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January 28, 2009
File No.: 04.02.06.02
Project No. 357891

Mr. John Kessler, Project Manager
California Energy Commission
Systems Assessment and Facilities Siting Division
1516 9th Street, MS 15
Sacramento, CA 95814-5504

RE: Data Response, Set 2G
Ivanpah Solar Electric Generating System (07-AFC-5)

Dear Mr. Kessler:

On behalf of Solar Partners I, LLC, Solar Partners II, LLC, Solar Partners IV, LLC, and Solar Partners VIII, LLC (Applicant), please find attached one original and 12 hard copies of Data Response, Set 2G, which provides a Draft Closure and Revegetation Plan.

Please call me if you have any questions.

Sincerely,

CH2M HILL

John L. Carrier

John L. Carrier, J.D.
Program Manager

Enclosure
c: POS List
Project File

Ivanpah Solar Electric Generating System (ISEGS)

(07-AFC-5)

Data Response, Set 2G

(Responses to Data Requests: Closure & Restoration)

Submitted to the

California Energy Commission

Submitted by

Solar Partners I, LLC; Solar Partners II, LLC; Solar Partners IV, LLC; and Solar Partners VIII, LLC

January 28, 2009

With Assistance from

CH2MHILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833

Introduction

Attached are Solar Partners I, LLC, Solar Partners II, LLC, Solar Partners IV, LLC, and Solar Partners VIII, LLC (Applicant) responses to the California Energy Commission (CEC) Staff's data requests for the Ivanpah Solar Electric Generating System (Ivanpah SEGS) Project (07-AFC-5). The CEC Staff served these data requests on May 8, 2008, as part of the discovery process for Ivanpah SEGS. The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as CEC Staff presented them and are keyed to the Data Request numbers. New graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 15 would be numbered Table DR15-1. The first figure used in response to Data Request 15 would be Figure DR15-1, and so on. AFC figures or tables that have been revised have "R1" following the original number, indicating revision 1.

Additional tables, figures, or documents submitted in response to a data request (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of a discipline-specific section and may not be sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

The Applicant looks forward to working cooperatively with the CEC and BLM staff as the Ivanpah SEGS Project proceeds through the siting process. We trust that these responses address the Staff's questions and remain available to have any additional dialogue the Staff may require.

Closure and Restoration (125)

BACKGROUND

Section 5.2.11.1, Mitigation Measure 1 – Site Rehabilitation Plan, addresses closure of the project following the cessation of facility operations and discusses elements of a closure plan. Data Request 30 asked for description of the likely components of a closure plan addressing decommissioning methods, timing of any proposed habitat restoration and restoration performance criteria. Applicant's response suggests that each project owner file a closure plan for review and approval at least 12-months prior to commencing the closure activities. BLM believes that the applicant must prepare a plan that addresses closure and restoration activities and that waiting to address the issues at the end of the useful life of the facility, will not ensure satisfactory restoration of the site in the fragile desert environment. In addition, the project design and footprint may need to accommodate vegetation salvage and/or propagation study plots. Further, the plan needs to recognize that closure activities may not only occur at the end of a 30 or 50 year life of the facility, but could happen at intermediate times during the project life.

DATA REQUEST

125. BLM requests the applicant develop a plan that will guide site restoration and closure activities. Initially the plan will describe the anticipated methods applicant proposes for revegetation of disturbed areas using native plant species including perennials, and will include methods used to monitor restoration of and evaluate success of revegetation efforts. The initial site restoration and closure plan will evaluate existing information gathered by applicant and other relevant studies to determine if existing data is sufficient to guide restoration of disturbed lands or if additional research is necessary to determine the most effective means to restore and revegetate the site at closure. The plan must address preconstruction salvage and relocation of succulent vegetation from the site to either an onsite or nearby nursery facility for study and propagation of seed sources to reclaim the disturbed area. In the case of unexpected closure, the plan should assume restoration activities could possibly take place prior to the anticipated lifespan of the plant. Specifically the closure and restoration plan must address the following:

    - Develop a revegetation research program based on information provided by a qualified expert in desert flora and revegetation. The program would include a review of available materials describing methods and success rates of revegetation programs in the Eastern Mojave Desert at similar elevations.

- A program to evaluate existing native plant vegetation data from the current inventories and identify proposed representative study plot locations within and adjacent to the project area for each of the four vegetative community subtypes cited in the AFC, Appendix 5.2B. This data will be used to identify dominate species to be used in revegetation. Baseline vegetation measurements from the project area and from surrounding non-disturbed areas must be established prior to any surface disturbing activities and will be used to evaluate and monitor vegetation trends and changing conditions over the life of the project that could be considered impediments to restoration activities (e.g. sustained drought). Prepare and submit a protocol to identify study plots and methodology to evaluate trends to BLM for review and approval prior to beginning studies.
- Identify the extent of succulent plant species to be salvaged and maintained in nursery areas either on site or in close proximity, that would be used for future transplanting and/or in propagation studies for seed sources.
- Monitoring and treatment of invasive species over the life of the project.
- Ground preparation procedures that would be needed to effectively reclaim the area.
- Implementation of monitoring programs after closure to verify revegetation results based upon the established goals for density and diversity.
- Provide yearly updates to agencies of progress achieved in connection to revegetation research.
- Identify, with justification, the vegetation considered unnecessary for revegetation or reclamation research that would be lost during construction that could be made available for public collection through plant salvage sales conducted by BLM.

Response: A Draft Closure, Revegetation and Rehabilitation Plan is provided as Attachment DR125-3A.

Attachment DR125-3A
Draft

Closure, Revegetation and Rehabilitation Plan for the Ivanpah Solar Electric Generating System Eastern Mojave Desert San Bernardino County, California

Prepared for

Ivanpah Solar Electric Generating System

January 2009

CH2MHILL
2485 Natomas Park Drive
Sacramento, California 95833

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Acronyms and Abbreviations

§	Section
°F	degrees Fahrenheit
μS/cm	microSiemens/cm
AFC	application for certification
BLM	Bureau of Land Management
BMP	best management practices
C:N	carbon to nitrogen ratio
CaCO3	calcium carbonate
CDCA	California Desert Conservation Area
CDFG	California Department of Fish and Game
CEC	California Energy Commission
COC	conditions of certification
DESCP	drainage, erosion, and sediment control plan
DR	data report
dS/m	deciSiemens per meter
FESA	Federal Endangered Species Act
FLPMA	Federal Land Policy and Management Act of 1976
gpm	gallon per minute
GPS	geographic positioning system
HDPE	high-density polyethylene
HP	high pressure
IP	intermediate pressure
Ivanpah SEGS	Ivanpah Solar Electric Generating Station
KRGT	Kern River Gas Transmission
kV	kilovolt
lbs/ac	pounds per acre
LORS	laws, ordinances, regulations, and standards

LP	low pressure
mg/L	milligrams per liter
MW	megawatt
MWH	megawatt-hour
NEMO	Northern and Eastern Mojave Coordinated Management Plan
NFPA	National Fire Protection Association
NPPA	Native Plant Protection Act
NW	northwest
PEIS	*Final Programmatic Environmental Impact Statement Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States*
Plan	Site Rehabilitation and Revegetation Plan
POD	plan of development
PVC	polyvinyl chloride
RH	relative humidity
ROW	right-of-way
SCE	Southern California Edison
SE	southeast
SPCC	Spill Containment and Countermeasures Plan
SRB	solar receiver boiler
STG	steam turbine generator
SWPPP	stormwater pollution prevention plan
TBD	*Technical Basis Document for Revegetation and Reclamation Planning, Ivanpah Solar Electric Generating System, Eastern Mojave Desert, San Bernardino County, California*
USFWS	U.S. Fish and Wildlife Service
WMP	*Weed Management Plan for the Ivanpah Solar Electric Generating System (CH2M HILL, 2008c)*

SECTION 1

Introduction

1.1 Plan Purpose

The purpose of this site rehabilitation and revegetation plan (Plan) is to set forth the procedures and practices that would be employed by the project owner, to meet federal and state requirements for the reclamation of sites temporarily affected during construction of the Ivanpah Solar Electric Generating Station (Ivanpah SEGS), and for the rehabilitation and revegetation of the project after decommissioning. This includes fulfilling the relevant mitigation measures identified in the Application for Certification (AFC) submitted to the California Energy Commission (CEC). In turn, the responsible agencies, including the Bureau of Land Management (BLM), the U.S. Fish and Wildlife Service (USFWS), the California Department of Fish and Game (CDFG), and the CEC should use this Plan as a basis to review and evaluate the rehabilitation program at Ivanpah SEGS. Figure 1-1 (all figures are located at the end of the section) shows the general location of the Ivanpah SEGS project. Figure 1-2 shows the site plan and linear facilities associated with the project.

The nature and size of the disturbed areas described in this Plan are based on the Plan of Development (POD) for the Ivanpah SEGS project. As with any large, multi-year project, there are always potential changes in the POD and the operating measures that will be occasioned by unanticipated operational exigencies or external factors. Because these changes could affect the rehabilitation and revegetation measures, and anticipated schedules, this Plan should be viewed as preliminary, subject to ongoing modifications in coordination with responsible parties. This Plan also includes procedures for modifying methods or criteria, if the project owner or the responsible agencies find the need to do so.

1.2 Project Description

The Ivanpah SEGS project consists of developing and operating three solar energy plants to be located in the Ivanpah Valley, in San Bernardino County, California, 4.5 miles southwest of Primm, Nevada. The site is located in Township 17N, Range 14E, and Township 16N, Range 14E on land administered by the BLM. Access to the site is through the Yates Well Road interchange on Interstate 15 (I-15) and then on Colosseum Road to the west of the Primm Valley Golf Club. The first 100-megawatt (MW) plant at the south end of the project, known as Ivanpah 1, would be owned by Solar Partners II, LLC. Solar Partners I, LLC, would own the middle 100-MW plant known as Ivanpah 2. The northernmost 200-MW plant, known as Ivanpah 3, would be owned by Solar Partners VIII, LLC (Figure 1-2). The three plants, and their shared facilities (to be owned by Solar Partners IV), collectively are known as the "Ivanpah Solar Electric Generating System" or "Ivanpah SEGS." The Applicant is seeking a separate right-of-way (ROW) grant from the BLM for each of the three plants and for the shared facilities.

The companies have filed SF 299 ROW grant applications for use of the land with the Bureau's Needles Field Office. The 100-MW Ivanpah 1 solar plant site would require approximately 914 acres (1.4 square miles), 100-MW Ivanpah 2 solar plant site would require approximately 921 acres (1.4 square miles), and the 200-MW Ivanpah 3 site would require approximately 1,843 acres (2.9 square miles). In addition, the Administration Building/warehouse, a substation, and detention ponds would need to be located in the area between Ivanaph 1 and 2 would require approximately 66 acres, along with other permanent facilities like transmission towers, linear facilities and access roads.

The total area required for construction and operation of all three solar plant sites including the shared infrastructure is approximately 4,065 acres (minus the acreage for existing established dirt roads equals about 4,060 acres, net). This includes approximately 3,760 acres of permanent effects and approximately 300 acres of work area that would be subject to restoration following construction.

Concurrent with the BLM ROW filing process, an AFC was filed with the CEC. In response, the CEC and the BLM noted their intention to conduct a joint environmental review of the Ivanpah SEGS project. It is expected that the two agencies will coordinate their analyses and issue joint environmental documents and separate decisions. As discussed in Section 1.3.1, this Plan addresses data requests filed by the CEC and BLM pursuant to these applications.

1.2.1 Project Phasing

The phasing is planned so that Ivanpah 1 (southern site) would be constructed first, followed by Ivanpah 2 (middle site), then Ivanpah 3 (northern site). However, based on market conditions, the order of development could change. Construction of the shared facilities would occur with the first solar plant. To minimize ground disturbance, construction on a subsequent phase will not begin until financing has been obtained.

To reduce impacts on the land and provide operating efficiencies, the three solar plants would share certain infrastructure. The same groundwater wells (a primary with a second well for 100 percent redundant backup) and water lines would provide water to all three plants. The three plants would share access through a realigned Colosseum Road. Each plant would have paved access from Colosseum Road to its power block. The shared facilities would also include an administration building, maintenance facilities, and control room for maintenance crew and operators. The natural gas pipeline would serve all three plants, and all three plants would interconnect to a single new substation. A single line and section of electrical poles would carry electrical circuits for Ivanpah 2 and 3, as the generation tie lines approach the entrance to the substation. These facilities are located between Ivanpah 1 and 2, outside of the fence line of either plant. These shared facilities would be owned by a single company, Solar Partners IV, LLC, that will hold the BLM ROW for the land for the shared facilities.

A package sewage treatment plant would be located at the Administration Building/Operations and Maintenance area, located between Ivanpah 1 and 2. This primary wastewater collection system would collect process wastewater from the plant equipment, including the boilers and water treatment equipment. Additionally, each phase would include a small onsite wastewater plant located in the power block that treats wastewater from domestic waste streams such as showers and toilets. Sewage sludge would be removed from the site by a sanitary service provider. Wastewater would be recycled in the system, except for a small stream that would be treated and used for landscape irrigation. If necessary, a small filter/purification system would be used to provide potable water at the Administration Building.

1.2.2 Facility Layout and Construction

This section describes the various construction activities for the Ivanpah SEGS project. Included in these activities are the preparation and submittal of annual reports by January 31 each year during project construction to the BLM, USFWS, CDFG, and the CEC documenting the effectiveness and practicality of the avoidance and minimization measures for desert tortoises and other sensitive resources.

1.2.2.1 Schedule and Workforce

Construction of the solar electric generating station, from site preparation and grading to commercial operation, is expected to begin after the Third Quarter of 2009 and be completed by the Fourth Quarter of 2013; however, the order of construction may change. There would be an average and peak workforce of approximately 474 and 959, respectively, of construction craft people, supervisory, support, and construction management personnel onsite during construction. The peak construction site workforce level is expected to occur in Month 32.

Typically, construction would be scheduled to occur between 5 a.m. and 7 p.m. on weekdays and Saturdays. Additional hours may be necessary to make up schedule deficiencies, or to complete critical construction activities (e.g., pouring concrete at night during hot weather and working around time-critical shutdowns and constraints). During some construction periods and the startup phase of the project, some activities would continue 24 hours per day, 7 days per week.

1.2.2.2 Construction Access

The construction laydown and parking would occupy areas of the plant sites within the heliostat (i.e., mirror) fields and in the Construction Logistics Area between Ivanpah 1 and 2 (Figure 1-3). Construction access would be from Colosseum Road to the plant entrance road (Figure 1-2). Colosseum Road is an existing dirt road, which is planned to be asphalted from the Primm Valley Golf Club to the project site. The project would re-route a portion of Colosseum Road around the southern end of the Ivanpah 2 site. Paved roads would allow access to the power blocks of the three Ivanpah sites. Table 1-1 provides an estimate of the average and peak construction traffic during the 48-month construction period for all three phases of the plant and associated linear facilities.

TABLE 1-1
Average and Peak Construction Traffic

Vehicle Type	Average Daily Trips	Peak Daily Trips
Construction Workers	19 buses + 95 personal vehicles	39 buses + 192 personal vehicles
Deliveries	62	145
Total	**176**	**376**

1.2.2.3 Clearing and Grading

The Ivanpah SEGS project is intended to be constructed in three stages, beginning with site preparation. Initial site clearing and grading of the three phases (Ivanpah 1, 2, and 3) would take place over a 5-month period, commencing once the CEC license and project financing are obtained. Construction of each site would be staggered to begin about 12 months following the start of the prior site. For construction of the phased facilities, no work would be done within a project site until project financing has been obtained for that site and construction is ready to proceed. Construction of the shared facilities would be part of the initial phase of the project. Prior to clearing and grading, each site boundary would be permanently fenced with chain-link for security purposes, and permanent desert tortoise exclusionary fencing would be attached to the base of the security fence or installed outside the security fence to allow construction of linear facilities. Low clearance gates would be installed to allow equipment access to the sites and exclude desert tortoises. The first step would include clearing an approximate 10-foot-wide linear swath of vegetation along the entire outer edge of each facility boundary to create a perimeter road and install the fencing. The perimeter road would be within the fence line or site boundary.

Heliostat Arrays and Solar Towers

Once the fence is installed, and prior to site clearing and grading, a desert tortoise clearance survey per USFWS protocol would be performed. Upon completion of the desert tortoise clearance survey and prior to clearing and grading, the succulents that would otherwise be removed or affected during construction would be salvaged as described in Section 4, Native Plant Salvage and Reuse. These activities would be coordinated with BLM.

The estimated size of the area for Ivanpah 1 (Phase 1) is about 914 acres; for Ivanpah 2 (Phase 2) the area is approximately 921 acres; and for Ivanpah 3 (Phase 3) the area is about 1,843 acres. To construct the heliostat array fields located within these sites, some clearing and grading would occur. The amount of area subject to grading varies with each site. Grading of each site will be minimized to the degree possible to accommodate access for construction of the heliostats and for service and cleaning of the heliostat mirrors. Although soil disturbance would be minimized to the degree possible, the entire site would be permanently affected because it would no longer be available to tortoises. The sites would be surrounded by a fence to exclude tortoises during construction and operation. Inclusive of these sites and the area used for access roads, transmission poles, and the substation and administration buildings, the total area that would be permanently disturbed by clearing and grading activities consists of approximately 3,760 acres or about 5.9 square miles.

The heliostat fields for Ivanpah 1, 2, and 3 consist of concentric linear arrays of heliostats separated by service paths. The ground surface beneath the heliostat arrays would be bladed to a depth of not more than 1 to 3 inches to facilitate their construction. Also, vegetation throughout the site will be mowed leaving it less than 1-foot tall. If possible, the ground surface between every other heliostat array would remain desert scrub. In areas where blading is not required, existing root systems would remain in place to anchor the soil and decrease risk for erosion. Occasional cutting of the vegetation would be required under the heliostat arrays to control plant re-growth. All cut vegetation would be mulched and maintained in windrows for use in revegetation (Chapter 7). A minimum amount of cutting and filling within the access roads is planned. Some re-grading for maintenance would most likely be required as a result of soil erosion and regular use.

The solar fields would consist of one heliostat array constructed within each 100-MW plant (Ivanpah 1 and 2) and five heliostat arrays constructed within the 200-MW plant (Ivanpah 3; Figure 1-2). Each heliostat array would be arranged around a single centralized solar receiver tower that will be 459 feet tall. In addition, FAA-required lighting and a lightening pole would extend above the top of the towers approximately 5 to 10 feet (1.5 to 3 meters). The heliostats will automatically track the sun throughout the day and reflect the solar energy to the solar tower. It is estimated that the 100- and 200-MW sites would contain approximately 55,000 and 104,000 heliostats, respectively. Each heliostat would support two mirrors. Each mirror is 7.22 feet high by 10.5 feet wide (2.20 meters by 3.20 meters) yielding a reflecting surface of 75.8 square feet (7.04 square meters).

Stormwater Management

To manage stormwater runoff while maintaining hydrologic connectivity, the solar field development would maintain unobstructed sheet flow to the degree possible. The finish grade of the power block and power tower areas would be 3 feet above the surrounding grade with moderate transition slopes to protect them from floods and return the relatively small local diversions to sheet flow through the solar fields. If required, detention ponds may be used on the west side of the project site to reduce the stormwater velocity and allow sediment to drop out. For current planning purposes, two concrete-lined holding basins of about 40 feet by 60 feet are included in the power block. They also serve as boiler commissioning and emergency outfalls from any of the processes. Also, a few drainage channels may be required to redirect the stormwater and minimize erosion. The project would be designed to maintain, to the extent possible, the existing sheet flow patterns and ephemeral drainages on the site.

Transmission System

Ivanpah 1, 2, and 3 would be interconnected to the existing Southern California Edison (SCE) grid through an upgraded SCE 115-kV line passing through the site on a northeast-southwest ROW (see Figure 1-2). A new 220-kilovolt (kV)/115-kV breaker-and-a-half substation would be constructed between Ivanapah 1 and 2 that would be used to connect Ivanpah SEGS to the electrical grid. The new Ivanpah Substation and system upgrades would be for the benefit of Ivanpah SEGS and other interconnecting customers in the regional cluster, as well as future growth. The Ivanpah Substation and 220-kV upgrade would involve the installation of a 1,400-foot section of electrical poles and is expected to be completed before the Ivanpah SEGS comes on line.

The timing of the 115-kV upgrade between Ivanpah Substation and the Mountain Pass Substation would depend on the development of other generation projects ahead in the queue. Power from each Ivanpah plant would be interconnected to the California Independent System Operator (CAISO) grid via 115-kV generator tie lines to the new Ivanpah Substation. The design of the Ivanpah Substation and associated line upgrades would be performed by SCE. The environmental permitting work for the 115/220-kV line upgrade as well as other system improvements is also being done by SCE.

The proposed Ivanpah substation would also require new telecommunication infrastructure to be installed to provide protective relay circuit, Supervisory Control and Data Acquisition (SCADA) circuit, data, and telephone services. The telecommunication path from Ivanpah substation to local carrier facility interface at Mountain Pass area consist of approximately 8 miles of fiber optic cable to be installed overhead on existing poles and new underground conduits to be constructed in the substation and Telecom Carrier interface point. This fiber route consists of two segments (Figure 1-4). The first segment is from Ivanpah substation to Mountain Pass substation using the existing Nipton 33-kV distribution line poles built along the transmission line corridor that crosses between Ivanpah 1 and 2. The second segment is from Mountain Pass substation using the Earth 12-kV lines to an interface point to be designated by the local telecommunication carrier.

Natural Gas System

Natural gas would be used as a supplementary fuel. It will be obtained from the Kern River Gas Transmission (KRGT) pipeline about 0.5 mile north of Ivanpah 3 (Figure 1-2). A permanent gas metering station (100 feet by 150 feet) would be located at the point of connection. From the tap station, the natural gas line would head south along the western edge of Ivanpah 3 to a metering station (10 feet by 40 feet) in its southeast corner. The gas line and metering station would be located outside the project's fenced heliostat fields and a dirt access road would follow the pipeline so that the gas company has access to them for maintenance.

From the metering station at Ivanpah 3, the gas line (and dirt access road) would continue along the eastern edge of Ivanpah 2 to another metering station (20 feet by 40 feet) on the southeast corner, south of Colosseum Road that would service Ivanpah 1 and 2. The gas line and metering station would be located within the surveyed area, but outside the fenced heliostat fields. From that metering station, the gas line to Ivanpah 1 would be located alongside or under the paved access road that goes from Colosseum Road past the Administration Building to Ivanpah 1's power block.

A gas-metering station would be required at the KRGT tap point to measure and record gas volumes. In addition, facilities would be installed to regulate the gas pressure and to remove any liquids or solid particles. Construction activities related to the metering station and metering sets would include grading a pad and installing above- and belowground gas piping, metering equipment, gas conditioning, pressure regulation, and possibly pigging facilities. Either a distribution power line or photovoltaic cells and batteries would be used for metering-station-operation lighting, communication equipment, and perimeter chain-link fencing for security would also be installed.

The primary method of construction includes excavation of an open trench approximately 36 inches wide and 3 to 10 feet deep, depending on the site-specific soil type. With loose soil, a trench up to 8 feet wide at the top and 3 feet wide at the bottom may be required. The pipeline would be buried to provide a minimum cover of 36 inches. During construction, a 75-foot-wide ROW may be disturbed. This temporary construction corridor would be used to store the excavated soil, provide access for equipment and vehicles, and space for fitting the pipeline prior to installation and backfill using a backhoe. If steel piping is used, a cathodic protection system would be designed to control the electrochemical corrosion of designated metal piping buried in the soil. Depending upon the corrosion potential and the site soils, passive or impressed current cathodic protection would be provided.

Construction would result in temporary impacts on the ROW (e.g., vegetation clearing, trench excavation, soil compaction, dust generation, and restoration). These activities would be preceded by a biologist conducting pre-construction and clearance surveys for plant and wildlife species. It is likely that only enough trench for the day would be cut to place pipe, fit, and backfill. This trenching limit prevents sections of trench from remaining open overnight and possibly entrapping wildlife. All open ends of pipes would be covered to prevent entrapment of wildlife. The temporary construction disturbance area for the natural gas pipeline would be a 200-foot by 200-foot area required for the KRGT tap point. Construction of the Ivanpah 3 metering set would use a temporary laydown area within the Ivanpah 3 site; whereas, construction of the Ivanpah 1 or 2 metering set would use a temporary 1.37-acre triangular area just south of the metering set.

