native plants and animals. The plan

would identify nuisance and pest species that are likely to occur in the area, risks associated with these species, species specific control measures, and monitoring requirements.

- An Integrated Vegetation Management Plan should be developed that is consistent with applicable regulations and agency policies for the control of noxious weeds and invasive plant species. The plan should address monitoring; ROW vegetation management; the use of certified weed-free seed and mulching; the cleaning of vehicles to avoid introducing invasive weeds; and the education of personnel on weed identification, the manner in which weeds spread, and the methods for treating infestations. For transmission line ROWs, the plan should be consistent with the existing vegetation management plan for that ROW. Principles of integrated pest management, including biological controls, should be used to prevent the spread of invasive species, per the Vegetation Treatments Using Herbicides on BLM Lands in 17 Western States, and the National Invasive Species Management Plan, 2009. The plan should cover periodic monitoring, reporting, and immediate eradication of noxious weed or invasive species occurring within all managed areas. A controlled inspection and cleaning area should be established to visually inspect construction equipment arriving at the project area and to remove and collect seeds that may be adhering to tires and other equipment surfaces. To prevent the spread of invasive species, project developers should work with the local BLM field office to determine whether a pre-activity survey is warranted and, if so, to conduct the survey. If invasive plant species are present, project developers should work with the local BLM field office to develop a control strategy. The plan should include a post construction monitoring element that incorporates adaptive management protocols.
- Where revegetation and restoration are used as tools to mitigate or rehabilitate project impacts following construction and/or decommissioning, the project developer should assist in ongoing BLM efforts to procure and develop locally and regionally appropriate native plant materials. Where conditions permit, the developer could collect and voucher seeds from native plant species identified on BLM target lists for regional native plant material development following the BLM Seeds of Success Protocol as described in BLM’s Integrated Vegetation Management Handbook (BLM 2008e). On the basis of the expected need for native plant materials, the project developer could contribute funding to support the BLM Native Plant Materials Development Program. The suggested funding rate is $100.00 USD per acre for each acre on which restoration or revegetation will be used to mitigate project impacts and for each acre expected to be rehabilitated following site decommissioning.
- To reduce the risk of non-native and nuisance aquatic species introductions, equipment used in surface water should be decontaminated as appropriate especially equipment used to convey water (i.e., pumps).
- Herbicide use should be limited to nonpersistent, immobile substances. Only herbicides with low toxicity to wildlife and nontarget native plant species should be used, as

determined in consultation with the USFWS. The typical herbicide application rate rather than the maximum application rate should be used where effective. All herbicides should be applied in a manner consistent with their label requirements and in accordance with guidance provided in the Final PEIS on vegetation treatments using herbicides (BLM 2007). No herbicides should be used near or in surface water, streams (including ephemeral, intermittent, or perennial), riparian areas, or wetlands. Setback distances should be determined through coordination with federal and state resource management agencies. Before herbicide treatments are begun, a qualified biologist should conduct bird nest surveys and special status species surveys to identify the special measures or BMPs necessary to avoid and minimize impacts on migratory birds and special status species.

- An Ecological Resources Mitigation and Monitoring Plan should be developed to avoid (if possible), minimize, or mitigate adverse impacts on important ecological resources. The plan should include but not necessarily be limited to the following element, where applicable:
    - Revegetation, soil stabilization, and erosion reduction measures that should be implemented to ensure that all temporary use areas are restored. The plan should require that restoration occur as soon as possible after activities are completed in order to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.
    - Mitigation and monitoring unavoidable impacts on waters of the United States, including wetlands.
    - Compensatory mitigation and monitoring to address any significant direct, indirect, and cumulative impacts on and loss of habitat for special status plant and animal species.
    - Demonstration of compliance of the project with the regulatory requirements of the Bald and Golden Eagle Protection Act. The plan should be developed in coordination with the USFWS.
    - Measures to protect birds (including migratory species protected under the Migratory Bird Treaty Act) developed in coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies).
    - Measures to protect raptors developed in coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies).
    - Measures to protect bats developed in coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies).
    - Measures to mitigate and monitor impacts on special status species developed in coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies).

- Monitoring the potential for increase in predation of special status species (e.g., desert tortoise, Utah prairie dog, and greater sage-grouse) from ravens and other species that are attracted to developed areas and opportunistically use tall structures to spot vulnerable prey. Raven and other predator monitoring should also be addressed in the Nuisance Animal and Pest Control Plan.
- Clearing and translocation of special status species, including the steps to implement the translocation as well as the follow-up monitoring of populations in the receptor locations, as determined in coordination with the appropriate federal and state agencies. The need for a Special Status Species Clearance and Translocation Plan should be determined on a project-specific basis.

- At the project level, recommendations contained in the Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocol; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance (Pagel et al. 2010) should be considered in project planning, as appropriate. In addition, Instruction Memorandum No. 2010-156, Bald and Golden Eagle Protection Act—Golden Eagle National Environmental Policy Act and Avian Protection Plan Guidance for Renewable Energy (BLM 2010b) should be adhered to until programmatic permits from the USFWS are available. The analysis of potential impacts on and mitigation for golden eagles should be made in coordination with the USFWS, and the initiation of interagency coordination on golden eagle issues should occur early in the planning process.
- Take of golden eagles and other raptors should be avoided. Mitigation regarding the golden eagle should be developed in consultation with the USFWS and appropriate state natural resource agencies. A permit may be required under the Bald and Golden Eagle Protection Act.
- A Water Resources Monitoring and Mitigation Plan should be developed for each project. Changes in surface water or groundwater quality (e.g., chemical contamination, increased salinity, increased temperature, decreased dissolved oxygen, and increased sediment loads) or flow that result in the alteration of terrestrial plant communities or communities in wetlands, springs, seeps, intermittent streams, perennial streams, and riparian areas (including the alterations of cover and community structure, species composition, and diversity) off the project site should be avoided to the extent practicable. A monitoring plan should be developed that determines the effects of groundwater withdrawals on plant communities. See Section 5.9.3 for measures applicable to protecting water quality.
- Ecological monitoring programs should provide for monitoring during all project phases, including periods prior to construction (to establish baseline conditions) and during construction, operations, and decommissioning.
- The monitoring program requirements, including adaptive strategies, should be established at the project level to ensure that potential adverse impacts are mitigated. Monitoring programs should consider the monitoring requirements for each ecological

resource present at the project site, establish metrics against which monitoring observations can be measured, identify potential BMPs, and establish protocols for incorporating monitoring observations and additional BMPs into standard operating procedures and BMPs.

- A Spill Prevention and Emergency Response Plan should be developed that considers sensitive ecological resources. Spills of any toxic substances should be promptly addressed and cleaned up before they can enter aquatic or other sensitive habitats as a result of runoff or leaching. Section 5.9.3 also discusses the need for a Spill Prevention and Emergency Response Plan.
- A Fire Management and Protection Plan should be developed to implement measures that minimize the potential for a human-caused fire to affect ecological resources and that respond to natural fire situations.
- A Trash Abatement Plan should be developed that focuses on containing trash and food in closed and secured containers and removing them periodically to reduce their attractiveness to opportunistic species, such as common ravens, coyotes, and feral dogs that could serve as predators on native wildlife and special status animals.
- Prior to any ground-disturbing activity, seasonally appropriate walkthroughs should be conducted by a qualified biologist or team of biologists to ensure that important or sensitive species or habitats are not present in or near project areas. Attendees at the walkthrough should include appropriate federal agency representatives, state natural resource agencies, and construction contractors, as appropriate. Habitats or locations to be avoided (with appropriately sized buffers) should be clearly marked.
- If it is determined through coordination with the appropriate federal and state agencies (e.g., BLM, USFWS, and state resource management agencies) that it is necessary to translocate plant and wildlife species from project areas, developers should ensure that qualified biologists conduct pre- and post-translocation surveys for target species (especially if the target species are special status species) and release individuals to protected off-site locations as approved by the federal and state agencies. The biologists should coordinate with appropriate agencies the safe handling and transport of any special status species encountered.
- In accordance with adaptive management strategies, new BLM Instruction Memorandums (IMs) addressing wildlife and plants issues should be incorporated as appropriate.

## Site Characterization

Site characterization activities would generally result in only minimal impacts on ecological resources. The amount and extent of necessary pre-project survey data would be determined, in part, on the basis of the environmental setting of the proposed project location. Potentially applicable BMPs include the following:

- Vehicles and site workers should avoid entering aquatic habitats such as streams and springs during site characterization activities until surveys by qualified biologists have evaluated the potential for unique flora and fauna to be present.
- Meteorological towers and solar sensors should be located to avoid sensitive habitats or areas where wildlife (e.g., sage-grouse) are known to be sensitive to human activities; applicable land use plans or best available information and science shall be referred to in order to determine avoidance distances. Installation of these components should be scheduled to avoid disrupting wildlife reproductive activities or migratory or other important behaviors. Guy wires on meteorological towers should be avoided whenever possible. If guy wires are necessary, permanent markers (bird flight diverters) should be attached to them to increase their visibility.
- Meteorological towers, soil borings, wells, and travel routes should be located to avoid important, sensitive, or unique habitats including but not limited to wetlands, springs, seeps, ephemeral streams, intermittent streams, 100-year floodplains, ponds and other aquatic habitats, riparian habitat, remnant vegetation associations, rare natural communities, and habitats supporting special status species populations, as identified in applicable land use plans or best available information and science.

## Construction

Implementation of BMPs during the construction phase may eliminate or reduce the potential for direct or indirect impacts on ecological resources. Potentially applicable BMPs for ecological resources during the construction phase of a solar energy project include the following:

- Prior to construction of the facility, environmental training should be provided to contractor personnel whose activities or responsibilities could affect the environment during construction. An environmental compliance officer and other inspectors, the contractor’s construction field supervisor(s), and all construction personnel should be expected to play an important role in maintaining strict compliance with all permit conditions in order to protect wildlife and their habitats to the extent practicable during construction.
- Prior to construction, all areas to be disturbed should be surveyed by qualified biologists using approved survey techniques or established species-specific survey protocols to determine the presence of special status species in the project area.
- If possible, on-site construction access routes should be rolled and compacted to allow trucks and equipment to access construction locations. Following construction, disturbed areas should be lightly raked and/or ripped and reseeded with seeds from low-stature plant species collected from the immediate vicinity.
- To the extent practicable, vegetation clearing, grading, and other construction activities should occur outside of the bird breeding season. If activities are planned for the breeding season, a survey of nesting birds should be conducted first. If active nests are not detected, construction activities may be conducted. If active nests are detected, the nest area should be flagged, and no activity should take place near the nest (at a distance coordinated with the USFWS) until nesting is completed (i.e., nestlings have fledged or the nest has failed) or until appropriate agencies agree that construction can proceed with the incorporation of agreed-upon monitoring measures. If active nests are not detected, appropriate agencies should be consulted to confirm that construction may proceed.

- Explosives should be used only within specified times and at specified distances from sensitive wildlife or surface waters, as established by the managing agency, or other federal and state agencies. The occurrence of flyrock from blasting should be limited by using blasting mats.
- The extent of habitat disturbance during construction should be reduced by keeping vehicles on access roads and minimizing foot and vehicle traffic through undisturbed areas.
- Temporary or project-created access roads should be closed to unauthorized vehicle use, where appropriate.
- Where a pipeline trench may drain a wetland, trench breakers should be constructed and/or the trench bottom should be sealed to maintain the original wetland hydrology.
- Because open trenches could impede the seasonal movements of large game animals and alter their distribution, they should be backfilled as quickly as is possible. Open trenches could also entrap smaller animals; therefore, escape ramps should be installed at regular intervals along open-trench segments at distances identified in the applicable land use plan or best available information and science.
- An appropriate number of qualified biological monitors (as determined by the federal authorizing agency and the USFWS) should be on-site during initial site preparation and during the construction period to monitor, capture, and relocate animals that could be harmed and are unable to leave the site on their own.
- When possible, any reptile or amphibian species found in harm's way should be relocated away from the activity.
- Construction debris, especially treated wood, should not be stored or disposed of in areas where it could come in contact with aquatic habitats.
- As directed by the local BLM field office, Joshua trees (*Yucca brevifolia*), other Yucca species, and most cactus species, shall be salvaged prior to land clearing, and they shall be transplanted, held for use to revegetate temporarily disturbed areas, or otherwise protected as prescribed by state or local BLM requirements.
- Project-specific Integrated Vegetation Management Plans shall investigate the possibility of revegetating parts of the solar array area. Where revegetation is accomplished, fire breaks are required, such that the vegetated areas would not result in increased fire hazard.

## Operations

BMPs that limit periodic or continued impacts from operations of a solar energy facility include the following:

- Areas left in a natural condition during construction (e.g., wildlife crossings) should be maintained in as natural a condition as possible within safety and operational constraints.
- To minimize habitat loss and fragmentation, as much habitat as possible should be re-established after construction is complete by maximizing the area reclaimed during solar energy operations.
- Lighting should be designed to provide the minimum illumination needed to achieve safety and security objectives. It should be shielded and orientated to focus illumination on the desired areas and to minimize or eliminate lighting of off-site areas or the sky. All

unnecessary lighting should be turned off at night to limit attracting migratory birds or special status species.

- To minimize the potential for bird strikes, applicants should use audio visual warning system (AVWS) technology for any structures exceeding 200 ft. (60 m) in height. If the FAA denies a permit for use of AVWSs, applicants should coordinate with the USFWS and appropriate state natural resource agencies to identify lighting that meets the minimum FAA safety requirements, and minimizes the possibility of bird strikes.
- Evaporation ponds should be fenced and netted, where feasible, to prevent use by wildlife. Open water sources in the desert provide subsidies to ravens and other predators that feed on special status species (e.g., desert tortoise). In addition, these water sources may have elevated levels of harmful contaminants (e.g., TDS and selenium) and could attract wildlife into an industrialized area where they are more likely to be killed. The lower 18 in. (46 cm) of the fencing should be a solid barrier that would exclude entrance by amphibians and other small animals.
- In order to prevent the effects of the West Nile virus on wildlife, a mosquito abatement program should be implemented for all evaporation ponds or other standing bodies of water that have the potential to support mosquito reproduction.
- Appropriate fish screens should be installed on cooling water intakes to limit the potential for impingement impacts on organisms in surface water sources used for cooling water. Intake designs should minimize the potential for aquatic organisms from surface waters to be entrained in cooling water systems.

## Decommissioning/Reclamation

BMPs to protect ecological resources during and following decommissioning and reclamation include the following:

- A Decommissioning and Site Reclamation Plan that is specific to the project should be developed, approved by the BLM, and implemented and should include the following elements:
    - The plan should contain an adaptive management component that allows for the incorporation of lessons learned from monitoring data.
    - The plan should require that land surfaces be returned to pre-development contours to the greatest extent feasible immediately following decommissioning.
    - The plan should be designed to expedite the re-establishment of vegetation and require restoration to be completed as soon as practicable.
    - To ensure rapid and successful re-establishment efforts, the plan should specify site-specific measurable success criteria, including target dates, which should be developed in coordination with the BLM and be required to be met by the operator.
    - Vegetation re-establishment efforts should continue until all success criteria have been met.
    - Bonding to cover the full cost of vegetation re-establishment should be required.
    - Species used for re-establishing vegetation should consist of native species that are dominant within the plant communities in adjacent areas that have similar soil conditions.
    - The plan should require the use of weed-free seed mixes of native shrubs, grasses, and forbs of local sources where available. When available, seeds of known

origin, as labeled by state seed certification programs, should be used. Local native genotypes should be used. If cultivars of native species are used, certified seed (i.e., blue tag) should be used. "Source identified" seeds (i.e., yellow tag) should be used when native seeds are collected from wildland sites.

    - The cover, species composition, and diversity of the re-established plant community should be similar to those present on-site prior to project development and in the vicinity of the site. Baseline data should be collected in each project area prior to its development as a benchmark for measuring the success of reclamation efforts. In areas where suitable native species are unavailable, other plant species approved by the BLM could be used. If non-native plants are necessary, they should be noninvasive, noncompetitive, and ideally, be short-lived, have low reproductive capabilities, or be self-pollinating to prevent gene flow into the native community. The non-native plants that are used should not exchange genetic material with common native plant species.
    - The plan should be developed in coordination with appropriate federal and state agencies.
- Access roads should be reclaimed when they are no longer needed. However, seasonal restrictions (e.g., nest and brood rearing) should be considered, as appropriate (e.g., identified in the land use plan or substantiated by best available information or science).
- All holes and ruts created by the removal of structures and access roads should be filled or graded.
- While structures are being dismantled, care should be taken to avoid leaving debris on the ground in areas where wildlife regularly move.
- Post-decommissioning protocols should include monitoring for the recovery of native vegetation, colonization and spread of invasive species; use by wildlife; and use by special status species. Monitoring data should be used to determine the success of reclamation activities and the need for changes in ongoing management or for additional reclamation measures. Ongoing visual inspections for a minimum of 5 years following decommissioning activities should be required to ensure that there is adequate restoration and minimal environmental degradation. This period should be extended until satisfactory results are obtained.
- The facility fence should remain in place for several years to help reclamation (e.g., the fence would preclude large mammals and vehicles from disturbing revegetation efforts). Shorter times for maintaining fencing may be appropriate in cases where the likelihood of disturbance by cattle and wildlife is low. In some cases, it may be appropriate to replace the original exclusion fence with a new fence that excludes cattle and vehicles but allows for use by pronghorn and large-game wildlife. This secondary fencing shall remain in place until the revegetation efforts meet success criteria.
- The placement of transmission towers within aquatic and wetland habitats should be avoided whenever feasible. If towers must be placed within these habitats, they should not impede flows or fish passage.
- If transmission lines are located near aquatic habitats or riparian areas (e.g., minimum buffers identified in the applicable land use plan or best available science and information), vegetation maintenance should be limited and performed mechanically rather than with herbicides. Cutting in wetlands or stream and wetland buffers should be done by hand or by feller-bunchers. Tree cutting in stream buffers should target only

trees able to grow into a transmission line conductor clearance zone within 3 to 4 years. Cutting in such areas for construction or vegetation management should be minimized, and the disturbance of soil and remaining vegetation should be minimized.

- Habitat disturbance should be minimized by considering the use of helicopters for construction, to lessen the need for access roads, and by locating transmission facilities in previously disturbed areas. Existing utility corridors and other support structures should be used to the maximum extent feasible.
- The establishment and spread of invasive species and noxious weeds within the ROW and in associated areas where there is ground surface disturbance or vegetation cutting should be prevented. The area should be monitored regularly, and invasive species should be eradicated immediately.
- If needed, temporary access roads should be developed primarily by the removal of woody vegetation, although temporary timber mats should be used in areas of wet soils. Wide-tracked or balloon-tired equipment, timber corduroy, or timber mat work areas should be used on wet soils where wetland or stream crossings are unavoidable and where crossing on frozen ground is not possible in winter. Areas rutted by equipment should be immediately regraded and revegetated. Towers should be installed by airlift helicopters, where necessary, to avoid extensive crossing of wetlands or highly sensitive areas (such as those identified as rare natural habitats).
- ROW development and construction activities should adhere to locally established wildlife and/or habitat protection provisions. Exceptions or modifications to spatial buffers or timing limitations should be evaluated on a site-specific/species-specific basis in coordination with the local federal administrator and state wildlife agency.
- Restrictions on timing or duration may be required to minimize impacts on nesting birds (especially neotropical migrants and listed species), and should be developed in coordination with the USFWS.
- To the extent practicable, work personnel should stay within the ROW and/or easements.
- Removal of raptor nests should take place only if the birds are not actively using the nest, particularly during the nesting and brood-rearing period. Nests should be relocated to nesting platforms, when possible; otherwise, they must be destroyed when removed. An annual report on all nests moved or destroyed should be provided to the appropriate federal and/or state agencies. Coordination with the USFWS should occur in the event that a raptor nest is located on a transmission line support structure. Removal or relocation of a golden eagle or bald eagle nest (even an inactive nest) requires a permit from the USFWS.
- Raven nests should be removed from transmission towers to reduce predation pressure on sensitive species such as the desert tortoise, greater sage-grouse, and Utah prairie dog. Raven nests can be removed only when inactive (i.e., no eggs or young), if removal is otherwise necessary, a Migratory Bird Treaty Act take permit from the USFWS is required. The removal of raven nests should be addressed in the Nuisance Animal and Pest Control Plan.
- Current guidelines and methodologies (e.g., APLIC and USFWS 2005; APLIC 2006) would be used in the design and analysis of the proposed transmission facilities in order to minimize the potential for raptors and other birds to be electrocuted by them or collide with them.

- Transmission line support structures and other facility structures should be designed to discourage their use by raptors for perching or nesting (e.g., by use of anti-perching devices). This design would also reduce the potential for increased predation of special status species such as the desert tortoise, sage grouse, and Utah prairie dog. Mechanisms to visually warn birds (permanent markers or bird flight diverters) should be placed on transmission lines at regular intervals to prevent birds from colliding with the lines.
- To the extent practicable, the use of guy wires should be avoided because these pose a collision hazard for birds and bats. Guy wires should be clearly marked with bird flight diverters to reduce the probability of collision.
- Shield wires should be marked with devices that have been scientifically tested and found to significantly reduce bird collision potential.
- Any mortality of important bird species (e.g., raptors) that is associated with power lines should be monitored and reported to the managing agency and the USFWS, and measures should be taken to prevent future mortality.

## Transmission Lines and Roads

Many of the BMPs presented above could also reduce, minimize, or avoid impacts on ecological resources from the construction and operation of transmission lines. In addition, the following BMPs are specifically applicable to protecting ecological resources from transmission lines construction, operation, and maintenance:

- The placement of transmission towers within aquatic and wetland habitats should be avoided whenever feasible. If towers must be placed within these habitats, they should not impede flows or fish passage.

- If transmission lines are located near aquatic habitats or riparian areas (e.g., minimum buffers identified in the applicable land use plan or best available science and information), vegetation maintenance should be limited and performed mechanically rather than with herbicides. Cutting in wetlands or stream and wetland buffers should be done by hand or by feller-bunchers. Tree cutting in stream buffers should target only trees able to grow into a transmission line conductor clearance zone within 3 to 4 years. Cutting in such areas for construction or vegetation management should be minimized, and the disturbance of soil and remaining vegetation should be minimized.

- Habitat disturbance should be minimized by considering the use of helicopters for construction, to lessen the need for access roads, and by locating transmission facilities in previously disturbed areas. Existing utility corridors and other support structures should be used to the maximum extent feasible.

- The establishment and spread of invasive species and noxious weeds within the ROW and in associated areas where there is ground surface disturbance or vegetation cutting should be prevented. The area should be monitored regularly, and invasive species should be eradicated immediately.

- If needed, temporary access roads should be developed primarily by the removal of woody vegetation, although temporary timber mats should be used in areas of wet soils. Wide-tracked or balloon-tired equipment, timber corduroy, or timber mat work areas should be used on wet soils where wetland or stream crossings are unavoidable and where crossing on frozen ground is not possible in winter. Areas rutted by equipment should be immediately regraded and revegetated. Towers should be installed by airlift helicopters, where necessary, to avoid extensive crossing of wetlands or highly sensitive areas (such as those identified as rare natural habitats).

- ROW development and construction activities should adhere to locally established wildlife and/or habitat protection provisions. Exceptions or modifications to spatial buffers or timing limitations should be evaluated on a site-specific/species-specific basis in coordination with the local federal administrator and state wildlife agency.
- Restrictions on timing or duration may be required to minimize impacts on nesting birds (especially neotropical migrants and listed species), and should be developed in coordination with the USFWS.
- To the extent practicable, work personnel should stay within the ROW and/or easements.
- Removal of raptor nests should take place only if the birds are not actively using the nest, particularly during the nesting and brood-rearing period. Nests should be relocated to nesting platforms, when possible; otherwise, they must be destroyed when removed. An annual report on all nests moved or destroyed should be provided to the appropriate federal and/or state agencies. Coordination with the USFWS should occur in the event that a raptor nest is located on a transmission line support structure. Removal or relocation of a golden eagle or bald eagle nest (even an inactive nest) requires a permit from the USFWS.
- Raven nests should be removed from transmission towers to reduce predation pressure on sensitive species such as the desert tortoise, greater sage-grouse, and Utah prairie dog. Raven nests can be removed only when inactive (i.e., no eggs or young), if removal is otherwise necessary, a Migratory Bird Treaty Act take permit from the USFWS is required. The removal of raven nests should be addressed in the Nuisance Animal and Pest Control Plan.
- Current guidelines and methodologies (e.g., APLIC and USFWS 2005; APLIC 2006) would be used in the design and analysis of the proposed transmission facilities in order to minimize the potential for raptors and other birds to be electrocuted by them or collide with them.
- Transmission line support structures and other facility structures should be designed to discourage their use by raptors for perching or nesting (e.g., by use of anti-perching devices). This design would also reduce the potential for increased predation of special status species such as the desert tortoise, sage grouse, and Utah prairie dog. Mechanisms to visually warn birds (permanent markers or bird flight diverters) should be placed on transmission lines at regular intervals to prevent birds from colliding with the lines.
- To the extent practicable, the use of guy wires should be avoided because these pose a collision hazard for birds and bats. Guy wires should be clearly marked with bird flight diverters to reduce the probability of collision.
- Shield wires should be marked with devices that have been scientifically tested and found to significantly reduce bird collision potential.

- Any mortality of important bird species (e.g., raptors) that is associated with power lines should be monitored and reported to the managing agency and the USFWS, and measures should be taken to prevent future mortality.

## WIND ENERGY DEVELOPMENT

The previous evaluations identified a number of potential impacts that could be incurred during the construction, operation, and decommissioning of a wind energy facility. A variety of BMPs may be implemented at wind energy projects to reduce potential ecological impacts, and these are described in the following sections. In addition, monitoring during the various phases of wind energy development can be utilized to identify potential concerns and direct actions to address those concerns. Monitoring data can be used to track the condition of ecological resources, to identify the onset of impacts, and to direct appropriate site management responses to address those impacts.

The following sections identify measures that may be appropriate for mitigating impacts that could be associated with new wind energy projects. In addition to these measures, a variety of federal and state agencies and environmental organizations have identified measures for mitigating the ecological impacts of other human activities. BLM guidance documents also identify measures for mitigating ecological impacts associated with other approved activities on

BLM-administered lands and these BMPs may be applicable to wind energy projects (see Section 3.6.2).

### Mitigation during Site Monitoring and Testing

Site monitoring and testing would generally result in only minimal impacts to ecological resources. The following BMPs may ensure that ecological impacts during this stage of the project would be minimal:

- Existing roads should be used to the maximum extent feasible to access a proposed project area.
- If new access roads are necessary, they should be designed and constructed to the appropriate standard.
- Existing or new roads should be maintained to the condition needed for facility use.
- The area disturbed during the installation of meteorological towers (i.e., the tower footprint and its associated lay-down area) should be kept to a minimum.
- Individual meteorological towers should not be located in or near sensitive habitats or in areas where ecological resources known to be sensitive to human activities are present.
- Installation of meteorological towers should be scheduled to avoid disruption of wildlife reproductive activities or other important behaviors (e.g., during periods of sage-grouse nesting).

### Mitigation during Plan of Development Preparation and Project Design

BMPs may be considered during preparation of the POD and project design to ensure that the siting of the overall wind energy development project and of individual facility structures, as well as various aspects of the design of individual facility structures, do not result in unacceptable impacts to ecological resources. The following measures should be incorporated into the development of the POD and siting of the wind development project:

- The BLM and operators should contact appropriate agencies early in the planning process to identify potentially sensitive ecological resources that may be present in the area of the wind energy development.
- The operators should conduct surveys for federal- and state-protected species and other species of concern within the project area.
- Operators should evaluate avian and bat use (including the locations of active nest sites, colonies, roosts, and migration corridors) of the project area by using scientifically rigorous survey methods (e.g., see NWCC 1999).
- The project should be planned to avoid (if possible), minimize, or mitigate impacts to wildlife and habitat.
- Discussion should be held with the appropriate BLM Field Office staff regarding the occurrence of sensitive species or other valued ecological resources in the proposed project area.
- Existing information on species and habitats in the project area should be reviewed.

The amount and extent of necessary preproject data would be determined on a project-by-project basis, based in part on the environmental setting of the proposed project location. Methods for collecting such data may be found in NWCC (1999).

## Mitigating Habitat Impacts

The following measures may be incorporated into the POD and considered during project siting to minimize potential habitat disturbance:

- If survey results indicate the presence of important, sensitive, or unique habitats (such as wetlands and sagebrush habitat) in the project vicinity, facility design should locate turbines, roads, and support facilities in areas least likely to impact those habitats.
- Habitat disturbance should be minimized by locating facilities (such as utility corridors and access roads) in previously disturbed areas (i.e., locate transmission lines within or adjacent to existing power line corridors).
- Existing roads and utility corridors should be utilized to the maximum extent feasible.
- New access roads and utility corridors should be configured to avoid high quality habitats and minimize habitat fragmentation.
- Site access roads and utility corridors should minimize stream crossings.
- Individual project facilities should be located to maintain existing stands of quality habitat and continuity between stands.
- The creation of, or increase in, the amount of edge habitat between natural habitats and disturbed lands should be minimized.

- To minimize impacts to aquatic habitats from increased erosion, the use of fill ramps rather than stream bank cutting should be designated for all stream crossings by access roads.
- Stream crossings should be designed to provide in-stream conditions that allow for and maintain uninterrupted movement and safe passage of fish.

## Mitigating Site/Wildlife Interactions

To reduce the potential use of site facilities by perching birds, to reduce the potential for collisions with project facilities, and to reduce the potential for electrocution, the following measures should be considered during the development of the POD and design of individual facility structures:

- Locations that are heavily utilized by migratory birds and bats should be avoided.
- Permanent meteorological towers, transmission towers, and other facility structures should be designed to discourage their use by birds for perching or nesting.
- The use of guy wires on permanent meteorological towers should be avoided or minimized.
- Electrical supply lines should be buried in a manner that minimizes additional surface disturbance. Overhead lines should be used in cases where the burial of lines would result in further habitat disturbance.
- Power lines should be configured to minimize the potential for electrocution of birds, by following established guidelines (e.g., APLIC [1996], APLIC and USFWS [2005]).
- Operators should consider incorporating measures to reduce raptor use of the project site into the design of the facility layout (e.g., minimize road cuts and maintain nonattractive vegetation around turbines).
- Turbines and other project facilities should not be located in areas with known high bird usage; in known bird and/or bat migration corridors or known flight paths; near raptor nest sites; and in areas used by bats as colonial hibernation, breeding, and maternity/nursery colonies, if site studies show that they would pose a high risk to species of concern.
- Wind energy projects should not be located in areas with a high incidence of fog and mist.
- To reduce attraction of migratory birds to turbines and towers, the need for or use of sodium vapor lights at site facilities should be minimized or avoided.
- Turbines should be configured to avoid landscape features known to attract raptors, if site studies show that placing turbines there would pose a significant risk to raptors.

## MITIGATION DURING CONSTRUCTION

Construction of a wind energy project may impact ecological resources. A variety of measures may be implemented to minimize the potential for these impacts. In addition to general engineering practices, existing BLM program-specific guidance documents (see Section 3.6.2) identify other BMPs for activities on program-specific BLM-administered lands that may be applicable to wind energy development projects.

### Mitigating Habitat Disturbance

To mitigate habitat reduction or alternation during construction, the following measures may be implemented:

- The size of all disturbed areas should be minimized.
- Where applicable, the extent of habitat disturbance should be reduced by keeping vehicles on access roads and minimizing foot and vehicle traffic through undisturbed areas.

### Mitigating Disturbance and Injury of Vegetation and Wildlife

These measures may be applicable to mitigate the disturbance or injury of biota during construction:

- In consultation with staff from the BLM and other appropriate natural resource agencies, construction activities should be scheduled to avoid important periods of wildlife courtship, breeding, nesting, lambing, or calving.
- All construction employees should be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship, nesting) seasons. In addition, any pets should not be permitted on site during construction.
- Buffer zones should be established around raptor nests, bat roosts, and biota and habitats of concern, if site studies show that proposed facilities would pose a significant risk to avian or bat species of concern.
- Noise-reduction devices (e.g., mufflers) should be maintained in good working order on vehicles and construction equipment.
- Explosives should be used only within specified times and at specified distances from sensitive wildlife or surface waters as established by the BLM or other federal and state agencies.
- The use of guy wires on permanent meteorological towers should be avoided.

### Mitigating Erosion and Fugitive Dust Generation

Measures to minimize disturbance of ecological resources from erosion and fugitive dust may include:

- Erosion controls that comply with county, state, and federal standards should be applied. Practices such as jute netting, silt fences, and check dams should be applied near disturbed areas.

- All areas of disturbed soil should be reclaimed using weed-free native grasses, forbs, and shrubs. Reclamation activities should be undertaken as early as possible on disturbed areas.
- Dust abatement techniques should be used on unpaved, unvegetated surfaces to minimize airborne dust.
- Construction materials and stockpiled soil should be covered if they are a source of fugitive dust.
- Erosion and fugitive dust control measures should be inspected and maintained regularly.

### Mitigating Fuel Spills

To minimize potential impacts to ecological resources from accidental fuel spills, the following BMPs may be implemented:

- All refueling should occur in a designated fueling area that includes a temporary berm to limit the spread of any spill.
- Drip pans should be used during refueling to contain accidental releases.
- Drip pans should be used under fuel pump and valve mechanisms of any bulk fueling vehicles parked at the construction site.
- Spills should be immediately addressed per the appropriate spill management plan, and soil cleanup and soil removal initiated if needed.

### Mitigating Establishment of Invasive Vegetation

The following measures may be implemented to minimize the potential establishment of invasive vegetation at the site and its associated facilities:

- Access roads and newly established utility and transmission line corridors should be monitored regularly for invasive species establishment, and weed control measures should be initiated immediately upon evidence of invasive species introduction.
- All areas of disturbed soil should be reclaimed using weed-free native shrubs, grasses, and forbs.

## MITIGATION DURING OPERATION

### Mitigating Fuel Spills and Exposure to Site-Related Chemicals

The following measures may be implemented to minimize the potential for exposure of biota to accidental spills:

- Drip pans should be used during refueling to contain accidental releases.
- Pesticide use should be limited to nonpersistent, immobile pesticides and herbicides and should only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Spills should be immediately addressed per the appropriate spill management plan, and soil cleanup and removal initiated, if needed.

## Mitigating Establishment of Invasive Vegetation

The following measure may be implemented to minimize the potential establishment of invasive vegetation at the site and its associated facilities:

- Access roads, utility and transmission line corridors, and tower site areas should be monitored regularly for invasive species establishment, and weed control measures should be initiated immediately upon evidence of invasive species introduction.

## Mitigating Site/Wildlife Interactions

Measures to mitigate these interactions were previously addressed by the measures identified for inclusion in development of the POD and facility siting and design. The following measures may further reduce the potential for bird collisions, primarily through reducing the attractiveness of the facility to birds:

- Higher-height vegetation (i.e., shrub species) should be encouraged along transmission corridors to minimize foraging in these areas by raptors to the extent local conditions will support this vegetation.
- Areas around turbines, meteorological towers, and other facility structures should be maintained in an unvegetated state (e.g., crushed gravel), or only vegetation that does not support wildlife use should be planted.
- All unnecessary lighting should be turned off at night to limit attracting migratory birds.
- Employees, contractors, and site visitors should be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. In addition, pets should be controlled to avoid harassment and disturbance of wildlife.
- Observations of potential wildlife problems, including wildlife mortality, should be reported to the BLM authorized officer immediately.

## Mitigation during Decommissioning

The measures identified to mitigate construction impacts are applicable to decommissioning activities and may include:

- All turbines and ancillary structures should be removed from the site.
- Topsoil from all decommissioning activities should be salvaged and reapplied during final reclamation.
- All areas of disturbed soil should be reclaimed using weed-free native shrubs, grasses, and forbs.
- The vegetation cover, composition, and diversity should be restored to values commensurate with the ecological setting.

Following removal of the project facilities, implementation of appropriate habitat restoration activities could restore disturbed areas to preproject conditions.

## Mitigation for Threatened, Endangered, and Sensitive Species

If federal listed species are present in the project vicinity, the BLM will consult with the USFWS as required by Section 7 of the ESA. A Biological Assessment could be required, in addition to the assessment of impacts in the site-specific NEPA document for the project. Subsequently, formal consultation may be required that would result in a Biological Opinion issued by the USFWS. The Biological Opinion would specify reasonable and prudent measures and conservation recommendations to minimize impacts on the federal listed species at the site. A variety of site-specific and species-specific measures may be required to mitigate potential impacts to special status species if present in the project area. Such measures may include:

- Field surveys should be conducted to verify the absence or presence of the species in the project area and especially within individual project footprints.
- Project facilities or lay-down areas should not be placed in areas documented to contain or provide important habitat for those species.

# I-B3: CULTURAL AND HISTORIC RESOURCES

## BEST MANAGEMENT PRACTICES

### COMMON TO ALL

- Project developers should conduct a records search of published and unpublished literature for past cultural resource finds in the area; coordinate with researchers working locally in the area, and, depending on the extent of existing information, develop a survey design in coordination with the managing agency and SHPO, and complete a Class III cultural resources inventory. The inventory should be conducted according to the standards set forth in the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716), BLM Handbook H-8110: Guidelines for Identifying Cultural Resources (BLM 2002), and revised BLM Manual 8110 (BLM 2004). All inventory data should be provided to the managing agency in digitized format that meets applicable accuracy standards, including shape files for surveyed areas.
- Consult with Native American governments early in the planning process to identify issues and areas of concern regarding the proposed renewable energy development. Aside from the fact that consultation is required under the NHPA, consultation is necessary to establish whether the project is likely to disturb traditional cultural properties, affect access rights to particular locations, disrupt traditional cultural practices, and/or visually impact areas important to the Tribe(s). Under the conditions of the nationwide BLM PA, the state BLM offices should already have established a relationship with local Tribal governments. A list of the federally recognized Tribes for the 11-state region is available in Chapter 7.
- If cultural resources are present at the site, or if areas with a high potential to contain cultural material have been identified, a CRMP should be developed. This plan should address mitigation activities to be implemented for cultural resources found at the site. Avoidance of the area is always the preferred mitigation option. Other mitigation options include archaeological survey and excavation (as warranted) and monitoring. If an area exhibits a high potential, but no artifacts are observed during an archaeological survey, monitoring by a qualified archaeologist could be required during all excavation and earthmoving in the high-potential area. A report should be prepared documenting these activities. The CRMP also should (1) establish a monitoring program, (2) identify measures to prevent potential looting/vandalism or erosion impacts, and (3) address the education of workers and the public to make them aware of the consequences of unauthorized collection of artifacts and destruction of property on public land.
- If significant or NRHP-eligible cultural resources are present at the site and would be adversely affected or if areas with a high potential to contain additional cultural material have been identified, a formalized agreement should be required to address management and mitigation options in the form of various planning documents (such as a monitoring and mitigation plan, data recovery plan, historic treatment plan, etc.). The agreement

should be developed in consultation with the SHPO, appropriate federally recognized Tribes, and any consulting parties. The agreement also should identify measures to prevent potential looting/vandalism or erosion impacts and address the education of workers and the public to make them aware of the consequences of unauthorized collection of cultural resources on public land.

- Unexpected discovery of cultural or paleontological resources during construction will be brought to the attention of the responsible BLM authorized officer immediately. Work will be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate BMPs are being developed.

## GEOTHERMAL ENERGY DEVELOPMENT

- Before any specific permits are issued under leases, treatment of cultural resources will follow the procedures established by the Advisory Council on Historic Preservation for compliance with Section 106 of the National Historic Preservation Act. A pedestrian inventory will be undertaken of all portions that have not been previously surveyed or are identified by BLM as requiring inventory to identify properties that are eligible for the NRHP. Those sites not already evaluated for NRHP eligibility will be evaluated based on surface remains, subsurface testing, archival, and/or ethnographic sources. Subsurface testing will be kept to a minimum whenever possible if sufficient information is available to evaluate the site or if avoidance is an expected mitigation outcome. Recommendations regarding the eligibility of sites will be submitted to the BLM, and a treatment plan will be prepared to detail methods for avoidance of impacts or mitigation of effects. The BLM will make determinations of eligibility and effect and consult with SHPO as necessary based on each proposed lease application and project plans. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated. Avoidance of impacts through project design will be given priority over data recovery as the preferred BMP. Avoidance measures include moving project elements away from site locations or to areas of previous impacts, restricting travel to existing roads, and maintaining barriers and signs in areas of cultural sensitivity. Any data recovery will be preceded by approval of a detailed research design, Native American Consultation, and other requirements for BLM issuance of a permit under the Archaeological Resources Protection Act (BLM 2007a).

- Operators will determine whether paleontological resources exist in a project area on the basis of the sedimentary context of the area, a records search for past paleontological finds in the area, and/or, depending on the extent of existing information, a paleontological survey.

## Solar energy development

For all potential impacts, the application of BMPs developed in consultation under Section 106 of the National Historic Preservation Act (NHPA) would avoid, reduce, or mitigate the potential for adverse impacts on significant cultural resources. Section 106 consultations between the BLM and the State Historic Preservation Officers (SHPOs), appropriate Tribes, and other consulting parties would be required. Thresholds for the involvement of and review by the Advisory Council on Historic Preservation (ACHP) include non-routine interstate and/or interagency programs; undertakings directly and adversely affecting National Historic Landmarks or National Register eligible properties of national significance; and/or highly controversial undertakings, when ACHP review is requested by the managing agency, SHPO, Indian Tribe, local government, or the applicant for a BLM authorization. Ongoing Tribal consultation, in accordance with the NHPA, would help determine areas of sensitivity, appropriate survey and mitigation needs, and other issues of concern, such as access rights or disruption of cultural practices (see Section 5.16.3), and to take those concerns into consideration during project development. The following describes the process the BLM follows to address impacts on historic properties for individual projects.

Site-specific NEPA analyses and a Section 106 review would be conducted on individual projects. The BLM would require the completion of comprehensive identification (e.g., field inventory), evaluation, protection, and resolution of adverse effects (mitigation) following the policies and procedures contained in the 1997 BLM National Programmatic Agreement (PA) (BLM 1997) and under state protocols.7 If significant cultural resources are present at the project location or if there is a high potential for the project area to contain significant cultural resources that could be adversely affected, a formalized agreement may be required to address management and mitigation options (e.g., avoidance, data recovery, monitoring, preventive measures for looting, vandalism, and erosion, and worker education) in the form of various planning documents (e.g., cultural resources monitoring and mitigation plan, cultural data recovery plan, historic properties treatment plan). The agreement should be developed in consultation with the SHPO, appropriate federally recognized Tribes, and any consulting parties. Also, the BLM would continue to implement government-to-government consultation with Tribes and state and local governments on a case-by-case basis.

The BLM does not approve any ground-disturbing activities that may affect any historic properties, sacred sites or landscapes, and/or resources protected under the NHPA; the American Indian Religious Freedom Act; the Native American Graves Protection and Repatriation Act (NAGPRA); E.O. 13007, “Indian Sacred Sites” (*Federal Register*, Volume 61, page 26771, May 24, 1996); or other statutes and E.O.s until it completes its obligations under applicable requirements of the NHPA and other authorities. The BLM may require modification to development proposals to protect such properties, or it may disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or otherwise mitigated.

The BLM develops specific BMPs on a project-by-project basis. Avoidance of the resource is the preferred option. Data recovery is a common option for addressing adverse effects, but it does not eliminate the adverse effect. Mitigation of adverse effects can include many other options, such as monitoring and surveillance to protect sites from looting or vandalism; off-site mitigation; education and interpretive programs, including the use of volunteers; and funding of historic preservation efforts proportionate to the anticipated effects.

Several BMPs for other disciplines (soils, air quality, vegetation, hydrology) to encourage use of previously disturbed lands, prevent erosion, and require use of designated routes only to prevent off-road damage are also appropriate for protecting historic properties, but are not all repeated here (access roads and water control structures would be considered part of the area of potential effects and would require a survey). To protect sacred sites and portions of historic trails that are potentially eligible for listing on the NRHP from visual intrusion and to maintain the integrity of the historic cultural setting, the managing agency could require that surface disturbance be restricted or prohibited within the viewshed of a sacred site or within the viewshed of the trail along those portions of the trail for which eligibility is tied to the visual setting. Mitigation for the demolition of historic structures typically entails detailed architectural records and historical documentation; for the impacts on settings of historic structures, measures such as those for historic trails and sacred sites are appropriate. Ultimately, mitigation strategies would be determined during project-specific consultation.

Specific BMPs to reduce impacts on cultural resources should be required and include the following, as applicable.

## Siting and Design

- The use of previously disturbed lands, rather than pristine lands, should be encouraged.
- A phased sampling strategy, beginning with a Class II inventory to assess various alternative development areas, is recommended prior to the selection of individual project locations. The Class II inventory should meet the standards set forth in the Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716), BLM Handbook H-8110: Guidelines for Identifying Cultural Resources (BLM 2002), and revised BLM Manual 8110 (BLM 2004a).
- To protect historic properties, sacred sites, and portions of historic trails that are eligible for listing in the NRHP from visual intrusion and to maintain the integrity of the historic cultural setting, the managing agency could require that surface disturbance be restricted or prohibited within the viewshed of a historic property, sacred site, or trail segment for which eligibility is tied to the visual setting. These types of adverse effects will be minimized, avoided, or otherwise resolved (mitigated) through the Section 106 consultation process.