Water System

Two new wells would be drilled and developed to provide raw water for the Ivanpah SEGS project. The water would be drawn daily from one of the two wells that would be located near the northwest corner of Ivanpah 1 (Figure 1-2), with the other well serving as 100 percent redundant backup. To reduce impacts on the land and provide operating efficiencies, the wells would provide water to all three plants. The complete 400-MW Ivanpah SEGS project would require up to 46 gallons per minute (gpm) of raw water makeup, which would be drawn from the wells and distributed to the plants through underground high-density polyethylene (HDPE) or polyvinyl chloride (PVC) pipe. Each plant would have a raw water tank with a capacity of 250,000 gallons. A portion of the raw water (100,000 gallons) is for plant use, while the majority would be reserved for fire water.

There would be a dirt access road to the wells approximately 600 feet long. The water supply line would go from the wells to the paved road on the northwest corner of Ivanpah 1 and run north to the Administration Building, Ivanpah 2 and 3 along the same corridor as the gas line, and south to Ivanpah 1 along the paved access road leading to the power block.

The primary method of construction of the water supply line includes excavation of an open trench approximately 36 inches wide and 5 to 10 feet deep, depending on the site-specific soil type. With loose soil, a trench up to 8 feet wide at the top and 3 feet wide at the bottom may be required. The pipeline would be buried to provide a minimum cover of 36 inches. During construction, a 50-foot-wide ROW may be disturbed. This temporary construction corridor would be used to store the excavated soil, provide access for equipment and vehicles, and space for fitting the pipeline prior to installation and backfill using a backhoe.

Construction would result in temporary impacts on the corridor (e.g., vegetation clearing, trench excavation, soil compaction, dust generation, and revegetation). A similar strategy as that described for the gas line to minimize impacts on biological resources would be used.

The temporary construction disturbance area for the water supply line outside of the project footprint for three solar fields encompasses 1.2 acres, with permanent disturbance of about 0.38 acre.

A monitoring well would be installed southeast of the Administration Building near a northwest corner of Ivanpah 1 (Figure 1-2). The permanent area required for the installation of the monitoring well and 12-foot-wide dirt access road is 0.23 acre.

1.2.3 Operations

Management, engineering, administrative staff, skilled workers, and operators would serve the three Ivanpah SEGS plants. Ivanpah SEGS is expected to employ up to 90 full-time employees. The facility would be operated 7 days a week, 14 hours per day. Ivanpah SEGS is expected to have an annual plant availability of 92 to 98 percent. The plants would be operated and maintained by common crews of operators, working out of the Administration Building and Operations and Maintenance area between Ivanpah 1 and 2.

1.2.3.1 Power Generation

The proposed project site includes three heliostat fields and three solar concentrating thermal power plants, based on distributed power tower and heliostat mirror technology, in which heliostat (mirror) fields focus solar energy on power tower receivers near the center of the heliostat array. The solar field and power generation equipment are started up each morning after sunrise and insolation buildup, and shut down in the evening when insolation drops below the level required to keep the turbines online.

1.2.3.2 Water System

Water consumption is considered minimal (estimated at less than 100 acre-feet per year for all three phases) and would mainly be used to provide water for washing heliostats and to replace boiler feedwater blowdown. Groundwater would go through a de-ionizing treatment system for use as boiler makeup water and to wash the heliostats. Operational requirements include washing the solar heliostats on a nightly basis (all heliostats are washed once every 2 weeks). Because of dust created during site grading, this washing cycle may be more frequent (but not likely more than double) when Ivanpah 1 is operating and Ivanpah 3 is being graded. Thus, for no more than the first 5 months of construction of Ivanpah 3, Ivanpah 1 could use twice as much water.

Best management practices (BMP) for the use of wash water are outlined in the Drainage, Erosion, and Sediment Control Plan (DESCP, Attachment DR140-1A, in Data Response Set 2B). Because the water used for heliostat washing would be deionized, it will be of very high quality containing only minimal iron and copper from the water piping. A pressure washer or other method would be used to wash the heliostats to minimize the amount of water used (about 2.5 gallons per heliostat), and no water is anticipated to run offsite as a result of these washing activities. Because of the high evaporation rates in the area, and the minimal amount of water that would be used, it is likely that wash water would evaporate at or just below the ground surface. By implementing good engineering practices and BMPs in the project design and operation, and because stormwater discharge during construction would adhere to a stormwater pollution prevention plan (SWPPP) and the DESCP, and to state water quality standards, no significant impacts on surface or subsurface water quality are expected during operation of the project.

1.2.3.3 Fire Protection

The fire protection system would be designed to protect personnel and limit property loss and plant downtime in the event of a fire. The primary source of fire protection water would be the raw water storage tank. An electric jockey pump and electric-motor-driven main fire pump would be provided to increase the water pressure in the plant fire main to the level required to serve firefighting systems. In addition, a backup diesel engine-driven fire pump would be provided to pressurize the fire loop if the power supply to the electric-motor-driven main fire pump fails. A fire pump controller would be provided for each fire pump.

1.2.4 Closure and Decommissioning

Facility closure can be temporary or permanent. Temporary closure is a shutdown for a period exceeding the time required for normal maintenance, including closure for overhaul or replacement of a steam turbine. Causes for temporary closure include a disruption in the supply of natural gas or damage to the plant from earthquake, fire, storm, or other natural acts. Permanent closure is defined as a cessation in operations with no intent to restart operations because of plant age, damage to the plant beyond repair, economic conditions, or other reasons. Temporary closures are not discussed in this Plan. This Plan focuses on permanent closure and subsequent decommissioning activities. Plant closure is discussed in more detail in Section 8.

Because the conditions that would affect the decommissioning decision are largely unknown at this time, these conditions, as well as the final goals of closure activities would be reviewed and assessed between 3 and 5 years prior to the beginning of decommissioning activities (see Section 8). In general, the decommissioning plan for the facility would attempt to maximize the recycling of all facility components. The Applicant would attempt to sell unused chemicals back to the suppliers or other purchasers or users. Equipment containing chemicals would be drained and shutdown to ensure public health and safety and to protect the environment. All nonhazardous wastes would be collected and disposed of in appropriate landfills or waste collection facilities. Hazardous wastes would be disposed of according to all applicable laws, ordinances, regulations, and standards (LORS). The site would be secured 24 hours per day during the decommissioning activities.

For the purpose of this Plan, it is assumed that the removal of all equipment and appurtenant facilities would be required, and would be achieved in conformance with all applicable LORS and local/regional plans. Aboveground structures would be removed through mechanical or other approved methods, and trucked offsite. Foundations would be physically removed to a depth of 3 feet or more through excavation, breakup, and pulling. Once all structural elements are removed, the ground surface would be recontoured to minimize the topographic variability between on- and offsite areas, and to ensure that the gradient across the alluvial fans is restored. Pipelines would be closed off and abandoned in place.

1.3 Closure, Revegetation and Rehabilitation Plan Goals and Objectives

The overarching goal of this plan is to provide guidelines, methods, and criteria for measuring the progress of revegetation of areas temporarily disturbed during project construction; manage the site surface at the Ivanpah SEGS facility during its planned 50 years of operation; and rehabilitate and revegetate the project site upon facility decommissioning. This goal can be summarized as follows:

- Describe the methods for rehabilitation and revegetation of temporary disturbance areas that would create natural-appearing topography, and reduce potential for erosion, especially through deflation.
- Implement a practical revegetation program that would accelerate natural vegetation succession and, over time, promote the establishment of a plant community dominated by native perennials.
- Establish a weed management program applicable to the construction, operation, and decommissioning of the project site that would identify the non-native species requiring eradication, and the means to accomplish that eradication.
- Identify means and methods that will minimize, to the extent practicable, long-term maintenance and support requirements, such as irrigation, weeding, or reseeding.
- Reduce the visual contrasts between temporary disturbed areas and adjacent undisturbed areas through revegetation.
- Anticipate wildlife management needs as habitat suitable to support cover and breeding opportunities for desert fauna development in temporary disturbed areas, in operational areas of the Ivanpah SEGS, and after decommissioning.

1.3.1 Conformance with Agency Requirements

The objective of this Plan is to conform with a request by the BLM and CEC to provide a site revegetation and closure plan as stated in Data Request 30 (CEC, 2007), which was later revised with Data Request 125 (CEC, 2008):

> **BACKGROUND**
>
> AFC section 5.2.11.1, Mitigation Measure 1 – Site Rehabilitation Plan, addresses closure of the project following the cessation of facility operations and discusses elements of a project closure plan. Permanent closure is an issue of concern regarding biological resources due to the proposed facility location on a relatively large and undisturbed habitat area as well as the potential threats to biological resources posed by abandoned equipment and hazardous materials.
>
> **Data Request**
>
> 30. Please describe the likely components of a closure plan (e.g., decommissioning methods, timing of any proposed habitat restoration, restoration performance criteria), and discuss each relative to biological resources and specifically to desert tortoise and its habitat.

BACKGROUND

Section 5.2.11.1, Mitigation Measure 1 – Site Rehabilitation Plan, addresses closure of the project following the cessation of facility operations and discusses elements of a closure plan. Data Request 30 asked for description of the likely components of a closure plan addressing decommissioning methods, timing of any proposed habitat restoration and restoration performance criteria. Applicant's response suggests that each project owner file a closure plan for review and approval at least 12-months prior to commencing the closure activities. BLM believes that the applicant must prepare a plan that addresses closure and restoration activities and that waiting to address the issues at the end of the useful life of the facility, will not ensure satisfactory restoration of the site in the fragile desert environment. In addition, the project design and footprint may need to accommodate vegetation salvage and/or propagation study plots. Further, the plan needs to recognize that closure activities may not only occur at the end of a 30 or 50 year life of the facility, but could happen at intermediate times during the project life.

DATA REQUEST

125. BLM requests the applicant develop a plan that will guide site restoration and closure activities. Initially the plan will describe the anticipated methods applicant proposes for revegetation of disturbed areas using native plant species including perennials, and will include methods used to monitor restoration of and evaluate success of revegetation efforts.

The initial site restoration and closure plan will evaluate existing information gathered by applicant and other relevant studies to determine if existing data is sufficient to guide restoration of disturbed lands or if additional research is necessary to determine the most effective means to restore and revegetate the site at closure[1].

The plan must address preconstruction salvage and relocation of succulent vegetation from the site to either an onsite or nearby nursery facility for study and propagation of seed sources[2] to reclaim the disturbed area. In the case of unexpected closure, the plan should assume restoration activities could possibly take place prior to the anticipated lifespan of the plant. Specifically the closure and restoration plan must address the following:

- Develop a revegetation research program based on information provided by a qualified expert in desert flora and revegetation. The program would include a review of available materials describing methods and success rates of revegetation programs in the Eastern Mojave Desert at similar elevations.
- A program to evaluate existing native plant vegetation data from the current inventories and identify proposed representative study plot locations within and adjacent to the project area for each of the four vegetative community subtypes cited in the AFC, Appendix 5.2B. This data will be used to identify dominate (*sic*) species to be used in revegetation[3].

[1] This has been accomplished by the previously submitted *Technical Basis Document For Revegetation and Reclamation Planning* included by reference in this document (see Attachment DR125-1A, Data Response Set 2B).

[2] As described more thoroughly in the *Technical Basis Document* succulent salvage is recommended neither for seed sourcing nor for research, since neither is required to develop effective revegetation strategies and methods.

[3] As noted in the *Technical Basis Document* this activity is unnecessary. Native plant species most suitable for revegetation of the area have been identified according to the manner described in the *Technical Basis Document*.

Baseline vegetation measurements from the project area and from surrounding non-disturbed areas must be established prior to any surface disturbing activities and will be used to evaluate and monitor vegetation trends and changing conditions over the life of the project that could be considered impediments to restoration activities (e.g. sustained drought). Prepare and submit a protocol to identify study plots and methodology to evaluate trends to BLM for review and approval prior to beginning studies.

- Identify the extent of succulent plant species to be salvaged and maintained in nursery areas either on site, or in close proximity, that would be used for future transplanting and/or in propagation studies for seed sources.
- Monitoring and treatment of invasive species[4] over the life of the project.
- Ground preparation procedures that would be needed to effectively reclaim the area.
- Implementation of monitoring programs after closure to verify revegetation results based upon the established goals for density and diversity.
- Provide yearly updates to agencies of progress achieved in connection to revegetation research.
- Identify, with justification, the vegetation considered unnecessary for revegetation or reclamation research that would be lost during construction that could be made available for public collection through plant salvage sales conducted by BLM.

The *Technical Basis Document for Revegetation and Reclamation Planning*, *Ivanpah Solar Electric Generating System, Eastern Mojave Desert, San Bernardino County, California* (see Attachment DR125-1A, Data Response Set 2B) is incorporated herein by reference. It demonstrates that there is sufficient information on the ecological dynamics of revegetation, as well as the applicable techniques that can be used to accelerate revegetation. Therefore, a research program is unnecessary.

1.3.2 Integral Documents

Other documents on rehabilitation and revegetation planning for the Ivanpah SEGS project have been prepared and are used in this Plan. They are described in this section.

1.3.2.1 The Technical Basis Document and Revegetation Methods

The *Technical Basis Document* (TBD) is divided into two main sections. The first section provides some detail on the ecological dynamics of vegetation succession (natural revegetation) in desert scrub ecosystems, focusing on the findings of previous studies in the Mojave Desert. The second section provides a summary of the revegetation techniques used in different projects in the Mojave Desert, and assessment of the methods identifying which are most practicable, and which are least likely to yield satisfactory results.

The TBD arrived at several findings integral to this Plan and to its compliance with the Data Request 125. First, a research program is unnecessary to identify revegetation methodology, appropriate revegetation plant taxa, soil preparation and management, and other details of

[4] This has been accomplished by the previously submitted *Weed Management Plan for the Ivanpah Solar Electric Generating System* included as Appendix A to this document.

a revegetation program because these methods have been thoroughly vetted in revegetation sites and programs throughout the Mojave Desert. This includes the extensive revegetation research and implementation program at the Castle Mountain Mine, as well as other programs. Vegetation succession after disturbance can be accelerated by taking advantage of the means and methods of vegetation propagation developed by these other projects in the Mojave Desert. The plant species adapted to ground disturbance and, therefore, most appropriate for revegetation, as well as the late successional and climax species at Ivanpah SEGS, are known and published studies are available to support these determinations.

Second, study plots in undisturbed desert scrub would be necessary to identify revegetation goals or to monitor revegetation progress; those goals and that progress can be stated in terms of the rates and components of successional processes. Criteria for revegetation success need to be established on the basis of successional plant associations rather than mature climax vegetation. It is physically impossible to immediately return a vegetation community to its predisturbance composition and appearance simply because the soil conditions preclude that option. An open-air nursery facility would be employed for succulent salvage, but no more elaborate facility is otherwise needed to support the revegetation effort.

Third, the plant species most appropriate to revegetation efforts can be identified with the available information on the flora of Ivanpah SEGS. Disturbance-adapted winter annuals were identified during the survey of the project site, as well as perennials that favor the poor soils and disturbed habitats of washes and roadsides. Different propagation methods have also been tried, and were challenged by the extremely rigorous environment of the Mojave Desert. However, there are data to identify the methods that represent the best balance of practicality, environmental realism, and economics. An example of environmental realism is avoiding the use of prolonged irrigation to establish plants for revegetation. As could be expected in this Mojave Desert environment, such plants experience a very high mortality rate at the end of the irrigation period.

- Fourth, soil salvage and site preparation is needed for desert restoration sites. Measures used include the following: (1) topsoil stockpiling and subsequent redistribution to enhance revegetation efforts; (2) windrowing mulched vegetation, topsoil, and subsoil in separate rows is favored; (3) windrowed vegetation can be mulched over the site to increase moisture retention and reduce erosion; (4) deep ripping (to 48 inches) and scarification (to a shallower depth) are often employed to provide decompaction after construction activities, and to provide a rough surface for seed catchment; and (5) rough and fine grading on sloped sites are implemented to create topographic diversity with more natural, undulating landforms, which serves to reduce erosion; microcatchment basins may be installed to facilitate runoff capture and as a settling basin for sediments and seeds.

- Finally, seed collection and plant propagation through broadcast seeding appear to be the most practical for revegetation in most cases. Seed collection needs to be from target species occurring within 25 miles of the site to ensure that local ecotypes adapted to local climate, soil, and other site conditions are employed. Bulk seed can be collected by direct harvest from plants, underneath shrubs, and from windblown debris caught in depressions and washes; areas near roadsides or invasive plants would be avoided. The advantages of bulk seed include acquiring seed that may naturally be inoculated with beneficial microorganisms, acquiring a larger diversity of seed, including annuals, and acquiring seeds that can be sown immediately without concern for dormancy.

- Fall seeding is recommended, although seeding has been conducted throughout the winter. Broadcast seeding can be effective, but should be followed with a drag device to provide some soil disturbance and to bury the seed. Hydroseeding is not recommended because pre-soaked seed will fail in the absence of further irrigation. Seeds are especially vulnerable to predation by rodents, ants, birds, or other organisms, and methods (e.g., drill seeding) to protect seed by burying can be beneficial. Mulching appears to contribute to seeding success. Cleared vegetation from the site can be mulched or straw mulch used.

1.3.2.2 The Weed Management Plan

The *Weed Management Plan for the Ivanpah Solar Electric Generating System* (Attachment DR13-1A, Data Response Set 1F) describes the weed species that occur or are likely to occur in the project site, and prescribes management actions that may be taken to monitor for an eradicate-specified species. It also discriminates between ubiquitous species and those species that are currently rare or absent in the project site. The former are beyond eradication, and can be expected to be present as elements of the post-disturbance successional flora at Ivanpah SEGS. The Weed Management Plan (WMP) also describes applicable regulations for the use of herbicides on federally managed lands in California, and provides the basis for proper control of herbicides at Ivanpah SEGS.

1.3.2.3 Other Plans and Documents

The *Biological Assessment* (to be prepared by BLM), the Data Responses for the Ivanpah Solar Electric Generating System (all sets of data responses), and the *Preliminary and Final Staff Assessment/Draft and Final Environmental Impact Statement* for the Ivanpah SEGS are additional documents that provide relevant data, context information, and guidance for this Plan. (They have not been finalized at the time of this writing.)

1.4 Conservation and Management Plans

This section discusses the conservation and management plans relevant to surface management and noxious weed control at Ivanpah SEGS. These plans were developed either in response to regulatory mandates or following internal agency guidance.

1.4.1 California Desert Conservation Area Plan

The California Desert Conservation Area (CDCA) comprises one of two national conservation areas established by Congress at the time of the passage of the Federal Land and Policy Management Act (FLPMA). FLPMA outlines how the BLM will manage public lands and its overarching multiple use goals. Congress specifically provided guidance for the management of the CDCA and directed the development of the 1980 CDCA Plan (BLM, 1980). The 1980 CDCA Plan does not provide specifics on revegetation of disturbed sites, but specifies limits on manipulation of vegetation for purposes of noxious weed management, forage production, or wildlife management.

Specifically, the 1980 CDCA Plan limits the use of mechanical and chemical control of noxious weeds, as well as exclosures and prescribed burning, to certain land designations, and typically after a site-specific management plan is developed. In addition, the plan limits actions with adverse impacts on wetland and riparian areas, and requires initiation of programs to rehabilitate those areas in a deteriorated condition.

1.4.2 Northern and Eastern Mojave (NEMO) Coordinated Management Plan

As an amendment to the 1980 CDCA Plan, the BLM produced the Northern and Eastern Mojave Coordinated Management Plan (NEMO; BLM, 2002). This document consists of proposed management actions and alternatives for public lands in the NEMO Planning Area which encompasses 3.3 million acres, and includes the Ivanpah SEGS project. The area borders Nevada on the east, Fort Irwin and the West Mojave (WEMO) Planning Area on the west, and I-40 and the Northern and Eastern Colorado[5] (NECO) Planning Area on the south. The identified goals for the NEMO Planning Area include the following:

- Adopt standards for public land health and guidelines for grazing management;
- Identify management actions to conserve and recover threatened and endangered (T&E) species, including the Mojave population of the desert tortoise (*Gopherus agasizii*);
- Adopt a strategy for route designation in the NEMO Planning Area consistent with 43 CFR 8342.1.

This NEMO planning effort was developed in part in response to the USFWS recovery plan for the federal- and State of California-listed desert tortoise. The NEMO plan adopted the goals of both recovery plans and the recovery objectives for the desert tortoise. This planning effort has developed strategies that vary in some respects from the recommended actions in the USFWS recovery plan. These differences are based on identifying recovery unit and Desert Wildlife Management Area specific alternatives to meet the goals of the USFWS recovery plan.

1.4.3 Bureau of Land Management's Herbicide Usage Guidelines

The BLM prepared the *Final Programmatic Environmental Impact Statement Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States* (PEIS; U.S. Department of the Interior, 2007). This document incorporates extensive public input and outlines the specific decisions, standard operating procedures, and mitigation measures for the use of herbicides on BLM-managed lands. The selected alternative (Alternative B) identifies the herbicide active ingredients approved for use on BLM-managed lands. It also identifies herbicide active ingredients that are no longer approved for use. The record of decision for the PEIS defers to approved land use plans to determine the number of acres to be treated through the BLM's integrated pest management program.

The PEIS includes information in Appendix B (Herbicide Treatment Standard Operating Procedures) regarding management of noxious weeds and application of pesticides on BLM land. Table B-1, Prevention Measures, specifies avoidance measures to limit noxious weed

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[5] In California, the floristically defined Lower Colorado Valley subdivision of the Sonoran Desert (Shreve, 1964), lying in extreme southeastern California and adjacent Arizona and Mexico, is frequently called the "Colorado Desert."

infestation. This table can also be found in the *Weed Management Plan* (Attachment DR13-1A, Data Response Set 1F).