## Construction, Operation, and Decommissioning/Reclamation

- In cases where there is a probability of encountering cultural resources during construction that could not be fully detected during a Class III inventory, cultural field monitors (appropriate for the resource anticipated) should be employed to monitor ground disturbing activities. Development of a monitoring plan is recommended.
- The unexpected discovery of cultural resources during construction should be brought to the attention of the responsible authorized officer immediately. Work should be halted in the vicinity of the find. The area of the find should be protected to ensure that resources are not removed, handled, altered, or damaged while they are being evaluated and to ensure that appropriate BMPs are being developed.
- The use of management practices, such as training/education programs for workers and the public, should be implemented to reduce occurrences of human-related disturbances to nearby cultural sites. The specifics of these management practices should be

established in project-specific consultations between the applicant and the BLM as well as with the SHPO and Tribes, as appropriate.

## NATIVE AMERICAN CONCERNS

### Potentially Applicable BMPs

Government-to-government consultations among the managing agency and the directly and substantially affected Tribes is required under Executive Order 13175 *(Federal Register*, Volume 65, page 67249). In addition, Section 106 of the NHPA requires federal agencies to consult with Indian Tribes for undertakings on Tribal lands and for historic properties of significance to the Tribes that may be affected by an undertaking (CFR 36 800.2 (c)(2)). BLM Manual 8120 (BLM 2004b) and Handbook H-8120-1 (BLM 2004c) provide guidance for Native American consultations. For impacts on Native American resources, such as traditional cultural properties, that constitute historic properties under the NHPA, the application of BMPs developed in consultation under Section 106 of the NHPA would avoid, reduce, or mitigate the potential for adverse impacts. The use of management practices, such as training/education programs for workers and the public, could reduce occurrences of human related disturbances to nearby cultural sites. The specifics of these management practices should be established in project-specific consultations among the applicant and the managing agency, Tribes, and SHPOs, as appropriate. See Section 5.15.3 for additional potential BMPs for historic properties.

For those resources not considered historic properties under the NHPA, ongoing Tribal consultation would help determine other issues of concern, including but not limited to access rights, disruption of cultural practices, impacts on visual resources important to the Tribes, and impacts on subsistence resources. Ecological issues and potential BMPs are discussed in Section 5.10. Impacts on water use and quality and potential BMPs are discussed in Section 5.9. It should be noted that even when consultation and an extensive inventory or data collection occur, not all impacts on tribally sensitive resources can be fully mitigated.

Some specific BMPs are listed below (all BMPs listed in Section 5.15.3 for cultural resources would also apply to historic properties of concern to Native Americans):

- The importance of any Native American archaeological or other culturally important site identified in archaeological inventories in project areas should be determined and validated through consultation with appropriate Native American governments and cultural authorities. Appropriate mitigation steps, such as avoidance, removal, repatriation of Native American human remains and associated items of cultural patrimony, or curation, should be determined during this consultation.
- Visual intrusion on sacred areas should be avoided to the extent practical through the selection of the solar facility location and solar technology. When avoidance is not possible, timely and meaningful consultation with the affected Tribe(s) should be conducted to formulate a mutually acceptable plan to mitigate or reduce the adverse effect.
- Tribal burial sites should be avoided. A contingency plan for encountering unanticipated burials and funerary goods during construction, maintenance, or operation of a solar facility should be developed as part of a formalized agreement to address management and mitigation options for significant cultural resources (see Section 5.15.3) in consultation with the appropriate Tribal governments and cultural authorities well in

advance of any ground disturbances. The contingency plan should include consultation with the lineal descendants or Tribal affiliates of the deceased and human remains and objects of cultural patrimony should be protected and repatriated according to NAGPRA statutory procedures and regulations.

- Springs and other water sources that are or may be sacred or culturally important should be avoided whenever possible. If construction, maintenance, or operational activities must occur in proximity to springs or other water sources, appropriate measures, such as the use of geotextiles or silt fencing, should be taken to prevent silt from degrading water sources. The effectiveness of these mitigating barriers should be monitored. Measures for preventing water depletion impacts on spring flows should also be employed. Particular mitigations should be determined in consultation with the appropriate Native American Tribe(s).
- Culturally important plant species should be avoided when possible. When it is not possible to avoid these plant resources, consultations should be undertaken with the affected Tribe(s). If the species is available elsewhere on agency-managed lands, guaranteeing access may suffice. For rare or less common species, establishing (transplanting) an equal amount of the plant resource elsewhere on agency-managed land accessible to the affected Tribe may be acceptable.
- Culturally important wildlife species and their habitats should be avoided. When it is not possible to avoid these habitats, solar facilities should be designed to minimize impacts on game trails, migration routes, and nesting and breeding areas of Tribally important species. Mitigation and monitoring procedures should be developed in consultation with the affected Tribe(s).
- Archaeological sites created by ancestral Native American populations should be avoided whenever possible. However, when archaeological excavations are necessary, affiliated Tribe(s) should be consulted, and the concerns of the affected descendant Native American population taken into account when developing a data recovery strategy. Possible mitigations include scientific excavation; monitoring or participation in excavations by Tribal representatives; and repatriation or approved curation of artifacts.
- Rock art (panels of petroglyphs and/or pictographs) should be avoided whenever possible. These panels may be just one component of a larger sacred landscape, in which avoidance of all impacts may not be possible. Mitigation plans for eliminating or reducing (minimizing) potential impacts on rock art should be formulated in consultation with the appropriate Tribal cultural authorities.
- Standard noise BMPs (see Section 5.13.3) should be employed when solar facilities would be located near sacred sites to minimize the impacts of noise on culturally significant areas.
- Health and safety BMPs for the general public (see Section 5.21.3) should be employed when solar facilities are located near to Native American traditional use areas in order to minimize potential health and safety impacts to Native Americans.
    - Prior to construction, consideration should be given to training contractor personnel whose activities or responsibilities could affect resources of significance to Native Americans during construction.
    - When there is a reasonable expectation of encountering previously unidentified cultural resources during construction, monitoring of construction by a qualified

cultural resource specialist should be considered to minimize impacts on resources of significance to Tribes to the extent possible.

## WIND ENERGY DEVELOPMENT

- Archaeological sites and historic properties present in the area of potential effect should be reviewed to determine whether they meet the criteria of eligibility for listing on the NRHP. Cultural resources listed on or eligible for listing on the NRHP are considered "significant" resources.
- When any ROW application includes remnants of a National Historic Trail, is located within the viewshed of a National Historic Trail's designed centerline, or includes or is within the viewshed of a trail eligible for listing on the NRHP, the operator should evaluate the potential visual impacts to the trail associated with the proposed project and identify appropriate BMPs for inclusion as stipulations in the POD.
- Periodic monitoring of significant cultural resources in the vicinity of development projects may help curtail potential looting/vandalism and erosion impacts. If impacts are recognized early, additional actions can be taken before the resource is destroyed.

# I-B4: HAZARDOUS MATERIALS, PESTICIDES, AND WASTE MANAGEMENT

## BEST MANAGEMENT PRACTICES

---

## COMMON TO ALL

- Operators will develop a hazardous materials management plan addressing storage, use, transportation, and disposal of each hazardous material anticipated to be used at the site. The plan will identify all hazardous materials that would be used, stored, or transported at the site. It will establish inspection procedures, storage requirements, storage quantity limits, inventory control, nonhazardous product substitutes, and disposition of excess materials. The plan will also identify requirements for notices to federal and local emergency response authorities and include emergency response plans.
- Operators will develop a waste management plan identifying the waste streams that are expected to be generated at the site and addressing hazardous waste determination procedures, waste storage locations, waste-specific management and disposal requirements, inspection procedures, and waste minimization procedures. This plan will address all solid and liquid wastes that may be generated at the site.
- A comprehensive Spill Prevention and Emergency Response Plan should address the possibility of accidental releases for all hazardous materials stored on site. The plan should include the following: be written, periodically updated, and made available to the entire workforce; contain procedures for timely notification of appropriate authorities, including the designated BLM land manager; provide spill/emergency contingency planning for each type of hazardous material present, including the abatement or stabilizing of the release, recovery of the spilled product, and remediation of the affected environmental media; be supported by the strategic deployment of appropriate spill response materials and equipment, including PPE for individuals with spill or emergency response assignments; provide for prompt response to spills and timely delivery of recovered spill materials and contaminated environmental media to appropriately permitted off-site treatment or disposal facilities; formally assign spill and emergency response duties to specified individuals; provide and document appropriate training to individuals with spill or emergency response assignments; provide general awareness training to remaining facility personnel; and provide for written documentation of each event, including root cause analysis, description of corrective actions taken, and characterization of the resulting environmental or health and safety impacts.

## GEOTHERMAL ENERGY DEVELOPMENT

- A safety assessment will be conducted to describe potential safety issues and the means that would be taken to mitigate them, including issues such as site access, construction, safe work practices, security, heavy equipment transportation, traffic management, emergency procedures, and fire control.

- A health and safety program will be developed to protect both workers and the general public during construction and operation of geothermal projects.
- Regarding occupational health and safety, the program will identify all applicable federal and state occupational safety standards; establish safe work practices for each task (e.g., requirements for personal protective equipment and safety harnesses; Occupational Safety and Health Administration [OSHA] standard practices for safe use of explosives and blasting agents; and measures for reducing occupational electric and magnetic fields [EMF] exposures); establish fire safety evacuation procedures; and define safety performance standards (e.g., electrical system standards and lightning protection standards). The program will include a training program to identify hazard training requirements for workers for each task and establish procedures for providing required training to all workers. Documentation of training and a mechanism for reporting serious accidents to appropriate agencies will be established.
- Regarding public health and safety, the health and safety program will establish a safety zone or setback for generators from residences and occupied buildings, roads, ROWs, and other public access areas that is sufficient to prevent accidents resulting from the operation of generators. It will identify requirements for temporary fencing around staging areas, storage yards, and excavations during construction or rehabilitation activities. It will also identify measures to be taken during the operation phase to limit public access to hazardous facilities (e.g., permanent fencing would be installed only around electrical substations, and facility access doors would be locked).
- Operators will consult with local planning authorities regarding increased traffic during the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) will be identified and addressed in the traffic management plan.
- Operators will develop a fire management strategy to implement measures to minimize the potential for a human-caused fire.
- All refueling will occur in a designated fueling area that includes a temporary berm to limit the spread of any spill.
- Drip pans will be used during refueling to contain accidental releases.
- Drip pans will be used under fuel pump and valve mechanisms of any bulk fueling vehicles parked at the construction site.
- Any containers used to collect liquids will be enclosed or screened to prevent access to contaminants by wildlife, livestock, and migratory birds.
- Spills will be immediately addressed per the spill management plan, and soil cleanup and removal initiated as soon as feasible.

## SOLAR ENERGY DEVELOPMENT

Means to eliminate or reduce adverse impacts from hazardous materials and wastes include compliance with applicable laws, ordinances, and regulations and conformance with relevant industry standards (including those issued by nonregulatory bodies such as the National Fire

Protection Association). For the solar facility projects issued ROWs by the BLM, construction and operation plans must also incorporate elements of relevant construction standards and interconnection requirements of the transmission system operator as well as the reliability requirements of FERC orders.16

Solar facility developers should construct several plans addressing various aspects of hazardous materials and waste, including a Hazardous Materials and Waste Management Plan, a Construction and Operation Waste Management Plan, a Fire Management and Protection Plan, a Nuisance Animal and Pest Control Plan, and Vegetation Management Plan (if the facility will use pesticides/herbicides), and a Spill Prevention and Emergency Response Plan. These plans will include the following items:

- A Construction and Operation Waste Management Plan should identify the waste streams that are expected to be generated at the site and address hazardous waste determination procedures, waste storage locations, waste-specific management and disposal requirements (e.g., selecting appropriate waste storage containers, appropriate off-site treatment, storage, and disposal facilities), inspection procedures, and waste minimization procedures. The plan should address all solid and liquid wastes that may be generated at the site in compliance with the CWA requirements to obtain the project's NPDES permit.
- A Fire Management and Protection Plan should be developed to implement measures to minimize the potential for fires associated with substances used and stored at the site. The flammability of the specific HTF used at the facility should be considered.
- If pesticides/herbicides are to be used on the site, a Nuisance Animal and Pest Control Plan and an Integrated Vegetation Management Plan should be developed to ensure that applications will be conducted within the framework of managing agencies and will entail the use of only EPA-registered pesticides/herbicides that are nonpersistent and immobile and approved by the managing agency.

Potentially applicable BMPs for hazardous materials and wastes at solar facilities include the following:

- All site characterization, construction, operation, and decommissioning activities should be conducted in compliance with applicable federal and state laws and regulations, including the Toxic Substances Control Act of 1976, as amended (15 USC 2601, et seq.). In addition, any release of toxic substances (leaks, spills, and the like) in excess of the reportable quantity established by 40 CFR Part 117 should be reported as required by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Section 102b. A copy of any report required or requested by any federal agency or state government as a result of a reportable release or spill of any toxic substances should be furnished to the authorized officer concurrent with the filing of the reports to the involved federal agency or state government. In addition, the United States should be indemnified against any liability arising from the release of any hazardous substance or hazardous waste on the facility or associated with facility activities.
- Project developers should survey project sites for unexploded ordnance, especially if projects are within 20 mi (32 km) of a current U.S. Department of Defense (DoD) installation or formally used defense site.
- Pollution prevention opportunities should be identified and implemented, including material substitution of less hazardous alternatives, recycling, and waste minimization.

- Systems containing hazardous materials should be designed and operated in a manner that limits the potential for their release, constructed of compatible materials in good condition (as verified by periodic inspections), including provision of secondary containment features (to the extent practical); installation of sensors or other devices to monitor system integrity; installation of strategically placed valves to isolate damaged portions and limit the amount of hazardous materials in jeopardy of release; and robust inspection and use of repair procedures.

Systems containing hazardous materials should be designed and operated in a manner that limits the potential for their release, constructed of compatible materials in good condition (as verified by periodic inspections), including provision of secondary containment features (to the extent practical); installation of sensors or other devices to monitor system integrity; installation of strategically placed valves to isolate damaged portions and limit the amount of hazardous materials in jeopardy of release; and robust inspection and use of repair procedures.

- Dedicated areas with secondary containment should be established for off-loading hazardous materials transport vehicles.
- To the greatest extent practical and by considering the remoteness of a given facility, "just-in-time" ordering procedures should be employed that are designed to limit the amounts of hazardous materials present on the site to quantities minimally necessary to support continued operations. Excess hazardous materials should receive prompt disposition.
- Written procedures for the storage, use, and transportation of each type of hazardous material present should be provided, including all vehicle and equipment fuels.
- Authorized users for each type of hazardous material should be identified.
- Procedures should be established for fuel storage and dispensing, including shutting off vehicle (equipment) engines; using only authorized hoses, pumps, and other equipment in good working order; maintaining appropriate fire and spill response materials at equipment-fueling stations; providing emergency shutoffs for fuel pumps; ensuring that fueling stations are paved; ensuring that both aboveground fuel tanks and fueling areas have adequate secondary containment; prohibiting smoking, welding, or open flames in fuel storage and dispensing areas; equipping the area with fire suppression devices, as appropriate; conducting routine inspections of fuel storage and dispensing areas; requiring prompt recovery and remediation of all spills, and providing for the prompt removal of all fuel and fuel tanks used to support construction vehicles and equipment at the completion of facility construction and decommissioning phases.
- Refueling areas should be located away from surface water locations and drainages and on paved surfaces; features should be added to direct spilled materials to sumps or safe storage areas where they can be subsequently recovered.
- All vehicles and equipment should be in proper working condition to ensure that there is no potential for leaks of motor oil, antifreeze, hydraulic fluid, grease, or other hazardous materials.
- Hazardous materials and waste storage areas or facilities should be formally designated and access to them restricted to authorized personnel. Construction debris, especially treated wood, should not be disposed of or stored in areas where it could come in contact with aquatic habitats.

- Design requirements should be established for hazardous materials and waste storage areas that are consistent with accepted industry practices as well as applicable federal, state, and local regulations and that include, at a minimum, containers constructed of compatible materials, properly labeled, and in good condition; secondary containment features for liquid hazardous materials and wastes; physical separation of incompatible chemicals; and fire-fighting capabilities when warranted.
- Written procedures should be established for inspecting hazardous materials and waste storage areas and for plant systems containing hazardous materials; identified deficiencies and their resolution should be documented.
- Schedules should be established for the regular removal of wastes (including sanitary wastewater generated in temporary, portable sanitary facilities) for delivery by licensed haulers to appropriate off-site treatment or disposal facilities.
- During facility decommissioning, the following should occur: emergency response capabilities should be maintained throughout the decommissioning period as long as hazardous materials and wastes remain on-site, and emergency response planning should be extended to any temporary material and equipment storage areas that may have been established; temporary waste storage areas should be properly designated, designed, and equipped; hazardous materials removed from systems should be properly containerized and characterized, and recycling options should be identified and pursued; off-site transportation of recovered hazardous materials and wastes resulting from decommissioning activities should be conducted by authorized carriers; all hazardous materials and waste should be removed from on-site storage and management areas (including surface impoundments), and the areas should be surveyed for contamination and remediated as necessary.

## WIND ENERGY DEVELOPMENT

The following BMPs are recommended for implementation during all activities associated with a wind energy project:

- The BLM should be provided with a comprehensive listing of the hazardous materials that would be used, stored, transported, or disposed of during activities associated with site monitoring and testing, construction, operation, and decommissioning of a wind energy project.

- Operators should develop a spill prevention and response plan identifying where hazardous materials and wastes are stored on site, spill prevention measures to be implemented, training requirements, appropriate spill response actions for each material or waste, the locations of spill response kits on site, a procedure for ensuring that the spill response kits are adequately stocked at all times, and procedures for making timely notifications to authorities.

- Operators should develop a storm water management plan for the site to ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion.

- If pesticides are to be used on the site, an integrated pest management plan should be developed to ensure that applications will be conducted within the framework of BLM and DOI policies and entail the use of only EPA-registered pesticides. Pesticide use should be limited to nonpersistent, immobile pesticides and should only be applied in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.

- Secondary containment should be provided for all on-site hazardous materials and waste storage, including fuel. In particular, fuel storage (for construction vehicles and equipment) should be a temporary activity occurring only for as long as is needed to support construction and decommissioning activities. Fuel storage facilities should be removed from the site after these activities are completed.
- Wastes should be properly containerized and removed periodically for disposal at appropriate off-site permitted disposal facilities.
- In the event of an accidental release to the environment, the operator should document the event, including a root cause analysis, appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event should be provided to the BLM authorized officer and other federal and state agencies, as required.
- Any wastewater generated in association with temporary, portable sanitary facilities should be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility. Temporary, portable sanitary facilities provided for construction crews should be adequate to support expected on-site personnel and should be removed at the completion of construction activities.

# I-B5: NOISE AND VIBRATION

## BEST MANAGEMENT PRACTICES

## COMMON TO ALL

- Project developers should take measurements to assess the existing background ambient sound levels both within and outside the project site and compare them with the anticipated noise levels associated with the proposed facility. The ambient measurement protocols of all affected land management agencies should be considered and utilized. Nearby residences and likely sensitive human and wildlife receptor locations should be identified at this time. Noisy construction activities (including blasting) should be limited to the least noise-sensitive times of day (daytime only between 7 a.m. and 10 p.m.) and weekdays.

## GEOTHERMAL ENERGY DEVELOPMENT

- Within [2] miles of existing, occupied residences, geothermal well drilling or major facility construction operations will be restricted to non-sleeping hours (7:00 am to 10:00 pm).
- All equipment will have sound-control devices no less effective than those provided on the original equipment. All construction equipment used will be adequately muffled and maintained.
- All stationary construction equipment (i.e., compressors and generators) will be located as far as practicable from nearby residences.
- If blasting or other noisy activities are required during the construction period, nearby residents will be notified by the operator at least 1 hour in advance.
- Explosives will be used only within specified times and at specified distances from sensitive wildlife or streams and lakes, as established by the federal and state agencies.

## SOLAR ENERGY DEVELOPMENT

The following BMPs during construction, operation, and decommissioning are recommended as ways to reduce potential noise impacts on the neighboring communities. Many of the BMPs recommended below have been adapted from those discussed in the following references: Beacon Solar, LLC (2008); BrightSource Energy, Inc. (2007); DOI and USDA (2007); SES Solar Two, LLC (2008); Wang (1979); and Wood (1992).

### Siting and Design

- Siting of stationary construction equipment (e.g., compressors and generators) should be as far from nearby residences and other sensitive receptors as the specific project configuration allows.

- Permanent sound-generating facilities (e.g., compressors, pumps) should be sited away from residences and other sensitive receptors. In areas of known conflicts, consideration should be given to the installation of acoustic screening.
- Where feasible, low-noise systems (e.g., for ventilation systems, pumps, generators, compressors, and fans) should be incorporated, and equipment that has no prominent discrete tones should be selected.
- If a wet-cooling tower is to be used, the louvered side should be sited to face away from sensitive human receptors. The cooling tower should be located such that nearby equipment can act as a barrier and further reduce noise. Quieter fans should be selected in the facility design, and fans should be operated at a lower speed, particularly if they are to operate at night. If a high degree of reduction in noise is required, silencers should be used on the fan stacks.
- Noise reduction measures that should be considered include siting noise sources to take advantage of topography and distance and constructing engineered sound barriers and/or berms or sound-insulated buildings, if needed, to reduce potential noise impacts at the locations of nearby sensitive receptors. As an alternative, solar facilities generating higher operational noise (e.g., a solar dish engine facility) could take advantage of higher background noise. For example, they could be sited within an existing noisy area, such as close to a well-traveled highway, where the ambient sounds partially mask the noise from the facility.

## General Multiphase Measures

- All equipment should be maintained in good working order in accordance with manufacturers' specifications. For example, suitable mufflers and/or air-inlet silencers should be installed on all internal combustion engines (ICEs) and certain compressor components.
- If residences or sensitive receptors are nearby, noisy equipment, such as turbines and motors, should be placed in enclosures.
- All vehicles traveling within and around the project area should be operated in accordance with posted speed limits to reduce vehicle noise levels.
- Warning signs should be posted in high-noise areas, and a hearing protection program should be implemented for work areas with noise in excess of 85 dBA.
- Project developers should realize that complaints about noise may still occur, even when the noise levels from the facility do not exceed regulatory levels. Accordingly, a noise complaint process and hotline for the surrounding communities should be implemented, including documentation, investigation, evaluation, and resolution of all legitimate project-related noise complaints.

## Construction and Decommissioning/Reclamation

- Construction and decommissioning activities and construction traffic should be scheduled to minimize disruption to nearby residents and existing operations surrounding the project areas.
- If residences or sensitive receptors are nearby, noisy construction and decommissioning activities should be limited to the least noise-sensitive times of day (daytime between 7 a.m. and 7 p.m.) and weekdays. Quieter activities, such as instrumentation or interior installation, could be conducted at any time.
- Whenever feasible, different noisy activities should be scheduled to occur at the same time, since additional sources of noise generally do not increase noise levels at the site boundary by much. That is, less-frequent but noisy activities would generally be less annoying than lower level noise occurring more frequently.
- Noise control measures (e.g., erection of temporary wooden noise barriers) should be implemented if noisy activities are expected near sensitive receptors.
- If noisy activities, such as blasting or pile driving, are required during the construction or decommissioning period, nearby residents should be notified in advance.

## Operations

- If noise from a transformer becomes an issue, a new transformer with reduced flux density, which generates noise levels as much as 10 to 20 dB lower than National Electrical Manufacturers Association (NEMA) standard values, could be installed. Alternatively, barrier walls, partial enclosures, or full enclosures could be adopted to shield or contain the transformer noise, depending on the degree of noise control needed.

## Transmission Lines and Roads

Most BMPs applied to the construction, operation, and decommissioning activities discussed above should also be implemented during the entire life of transmission lines. An additional BMP in the case of helicopter use, typically of short duration but with high-level noise, is the following:

- Helicopter flights at low altitude (under 1,500 ft [457 m]) near noise-sensitive receptors should be minimized except at locations where only helicopter activities can perform the task.

# WIND ENERGY DEVELOPMENT

The following BMPs are recommended as ways to reduce potential noise impacts:

- Noisy construction activities (including blasting) should be limited to the least noise-sensitive times of day (daytime only between 7 a.m. and 10 p.m.) and weekdays.

- Whenever feasible, different noisy activities (e.g., blasting and earthmoving) should be scheduled to occur at the same time since additional sources of noise generally do not add a significant amount of noise. That is, less-frequent noisy activities would be less annoying than frequent less-noisy activities.

- All equipment should have sound-control devices no less effective than those provided on the original equipment. All construction equipment used should be adequately muffled and maintained.
- All stationary construction equipment (i.e., compressors and generators) should be located as far as practicable from nearby residences.
- If blasting or other noisy activities are required during the construction period, nearby residents should be notified in advance.

# I-B6: PALEONTOLOGICAL RESOURCES

## BEST MANAGEMENT PRACTICES

---

### COMMON TO ALL

- If paleontological resources are present at the site or if areas with a high potential to contain paleontological material have been identified, a paleontological resources management plan should be developed. This should include a mitigation plan; mitigation may include avoidance, removal of fossils (data recovery), stabilization, monitoring, use of protective barriers and signs, or use of other physical or administrative protection measures. The paleontological resources management plan should also identify measures to prevent potential looting, vandalism, or erosion impacts and address the education of workers and the public to make them aware of the consequences of unauthorized collection of fossils on public land.
- Project developers should determine whether paleontological resources exist in a project area on the basis of the following: the sedimentary context of the area and its potential to contain paleontological resources (PFYC [potential fossil yield classification] Class, if it is available); a records search of published and unpublished literature for past paleontological finds in the area; coordination with paleontological researchers working locally in potentially affected geographic areas and geologic strata; and/or depending on the extent of existing information, the completion of a paleontological survey.
- If an area has a high potential but no fossils are observed during survey, monitoring by a qualified paleontologist may be required by the managing agency during all excavation and earthmoving activities in the sensitive area. Development of a monitoring plan is recommended.

### GEOTHERMAL ENERGY DEVELOPMENT

- Before any specific permits are issued under leases, treatment of cultural resources will follow the procedures established by the Advisory Council on Historic Preservation for compliance with Section 106 of the National Historic Preservation Act. A pedestrian inventory will be undertaken of all portions that have not been previously surveyed or are identified by BLM as requiring inventory to identify properties that are eligible for the NRHP. Those sites not already evaluated for NRHP eligibility will be evaluated based on surface remains, subsurface testing, archival, and/or ethnographic sources. Subsurface testing will be kept to a minimum whenever possible if sufficient information is available to evaluate the site or if avoidance is an expected mitigation outcome. Recommendations regarding the eligibility of sites will be submitted to the BLM, and a treatment plan will be prepared to detail methods for avoidance of impacts or mitigation of effects. The BLM will make determinations of eligibility and effect and consult with SHPO as necessary based on each proposed lease application and project plans. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized or mitigated. Avoidance of impacts through project design will be given priority over data recovery as the preferred BMP. Avoidance measures include moving project elements away from site locations or to areas of previous impacts, restricting travel to existing roads, and maintaining barriers and signs in areas of cultural sensitivity. Any data recovery will be preceded by approval of a detailed research design, Native American Consultation, and other requirements for BLM issuance of a permit under the Archaeological Resources Protection Act (BLM 2007a).

## SOLAR ENERGY DEVELOPMENT

For all potential impacts, the application of BMPs developed in consultation with the BLM could reduce or eliminate (if avoidance of the resource is chosen) the potential for adverse impacts on significant paleontological resources. Coordination between the project developer and the managing agency would be required for all projects before areas are developed. The use of management practices, such as training/education programs to reduce the amount of inadvertent destruction to paleontological sites, could also reduce the occurrences of human-related disturbances to nearby sites. The specifics of these management practices would be established in project-specific coordination between the project developer and the managing agency. BLM Instruction Memorandum (IM) 2009-011 provides guidance for assessing potential impacts on paleontological resources and determining BMPs.

BMPs to reduce impacts on paleontological resources would be required and could include the following, as applicable:

- If fossils are discovered during construction, the managing agency should be notified immediately. Work should be halted at the fossil site and continued elsewhere until a qualified paleontologist can visit the site and make site-specific recommendations for collection or other resource protection. The area of the discovery should be protected to ensure that the fossils are not removed, handled, altered, or damaged.

If these types of BMPs are implemented during the initial project design and planning phases and are adhered to throughout the course of development, the potential impacts on paleontological resources discussed under the Section 5.14.1 would be mitigated to the fullest extent possible. Adopting this approach does not mean that there would be no impacts on paleontological resources. The exact nature and magnitude of the impacts would vary from project to project and would need to be examined in detail in future NEPA reviews of site specific projects.

## WIND ENERGY DEVELOPMENT

To mitigate or minimize potential paleontological resource impacts, the following BMPs could be adopted:

- Operators should determine whether paleontological resources exist in a project area on

# I-B7: SAFETY, HEALTH, AND NUISANCES

## BEST MANAGEMENT PRACTICES

## SOLAR ENERGY DEVELOPMENT

### Occupational Health and Safety

The following BMPs to protect solar energy facility and transmission line workers are recommended for implementation during all phases associated with a project.

- All site characterization, construction, operation, and decommissioning activities must be conducted in compliance with applicable federal and state occupational safety and health standards (e.g., the Occupational Health and Safety Administrations [OSHA's] Occupational Health and Safety Standards, 29 CFR Parts 1910 and 1926, respectively).
- A safety assessment should be conducted to describe potential safety issues and the means that would be taken to mitigate them, covering issues such as site access; construction; safe work practices; glare exposure from mirrors, heliostats, and/or power towers; security; heavy equipment transportation; traffic management; emergency procedures; and fire control.
- A health and safety program should be developed to protect workers during site characterization, construction, operation, and decommissioning of a solar energy project. The program should identify all applicable federal and state occupational safety standards and establish safe work practices addressing all hazards, including requirements for developing the following plans: general injury prevention; PPE requirements and training; respiratory protection; hearing conservation; electrical safety; hazardous materials safety and communication; housekeeping and material handling; confined space entry; hand and portable power tool use; gas-filled equipment use; and rescue response and emergency medical support, including on-site first-aid capability.
- In addition, the health and safety program should address OSHA standard practices for the safe use of explosives and blasting agents (e.g., if used to construct foundations for power tower facilities); measures for reducing occupational EMF exposures; the establishment of fire safety evacuation procedures; and required safety performance standards (e.g., electrical system standards and lighting protection standards). The program should include training requirements for applicable tasks for workers and establish procedures for providing required training to all workers. Documentation of training and a mechanism for reporting serious accidents to appropriate agencies should be established.
- A health risk assessment should evaluate potential cancer and noncancer risks to workers from exposure to facility emission sources during construction and operations. If

potential risks are found to exceed applicable threshold levels, measures should be taken to decrease emissions from the source.

- Electrical systems should be designed to meet all applicable safety standards (e.g., National Electrical Code [NEC]) and should comply with the interconnection requirements of the transmission system operator.
- In the event of an accidental release of hazardous substances to the environment, project developers should document the event, including a root cause analysis, a description of appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event should be provided to the permitting agencies and other federal and state agencies within 30 days, as required.
- For the mitigation of explosive hazards, workers should be required to comply with the OSHA standard (29 CFR 1910.109) for the safe use of explosives and blasting agents.
- Measures should be considered to reduce occupational EMF exposures, such as backing electrical generators with iron to block the EMF, shutting down generators when work is being done near them, and otherwise limiting exposure time and proximity while generators are running.

## Public Health and Safety

The following BMPs for the protection of public health and safety are recommended for implementation during all phases associated with a solar energy project:

- The project health and safety program should address protection of public health and safety during site characterization, construction, operation, and decommissioning for a solar energy project. The program should establish a safety zone or setback for solar facilities and associated transmission lines from residences and occupied buildings, roads, ROWs, and other public access areas that is sufficient to prevent accidents resulting from various hazards during all phases of development. It should identify requirements for temporary fencing around staging areas, storage yards, and excavations during construction or decommissioning activities. It should also identify measures to be taken during the operations phase to limit public access to facilities (e.g., equipment with access doors should be locked to limit public access, and permanent fencing with slats should be installed around electrical substations).
- A Traffic Management Plan should be prepared for the site access roads to control hazards that could result from increased truck traffic (most likely during construction or decommissioning), to ensure that traffic flow would not be adversely affected and that specific issues of concern (e.g., the locations of school bus routes and stops) are identified and addressed. This plan should incorporate measures such as informational signs, flaggers (when equipment may result in blocked throughways), and traffic cones to identify any necessary changes in temporary lane configurations. The plan should be developed in coordination with local planning authorities.

- Solar facilities should be sited and designed properly to eliminate glint and glare effects on roadway users, nearby residences, commercial areas, or other highly sensitive viewing locations, or reduce it to the lowest achievable levels (see similar BMP under Section 5.14.3). Regardless of the solar technology proposed, a Glint and Glare Assessment, Mitigation, and Monitoring Plan should accurately assess and quantify potential glint and glare effects and determine potential health, safety, and visual impacts associated with glint and glare effects. The assessment should be conducted by qualified individuals using appropriate and commonly accepted software and procedures. The assessment results should be made available to the managing agency in advance of project approval. If the project design is changed during the siting and design process such that substantial changes to glint and glare effects may occur, glint and glare effects shall be recalculated, and the results made available to the managing agency. If any potential for exposure at levels that could cause retinal damage is identified, measures to eliminate the exposure should be implemented (e.g., slatted fencing to shield views from outside the facility). The plan should also set up a system for logging, investigating, and responding to complaints regarding glare.
- A health risk assessment should evaluate potential cancer and noncancer risks to the general public from exposure to facility emission sources during construction and operations. If potential risks are found to exceed applicable threshold levels, measures should be taken to decrease emissions from the source.
- Proper signage and or engineered barriers (e.g., fencing) should be used to limit access to electrically energized equipment and conductors in order to prevent access to electrical hazards by unauthorized individuals or wildlife.
- Because of the high global warming potential of SF6, the use of alternative dielectric fluids that do not have a high global warming potential should be required.
- If operation of the solar facility and associated transmission lines and substations is expected to cause potential adverse impacts on nearby residences and occupied buildings from noise, sun reflection, or EMF, recommendations for addressing these concerns should be incorporated into the project design (e.g., establishing a sufficient setback from transmission lines).
- The project should be planned to comply with FAA regulations, including lighting requirements, and to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.
- Operators should develop a Fire Management and Protection Plan to implement measures to minimize the potential for a human-caused fire and to respond to human-caused or natural-caused fires.
- Project developers should work with appropriate agencies (e.g., DOE and TSA) to address critical infrastructure and key resource vulnerabilities at solar facilities, to minimize and plan for potential risks from natural events, sabotage, and terrorism.

## WIND ENERGY DEVELOPMENT

Potential public safety hazards during the site monitoring and testing phase are minimal. During construction, operation, and decommissioning of a wind energy development project, the hazards are greater but they can be effectively mitigated. These hazards include risks associated with major construction sites, rare tower failures, human-caused fire, EMF exposure, aviation safety interference, EMI, low-frequency sound, and shadow flicker. The following BMPs are recommended for implementation during all phases associated with a wind energy project:

- The project health and safety program should also address protection of public health and safety during construction, operation, and decommissioning of a wind energy project. The program should establish a safety zone or setback for wind turbine generators from residences and occupied buildings, roads, ROWs, and other public access areas that is sufficient to prevent accidents resulting from various hazards during the operation of wind turbine generators. It should identify requirements for temporary fencing around staging areas, storage yards, and excavations during construction or decommissioning activities. It should also identify measures to be taken during the operations phase to limit public access to facilities (e.g., permanent fencing should be installed around electrical substations, and turbine tower access doors should be locked to limit public access).
- Operators should consult with local planning authorities regarding increased traffic during the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) should be identified and addressed in the traffic management plan.
- If operation of the wind turbines is expected to cause significant adverse impacts to nearby residences and occupied buildings from shadow flicker, low-frequency sound, or EMF, site-specific recommendations for addressing these concerns should be incorporated into the project design (e.g., establishing a sufficient setback from turbines).
- The project should be planned to minimize EMI (e.g., impacts to radar, microwave, television, and radio transmissions) and comply with FCC regulations. Signal strength studies should be conducted when proposed locations have the potential to impact transmissions. Potential interference with public safety communication systems (e.g., radio traffic related to emergency activities) should be avoided.
- In the event an installed wind energy development project results in EMI, the operator should work with the owner of the impacted communications system to resolve the problem. Potential mitigation may include realigning the existing antenna or installing relays to transmit the signal around the wind energy project. Additional warning information may also need to be conveyed to aircraft with onboard radar systems so that echoes from wind turbines can be quickly recognized.
- The project should be planned to comply with FAA regulations, including lighting requirements, and to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.
- Operators should develop a fire management strategy to implement measures to minimize the potential for a human-caused fire.

# I-B8: SOILS, DRAINAGE, EROSION, STORMWATER, AND FLOODING

## BEST MANAGEMENT PRACTICES

---

## COMMON TO ALL

- The operator will perform a detailed geotechnical analysis prior to the construction of any structures; so they will be sited to avoid any hazards from subsidence or liquefaction (i.e., the changing of a saturated soil from a relatively stable solid state to a liquid during earthquakes or nearby blasting).

## SOLAR ENERGY DEVELOPMENT

### Soil Resources

The main objective of the BMPs for soil resources is to preserve the health and functioning of project area soils by reducing or controlling the ground-disturbing activities that cause the soil impacts described in Section 5.7.1. Preserving the health and functioning of project area soils is an essential step in reducing impacts on other important resources (Table 5.7-1). Erosion control measures would be based on an assessment of site-specific conditions and would include minimizing the extent of disturbed areas, stabilizing disturbed areas, and protecting slopes and channels in the project area. Measures to control sedimentation would focus on retaining sediment on-site and implementing controls along the project site perimeter (CASQA 2004).

Developers would conduct (as necessary) geotechnical engineering and hydrology studies to characterize site conditions related to drainage patterns, soils, vegetation, surface water bodies, land subsidence, and steep or unstable slopes. The results of such studies would be compiled into reports to aid in the permitting, design, and construction of a proposed solar energy project. In the geotechnical engineering report, factors such as soil properties, engineering constraints, the corrosive potential of construction materials, stability, and facility design criteria would be identified. The hydrology report would present data on local water bodies, surface water drainage patterns, floodplains, rainfall, and expected runon and runoff volumes and flow rates.

Many of the BMPs listed below would be components of the various plans required to mitigate the impacts of solar energy facilities, particularly the Drainage, Erosion, and Sedimentation Control Plan, Wind Erosion Management Plan, Access Road Siting and Management Plan, Dust Abatement Plan, Integrated Vegetation Management Plan, Ecological

Resource Mitigation and Monitoring Plan, Habitat Restoration and Management Plan, Spill Prevention and Emergency Response Plan, and Stormwater Management Plan. Plans would be revised or amended as necessary to account for changes in site conditions as a project proceeds from construction through decommissioning. Applicants must obtain and meet the requirements of all applicable federal, state, and county permits and building codes. Studies may also be needed to determine whether construction and operation of a solar facility within a proposed SEZ would affect the eolian processes that maintain nearby sand dunes (e.g., Big Dune in Amargosa Valley in Nevada). The need for such studies would be evaluated on a case-by-case basis.

The following subsections identify potentially applicable BMPs for solar energy facilities, grouped by phase of development. These measures address a range of site conditions and may not be applicable to every solar project. However, they should be implemented by projects if they are applicable. The mitigations measures listed here have been adapted from those outlined in reports such as DOI and USDA (2006), BLM (2010a), State of California Department of Transportation (2003), USFS (2000), and Desert Managers Group (2010). Project developers should implement these measures, as applicable, and develop others that address unique site conditions not anticipated here. Routine site inspections should be conducted to identify and correct improperly installed, damaged, or ineffective measures. Inspections should be made more frequently during the rainy season and during and following1 intense rainfall events to ensure the timeliness of corrective actions.

## Siting and Design

- The footprint of disturbed areas, including the number and size/length of roads, fences, borrow areas, and laydown and staging areas, should be minimized. The boundaries of disturbed area footprints should be clearly delineated on the ground (e.g., through the use of construction fencing).
- Project structures and facilities should be sited to avoid disturbance in areas with existing biological soil crusts to the extent possible.
- Project areas should be replanted with native vegetation at spaced intervals to the extent possible to break up areas of exposed soil and reduce soil loss by wind erosion (see also Section 5.10.5).
- Land disturbance (including crossings) in natural drainage systems and groundwater recharge zones, specifically ephemeral washes and dry lake beds, should be avoided. Any structures crossing drainages should be located and constructed so that they do not decrease channel stability or increase water volume or velocity. Developers should obtain all applicable federal and state permits.
- Solar facilities or components (e.g., heliostats, panels, dishes, and troughs) should not be placed in natural drainage ways.
- Adequate space (i.e., setbacks) between solar facilities and natural washes should be maintained to preserve their hydrological function and provide a buffer for flood control.
- Existing roads, disturbed areas, and borrow pits should be used. In addition, all borrow pits shall be identified beforehand, and included in the NEPA direct and indirect analyses. If new roads are necessary, they should be designed and constructed to the appropriate road design standards, such as those described in BLM Manual 9113 (BLM 1985) and BLM (2007). The specifications and codes developed by the U.S. Department of Transportation (DOT) should also be taken into account.
- New roads should be designed to follow natural land contours and avoid or minimize hill cuts in the project area and avoid existing desert washes. Siting of new roads and walking

trails (if any) should be consistent with the designation criteria specified by the BLM in 43 CFR 8342.1.

- Ground-disturbing geotechnical studies (e.g., geotechnical drilling) should adhere to the permitting requirements specified by the BLM in 43 CFR 2920.
- Roads should be designed on the basis of local meteorological conditions, soil moisture, and erosion potential in order to avoid erosion and changes in surface water runoff.
- Temporary roads should be designed with eventual reclamation in mind.
- Areas with unstable slopes should be avoided, and local factors that can cause slope instability (e.g., groundwater conditions, precipitation, earthquake activity, slope angles, and the dip angles of geologic strata) should be identified.
- Excessive grades should be avoided on roads, road embankments, ditches, and drainages, especially in areas with erodible soils.
- The creation of excessive slopes should be avoided during site preparation and construction. Special construction techniques should be used, where applicable, in areas of steep slopes, erodible soil, and drainage ways.
- Construction should be conducted in stages to limit the areas of exposed soil at any given time. For example, only land that will be actively under construction in the near term (e.g., within the next 6 to 12 months) should be cleared of vegetation.

## General Multiphase Measures

- Potential soil erosion should be controlled at culvert outlets with appropriate structures.
- Catch basins, roadway ditches, and culverts should be cleaned and maintained regularly.
- Abandoned roads and roads no longer needed should be subsoiled to increase infiltration and reduce soil compaction, then recontoured and revegetated.
- Ground-disturbing activities should be minimized, especially during the rainy season.
- Originally excavated materials should be stockpiled and used for backfill.
- The speed of vehicles and equipment on unpaved surfaces should be controlled to reduce dust emissions.
- Runoff from slope tops should be controlled and directed to settling or rapid infiltration basins (temporarily) until disturbed slopes are stabilized. Disturbed slopes should be stabilized as quickly as possible.
- Drainage crossings should be stabilized as quickly as possible, and channel erosion from runoff caused by the project should be prevented.
- Sediment-laden waters from disturbed, active areas within the project site should be retained through the use of barriers and sedimentation devices (e.g., berms, straw bales, sandbags, jute netting, or silt fences). Such barriers and devices should not be installed in wildlife crossing areas.
- Barriers and sedimentation devices should be placed around drainages and wetlands to prevent contamination by sediment-laden water.

- Sediment from barriers and sedimentation devices should be removed to restore sediment control capacity.
- Routine site inspections should be conducted to assess the effectiveness and maintenance requirements for erosion and sediment control systems.
- Barriers and sedimentation devices should be maintained, repaired, or replaced as necessary to ensure optimum control.
- A spill prevention plan to identify sources, locations, and quantities of potential chemical releases (through spills, leaks, or fires) and to define response measures and notification requirements should be developed and followed to reduce the potential for soil contamination. The plan should also identify individuals and their responsibilities for implementing the plan.

## Site Characterization and Construction

- Construction activities should take place over as short a timeframe as possible once ground disturbance has occurred. If an activity requires an extended schedule, measures to limit wind and water erosion should be employed during the activity (rather than after the activity), to the extent possible.
- Construction traffic should avoid unpaved surfaces (to reduce the risk of compaction) and reduce speed to lessen fugitive dust emissions.
- The clearing and disturbing of sensitive areas (e.g., steep slopes and natural drainages) and other areas should be avoided outside the construction zone. The construction zone boundaries should be clearly delineated on the ground (e.g., through the use of construction fencing).
- Ground disturbance from construction-related activities, such as vehicle and foot traffic, should avoid areas with intact biological soil crusts to the extent possible. For cases in which impacts cannot be avoided, soil crusts should be salvaged and restored, on the basis of recommendations by BLM, once construction has been completed.
- The creation of excessive slopes should be avoided during site preparation and construction (e.g., during excavation).Special construction techniques should be used, where applicable, in areas of steep slopes, erodible soil, and stream channel crossings.
- Electrical lines from solar collectors should be buried along existing features (e.g., roads or other paths of disturbance) to minimize the overall area of surface disturbance whenever possible.
- Borrow materials should be obtained only from authorized and permitted sites.
- Construction grading should be conducted in compliance with good industry practice (e.g., the American Society for Testing and Materials [ASTM] international standard methods) and other requirements (e.g., BLM and/or local grading and construction permits), as they apply.
- Erosion control structures (e.g., rock lining or apron) should be added at culvert outlets to reduce flow velocity and minimize the potential for scouring.