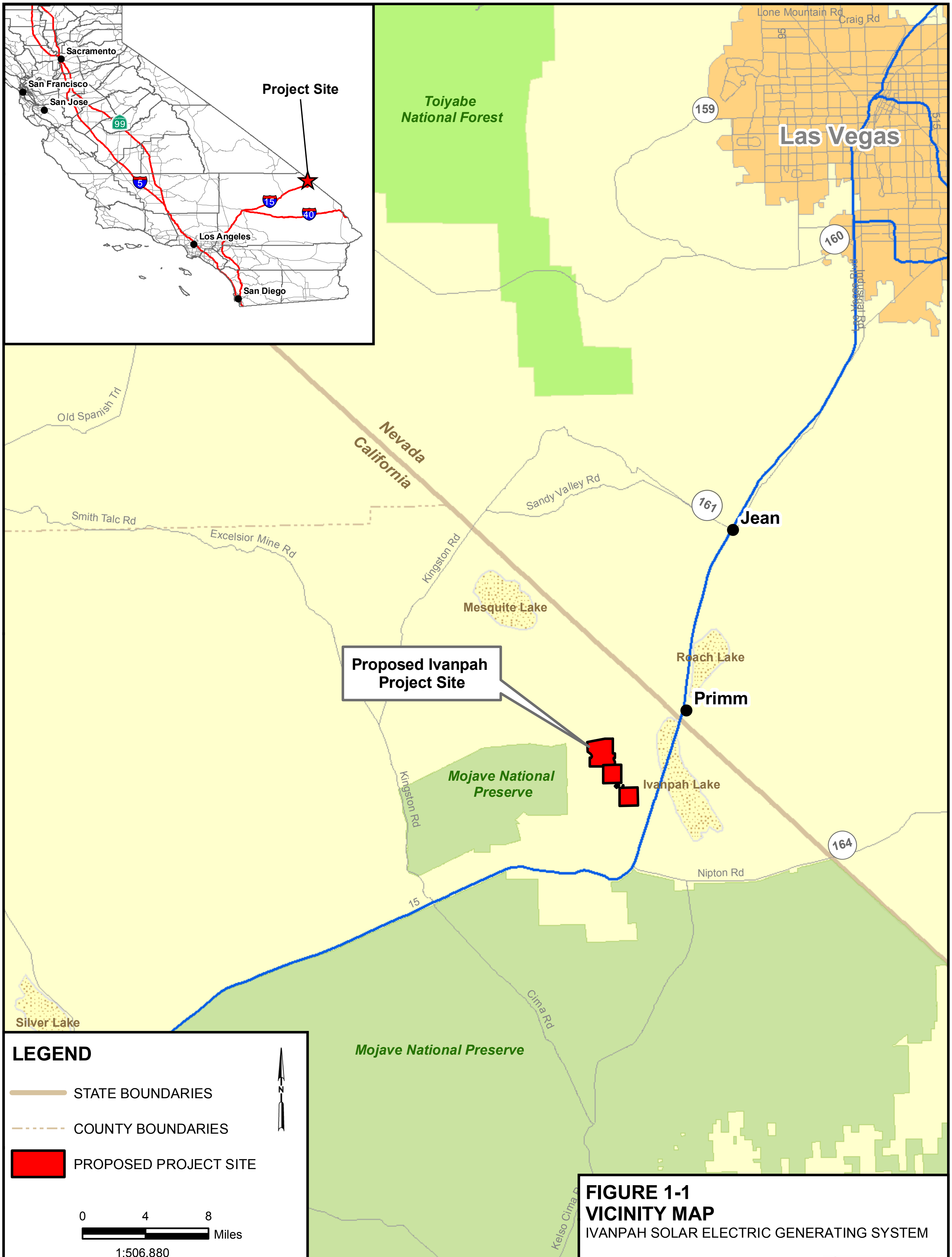

FIGURE 1-1
VICINITY MAP
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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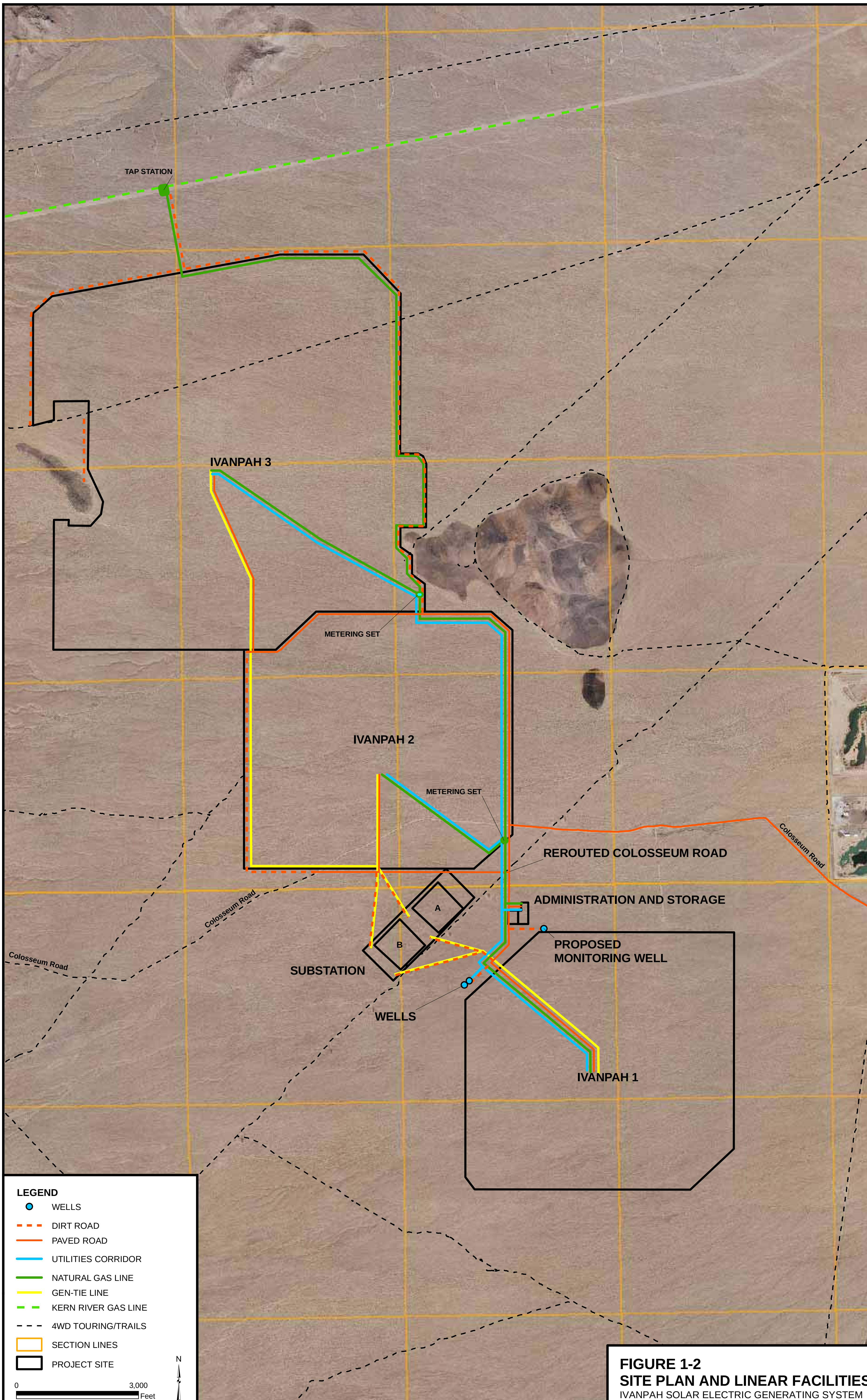
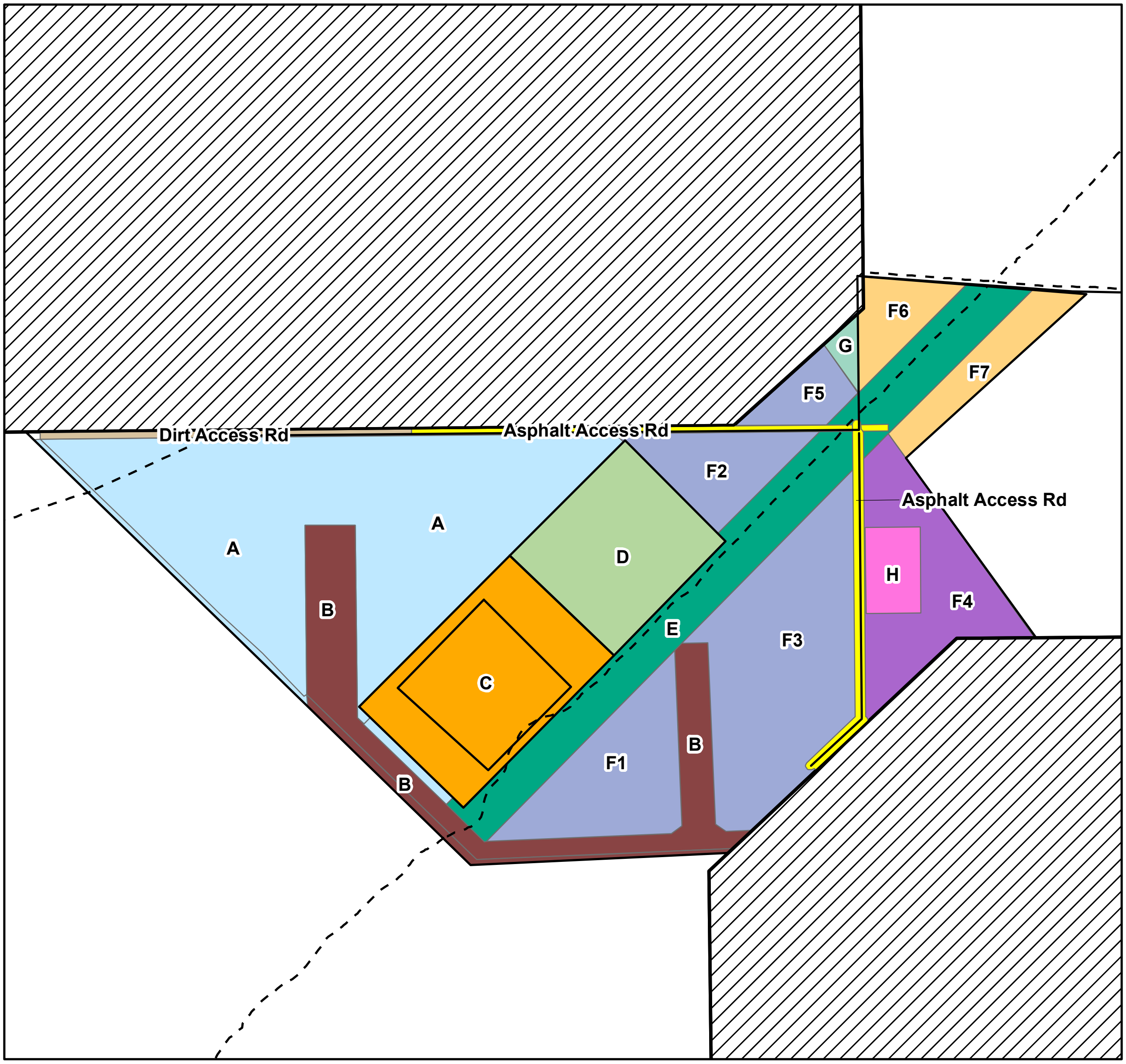


FIGURE 1-2
SITE PLAN AND LINEAR FACILITIES
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM



LEGEND
Construction Logistics Area
A: Potential Equipment and Material Storage (99.4 acres)
B: Retention Basins and Diversion Channel (29.1 acres)
C: Substation Location (35.6 acres)
D: Substation Construction Laydown (25.7 acres)
E: Existing Transmission Line Corridor (47.9 acres)
F1-F3, F5: General Construction Parking and Equipment Laydown (85.7 acres)
F4: Contractor Trailers (30.7 acres)
F6-F7: Equipment Laydown and Wash Areas (16.4 acres)
H: Administration/ Warehouse and Parking (5.7 acres)
G: Gas Metering Station Construction Laydown Area (1.6 acres)
Asphalt Access Rd: Not included in acreage calculations
Dirt Access Rd: Not included in acreage calculations
Project Site

0 600 1,200
Feet

N

FIGURE 1-3
CONSTRUCTION LOGISTICS AREA
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

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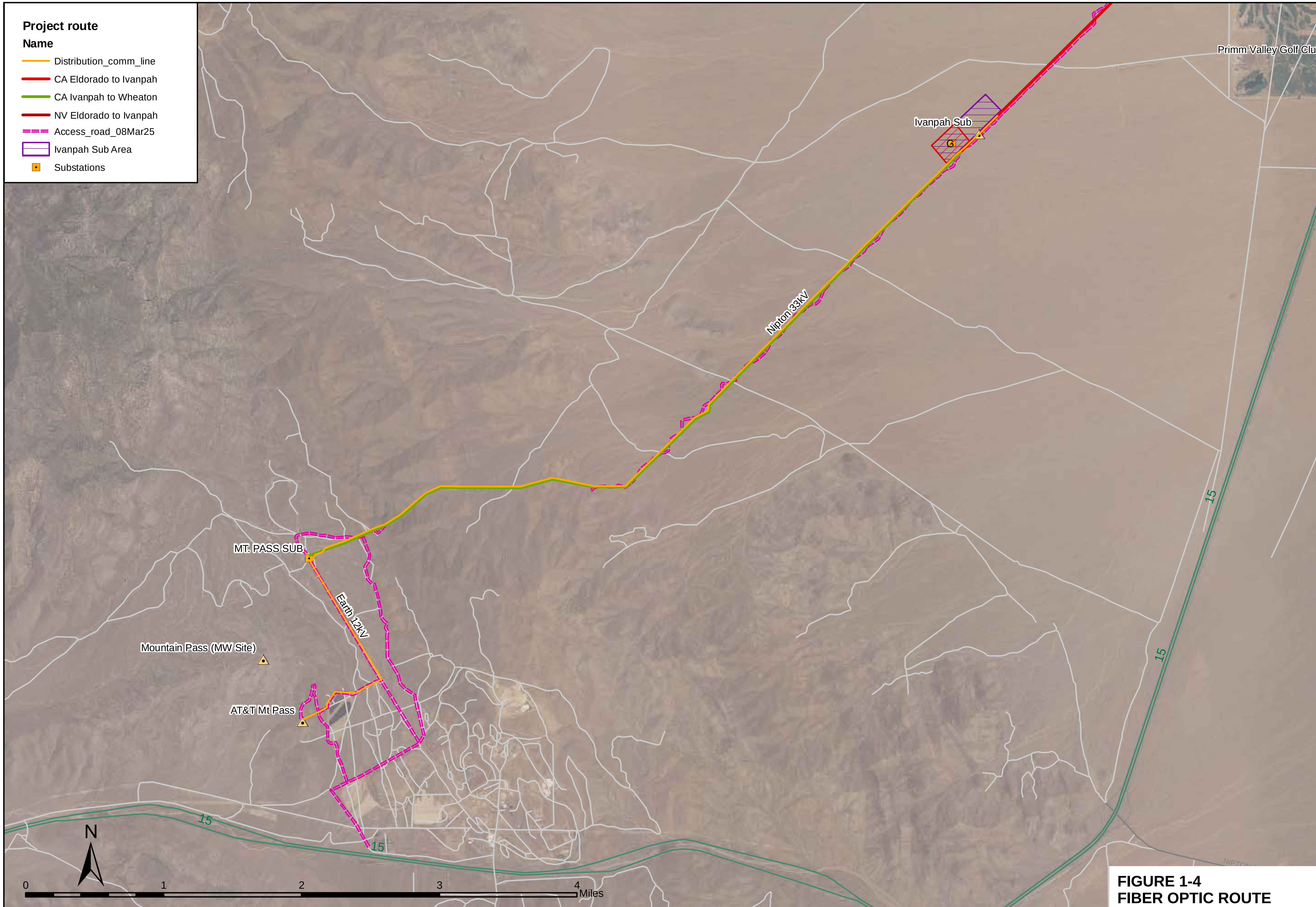

FIGURE 1-4
FIBER OPTIC ROUTE
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

Source: Southern California Edison

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SECTION 2

Rehabilitation Areas

Rehabilitation as used in this Plan refers to the removal of temporary or permanent structures, mechanical recontouring of the surface, mechanical measures to enhance soil conditions such as compaction or decompaction, and surface stabilization through revegetation. The rehabilitation activities discussed in this Plan address the three major phases of the Ivanpah SEGS project: construction, operations, and ultimate decommissioning. Temporary disturbance areas are those areas that are required for the construction phase of the project, and which will then be relinquished (in the case of laydown areas or extra work spaces) or no longer required for surface occupancy (such as a pipeline or transmission line ROW). Different areas will require different specific management considerations depending on a range of factors described in this section.

Project linears include new construction within undisturbed desert scrub for pipeline and transmission line ROWs, and activities associated with upgrades within existing ROWs. Construction staging areas and temporary access roads are also included. Pipeline construction would involve cut and cover techniques. Transmission line construction would involve some temporary disturbance along with permanent tower placement and an access road for maintenance.

2.1 Construction Phase

Ivanpah SEGS consists of three separate plants that would be built sequentially, with the shared facilities to be built with the first project. Rehabilitation during the construction phase will be focused on temporary disturbance areas, as described below.

2.1.1 Gas Pipeline

During construction of Ivanpah 1, approximately 6 miles of 4- to 6-inch gas pipeline, installed at a minimum depth of 36 inches, would be constructed as part of the construction of Ivanpah 1; with 4.6 miles being outside the Ivanpah 1 site boundary. The gas line will connect to the existing KRGT line at a 100-foot by 150-foot tap station, which would lie within the utility corridor to the north of the project site. A 75-foot-wide construction corridor would be used for construction of the gas line. In addition, a 200-foot by 200-foot construction area would be required for the tap station. After pipeline installation and testing, a 12-foot-wide dirt road would be maintained over or alongside the gas line for maintenance, resulting in approximately 36.3 acres of desert scrub that would require rehabilitation and revegetation along the line and at the tap station construction site, once construction of these elements is completed.

During construction of Ivanpah 2, the gas line will be extended from the 20-foot by 40-foot gas metering set in the southeast corner of Ivanapah 2 to the power block. Construction of the metering set that will serve Ivanpah 1 and 2, will use a construction laydown area of 1.37 acres. The section of pipeline serving Ivanpah 2 will be within the solar field and will not require rehabilitation and revegetation until the plant is decommissioned. However, the 1.37-acre construction area will be rehabilitated and revegetated once construction of the gas line to Ivanaph 2 and metering set is completed.

During construction of Ivanpah 3, the gas line will be extended from the gas metering set in the southeast corner of Ivanapah 3 to the power block. This section of pipeline will be within the solar field and will not require rehabilitation and revegetation until the plant is decommissioned. The construction laydown area for the construction of the Ivanapah 3 metering set will be located within the Ivanpah 3 solar field, and will not require rehabilitation and revegetation.

The ground disturbance associated with the cut and cover installation of pipeline includes disrupting soil horizons at depth. Key considerations include the following:

- Soil disturbance during construction and temporary use would create habitat well-suited to disturbance-adapted invasive species, and measures stipulated in the weed control management plan will need to be implemented.
- Cut and cover for pipeline construction and other construction activities will alter topographic surfaces, compact soils in some areas, and reduce the bonding of soil particles in other areas. These activities would increase the risk of erosion from wind and surface water, and soil-profile disruption will affect the capacity of the site to support revegetation. To accelerate revegetation and surface stabilization, the top soils would be stockpiled upon clearing of the ROW, and then redistributed after construction is complete. Other measures, such as compaction of soil where excavation took place, decompaction by ripping where vehicle compaction of surface layers took place, will be necessary to rehabilitate soil conditions and would be incorporated into the recontouring of the ROW.
- Revegetation with native species will be implemented as described in Section 7. Because of the large area, seeding with early-successional native species will be recommended. Succulent transplant would also be appropriate, with succulents removed from the site windrowed in trenches adjacent to the work area.

2.1.2 Water Pipeline

Well water would be used to supply domestic and industrial water needs. Two 100 percent redundant capacity wells would be located to the east of Ivanpah 1 that would supply water to all three plants. The wells would be connected to the project through an approximate 600-foot-long water line from the farthest well to the water main which would be located next to (or under) the paved road between Ivanpah 1 and 2, from where it would be extended to each plant. Approximately 2 miles of water line would be constructed as part of Ivanpah 1 from the wells to the Administration Building and to the power block of the Ivanpah 1 site. It is anticipated that a 50-foot-wide construction corridor will be needed. Approximately 3.6 acres of desert scrub would require rehabilitation and revegetation (the distance from the wells to Administration Building and to the top of Ivanaph 1). However, this segment of the water main will be within the larger Construction Logistics Area, which will be revegetated once construction of the three phases is completed.

During construction of Ivanpah 2 the water main will be extended from the Administration Building to the Ivanpah 2 power block, again assuming a 50-foot-wide construction corridor. Revegetation will occur along the line from the Administration Building to when it enters Ivanpah 2, a distance of about 1,600 feet. Hence, approximately 1.85 acres of desert scrub would require rehabilitation and revegetation. However, this area is also within the Construction Logistics Area, which will be revegetated once construction is completed.

During construction of Ivanpah 3 the water main will be extended along the east side of Ivanpah 2 to a location near the gas metering station, a distance of about 8,000 feet. At that point the water line will enter the plant and continue to the power block. The water line, along with the gas line, will be located outside the plant’s security fence and so will be revegetated once construction is completed. Hence, approximately 9.2 acres of desert scrub would require rehabilitation and revegetation.

The same considerations will be given to water line construction areas as are given to gas line construction areas.

2.1.3 Gen-tie Lines

The location of the Ivanpah Substation will likely be in location B shown on Figure 1-2; although the two locations were being considered are shown in the figure. One new single-circuit 115-kV overhead transmission line (the generation tie line, or “gen-tie” line) would extend from the Ivanpah 1 switchyard (at the power block) to the Ivanpah Substation. It would have an estimated length of about 6,600 feet from the edge of Ivanpah 1 to the location B substation site. The area temporarily disturbed during construction of the gen-tie line will require revegetation and weed management. However, this segment of the gen-tie line will be located within the Construction Logistics Area, which will be revegetated once construction of the third phase (Ivanpah 3) is complete. In addition, a 12-foot-wide dirt road would be maintained near the gen-tie line to provide ongoing access for insulator cleaning and transmission line maintenance. The gen-tie line and access road would enter the substation on the south end.

Similar to Ivanpah 1, Ivanpah 2 would require about 1,500 feet of gen-tie line to be constructed between the Ivanpah 2 site and the substation site (at location B). As with Ivanpah 1, this line will be located within the Construction Logistics Area, which will be revegetated once construction of the third phase is complete. Also, a 12-foot-wide dirt road would be maintained near the gen-tie line to provide ongoing access for insulator cleaning and maintenance.

During construction of Ivanpah 3, a 13,100-foot-long gen-tie line will be constructed from the Ivanpah 3 switchyard to a point at the south end of Ivanpah 2 where it will be added to the 1,500-foot-long section of transmission towers that bring the Ivanpah 2 gen-tie line to the substation. The 13,100-foot-long section of gen-tie line will be constructed within the security fencing of Ivanpah 2 and 3. Hence, that corridor will not require rehabilitation and revegetation until Ivanpah 3 is decommissioned.

Key considerations for revegetation of the gen-tie lines include the following:

- Soil disturbance in support of construction will increase likelihood of noxious weed introductions. Regular weed monitoring and management during construction would be required. Ongoing maintenance activities at towers will also have the potential for ongoing introduction of weedy species through soil disturbance and equipment entrance; ongoing weed management would be required.

- Where temporary access is needed to install facilities, no removal of existing vegetation or grading would occur. Rather, trucks and equipment would drive over and crush existing desert scrub vegetation without direct removal. Crushed vegetation is much more likely to show a rapid recovery than sites where vegetation is removed and reseeded, or where soils are more intensively disturbed.
- Where soil is substantially disturbed, rehabilitation and revegetation considerations listed for pipeline construction apply.

2.1.4 Staging and Laydown Area

The Construction Logistics Area between Ivanpah 1 and 2 will serve as the location for construction parking, staging site construction, including location of construction trailers, storing pipe and other pipeline construction materials (see Figure 1-3). Although some portions of the site would be subjected to permanent development, any remaining portions would be restored and revegetated when no longer needed, with the same key considerations of other restoration areas as described above.

2.2 Operations Phase

Rehabilitation areas identified during the operations phase are most likely to consist of areas that have been affected by sheet flow or scour resulting from flood events that are a dominant geomorphic element on this bajada. After due consideration to ensuring that through-drainage is maintained, those areas affected by water erosion will be revegetated according to the procedures outlined in Section 7, Site Rehabilitation Plan. Other surface management activities implemented during the operations phase are described in Section 5, Surface Management Plan.

2.3 Decommissioning

Decommissioning of the facility would occur sequentially in the reverse order of construction, with Ivanpah 1 being the first to be decommissioned, followed by Ivanpah 2, then Ivanpah 3 and the shared facilities being that last to be decommissioned. Access roads that are no longer required by the land management agencies would be rehabilitated. Physical components of the generation facilities and appurtenant utilities would be removed using the practicable methods that are least disruptive to the soils column and surrounding habitat and to a depth that will not impede growth of vegetative cover. The sites would then be recontoured, the soil environment rehabilitated, and the revegetation protocol using native species implemented as described in Section 7. The revegetated areas will be monitored for noxious weeds, and for reasonable progress in the vegetation succession. Section 8 provides the site closure plan, which includes a more detailed description of decommissioning activities.

SECTION 3

Existing Site Conditions

3.1 Project Location and Jurisdiction

The three solar thermal plants collectively referred to as the Ivanpah SEGS would be located in the Ivanpah Valley in southern California's Mojave Desert, near the Nevada border, to the west of Ivanpah Dry Lake (Figure 1-1). The project would be located in San Bernardino County, California, on federal land managed by the BLM. It lies a few miles north of the I-15 corridor, and a few miles east of the boundary of the Mojave National Preserve managed by the National Park Service. The BLM's management responsibilities under FLPMA include ensuring that lands under its jurisdiction are available for multiple uses, including appropriate economic pursuits such as mining, grazing, and energy development.

3.2 Physiographic Setting

The Ivanpah Valley lies in the Basin and Range physiographic province of the Western United States. Hydrographically, it is part of the Great Basin because it possesses no drainage outlet to the sea. The Ivanpah Valley is typical of Basin and Range valleys in that it is much longer north-south than it is wide east-west, and it lies at a relatively high altitude with base elevations on the playa of more than a half-mile above sea level. It lies about 45 miles west of the trough of the Colorado River.

The Ivanpah Valley is a topographically closed basin, and surface water drainage that does not evaporate or infiltrate reaches the valley axis, where it evaporates on Ivanpah Dry Lake or Roach Dry Lake. These playas possess a substantial drainage basin that extends over about 50 miles from the southern flank of Potosi Mountain, Nevada, in the northeast, to the eastern flank of Cima Dome, California, in the southwest. This drainage basin includes parts of the southern Spring Range, the Lucy Grey and Mescal Ranges, the New York Mountains, Clark Mountain, and the Mid Hills. Some of these orographic features extend to slightly high elevations and, together with the size of the drainage basin, make this basin capable of considerable runoff.

The Ivanpah SEGS project area extends over the eastern bajada of Clark Mountain, from an elevation of about 3,400 feet on its western boundary to about 2,800 feet on its eastern boundary. The bajada is composed of a number of coalescing alluvial fans that issue from different canyons on the east side of Clark Mountain. The bajada extends east to the edge of Ivanpah playa, descending over 5.5 to 6 miles from about 4,000 feet above mean sea level at the toe of the mountain, to about 2,610 feet on the edge of the playa. As is typical of these surfaces, the alluvium ranges from coarse, bouldery material near the fan head (also termed the apex or proximal portion of the fan), to fine sands and silts at the toe or distal portion of the fan.

From a geomorphological perspective, the alluvial fan complex, or bajada, over which the project extends is not a stabilized surface. Relatively recent erosional land forms in the form of channels, bar-and-swale topography, and areas of recent sheet flow typify much of the Clark Mountain bajada. The channels originate not only near the head of the bajada but also along its middle reaches, and extending across its toe, suggesting that the fan surfaces there are also not aggradational.

3.3 Local Environmental Factors

From the point of view of the biota of the Ivanpah SEGS project area, the most significant limiting factor in this ecosystem is drought, or the lack of free water available to plants and animals. Every organism native to this locality is adapted to drought conditions brought on by aridity. Other important limiting factors include high temperatures in the summer months, especially high surface temperatures (sustained in excess of 120 degrees Fahrenheit [˚F]), sustained intense solar radiation, and the occurrence of winter freezes.

3.3.1 Soils

Bainbridge (2007) suggests that two major soil classifications may be representative of most soils in the Mojave Desert: young undifferentiated soils, such as those occurring on flood deposits, and highly structured older soils. Older soils often contain caliche layers that effectively block moisture movement and root penetration, while younger soils can transmit water into deeper horizons. While this classification largely disregards the gradient that also exists with intermediate, moderately developed soils also being present, mature and young, undifferentiated soils are present at the Ivanpah SEGS.

From a geomorphological perspective, the alluvial fan complex, or bajada, over which the Ivanpah SEGS extends is not a stabilized surface. Relatively recent erosional land forms in the form of channels, bar-and-swale topography, and areas of recent sheet flow typify much of the Clark Mountain bajada. The channels originate not only near the head of the bajada but also along its middle reaches, and extend across its toe, suggesting that the fan surfaces there are also not aggradational. Ongoing dissection across the bajada shows that its current morphology is best classified as “erosional.” Data also indicate that more than 80 percent of the surface has been subject to relatively recent scour or deposition from washes originating in the hills to the west (CH2M HILL, 2008b).

Older alluvial surfaces at the Ivanpah SEGS are covered by desert pavement. Desert pavement surface is composed of closely packed, interlocking angular or rounded pebble to cobble-sized clasts. Older desert pavement surfaces are darker than younger surfaces lacking desert pavement because the clasts composed of resistant mineralogies support a dark coating of desert varnish. Fine, eolian silt often underlies desert pavement, and once the pavement “crust” is broken by heavy equipment, disruption of this landscape surface exposes the silt layer and leads to greater wind and water erosion. Furthermore, high salt concentrations are typically found in soils underlying desert pavement having small-sized clasts. Therefore, disruption of this type of surface can lead to mobilization of salts, including nitrate (Graham et al., 2008).

The soil types that are primarily affected by the Ivanpah SEGS are Arizo loamy sand, 2 to 8 percent slopes; and Popups sandy loam, 4 to 30 percent slopes. Table 3-1 provides typical pedon soil descriptions. Erosion potential of each through water is considered to be negligible to medium; and moderate to high through wind erosion (AFC, Soils Section). Soil map units are identified on a landscape scale. Dominant soil types typically occupy about 75 to 85 percent of the soil map unit; however, other soils that could have dissimilar characteristics can occupy 15 to 25 percent. Across the Ivanpah SEGS, there is also substantial variation in parent material, with a range that includes soils developed on polymineralic alluvium composed of granitic and metamorphic rocks, to those developed in alluvium derived from Paleozoic limestone and dolomite. Therefore, management and restoration decisions should be made only after a field investigation is performed to describe onsite soils and their physical and chemical properties.

TABLE 3-1
Soil Pedon Descriptions

Soil Unit	Horizon	Depth (inches)	Color	Description
Arizo Series (Map unit 3520): These are very deep, excessively drained soils that formed in mixed alluvium. Soils are usually dry, moist throughout for short periods from December through March. Periodically moist in upper part during July through October.	A	0 to 8	Light brownish gray (10R 6/2) dry; dark grayish brown (10YR 4/2) moist	Very gravelly fine sand, weak coarse platy structure; slightly hard, very friable, nonsticky and nonplastic; few fine and medium roots; few fine vesicular and many very fine and fine interstitial pores; 35 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary
	Bk	8 to 36	Light brownish gray (10YR 6/2) dry; dark grayish brown (10YR 4/2) moist	Extremely gravelly sand; single grained; loose, nonsticky and nonplastic; few fine and medium roots; many very fine and fine interstitial pores; 60 percent pebbles and 10 percent cobbles; few very thin coats of calcium carbonate on undersides of pebbles; strongly effervescent; moderately alkaline (pH 8.2); gradual wavy boundary
	C	36 to 62	Light brownish gray (10YR 6/2) dry; dark grayish brown (10YR 4/2) moist)	Extremely gravelly sand; single grained; loose, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine, and few medium interstitial pores; 60 percent pebbles, 20 percent cobbles and 3 percent stones; strongly effervescent; moderately alkaline (pH 8.2).

TABLE 3-1
Soil Pedon Descriptions

Soil Unit	Horizon	Depth (inches)	Color	Description
Popups Series (Map Unit 4122): These are moderately deep to a duripan, well-drained above the duripan	A	0 to 2	Brown (10YR 5/3) dray; dark brown (10YR 3/3) moist	Very gravelly sandy loam; weak medium platy structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and few fine roots; common fine interstitial pores and few very fine and fine tubular pores; 45 percent gravel; noneffervescent; slightly alkaline (pH 7.6); abrupt smooth boundary
	Bw	2 to 12	Yellowish brown (10YR 5/4) dry; dark yellowish brown (10YR 4/4) moist)	Gravelly sandy loam, weak medium sub-angular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and few fine and medium roots; few very fine and fine tubular pores; 30 percent gravel; noneffervescent; slightly alkaline (pH 7.6); gradual wavy boundary.
	Btk	12 to 33	Light brown (7.5YR 6/4) dry; brown (7.6YR 4/4) moist	Gravelly sandy loam, moderate coarse sub-angular blocky structure; very hard, very friable, slightly sticky and slightly plastic; common very fine and few fine and medium roots; common very fine and few fine interstitial and tubular pores; many discontinuous faint clay skins on ped faces and sand and gravel coats; few fine irregular soft seams of lime; 15 percent gravel, 3 percent cobbles, and 5 percent stones; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary
	Bkqm	33 to 60	Very pale brown (10YR 8/2) dry; pale brown (10YR 6/3) moist	Weakly cemented duripan, massive; very hard, very firm, brittle; violently effervescent. Has about 0 to 0.5 percent organic matter; 10 to 18 percent clay; depth to duripan is 20 to 40 inches

Source: U.S. Department of Agriculture, Natural Resources Conservation Services, 2008. (Official Soil Series Descriptions from Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Official Soil Series Descriptions [Online WWW]. Available URL: "http://soils.usda.gov/technical/classification/osd/index.html" [Accessed 24 July 2008]. USDA-NRCS, Lincoln, NE.

Desert soil temperatures can reach up to 160°F in the summer, and bare soils can exceed ambient air temperature by up to 25 to 32°F. These temperatures can inhibit plant growth; however, some plant species provide sufficient shade such that soil temperatures are reduced to survivable levels for other species rooted beneath their canopies. Soil temperatures in the spring and fall generally range between 70 to 86°F, which is conducive to plant establishment and growth. Soil temperatures are also moderated by summer rains, and some species, such as the cacti, can rapidly extend rootlet systems to take advantage of these periods of high soil moisture and lower temperatures.

Desert soils generally have low fertility, and most nutrients are located in surface soils. The high soil pH of desert soils (generally above pH 8 if calcium carbonate is present) further limits availability of many nutrients. Most desert perennials have been shown to be mycorrhizal (Bainbridge, 2007), and the root-zone symbiosis between these plants and the mycorrhizae can significantly increase the plant's ability to take up nutrients (especially phosphorus) and water. Additionally, some desert plant species (e.g., mesquite) are able to fix nitrogen by reducing atmospheric nitrogen to ammonia in root nodules that are formed in association with rhizobial bacteria.

3.3.2 Climate and Water Resources

Ivanpah Valley is an arid to semi-arid, topographically closed basin in the eastern Mojave Desert, about 50 miles west of the Colorado River trough. There are no meteorological stations at or near the Ivanpah SEGS. The closest meteorological station is at Mountain Pass 7 miles to the southwest which, at about 4,800 feet elevation, receives more precipitation and is colder than Ivanpah SEGS, which lies between 2,800 and 3,400 feet elevation. The Ivanpah SEGS AFC provides the precipitation data for Searchlight, Nevada, 32 miles to the east-southeast, as representative of the project site. At an elevation of about 3,540 feet it is near the elevation of Ivanpah SEGS. However, some analyses indicate that precipitation values for Searchlight are likely to be excessive for the project site. Although Searchlight is near the elevation of Ivanpah SEGS, its position farther east means that it receives more precipitation than comparable elevations to the west (Winograd and Thordarson, 1975).

To estimate the temperature and precipitation of the project site, lapse rate calculations were used based on the meteorological data from a Las Vegas, Nevada, low elevation station about 40 miles to the north-northwest, and from Mountain Pass. These calculations were based on long-term averages, as well as the 1971 through 2000 "normalized" period of measurement (Tables 3-2 and 3-3). They supersede those values published in the AFC as representative of the Ivanpah SEGS area. The estimated average annual and monthly precipitation and temperature for Ivanpah SEGS are presented as values for the lowest part of the project area (the northeast corner of Ivanpah 1 at ca. 2,760 feet elevation), and for the highest (the northwest corner of Ivanpah 3 at ca. 3,410 feet elevation). This approximately 650-foot elevation gain across the project area results in differences in estimated annual precipitation of more than an inch, and about 1.3˚F in mean annual temperature. The differences in estimated monthly precipitation between high and low elevations across the site are largest in the summer because lapse rates of precipitation with elevation are greater in the summer. This reflects the tendency of orographically-induced summer thunderstorms to nucleate over high topography, and for higher elevations to receive proportionately more precipitation during this season.

TABLE 3-2
Summary of Precipitation Data for Two Nearby Stations and Estimates for Ivanpah SEGS

Average:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Long-term period (Las Vegas, 1937 through 2007; Mountain Pass, 1955 through 2005)													
Las Vegas; 2,165 feet elevation	0.5	0.58	0.46	0.21	0.15	0.07	0.44	0.45	0.33	0.26	0.37	0.39	4.19
Mountain Pass; 4,790 feet elevation	0.94	0.91	0.89	0.47	0.27	0.2	1.04	1.23	0.59	0.52	0.69	0.64	8.40
Ivanpah SEGS SE (2,760 feet elevation)	**0.59**	**0.65**	**0.55**	**0.27**	**0.18**	**0.10**	**0.57**	**0.62**	**0.39**	**0.32**	**0.44**	**0.44**	**5.08**
Ivanpah SEGS NW (3,410 feet elevation)	**0.71**	**0.74**	**0.67**	**0.34**	**0.21**	**0.13**	**0.73**	**0.83**	**0.46**	**0.39**	**0.53**	**0.51**	**6.24**
Normalized period 1971 through 2000													
Las Vegas; 2,165 feet elevation	0.6	0.68	0.49	0.23	0.23	0.11	0.38	0.51	0.28	0.24	0.33	0.43	4.51
Mountain Pass; 4,790 feet elevation	1.07	1.19	1.03	0.5	0.36	0.33	0.95	1.27	0.65	0.43	0.74	0.83	9.34
Ivanpah SEGS SE (2,760 feet elevation)	**0.70**	**0.79**	**0.60**	**0.29**	**0.26**	**0.16**	**0.50**	**0.67**	**0.36**	**0.28**	**0.42**	**0.51**	**5.53**
Ivanpah SEGS NW (3,410 feet elevation)	**0.83**	**0.93**	**0.75**	**0.36**	**0.29**	**0.22**	**0.66**	**0.88**	**0.46**	**0.33**	**0.53**	**0.62**	**6.86**

Notes:
Grey-shaded values are estimates based on elevational lapse rates.
All values are in inches.
NW = northwest
SE = southeast
Source: Desert Research Institute, n.d.

TABLE 3-3
Summary of Temperature Data for Two Nearby Stations and Estimates for Ivanpah SEGS

Average of Daily Means:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Long-term period (Las Vegas, 1937 through 2007; Mountain Pass, 1955 through 2005)													
Las Vegas; 2,165 feet elevation	45.7	50.6	56.8	64.9	74.7	84.2	90.4	88.4	80.5	67.8	54.1	46.0	67.0
Mountain Pass; 4,790 feet elevation	39.9	43	47.4	53.7	63	73.1	79.7	77.3	70.2	59.3	47.6	40.6	57.9
Ivanpah SEGS SE (2,720 feet elevation)	**44.5**	**49.0**	**54.8**	**62.5**	**72.2**	**81.8**	**88.1**	**86.0**	**78.3**	**66.0**	**52.7**	**44.9**	**65.1**
Ivanpah SEGS NW (3,445 feet elevation)	**42.9**	**46.9**	**52.2**	**59.4**	**69.0**	**78.8**	**85.2**	**83.0**	**75.5**	**63.7**	**50.9**	**43.4**	**62.6**
Normalized period 1971 through 2000													
Las Vegas; 2,165 feet elevation	47.0	52.2	58.3	66.0	75.4	85.6	91.2	89.3	81.3	68.7	55.0	47.0	68.1
Mountain Pass; 4,790 feet elevation	39.4	42.6	47.2	54	62.5	73.7	79.5	77.6	70.5	59.1	47.4	39.9	57.8
Ivanpah SEGS SE (2,720 feet elevation)	**45.39**	**50.16**	**55.94**	**63.45**	**72.66**	**83.07**	**88.72**	**86.82**	**79.01**	**66.66**	**53.39**	**45.49**	**65.91**
Ivanpah SEGS NW (3,445 feet elevation)	**43.30**	**47.52**	**52.89**	**60.15**	**69.11**	**79.80**	**85.50**	**83.60**	**76.04**	**64.02**	**51.30**	**43.54**	**63.08**

Notes:
Grey-shaded values are estimates based on elevational lapse rates.
All values are in degrees Fahrenheit.
NW = northwest
SE = southeast

Source: Desert Research Institute, n.d.

The average monthly precipitation values show that most of the precipitation in the project site falls as winter rain during December through March, and as summer rains during the monsoon season of the Southwest, in July through September. This bimodal (winter-summer) precipitation regime is shared with the rest of the eastern Mojave Desert (Beatley, 1976), but not with regions farther west in the central and western Mojave Desert, where there is no predictable summer rainfall. Winter rains are associated with frontal systems moving inland from the Pacific Ocean, and can result in periods of cloudiness and intermittent precipitation lasting for days. Summer rains are the product of thunderstorms that result from the thermal convection and orographic uplift of maritime tropical air advected into the desert interior from the south and southeast. They are brief and frequently intense rainfall events that can produce considerable runoff.

The estimated rainfall for a 100-year 24-hour event is 3.28 inches, and 2.83 inches for a 6-hour event; a 10-year 24-hour event is 1.92 inches, and 1.60 inches for a 6-hour event. Intense rain events in southern California deserts can deliver the annual average rainfall in a short period of time, causing extensive sheet erosion and flash floods. The amount of moisture held within the soil depends on the amount of precipitation, rate of infiltration and retention, ground cover, and soil texture. Surface soils can be moist for only short periods of time during the year, and water typically evaporates before it can percolate deeper into the vadose zone. This process also results in the deposition of calcium carbonate leached from the surface, leading to thick caliche or calcrete horizons in older soils. Most water recharge occurs in desert washes, where sufficient moisture could remain to allow for establishment and survival of tree seedlings (Bainbridge, 2007). In the immediate vicinity of Ivanpah SEGS, the arborescent flora of the desert riparian vegetation is restricted to the catclaw acacia (*Acacia greggii*) and the desert willow (*Chilopsis linearis*).

Episodes of inundation of Ivanpah Dry Lake are relatively frequent, although the water seldom exceeds a few inches in depth, and concentrates in the lowest, northern end of the basin. There are numerous springs along the faults bordering the Clark and Mescal mountains, and the ephemeral washes of the flanking bajadas are innumerable. From a geomorphic perspective, the alluvial fan complex, or bajada, over which the Ivanpah SEGS extends is not a stabilized surface. Relatively recent erosional land forms in the form of channels, bar-and-swale topography, and areas of recent sheet flow typify much of the Clark Mountain bajada. The channels originate not only near the head of the bajada but also along its middle reaches, and extend across its toe, suggesting that the fan surfaces there are also not aggradational. Ongoing dissection across the bajada shows that its current morphology is best classified as "erosional." Data indicate that more than 80 percent of the surface has been subject to relatively recent scour or deposition from washes originating in the hills to the west (CH2M HILL, 2008b).

Groundwater from the deep Paleozoic carbonate aquifer (Winograd and Thordarson, 1975) is pumped from three well sites on the Clark Mountain bajada to supply the Primm Valley Golf Club, and would be used to supply potable water and process water to the Ivanpah SEGS. As could be expected, this water is relatively high in dissolved carbonates and silica.

3.4 Biological Resources

3.4.1 Biogeography

The Ivanpah SEGS project area lies entirely within Mojave Desert scrub vegetation. The Mojave Desert is one of the three warm deserts of North America; the Chihuahuan and Sonoran Deserts are the other two. The floristically (as opposed to hydrographically) defined Great Basin Desert to the north is the largest of North America's cold deserts, and would be considered chiefly steppe if it occurred in the Old World. The Mojave Desert is a temperate desert with cold winters as well as warm summers. In considering its latitudinal position, it is comparatively far to the north. The frequency and severity of winter freezes in this area is one of the principal limiting factors preventing the occurrence of a suite of warm-desert species typical of the Colorado Desert, not more than 100 miles to the south. These include distinctive forms such as smoke tree (*Psorothamnus spinosus*), palo verde (*Cercidium microphyllum*, *C. floridum*), and ocotillo (*Fouquieria splendens*). Catclaw acacia and desert willow are two arborescent desert plants that range far enough north to occur in and near the project site.

3.4.2 Vegetation Zonation

From the point of view of local elevation, lying between about 2,700 and 3,445 feet elevation, the Ivanpah SEGS project area is near the upper limit of creosote bush (*Larrea tridentata*)-burrobush (*Ambrosia dumosa*) desert scrub. While creosote bush as high as 6,000 feet elevation on south-facing slopes near its northern limit, creosote bush-dominated scrub does not typically extend above about 3,600 feet. The relative diversity of creosote bush-burrobush scrub here reflects its mesic character. At slightly higher elevations, mixed desert scrub is found, in which several woody perennials maintain co-dominance. Above this mixed desert scrub, generally between about 4,800 and 6,000 feet, blackbrush (*Coleogyne ramosissima*) scrub is the typical vegetation cover on alluvial slopes. Above this elevation, woodland can be found especially in mesic habitats. On the lower flanks and piedmont of Clark Mountain, the hallmark of the lower edge of woodland is the California juniper (*Juniperus californica*), which gives way at higher elevations to the more mesophytic Utah juniper (*J. osteosperma*)-pinyon (*Pinus monophylla*) woodland.

The hallmark of the Mojave Desert, the Joshua-tree (*Yucca brevifolia*), does not occur on the bajada extending from the edge of Ivanpah Dry Lake to the flanks of Clark Mountain. It occurs about 12 miles to the southwest near Mountain Pass, as well as in the southern Ivanpah Valley along the Cima Road. Its absence in the project site is a manifestation of Joshua-tree's typically patchy distribution (Rowlands, 1978). Recent reconnaissance located Joshua-trees on the piedmont of Clark Mountain to the west where it occurs primarily as an associate of woodland at elevations exceeding about 4,800 feet.

3.4.3 Local Plant Associations

The creosote bush-burrobush desert scrub of the Ivanpah SEGS project area is itself composed of several different plant associations that describe a continuum from xeric, low diversity scrub to mesophytic, mixed desert scrub at high elevations, and from disturbance-adapted scrub of recently scoured washes to the mature scrub of stable interfluves. Creosote bush is usually the dominant or co-dominant shrub species, while burro bush is usually more abundant but smaller. Common shrub and subshrub associates, especially at higher elevations near the transition with mixed desert scrub, include the following:

- Box-thorn or wolfberry (*Lycium andersonii*; *L. cooperi*)
- Ratany (*Krameria erecta*)
- Ground thorn (*Menodora spinescens*)
- California buckwheat (*Eriogonum fasculatum*)
- Paddle-leaf sage (*Salvia dorrii*)
- Virgin River brittlebush (*Encelia virginensis*)
- Mormon tea (*Ephedra nevadensis; E. funerea*)

Different succulent species occur in the project site, and are distributed throughout the creosote bush-burrow bush desert scrub. A few are visually prominent because of their size, such as the Mojave yucca (*Yucca schidigera*) and the staghorn cholla (*Opuntia acanthocarpa*). Barrel cacti present include both the California barrel cactus (*Ferocactus cylindraceus* var. *lecontei*) that ranges chiefly into the southern Mojave and Colorado deserts, and the cotton-top barrel cactus (*Echinocactus polycephalus*). Prickly-pear cacti include the relatively common beavertail prickly-pear (*Opuntia basilaris*), as well as the flapjack prickly-pear (*Opuntia chlorotica*) and the Mojave prickly-pear (*O. erinacea*), both of which have affinities with higher elevation desert scrub. Other cholla species include the diamond cholla (*Opuntia ramosissima*), the Mojave silver cholla (*O. echinocarpa*), and the club cholla (*O. parishii*). There appears to be a higher diversity and density of cacti on alluvial surfaces that are composed primarily of limestone clasts, or older surfaces that appear underlain by a well-developed carbonate horizon.

There is a diverse annual and short-lived biennial flora in the Ivanpah SEGS project area. The annual habit is an effective adaptation to desert environments. For most of the year and for most years, the plant remains as a seed in the soil, germinating and flowering only on those rare occasions when soil moisture is high and sustained for a sufficient period of time. Most herbaceous plants other than the grasses are winter annuals (e.g. *Bromus madritensis, Cryptantha* spp., *Eriogonum* spp., *Erodium cicutarium*, *Lepidium* spp.), while a smaller proportion are summer annuals (*Kallestroemia grandiflora, Tribulis terrestris*).