- Temporary stabilization of disturbed areas that are not actively under construction should occur throughout the construction phase. Soil stabilization methods such as erosion matting (organic or synthetic mats or blankets) or soil aggregation (binding) are examples of measures that should be used to limit wind erosion and dust emissions, as site conditions warrant.
- Permanent stabilization of disturbed areas should occur during final grading and landscaping of the site.
- Water or other stabilizing agents should be used to wet roads in active construction areas and laydown areas in order to minimize the windblown erosion of soil.
- Topsoil from all excavation and construction activities should be salvaged so it can be reapplied to the disturbed area once construction is completed.
- Native plant communities in disturbed areas should be restored by natural revegetation or by seeding and transplanting (using weed-free native grasses, forbs, and shrubs), on the basis of BLM recommendations, as early as possible once construction is completed (see also Sections 5.10.1 and 5.10.5).
- Construction on wet soils should be avoided.

## Operations

- All appropriate BMPs developed for the construction phase should be applied to similar activities during the operations phase.
- The area disturbed by operation of a solar energy project should be minimized (e.g., by using existing roads).

## Decommissioning/Reclamation

- All BMPs developed for the construction phase should be applied to similar activities during the decommissioning/reclamation phase.
- The original grade and drainage pattern should be re-established.
- Native plant communities in disturbed areas should be restored by natural revegetation or by seeding and transplanting (using weed-free native grasses, forbs, and shrubs), on the basis of BLM recommendations, as early as possible once decommissioning is completed (see also Sections 5.10.1 and 5.10.5).

## Geologic Hazards

The potential geologic hazards that could be significant at solar project sites in the six-state study area include seismic ground shaking, ground rupture, liquefaction, volcanic activity, slope instability, subsidence (collapse) and settlement, expansive soils, and flooding and debris flows.). Solar project developers should conduct geotechnical studies (as needed) to identify and assess these hazards and to propose facility design criteria and site-specific BMPs. The BMP to address geologic hazards therefore would be to build project structures in accordance with the design basis recommendations specified in the project-specific geotechnical investigation report.

Structure designs must meet the requirements of all applicable federal, state, and county permits and building codes.

In areas of high seismic activity (especially those having soils with a high liquefaction potential) or in areas that encompass 100-year floodplains, the most effective BMP is to alter the location or scope of the proposed project.

## MINERALS (FLUIDS, SOLIDS, AND GEOTHERMAL RESOURCES)

### Potentially Applicable BMPs

- Where valid mining claims or leases exist, early coordination with claim or lease holders should be initiated to determine whether it would be possible to locate solar facilities in or near these areas in such a way as to avoid future adverse effects on mineral development activities.
- All solar energy development ROWs should contain the stipulation that BLM retains the right to issue oil and gas or geothermal leases with stipulation of no surface occupancy within the ROW area. Upon designation, SEZs should be classified as no-surface-occupancy areas for oil and gas and geothermal leasing.
- Transmission lines should be located to avoid conflicts with mining activities in areas with active mineral development.

## WIND ENERGY DEVELOPMENT

The potential for impacts to geologic resources and soils would occur primarily during construction and decommissioning. The following BMPs could reduce impacts:

- The size of disturbed land should be minimized as much as possible. Existing roads and borrow pits should be used as much as possible.
- Topsoil removed during construction should be salvaged and reapplied during reclamation. Disturbed soils should be reclaimed as quickly as possible or protective covers should be applied.
- Erosion controls that comply with county, state, and federal standards should be applied. Practices such as jute netting, silt fences, and check dams should be applied near disturbed areas.
- On-site surface runoff control features should be designed to minimize the potential for increased localized soil erosion. Drainage ditches should be constructed where necessary but held to a minimum. Potential soil erosion should be controlled at culvert outlets with appropriate structures. Catch basins, drainage ditches, and culverts should be cleaned and maintained regularly.
- Borrow material should be obtained only from authorized and permitted sites.
- Access roads should be located to follow natural contours of the topography and minimize side hill cuts.
- Foundations and trenches should be backfilled with originally excavated materials as much as possible. Excavation material should be disposed of only in approved areas to

control soil erosion and to minimize leaching of hazardous constituents. If suitable, excess excavation materials may be stockpiled for use in reclamation activities.

# I-B9: TRAFFIC AND TRANSPORTATION ROADS

## BEST MANAGEMENT PRACTICES

### COMMON TO ALL

- A traffic management plan should be prepared for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan should incorporate measures such as informational signs, flaggers when equipment may result in blocked throughways, and traffic cones to identify any necessary changes in temporary lane configuration. Signs should be placed along roads to identify speed limits, travel restrictions, and other standard traffic control information. To minimize impacts on local commuters, consideration should be given to limiting construction vehicles traveling on public roadways during the morning and late afternoon commute time.

### GEOTHERMAL ENERGY DEVELOPMENT

- Operators will consult with local planning authorities regarding increased traffic prior to the construction phase, including an assessment of the number of vehicles per day, their size, and type. Specific issues of concern (e.g., location of school bus routes and stops) will be identified and addressed in the traffic management plan.
- To plan for efficient use of the land, necessary infrastructure will be consolidated wherever possible.
- Existing roads and pad sites will be used to the maximum extent feasible, but only if located in a safe and environmentally sound location. No new roads and pad sites will be constructed without agency authorization. If new roads and pad sites have been authorized, they will be designed and constructed by the operator to the appropriate agency standard, no higher than necessary to accommodate their intended function. Roads and pad sites will be routinely maintained by the operator maintain public safety and to minimize impacts to the environment such as erosion, sedimentation, fugitive dust, loss of vegetation.
- An access road siting and management plan will be prepared incorporating existing Agency standards regarding road design, construction, and maintenance such as those described in the BLM 9113 Manual and the *Surface Operating Standards for Oil and Gas Exploration and Development* (i.e., the Gold Book, 4th Edition, 2007).
- Where possible, access roads will be located to follow natural contours and minimize side hill cuts and fills. Excessive grades on roads, road embankments, ditches, and drainages shall be avoided, especially in areas with erodible soils.
- Roads will be designed so that changes to surface water runoff are minimized and new erosion is not initiated.

- Access roads will be located to minimize stream crossings. All structures crossing streams will be located and constructed so that they do not decrease channel stability or increase water velocity. Operators will obtain all applicable federal and state water crossing permits.
- Roads will be located away from drainage bottoms and avoid wetlands, if practicable.
- Traffic will be restricted to the roads developed for the project. Use of other unimproved roads will be restricted to emergency situations.
- Signs will be placed along roads to identify speed limits, travel restrictions, and other standard traffic control information. Signs directing vehicles to alternative park access and parking will be posted in the event construction temporarily obstructs recreational parking areas near trailheads. Whenever active work is being performed, the area will be posted with "construction ahead" signs on any adjacent access roads or trails that might be affected.
- Project personnel and contractors will be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and fugitive dust.
- When practical, construction activities will be avoided during high recreational use periods.
- The operator will obtain agency authorization prior to borrowing soil or rock material from agency lands.
- Road use will be restricted during the wet season if road surfacing is not adequate to prevent soil displacement, rutting, etc., and resultant stream sedimentation.
- Access roads and on-site roads will be surfaced with aggregate materials where necessary to provide a stable road surface, support anticipated traffic, reduce fugitive dust, and prevent erosion,
- Dust abatement techniques will be used before and during surface clearing, excavation, or blasting activities. Dust abatement techniques will be used on unpaved, unvegetated surfaces to minimize fugitive dust. Speed limits (e.g., 25 mph [40 kph]) will be posted and enforced to reduce fugitive dust. Construction materials and stockpiled soils will be covered if they are a source of fugitive dust.
- Culvert outlets will be rip-rapped to dissipate water energy at the outlet and reduce erosion. Catch basins, roadway ditches, and culverts will be cleaned and maintained regularly.

## SOLAR ENERGY DEVELOPMENT

Depending on site-specific characteristics, a number of BMPs may be required for transportation impacts. Appropriate measures should be determined during the siting and design phase through the development of a Transportation Plan and a Traffic Management Plan. Measures appropriate to implement include the following:

- Easements could be required for public roadway corridors through a site to maintain proper traffic flows and retain more direct routing for the local population.
- To mitigate impacts related to the daily commutes of construction workers, the operator may be required to implement local road improvements, provide multiple site access locations and routes, stagger work schedules for different work functions (e.g., site preparation, array foundation installation, array assembly, and electrical connections), shift work hours to facilitate off-peak commuting times to minimize impact on local commuters, and/or implement a ride-sharing or shuttle program.
- To reduce hazards for incoming and outgoing traffic, as well as to expedite traffic flow, the operator may be required to implement traffic control measures, such as intersection realignment coupled with speed limit reduction; the installation of traffic lights and/or other signage; and the addition of acceleration, deceleration, and turn lanes on routes with site entrances. These types of measures can be considered during the siting and design phase through development of the following plans:
    - Transportation Plan, particularly for oversized or overweight components specific to a solar energy development (STGs). The plan should consider component sizes, weights, origin, destination, and unique handling requirements. It should also evaluate alternate transportation approaches (barge, rail).

## WIND ENERGY DEVELOPMENT

Potential impacts from transportation activities related to site monitoring and testing, construction, operation, and decommissioning of typical wind energy development projects are expected to be low, provided appropriate planning and implementation actions are taken. The following measures to mitigate transportation impacts address the expected major activities associated with future wind energy development projects and general safety standards.

- Existing BLM standards regarding road design, construction, and maintenance are described in the BLM Manual 9113 (BLM 1985) and the Gold Book (RMRCC 1989). An access road siting and management plan should be prepared incorporating these standards, as appropriate. Generally, roads should be required to follow natural contours; be constructed in accordance with standards as described in BLM Manual 9113; and be reclaimed to BLM standards. As described in BLM Manual 9113, BLM roads should be designed to an appropriate standard no higher than necessary to accommodate their intended functions.

- Existing roads should be used to the maximum extent possible, but only if in safe and environmentally sound locations. If new access roads are necessary, they should be designed and constructed to the appropriate standard no higher than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles). Abandoned roads and roads that are no longer needed should be recontoured and revegetated.

- A transportation plan should be developed, particularly for the transport of turbine components, main assembly cranes, and other large pieces of equipment. The plan should consider specific object sizes, weights, origin, destination, and unique handling requirements and should evaluate alternative transportation approaches (e.g., barge or rail). In addition, the process to be used to comply with unique state requirements and to obtain all necessary permits should be clearly identified.

- Project personnel and contractors should be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow.
- During construction and operation, traffic should be restricted to the roads developed for the project. Use of other unimproved roads should be restricted to emergency situations.

# I-B10: AVIATION

## BEST MANAGEMENT PRACTICES

---

### SOLAR ENERGY DEVELOPMENT

- Decisions regarding the location of solar facilities and transmission facilities near or within MTRs or adjacent to military or civilian airports should be coordinated with military and civilian airspace managers very early in the processing of solar project applications, in order to identify and mitigate potential impacts on military and civilian airport and airspace use.
- The FAA shall be contacted early in the process of considering a solar energy project application to determine if there might be any potential impacts on aviation and if any mitigation might be required to protect military or civilian aviation use.
- As part of the evaluation of impacts from the development of solar energy facilities, their potential for impacting the operation of existing military installations, either because they displace species onto an installation or because they increase the significance of special status species populations on the installation, should be included as part of the environmental impact analysis of the solar energy project.

# I-B11: VISUAL RESOURCES

## BEST MANAGEMENT PRACTICES

---

## COMMON TO ALL

- Project developers should exhaust opportunities to minimize visual dominance of projects by siting projects outside the viewsheds of KOPs, or by siting them as far away as possible, diminishing dominance by maximizing visible separation with distance.
- Facility siting should incorporate measures to minimize the profile of all facility-related structures to reduce visibility and visual dominance within the viewshed, particularly for facilities proposed within the foreground/ middle ground distance zone (0 to 5 mi [0 to 8 km]) of sensitive viewing locations with extended viewing opportunities and/or moving viewpoints, including, but not limited to National Scenic Byways, All-American Roads, State Scenic Byways and BLM Backcountry Byways, SRMAs, trails, residential areas, etc.
    - Construct low-profile structures whenever possible to reduce structure visibility.
    - Select and design materials and surface treatments to repeat or blend with landscape elements.
    - Site projects outside of the viewsheds of publically accessible vantage points, or if this cannot be avoided, as far away as possible;
    - Site projects to take advantage of both topography and vegetation as screening devices to restrict views of projects from visually sensitive areas;
    - Site facilities away from and not adjacent to prominent landscape features (e.g., knobs and water features);
    - Avoid placing facilities on ridgelines, summits, or other locations such that they will be silhouetted against the sky from important viewing locations;
    - Collocate facilities to the extent possible to use existing and shared rights-of-way, existing and shared access and maintenance roads, and other infrastructure to reduce visual they do not bisect ridge tops or run down the center of valley bottoms.
    - Select colors that would reduce the visual impact. Non-reflective paint and coatings should be applied to the exterior of the structures.

## GEOTHERMAL ENERGY DEVELOPMENT

- When any ROW application includes remnants of a National Historic Trail, is located within the viewshed of a National Historic Trail's designated centerline, or includes or is within the viewshed of a trail eligible for listing on the NRHP, the operator will evaluate the potential visual impacts to the trail associated with the proposed project and identify appropriate BMPs for inclusion in the operation plan.

- Site linear features (aboveground pipelines, rights-of-way, and roads) to follow natural land contours rather than straight lines (particularly up slopes) when possible. Fall-line cuts should be avoided.
- Site facilities, especially linear facilities, to take advantage of natural topographic breaks (i.e., pronounced changes in slope) to avoid siting facilities on steep side slopes.
- Where available, site linear features such as rights-of-ways and roads to follow the edges of clearings (where they will be less conspicuous) rather than passing through the centers of clearings.
- Site facilities to take advantage of existing clearings to reduce vegetation clearing and ground disturbance, where possible.
- Site linear features (e.g., trails, roads, rivers) to cross other linear features at right angles whenever possible to minimize viewing area and duration.
- Site and design structures and roads to minimize and balance cuts and fills and to preserve existing rocks, vegetation, and drainage patterns to the maximum extent possible.
- Paint grouped structures the same color to reduce visual complexity and color contrast.
- Design and install efficient facility lighting so that the minimum amount of lighting required for safety and security is provided but not exceeded and so that upward light scattering (light pollution) is minimized. This may include, for example, installing shrouds to minimize light from straying off-site, properly directing light to only illuminate necessary areas, and installing motion sensors to only illuminate areas when necessary.
- Site construction staging areas and laydown areas outside of the viewsheds of publically accessible vantage points and visually sensitive areas, where possible, including siting in swales, around bends, and behind ridges and vegetative screens.
- Discuss visual impact mitigation objectives and activities with equipment operators prior to commencement of construction activities.
- Mulch or scatter slash from vegetation removal and spread it to cover fresh soil disturbances or, if not possible, bury or compost slash.
- If slash piles are necessary, stage them out of sight of sensitive viewing areas.
- Avoid installing gravel and pavement where possible to reduce color and texture contrasts with existing landscape.
- Use excess fill to fill uphill-side swales resulting from road construction in order to reduce unnatural-appearing slope interruption and to reduce fill piles.
- Avoid downslope wasting of excess fill material.
- Round road-cut slopes, vary cut and fill pitch to reduce contrasts in form and line, and vary slope to preserve specimen trees and nonhazardous rock outcroppings.
- Leave planting pockets on slopes where feasible.

- Combine methods of re-establishing native vegetation through seeding, planting of nursery stock, transplanting of local vegetation within the proposed disturbance areas and staging of construction enabling direct transplanting.
- Revegetate with native vegetation establishing a composition consistent with the form, line, color, and texture of the surrounding undisturbed landscape."
- Provide benches in rock cuts to accent natural strata.
- Use split-face rock blasting to minimize unnatural form and texture resulting from blasting.
- Segregate topsoil from cut and fill activities and spread it on freshly disturbed areas to reduce color contrast and to aid rapid revegetation.
- Bury utility cables in or adjacent to the road where feasible.
- Minimize signage and paint or coat reverse sides of signs and mounts to reduce color contrast with existing landscape.
- Prohibit trash burning; store trash in containers to be hauled off-site for disposal.
- Undertake interim restoration during the operating life of the project as soon as possible after disturbances. During road maintenance activities, avoid blading existing forbs and grasses in ditches and along roads.
- Randomly scarify cut slopes to reduce texture contrast with existing landscape and to aid in revegetation.
- Cover disturbed areas with stockpiled topsoil or mulch, and revegetate with a mix of native species selected for visual compatibility with existing vegetation.
- Restore rocks, brush, and natural debris whenever possible to approximate preexisting visual conditions.

## SOLAR ENERGY DEVELOPMENT

The nature, extent, and magnitude of visual impacts from utility-scale solar facilities will vary on a site-specific basis and depend on the specific phase of the project (e.g., construction or operation). Similarly, visual impact BMPs will vary on a site-specific basis and depend on the specific phase of the project.

The BLM and DOI, as well as other federal agencies such as the USFS, have established BMPs for visual impacts of energy production, transmission, roads, and other forms of development on federal lands of the western United States. Several of their publications (BLM 1984, 1985, 1986a,b, 1992, 2006b, 2008b; DOI and USDA 2006; USFS 1975, 1977, 2001) were the primary sources for the BMPs listed in this section. Additional BMPs were identified in Stirling Energy Systems' Application for Certification, submitted to the BLM (SES Solar Two, LLC 2008). These publications describe additional BMPs and provide related information. This section presents potential BMPs applicable to utility-scale solar energy projects and associated electricity transmission projects and potential BMPs specific to electricity transmission projects. Solar energy development and related activities proposed on BLM-administered lands and connected actions should abide by VRM policies and procedures defined in Visual Resource

Management Manual M-8400 and handbooks, Visual Resource Inventory H- 8410-1, and Visual Resource Contrast Rating H-8431-1. Other policy requirements and clarifications are available in Instructional Memorandums 98-164 and 2009-167 (BLM 1998, 2009b).

## Siting and Design

The greatest potential for visual impact mitigation associated with a utility-scale solar energy project and associated electricity transmission facilities occurs as a result of decisions made during the siting and design of the project. Visual impacts can be substantially reduced or avoided by careful project siting.

The BLM RMPs designate VRM Classes I IV, which establish objectives for managing allowable levels of visual change to the landscape. Solar development and related activities are required to meet the VRM Class objectives. Project developers should consult the VRM Class designations and associated management objectives during the early phases of project planning, including those related to project due diligence, site selection, planning, and design. It is the developer's responsibility to conduct an early investigation into the respective project's compatibility with the VRM Class objectives, and the potential that these objectives can be met by applying thoughtful and creative design principles. Project developers should document and demonstrate how the visual management objectives were factored into the various phases of project planning and decision rationale.

The BLM Visual Resource Inventory (VRI) class values, including those for Scenic Quality, Sensitivity, and Distance Zones, should also be factored into the project planning, design, and decision making. Project developers should demonstrate how the visual values influence project design and document how impacts on these values are minimized through consideration for the proposed project location and its relationship to the surrounding viewshed. This information should be included as a part of the critical due diligence information considered when determining and selecting solar development sites and ROW boundaries. ROW location, size, and boundary determinations should consider terrain characteristics and opportunities for full or partial project concealment by recessing the project into the landscape terrain. Project developers should consult with the BLM in the early phases of project planning to help determine the proposed project's potential conformance to the applicable RMP's VRM Class designation and other potential constraints, thus avoiding costly unforeseen planning implications and re-design.

A qualified and licensed professional landscape architect with demonstrated experience with the BLM's VRM policies and procedures should be a part of the developer's and the BLM's respective planning teams evaluating visual resource issues as project siting options are considered. The visual issues should be addressed throughout the planning and design process and the final project plans should reflect intended methods for mitigating visual impacts.

The appropriate BLM field office and locally based public should be consulted to provide input on identifying important visual resources in the project area and on the siting and design process. The public should be involved and informed about the visual site design elements of the proposed solar energy facilities. Possible approaches include conducting public forums for disseminating information, offering organized tours of operating solar energy development projects, and using computer and visualization simulations in public presentations.

Project developers should also consult on viewshed protection objectives and practices with the respective land management agencies that have been assigned administrative responsibility for landscapes having special designations, such as Wilderness Areas, National Scenic and Historic Trails, Wild and Scenic Rivers, etc., and National Parks and National Wildlife Refuges located within the project's viewshed. Developers should demonstrate a concerted effort to reconcile conflicts while recognizing that the BLM retains authority for final decisions determining project approval and conditions.

The following are specific to National Historic Trails, but possibly pertain to other specially designated lands, such as Wild and Scenic Rivers, Wilderness Areas, National Parks, and National Wildlife Refuges:

- For applications that include artifacts and remnants of a National Historic Trail, are located within the viewshed of a National Historic Trail's designated centerline, or include or are within the viewshed of a trail eligible for listing on the *National Register of Historic Places* (NRHP) by virtue of its important historical or cultural values and integrity of setting, the applicant should evaluate the potential visual impacts on the trail associated with the proposed project; minimize, avoid, or mitigate adverse effects through the Section 106 consultation process; and identify appropriate BMPs for inclusion as stipulations in the Plan of Development (POD). This requirement does not supersede or amend National Historic Trails requirements cited in other sections, but is in addition to and supportive of them.
- Because the landscape setting observed from units of the National Park system, national historic sites, national trails, and Tribal cultural resources may be a part of the historic context contributing to the historic significance of the site or trail, project siting should avoid locating facilities that would alter the visual setting in a way that would reduce the historic significance or function, even if compliant with VRM objectives. This requirement does not supersede or amend national historic sites, national trails, and Tribal cultural resources requirements cited in other sections, but is in addition to and supportive of them.