3.4.3.1 Disturbance-adapted Plant Associations

There is a different and distinct desert scrub plant association that occupies recently disturbed areas, such as the washes and arroyos that occur in abundance throughout the desert west. Ephemeral washes have poorly developed soils and usually support a distinctive, disturbance-adapted flora. The following perennials, although adapted chiefly to desert riparian habitats, can also occur on the interfluves on more mature soils:

- Cheesebush (*Hymenoclea salsola*)
- Black-band rabbitbrush (*Chrysothamnus paniculatus*)
- Desert almond (*Prunus fasciculata*)
- Wooly bursage (*Ambrosia eriocentra*)
- Bladder-sage (*Salazaria mexicana*)
- Catclaw acacia (*Acacia greggii*)
- Desert willow (*Chilopsis linearis*)

Catclaw acacia and desert willow are the only two small trees that occur near the Ivanpah SEGS.

3.4.3.2 Weedy Flora

The WMP lists the weed species that occur or could occur in the project area. There are a few woody perennials such as salt cedar (*Tamarix ramosissima*), tree-of-heaven (*Ailanthus altissima*), and camel thorn (*Alhagi camelorum*), but most are annual plants. The annual weeds include several species that have become well-naturalized in the region, and that function essentially as native plants to the extent that they occur in many different habitats and in areas far removed from human disturbance. These species are to be used as part of the revegetation effort to the extent that, if they self-seed into previously disturbed areas, they would be allowed to remain as members of the colonizing flora critical to accelerating revegetation. The weed species currently designated as part of the acceptable pioneer flora with utility in revegetation are the following:

- Red brome or red chess (*Bromus madritensis* ssp. *rubens*)
- Filaree or storksbill (*Erodium cicutarium*)
- Mediterranean grass (*Schismus arabicus*, *S. barbatus*)
- Tumble-weed, Russian thistle (*Salsola tragus*)

The term “weed” is normally applied to non-native plant species that typically colonize recently disturbed ground, but certain native annuals also share the trait of being adapted to recently disturbed soil. These include members of the Polygonaceae, especially species in the genus *Eriogonum,* some annual Asteraceae such as *Malacothrix* and *Geraea*, and the globe mallow *Sphaeralcea ambigua*.

SECTION 4

Native Plant Salvage and Reuse

As further discussed in the TBD, it is not a common practice to salvage desert shrubs for later transplant because those transplant efforts generally experience a low success rate. Therefore, Ivanpah SEGS would not salvage shrubs, not because they are unnecessary, but because such salvage efforts would be impractical. Certain succulent species (especially the cacti) are exceptions that are not only of relatively high aesthetic value, but have physiological adaptations that confer a significantly higher success rate on attempts to salvage and maintain.

4.1 Cacti and Yucca of the Project Area

4.1.1 Growth Forms

The cacti and yucca (collectively termed "succulents") of the project site are all native species; there are no introduced non-native succulents in the area. All share the trait of storing moisture in plant tissues above the ground, and in some (the barrel cacti), their entire aboveground biomass can be thought of as a single water storage organ; hence, the name succulent. Cacti are also leafless, and their chlorophylous surfaces consist of the tissue covering their stems. Most taxa are heavily armed with stout siliceous spines. Many species of *Opuntia* are also armed with glochids, which are millimeter-scale spines that readily detach and penetrate the skin. Cactus species readily generate rootlets and root systems in response to seasonal increases in soil moisture. However, even with these commonalities, there are several distinct body plans among the Mojave Desert succulents that are relevant to their handling and salvage.

4.1.1.1 Single-stemmed Cacti

The single-stemmed cacti, or cylindrocacti, are those cactus species characterized by a single stem, usually slightly inflated. They range from very large barrel cacti (e.g., the California barrel cactus [*Ferocactus lecontii* var. *cylindraceus*], the cotton-top barrel cactus [*Echinocactus polycephalus*]), to slightly small pincushion and fishhook cacti [*Coryphantha chlorantha, Mammilaria microcarpa*]). One plant can be composed of a single stem, such as the California barrel cactus, or there can be up to a dozen stems sprouting out to make up one individual, such as the many-headed barrel cactus and the hedgehog cactus (*Echinocereus engelmannii*). However, these stems always branch from the ground-level perennating (i.e. persistent from year to year) buds, and the stems neither branch nor are they segmented.

4.1.1.2 Segmented Cacti

Segmented cacti in the Ivanpah SEGS include prickly-pears (*Opuntia* subgen. *Platyopuntia*) and chollas (*Opuntia* subgen. *Cylindropuntia*), the latter also including *Grusonia* (Table 4-1) which is doubtfully distinct from *Opuntia* (Hickman, 1993). Prickly-pears are ascendant plants with an architecture composed of flat, jointed, succulent pads. Some prickly-pears

(*Opuntia chlorotica*) can grow up to 5 feet in this area, while other taxa (*O. basilaris*) can be diminutive and consist of a few to a dozen or so pads that do not branch extensively. Chollas are more typically ascendant and shrub-like, although their branching architecture consists of succulent, cylindrical joints. Buckhorn chollas (*Opuntia acanthocarpa*) can exceed 5 feet in height and, with dense golden spines, can be more visually appealing compared with the non-descript and smaller silver cholla (*O. echinocarpa*). Cholla joints are cylindrical and those of most species are relatively short and detach easily from the mother plant with no injury. Their spines are typically sheathed with microscopic recurved barbs, and are of a design that allows the joints to "hitchhike" once they attach to the foot of an animal. Accordingly, cholla cacti often reproduce vegetatively as dropped joints are scattered beyond the parent plant, and then take root.

TABLE 4-1
Succulents Found Growing Within the Ivanpah SEGS Project Area

Taxon	Common Name	Notes
Cactaceae		
Coryphantha chlorantha	Desert pincushion	C; cryptic
Echinocactus polycephalus	Cotton-top or clustered barrel cactus	C
Echinocereus engelmannii	Hedgehog cactus	C
Ferocactus cylindraceus var. *lecontei*	California barrel cactus	C; highly valued as a landscaping element
Grusonia [*Opuntia*] *parishii*	Parish club-cholla	S; the only cholla with a prostrate habit
Mammillaria tetrancistra	fish-hook cactus	C; cryptic
Opuntia acanthocarpa var. *coloradensis*	buckhorn cholla	S
Opuntia basilaris var. *basilaris*	beavertail prickly-pear	S
Opuntia chlorotica	pancake prickly-pear	S; more common in higher elevation mixed scrub habitats
Opuntia echinocarpa	silver cholla	S
Opuntia echinocarpa x *O. ramosissima*	hybrid silver x pencil cholla	S
Opuntia erinacea	Mojave prickly-pear	S
Opuntia ramosissima	pencil or diamond cholla	S
Liliaceae		
Yucca schidigera	Mojave yucca	Y

Notes:
C = cylindrocacti (single-stemmed cacti)
S = segmented or jointed cacti
Y = yucca

4.1.1.3 Yucca

Although technically succulents, yucca species are unrelated to cacti, are actually perennial monocots (grasses and allies), and are classified in the lily family (Table 4-1). There are several yucca native to the Mojave Desert, although only one species, the Mojave yucca (*Yucca schidigera*), occurs in the Ivanpah SEGS project area. Younger Mojave yucca plants lack trunks, and possess stout, inflexible leaves that are more than 24 inches long with sharp, piercing tips. Older Mojave yucca possess single or simple-branching trunks sheathed in dead leaves, with a rosette of live leaves at the top of the trunk. Leaves of these older plants are generally less than 18 inches long, but still quite stout and sharp-pointed.

4.2 Ecophysiologically Relevant Notes

The ecophysiology of North American cacti was a principal subject of study during the first decades of the 20th Century, as summarized by McGinnies (1981). Cacti resist desiccation partly because they lack leaves and have a very small surface-to-mass ratio. Their cuticle is also slightly thick, with stomata that close tightly during the day, open after dark, and respire at night to reduce moisture loss. Their root systems can also grow rapidly in response to increases in soil moisture, and rootlets also dieback readily, minimizing moisture loss caused by soil desiccation. Injuries, whether to the stem or root system of cacti, also callous quickly in the absence of fungi or other pathogens. Cacti are also rich in water and nutrients.

Many of the physiological adaptations of succulents to desert environments also mean that they are relatively easy to transplant successfully if appropriate measures are taken. Some of these measures anticipate the vulnerability of cacti to soil pathogens. Rooted primarily in dry soils, cacti typically do not have the resistance to fungal pathogens possessed by most plants of more humid habitats.

The transplant success rates for yucca species are significantly below those for cactus species.

4.3 Relevant Laws, Ordinances, Regulations, and Standards

4.3.1 Federal LORS

The Federal Endangered Species Act, Section 7 (FESA; 16 United States Code, Section [§] 1531 et seq., 50 *Code of Federal Regulations* §17.1 et seq.) provides for the designation and protection of threatened and endangered plant, as well as animal species, and habitat critical to their survival. The FESA authorizes the USFWS to review a proposed federal action to assess potential impacts on listed species. Listed species are those that have been determined to be endangered or threatened after study, and have been listed in the *Federal Register*. The FESA prohibits the "take" of listed species. The FESA and implementing regulations define "take" to include mortality and other actions that could result in adverse impacts such as harassment, harm, or loss of critical habitat. No succulent species are federally listed as threatened or endangered were observed during comprehensive biological surveys at the Ivanpah SEGS, and none are anticipated to occur at the project site.

4.3.2 State and Local LORS

The Native Plant Protection Act (NPPA) of the 1977 Fish and Game Code (Sections 1900 through 1913) directed the CDFG to carry out the Legislature's intent to “preserve, protect and enhance rare and endangered plants in this State.” The NPPA gave the California Fish and Game Commission the power to designate native plants as “endangered” or “rare” and protect endangered and rare plants from take.

The California Desert Native Plants Act of 1983 (Division 23 [commencing with Section 80001]) of the Food and Agricultural Code is intended to protect California desert plants from unlawful harvesting on both public and privately held lands, and to provide information necessary to legally harvest native plants. This code allows removal of certain non-listed desert plants under permits issued by the county agricultural commissioner or sheriff. The Act specifically defines plants that may have limited harvest with appropriate landowner approval and permitting. "Landowner" includes the public agency administering any public lands within the areas subject to this division. The county agricultural commissioner may establish specific cutting, harvesting, and plant care criteria that would include the most favorable and practical horticultural methods and seasons to ensure the survivability of the plants, and to ensure compliance with existing local, state, and federal regulations.

Title 8 of the San Bernardino County Development Code, Division 9, Plant Protection and Management, includes regulations on removing and salvaging desert plants. Chapter 4, Desert Native Plant Protection, prohibits removal of protected desert plants, except as approved by the State Department of Food and Agriculture, and as specified in the Desert Native Plant Act of 1983, as amended. The San Bernardino County Agricultural Commissioner will be responsible for issuing the appropriate tags, seals, and permits required by the state. However, this regulation generally applies only to private lands, or unincorporated county land, and does not apply to federal government lands.

4.3.3 Standards

The BLM does not allow the collection or the take of cacti and yucca on federally managed lands without a special use or other applicable permit. Although most cactus species are not on the BLM’s (2004) Sensitive Plant List, the BLM typically requires some level of salvage of succulent species in the Mojave Desert of California and adjacent Nevada. These standards usually follow a hierarchy of perceived horticultural value whereby those species most valued by landscapers and collectors (and those most commonly lost as a result of poaching on federal lands) are most frequently identified for salvage.

4.4 Affected Species and Species to be Salvaged

Table 4-1 lists the succulents within the Ivanpah SEGS project area, and notes their growth forms and other information in the notes column. During biological surveys of the project site, the locations of barrel cacti (both cotton-top and California barrels) were recorded with handheld geographic position system (GPS) units. The data indicate that there are several thousand barrel cacti within the Ivanpah SEGS project area, although densities do not appear high at less than 15 plants per acre, as discussed in the Ivanpah SEGS *Draft Biological Assessment for the Ivanpah Solar Electric Generating Station* (Ivanpah SEGS, 2008).

4.5 Salvage Techniques

This section codifies acceptable salvage techniques for all cactus species regardless of whether those species are planned for salvage at this time.

4.5.1 Flagging during Sweeps for Tortoise Removal

Qualified field technicians would be responsible for locating and flagging succulents during the sweeps of the areas to be disturbed before construction kickoff. The surveyor's tape to be used will bear a specific color/striping scheme to distinguish it from the marking tapes being used by crews, such as the tortoise biologists.

4.5.2 Removal and Cleaning

Large succulents, such as the larger barrel cacti, would be salvaged using a three-man crew, a small bobcat-style front-end loader, and a flatbed utility truck. The plant will first be wrapped with burlap, and a guide rope will be affixed, if necessary. The bucket of the front-end loader would then scoop the plant (including the root ball) out of the ground. The plant would then be carried to the flatbed truck and heeled over on the bed of the truck. Care will be taken to minimize disturbance to the main root mass, and to minimize damage to the plant from truck transportation. Succulents would be arrayed just one layer thick during transportation to avoid damage.

Smaller single-stemmed succulents would be salvaged using two-man crews with shovels. The succulent will be manually dug out of the ground, taking care to minimize damage to the root ball. The plant will then be heeled over onto a pallet. When full, the pallet will be secured with burlap. When a number of secured pallets are ready, they will be picked up by a forklift-equipped bobcat and placed in a flatbed utility truck for transport to the stockpile area. The base of the single-stemmed succulents would be brushed with a coarse fiber brush or broom to remove excess dirt. The roots and rootlets would be trimmed with clippers to a length of 2 to 6 inches from the mother plant. This will allow the root system to callous and dry, thereby minimizing the chance of fungal growth.

Segmented cacti (chollas and prickly-pears) would be salvaged by taking cuttings (the prickly-pears) or (for the chollas) simply breaking off a series of the easily detachable joints. The highly spinescent cactus pads and joints should be handled carefully to prevent them from getting tangled, and for health and safety concerns. For prickly-pear pads and cholla joints, using simple paper bags can be effective. They allow easy handling and labeling of the specimens, and allow their exteriors to dry and detachment points to callous without promoting fungal growth.

4.5.3 Transplanting and Temporary and Long-term Stockpiling

Succulent stockpiles would be used if the plants are not to be immediately donated or transferred to another party and transported offsite. An open-air nursery area would be a separately designated and fenced area used for succulent stockpiling.

Temporary stockpiling is recommended prior to transplanting because it allows the damaged roots to callous over, the base of the plant to dry and, therefore, minimizes the chance of fungal growth, which is frequently fatal to cacti. Cacti, to be temporarily stockpiled, will first need to have their roots trimmed as previously described. The plant would then be gently laid on its side on a pallet and allowed to air dry for at least 3 weeks but not longer than 6 months. Collected cholla joints and prickly-pear pads should also be allowed to dry under cover for a period of one to several weeks. Because they are generally smaller, they cannot be subject to desiccation for as long as the single-stem cacti, and should be replanted within 3 months of harvesting.

For long-term stockpiling that might be required for long-term revegetation, cacti should be planted in windrows that are created by excavating a linear trench, and then healing one cactus into the trench at generally regular intervals so that each cactus is spaced sufficiently (usually 1 to 2 feet) to allow mechanical recovery of the plant with no injury to adjacent plants. Larger plants (e.g., barrel cacti) can be healed into the ground with the use of a backhoe and an assistant with a shovel. The cactus should be buried so that its base is underground. The soil to be used will be the native soil screened to remove cobble-sized and larger rocks. The succulents planted for long-term stockpiling in pre-dug linear trenches will not be watered unless it is determined that there has been a significant rainfall deficit at the nursery site for more than 6 months. A single pass with a watering truck every 3 months should be sufficient to permit most plants to survive.

4.6 Succulent Reuse, Donation, or Sale

Although it is suggested that salvaged succulents could be used for seed source (Section 1.3.1) this practice is not widely used in revegetation in the arid west because vegetative propagation of cacti is simple and effective. Cuttings of *Opuntia* species (prickly-pear and cholla), and transplants of single-stem cacti, are far more hardy that cactus seedlings. Cacti planted in the open-air nursery for long-term stockpiling can be accessed to collect seed in favorable years after they set fruit. Their close proximity in the nursery should promote good pollination.

Reuse, donation, or approved sale of cacti may be identified by Ivanpah SEGS and the BLM as appropriate manners of disposition of the cacti in long-term stockpiles. There would be some use for cacti in revegetation of temporary disturbance areas, but this use would be limited according to the area from which the salvage took place. Although specific planting strategies have yet to be developed, succulents can be transplanted into recently seeded areas to provide increased microhabitat heterogeneity. Nevertheless, there would be large areas occupied by Ivanpah SEGS that would not be available for revegetation until after decommissioning, which is planned to occur about a half-century after build-out. At this time, Ivanpah SEGS does not plan to maintain a long-term stockpile of succulents for use in revegetation after decommissioning.

SECTION 5

Surface Management Plan

5.1 Erosion Control

Because the proposed site is located on federal land under the control of the BLM, the project is not under the direct authority of San Bernardino County. However, for design purposes, the erosion and sedimentation control BMPs will be engineered to meet the requirements of San Bernardino County, unless other specific direction is provided by the BLM or CEC. Construction of the project would also be subject to requirements of the state National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction Activities. BMPs will be developed and implemented to provide an effective combination of erosion and sediment controls.

Source controls and structural controls are proposed for management erosion and sedimentation, and include the following (see DESCP, Attachment DR140-1A, in Data Response Set 2B).

1. Existing vegetation will be mowed and root systems will be left to minimize wind and water erosion, except where needed for construction or maintenance.
2. As needed, stone filters and check dams would be strategically placed throughout the project site to provide areas for sediment deposition and to promote the sheet flow of stormwater before leaving the project site. Where available, native materials (rock and gravel) would be used to construct the stone filter and check dams. A stone crusher may be provided onsite to allow for use of local stone to produce gravel.
3. Ephemeral washes that convey offsite drainage onto the project site are to be directed to detention ponds and diversion channels to control velocities and redirect the flow of water.
4. Diversion berms are to be used to redirect stormwater. Diversion channels will be armored, as required, to prevent erosion and scouring.
5. Erosion and sedimentation control calculations will be performed to verify acceptable stormwater velocities, calculate BMP cleanout frequencies, and to size riprap.
6. Silt fences would be used extensively during each phase of construction to minimize wind and water erosion. Silt fence locations have yet to be determined and will provided on the 90 percent engineering drawings.
7. Periodic maintenance would be conducted, as required, after major storm events and when the volume of material behind the check dams exceeds 50 percent of the original volume. Stone filters and check dams are not intended to alter drainage patterns but to minimize soil erosion and promote sheet flow.
8. Erosion and sedimentation control BMP design is to be in accordance with applicable federal, state, and local codes and standards.

Because low-impact development practices will be incorporated into the project design, construction, and operation, the increase in sediment yield from the project site is not expected to be substantially greater than pre-project condition. Where only limited grading is required on the sites, natural vegetation would be cut off at ground surface, and many species, such as creosote bush, can resprout. Above- and belowground portions of plants would only be removed in areas that require more extensive grading. By limiting disturbance of existing vegetation, plants will continue to filter both water- and wind-carried sediment.

5.2 Post-Construction Site Stabilization

Site areas disturbed during construction will be permanently stabilized by aggregate paving, bituminous paving, or seeding with native seed depending on their intended use during the operational phase of the project. All areas to be seeded will use solely indigenous plant species. Following site disturbance, but prior to permanent stabilization, site areas disturbed during construction would be temporarily stabilized with mulch produced from local materials. Detention pond inlet and weirs will be topped with local stone (riprap) to protect against erosion. Termination of the General Permit for Stormwater Discharges Associated with Construction Activities will be obtained once the permit’s stabilization requirements have been achieved.

5.3 Heliostat Washing

Heliostat washing would occur at night, at a rate of 2.5 gallons per heliostat, and at 2-week intervals. A worst-case scenario of mirror wash water quality is provided in Table 5-1, along with the estimated loading of each constituent over the 50-year life of the project. These concentrations are not expected to adversely affect rehabilitation efforts. Although the wash water pH is alkaline, it is not substantially different than the existing soil pH (about 8.2).

TABLE 5-1
Estimated Wash Water Quality and 50-Year Buildup (Table DR137-1 from Data Response, Set 2B)

Constituent	Concentration	Estimated 50-year buildup (lbs/ac)
Hardness as $CaCO_3$	0.005 mg/L	0.008
Copper	0.01 mg/L	0.016
Iron	0.03 mg/L	0.047
Silica	0.3 mg/L	0.474
Conductivity	<1 µS/cm (<.001 dS/m)	
pH	8.5	

Notes:

µS/cm = microSiemens/cm
$CaCO_3$ = calcium carbonate
dS/m = deciSiemens per meter
lbs/ac = pounds per acre
mg/L = milligrams per liter

The amount of wash water that is expected to infiltrate the soil during washing is minimal (0.005 inch across the site; Table 5-2). Because water will drip off the mirrors' bottom edges onto the soil surface immediately below each mirror, and will not be distributed uniformly across each of the sites, Table 5-2 underestimates the actual water depth that would be produced in the soil with washing. Nevertheless, with washing occurring at 2-week intervals, all wash water is expected to evaporate, leaving little, if any, water available for weed establishment or plant growth. (For comparison, annual pan evaporation in the Mojave is about 100 inches.) However, if growth of weedy species is found to be promoted with mirror washing, appropriate control measures would be required. Chemical weed control, if needed, would likely be required only once per year, in the spring and would be implemented according to the protocol specified in the approved *Weed Management Plan* for this project (Attachment DR13-1A, Data Response Set 1F).

TABLE 5-2
Estimated Wash Water Volume and Depth per 2-Week Wash Cycle (Table DR137-2, Data Response Set 2B)

Location	Number of Heliostats	Heliostat Field Area (acres)	Wash Water Amount (gallons per wash cycle)	Wash Water Amount (acre-inch per wash cycle)	Wash Water Depth for Site (inches per wash cycle)
Ivanpah 1	55,000	914	137,500	5.06	0.006
Ivanpah 2	55,000	921	137,500	5.06	0.005
Ivanpah 3	104,000	1,843	260,000	9.57	0.005
Total	214,000	3,677	535,000	19.70	**0.005**

Evaporation will leave a minimal amount of residual salt accumulation, which would be translocated downward through the soil profile or be transported with runoff during winter rains. The wash water is not expected to have an adverse effect on soil permeability because sodium concentrations are negligible.

5.4 Wildlife and Habitat Management

As previously noted, to minimize impact on the soil, blading for the facilities would not go deep (i.e., less than 3 inches) and would be limited to areas required for construction access and heliostat maintenance. Therefore, substantial populations of small vertebrates and arthropods would persist within the boundaries of the heliostat fields. Borrows would remain at least partly intact in bladed areas, and crown sprouting of some shrubs after construction can be expected. Therefore, the functioning elements of an ecosystem would be part and parcel of the operational phase of the Ivanpah SEGS.

The fauna of the Ivanpah SEGS heliostat fields is likely to include packrats (*Neotoma lepida*), kangaroo rats (*Dipodomys* sp.), and smaller rodents such as the pocket mice and deer mice (*Perognathus* sp., *Peromyscus* sp.), snakes including rattlesnakes (*Crotalus* sp.), a number of lizard species, and a variety of insects. Desert tortoise will be removed prior to construction, and larger vertebrates would likely be kept out of the heliostat fields by the tortoise and security fencing. This is likely to include larger predators including the ubiquitous coyote (*Canis latrans*), but perhaps not the smaller predators such as the kit fox (*Vulpes macrotis*) or the badger (*Taxidea taxus*). Measures to manage this seminatural ecosystem within the boundaries of Ivanpah 1, 2, and 3 should be guided by a “hands-off” principal as much as is practical and consistent with health and safety concerns. The water from nocturnal mirror washing may attract small vertebrates, but these are expected to congregate after the washing truck passes. Should there be high population growth rates of small vertebrates within the fence line, it could attract predators and some, such as the badgers, are industrious diggers. Therefore, careful and frequent monitoring of the tortoise fence will be necessary.

SECTION 6

Preliminary Landscape Design

It is anticipated that some onsite facilities would require landscaping. This section describes appropriate low water use conceptual landscaping plans that provide soil stabilization, aesthetic benefits, and microhabitat improvement at plant facilities. Areas that would benefit from landscape improvements include the Wastewater Treatment, Administrative, and Electrical Building, and potentially the facility entrance plaza. These landscape plans would require minimal irrigation (with recycled plant water), consist of California natives present in the region, and provide some shade and visual relief.

6.1 Landscape Design

6.1.1 Planting Design

The landscape design goal is to produce a robust and manageable desert landscape. The landscaping would use an entirely native palette using natural clumping patterns with select plants used as highlights. The design will include small desert trees, accents, shrubs, and groundcovers, and may be seasonally enhanced with native wildflowers. Ongoing management of the landscape would ensure a relatively manicured appearance appropriate for developed facilities. Supplemental irrigation using recycled water will be available, as needed, to minimize normal seasonal diebacks.

6.1.2 Plant Palette

The plant palette for landscaping will consist of all native California desert plants, primarily consisting of those found onsite during the biological investigation, and all naturally present in the desert region near the Ivanpah SEGS project area. This is as required by the resource agencies and committed to in the AFC. Table 6-1 provides the proposed conceptual plant palette.

TABLE 6-1
Preliminary Plant Palette, Ivanpah 1 Landscaped Areas

Botanical Epithet	Common name
Acacia greggii	catclaw acacia
Ambrosia dumosa	burrobush, white bursage
Chilopsis linearis var. arcuata	desert willow
Echinocactus polycephalus	cotton-top barrel cactus
Encelia virginensis	Virgin River brittlebush
Eriogonum deflexum	flat-topped buckwheat
Eriogonum fasciculatum ssp. polifolium	California buckwheat
Ferocactus cylindraceus var. lecontei	California barrel cactus
Hymenoclea salsola	cheesebush
Yucca schidigera	Mojave yucca
Salvia dorrii	desert sage

Figure 6-1 provides a conceptual planting plan for the Administrative/Warehouse Building and the adjacent parking area.

6.2 Planting Requirements

6.2.1 Plant Stock

Plant material used for facility landscaping would include salvaged material from developed sites (succulents), along with native plant material acquired locally or contract-grown for site rehabilitation activities.

6.2.2 Soil Preparation

Soil preparation will require native topsoils to be banked during construction and replaced to a minimum depth of 8 inches. Prior to topsoil replacement, decompaction should be implemented to loosen lower soil horizons after parking and building construction activities are complete.

6.2.3 Fertilizers and Additives

Mycorrhizae inoculum may be used to increase plant growth; however, native soils may have adequate inoculum depending on duration of stockpiling. Native plants are normally adapted to low nutrient conditions, and fertilizers are generally not required. However, if necessary, low doses of organic fertilizer supplements can be used. To discourage weed growth, no chemical fertilizers should be used.

6.2.4 Mulch

Vegetation cleared from the site during construction may be shredded and used as mulch. Alternatively, decorative gravel soil coverings are sometimes used in desert landscaping.

6.3 Irrigation Requirements

The limited landscape planting areas are proposed to use treated wastewater for supplemental irrigation to extend growth and flowering periods for the desert palette. Irrigation would be applied through drip tubing directly to the base of plants. In general, irrigation requirements are anticipated to be small, and application should be monitored to avoid overwatering, which can damage dry-adapted desert vegetation.

6.4 Operations and Maintenance

Typical operations and maintenance requirements for native landscapes are low once established. Anticipated measures include weeding, annual pruning, and soil monitoring.

6.4.1 Weeding

Weeding should occur frequently, typically weekly, during the initial growth period to ensure that invasive plants do not mature and set seed. Weeding activities will follow the approved WMP. Once the native materials are established, weeding frequency would drop to a quarterly interval.

6.4.2 Pruning

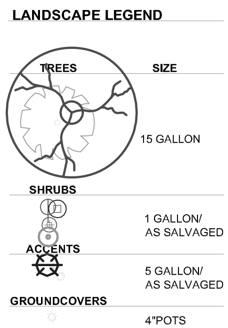
Pruning dead vegetation for plant health should occur annually, or as desired, to maintain plant health and aesthetic value.

6.4.3 Soil Monitoring

Treated wastewater often has a mild salt content. Soil monitoring should occur on a yearly basis to ensure that irrigation application is appropriate and to manage salt accumulation in soils.

LANDSCAPE PALETTE

Botanical Epithet	Common name	Form
Acacia greggii	catclaw acacia	Tree
Ambrosia dumosa	burrobush, white bursage	Shrub
Chilopsis linearis var. arcuata	desert willow	Tree
Echinocactus polycephalus	cotton-top barrel cactus	Accent
Encelia farinosa	Brittle bush	Shrub
Encelia virginensis	Virgin River brittlebush	Shrub
Eriogonum deflexum	flat-topped buckwheat	Groundcover
Eriogonum fasciculatum ssp. polifolium	California buckwheat	Shrub
Ferocactus cylindraceus var. lecontei	California barrel cactus	Accent
Hymenoclea salsola	cheesebush	Shrub
Yucca schidigera	Mojave yucca	Accent
Salvia dorrii	desert sage	Accent



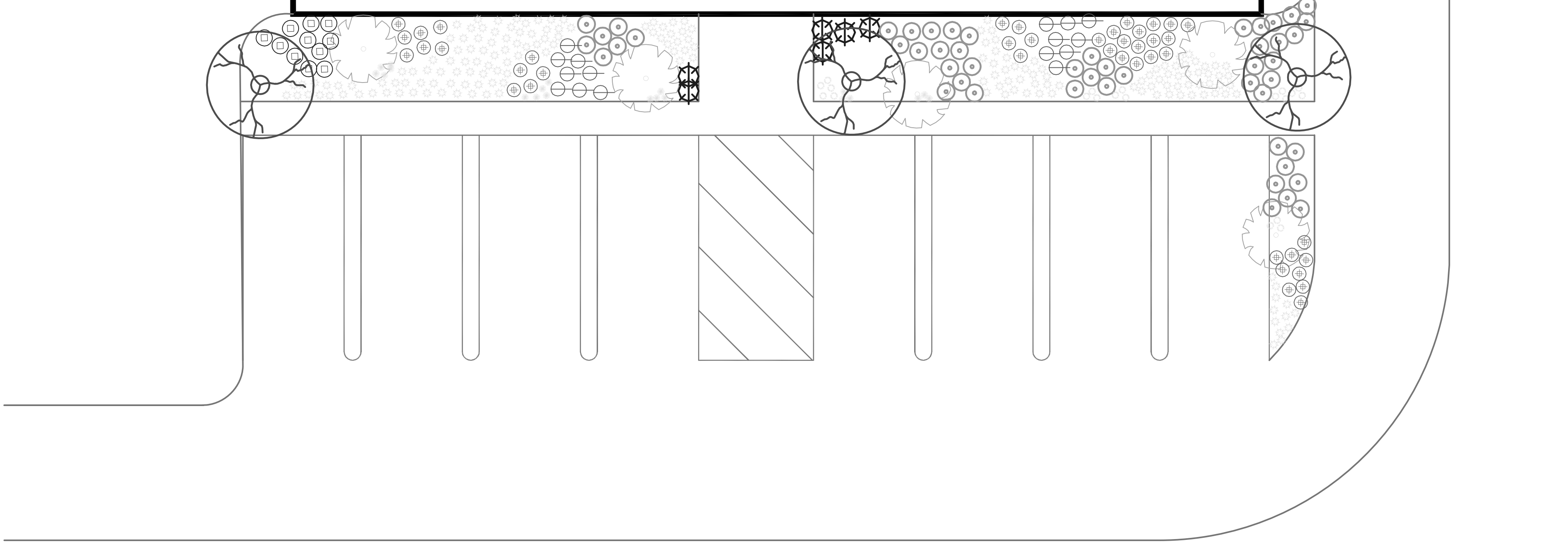


FIGURE 6-1
CONCEPTUAL LANDSCAPE PLAN AND PALETTE FOR THE ADMINISTRATIVE/WAREHOUSE BUILDING
IVANPAH SOLAR ELECTRIC GENERATING SYSTEM

CH2MHILL

SECTION 7

Site Rehabilitation Plan

7.1 Rehabilitation Methods

7.1.1 Site Preparation

Soil disturbance in the project area should be kept to a minimum to limit wind and water erosion and ensure successful site rehabilitation. The only areas where soils should be disturbed are in the permanent impact area associated with pipeline installation, and in areas requiring extensive grading within the heliostat arrays. Areas requiring extensive earth movement should have topsoil salvaged and stockpiled for later reuse. The following sections describe these operations. No earth movement and, therefore, no topsoil salvage, should be required on temporary impact areas associated with the pipeline construction, staging/laydown areas, or heliostat arrays with minimal disturbance (i.e., vegetation removal only).

7.1.2 Soil Rehabilitation

Soil characteristics that must be considered to ensure successful rehabilitation of the site include potential for water and wind erosion; soil structure; potential for water to infiltrate the soil; soil texture; fertility, organic matter; soil organisms; and soil crusts. Because project construction will disrupt the fragile, undisturbed soil environment, surface management during implementation of rehabilitation activities and project operations should be conducted with the goal to speed recovery of native soil functions, by encouraging restoration of soil biological activity and encouraging plant establishment (Bainbridge, 2007).

7.1.2.1 Baseline Condition

Because natural variation occurs within soil map units, soils at the Ivanpah SEGS should be initially characterized to set a baseline by which rehabilitation success can be evaluated over time. Baseline characterization should include the following:

- Profile description of representative pedon
- Characterization of surface condition (i.e., is desert pavement or cryptogamic crust present)
- Soil texture (i.e., percent sand, silt, and clay)
- Bulk density
- Fertility (i.e., nutrient status, electrical conductivity, sodium adsorption ratio)
- Organic matter content and C:N ratio
- Documentation of soil biota (i.e., presence of ants, termites)

7.1.2.2 Soil Testing/Augmentation

No soil testing, other than testing to determine reference baseline conditions in the soil, should be required. Augmentation with fertilizers should be avoided for the following reasons: (1) nitrogen additions will encourage vegetative growth such that soil moisture could be depleted too early in the growing season and, thus, hurt plant establishment; (2) addition of nutrients reduces mycorrhizal activity; (3) increasing plant nutrients can indirectly increase plant herbivory by making the plant material more attractive as food items. However, it may be desirable to add organic matter that has a high C:N ratio. Addition of wood chips or mulched woody debris, which would naturally be present in stockpiled topsoil (and, thus, would not have to be added) if some plant material was allowed to remain during the plant clearing phase, would encourage microbial activity as well as termite activity, leading to improved soil structure.

7.1.2.3 Top Soil Banking and Storage

The top 2 inches of desert soils generally contain the majority of seeds, nutrients, biotic crust organisms, and organic matter. Therefore, to facilitate soil rehabilitation and plant establishment, the topsoil should be removed and stockpiled, where appropriate, and then respread on the surface when earthwork is complete. Removal and stockpiling of topsoil can cause changes in soil properties, and care should be taken to limit adverse effects. For example, stockpiling has been shown to reduce organic carbon (especially at the surface), reduce microbial activity and mycorrhizal inoculum potential for vesicular-arbuscular mycorrhizae (Bainbridge, 2007). Prior to topsoil removal, vegetation would be removed by mowing. However, to ensure soil function remains as similar to that of undisturbed soils as possible, some plant material should be left unstripped prior to soil salvaging to reduce losses of organic carbon and to maintain healthy microbial communities.

7.1.2.4 Pipeline

The gas pipeline impact area is estimated to be 4.6 miles or 36.3 acres. Prior to any earth movement to install the gas pipeline, a 75-foot-wide corridor should be flagged or staked along the length of the pipeline installation footprint representing the temporary and permanent impact areas. No disturbance outside of this area should occur. Following installation of the gas pipeline, a 12-foot-wide dirt road would be constructed directly above or alongside the pipeline (permanent impact). The remaining 63-foot width represents the temporary impact area along which vehicles/equipment would travel and materials would be temporarily placed. A similar process would be followed for the 50-foot-wide water line construction corridor.

To the extent possible, vegetation should remain undisturbed in the temporary impact area. Where necessary, vegetation will be reduced by driving over plants or mowing. Following vegetation reduction, the top 2 to 4 inches of topsoil should be carefully removed by an experienced operator using a dragline, excavator, scraper, or dozer (Bainbridge, 2007). Topsoil should be stored in windrows adjacent to the removal area; stockpiles should be shallow and steep. No traffic over stockpiles should occur because this would compact the soil, damage structure, and reduce biological activity. No mixing of the topsoil with the subsoil should occur because this would dilute nutrients and organic matter. Stockpiles should be kept dry during storage. Wet stockpiles show a greater reduction of vesicular arbuscular mycorrhizae propagules than dry stockpiles (Bainbridge, 2007).

7.1.2.5 Heliostat Arrays

The heliostat fields would consist of concentric linear arrays of heliostats separated alternatively by undisturbed habitat and by service roads. The ground surface beneath the heliostat arrays would be bladed to a depth of not more than 1 to 3 inches to facilitate their construction. The ground surface of the service roads would be similarly bladed and then covered with 4 inches of gravel to mitigate dust generation during use. The ground surface between every other heliostat array would remain undisturbed desert scrub habitat. The bladed areas within each heliostat field will have its topsoil salvaged, as described in Section 7.1.2.3) for the temporary work areas. The topsoil would be stockpiled for respreading in areas identified for revegetation once grading is complete.

Top Soil Placement

Topsoil should be respread as soon as possible following temporary disturbances such as pipeline installation or grading within the heliostat arrays.

Rehabilitation of Temporary Disturbance Areas

Once vegetation has been reduced and topsoil has been salvaged, the pipelines would be placed approximately 3 feet deep. Construction would occur in concert with trenching. The majority of the soils are mapped as Arizo series, which are composed of loose alluvium to the 3-foot depth. Other soils are mapped as Popups series, and trenching in this soil type would likely encounter a duripan at about the 3-foot depth. Following pipeline installation, subsoil should be carefully replaced around pipes and compacted to achieve a similar bulk density as native soil B or C horizons. Following replacement of subsoil, topsoil should be placed on the surface to achieve a final thickness of 2 to 4 inches. Using a shovel or similar equipment, soil should be chopped into the subsoil to improve hydraulic connectivity with underlying materials. Where revegetation is to take place, topsoil should be compacted to achieve a bulk density similar to the undisturbed soils, but in no instance should bulk density be greater than 1.6 gram per cubic centimeter. Compaction of roads constructed directly above or alongside the pipelines will be in accordance with requirements for roadway construction.

Heliostat Arrays

For cut and fill areas within the heliostat arrays, care should be taken to achieve soil layering that is similar to that of undisturbed soils (i.e., materials conforming to B and C horizons should be layered accordingly in cut and fill areas). Subsoils should have bulk densities that are similar to undisturbed soils. Topsoil should be placed on the soil surface, and fine grading should be performed for final surface shaping and compaction in accordance with the grading and drainage plans for the project.

7.1.2.6 Soil Decompaction

Temporary impact areas along pipeline corridors, such staging/laydown areas, may be compacted as the result of equipment traffic and material storage. Compaction can reduce the ability of water to enter the soil and inhibit root growth of plants. By decompacting soils, water status as well as plant establishment during site revegetation would be improved. The method of decompaction will depend on how compacted the soil has become following construction of the project. For areas that have minor to moderate compaction, a spader might be the best option for decompacting the soil. Spaders can reach a depth of about 8 inches (i.e., the approximate thickness of the A horizon in the Arizo soils), and can break up the soil without inverting it (Bainbridge, 2007). Another alternative if compaction is not severe is to use a garden fork or auger to dig holes at random across the compacted landscape. This would allow for capture of moisture and seeds without disturbing soil layers. Where compaction is severe, deep ripping might be the best option for decompacting the soil. If needed, deep ripping should be performed to a depth of approximately 18 inches, and organic matter should be added prior to or during ripping (Bainbridge, 2007). Following decompaction, the soil surface should be shaped with fine grading to provide small pits, swales, or microcatchments to capture water because moist soils allow for easier penetration by roots and burrowing animals.

7.1.3 Appropriate Plant Species

After vegetation and soil disturbance, the site cannot be immediately returned to its predisturbance condition, or climax vegetation, because the abiotic and biotic conditions of the soil are no longer appropriate for that plant association. Vegetation succession is the natural process through which site conditions evolve to approximate the undisturbed (or predisturbance) condition. In most ecosystems, this takes decades to centuries (Clements, 1916), but the first stages occur quickly. Even in the absence of human intervention, recolonization by pioneer plant species (in some cases, non-native weeds) occurs within a year, and the first successional perennials are usually present within 2 to 3 years.

A practically attainable approach to revegetation at Ivanpah SEGS will be to accelerate the natural successional process by emphasizing seeding of early successional plants. This strategy maximizes the probability of success; it has been used on comparable desert areas and is considered viable, if the extended timeframe for establishment is acceptable. The primary challenge with seeding in the Mojave is the highly variable and typically sparse rainfall (CH2M HILL, 2006). However, where the seedbank can be placed to persist for some years after sewing, chances of an ample rainfall year are increased.

The plant species most appropriate to revegetation efforts can be identified with the available information on the flora of Ivanpah SEGS. The last 2 years of vegetation surveys are sufficient to identify the species adapted to ground disturbance, as well as late successional and climax species, and published studies are available to support these determinations. The following sections detail the proposed approach based on this information.

7.1.3.1 Succession after Disturbance

As detailed in the TBD (CH2M HILL 2008a), studies have affirmed a basic feature of vegetation recovery after disturbance in desert environs. After vegetation has been removed from an area, “pioneer species” are the first to establish on the barren ground. In the Mojave Desert, pioneer species include weedy, non-native species including tumbleweed (*Salsola* spp.), filaree or storksbill (*Erodium cicutarium*), red brome (*Bromus madritensis* ssp. *rubens*), London rocket (*Sisymbrium irio*), and others. These plants, often annuals, are the first to naturally colonize disturbed sites.

As time passes, additional species will naturally colonize the site, typically consisting of early-successional perennial species. At Ivanpah SEGS, early-successional perennial species identified during botanical surveys included fourwing saltbush (*Atriplex canescens*), cheesebush (*Hymenoclea salsola*), black-banded rabbitbrush (*Chrysothamnus paniculatus*), and others.

"Climax" species are termed such because they are typical of the final stage of vegetation succession after disturbance, and in low desert habitats typically include creosote bush (*Larrea tridentata*), white bursage (*Ambrosia dumosa*), and pima ratany (*Krameria erecta*). Because they represent plants that are not as well adapted to disturbed soil conditions, success rates using these plants can be expected to be lower, but inclusion of the climax species in revegetation plans is nevertheless a common approach in the region. For Ivanpah SEGS, it is recognized that these species are less likely to colonize the revegetation sites in timeframes relevant to the site rehabilitation, and they will not be emphasized in the revegetation approach. However, because seed would be partly collected in bulk, some late-successional plants will be included in the seed mix.

An exception to this general pattern of succession might be seen on sites with consistent surface moisture or high groundwater, where the woody perennial Mediterranean tamarisk or saltcedar (*Tamarix ramosissima*) can often be the first to invade after disturbance, but can also establish dense stands that preclude establishment of any subsequent vegetation types. This is effectively achieved through aggressive competition for light and water resources, altered soil chemistry (i.e., increased salinity), and a heavy litter layer that precludes seeds of most other desert vegetation from germinating (Shafroth et al. 2005; Glenn and Nager, 2005; Ryan, 2006).

7.1.3.2 Plant Species Diversity

Promoting species diversity in the revegetation approach has various benefits, such as: (1) different species are adapted to slightly different microsites and physical conditions; (2) plant community stressors, such as periods of excessive drought, could affect different species with differential survival; and (3) greater diversity can provide a more acceptable visual landscape and promote more suitable wildlife habitat. A wide range of perennial and annual plants were identified in the Ivanpah SEGS botanical surveys, as reported in the AFC (CH2M HILL, 2007).

7.1.3.3 Local Ecotypes

The use of seeds from onsite or adjacent lands or from the nearest vendor providing locally harvested seeds is important because seed from distant or unidentified sources could have genotypes that are less likely to survive conditions on the site (Bossard et al., 2000). To achieve this on remote revegetation sites like that at Ivanpah SEGS, it is often necessary to collect local seed specifically for the project, or contract with a seed vendor. Seed should be collected within 25 miles of the site, and at similar elevations and conditions as are found at the Ivanpah SEGS project area.

7.1.3.4 Selected Plants for Seeding

Seed collection will be performed in support of the Ivanpah SEGS project. This would be conducted by contract with a native seed collection company, according to the project owner's specifications. Seed would be collected from individual plants, as well as from bulk seed deposits, such as in depressions or other natural catchments. As a result, the seed collection would have a built-in diversity. However, collection will occur, both at individual early-successional perennial shrubs, or adjacent to plant communities that have a high proportion of early-successional perennial shrubs. Some additional late-successional species may also be collected, where seed production is substantial and easily collected, or where ready opportunities are identified during seed collection efforts.

Species targeted for collection and, therefore, revegetation, are described in Table 7-1. These species have a diverse array of growth forms, and are generally disturbance-adapted plant species. These represent target species identified for seed collection; however, the ultimate seed collection would be highly dependent on availability and ease of collection.

TABLE 7-1
Seeds Targeted for Collection in Support of Revegetation, Ivanpah SEGS

Scientific Name	Common Name	Normal Successional Stage	Remarks
Perennials (Shrubs 1 to 3 feet tall at Maturity)			
Ambrosia eriocentra	wooly bursage	early	This is a late-successional shrub often co-dominant with creosote bush in desert scrub communities. It is included here because it produces profuse seeds that are easy to collect, and some establishment in disturbed communities may be achieved.
Atriplex canescens	four-wing saltbush	early – late	Disturbance-adapted, versatile species. Saltbush is adapted not only to disturbed soils and, therefore, a robust early-successional species, but (as it name implies) it is also adapted to poor-quality soils high in sulfates and chlorides.
Crysothamnus paniculatus	Desert rabbitbrush	early	A successional shrub common in the washes of the area.
Eriogonum fasciculatum ssp. polifolium	California buckwheat	early – late	Found throughout the proposed project site.
Hymenoclea salsola	Cheesebush	early	A common disturbance-adapted species on the project site.
Salazaria mexicana	Bladder sage	early – mid	An early to mid-successional shrub common in washes.
Annuals or Short-Lived Biennials (a few inches to 2 feet tall)			
Baileya multiradiata	Desert marigold	early	Provides showy flowers early in its life cycle.
Camissonia boothii	Primrose; woody bottlewasher	early	Depending on availability and cost, may be desirable.
Eriogonum deflexum; E.inflatum	Flat-topped buckwheat; desert trumpet	early	Several potentially suitable annual species of buckwheat occur onsite; all are disturbance adapted.
Lepidium lasiocarpum	Modest peppergrass	early	A common annual of the Mojave Desert.
Plantago insularis	Plantain	early	Grass-like species, propagates well on disturbed soils, often less costly than many other species

Notes:
Seeds of these species would be in addition to those contained in the conserved topsoil to be respread back across the site, and those that would be dispersed naturally to the site over time from offsite sources.

7.1.3.5 Selected Plants for Transplanting

Attempts at transplanting desert plants have often met with unsatisfactory results. Even when supported by the extensive research and testing facilities at Castle Mountain Mine, transplant success was reported as very low, and generally ineffective (Bamberg Ecological, 2006). Even efforts initially reported as successful were clouded by later reports of high mortality after several years of monitoring. However, among a few species of succulents, transplanting can be successful. This includes species of barrel cacti (*Echinocactus; Ferocactus*) and various species of cholla (*Opuntia*), which actually establish well from joints. These transplants can be especially advantageous in acting as "nurse plants," that is, grown plants in revegetation areas that provide beneficial modifications to the microclimate, such as shading or wind protection, which can enhance establishment of seeded plant species (Kigel. 1995).