Project developers should obtain engineering-design-quality topographical data and use digital terrain-mapping tools at a landscape-viewshed scale for project location selection, site planning and design, visual impact analysis, and visual impact mitigation planning and design. Visual mitigation planning and design should be performed through field assessments, applied global positioning system (GPS) technology, photo documentation, use of computer-aided design and development software, three-dimensional GIS modeling software, and imaging software to depict visual simulations to reflect a full range of visual resource BMPs. The digital terrain-mapping tools should be applied at a resolution and contour interval suitable for site design and accurate placement of proposed developments into the digital viewshed. Visual simulations should be prepared and evaluated in accordance with *Visual Resource Contrast Rating* in BLM Handbook H-8431-1 (BLM 1986b) and other agency directives, to create spatially accurate depictions of the appearance of proposed facilities. Simulations should depict proposed project facilities from key observation points (KOPs) and other visual resource sensitive locations.

The siting and design of solar facilities, structures, roads, and other project elements should explore and document design considerations for repeating the natural form, line, color, and texture of the existing landscape in accordance and compliance with the VRM class objectives.

The full range of visual BMPs should be considered, and plans should incorporate all pertinent BMPs. Visual resource monitoring and compliance strategies should be included as a part of the project mitigation plans to cover the construction, operation, and decommissioning phases.

Conformance with VRM objectives should be determined through the use of the BLM contrast rating procedures defined in *Visual Resource Contrast Rating* in BLM Handbook H-8431-1 (BLM 1986b). Visual contrast rating mitigation of visual impacts should abide by the requirements outlined in the handbook and other BLM directives. Plans for facilities determined not to be in conformance with VRM objectives should not be approved or should be redesigned in order to meet the VRM objectives, and updated visual simulations should be prepared. Revised project plans and simulations should be re-evaluated using the Contrast Rating procedures and repeated until the proposed action is found to be in conformance.

KOPs should be selected by first determining the extent of the viewshed by using the viewshed modeling tools previously cited. The viewshed modeling should illustrate the areas from where proposed facilities may be seen out to 25 mi (40 km)—line-of-sight measured from the top elevations of facilities out to 5.5 ft (1.7 m) above the ground terrain. From within the areas, KOPs would then be selected at places where people would be expected—at roads, trails, campgrounds, recreationally active river corridors, residential areas, etc. For the purpose of conducting a visual contrast rating evaluation, the number of KOPs would be reduced to those that serve as the best representations for demonstrating conformance to the respective VRM class objectives. The BLM must approve KOP selections, and the BLM reserves the right to require additional KOPs to further determine the extent of visual impact and conformance to VRM class objectives.

Visual design elements should be integrated into the construction plans, details, shop drawings and specifications; these should include, but not limited to, grubbing and clearing, vegetation thinning and clearing, grading, revegetation, drainage, and structural plans. Visual design elements within the plans should be measureable and monitored while under construction, while operational, and when decommissioned. The plans should include a monitoring and compliance plan that establishes the monitoring requirements and thresholds for acceptable performance. The contrast rating procedures should also be integrated as field-measuring compliance tools during operation and after decommissioning.

The following specific project siting measures can help reduce visual impacts of solar energy development projects and associated, but independent facilities. Project planning and designs should demonstrate the relevance and application of all BLM visual BMPs to the specific project, including, but not limited the following considerations.

## Viewshed-Based Site Selection and Siting

- Project developers should exhaust opportunities to minimize visual dominance of projects by siting projects outside the viewsheds of KOPs, or by siting them as far away as possible, diminishing dominance by maximizing visible separation with distance.
- Locating of facilities near visually prominent landscape features (e.g., knobs and waterfalls) that naturally draws an observer’s attention should be avoided.
- Visual “skylining” should be avoided by placing structures, transmission lines, and other facilities away from ridgelines, summits, or other locations where they would silhouette

against the sky from important viewing locations. Siting should take advantage of opportunities to use topography as a backdrop for views of facilities and structures to avoid skylining. Alternatives should be evaluated, and the least visually intrusive option should be selected when linear facilities (e.g., transmission lines) cross over ridgelines.

- Siting of linear features (e.g., ROWs and roads) should follow natural land contours rather than straight lines, particularly up slopes. Fall-line cuts should be avoided. Following natural contours echoes the lines found in the natural landscape and often reduces cut-and-fill requirements; straight lines can introduce conspicuous linear contrasts that appear unnatural.
- Linear developments (e.g., transmission lines, pipelines, and roads) should follow the edges of natural clearings or natural lines of transition between vegetation type, topography, etc. (where they would be less conspicuous), rather than passing through the center of clearings.

## Reduction of Surface Disturbance, Grading and Edge Treatments

- In visually sensitive areas, air transport capability shall be used to mobilize equipment and materials for clearing, grading, and erecting transmission towers, thereby preserving the natural landscape conditions between tower locations and reducing the need for permanent and/or temporary access roads.
- Vegetation and ground disturbance should be minimized and take advantage of existing clearings.
- Structures and roads should be designed and located to minimize and balance cuts and fills. Retaining walls, binwalls, half bridges, and tunnels should be used to reduce cut-and-fill.
- Road-cut slopes should be rounded, and the cut-and-fill pitch should be varied to reduce contrasts in form and line; the slope should be varied to preserve specimen trees and nonhazardous rock outcroppings.
- Natural or previously excavated bedrock landforms should be sculpted and shaped when excavation of these landforms is required. Percent backslope, benches and vertical variations should be integrated into a final landform that repeats the natural shapes, forms, textures, and lines of the surrounding landscape. The earthen landform should be integrated and transitioned into the excavated bedrock landform. Sculpted rock face angles, bench formations, and backslopes need to adhere to the natural bedding planes of the natural bedrock geology. Half-case drill traces from presplit blasting should not remain evident in the final rock face. The color contrast from the excavated rock faces should be removed by color treating with a rock stain. Native vegetation (where feasible), or a mix of native and non-native species (if necessary to ensure successful revegetation) should be re-established with the benches and cavities created within the created bedrock formation.

- Where screening topography and vegetation are absent or minimal, natural looking earthwork landforms, vegetative, or architectural screening should be used to minimize visual impacts. The shape and height of earthwork landforms must be adapted to the surrounding landscape, and must consider distance and viewing angle from KOPs in order to ensure that the earthworks are visually unobtrusive.
- Openings in vegetation for facilities, structures, roads, etc., should be feathered and shaped to repeat the size, shape, and characteristics of naturally occurring openings.
- Topsoil from the site should be stripped, stockpiled, and stabilized before excavating earth for facility construction.
- All electrical collector lines and pipelines should be buried in a manner that minimizes additional surface disturbance (e.g., along roads or other paths of surface disturbance).

## Building and Structural Materials

Visual impacts associated with solar energy and electricity transmission projects should be mitigated by choosing appropriate building and structural materials and surface treatments (i.e., paints or coatings designed to reduce contrast and reflectivity). A careful study of the site should be performed to identify appropriate colors and textures for materials; both summer and winter appearance should be considered as well as seasons of peak visitor use. Massing and scale of structures and the architectural character appropriate to the region where a solar facility is to be located should be considered (USFS 2001). Architectural character considerations should include integration of vertical and horizontal relief variation to create shadow lines that diminish the overall visual scale and dominance of facilities. The choice of colors should be based on the appearance at typical viewing distances and consider the entire landscape around the proposed development. Appropriate colors for smooth surfaces often need to be two to three shades darker than the background color to compensate for shadows that darken most textured natural surfaces. The BLM Standard Environmental Color Chart CC-001 and guidance should be referenced when selecting colors (BLM 2008d).

Specific BMPs include the following:

- Solar panel backs should be color-treated to reduce visual contrast with the landscape setting.
- Solar towers should be color-treated to reduce visual contrast.
- Materials, coatings, or paints having little or no reflectivity should be used whenever possible.
- Grouped structures should all be painted the same color to reduce visual complexity and color contrast.
- Multiple color camouflage technology applications should be considered for projects within sensitive viewsheds and with visibility distance between 0.25 and 2 mi (0.40 and 3.20 km). BLM guidance on the use of color to mitigate visual impacts should be consulted (BLM 2008d).
- Aboveground pipelines should be painted or coated to match their surroundings.

- Consideration should be given to the appropriate choice of monopoles vs. lattice towers for a given landscape setting. Monopoles may reduce visual impacts more effectively than lattice towers in foreground and midground views within built or partially built environments, while lattice towers tend to be more appropriate for less-developed rural landscapes where the latticework would be more transparent against background textures and colors.

## Glint and Glare

- Solar facilities should be sited and designed properly to eliminate glint and glare effects on roadway users, nearby residences, commercial areas, or other highly sensitive viewing locations, or to reduce them to the lowest achievable levels. Regardless of the solar technology proposed, a study to accurately assess and quantify potential glint and glare effects and to determine the potential health, safety, and visual impacts associated with glint and glare should be conducted. The assessment should be conducted by qualified individuals using appropriate and commonly accepted software and procedures. The assessment results must be made available to the BLM in advance of project approval. If the project design is changed during the siting and design process such that substantial changes to glint and glare effects may occur, glint and glare effects should be recalculated, and the study results made available to BLM.
- Mirrors/heliostats should be deployed and operated to avoid high-intensity light (glare) being reflected toward off-site ground receptors. Where off-site glare is unavoidable and project site/off-site spatial relationships favor effective results, fencing with privacy slats or similar screening materials should be employed.
- Electricity transmission-distribution projects should utilize nonspecular conductors and nonreflective coatings on insulators.

## Night-Sky Protection

- A lighting plan should be prepared that documents how lighting will be designed and installed to minimize night-sky impacts during facility construction and operations. Lighting for facilities should not exceed the minimum number of lights and brightness required for safety and security, and should not cause excessive reflected glare. Low-pressure sodium light sources should be used to reduce light pollution. Full cut-off luminaires should be used to minimize uplighting. Lights should be directed downward or toward the area to be illuminated. Light fixtures should not spill light beyond the project boundary. Lights in highly illuminated areas that are not occupied on a continuous basis should have switches, timer switches, or motion detectors so that the lights operate only when the area is occupied. Where feasible, vehicle mounted lights should be used for night maintenance activities. Wherever feasible, consistent with safety and security, lighting should be kept off when not in use. The lighting plan should include a process for promptly addressing and mitigating complaints about potential lighting impacts.

- To minimize night-sky impacts from hazard navigation lighting associated with solar facilities, the applicant should use AVWS technology for any structures exceeding 200 ft (61 m) in height. If the FAA denies a permit for use of AVWS, the applicant should limit lighting to the minimum required to meet FAA safety requirements. The use of red or white strobe lights should be prohibited unless the BLM approves its use, because of conflicting mitigation requirements.
- The use of signs and project construction signs should be minimized. Necessary signs should be made of non-glare materials and utilize unobtrusive colors. The reverse sides of signs and mounts should be painted or coated using the most suitable color selected from the BLM Standard Environmental Color Chart (BLM 2008d) to reduce color contrasts with the existing landscape; however, placement and design of any signs required by safety regulations must conform to regulatory requirements.
- Commercial symbols or signs and associated lighting on buildings or other structures should be prohibited.

## General Multiphase Measures

- "Good housekeeping" procedures should be developed to ensure that the site is kept clean of debris, garbage, fugitive trash or waste, and graffiti; to prohibit scrap heaps and dumps; and to minimize storage yards. BMPs for effective waste management should be employed.

## Construction

A pre-construction meeting with BLM landscape architects or other designated visual/scenic resource specialists should be held before construction begins to coordinate on the VRM mitigation strategy and confirm the compliance-checking schedule and procedures. Final design and construction documents will be reviewed for completeness with regard to the visual mitigation elements, assuring that requirements and commitments are adequately addressed. The construction documents should include, but not be limited to grading, drainage, revegetation, vegetation clearing, and feathering plans, and they must demonstrate how VRM objectives will be met, monitored, and measured for conformance.

Project developers should integrate interim/final reclamation VRM mitigation elements early in the construction process; these may include treatments such as thinning and feathering vegetation along project edges, enhanced contour grading, salvaging landscape materials from within construction areas, special revegetation requirements, etc. Developers should coordinate with BLM in advance to have BLM landscape architects or other designated visual/scenic resource specialists on-site during construction to work on implementing visual resource requirements and BMPs.

Visual impacts associated with construction activities can be partially mitigated by implementing the following BMPs, where feasible:

- Project developers should reduce visual impacts during construction by clearly delineating construction boundaries and minimizing areas of surface disturbance;

preserving existing, native vegetation to the greatest extent possible; utilizing undulating surface-disturbance edges; stripping, salvaging, and replacing topsoil; using contoured grading; controlling erosion; using dust suppression techniques; and restoring exposed soils to their original contour and vegetation.

- A Decommissioning and Site Reclamation Plan should be in place prior to construction. Reclamation of the construction site should begin immediately after construction to reduce the likelihood of visual contrasts associated with erosion and invasive weed infestation and to reduce the visibility of temporarily disturbed areas as quickly as possible.
- Visual impact mitigation objectives and activities should be discussed with equipment operators before construction activities begin.
- Existing rocks, vegetation, and drainage patterns should be preserved to the maximum extent possible.
- Brush-beating or mowing or using protective surface matting rather than removing vegetation should be employed where feasible.
- Slash from vegetation removal should be mulched and spread to cover fresh soil disturbances as part of the revegetation plan. Slash piles should not be left in sensitive viewing areas.
- All areas of disturbed soil should be reclaimed by using weed-free native grasses, forbs, and shrubs representative of the surrounding and intact native vegetation composition and/or using non-native species, if necessary to ensure successful revegetation.
- The visual color contrast of graveled surfaces should be reduced with approved color treatment practices.
- Horizontal and vertical pipeline bending should be used in place of cut-and fill activities where feasible.
- Road-cut slopes should be rounded, and the cut-and-fill pitch should be varied to reduce contrasts in form and line. The slope should be varied to preserve specimen trees and nonhazardous rock outcroppings.
- Topsoil from cut-and-fill activities should be segregated and spread on freshly disturbed areas to reduce color contrast and aid rapid revegetation. Topsoil piles should not be left in sensitive viewing areas.
- Excess fill material should not be disposed of downslope to avoid creating color contrast with existing vegetation and soils.
- Excess cut-and-fill materials should be hauled in or out to minimize ground disturbance and impacts from fill piles.
- Natural or previously excavated bedrock landforms should be sculpted and shaped when excavation of these landforms is required, and landforms should conform to the requirements listed and further described under Section A.2.2.13.1, Siting and Design. Half-case drill traces from presplit blasting should not remain evident in the final rock face. The color contrast from the excavated rock faces should be removed by color-

treating with a rock stain. Native vegetation (where feasible, or a mix of native and non-native species if necessary to ensure successful revegetation) should be re-established with the benches and cavities created within the created bedrock formation.

- Communication and other local utility cables should be buried where feasible.
- Culvert ends should be painted or coated to reduce color contrasts with the existing landscape.
- No paint or permanent discoloring agents should be applied to rocks or vegetation to indicate surveyor construction activity limits.
- All stakes and flagging should be removed from the construction area and disposed of in an approved facility.

## Operations

Terms and conditions for VRM mitigation compliance should be maintained and monitored for compliance with visual objectives, adaptive management adjustments, and modifications as necessary and approved by the BLM landscape architect or other designated visual/scenic resource specialist.

Visual impacts associated with operation and maintenance activities could be partially mitigated by implementing the following measures, where applicable:

- The project developer should maintain revegetated surfaces until a self-sustaining stand of vegetation is re-established and visually adapted to the undisturbed surrounding vegetation. No new disturbance should be created during operations without completion of a VRM analysis and approval by the authorized officer.
- Interim restoration should be undertaken during the operating life of the project as soon as possible after disturbances.
- Maintenance activities should include dust abatement (in arid environments) and noxious weed control.
- Road maintenance activities should avoid blading existing forbs and grasses in ditches and adjacent to roads.
- Painted facilities should be kept in good repair and repainted when color fades or flakes.
- Color-treated solar panel/mirror backs/supports should be kept in good repair, and retreated when color fades and flakes.

## Decommissioning/Reclamation

A Decommissioning and Site Reclamation Plan, covering visual impact BMPs, should be in place prior to construction, and reclamation activities should be undertaken as soon as possible after disturbances occur and be maintained throughout the life of the project. The following decommissioning/reclamation activities/practices can partially mitigate visual impacts associated with solar energy development, where feasible:

- Predevelopment visual conditions, and the inventoried visual quality rating (A, B, C) and integrity should be reviewed, and the visual elements of form, line, color, and texture should be restored to pre-development visual compatibility or to that of the surrounding landscape setting conditions, whichever achieves the better visual quality and most ecologically sound outcome.

- A Decommissioning and Site Reclamation Plan should be developed, approved by the BLM, and implemented. The plan should require that all aboveground and near-ground structures be removed. Some structures should only be removed to a level below the ground surface that will allow reclamation/restoration. Topsoil from all decommissioning activities should be salvaged and reapplied during final reclamation. The plan should include provisions for monitoring and determining compliance with the project's visual mitigation and reclamation objectives.
- Soil borrow areas, cut-and-fill slopes, berms, water bars, and other disturbed areas should be contoured to approximate naturally occurring slopes, thereby avoiding form and line contrasts with the existing landscapes. Contouring to a rough texture would trap seed and discourage off-road travel, thereby reducing associated visual impacts.
- Cut slopes should be randomly scarified and roughened to reduce texture contrasts with existing landscapes and aid in revegetation.
- A combination of seeding, planting of nursery stock, transplanting of local vegetation within the proposed disturbance areas, and staging of construction enabling direct transplanting should be considered. Where feasible, native vegetation should be used for revegetating to establish a composition consistent with the form, line, color, and texture of the surrounding undisturbed landscape.
- Stockpiled topsoil should be reapplied to disturbed areas, and the areas should be revegetated by using a mix of native species selected for visual compatibility with existing vegetation, where applicable, or by using a mix of native and non-native species if necessary to ensure successful revegetation.
- Gravel and other surface treatments should be removed or buried.
- Rocks, brush, and forest debris should be restored whenever possible to approximate pre-existing visual conditions.
- Edges of revegetated areas should be feathered to reduce form and line contrasts with the existing landscapes.
- A decommissioning VRM monitoring and compliance plan should be prepared by the operator and approved by the BLM that establishes the schedule and terms for monitoring and the conditions and methods of measurement for determining compliance.

## Use of Off-Site BMPs

- In addition to BMPs that directly reduce the visual resource impacts of solar energy and associated facilities, the off-site mitigation of visual impacts may be an option in some situations. Off-site mitigation should be considered in situations where nonconforming proposed actions may lead to changing the VRM Class objectives through an RMP amendment. Unavoidable visual impacts may then be mitigated by a correction or remediation of a nonconforming existing condition resulting from a different proposed action located within the same viewshed for impacts of approximately equal magnitude, and within the same or a more protective VRM class. The off-site mitigation serves as a means to offset and recover the loss of visual landscape integrity. For example, off-site mitigation could include reclaiming unnecessary roads, removing abandoned buildings, reclaiming abandoned mine sites, putting utility lines underground, rehabilitating and revegetating existing erosion or disturbed areas, or establishing scenic conservation easements. In situations where off-site mitigation opportunities are absent within the same viewshed, then different viewsheds that need mitigation of visual impacts because they could affect highly sensitive visual resources (e.g., along National Scenic and Historic Trails, Wild and Scenic River corridors, Scenic or Backcountry Byways, etc.) may be considered. BLM policy guidance on off-site mitigation procedures is contained in BLM Instruction Memorandum No. 2008-204, Offsite Mitigation (BLM 2008f).

## WIND ENERGY DEVELOPMENT

BMPs are a means of reducing visual impacts on public aesthetic resources. The BLM and USFS have established BMPs pertaining to visual impacts of energy production on federal lands of the western United States (BLM 1984, 1986a,b, 2004a-d; RMRCC 1989).

Additional BMPs have been derived from experiences with wind energy on several continents, particularly North America, Europe, and Australia. Useful lessons drawn from less-than-best practices in early California wind energy developments have enriched mitigation practices on other continents. North American experience in Texas and mountainous areas of the Appalachian region play a lesser role, although limited experience in Vermont, with its strong landscape protection tradition, offers informed perspective on visual impacts and mitigation. Europe offers the longest and most pervasive experience with contemporary (and ancient) wind energy development, especially with recent development in highly populated areas and with intensive social and aesthetic impacts. Australia might offer the best analog to development in the rural/remote, arid, range, and mountain lands of the western United States, but its literature does not yet provide sufficient information. Many sources were consulted in developing the following list of recommended BMPs for addressing visual impacts on BLM-administered lands (NWCC 2002; AusWEA 2002; Gipe 1998, 2002; NYSDEC 2000).

- Existing BMPs developed by the BLM regarding VRM should be followed.
- The public should be involved and informed about the visual site design elements of the proposed wind energy projects. Possible approaches include conducting public forums for disseminating information regarding wind energy development, such as design, operations, and productivity; offering organized tours of operating wind energy development projects (Gipe 2002); using computer simulation and visualization techniques in public presentations; and conducting surveys regarding public perceptions and attitudes about wind energy development.
- Turbine arrays and the turbine design should be integrated with the surrounding landscape. To accomplish this integration, several elements of design need to be incorporated.

- The operator should provide visual order and unity among clusters of turbines (visual units) to avoid visual disruptions and perceived “disorder, disarray, or clutter” (Gipe 2002).
- The operator should create visual uniformity in the shape, color, and size of rotor blades, nacelles, and towers (Gipe 1998).
- The use of tubular towers is recommended. Truss or lattice-style wind turbine towers with lacework, pyramidal, or prism shapes should be avoided. Tubular towers present a simpler profile and less complex surface characteristics and reflective/shading properties.
- Components should be in proper proportion to one another. Nacelles and towers should be planned to form an aesthetic unit and should be combined with particular sizes and shapes in mind to achieve an aesthetic balance between the rotor, nacelle, and tower (Gipe 1998).
- The operator should use nonreflective paints and coatings to reduce reflection and glare. Turbines, visible ancillary structures, and other equipment should be painted before or immediately after installation. Uncoated galvanized metallic surfaces should be avoided because they would create a stronger visual contrast, particularly as they oxidize and darken.
- Commercial messages on turbines and towers should be prohibited (Gipe 2002).

• The site design should be integrated with the surrounding landscape.
  - To the extent practicable, the operator should avoid placing substations or large operations buildings on high land features and along “skylines” that are visible from nearby sensitive viewpoints. The presence of these structures should be concealed or made less conspicuous. Conspicuous structures should be designed and constructed to harmonize with desirable or acceptable characteristics of the surrounding environment (Gipe 2002).
  - The operator should bury power collection cables or lines on the site in a manner that minimizes additional surface disturbance.
  - Commercial symbols (such as logos), trademarks, and messages should not appear on sites or ancillary structures of wind energy projects. Similarly, billboards and advertising messages should also be prohibited (Gipe 1998, 2002).
  - Site design should be accomplished to make security lights nonessential. Such lights increase the contrast between a wind energy project and the night sky, especially in rural/remote environments, where turbines would typically be installed. Where they are necessary, security lights should be extinguished except when activated by motion detectors (e.g., only around the substation) (Gipe 1998).