Limited transplanting of succulents is proposed on Ivanpah SEGS revegetation sites, as described previously in Section 4 and summarized here. The following species would be salvaged:

- The single-stemmed cacti, or cylindrocacti, are those cactus species characterized by a single stem, usually slightly inflated. On the project site, they include the very large barrel cacti (e.g., the California barrel cactus, the cotton-top barrel cactus), to small pincushion and fishhook cacti (*Coryphantha chlorantha, Mammilaria microcarpa*), or hedgehog cactus (*Echinocereus engelmannii*).
- Segmented cacti in the Ivanpah SEGS include prickly-pears (*Opuntia* subgen. *Platyopuntia*) and chollas (*Opuntia* subgen. *Cylindropuntia*), the latter also including *Grussonia*. Species of prickly-pear include *Opuntia chlorotica* or *O. basilaris*. Chollas are more typically ascendant and shrub-like and include buckhorn chollas (*Opuntia acanthocarpa*) or silver cholla (*O. echinocarpa*).

7.1.3 Seed and Native Stock Collection and Storage

7.1.3.6 Seed Bank Protection

In temporary disturbance areas at Ivanpah SEGS, the existing seed bank could have a substantial contribution to successful revegetation. This seed has advantages over subsequently sewn seed in that it has originated locally, and is best adapted to the local microclimate and site conditions; and secondly, it has resided in the topsoil and/or litter for some unknown period of time, during which seed dormancy might have been broken.

However, soil disturbance is likely to excessively disrupt the position of seeds in the soil column, and seed buried at depths greater than 2 to 3 centimeters might not emerge (Kigel, 1995). Measures have been proposed for vegetation windrowing, which will capture seed still on the plant, and topsoil salvage and banking. These same measures would, to some extent, preserve at least a portion of the seed bank intact.

7.1.3.7 Seed Supply

Production of native seeds is highly cyclical, depending largely on annual precipitation timing and amount. Soil moisture is the limiting factor in desert ecosystems, and will ultimately determine the extent to which: (1) annual plants germinate, (2) germinated plants mature to produce fruit and set seeds, and (3) perennial plants produce fruit and set seed (Delph, 1986; Kigel, 1995). For optimal seed collection of perennials, a relatively wet rainy season will result in higher seed production. However, even a single, large rain occurring during late fall or early winter can result in annual germination and seed production; however, soil moisture must persist long enough for plants to mature and set seeds. When plants are able to germinate earlier in the normal germination season (fall and winter), they generally produce a higher seed crop (Narita, 1998; Kigel, 1995). However, if heavy rains occur too early in the fall, and annual plants respond by germinating, they can be vulnerable to subsequent heat and desiccation.

Because it requires responding to precipitation events that are not effectively predictable, advanced planning of seed collection would be required to ensure early and continuous seed collection, as needed, up to the time of planting. A seed collection program will be initiated within 2 years of potential site disturbance, and continue through until revegetation seed broadcast is complete. This would allow for some variation in annual seed production while still ensuring a robust collection.

7.1.3.8 Seed Collection

Protocol

Seed collection will be initiated within 2 years of ground disturbing activity, and would continue until adequate seed has been acquired for site revegetation, or until revegetation is complete. The seed to be collected will be of local origin, collected within 25 miles of the Ivanpah SEGS project area, and at similar elevations and vegetation conditions. Where feasible, seed will be collected directly from the Ivanpah SEGS project area before site disturbance.

A seed “collection” would represent seed collected from a single “collection area” (generally defined to be no more than a 1/4-mile radius) on a single day. Mature seed will be collected from healthy, robust stands. To increase genetic diversity, no more than 20 percent of each collection would come from an individual plant. Collection would occur from only 40 percent of the plants in a collection area. Bulk seed would be collected, focusing on locations where a high proportion of early-successional native plants are present and shedding seeds. Where feasible, seed would be collected directly beneath, or where seed is mature, directly from the plant. The plants targeted for direct seed collection are listed in Table 7-1.

Diversity will be achieved in the seed mix by collecting bulk seed from locations where it accumulates, such as depressions or at the base of shrubs. Additional seed, which is easy to collect, may be added from late-successional species, such as burro bush. Site characteristics and seed-lot tracking would be performed, including notes on collection date, dominant species, stand conditions, and expected species composition of seed. Seed will not be collected from areas with noxious weeds present, unless collected directly from native plants in the area.

7.1.3.9 Native Seed Vendors

It is anticipated that if native seed vendors are used, they would be contracted to collect seeds as specified in this Plan. Under this Plan, federal certification content of seed will be negotiated to include, at a minimum, collection location, approximate seed content by species, purity, germination, origin, test data, and net weight (as pure live seed). Seed must contain a zero percent noxious weed seed to be acceptable.

Nondestructive evaluation to determine viability using X-rays is effective and economical. Techniques such as staining, inspection, and germination tests can also be helpful. Cleaning, dewinging, and upgrading seed before storage can: (1) reduce weight and bulk, (2) improve storage life, and (3) increase germination. These approaches will be evaluated depending on seed collection results and conditions.

7.1.3.10 Seed Storage

The seeds of many native plants can lose their viability quickly if they are not stored under controlled conditions. Because seeds are hygroscopic (i.e., they pick up and release moisture from the air), their moisture content can increase to a point where they are vulnerable to storage fungi or mold. Seed moisture content of 10 percent or less is preferred (Elias et al., 2002) and can be achieved by maintaining low storage temperature and relative humidity. Seeds in storage must also be protected from rodents and insect pests, such as weevils.

Dormancy is common in the seeds of many native species, as further discussed in Section 7.1.5.2. Specialized methods, or specific storage conditions, are often necessary to effectively break seed dormancy. This can be complicated by year-to-year and plant-to-plant variation.

Seed storage requirements will include the following:

- After collection, seeds will be packed tightly in paper storage bags and appropriately labeled.
- Storage would occur in a temperature-controlled seed storage unit until 2 months prior to sewing, at a constant temperature of 55°F or less, and a controlled relative humidity (RH) of 45 percent or less.
- If seed storage is required for more than 1 year, storage temperature will be reduced to 50°F or less, and RH reduced to 40 percent or less.
- Prior to sowing, seeds will be relocated to rodent-proof cages, stored at ground level, at the site of revegetation, in an effort to break dormancy; within storage cages, seed lots will be covered with burlap. The storage regime will be maintained prior to planting for a period of 2 months.

7.1.4 Propagation

7.1.4.1 Germination

Germination is the most vulnerable phase in a plant development, representing the risky transition from seeds, which are the most resistant to drought and temperature extremes, to seedlings, which are the most sensitive. Hence, complex adaptations have developed in plants to regulate germination in arid environments (Kigel, 1995). This ensures that when germination occurs, there is likely to be ample soil moisture to support the developing plant, and temperatures will be favorable to plant growth. In desert annuals, a successful germination strategy would lead to rapid flower and seed production;. In perennials, this strategy would lead to better chances of seedling survival and long-term plant establishment.

Mass germination occurs only after a certain threshold of precipitation occurs (effective rain), and typically in desert environments, that can vary depending on microtopography, substrate permeability, and evaporation. Rain events less than the needed threshold can result in patchy germination, primarily where runoff has collected. Multiple mass germination events can occur throughout the season if episodic rain events occur, resulting in different cohorts of developing plants. Generally, early germinants will have a competitive advantage, unless an extended drought period occurs after the early-germination effective rain, in which case, high mortality could occur among early germinants (Kigel, 1995).

7.1.4.2 Dormancy

Moisture availability is not the only factor in determining germination of seeds in arid areas. Seeds of arid land plants often have an inherent dormancy, and will not germinate even in a controlled setting until that dormancy is broken. Dormancy can be either intrinsic to the embryo, or imposed by the coat of the seed or the dispersal mechanism (Kigel, 1995). It can result from chemical inhibitors that are released upon initial seed hydration, but could take additional water to ultimately leach away. Mechanical or physical barriers can also be imposed by the seed or dispersal mechanism coat that: (1) prevents embryo growth or root elongation, (2) is impermeable to water or gases, or (3) releases chemical inhibitors (Kigel, 1995).

Because multiple dormancy mechanisms are often present, methods for breaking dormancy can be complex, and are often species-specific. Chemical inhibition to germination can often be broken by repeated leaching (Bainbridge et al., 1995; Kigel 1995); however, this could also be affected by seed age, which plays a role in breaking physical dormancy. Changes in the physical environment, such as temperature or photoperiod changes (termed stratification), or physical alteration of the seed coat (scarification), can play a critical role in releasing dormancy in some desert plants (Bamberg Ecological, 2005).

Rinsing seeds prior to seeding to remove inhibiting chemicals is a commonly used practice to improve germination success rates for some species. Rinsing is particularly effective for creosote to remove inhibiting chemicals (Bainbridge et al., 1995). Scarification can be achieved by physically roughening seed coats by tumbling with sand, or chemically attacking seed coats with compounds such as sulfuric acid. Stratification can be achieved by storage under cold-moist or warm-moist conditions. Requirements of some seeds may include remaining in the soil for 1 or more years before they are able to germinate (Bamberg Ecological, 2005). Capon and Van Asdall (1967) found that annuals native to the Mojave and Sonora deserts reached maximum germination when subjected to up to 5 weeks of higher temperatures (122°F) prior to planting. Daily temperature fluctuations are reported as an important requirement for breaking dormancy in arid and semi-arid species of hard-seeded annuals (Kigel, 1995).

Because seed would be generally collected and stored in bulk, a single strategy for breaking dormancy is not possible. The targeted early-successional species tend to have less rigorous requirements for breaking dormancy than late-successional species (Bamberg Ecological, 1995). Therefore, the only treatment implemented on seed supplies to break dormancy will include: (1) storing seeds in the field prior to sewing to effect a natural warm and cold regime, which may result in stratification, and (2) sewing seeds in the fall when field conditions should be optimal to break dormancy naturally.

7.1.5 Salvage Plant Storage

Limited transplanting is proposed on Ivanpah SEGS revegetation sites, and will be restricted to cacti (Section 4), as summarized below:

- Larger barrel cacti and smaller single-stemmed succulents will be salvaged by removing them with small equipment or crews with shovels. Cacti to be temporarily stockpiled will first have their roots trimmed; the plant will then be gently laid on its side on a pallet and allowed to air dry for at least 3 weeks but not longer than 6 months.
- Segmented cacti (chollas and prickly-pears) will be salvaged by taking cuttings (the prickly-pears) or (for the chollas) simply breaking off a series of the easily-detachable joints. Storage in simple paper bags allows for easy handling and labeling of the specimens, and allows their exteriors to dry and detachment points to callous without promoting the fungal growth. Collected cholla joints and prickly-pear pads should also be allowed to dry under cover for a period of 1 to several weeks; however, they cannot be subject to desiccation for as long as and should be replanted within 3 months of harvesting.
- For long-term stockpiling, cacti should be planted in windrows that are created by excavating a linear trench and then healing one cactus into the trench at generally regular intervals such that each cactus is separated by sufficient room (usually 1 to 2 feet) to allow mechanical recovery of the plant with no injury to adjacent plants. The succulents planted for long-term stockpiling in pre-dug linear trenches will not be watered unless it is determined that there has been a significant rainfall deficit for longer than 6 months. A single pass with a watering truck every 3 months will then be sufficient to permit most plants to survive.

7.2 Applicable Planting Techniques

The seeding techniques discussed in this section are restricted to those that would be applicable at the Ivanpah SEGS. Other techniques are not discussed. For example, hydroseeding is rarely used in desert restoration. Bainbridge et al. (1995) strongly discourage its use for any desert revegetation, primarily because precipitation or irrigation must follow seeding, or the pre-soaked seed will fail. In addition, large quantities of water are needed. These are consistent with the findings of other desert revegetation studies.

7.2.1 Seeding

Relative to other project costs, seed is a small component, and seeding rates should be high to account for the potential for poor germination as well as predator loss. Specific challenges with seeding, and appropriate remedies to those challenges, are summarized in this section.

A major drawback of seeds is that they are very vulnerable to predation from mice, birds, and seed-eating insects. Up to 95 percent of seed sewn can be expected to be lost to predation prior to germination and establishment. Ants, in particular, are a significant factor in the loss of seeds prior to germination in the Mojave (Anderson and Ostler, 2002). A possible approach to reducing ant predation is to apply cracked wheat to the soil surface prior to seeding so the ants are satiated; however, where germination relies of natural rainfall, this method might not be effective because it could be a 1 or more from seeding to germination (Bainbridge et al,. 1995).

Compensating for variability in annual rainfall by ensuring seed are persistent once sewn increases chances of germination. Effective rainfall events might not occur every year, but chances substantially increase over a 2- to 3-year period. Ensuring seed persistency requires reducing predation by burying seed, which can be achieved by dragging seed with a light drag, or drilling seed with a rangeland seed driller. While buried seed may also be predated, it is likely to persist at greater rates than surface seed. Surface seed not predated by ants can be collected by wind in basins and depressions, where if discovered by rodents, becomes a concentrated resource visited continuously. Kangaroo rats (*Dipodomys* spp.) are adapted to exploit concentrated seed collections (such as shedding plants or seeds collected in depressions). Alternatively, pocket mice (*Perognathus* spp.) are better adapted to sift surface soils for shallowly buried seeds.

The low cost of a seeding approach relative to vegetative container-grown plants would be, at least partially, offset by the lower expected success rate. It takes many seeds to result in one plant seedling. For most species, seeding rates of 100 to 500 seeds per square meter are recommended (Bainbridge et al., 1995).

Most desert seeds under natural conditions are located at or near the soil surface. As many as 80 or 90 percent of the seedbank is within 2 centimeters of the soil surface, with many located within millimeters of the surface or in surface litter. Seedlings of many desert annuals cannot emerge from depths greater than 1 centimeter, and desert shrubs usually do not emerge from depths greater than 4 centimeters (Kigel, 1995). These data are important in planning seed broadcasting. However, the depth of seed placement must be balanced against the risks of predation.

Typically seed application methods are summarized in the following sections.

7.2.1.1 Imprint Seeding

Placing seeds in a pattern of small mechanically created depressions is considered a potentially useful technology for areas with finer textured soils. Seeds remain trapped in depressions, which subsequently capture water during rainfall events or irrigation. Imprinting is not useful on loose and sandy soils, where erosive forces can quickly re-level the surface (Bainbridge et al., 1995). Imprinting can be most effective in areas where infiltration is limited by surface crusts and areas with summer and winter rains (Bainbridge et al., 1995).

Imprint seeding is not proposed for Ivanpah SEGS primarily because imprinted seed is still exposed to surface predation, and seed might not persist over the long time periods that may be required for natural germination. Imprint seeding was successfully used at revegetation efforts at Edwards Air Force Base, but irrigation was used in that effort (CH2M HILL, 2006).

7.2.1.2 Broadcast Seeding

Broadcast seeding can be a viable approach for desert restoration. Seeding can be distributed by hand, by manual wheeled devices, or by seeding equipment. On large sites, seed has also been aerial broadcast by cropdusters (Bainbridge et al., 1995). An implement that can lightly disturb the soil surface is needed after seeding for incorporation (covering the seeds with soil). One example of equipment effective at incorporating seed is a drag consisting of a flat framework supporting small tines that disturb the soil. Seeding rates should be 50 to 100 percent higher for broadcast as compared with drill seeding (Bainbridge et al., 1995) because predation losses tend to be greater for broadcast seed than for drilled seed.

7.2.1.3 Rangeland Drill Seeding

A rangeland drill is a seeding implement that is designed to open a slot in the soil, place seeds in the slot, and firmly cover the seeds with soil. Rangeland drill seeding is effective on relatively level terrain, but debris and rocks could be problematic, and a rangeland drill might not operate in rough or rocky terrain. In addition, resulting seeding might be in rows when germination occurs, and might not appear natural. The appearance of rows diminishes with time. Using multiple seed bins on the drill might be required to accommodate differences in seed characteristics.

7.2.1.4 Seeding Protocol

Seeding protocol based on successful methodologies described in previous sections is summarized as follows:

1. Seed will be removed from site stratification storage at the time of seeding.
2. Seed from multiple lots will be thoroughly blended into a single application batch. Seed count in pure live seed by weight will be determined in the application batch from individual seed lot statistics contributing to the batch.
3. Seed will be distributed at a rate of 150 seeds per square meter of seeded area. Seed will be distributed using a rangeland drill seeder with no disk openers or press wheels (essentially dropping the seed on the ground as a broadcast seeding).
4. The drill seeder will be followed with a drag to incorporate the seed.
5. Seeding will occur between October 15 and January 15.
6. Windrowed vegetation from the site will be mulched and distributed across the site after seeding (Section 7.2.2), supplemented with commercial straw mulch (weed-free certified), where needed, to apply a total mulch of 2 tons per acre.

7.2.2 Mulch

Distribution of mulch after or during seeding allows for protection of the soil surface from erosion and could provide some seed protection. While weed-free certified mulch is available from commercial vendors, it is recommended for Ivanpah SEGS that mulch be shredded first from existing windrowed vegetation, then supplemented with weed-free certified straw mulch from commercial vendors as needed. Mulch application of 2 tons per acre would be adequate.

7.2.3 Container-grown Plants

Container-grown plants have been used on desert revegetation projects, although this practice is generally confined to relatively small restoration areas (CH2M HILL, 2006). Container stock installation requires an associated irrigation method to supply irrigation at a minimum through the first year. While container-grown stock could provide rapid cover in the short term, it might not provide any greater cover or density over the long term compared with other seeding approaches to warrant the additional expense. For this reason, installation of container-stock is not proposed at Ivanpah SEGS except for landscaping with native vegetation around some facilities, as described in Chapter 6.

7.2.4 Natural Colonization

This alternative relies only on natural processes such as viable seeds that may remain in the topsoil after disturbance or seeds that blow in or are transported by animals to revegetate the site. Revegetation will ultimately occur through natural colonization, or at a slower rate than seeding approaches and with less predictable results. This approach is particularly hampered by the loss of a portion of the natural seed bank during soil disturbance. As such, this approach is not considered viable at Ivanpah SEGS.

7.3 Irrigation and Natural Precipitation

Even desert-adapted plants require water. Once established, plants have a transpiration demand, whereby they take up water by the roots and move it through the plant where it exits through the leaves. Some species are better able to reduce transpiration demand in dry periods or have other water-saving strategies such as storing water in leaves as with succulents. Regardless of the species, without water there is no germination, growth, and survival. Because of this, many desert revegetation efforts introduce additional water using irrigation techniques. This section discusses the relative merits, limitations, and typical methods of irrigating desert revegetation sites.

7.3.1 Water Demand

Water to support plant germination, growth, and survival must either come from precipitation or irrigation unless plant roots can access groundwater. Supplemental irrigation is often a revegetation strategy on smaller desert revegetation sites. Where irrigation is used, it is needed during the key establishment period during the first year, and generally extends into the second year. Where planting consists of seeding, irrigation may be used to germinate seed and establish seedlings, along with supporting young plants through the first one or two seasons. Where planting consists of container stock, irrigation is always used to establish the plants through the first summer, at a minimum, and potentially into the second year. The objective is to provide greater predictability in the initial establishment period, while ensuring perennial vegetation can develop to the point where it relies on natural precipitation. Where there is enough precipitation during key establishment periods, little or no supplemental irrigation is needed.

7.3.2 Natural Precipitation Approach

Ivanpah SEGS is not proposing to provide supplemental irrigation. In part, irrigation systems are generally not practical on desert revegetation projects greater than a few acres. In addition, approaches that rely on irrigation: (1) could promote vegetation growth during periods of drought, when desert plants are normally in a period of inactivity, or are persisting in a seed stage that is most resistant to drought, (2) might not allow plants to become sufficiently hardened to persist after irrigation is turned off, or if sufficient irrigation is not provided, and (3) would promote greater establishment of noxious weeds, which often outcompete natives in enhanced resource conditions, such as with increased water supply.

7.3.2.1 Precipitation

A detailed discussion of local climate can be found in Section 3. At about 5.1 to 6.2 inches (Table 3-2) per year, the amount of precipitation falling on the project area is low, with approximately one-third occurring as summer rains during the Southwest's monsoon (July through September) and a half falling during the winter season (November through March). During the Mojave Desert's arid foresummer (May through June), almost no precipitation can be expected while daily surface temperatures often exceed 110°F. However, these represent average values. As is typical of all deserts, rainfall varies dramatically from year to year. Winter rains or summer rains can and do frequently fail. Sometimes they fail consecutively so that there is scant rainfall for more than a year. The irregularity of rainfall is as much a feature of the precipitation climatology of Ivanpah SEGS as is the scant amount of rainfall received. In wetter than normal years, rainfall is sufficient to trigger the germination and allow the establishment of annual and perennial plants. In normal to drier than normal years, seeds are unlikely to germinate, and remain dormant in the soil, persisting until sufficient rainfall occurs. This form of adaptation to aridity (avoidance of drought by remaining dormant in the seed stage) is shared by virtually all annual plant species that occur in the Ivanpah SEGS project area. An important implication for revegetation is that seed, once broadcast and incorporated into the soils column, can persist until climatic conditions are favorable for germination and growth, even if it takes years (Shreve, 1964).

7.3.3 Irrigation

Irrigation approaches used in desert revegetation include truck irrigation, portable irrigation systems, and temporary pipe irrigation, none of which are successful on revegetation efforts because plants ultimately have to be weaned off artificial watering and mortality is subsequently high. To minimize water efficiency, and to conform with the environmental conditions of the Mojave Desert, no irrigation is planned for revegetation of the Ivanpah SEGS.

7.4 Herbivory and Granivory

Revegetation sites are vulnerable to predation, herbivory, and other forms of animal damage. Specific problems include: (1) predation on seeds from ants, rodents, birds, or other granivores; (2) damage to irrigation lines because Ivanpah SEGS is not proposing irrigation, this would not be a problem; or (3) herbivory on seedlings or establishing plants.

Seed predation by ants and rodents is a major issue on seeded sites. To mitigate the effects of this predation, shallow burying is recommended. It is recommended that a drag be used to disperse seed and bury it in the top 1 to 2 centimeters of soil.

Herbivory on seedlings and young growing plants is also of concern that can be lessened when relying on natural precipitation to germinate and establish seedlings. This is because the revegetation site would be established under the same precipitation regime as adjacent non-disturbed habitats. When effective-rain events occur, germination of annuals and perennials will be widespread throughout the entire area, providing an abundance of growing vegetation for herbivores, and generally satiating the herbivore population. Therefore, grazing pressure on the revegetation site would be less than if it was irrigated, and the revegetated site would be the only actively growing site during dry periods.

7.5 Revegetation Monitoring

Monitoring of ecosystem function could include soil moisture, soil strength using penetrometer measurements, soil organic matter, insect activity measurements (e.g., count of ant mounds), mycorrhizae assays, litter decomposition rates, establishment rates of cryptobiotic crusts, and establishment of native versus invasive species. Ecosystem structure includes factors such as density, diversity, richness, cover, and seedling establishment.

7.5.1 Criteria for Progress

Reference sites representing intact, native vegetative communities with similar composition and conditions, and near the area being revegetated, can be used as a standard of comparison for determining revegetation success. In this approach, revegetation success can be evaluated based on how similar the structure and function of the revegetated plant community is to the structure and function of the plant community in the reference area. There is utility to this approach in humid to subhumid ecosystems where vegetational succession takes place on the scales of years to decades. However, as noted in the TBD, no such rapid response can be expected with Mojave Desert scrub vegetation, where vegetation succession occurs on the scale of decades to centuries. Monitoring of a reference site can theoretically be used to understand the effects of climatic trends (Bainbridge, 2007). For example, if a severe drought occurs in undisturbed areas, native plants die, and poor seedling establishment is observed, it would be unreasonable to expect more from the restored site. However, in this region where drought is more the rule than the exception, reference to climate data from regional meteorological stations would be sufficient.

At the Ivanpah ISEGS project area, revegetation will occur through seeding with pioneer and early-successional species, in addition to seedling establishment resulting from dispersal of the native seedbank and, for temporary disturbance areas, transplanting salvaged succulent species. Therefore, the species composition of the revegetated sites will not be directly comparable to any reference site in a mature desert scrub community. Success will be realistically linked to seedling establishment and survival, initial density of annuals, increase in the cover and species richness of perennial shrubs, and evolution of the site toward a mature, climax community. To realistically measure the establishment of plants in this harsh environment, poor results during dry years will not be considered to reflect poor progress in revegetation.

7.5.2 Field Monitoring

Field monitoring should be conducted using line transect and quadrat techniques. Line transects provide effective cover data, while data from quadrats more effectively evaluate density and reflect the species richness of the plant community. The transect length and quadrat area should be representative of the plant community and large enough to capture 90 percent of the species that are present. A minimum of three 100-foot transects and three 100-square-foot quadrats, equally spaced across each revegetated area, should be identified. These permanent monitoring locations within the restoration area would be recorded using GPS and will be staked in the field. A map will be created, using an aerial photograph as a base layer, showing each monitoring site and photo documentation locations within the sites.

7.5.2.1 Schedule

Monitoring will be conducted for a period of 9 years from the date of revegetation, except at sites where revegetation is not proceeding satisfactorily. In that case, monitoring may be extended on a year-by-year basis until success criteria are met. Monitoring will be performed annually during the first 3 years following revegetation, and biannually thereafter. Monitoring sessions will occur between March 15 and April 15.

7.5.2.2 Survey Data

Visual inspections would be conducted to document germination, growth, and survival of seeded species, and growth and survival of transplanted succulents. Data collected will include species composition and cover, general size and vigor of the plants, percent live versus dead plants, whether species are annual or perennial, percent germination, observed soil erosion, evidence of wildlife utilization, and any other information that would be useful in evaluating success. The following factors will be evaluated on revegetated sites.

Germination and Survivorship

The first monitoring event would occur at the end of the winter/spring rainy season, several months following seeding. At that time, percent seed germination would be estimated based on the known seeding rate. The populations present at the first sampling (t_o) define the original cohort. Survivorship will be set to 1.0 for the original cohort and will be equal to the proportion of the population surviving at subsequent monitoring dates (Barbour et al., 1987). Species density measurements (i.e., number of live individuals present per unit area for each species) will be used to estimate survivorship for perennials and reproductive success for annual species. Numbers of live versus dead individuals that are observed for each species will be recorded along with overall plant vitality and size.

Cover and Density

Density refers to the number of individuals per unit area (e.g., 3,000 creosote bushes per hectare), while diversity refers to the number of species present per unit area. Density alone is a static measurement and does not reveal anything about the spatial distribution, or pattern, of the species (Barbour et al., 1987). In random patterns, the location of one plant has no bearing on the location of another; in clumped patterns, the presence of one plant means there is a high probability of finding another close by; in a regular pattern, plants are evenly distributed. Cover refers to the estimated area along a linear transect or within a quadrat that is occupied by a particular species. Plant density and cover will be determined for each species present at each monitoring event, and then summed to determine overall density and cover. The spatial distribution pattern will also be documented for each species present.

Species Richness and Diversity

Species richness refers to the number of different species per unit area within a given community. Each species may vary in relative abundance (e.g., Species A may have 100 individuals, while Species B has 20 individuals). The distribution of individuals among the species is referred to as "species evenness." Species diversity is equal to species richness weighted by species evenness, and there are many formulae available for determining a diversity index. Diversity can be described as the total number of species in the sample (Barbour et al., 1987). This or other appropriate measures of diversity will be determined at each monitored location.

Pioneer Species

An undisturbed plant community typically contains an abundance of native flora and few exotic, weedy species. Conversely, disturbed plant communities have a high proportion of pioneer and early-successional species, most of which are herbaceous species. Many of the most aggressive pioneer species are non-native plants such as storksbill and red brome. Revegetation success will be measured, in part, by density and cover of weedy pioneer species present. During each monitoring event, species composition and density measurements will include an evaluation of weedy species. If warranted, corrective measures will be taken to reduce presence of noxious weeds to ensure successful revegetation.

Photographic Documentation

At each revegetation site, multiple permanent photo locations will be identified and recorded using GPS. If there are historical photographs of monitoring sites, they would be helpful in establishing photo points so that one could use the historical photos to compare with photos of conditions after revegetation. Photo locations will be shown on maps of the monitoring sites. Photo points will be clearly marked in the field using vandalism-proof concrete markers that show orientation for taking the photograph. Orientation will also be obtained with a compass and recorded. A piece of rebar driven deep into the ground and bent over can be used as a vandalism-resistant anchor for concrete markers (Bainbridge, 2007). Photographs will be taken at each monitoring event at established points using the same camera settings and film (if applicable) each time. Camera, settings, film, and lens type will also be recorded. Whenever feasible, a meter stick or range pole will be used as a scale to illustrate the relative size of plants in photographs.

7.5.2.3 Data Analysis

The primary data that would be collected at each revegetation monitoring site include the following:

- Numbers of individuals for each species present in quadrats
- Species and overall density
- Percent cover for species encountered with line transects
- Evidence of biological activity (e.g., ant mounds, rodent disturbance, fecal pellets)
- Evidence of erosion

These data would allow computation of derived data and statistics such as perennial verses annual coverage, weedy species composition and density, survivability, and species richness, which will allow revegetation progress to be tracked over time. Quadrats and line transects will be established at least at three sites within each revegetation area (e.g., pipeline alignment). Results can be shown graphically for visual comparison among sites. Additionally, results over time can reveal trends in site rehabilitation.

7.5.2.4 Recordkeeping and Reporting

Following completion of seeding and transplanting of temporary disturbance areas, a report will be prepared that includes the following:

- Maps showing revegetation areas and monitoring locations, including photo-documentation points
- For each monitoring site, information including original plant community type; site preparation; method of application; source, purity, and application rate; type and quantity of soil amendment; type and quantity of mulch; total acreage treated for each site; date of backfilling; date of seeding; results of any prior monitoring at the site
- For each monitoring site, the data and analyses outlined in Sections 7.5.2.2 and 7.5.2.3

By July 30 of each year following monitoring of the sites, an annual report will be prepared that documents all data that were collected, including maps. The data will include the following:

- Maps showing revegetation areas and monitoring locations, including photo-documentation points;
- For each monitoring site, background information including original plant community type; site preparation; method of application; source, purity, and application rate; type and quantity of soil amendment; type and quantity of mulch; total acreage treated for each site; date of backfilling; date of seeding; results of any prior monitoring at the site.
- For each monitoring site, the data and analyses outlined in Sections 7.5.2.2 and 7.5.2.3, above.

Results and trends will be shown graphically and statistics will be applied, as applicable. The report will contain a discussion of results, including relevant observations such as erosion on the site. The discussion will include a summary of all other relevant activities pertaining to monitoring and revegetation, including any corrective actions that were taken, and will include conclusions as to whether the revegetation effort is moving toward success. Field data sheets will be included as an appendix to the regular report.

Closure Plan

Facility closure can be temporary or permanent. Temporary closure is a shutdown for a period exceeding the time required for normal maintenance, including closure for overhaul or replacement of a steam turbine. Causes for temporary closure could include disruption in the supply of natural gas, damage to an integral component from natural events such as earthquake or flood, or a radical change in the market for electrical energy. Permanent closure is defined as a cessation in operations with no intent to restart operations because of plant age, damage to the plant beyond repair, economic conditions, or other reasons. Temporary closures are not discussed in this Plan, which focuses on permanent closure and subsequent decommissioning activities.

Because the conditions that would affect the decommissioning decision and overall goals for rehabilitation are uncertain (see Section 8.1, below), they would be reviewed and a Final Closure Plan prepared when the timing for decommissioning is more imminent.

It is also assumed that this would take place in the same sequence as project construction, with Ivanpah 1 being the first to be decommissioned, followed by Ivanpah 2, then the shared facilities along with Ivanpah 3. It is also assumed that decommissioning of each phase would begin 50 years after the commencement of commercial operation of that phase with common facilities being decommissioned with the final phase.

In general, the decommissioning plan for the facility would attempt to maximize the recycling of all facility components. The Applicant would attempt to sell unused chemicals back to the suppliers or other purchasers or users. Equipment containing chemicals would be drained and shut down to ensure public health and safety and to protect the environment. All nonhazardous wastes would be collected and disposed of in appropriate landfills or waste collection facilities. Hazardous wastes would be disposed of according to all applicable laws, ordinances, regulations, and standards (LORS). The site would be secured 24 hours per day during the decommissioning activities.

For the purpose of this Plan, it is assumed that the removal of all equipment and appurtenant facilities would be required, and would be achieved in conformance with all applicable LORS and local/regional plans. Aboveground structures would be removed through mechanical or other approved methods, and trucked offsite. Foundations would be physically removed to a depth of 3 feet or more through excavation, breakup, and pulling. Once all structural elements are removed, the ground surface would be recontoured to minimize the topographic variability between on- and offsite areas, and to ensure that the gradient across the alluvial fans is restored. Pipelines would be closed off and either removed or abandoned in place.

As used here, “closure” is synonymous with decommissioning and includes removal of the facilities and materials that were employed to support the operation of the Ivanpah SEGS, and the physical operations necessary to return the surface to a condition wherein the revegetation and rehabilitation activities described in Section 7 may then take place. Based on the terms of the current lease being negotiated between the project owners and the BLM, and assuming a full lease lifetime, this process will begin 50 years after the beginning of commercial operation of the first component of the project, Ivanpah 1. Currently scheduled to begin operation in 2011, closure would therefore commence in 2061. Several contingencies must be met prior to the physical activities of closure begin, and these are described first in Section 8.1, followed by a description of the plan itself.

8.1 Accommodating Uncertainty and Affirming Requirements

Given current circumstances and the history of vast changes in the landscape of the American west in the last century, it would be unrealistic to assume that closure of the Ivapah SEGS, beginning ca. 2061, would involve wholesale decommissioning and dismantling of the facility, followed by rehabilitation and revegetation efforts to return the landscape to desert scrub similar to what exists at the site in 2008. Energy transmission facilities exist within a few miles of Ivanpah SEGS that are much older than 50 years, and there are of course hydroelectric facilities that are of the same age and that can be anticipated to be in operation for at least decades to come. It is also possible that other development may occur in this portion of the Ivanpah Valley in response to regional economic priorities and societal demands. Finally, it is widely acknowledged among scientists that global climate change is accelerating with impacts that are now measurable (e.g. Barnett et al., 2008; Westerling et al., 2006), and therefore, that constraints of the physical environment on everything from energy demand to potential natural vegetation will be substantively different 50 years in the future compared with the present and recent past. Therefore, adopting the components of an adaptive management approach to the decommissioning of the Ivanpah SEGS is important to address these uncertainties. These include a programmed assessment of circumstances, and reaffirmation of goals and requirements, and then the preparation of a *Final Closure Plan* to implement those goals as well as all relevant requirements.

8.1.1 Assessment and Affirmation

Not more than 5 years, and not less than 3 years prior to the required beginning of closure activities, or in the current schedule scenario in the period 2056 to 2058, the project owners will meet with the state and federal agencies responsible for land management and oversight of decommissioning to confirm the overarching goals of decommissioning and site rehabilitation. These will then be codified in the *Final Closure Plan*, which will be reviewed and approved by the agencies involved. The two fundamental questions to be addressed should include, but not necessarily be restricted to, the following:

- Is the required action moving forward the decommissioning of this energy generation facility?
- If so, then is the desired goal of closure and rehabilitation the return of the land to desert scrub vegetation?

The answers to these two questions will frame the context of the decommissioning of the Ivanpah SEGS, as well as subsequent reclamation and revegetation activities. Obviously, if in the next 50 years urbanization has spread to this valley, then it would be incorrect to assume that the goal of reclamation would be the return of this land to desert scrub. To follow this hypothetical line of reasoning then, the best use of the land may then be for residential, commercial, or industrial development. Therefore, this meeting to assess circumstances in the late 21st Century and affirm appropriate goals of closure and rehabilitation will be an appropriate and important action considering the uncertainty involved in predicting the future.

8.1.2 Assumptions in This Document

This document is not the *Final Closure Plan* described above; nor, given the uncertainty of the future, could a closure plan be written that would adequately anticipate the circumstances that need to be addressed more than half a century from now. Nevertheless, there are some basic assumptions made in this document to address current agency requirements for a closure plan, as well as the actions that are necessary and appropriate to effect rehabilitation and revegetation of temporarily disturbed areas that will be created during construction activities. These will, to a certain extent, appear to be at odds with the prudent uncertainty articulated above, but they serve to provide a baseline of goals and objectives that can be used as benchmarks, or a baseline, in the latter half of this century during the development of the *Final Closure Plan*. These include the following:

- All facility components within 3 feet of the recontoured grade will be physically removed from the Ivanpah SEGS.
- Clean concrete debris will be used as contour fill material at depths greater than 3 feet from final grade.
- All service roads would be abandoned and the land surface recontoured to return the topography to that similar with the surrounding topography.
- Rehabilitation treatment of the land surface preparatory to revetetation activities would occur as described in Section 5 and 7, above.
- Revegetation measures would be implemented as described in Sections 4 and 7.

As noted, events in the next 5 to 6 decades may render one or more of these assumptions invalid or inappropriate. Their articulation nevertheless addresses current agency requirements, gives appropriate guidance and methodologies should they indeed prove to be valid, and also provides a baseline from which plan changes in 50 years can be described.

8.2 The Initial Closure Plan

This section follows closely and incorporates portions of the *Conceptual Decommissioning and Reclamation Plan* for the Ivanpah SEGS developed by WorleyParsons (2008). Other sections of this document, particularly Sections 4 through 7, articulate the elements of rehabilitation and revegetation that will be implemented. This section provides more detail on the physical steps that will be taken to effect closure of the Ivanpah SEGS, or return of the land to a status consistent with land management priorities as they may exist in 50 years.

8.2.1 Objectives

The project goals for Site closure include removal of all improvements within 3 feet of final grade, restoration of the lines and grades in the disturbed area of the Ivanpah SEGS site to match the gradients of the surround land in ca. 2060, and do so in such a manner as to facilitate the effectiveness of the reclamation and revegetation procedures outlined in Sections 4 through 7. The proposed implementation strategy to achieve these goals incorporates the following approaches:

- Use industry standard demolition means and methods to decrease personnel and environmental safety exposures by minimizing time and keeping personnel from close proximity to actual demolition activities to the extent practical.
- Plan each components of the decommissioning project such that personnel and environmental safety are maintained while efficiently executing the work.
- The *Final Closure Plan* will specify how each major effort will be performed and integrated to achieve the project goals.
- Train field personnel for decommissioning actions to be taken in proportion to the personnel, project or environmental risk for those actions.
- Evaluate the execution of the Final Closure Plan thru project oversight and quality assurance.
- Document implementation of the plan and compliance with environmental requirements.

The *Final Closure Plan* for the Site facilities will include the following major elements:

- Documentation of the establishment and continuing implementation of health, safety and environmental protection procedures.
- Complete rehabilitation planning pursuant to Section 8.1 that addresses the objectives closure and rehabilitation. That is, shall it be a return to desert scrub or a land use more compatible with planned activities in the Ivanpah Valley in the 2060s?
- Conducting pre-closure activities such as sequential shutdown and fluid and materials removal in conformance with established procedures.
- Demolition of the aboveground structures (dismantling and removal of improvements and materials) in a phased approach while still using some facilities until close to the end of the project. For instance, the water supply, administrative facilities, and some electrical power components will be modified to be used until very late in the decommissioning project.
- Demolition and removal of belowground facilities (floor slabs, footings, and underground utilities) as needed to meet the decommissioning goals.
- Soils cleanup, if needed, with special attention applied to retention pond and hazardous materials use/storage areas to ensure that clean closure is achieved.

- Disposal of materials in appropriate facilities for treatment/disposal or recycling.
- Recontouring of lines and grades to match the natural gradient and function of the alluvial fan, as reflected by current or planned land uses in ca. 2060.

Various types of decommissioning/demolition equipment will be used to dismantle each type of structure or equipment, and dismantling will proceed according to the following general staging process. The dismantling and demolition of aboveground structures will be followed by concrete removal as needed to ensure that no concrete structure remains within 3 feet of final grade (i.e., floor slabs, belowground walls, and footings). The third stage consists of removal/dismantling of underground utilities within 3 feet of final grade, followed by excavation and removal of soils as needed, and then final site contouring. Assuming that the planning described in Section 8.1 affirms the revegetation goals described herein, then final surface preparation will be in concert with reseeding and other revegetation activities described in Section 7.

8.2.2 Pre-demolition Activities

Pre-decommissioning activities consist of preparing the Site area for demolition. These activities include removal of remaining residues such as in the retention ponds and boilers, as well as products such as diesel fuel, hydraulic, lubricating, and mineral oils, and other materials identified in the *Final Closure Plan* in order to reduce personnel health and environmental risk, and to facilitate decommissioning. All operational liquids and chemicals are expected to be removed at this time as well, such as boiler feed/condensate waters, laboratory equipment and chemicals, boiler/condensate addition chemicals as well as any maintenance lubricants, and solvents, etc. Hazardous material and petroleum containers and pipelines will be rinsed clean when feasible and the rinsate collected for offsite disposal. In general, these materials will be place directly into tanker trucks or other transport vessels and removed from the site at the point of generation to minimize the need for hazardous material and waste storage at the Site.

Decommissioning operations of the site are assumed to span several years, and will, therefore, leave access, fencing, electrical power, and raw/sanitary water facilities available for limited use by the decommissioning workers.

8.2.3 Demolition of Aboveground Structures

Demolition entails breakdown and removal of aboveground structures and facilities, including transmission lines and overland piping between the reheat tower and collecting tower at Ivanpah 3. Residual materials from these activities will be transported via heavy haul dump truck to a central recycling/staging area where the debris will be processed for transport to an offsite recycler. A project recycle center (either at each power unit as the work progresses or at the central administration area) will be established to:

- Size reduce and stage metals and mirrors for transport to an offsite recycler
- Crush concrete and remove rebar
- Stage rebar for transport to an offsite recycler

- Temporarily store and act as a shipping point for any hazardous materials to an approved TSD facility

In this demolition, mechanized equipment and trained personnel are used to safely dismantle and remove aboveground structures including:

- Heliostats, their support structures, and control equipment
- Collector and reheat towers using explosives to put the towers on the ground, then conventional heavy equipment to size reduce and transport for recycling (this is the industry standard for safe demolition of large towers and massive concrete structures)
- Removal of the turbine generators, condensers and related equipment, transmission lines and towers, and aboveground pipelines
- Near the very end of the project, the removal of site-related fencing that is no longer necessary

8.2.4 Belowground Facilities and Utilities

The belowground facilities to be removed include concrete slabs and footings that would remain within 3 feet of final grade after final contouring. These materials will be excavated and transported to the onsite processing area(s) for processing and transport for ultimate recycling. The resulting trenches will be backfilled with suitable material of similar consistency and permeability as the surrounding native materials and compacted according to the guidelines for revegetation described in Section 7, while all access roads will be decompacted according to Section 7 guidelines.

8.2.5 Demolition Debris Management, Disposal, and Recycling

Demolition debris will be placed in temporary onsite storage area(s) pending treatment at the processing area, and final transportation and disposal/recycling according to the procedures listed below. The sequential phasing of decommissioning will be used such that a portion of the decommissioned Ivanpah 1 heliostat field will be used to accommodate the onsite storage areas needed to process the materials from Ivanpah 2 and 3 as well.

The demolition debris and removed equipment will be cut or dismantled into pieces that can be safely lifted or carried with the onsite equipment being used. The vast majority of glass and steel will be processed for transportation and delivery to an offsite recycling center. Some specific equipment such as boilers, transformers, turbine and generators may be transported as intact components, or sized-reduced onsite with cutting torches or similar equipment.

A front-end loader, backhoe, or equivalent appropriate equipment will be used to crush or compact compressible materials. These materials will be laid out in a processing area to facilitate crushing or compacting with equipment prior to transport for disposal/recycling. Materials such as steel, glass and other materials will be temporarily stockpiled at or near the processing location pending transport to an appropriate offsite recycling facility. Concrete foundations will be removed to a depth of at least 3 feet below (final) grade. Upon removal of the rebar material from concrete rubble, the residual crushed concrete will be layered beneath the ground surface but only at locations that will remain greater than 3 feet below the final grade elevation. This will reduce waste volume and transportation requirements.

8.2.6 Soils Cleanup and Excavation

The need for, depth and extent of, contaminated soil excavation will be based on observation of conditions and analysis of soil samples after removal of the evaporation pond and hazardous materials storage areas, and upon closure of the temporary recycling center(s) and waste storage areas using during decommissioning. Removal will be conducted to the extent required to meet regulatory cleanup criteria for the protection of groundwater and the environment. If contaminated soil removal occurs, the resulting excavations would be backfilled with native soil of similar permeability and consistency as the surrounding materials and compacted and revegetated according to the guidelines provided in Section 7.

8.2.7 Recontouring

Recontouring of the site will be conducted using standard grading equipment to return the land to match (within reason) the surrounding terrain topography and function at that time. Grading activities will be limited to previously disturbed areas that require recontouring. Efforts will be made to disturb as little of the natural drainage and vegetation as possible. Concrete rubble, crushed to approximately 2-inches in diameter or smaller, will be placed in the lower portions of fills, at depths at least 3 feet below final grade. Fills will be compacted to approximately 85 percent relative compaction by wheel or track rolling to avoid over-compaction of the soils. To the extent feasible and if consistent with revegetation prescriptions, efforts will be made to place a layer of coarser materials at the ground surface to add stability. Revegetation and habitat rehabilitation is discussed in Sections 4 through 7.

8.2.8 Hazardous Waste Management

Hazardous materials expected to be handled during the decommissioning process are listed in Table 8-1. These materials included lead acid batteries, sulfur hexafluoride, diesel, hydraulic oil, lubricating oil, and mineral oil. Any other operational chemicals listed as hazardous in the AFC will be removed as part of the terminal shutdown of the plant (see Section 8.2.2) prior to decommissioning activities.

TABLE 8.1
Hazardous Materials to be Handled During Closure

Material	Site Use	Location & Estimated Quantity	D&R Project Strategy
Lead-Acid Batteries (Sulfuric Acid and Lead) size of batteries approx 10cm x 5cm x 7cm	Electrical power	Heliostats 224,000 batteries	Remove prior to heliostat stanchion processing or demolition
Sulfur hexafluoride	Switchyard / switchgear devices	Contained within equipment 200 lbs.	Remove prior to switchgear removal

TABLE 8.1
Hazardous Materials to be Handled During Closure

Material	Site Use	Location & Estimated Quantity	D&R Project Strategy
Diesel No 2	Fuel for pump engine/generators	Near fire pump; max quantity 9,000 gallons.	Drain liquid from equipment prior to removal. Triple-rinse tanks and piping prior to processing and recycling. Rinsate fluid will be disposed offsite.
Hydraulic Oil	Used in turbine starter system, turbine control valve actuators.	Contained within equipment; max quantity onsite 500 gallons.	
Lubricating Oil	Used to lubricate rotating equipment.	Contained within equipment; max quantity onsite 30,000 gallons.	
Mineral Oil	Used in transformers	Contained within transformers; max quantity onsite 105,000 gallons	

Source: WorleyParsons (2008)

Fuel, hydraulic fluids and oils will be transferred directly to a tanker truck from the respective tanks and vessels. Storage tanks/vessels will be rinsed and rinsate will also be transferred to tanker trucks. Other items that are not feasible to remove at the point of generation, such as smaller containers lubricants, paints, thinners, solvents, cleaners, batteries and sealants will be kept in a locked utility building with integral secondary containment, meeting all requirements for hazardous waste storage until removal for proper disposal. It is anticipated that all oils and batteries will be recycled offsite at an appropriately licensed facility. Site personnel involved in handling these materials will be trained to properly handle them. Containers used to store hazardous materials will be inspected regularly for any signs of failure or leakage.

As part of the preparation of the *Final Closure Plan*, the Spill Containment and Countermeasures Plan (SPCC) for the site will be updated to cover spill prevention and countermeasures for handling of these materials during decommissioning. Procedures to decrease the potential for release of contaminants to the environment and contact with stormwater will be specified in the SWPPP. A site-specific Health and Safety Plan will also be prepared to specify requirements for establishing and maintaining a safe working environment during the implementation of the planned closure and rehabilitation activities.

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