• Operators should minimize disturbance and control erosion by avoiding steep slopes (Gipe 1998) and by minimizing the amount of construction and ground clearing needed for roads, staging areas, and crane pads. Dust suppression techniques should be employed in arid environments to minimize impacts of vehicular and pedestrian traffic, construction, and wind on exposed surface soils. Disturbed surfaces should be restored as closely as possible to their original contour and revegetated immediately after, or contemporaneously with construction. Action should be prompt to limit erosion and to accelerate restoring the preconstruction color and texture of the landscape.

- The wind development site should be maintained during operation. Inoperative or incomplete turbines cause the misperception in viewers that "wind power does not work" or that it is unreliable. Inoperative turbines should be completely repaired, replaced, or removed. Nacelle covers and rotor nose cones should always be in place and undamaged (Gipe 1998). Wind energy projects should evidence environmental care, which would also reinforce the expectation and impression of good management for benign or clean power. Nacelles and towers should also be cleaned regularly (yearly, at minimum) to remove spilled or leaking fluids and the dirt and dust that would accumulate, especially in seeping lubricants. Facilities and off-site surrounding areas should be kept clean of debris, "fugitive" trash or waste, and graffiti. Scrap heaps and materials dumps should be prohibited and prevented. Materials storage yards, even if thought to be orderly, should be kept to an absolute minimum. Surplus, broken, disused materials and equipment of any size should not be allowed to accumulate (Gipe 2002).
- Aesthetic offsets should be considered as a mitigative option in situations where visual impacts are unavoidable or where alternative mitigation options are only partially effective or uneconomical (NYSDEC 2000, BLM 2005a). An aesthetic offset is a correction or remediation of an existing condition located in the same viewshed of the proposed development that has been determined to have a negative visual or aesthetic impact. For example, aesthetic offsets could include reclamation of unnecessary roads in the area, removal of abandoned buildings, cleanup of illegal dumps or trash, or the rehabilitation of existing erosion or disturbed areas (BLM 2005a).
- A decommissioning plan should be developed, and it should include the removal of all turbines and ancillary structures and restoration/reclamation of the site.

# I-B12: WATER SUPPLY AND QUALITY

## BEST MANAGEMENT PRACTICES

### COMMON TO ALL

- Project developers should conduct a preliminary hydrologic study demonstrating a clear understanding of the local surface water and groundwater hydrology. The primary purpose of this preliminary hydrologic study is to identify surface watersheds and groundwater basins directly affected and connected to the location of the project site, and the study will include the following information:
  - The relationship of the project site hydrologic basin to the basins in the region;
  - Identification of all surface water bodies (including rivers, streams, ephemeral washes/drainages, lakes, wetlands, playas and floodplains);
  - Identification of all applicable groundwater aquifers; and
  - Preliminary estimates of the physical characteristics of surface water features and groundwater aquifers, the connectivity of surface water

- Operators will avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities.

### GEOTHERMAL ENERGY DEVELOPMENT

- Operators will develop a storm water management plan for the site to ensure compliance with applicable regulations and prevent offsite migration of contaminated storm water or increased soil erosion.

### SOLAR ENERGY DEVELOPMENT

The main objectives of the BMPs for water resources are (1) to promote the sustainable use of water resources through appropriate technology selection and conservation practices and (2) to protect the quality of natural water bodies (including streams, wetlands, ephemeral washes, and floodplains, as well as groundwater aquifers) in and around solar energy facilities. An important aspect of implementing these measures is coordination with federal, state, and local agencies that regulate the use of water resources to meet the requirements of permits and approvals needed (1) to obtain water for development and (2) to alter the land surface. In the following subsections, potentially applicable BMPs for solar energy facilities are given, grouped by phase of development

## Siting and Designing

- All structures related to the solar energy facility should be sited in locations that minimize impacts on surface water bodies, ephemeral washes, playas, and natural drainage areas (including groundwater recharge areas).
- Project developers should plan to implement water conservation measures related to solar energy technology water needs in order to reduce project water requirements. Developers would minimize the consumptive use of fresh water for power plant cooling by, for example, using dry cooling, using recycled or impaired water, or selecting solar energy technologies that do not require cooling water.
- Project developers should plan to avoid impacts on existing surface water features, including streams, lakes, wetlands, floodplains, intermittent streams, playas, and ephemeral washes/drainages (any unavoidable impacts would be minimized), in the development and in nearby regions according to:
    - All sections of the CWA, including Sections 401, 402, and 404 addressing licensing and permitting issues;
    - E.O. 11988 and E.O. 11990 of May 24, 1977, regarding floodplain and wetland management: E.O. 11988, “Floodplain Management” (Federal Register, Volume 42, page 26951 [42 FR 26951]), and E.O. 11990, “Protection of Wetlands” (42 FR 26961);
    - EPA stormwater management guidelines (EPA 2009a) and applicable state and local stormwater management guidelines;
    - National Wild and Scenic Rivers System (Public Law 90-542; 16 United States Code [U.S.C.] 1271 et seq.); and
    - Identification of impaired surface water bodies in accordance with Section 303(d) of the CWA.
- Project developers should avoid impacts on local surface water and groundwater drinking water supplies (amounts and water quality) and develop mitigation plans in the event that local drinking water sources are contaminated or depleted by project activities.
- Mitigation plans should be developed as described in Section 5.1. A Drainage, Erosion, and Sedimentation Control Plan should be developed that ensures protection of water quality and soil resources, demonstrates no increase in off-site flooding potential, and includes provisions for stormwater and sediment retention on the project site. The plan would identify site surface water runoff patterns and develop BMPs that prevent excessive and unnatural soil deposition and erosion throughout and downslope of the project site and project-related construction areas. The plan would achieve the following:
    - Runoff from parking lots, roofs, or other impervious surfaces would be directed to retention basins prior to being released downgradient of the site;

    - Any landscaping used for stormwater treatment would require little or no irrigation and would be recessed to create retention basins/areas used to capture runoff;
    - The amount of area covered by impervious surfaces would be reduced through the use of permeable pavement or other pervious surfaces; and
    - Natural drainages and a pre-project hydrograph would be maintained for the area.
- A Stormwater Management Plan should be developed for the site to ensure compliance with applicable regulations and prevent off-site migration of contaminated stormwater, changes in pre-project storm hydrographs, or increased soil erosion.
    - Siting in identified 100-yr floodplains should not be allowed within the development.
    - Project developers should maintain the pre-development flood hydrograph for all storms up to and including the 100-yr rainfall event. All stormwater retention and/or infiltration and treatment systems should also be designed for all storms up to and including the 100-yr storm event.
- As part of a Spill Prevention and Emergency Response Plan, measures to prevent potential groundwater and surface water contamination should be identified.
- Developers should be required to conduct a detailed hydrologic study that demonstrates their clear understanding of the local surface water and groundwater hydrology. At a minimum this hydrologic study should include:
    - Quantification of physical characteristics describing surface water features, such as streamflow rates, stream cross-sections, channel routings, seasonal flow rates (intermittent streams), peak flow rates (ephemeral washes/drainages), sediment characteristics and transport rates, lake depths, and surface areas of lakes, wetlands, and floodplains;
    - Hydrologic analysis and modeling to define the 100-yr, 24-hour rainfall event for the project area and calculation of projected runoff from this storm at site;
    - Hydrologic analysis and modeling to identify 100-yr floodplain boundaries of any surface water feature on the site;
    - Quantification of physical characteristics describing the groundwater aquifer, such as physical dimensions of the aquifer, sediment characteristics, confined/unconfined conditions, hydraulic conductivity and transmissivity distribution of the aquifer, groundwater surface elevations, and groundwater flow processes (direction, recharge/discharge, surface current basin extractions, surface water/groundwater connectivity, and lag times between groundwater withdrawals and surface water depletions);
    - Quantification of the regional climate, including seasonal and long-term information on temperatures, precipitation, evaporation, and evapotranspiration; and

- Quantification of the sustainable yield of surface waters and groundwater available to the project. Project developers should evaluate the water sources in terms of existing water rights and management plans for adequacy with regard to serving project demands while maintaining aquatic, riparian, and other water-dependent resources.
- Project developers should quantify water use requirements for project construction, operation, and decommissioning.
- Water sources used for potable water supply must meet federal, state, and local water quality standards (e.g., Sections 303 and 304 of the CWA).
- Developers should identify wastewater treatment measures and new or expanded facilities, if any, to be included as part of the facility's NPDES permit.
- Developers should coordinate with state/local regulatory agencies regarding the issuance of permits or "will-serve" agreements for the development and use of water and/or the operation of on-site wastewater treatment systems.
- Project developers should coordinate with appropriate water rights agencies for securing water rights.
- Project developers should choose appropriate water sources with respect to available water rights and management practices and with respect to maintaining aquatic, riparian, and other water-dependent sources (that may vary in water requirements on a temporal basis).
- Project developers who plan to use groundwater should develop and implement a groundwater Water Resources Monitoring and Mitigation Plan, which includes monitoring the effects of groundwater withdrawal for project uses, of vegetation restoration and dust control uses during decommissioning and of aquifer recovery after project decommissioning. Monitoring frequency should be decided on a site-specific basis and in coordination with federal, state, and local agencies that manage the groundwater resources of the region.
- If groundwater use is proposed, project developers should ensure that a comprehensive analysis of the groundwater basin is provided and that the following potential significant impacts are evaluated:
    - Creation or exacerbation of overdraft conditions and their potential to cause subsidence and loss of aquifer storage capacity;
    - Use that cause injury to other water rights claims in the basin;
    - Estimates of the total cone of depression considering cumulative drawdown from all potential pumping in the basin, including the project, for the life of the project through the decommissioning phase;
    - Changes in water quality that affect other beneficial use; and
    - Effects on surface water resources such as streams, springs, seeps, and wetlands that provide water and associated habitat for plants and animals.
- Project developers who plan to use surface water sources should develop a Water Resources Monitoring and Mitigation Plan that includes monitoring changes in flows,

volumes, and water quality during construction and operations as well as their recovery during decommissioning. Monitoring frequency should be decided on a site-specific basis and in coordination with federal, state, and local agencies that manage the surface water resources of the region.

- If surface water use is proposed, project developers should ensure that a comprehensive analysis of the supply is provided and that the following potential significant impacts are evaluated:
  - Effects on other users;
  - Effects on water quality;
  - Effects on other water resources;
  - Effects on other environmental resources, including plants and animals, that directly or indirectly depend on those water sources;
  - Effects on the natural hydrograph of the supply; and
  - Effects on the reliability of the supply.

## Site Characterization and Construction

- The facility should obtain and comply with a construction stormwater permit through the EPA or state-run NPDES program (whichever applies within the state). In addition, the EPA requires that any development larger than 20 acres (0/08 km2) and begun after August 2011 must comply with a requirement to monitor construction discharges for turbidity concentrations (EPA 2009c).
- Groundwater wells constructed during any stage of the project would conform to state and local standards and records should include:
  - Legal description (township, range, section, and quarter section);
  - Project map with proposed and existing well locations;
  - Well design characteristics: casing diameter, screened interval(s), well depth, and static water level;
  - Results of groundwater pumping tests or other tests done in the well;
  - Anticipated pumping capacity and peak pumping rates;
  - Identification of the groundwater aquifer and its hydrogeologic characteristics;
  - Estimation of the potential cone of depression that might be produced by the proposed pumping throughout the lifetime of a project by using an analytical or numerical model; and
  - Estimate of the total cone of depression considering cumulative drawdown from all potential pumping in the basin, including the project, for the life of the project through the decommissioning phase (also using an analytical or numerical model).
- Construction activities should avoid land disturbance in ephemeral washes and dry lakebeds; any unavoidable disturbance would be minimized. Stormwater facilities would be designed to route flow around the facility and maintain pre-project hydrographs.

- When stream or wash crossings are constructed, culverts or water conveyances for temporary and permanent roads should be designed to comply with county standards or to accommodate the runoff of a 100-year storm, whichever is larger.
- Geotextile mats should be used to stabilize disturbed channels and stream banks (CASQA 2003).
- Earth dikes, swales, and lined ditches should be used to divert work-site runoff that would otherwise enter a disturbed stream (CASQA 2003).
- Certified weed-free straw bale barriers should be installed to control sediment in runoff water; straw bale barriers should be installed only where sediment laden water can pond, thus allowing the sediment to settle out (CASQA 2003).
- Check dams (i.e., small barriers constructed of rock, gravel bags, sandbags, fiber rolls, or reusable products) should be placed across a constructed swale or drainage ditch to reduce the velocity of flowing water, thus allowing sediment to settle and reducing erosion (CASQA 2003).
- Special construction techniques should be used, where applicable, in areas of erodible soil, alluvial fans, and stream channel/wash crossings.
- Disturbed soils should be reclaimed as quickly as possible, or protective covers should be applied.
- Topsoil removed during construction should be reused for reclamation.
- Foundations and trenches should be backfilled with originally excavated material as much as possible; excess excavated material should be disposed of according to state and federal laws.
- If drilling activities are required as part of site characterization, any drilling fluids or cuttings should be maintained so that cuttings, fluids, or runoff from storage areas will not come in contact with aquatic habitats. Temporary impoundments for storing drilling fluids and cuttings should be lined to minimize the infiltration of runoff into groundwater or surface water.
- Washing equipment or vehicles in streams and wetlands should be avoided, because doing so increases their sediment loads.
- Entry and exit pits should be constructed in work areas to trap sediments from vehicles so that they do not enter into streams at stream crossings. Prerequisites to excavating the entry and exit pits should include:
    - Locating the entry and exit pits far enough from stream banks and at a sufficient elevation to avoid inundation by storm flow stream levels and to minimize excessive migration of groundwater into the entry or exit pits;
    - Isolating the excavation for the entry and exit pits from the surface water by using silt fencing to avoid sediment transport by stormwater; and
    - Isolating the spoils storage resulting from excavation of the entry and exit pits by using silt fencing to avoid sediment transport by stormwater.

- Good waste management practices should be adopted for handling, storing, and disposing of wastes generated by a construction project to prevent the release of waste materials into stormwater discharges. Waste management includes the following: spill prevention and control, construction debris and litter management, concrete waste management, and liquid waste management.
- Any wastewater generated in association with temporary, portable sanitary facilities should be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility. Portable sanitary facilities provided for construction crews should be adequate to support expected on-site personnel.
- The creation of hydrologic conduits between two aquifers should be avoided during foundation excavation and other activities.
- If chemical dust palliatives (suppressants) are used, they should be selected and applied in accordance with considerations stated in Section 5.11.1.3.
- When an herbicide/pesticide is used to control vegetation, the climate, soil type, slope, and vegetation type should be considered in determining the risk of herbicide/pesticide contamination (BLM 2006a). In addition, a Nuisance Animal and Pest Control Plan and an Integrated Vegetation Management Plan should be developed to ensure that applications are conducted within the framework of BLM and U.S. Department of the Interior (DOI) policies and standard operating procedures and will entail only the use of EPA-registered pesticides/herbicides that also comply with state and local regulations.
- All hazardous materials and vehicle/equipment fuels should be transported, stored, managed, and disposed of in accordance with accepted BMPs and in compliance with all applicable regulations and the requirements of approved plans, including, where applicable, a Stormwater Management Plan, Spill Prevention and Emergency Response Plan, and Hazardous Materials and Waste Management Plan (see Section 5.21 for further details).
- Project developers should avoid or minimize and mitigate the degradation of water quality (e.g., chemical contamination, increased salinity, increased temperature, decreased dissolved oxygen, and increased sediment loads) that could result from construction activities. Water quality in areas adjacent to or downstream from development areas should be monitored during the life of the project to ensure that water quality is protected.

## Operations

The use of water should not contribute to the significant long-term decline of groundwater levels or surface water flows and volumes. Any project-related water use should not contribute to withdrawals that exceed the sustainable yield of the surface water or groundwater source.

Water use should be minimized by implementing conservation practices, such as treating spent wash water and storing it for reuse.

The treatment of sanitary and industrial wastewater either on-site or off-site would comply with federal, state, and local regulations. Any discharges to surface waters would require NPDES permitting. Any storage or treatment of wastewater on-site should have proper lining of holding ponds and tanks to prevent leaks.

Berms and other controls should be used at facilities to prevent off-site migration of any leaked or spilled HTF, TES fluids, or any other chemicals stored or used at the site.

Project developers should avoid or minimize and mitigate the degradation of water quality (e.g., chemical contamination, increased salinity, increased temperature, decreased dissolved oxygen, and increased sediment loads) that could result from operations. Water quality in areas adjacent to or downstream from development areas should be monitored during the life of the project to ensure that water quality is protected.

### Decommissioning/Reclamation

- All management plans, BMPs, and stipulations developed for the construction phase should be applied to similar activities during the decommissioning/reclamation phase.
- Topsoil removed during construction should be reused during reclamation.
- Groundwater- and/or surface water-monitoring activities should be as outlined in the established groundwater monitoring plan for the site (discussed above).

## WIND ENERGY DEVELOPMENT

Potential water resource impacts would mostly occur during the site construction and decommissioning phases. Mitigations measures that could reduce such impacts include:

- The size of cleared and disturbed lands should be minimized as much as possible. Existing roads and borrow pits should be used as much as possible.
- Topsoil removed during construction should be salvaged and reapplied during reclamation. Disturbed soils should be reclaimed as quickly as possible or protective covers should be applied.
- Operators should identify unstable slopes and local factors that can induce slope instability (such as groundwater conditions, precipitation, earthquake activities, slope angles, and dip angles of geologic strata). Operators also should avoid creating excessive slopes during excavation and blasting operations. Special construction techniques should be used where applicable in areas of steep slopes, erodible soil, and stream channel/wash crossings.
- Erosion controls that comply with county, state, and federal standards should be applied. Practices such as jute netting, silt fences, and check dams should be applied near disturbed areas.
- Proposed construction near aquifer recharge areas should be closely monitored to reduce the potential for contamination of said aquifer. This may require a study to determine localized aquifer recharge areas.

- Foundations and trenches should be backfilled with originally excavated material as much as possible. Excess excavated material should be disposed of only in approved areas.
- Existing drainage systems should not be altered, especially in sensitive areas such as erodible soils or steep slopes. When constructing stream or wash crossings, culverts or water conveyances for temporary and permanent roads should be designed to comply with county standards, or if there are no county standards, to accommodate the runoff of a 10-year storm. Potential soil erosion should be controlled at culvert outlets with appropriate structures. Catch basins, roadway ditches, and culverts should be cleaned and maintained regularly.
- On-site surface runoff control features should be designed to minimize the potential for increased localized soil erosion. Drainage ditches should be constructed where necessary but held to a minimum. Potential soil erosion should be controlled at culvert outlets with appropriate structures. Catch basins, drainage ditches, and culverts should be cleaned and maintained regularly.
- Pesticide use should be limited to nonpersistent, immobile pesticides and should only be applied in accordance with label and application permi directions and stipulations for terrestrial and aquatic applications.

# I-B13: LANDS AND REALTY

## BEST MANAGEMENT PRACTICES

---

### SOLAR ENERGY DEVELOPMENT

- Where there are existing BLM ROW authorizations within solar energy development areas, pursuant to Title 43, Part 2807.14 of the Code of Federal Regulations (43 CFR 2807.14), the BLM would notify ROW holders that an application that might affect their existing ROW has been filed and would request their comments. Early discussion with existing ROW holders should occur to ensure their rights are protected and any issues are resolved.
- Where a designated transmission corridor is located within the area of proposed solar energy development project, the need for future transmission capacity in the corridor should be reviewed to determine whether the corridor should be excluded from solar development or whether the capacity of the designated transmission corridor can be reduced. Partially relocating the corridor to retain the current planned capacity would also be an option to consider, as will relocating the solar project outside the designated corridor.
- Legal access to private, state, and public lands surrounding the solar facilities should be retained to avoid creating areas that are inaccessible to the public and/or that would be difficult to manage. The effect on the manageability and uses of public lands remaining around boundaries of solar energy facilities should be considered during the environmental analysis of project applications.
- Coordination with federal, state, and county agencies; Tribes; property owners; and other stakeholders should be accomplished as early as possible in the planning process to identify potentially significant land use conflicts and issues and state and local rules that govern solar energy development. Significant issues that are raised, and potential modifications to proposed projects to eliminate or mitigate these issues, should be considered in the environmental analysis of the project application.
- Consolidation of access and other supporting infrastructure should be required for single projects and for cases in which there is more than one project in close proximity to another to maximize the efficient use of public land.
- The protection and preservation of evidence of the Public Land Survey System (PLSS) and related federal property boundaries are required of project developers. Prior to commencing any action, evidence of the PLSS and related property boundaries will be marked for protection. Coordination with BLM cadastral survey staff should be accomplished to help provide data, search for and evaluate evidence, locate monuments of the PLSS and related property boundaries, and protect them from destruction. If a

proposed action is within one-quarter mile of any project boundary, a Chain of Survey Certificate, conformal to the departmental standard, must be issued. In some cases, Land Description Reviews, Certificates of Inspection and Possession, Boundary Assurance Certificates, resurveys, re-monumentation, and/or referencing of PLSS corners may be required before the start of any action.

- If a proposed action might have an adverse effect on prime and unique farmland, this possibility should be discussed in the associated environmental analysis, along with a consideration of alternatives or appropriate BMPs.
- For solar energy and related transmission facilities, the hazards associated with the heights of facilities and the glare from reflective surfaces should be evaluated through coordination with local airport operators. Proposed construction of any facility that is taller than 200 ft (61 m) must be submitted to the Federal Aviation Administration (FAA) for evaluation of safety hazards.

## WIND ENERGY DEVELOPMENT

The previous evaluations identified potential land use impacts that could be incurred during the construction, operation, and decommissioning of a wind energy facility. The nature, extent, and magnitude of these potential impacts would vary on a site-specific basis and on the specific phase of the project (e.g., construction or operation). The greatest potential for land use impacts would occur as a result of decisions made during the design and siting of the wind energy project. A variety of BMPs may be incorporated, as stipulations, into the design and development of the POD and the design of a wind energy project to reduce potential land use impacts. These measures include:

- Wind energy projects should be planned to mitigate or minimize impacts to other land uses;
- Federal and state agencies, property owners, and other stakeholders should be contacted as early as possible in the planning process to identify potentially sensitive land uses and issues, rules that govern wind energy development locally, and land use concepts specific to the region;
- The DoD should be consulted regarding the potential impact of a proposed wind energy project on military operations in order to identify and address any DoD concerns;
- The FAA-required notice of proposed construction should be made as early as possible to identify any air safety measures that would be required;
- When feasible, a wind energy project should be sited on already altered landscapes;
- To plan for efficient land use, necessary infrastructure requirements should be consolidated whenever possible, and current transmission and market access should be evaluated; and
- Restoration plans should be developed to ensure that all temporary use areas are restored.

# I-B14: SPECIAL MANAGEMENT AREAS

## BEST MANAGEMENT PRACTICES

---

### SOLAR ENERGY DEVELOPMENT

- Solar facilities should be located and designed to minimize impacts on specially designated areas and lands with wilderness characteristics.
- Protection of existing values of specially designated areas and lands with wilderness characteristics should be evaluated during the environmental analysis of solar energy project applications, and the results should be incorporated into the project planning and design to minimize off-site impacts.
- Any lands that have not been recently inventoried for wilderness characteristics or any lands that have been identified in any citizen's wilderness proposal should be inventoried for wilderness characteristics prior to any solar development action being approved within these areas.

# I-B15: RANGELAND

## BEST MANAGEMENT PRACTICES

## SOLAR ENERGY DEVELOPMENT

### Livestock and Grazing

- Contact with grazing permittees should be initiated at the earliest possible time to explore whether modifications could be made to a solar development proposal to minimize impacts on grazing use; especially impacts related to water availability, livestock improvements, access road location, and movement of livestock between pastures. Compensation for or relocation of range improvements also should be discussed. The ROW applicant and permittee/lessee should be strongly encouraged to enter into an agreement that addresses mitigation and compensation for range improvements.
- Access roads should be constructed, improved, and maintained to minimize their impact on grazing operations. Road design would include appropriate fencing, cattle guards, and signs.
- Wherever there are reductions in grazing use, opportunities for mitigating this loss through changes in livestock management or installation of range improvements should be considered.

### Wild Horses and Burros

- Activities of project developers should be coordinated with the managing agency to ensure that impacts on wild horses and burros and their management areas are minimized. Issues that would need to be addressed could include the installation of fencing and access control, provision for movement corridors, delineation of open range, traffic management (e.g., vehicle speeds), compensatory habitat restoration, and access to or development of water sources.
- Access roads should be appropriately constructed, improved, and maintained and should employ appropriate signs to minimize potential horse and burro collisions. Fences should be built (as practicable) to exclude wild horses and burros from all project facilities, including all water sites built for the development of facilities and roadways.

### Wildland Fire

- In areas susceptible to wildland fires, coordination with the managing agency and local fire organizations should be required early in the project planning process to determine BMPs that would be incorporated into the design of the project to prevent an increase in wildland fire frequency.

- A vegetation plan designed to prevent the establishment of non-native, invasive species on the solar energy facility and along transmission line ROWs and roads should be developed and implemented to minimize the potential for increasing the frequency of wildland fires.
- The ROWs for solar facilities should be large enough to ensure there is a sufficient firebreak inside the ROW, so there would be no threat to facilities from either a wildland fire approaching from outside the ROW or a fire moving from inside to outside of the ROW. This distance should be determined through coordination with fire management staff, and actions, both active and passive (e.g., vegetation manipulation) should be undertaken specifically to remove the need for protective responses, by the managing agency, state, and local fire organizations.
- The effectiveness of developing and adhering to a fire safety plan and providing worker training to reduce fire risks should be evaluated.

# I-B16: RECREATION

## BEST MANAGEMENT PRACTICES

### SOLAR ENERGY DEVELOPMENT

- Public access through or around solar facilities should be retained to permit continued use of public lands and non-BLM administered lands.
- Solar facilities should not be placed in areas of unique or important recreation resources.
- Replacement of access lost for OHV use should be considered as part of the analysis of project-specific impacts. Any process for designating a replacement route would include the consideration of the designation criteria for routes as specified in 43 CFR 8342.1, and would be consistent with existing land use plans.

# I-B17: SOCIOECONOMICS

## BEST MANAGEMENT PRACTICES

---

### SOLAR ENERGY DEVELOPMENT

The economic effects of solar energy projects can be positive, with increases in employment, income, and state tax revenues; thus, few, if any, BMPs may be necessary. On the basis of the potential magnitude of employment impacts of each solar technology, however, it is possible that the socioeconomic impacts of solar development projects, notably the impacts of in-migrating workers on local housing markets and on local government expenditures and employment, would require BMPs. A large in-migrant labor force has the potential to produce some degree of social disruption, whereby the cultural and social values of in-migrants conflict with those of the resident population, potentially creating alienation, crime, alcoholism, drug use, mental health problems, and the disruption of family life.

The following BMPs may be applicable to avoid or reduce these impacts, depending on site- and project-specific conditions.

- To address impacts on local issues, the BLM may include stipulations in the ROW authorization or require solar developers to enter into mitigation agreements with individual local jurisdictions and county agencies, as necessary.
- Project developers should collect and evaluate available information describing the socioeconomic conditions in the vicinity of the proposed project, as needed, to predict potential impacts of the project.
- If the managing agency concluded that the project is likely to have a substantial impact on the economic or social conditions of local communities, project developers should work with state, local and Tribal agencies and governments to develop community monitoring programs that would be sufficient to identify and evaluate socioeconomic impacts resulting from solar energy development. Monitoring programs should collect data reflecting the economic, fiscal, and social impacts of development at the state, local, and Tribal levels. Parameters to be evaluated could include impacts on local labor and housing markets, local consumer product prices and availability, local public services (police, fire, and public health), and educational services. Programs also could monitor indicators of social disruption (e.g., crime, alcoholism, drug use, and mental health) and the effectiveness of community welfare programs in addressing these problems.
- If the managing agency concludes that the project is likely to have a substantial impact on the economic or social conditions of local communities, the agency may include stipulations in the ROW authorization (if BLM) or require solar developers to enter into mitigation agreements with individual local jurisdictions and county agencies, as necessary, to address local issues. Also, project developers should work with state, local, and Tribal agencies to develop community outreach programs that would help

communities adjust to changes triggered by solar energy development. Such programs could include any of the following activities:

  - Establishing vocational training programs for the local workforce to promote development of skills required by the solar energy industry;

- Developing instructional materials for use in area schools to educate the local communities on the solar energy industry;
  - Supporting community health screenings; and
  - Providing financial support to local libraries for the development of information repositories on solar energy, including materials on the hazards and benefits of commercial development. Electronic repositories established by the operators could also be of great value.

## ENVIRONMENTAL JUSTICE

Mitigation of environmental justice impacts, specifically those associated with visual impacts of solar generation facilities, may be required. Mitigation of visual impacts would include the siting of facilities to minimize contrast with scenic views, the appropriate use of construction materials that minimize scenic contrast, and the avoidance of traditional and cultural sites important to low-income and minority populations. Noise and dust impacts during construction of solar facilities, particularly those associated with the construction of access roads, would be reduced by using standard mitigation methods, while noise and any EMF effects during project operation would be minimal due to the remote locations of the majority of solar facilities in each of the six states and would be unlikely to require any mitigation.

Although the environmental impacts of solar development on low-income and minority populations are likely to be small, where such environmental justice impacts occur, the developer should make a plan to implement a number of BMPs to mitigate the potential environmental, economic, cultural, and health impacts on low-income and minority populations. These BMPs may include any or all of the following:

- Focused public information campaigns could be developed and implemented to provide technical and environmental health information directly to low-income and minority groups or to local agencies and representative groups. Key information would include the extent of any likely impact on air quality, drinking water supplies, subsistence resources, public services, and the relevant preventive measures that may be taken.
- Community health screenings for low-income and minority groups.
- Financial support to local libraries in low-income and minority communities could be provided for the development of information repositories on solar energy, including materials on the hazards and benefits of commercial development.

In addition to the environmental impacts that may affect low-income and minority populations, there are various economic impacts that may require mitigation, including lack of access to construction and operations employment. BMPs might include the following:

- Vocational training for the local low-income and minority workforce could be established to promote development of skills required by the solar energy industry, and
- Instructional materials could be developed for use in area schools to educate the local communities on the solar energy industry.

The likelihood of rapid population growth following the in-migration of workers in communities with low-income and minority populations could lead to overstressing of local community social structures. Beliefs and value systems among the local population and in migrants would likely contrast and, consequently, could lead to a range of changes in social and community life, including increases in crime, alcoholism, and drug use. In anticipation of these impacts, BMPs might include the following:

- Key information could be provided to local governments and directly to low-income and minority populations on the scale and timeline of expected solar projects and on the experience of other low-income and minority communities that have followed the same energy development path. In addition, information on planning activities that may be initiated to provide local infrastructure, public services, education, and housing could be made available.

# I-B18: RECLAMATION

## BEST MANAGEMENT PRACTICES

The following objectives, performance standards, and recommended reclamation BMPs and BMPs are based on the standards and guidelines found in the BLM and Forest Service Gold Book, 4th Edition, updated in 2007. [ ] Indicates site-specific values to be filled in by the authorized officer.

## RECLAMATION OBJECTIVES

- The objective of interim reclamation is to restore vegetative cover and a portion of the landform sufficient to maintain healthy, biologically active topsoil; control erosion; and minimize habitat, visual, and forage loss during the life of the well or facilities.
- The long-term objective of final reclamation is to return the land to a condition approximating that which existed prior to disturbance. This includes restoration of the landform and natural vegetative community, hydrologic systems, visual resources, and wildlife habitats. To ensure that the long-term objective will be reached through human and natural processes, actions will be taken to ensure standards are met for site stability, visual quality, hydrological functioning, and vegetative productivity.

### Reclamation Performance Standards

The following reclamation performance standards will be met:

**Interim Reclamation** – Includes disturbed areas that may be redisturbed during operations and will be redisturbed at final reclamation to achieve restoration of the original landform and a natural vegetative community.

- Will be judged successful when the BLM authorized officer determines that…
- Disturbed areas not needed for active, long-term production operations or vehicle travel have been recontoured, protected from erosion, and revegetated with a self-sustaining, vigorous, diverse, native (or as otherwise approved) plant community sufficient to minimize visual impacts, provide forage, stabilize soils, and impede the invasion of noxious, invasive, and non-native weeds.

**Final Reclamation** – Includes disturbed areas where the original landform and a natural vegetative community have been restored.

- Will be judged successful when the authorized officer determines that…
- The original landform has been restored for all disturbed areas including well pads, production facilities, roads, pipelines, and utility corridors.
- General: A self-sustaining, vigorous, diverse, native (or otherwise approved) plant community is established on the site, with a density sufficient to control erosion and invasion by non-native plants and to reestablish wildlife habitat or forage production. At

a minimum, the established plant community will consist of species included in the seed mix and/or desirable species occurring in the surrounding natural vegetation.

- Specific: No single species will account for more than [30]% total vegetative composition unless it is evident at higher levels in the adjacent landscape. Permanent vegetative cover will be determined successful when the basal cover of desirable perennial species is at least [80]% of the basal cover on adjacent or nearby undisturbed areas where vegetation is in a healthy condition; or [80]% of the potential basal cover as defined in the National Resource Conservation Service Ecological Site(s) for the area. Plants must be resilient as evidenced by well-developed root systems and flowers. [Shrubs, will be well established and in a "young" age class at a minimum (therefore, not comprised mainly of seedlings that may not survive until the following year).]
- In agricultural areas, irrigation systems and soil conditions are reestablished in such a way as to ensure successful cultivation and harvesting of crops.
- Erosion features are equal to or less than surrounding area and erosion control is sufficient so that water naturally infiltrates into the soil and gullying, headcutting, slumping, and deep or excessive rills (greater than 3 inches) are not observed.
- The site is free of State- or county-listed noxious weeds, oil field debris and equipment, and contaminated soil. Invasive and nonnative weeds are controlled.

## Reclamation Actions

- During initial well pad, production facility, road, pipeline, and utility corridor construction and prior to completion of the final well on the well pad, pre-interim reclamation stormwater management actions will be taken to ensure disturbed areas are quickly stabilized to control surface water flow and to protect both the disturbed and adjacent areas from erosion and siltation. This may involve construction and maintenance of temporary silt ponds, silt fences, berms, ditches, and mulching.
- When the last well on the pad has been completed, some portions of the well location will undergo interim reclamation and some portions of the well pad will usually undergo final reclamation. Most well locations will have limited areas of bare ground, such as a small area around production facilities or the surface of a rocked road. Other areas will have interim reclamation where workover rigs and fracturing tanks may need a level area to set up in the future. Some areas will undergo final reclamation where portions of the well pad will no longer be needed for production operations and can be recontoured to restore the original landform.
- The following minimum reclamation actions will be taken to ensure that the reclamation objectives and standards are met. It may be necessary to take additional reclamation actions beyond the minimum in order to achieve the Reclamation Standards.

## Reclamation - General

### Procedure:

- The agency will be notified 24 hours prior to commencement of any reclamation operations.

## Housekeeping:

- Immediately upon well completion, the well location and surrounding areas(s) will be cleared of, and maintained free of, all debris, materials, trash, and equipment not required for production.
- No hazardous substances, trash, or litter will be buried or placed in pits. Upon well completion, any hydrocarbons in the pit will be remediated or removed.

## Vegetation Clearing:

- Vegetation removal and the degree of surface disturbance will be minimized wherever possible.
- *[Example of site-specific requirement*: During vegetation clearing activities, trees and woody vegetation removed from the well pad and access road will be moved aside prior to any soil disturbing activities. Care will be taken to avoid mixing soil with the trees and woody vegetation. Trees left for wood gathering will be cut [twelve inches or less from the ground], delimbed, and the trunks, six (6) inches or more in diameter will be removed and placed either by the uphill side of the access road, or moved to the end of the road, or to a road junction for easy access for wood gatherers and to reduce vehicle traffic on the well pad. Trees with a trunk diameter less than six (6) inches and woody vegetation will be used to trap sediment, slow runoff, or scattered on reclaimed areas to stabilize slopes, control erosion, and improve visual resources.]

## Topsoil Management:

- Operations will disturb the minimum amount of surface area necessary to conduct safe and efficient operations. When possible, equipment will be stored and operated on top of vegetated ground to minimize surface disturbance.
- In areas to be heavily disturbed, the top [eight (8)] inches of soil material, will be stripped and stockpiled around the perimeter of the well location to control run-on and run-off, and to make redistribution of topsoil more efficient during interim reclamation. Stockpiled topsoil may include vegetative material. Topsoil will be clearly segregated and stored separately from subsoils.
- Earthwork for interim and final reclamation will be completed within 6 months of well completion or plugging unless a delay is approved in writing by the BLM authorized officer.
- Salvaging and spreading topsoil will not be performed when the ground or topsoil is frozen or too wet to adequately support construction equipment. If such equipment creates ruts in excess of four (4) inches deep, the soil will be deemed too wet.
- No major depressions will be left that would trap water and cause ponding.

## Seeding:

- Seedbed Preparation. Initial seedbed preparation will consist of recontouring to the appropriate interim or final reclamation standard. All compacted areas to be seeded will be ripped to a minimum depth of 18 inches with a minimum furrow spacing of 2 feet, followed by recontouring the surface and then evenly spreading the stockpiled topsoil. Prior to seeding, the seedbed will be scarified and left with a rough surface.

- If broadcast seeding is to be used and is delayed, final seedbed preparation will consist of contour cultivating to a depth of 4 to 6 inches within 24 hours prior to seeding, dozer tracking, or other imprinting in order to loosen up the soil and create seed germination micro-sites.
- Seed Application. Seeding will be conducted no more than 24 hours following completion of final seedbed preparation. A certified weed-free seed mix designed by BLM (shown below) to meet reclamation standards will be used. • The application rate shown in the table is based on [45] pure live seeds (PLS) per square foot, drill-seeded to a depth of 0.25 to 0.5 inch, which is the method that will be used where feasible. [However, shrub species will be seeded during the winter on the ground surface or preferably on top of snow.] In areas that will not be drill-seeded, the seed mix will be broadcast-seeded at twice the application rate shown in the table and covered no more than 0.25 inch deep with a harrow, drag bar, or roller or will be broadcast-seeded into imprints, such as fresh dozer cleat marks.
- No seeding will occur from [May 15 to September 15]. Fall seeding is preferred and will be conducted after [September 15] and prior to ground freezing. [Shrub species will be seeded separately and will be seeded during the winter.] Spring seeding will be conducted after the frost leaves the ground and no later than [May 15].

## Erosion Control and Mulching:

- Mulch, silt fencing, waddles, hay bales, and other erosion control devices will be used on areas at risk of soil movement from wind and water erosion.
- Mulch will be used if necessary to control erosion, create vegetation micro-sites, and retain soil moisture and may include hay, small grain straw, wood fiber, live mulch, cotton, jute, or synthetic netting. Mulch will be free from mold, fungi, and certified free of noxious or invasive weed seeds.
- If straw mulch is used, it will contain fibers long enough to facilitate crimping and provide the greatest cover.

## Pit Closure:

- Reserve pits will be closed and backfilled within **sixty (60)** days of release of the rig. All reserve pits remaining open after **sixty (60)** days will require written authorization of the authorized officer. Immediately upon well completion, any hydrocarbons or trash in the pit will be removed. Pits will be allowed to dry, be pumped dry, or solidified in-situ prior to backfilling.
- Following completion activities, pit liners will be completely removed or removed down to the solids level and disposed of at an approved landfill, or treated to prevent their reemergence to the surface and interference with long-term successful revegetation. If it was necessary to line the pit with a synthetic liner, the pit will not be trenched (cut) or filled (squeezed) while containing fluids. When dry, the pit will be backfilled with a minimum of 5 feet of soil material. In relatively flat areas the pit area will be slightly

mounded above the surrounding grade to allow for settling and to promote surface drainage away from the backfilled pit.

**Management of Invasive, Noxious, and Non-Native Species:**

- All reclamation equipment will be cleaned prior to use to reduce the potential for introduction of noxious weeds or other undesirable non-native species.
- An intensive weed monitoring and control program will be implemented prior to site preparation for planting and will continue until interim or final reclamation is approved by the authorized officer.
- Monitoring will be conducted at least annually during the growing season to determine the presence of any invasive, noxious, and nonnative species. Invasive, noxious, and non-native species that have been identified during monitoring will be promptly treated and controlled. A Pesticide Use Proposal (PUP) will be submitted to the BLM for approval prior to the use of herbicides.

## Interim Reclamation Procedures - Additional

**Recontouring:**

- Interim reclamation actions will be completed no later than 6 months from when the final well on the location has been completed, weather permitting. The portions of the cleared well site not needed for active operational and safety purposes will be recontoured to the original contour if feasible, or if not feasible, to an interim contour that blends with the surrounding topography as much as possible. Sufficient semi-level area will remain for setup of a workover rig and to park equipment. In some cases, rig anchors may need to be pulled and reset after recontouring to allow for maximum interim reclamation.
- If the well is a producer, the interim cut and fill slopes prior to reseeding will not be steeper than a 3:1 ratio, unless the adjacent native topography is steeper. Note: Constructed slopes may be much steeper during drilling, but will be recontoured to the above ratios during interim reclamation.
- Roads and well production equipment will be placed on location so as to permit maximum interim reclamation of disturbed areas. If equipment is found to interfere with the proper interim reclamation of disturbed areas, the equipment will be moved so proper recontouring and revegetation can occur.

**Application of Topsoil & Revegetation:**

- Topsoil will be evenly respread and aggressively revegetated over the entire disturbed area not needed for all-weather operations including road cuts & fills and to within a few feet of the production facilities, unless an all-weather, surfaced, access route or small “teardrop” turnaround is needed on the well pad.
- In order to inspect and operate the well or complete workover operations, it may be necessary to drive, park, and operate equipment on restored, interim vegetation within the previously disturbed area. Damage to soils and interim vegetation will be repaired and reclaimed following use. To prevent soil compaction, under some situations, such as the

presence of moist, clay soils, the vegetation and topsoil will be removed prior to workover operations and restored and reclaimed following workover operations.

**Visual Resources Mitigation for Reclamation:**

- Trees, if present, and vegetation will be left along the edges of the pads whenever feasible to provide screening.
- To help mitigate the contrast of recontoured slopes, reclamation will include measures to feather cleared lines of vegetation and to save and redistribute cleared trees, debris, and rock over recontoured cut and fill slopes.
- To reduce the view of production facilities from visibility corridors and private residences, facilities will not be placed in visually exposed locations (such as ridgelines and hilltops).
- Production facilities will be clustered and placed away from cut slopes and fill slopes to allow the maximum recontouring of the cut and fill slopes.
- All long-term above ground structures will be painted [Covert Green] (from the "Standard Environmental Colors" chart) to blend with the natural color of the late summer landscape background.

## Final Reclamation Procedures – Additional

- Final reclamation actions will be completed within 6 months of well plugging, weather permitting.
- All disturbed areas, including roads, pipelines, pads, production facilities, and interim reclaimed areas will be recontoured to the contour existing prior to initial construction or a contour that blends indistinguishably with the surrounding landscape. Resalvaged topsoil will be respread evenly over the entire disturbed site to ensure successful revegetation. To help mitigate the contrast of recontoured slopes, reclamation will include measures to feather cleared lines of vegetation and to save and redistribute cleared trees, woody debris, and large rocks over recontoured cut and fill slopes.
- Water breaks and terracing will only be installed when absolutely necessary to prevent erosion of fill material. Water breaks and terracing are not permanent features and will be removed and reseeded when the rest of the site is successfully revegetated and stabilized.
- If necessary to ensure timely revegetation, the pad will be fenced to BLM standards to exclude livestock grazing for the first two growing seasons or until seeded species become firmly established, whichever comes later. Fencing will meet standards found on page 18 of the BLM/FS Gold Book, 4th Edition, or will be fenced with operational electric fencing.
- Final abandonment of pipelines and flowlines will involve flushing and properly disposing of any fluids in the lines. All surface lines and any lines that are buried close to the surface that may become exposed in the foreseeable future due to water or wind erosion, soil movement, or anticipated subsequent use, must be removed. Deeply buried lines may remain in place unless otherwise directed by the authorized officer.

## Reclamation Monitoring and Final Abandonment Approval

- Reclaimed areas will be monitored annually. Actions will be taken to ensure that reclamation standards are met as quickly as reasonably practical.
- Reclamation monitoring will be documented in an annual reclamation report submitted to the authorized officer by [March 1]. The report will document compliance with all aspects of the reclamation objectives and standards, identify whether the reclamation objectives and standards are likely to be achieved in the near future without additional actions, and identify actions that have been or will be taken to meet the objectives and standards. The report will also include acreage figures for: Initial Disturbed Acres; Successful Interim Reclaimed Acres; Successful Final Reclaimed Acres. Annual reports will not be submitted for sites approved by the authorized officer in writing as having met interim or final reclamation standards. Monitoring and reporting continues annually until interim or final reclamation is approved. Any time 30% or more of a reclaimed area is redisturbed, monitoring will be reinitiated.
- The authorized officer will be informed when reclamation has been completed, appears to be successful, and the site is ready for final inspection.